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DESIGN THEORY AND COLLECTIVE CREATIVITY: A THEORETICAL FRAMEWORK TO EVALUATE KCP PROCESS

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ABSTRACT
KCP method is a new method for collective creative design. To evaluate and position this method in the constellation of other collective creativity method, we propose an integrated framework based on a general theory of innovative design reasoning, C-K theory. The approach led us to identify four main dimensions of a collective creativity method: 1- explore the whole conceptual potential of the initial concept, 2- involve and support people in a rule-breaking process, 3- enable relevant knowledge activation, acquisition and production, 4- manage collective acceptance and legitimacy of rules (re) building. We show that collective creativity methods have been proposed and are today improved to address these issues. We show that no one of these methods is able to combine dual expansion on both social and cognitive perspectives. We have shown that the KCP method can address all four dimensions. This performance comes from the fact that this method contrasts with classical creativity techniques, insofar as 1- it insists strongly on knowledge sharing, 2- the design reasoning is strongly oriented by the organizers when they propose the C-projectors and 3- it ends with a design strategy and not with a set of selected ideas.

Keywords: C-K theory, collective creativity, brainstorming

1- INTRODUCTION

Some years ago, the RATP –the Public Transportation Company of Paris Region- came to us to develop a new method that would help to design an innovative metro for the Paris region. The RATP asked the method to be strongly collective, enabling to involve all the stakeholders in the process (several company expert from multiple functions –engineering, operations, marketing, information systems, users, company partners, urban policy makers, marketing,…). It should be more collective than a "creative task force" cut from the rest of the company but it should also be more creative than a participative seminar building roadmaps of the future. This challenging question gave birth to the KCP method, a new collaborative creativity method, based on the most recent innovative design theory, C-K theory [1-3]. In the following years the KCP method was refined, codified and experimented in several situations (see below) and appears today as an interesting method for collective innovative design. This paper intends to characterize what "interesting" means by comparing KCP to existing methods, by characterizing its main "results" and by clarifying the specific features of the method that explain this unique performance.

We show that every collective creativity method can be characterized by four main performance criteria:

1- explore the whole conceptual potential of the initial concept,
2- involve and support people in a rule-breaking process,
3- enable relevant knowledge activation, acquisition and production,
4- manage collective acceptance and legitimacy of rules (re) building.

We show that collective creativity methods have been proposed and are today improved to address (one or several of) these criteria, but no one of these methods is able to combine dual expansion on both social and cognitive perspectives. Finally we show that the KCP method can address all four

dimensions. This performance comes from the fact that this method contrasts with classical creativity techniques, insofar as

1- it insists strongly on knowledge sharing,
2- the design reasoning is strongly oriented by the organizers when they propose the C-projectors and
3- it ends with a design strategy and not with a set of selected ideas.

The remainder of this paper is organized as follows: section 2 describes the methodology of the study, section 3 presents an integrated theoretical framework, based on C-K theory, to clarify the types of results expected from collective creative design and to position the different methods identified in the literature, section 4 presents the KCP process and shows what are the specific traits that helps KCP to meet the expectations. Section 5 discusses these results and presents the research agenda opened by KCP.

2- LITERATURE REVIEW AND RESEARCH METHOD: CASTING COLLECTIVE DESIGN METHODS IN A THEORETICAL FRAMEWORK

2-1. The issues raised by the methods for collective, creative design.

Brainstorming [4] is certainly the most famous method for collective creativity. Proposed by Osborn, the former director of the advertisement company BBDO, it focuses on ways of increasing the sharing of the ideas in groups: Osborn noted that groups often evaluate ideas as they are shared, which in turn may inhibit group members from sharing ideas that they think might not receive a favorable evaluation. Osborn proposed that groups follow a set of rules (focus on quantity, withhold criticism, welcome unusual ideas, combine and improve ideas) that emphasize the sharing of as many ideas as possible without evaluating these ideas until some later time period.
Lab experiments on brainstormins gave two main results:

