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ELABORATION OF A COMPONENTIAL CREATIVE PROCESS FOR SHORT IDEATION SESSIONS

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ELABORATION OF A COMPONENTIAL CREATIVE PROCESS FOR SHORT IDEATION SESSIONS

Mario DUBOIS

ABSTRACT

This research tends to be a contribution in assisting companies to better innovate, since researchers state that Small and medium enterprises (SMEs), which comprise the vast majority of employments and businesses, face barriers such as the lack of finances, skills and time to innovate.

For that, we chose to focus on the ideation session, which methodologies imply creativity tools and processes, but also, team preparation, risk management, eco innovation, etc. Literature reveals that Brainstorming is the most used creativity tool. This is consistent with results from secondary data analysis of "The 24 Hours of Innovation" (The 24 Hours) competition from 2007 to 2010: Brainstorming was used by 98,57 % of 968 participants. Yet, for many researchers, with Brainstorming, teams find almost the same sets of ideas, mostly low creative. We also found that many participants did not know what a creative process was and the difference between a creative process and a creativity tool.

For more productive ideation sessions (in quantity and quality), we chose a componential creative process approach to allow participants who would like it to use the Brainstorming, but most other creativity tools.

We named this framework "short ideation sessions". Then, as our research question, we wanted to know "How to elaborate a componential creative process for short ideation sessions". Our main research objective was that all components of our new process would have to be helpful, adopted and used by more than 50 % of participants.

Since we could not find creative processes with components like creativity tools made for short ideation sessions to help SMEs for example who lack time, we created classification and selection systems for existing creativity processes and tools we had listed, and selected three creative processes among 39 and nine creativity tools from 615.

Doing experimentation within The 24 Hours instead of companies presented, among other advantages, that of having a large population of more than 1000 participants working in the same setting, with the same rules and issues. Furthermore, we could repeat our experiment since the competition is renewable each year.

That is how, because lack of time prevented participants from using creativity processes and tools we proposed in 2012, we simplified them in 2013 and created "mini creativity tools" faster to learn and use. In 2014, we elaborated our Componential creative process for short ideation sessions with five components : 1. A simple three steps creative process; 2. Mini

creative tools associated to it; 3. A team preparation guide; 4. A creativity guide to help understand how to use the components of the creative process; 5. A chronological guide to help participants manage time. Participants found these components helpful to create at a rate varying between 60 % and 100 %, adopted and used them.

Expecting better results, we simplified our Componential five components model in three components for the experimentation planned in 2015.

Our main recommandations are to elaborate our new componential creative process for short periods of time other than 24 hours: from 5 minutes to 48 hours, experiment and adapted for different types of companies, technological and cultural.

Keywords: Chronological guide, componential, creativity, process, short ideation session, team preparation, tool.

ÉLABORATION D'UN PROCESSUS DE CRÉATIVITÉ PAR COMPOSANTES POUR LES COURTES SÉANCES D'IDÉATION

Mario DUBOIS

RÉSUMÉ

Selon les chercheurs, les Petites et moyennes entreprises (PME) par exemple, qui représentent la grande majorité des emplois, manquent de ressources financières, de compétences et de temps pouvant favoriser l'innovation. Par la présente recherche, nous aimerions apporter notre contribution dans l'aide aux entreprises à mieux innover.

Ainsi, nous avons choisi de mettre l'accent sur la séance d'idéation avec ses outils et processus de créativité, la préparation de l'équipe, la gestion des risques, l'éco-innovation, etc. Des chercheurs affirment que le remue-méninges est le plus utilisé dans les séances d'idéation. C'est ce qu'a révélé une analyse de données de la compétition « Les 24 Heures de l'innovation » où, de 2007 à 2010, 98,57 % de 968 participants ont utilisé cet outil de créativité. Pourtant, les chercheurs préviennent qu'il mène les équipes vers les mêmes idées souvent faibles. Nous avons également constaté que de nombreux participants confondaient processus et outil de créativité.