- Groups that follow Osborn's rules do indeed generate more ideas than those that do not [5]
- Group appear to generate half as many ideas as the combined total of ideas generated by the same number of individuals brainstorming alone (called nominal group) [6-8]

Social and cognitive factors of productivity loss in collective brainstorming

This second phenomenon raised several research that have provided evidence for both social and cognitive factors in brainstorming productivity loss. Identified social causes of production blocking are attention division [9,10], social pressure of ex post evaluation (social anxiousness [11]), perceived expertness upon creativity [12]) and missing recognition causing loafing and free riding.
Cognitive factors have attracted renewed interest in the last years, insisting on the risk of similarity in idea association (the idea association tends to follow the rule of similarity, meaning that the ideas generated from one idea tend to be in the same category as the initial idea - [13-15], this is coherent with the fixation effect reported by cognitive psychologists [16]), unique ideas have a poorly association value (they initiate less ideas since the knowledge required for generation is not shared by participants [17]), the risk of not fully exploring the full range of ideas [18-20] and the risk of cognitive load (each individual follows its own idea generation process while following the collective exchanges).
These factors have recently been incorporated into an integrative model [21,22]. This also led to propose refined brainstorming techniques like brainwriting, electronic brainstorming [23], sequential brainstorming (collective and then individual) [10]… They have been systematically reviewed in [24].

Beyond fluency: collective creativity methods dealing with expertise and legitimacy

These works focus on the idea production in lab experiment. Another stream of research tries to study brainstorming in a real setting. Actually Osborn himself considered brainstorming as a part of a more general process, creative problem solving (CPS) process. CPS distinguishes 6 stages in problem solving: mess finding, data finding, problem finding, idea finding (through brainstorming), solution finding and acceptance finding. CPS process has led to several creativity techniques around problem analysis (five Ws and H (question asking), Clarification, knowledge gathering,…). It led to sophisticated repeated brainstorming techniques like CNB, the creative notebook, devised by John Haefele of Procter and Gamble in 1962 to extend idea generation over several weeks: each participant

is given a notebook in which he should write at least one idea per day during several weeks and during this period he receives regularly further related information from the experts, the literature and colleague [25]. CPS also inspired several methods for collective creativity in the workplace (quality circle, Kaizen), to identify causes of a problem (Fish Bone Diagram, Ishikawa), to support change management processes (Systematized Direct Induction – SDI [25]). Another set of collective creativity methods, also inspired by Osborn, are methods seeking idea sharing between experts: in the 50s, RAND corporation organized expert teamwork to forecast the potential damage from atom bomb attacks. This led to the Delphi method of organizing expert work to generate a shared picture of the future (prospective scenario). Combining Delphi and Osborn creativity, political scientist Harold D. Lasswell proposed a method called "decision seminar" [26], being usefull either for expert collaborating on a common scientific issue or for political scientists involved in urban problem solving [27]. The list here is far from exhaustive, even if the missing methods are often variants of the above mentioned methods (for an extensive review, see [28])

These methods have actually received limited interest from the scientific community and are hardly described and analyzed in the literature. One explanation could be that they are difficult to reproduce in lab experiment conditions [20]. Some exceptions are the works of Amabile et al. on creative workplaces and organizational creativity killers [29,30], the analysis of brainstorming in a design firm, IDEO, by Hargadon and Sutton [31]. Both are based on in-depth empirical analysis. Savanovic and Zeiler proposed recently a method of collective creativity based on morphological overview to support idea sharing and structuration in *multidisciplinary* teams [32], this method being tested in lab experiments.

All these methods and analyses considerably broaden the analytical framework for collective creativity:

- they insist on the *psychological* and *social effect* of creativity: they claim to improve well-being of participants, to enable smoother change in organizations (SDI), to help involve workers in workplace improvement (TQM, quality circle)
- they tackle with the strong issue of *expertise and knowledge in collective creativity*. Creativity studies in lab experiment often rely on cases where no specific knowledge is required precisely to avoid a knowledge bias ("it is desirable to use brainstorming problems that do not require any unusual or specialized knowledge" write Paulus and Brown p. 250 [22]). CPS derived methods address the knowledge issue: they aims at acquiring knowledge of the problem (CPS first phases of information gathering), involving experts, building shared objects (Delphi, Decision seminar), making experts from different origins share knowledge (morphological overview,…), or even making participants *acquire* knowledge during brainstorming (see IDEO case or CNB).
- it appears also a clear contrast between the "open questions" used in lab experiment ("what can you do with a paperclip", "how to improve the university", "the advantages and disadvantages of having an extra thumb"), which are clearly in line with creativity tests [33,34] and the problem solving perspective, where the *feasibility and value* of the solutions might be as important as the quantity of ideas.
- The vast majority of creativity methods (be they collective or not) are actually based on the Closed World Condition (CWC) [35]. It states that the objects that exist in the system at the time of the problem are those that would be used to address it. This means that once a problem is defined (occasionally after a clarification phase), the objects that could be used to solve it are known. It is interesting to note that some methods, particularly at IDEO, underline the necessity to create new knowledge *during the innovative design process*, for instance through prototyping and experiencing. This capacity to produce knowledge during the innovative design process appears as a specific type of brainstorming. Moreover it introduce a new performance criteria for collective creativity: the knowledge and competences *gained* during the process.

This brief overview of the methods for collective creativity shows a surprising variety. This variety is not only in the process itself but also in the *objectives*, which can be highly contrasted: the *quantity of ideas* was the dominant criteria of brainstorming studies; in this perspective the objective of recent brainstorming variants was *to control so-called social and cognitive factors of productivity loss*; but this maximization of idea quantity (Fluency) was already a reduction of the famous *Guilford and Torrance creativity criteria* (Fluency, Flexibility, Originality and Elaboration) – justified by a high correlation in tests [36]; moreover the review shows that the objective of collective creativity might

also be *individual well-being, social and organizational consensus and legitimacy, competence sharing and acquisition,…* The methods are also varied in the research efforts that were devoted to their analysis: some of these methods have been intensively studied (by empirical observation or lab experiments) while others are hardly described in scientific literature.

2-2. Research methodology: comparing methods based on an integrated theoretical framework

Being aware of the existing methods of collective creativity, we can come back to our main objective: to position a new method, KCP method, in the constellation of methods already existing. But the variety and heterogeneity of method makes difficult a pairwise comparison. Another method consists in putting all methods in an integrated analytical framework: a meta-analysis of previous methods or studies create a common language and a framework, in which it is easier to position the new method. This method was used for instance in computational creative design by [37]. In the case of collective design method, the meta-analysis is compounded by the variety of the objectives targeted by the methods, and the great discrepancy in the intensity of research on the different methods.
Following Reich et al. recommendation [35], we will elaborate an integrated framework based on a theory of innovative design, C-K theory [1-3]. We assume that we have a general theory of how creative formulations can take place in design processes; based on this theory we will elaborate a framework for analyzing collective innovative design methods and positioning the new KCP method. This will lead us (1) to have a general understanding of the *objective* of a collective design method and (2) to understand the *specific traits* that enable KCP method to reach these objectives.

3- ANALYSING METHODS OF COLLECTIVE CREATIVITY IN AN INTEGRATED FRAMEWORK: MISSING A COLLECTIVE, DUAL EXPANSION METHOD

3.1- The C-K theory of innovative design.

C-K theory offers a clear and precise definition of design that is independent of any domain or professional tradition; it integrates creative thinking and innovation as the central core of the theory. C-K theory makes use of two spaces: (1) K – the knowledge space – is a space of propositions that have a logical status for a designer; and (2) C – the concepts space – is a space containing concepts which are propositions, or groups of propositions that have no logical status in K. This means that when a concept is formulated it is impossible to prove that it is a proposition of K. Design is defined as the process by which a concept generates other concepts or is transformed into knowledge, i.e., propositions in K.
Concepts can only be partitioned or included, not searched or explored. If we add new properties ($K \rightarrow C$), we partition the set into subsets; if we subtract properties we include the set in a set that contains it. Nothing else can be done. After partitioning or inclusion, concepts may still remain concepts ($C \rightarrow C$), or move to propositions of K ($C \rightarrow K$). The two spaces and four operators (including the $K \rightarrow K$) are shown in Figure 1.