Pour rendre les séances d'idéation plus productives (en quantité et en qualité), nous avons choisi une approche utilisant un processus créatif à composantes où le remue-méninges et bien d'autres outils de créativité pourraient être utilisés.

Dès lors, notre question de recherche était la suivante : « Comment élaborer un processus créatif à composantes pour les courtes séances d'idéation ? ». Notre objectif principal était que toutes les composantes du processus créatif que nous aurions créé fussent utiles par le fait que les participants à notre recherche les adopteraient et les utiliseraient à plus de 50 %.

Ne pouvant trouver de processus créatifs ayant pour composantes des outils conçus pour de courtes séances d'idéation afin d'aider des PME par exemple dont le temps consacré à l'innovation est souvent restreint, nous avons élaboré des systèmes de classification et de sélection d'outils et de processus créatifs existants. Ainsi, de 39 processus répertoriés, nous en avons sélectionné trois, et neuf outils de créativité d'une liste de 615.

Choisir pour modèle d'analyse Les 24 Heures de l'innovation au lieu d'entreprises présente plusieurs avantages, dont celui de disposer, dans un même cadre, d'une population de plus de 1000 participants soumis aux mêmes règles et ayant les mêmes enjeux. En outre, la compétition se renouvelant chaque année, nous pouvions répéter nos expérimentations.

Ainsi, les participants n'ayant pas eu le temps d'utiliser les processus et outils de créativité que nous leur avions proposés en 2012, nous avons simplifié ces derniers et, en 2013, créé de « mini outils de créativité » qui pouvaient être appris et utilisés plus rapidement. En 2014,

nous avons élaboré notre nouveau processus créatif à composantes pour les courtes séances d'idéation ; il avait cinq composantes: 1. Un processus créatif simple à trois composantes; 2. De mini outils de créativité associés; 3. Un guide de préparation de l'équipe; 4. Un guide de créativité pour aider à comprendre comment utiliser les composantes; 5. Un guide chronologique pour aider les participants à gérer le temps. Les participants ont trouvé ces composantes utiles, avec un taux variant entre 60 % et 100 % ; ils les ont adoptées et utilisées.

Visant de meilleurs résultats pour 2015, nous avons simplifié notre processus à cinq composantes pour ne lui en laisser que trois.

Il serait recommandable, entre autres, d'élaborer des versions de notre processus créatif à composantes pour des séances d'idéation courtes différentes de 24 heures: de 5 minutes à 48 heures, de les expérimenter puis les adapter afin qu'elles répondent aux besoins d'entreprises technologiques et culturelles.

Mots-clés : Composante, courte séance d'idéation, créativité, guide chronologique, outil, préparation de l'équipe, processus.

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LIST OF ABREVIATIONS

CPS	Creative Problem Solving
EIE	Économie, Innovation et Exportations (Government of Quebec)
EII	Explicit-Implicit Interaction process
ESTIA	École supérieure des technologies industrielles avancées (France)
ÉTS	École de technologie supérieure (Montréal)
HBRAS	Havard Business Review Analytic Services
ISP	Innovation Styles Profile
OCDE	Organisation de cooperation et de développement économique
OECD	Organization for Economic Co-operation and Development
MIT	Massachussets Institute of Technology
NASA	National Aeronautics and Space Administration
P&G	Procter & Gamble
PLM	Product Life Management Cycle
PMI	Project Management Institute
SMEs	Small and Medium Enterprises
STIC	Science, Technology and Innovation Council
The 24 Hours	The 24 Hours of Innovation
TPP	Technological Product and Process

INTRODUCTION

The interest in creativity and innovation has assumed great importance in the 21st century. For instance, many political leaders who have identified the need for change, state that creativity and innovation are essential for the future of their countries. In 2011, President Barak Obama from United States said: "We can create the jobs and industries of the future by doing what America does best – investing in the creativity and imagination of our people" (The White House, 2011). And, for European Union, this is what Prime Minister Jyrki Katainen of Finland said:

> The European Union's budgeting process is too unwieldy to meet modern world challenges. Spending must be made more flexible. More funds should be targeted at research, incentives for creativity and development of world-class expertise (Prime Minister'Office, Finland, 2011).