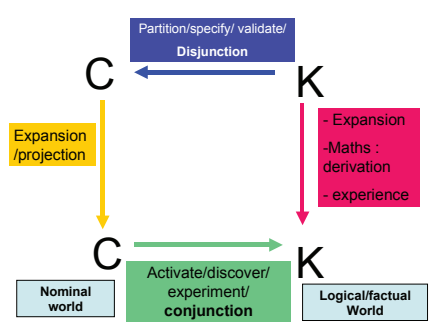

Figure 1: The four operators of C-K theory [1]

A space of concepts is necessarily tree structured as the only operations allowed are partitions and inclusions and it has initial disjunctions. Yet, we need to distinguish between two types of partitions: restrictive and expansive partitions.

- If the property we add to a concept is already known in *K* as a property of one of the entities concerned we have a *restricting partition*;
- if the property we add is not known in *K* as a property of one of the entities involved in the concept definition, we have an *expansive partition*.

Creativity is the results of expansive partitions of concepts [38].
Another view of the C-K dynamics is given in Figure 2. We recognize the necessary tree structure in *C*, while the structure in *K* could be completely different. We also see in this picture that any expansion in *C* is dependant of *K* and the reverse is true. Any choice to expand or not in *C* is K-dependant. Designs begins with a disjunction and will end only if some conjunction exists and is judged as an acceptable solution.

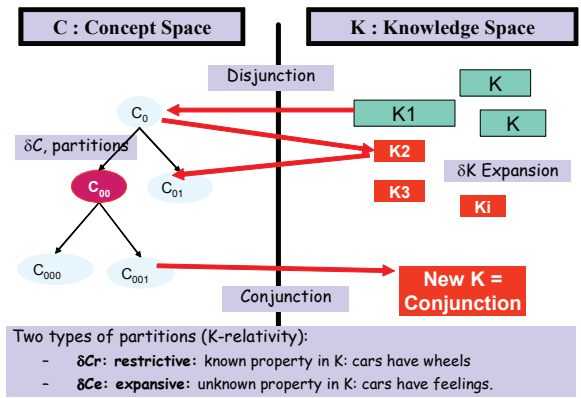

Figure 2: C-K dynamics [39]

3.2- A C-K based evaluation framework for evaluating collective creativity methods

This overview of the theory let us reasonably assume that C-K is a general theory of how creative formulations (C and K expansions) can take place in design processes through the interaction between *C* and *K* spaces.
This theory has to be combined with the collective dimension to really give an integrated framework for collective creativity. Based on socio-psychological approaches of creativity [21] and organizational approaches of design processes [40,41], we will cast C-K theory into two perspectives: a cognitive perspective and a social perspective [42]. Actually C-K theory, being a purely formal theory, doesn't directly address any of these dimensions. However it is possible to interpret the operators in each of them. It appears four main aspects of a collective creativity process:

- cognitive perspective of C-expansions (C→C and K→C operators)
- social perspective of C-expansions
- cognitive perspective of K-expansions (K→K and C→K operators)
- social perspective of K expansions.

3.2.1 cognitive perspective of C-expansions (C→C and K→C operators)

This first dimension of collective creativity methods characterizes their capacity to generate C-expansions. This dimension is well recognized in classical creativity methods and particularly in brainstorming-derived one. It is usually evaluated through creativity criteria (fluency, flexibility, originality, elaboration), which hence appear as estimators of the C-expansion. One can underline that in this theoretical framework fluency is a poor (biased) estimator since it is possible to reach a good fluency score by staying in the same branch of the C-tree, without even doing expansive partitions. Conversely, flexibility and originality can be considered as acceptable estimators of C-breadth

exploration and expansive partitions [43]. Phenomena like "similarity in idea association", "poor association power of unique ideas", "limited exploration of the potential range of ideas or cognitive load can be interpreted as issues in cognitive C-expansion. A collective creativity method can be more or less efficient to overcome these phenomena.
Several improvements suggested to brainstorming precisely try to meet this first requirement of cognitive C-expansion:

- mixing creative talents: since studies on personality have revealed strong differences in the capacity of individual to switch from one category to another during a brainstorming (see studies on creative personality: convergent/divergent personality (Torrance), adaptators vs innovators (Kirton 1989), analytical vs intuitive (Simonton 1998)) it has been suggested to select participants according to these personality trait.
- To organize an individual brainstorming after a collective one, occasionally by asking people to memorize the ideas of the collective brainstorming [10]: this procedure should help to overcome similarity and limited exploration of the range of ideas.
- Trained facilitators [44] (and trained participants [45]) should be able to limit useless elaboration on ideas, to provoke category shift; they should also help to control "off-tasks" behaviors.

Note that these methods raise also challenging issues in the cognitive C-expansion perspective: how to switch on the "right" categories? How to control a good or bad elaboration of ideas in the same category? Hence, the issue is not only to generate varied and original ideas (fluency, flexibility, originality, elaboration) but more broadly, *to manage the process to cover the whole conceptual potential of the initial concept.*

3.2.2. social perspective of C-expansions

Our framework show that a collective creativity method can also be characterized by a second criteria: the capacity of the method to involve and support people in the C-expansion endeavor. Organization and groups are apparently rather reluctant to C-expansion, as documented by several research (see for instance Amabile et al. in organization [41] or the analysis of students group dynamic in situation of innovative design [46]). This can be easily explained since creative design consists in breaking rules (be they design, organizational, social rules) [47], meaning that innovative design unavoidably threatens the rules at the basis of individual, group, organizations, industrial sectors, institutions… rediscussing or even destroying competence value, coordination techniques, established hierarchies and legitimacies. Actually brainstorming was devised to avoid that the established rules (evaluation) skip the rule breaking ideas too early.
Social factors of production blocking like "social pressure of post evaluation" or "perceived expertness upon creativity" can be interpreted as resistance to rule breaking, that recent advances in collective creativity methods try to overcome them (anonymous participants, selection of individual with low social anxiety).
This explains why collective creativity method can also be evaluated (see [45] on IDEO) on their capacity to involve people, to make them feel comfortable, and even tend to make them feel satisfied. It has been shown that brainstorming method tends to make people feel satisfied, even if this feeling is not correlated with the idea production – this phenomena is considered as an "illusion" by [48], from the cognitive perspective of C-expansion, but it could also be considered as a success of the method in the social perspective of C-expansion. Sutton and Hargadon [45] describe a process of "status auction" in IDEO brainstorming: it shows that this method not only makes people feel comfortable but creates a *collective recognition of the individual capacity to break the rules*. It tends to legitimate the venture into the unknown (C space) for company members.
To conclude, social perspective on C-expansion gives us a second performance criteria to characterize collective creativity methods: *the capacity to involve and support people in a rule-breaking process*.

3.2.3. cognitive perspective of K-expansions (K→K and C→K operators)

According to C-K theory, innovative design reasoning doesn't only consist in C-expansion but also in K-expansion. In brainstorming methods, this dimension was often limited to the management of the variety of members. Research works have shown that competences should be diverse but overlapping [49]. CPS-derived methods insist on the phase of problem clarification that consists in gathering relevant knowledge. Delphi, CNB, Decision Seminars are focusing on the capacity to leverage relevant knowledge and expertise. This phase is particularly developed at IDEO: "the facilitator or

client teaches participants about the products" and the competition, and designers learn on uses and users of the products [45].
Phenomena of *limitations* of knowledge expansion have been studied, like the convergence of a group of people on the common knowledge base [19]. [20] has underlined the necessity to "motivate group member on intellectual exchange and sharing relevant knowledge and to process carefully the pertinent information provided by other group members". But the brainstorming methods give little insight on how to do it. [45] underlined that IDEO brainstorming convey an attitude of wisdom, defined as "acting with knowledge while doubting what one knows", learning through prototyping and being aware of the necessity to bring new knowledge. As already mentioned, the methods rarely address this issue of learning and creating new knowledge during the process, since most of them assume more or less explicitly a Closed World Condition (CWC). This limits the performance of the method when it comes to this third criteria.
To conclude, cognitive perspective on K-expansion gives us a third performance criteria to characterize collective creativity method: *the capacity to enable relevant knowledge activation, acquisition and production*.

3.2.4. social perspective of K expansions.

Our theoretical framework show a fourth criteria to characterize a collective creativity method: the social dimension of knowledge expansion. This criterion appeared in some research works. For instance some creativity methods analysis have underlined the necessity for participants to accept knowledge variety and to deal with experts contradictions or conflicts. Some indications were given for conflict resolution: people should be motivated by accuracy and should not be pressured to accept a particular perspective [20,50]. This acceptance of variety has actually to be *broadened to the acceptance of emerging solution pathes and the creation of new competences*, ie the emergence of new rules (in the same sense as mentioned above in 3.2.1): whereas social dimension of C-expansion consisted in dealing with rule breaking acceptance, social dimension of K expansion consists in dealing with rule (re)building acceptance and legitimacy.
Some methods (brainstormings) hardly deal with this fourth dimension. Methods derived from CPS insist much more on it: TQM, quality circle, change management seminar (Systematized Direct Induction, SDI) are all oriented towards *consensus building and preparation of the actors* (workers, managers, experts…). IDEO method [45] involves customers in the session "to express positive emotions and to say positive words about the ideas generated during the meetings": this appears as a way to prepare the customer to accept the innovative solutions (and the related investment in new competence). Delphi and Decision Seminar methods are mainly oriented towards creating consensus between experts.
To conclude, social perspective on K-expansion gives us a fourth criteria to characterize collective creativity method: the capacity to *manage collective acceptance and legitimacy of rules (re) building.*

Finally, we summarize this theoretical comparison of collective creativity methods in table 1 below. Our C-K based theoretical framework enabled us:

1- to identify four dimensions to characterize collective creative methods (see table below): 1- *cover the whole conceptual potential of the initial concept, 2- involve and support people in a rule-breaking process, 3- enable relevant knowledge activation, acquisition and production*, 4- *manage collective acceptance and legitimacy of rules (re) building.*
2- To show that existing methods address one or several of these dimensions and moreover: the debates and evolutions around these methods can be described in the framework.
3- No method address all four dimensions. Roughly speaking: brainstorming methods mainly dealt with #1 and #2, whereas methods that could be characterized as "participative seminar" actally rather deal more with #3 and #4. IDEO brainstorming sounds like an exception since, according to Sutton and Hargadon, it addresses all four dimensions. However it seems to reqire highly skilled participants and few is said on how to reach these results.

These results, particularly point #3, explain why we had to devise a new method.

Table 1: The four criteria for evaluating a collective creative method.

	Cognitive	Social
C-expansion (K→C, C→C)	**Cover the whole conceptual potential of the initial concept** *Classical method:* brainstorming *Criteria*: fluency. *Issues in the literature*: limited expansions (similarity, based on limited K-base). *Method improvements*: mix divergent thinking/convergent thinking personalities, trained facilitator (filtering and orienting divergence)	**Involve and support people in a rule-breaking process** *Classical method:* brainstorming *Criteria*: well-being, participants satisfaction (ie feel comfortable in C-space). *Issues in the literature*: production blocking (social anxiousness, perceived expertness, missing recognition) *Methods improvements*: status auction, electronic brainstorming.
K-expansion (C→K, K→K)	**Enable relevant knowledge activation, acquisition and production** *Classical method*: participative workshops *Criteria* variety and overlapping *Issues in the literature*: limited performance because of CWC. *Method improvement*: wisdom attitude, learning during the process (on uses, on existing products), competence building	**Manage collective acceptance and legitimacy of rules (re) building** *Classical method*: consensus building methods *Criteria*: expert agreement *Issues in the literature*: conflict, difficulty to accept variety of skills, K distribution *Method improvement*: no pressure to accept particular perspective, make the customer be positive (prepare acceptance)

4- KCP WORKSHOP PRINCIPLES AND PROPERTIES

We can now describe and position KCP method in the theoretical framework.

4.1. Describing the main phases of a KCP process.

A KCP® workshop unfolds in threee phases as follows:

1- K-sessions to collectively build and share K bases. There are typically 6 to 10 half a day K-sessions, attended by all participants –the presenters are not necessary the participants. This phase doesn't' contain any creativity but is dedicated to "knowledge injection" for the experts to open up new perspectives. It is possible to list down the main pieces of knowledge to be addresses in such sessions: User, Client, Company strategy, State of the art, and phenomenology (scientific knowledge on phenomena, including, sociological one). This phase can reveal some weaknesses in the knowledge base of the company, for instance lack of knowledge of final users. Some key points must be underlined:

- This phase comprises a state of the art, similar to the "information gathering" phase of any CPS.
- However it extends classical state of the art since it prepares for future C-expansion while staying in K. How is it possible? Quite reasonably for the reason that "out of the box" thinking requires knowledge from "out of the box". Hence the K phase usually contain more skills and knowledge bases than the union of all participants. It will help to accept rule breaking and rule rebuilding in the following phase.
- Another aspect of preparing the venture in C, consists in identifying paradoxes, ambiguity, polysemy, strange cases, objects transformation over time (genealogical approach) and provocative examples. These are pieces of K that de-universalize and soften rules and object definitions. The K phase doesn't clear away polysemy and ambiguity but rather clarifies the multiple meanings and approaches of the objects.
- The K phase has hence two goals: to soften the definition of the objects and to begin to build new relationships between the objects or with new objects.

2- C phase. Typically this would take the form of a 2-days residential seminar with all participants (20 to 40 people). Compared to traditional creativity, some concepts ("projectors") are used as a starting point and should *not* be considered as proposals for further development. These "C-projectors" are prepared to *orient* collective creativity. Each projector leads each group to dig into one of the main alternatives in the innovation field. The set of projectors (3 to 6) is supposed to catch the whole potential of the innovation field. The concepts are carefully prepared by the organizers, who will use

C-K theory to ground and control their reasoning and projectors proposal. During the process, some "solutions" of one group will be reused by another. It means that each group doesn't design one solution but is building new (reusable) knowledge. Key points:`

- Contrary to brainstorming, relying on free divergence, the C phase manages the divergence phase. It aims at overcoming similarity effect and the lack of category shift. This can be true only if the projectors are well-designed. Some properties of the projectors have been identified: they consist in adding attributes to the initial (often reformulated) concept; the few added attributes should have three properties: they facilitate the exploration in one direction; they are contrasted; the set of the projectors reasonably covers the whole expansion of the initial (reformulated) concept.
- The C-phase doesn't aim at maximizing the number of "ideas" produced in the process. It rather focuses on "original" ideas (expansive partitions).
- The C-phase doesn't only produce concepts but also knowledge: participants can have a free access to web; they will also recall some knowledge they have but didn't consider as relevant until the emergence of expansive partitions.

3- P phase. This last phase consists in synthesizing the propositions into a structured design strategy. It clarifies which prototypes, mock-ups, new product developments or even research programs could be launched now or in a near future. It helps participants and top management to which the results will be presented, to assimilate the structure of the innovation field, to keep the variety of alternatives and avoid to focus on one apparently dominating solution.

- This phase does not consist in selecting on idea to develop it. It does not validate a choice to develop a product or service. It clarify a design strategy, presenting and keeping alive multiple alternatives, identifying actions to go on.
- The P phase aims at preparing the actors (make them informed, competent, aware of learning issues), and commit actors at all levels (top management, designers, engineers, scientists and even in some cases customers, users, partners…). This is not a selection committee were decision makers (be it top management using multi-criteria decision tools or the group of brainstorming participants voting for the best idea) decide and developers are in charge of realizing the chosen project.

This method has already been used in 14 industrial cases, listed below with the related initial concept:

- RATP (Bus Rapid Transit; 21st century Metro; local bus services; "walking"; night bus station)
- Thales (Cockpit of the future; Operations and Control Centers of the Future; new generation of single aisle aircraft)
- Vallourec (After threading)
- Volvo (Sustainable car)
- Areva (Smart grids)
- Competitive cluster Moveo (Safety for two-wheeled vehicles)
- Sagem (Home networking)
- Turbomeca (Future generation of turbines)

4.2- Theoretical comparison: analyzing KCP in the C-K framework

We can know analyze the KCP method using the four dimension of our theoretical framework. The analysis is done in the table 2, below. One analyses how each dimension is addressed by each phase (K, C and P).

This analysis reveals that KCP method addresses all four dimensions, contrary to usual collective creativity methods.

Table 2: analyzing KCP in the theoretical framework.

	Cognitive	Social
C-expansion (K→C, C→C)	**Cover the whole conceptual potential of the initial concept** *K phase:* variety and originality of mobilized competences. Variety and originality in the perspectives taken to present the objects. Prepare K "out of the box", prepare potential extensions of the objects (polysemy, genealogy, facets of the objects), potential links to other objects. *C-phase*: projectors, aiming at catching the main expansion direction of the initial concept. It doesn't aim at producing a good quantity of ideas but original ideas in the sense of expansive partitions. *P phase*: design strategy with several paths, not only development but clustering and reformulation, definition of an exploration strategy (multiple alternatives, repetition over time, demonstrators, prototypes, projects…)	**Involve and support people in a rule-breaking process** *K phase*: make use of expert knowledge and accept the limits of expert K. Provocative examples that shows new perspectives, possibly far from established design rules. *C phase*: stay in the unknown, structure the unknown, coopetition (multiple parallel explorations that will support each other) *P phase:* shared, legitimate design strategy: top management commitment on value management, designers ready for action; even some partners can be informed and prepared
K-expansion (C→K, K→K)	**Enable relevant knowledge activation, acquisition and production** *K phase:* prepare for value and robustness (value = stakeholder and their problems, user & uses, competition; robustness = phenomena, competition on innovation, instruments for validation and exploration,…) *C phase*: share emerging K during phases, identify missing competences *P phase*: K to be acquired or produced. Identification of required competences	**Manage collective acceptance and legitimacy of rules (re) building** *K phase:* open, multiple contributors, expertise recognition (not only technical, scientific or marketing experts but also user expertise, supplier expertise, prescribers expertise…) *C phase:* accept expert limits; agreement on missing & required K; all participants are opening their network for future knowledge acquisition *P phase*: top management commitment to resource acquisition strategy (alliances, R programs, hub and platforms, acquisition, competence building…)

5- DISCUSSION AND FURTHER RESEARCH

We have proposed a theoretical framework to analyse collective creativity methods. We have shown that existing methods are dealing with all four dimensions of the framework but no one of these methods are able to combine dual expansion on both social and cognitive perspectives. We have shown that a new method, called KCP, can address all four dimensions.

These results raise two series of questions:

- The empirical tests: today 14 KCP workshop have been managed. Based on the above mentioned framework it should be possible to evaluate the performance of these KCP workshops. But other tests could be done: lab experiments could be also conducted to test the KCP method.
- Contingent analysis: what are the main success factors and the contingent factors of the method? The factors may relate to: the KCP management (quality of the C-K analysis done to generate the projectors, competence level of the KCP animator, technical tools to support the KCP process…), the organizational context (are they other "innovation functions" able to make use of the KCP results?), the initial concept,…
- Next generation of KCP methods: the method addresses all four dimensions but in a very specific way. What could be gained by improving knowledge production or fast prototyping? KCP appears as a first order linearization of C-K. What about a second order development? What about other processes derived from C-K?

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