Meanwhile, Australian Prime Minister Julia Gillard addressed the Australian innovation organization:

> Innovation and an innovative culture are the keys to building sustainable businesses. Producing innovative goods and services, and being more creative in the way we do things will increase our productivity, improve our standard of living and ensure we sustain our international competitiveness and economic performance into the future (*Australian Innovation*, 2010).

Thus, for the countries of those authorities, investing funds to develop a culture of creativity and innovation is a key point to create economic growth.

A study made by the Havard Business Review Analytic Services (HBRAS) with 1214 business executives from around the world showed that, while the demand for new products, services and revenues is high, the risk of failed experimentations must be weighed against the actual state of the economy. The innovation process implemented to do new products and services development involve more people than before from ideation beyond products and services retirement (HBRAS, 2011, p. 1).

Meanwhile, future engineers will have to develop appropriate methods of production to face the challenges linked to the increasingly growing world population (Davidson *et al.*, 2010,

p. 3). And, according to Duderstadt, those future challenges will need “an ever-expanding knowledge base requiring new paradigms for engineering research that better link scientific discovery with innovation” (Duderstadt, 2008, p. v). New competencies need to be added to their curricula to meet the challenges of future engineers (Canadian Academy of Engineering, 2005, p. 45, Coyle *et al.*, 2013, p. 7, Nguyen and Pudlowski, 2007, p. 107-113, Unesco, 2010, p. 6, and Ambrose, 2013, p. 16).

Starting in June 2015, Canadian engineering Universities must demonstrate that the graduates possess 12 attributes requested by the Canadian Engineering Accreditation Board to meet the future challenge of engineers. Those attributes define new knowledge, technical and soft skills that graduates must learn through programs and activities (Engineers Canada, 2014).

In Quebec, École de technologie supérieure (ÉTS) and McGill University have decided to work together since 2009 to create the “Quartier de l’innovation”. It is intended to play both a collaborative and a mobilizing role, promoting a project with creative effervescence that has a national and international outreach (Quartier de l’innovation, 2015).

Creativity and innovation are important in every aspect of the lives of innovators and companies, as demonstrated above.

In the meantime, Small and medium enterprises (SMEs) face the problem of lack of resources like finances, skills that can promote creativity for innovation, and time (Tidd and Bessant, 2013, Flinders, Lynch and Holden, 2010, OECD, 2010). Yet, according to OECD (2010, p. 4), “SMEs represent the majority of all businesses and employment”. Then, for us, as far as the time barrier is concerned, we would need to help those SMES and companies find creative ideas or solutions to problems with the limited time at their disposal.

Our first interest in this research was to study methodologies to help companies to innovate. There was a multitude of possibilities of subjects research that we could select. We were interested to start at the beginning of innovation projects and more specifically, at the idea level.We wandered if there were aspects that may need to do research to improve creativity.

We chose to orientate our research on the methodologies aspect: Analysis of secondary data collected by researchers at École supérieure des technologies industrielles avancées (ESTIA) for an innovation challenge named “The 24 Hours of Innovation” (The 24 Hours) from 2007 to 2010 demonstrated that most of the participants used only one creativity tool during the event: The Brainstorming. Yet, acording to many researchers, there is a risk of productivity loss in quality and quantity of ideas linked to the use of the Brainstorming only when groups want to generate ideas. We chose to work on creativity methodologies in order to find how we could help innovators in teams and companies to find ideas using the Brainstorming and other creativity tools to gain productivity in ideation sessions, both in the quantity and quality of ideas. Then, we decided to work on components of the creativity.

The other aspect of our problem linked to the methodology was the search of a creative process helping to find ideas during short ideation sessions. We found a creative process dedicated to innovation sessions which are not planned: the Improvisational creative process for organizations of Fisher and Amabile (2009). Apart from that, the other creative processes are generally used for ideation sessions in a more or less predetermined time. Therefore, we came to think for a creative process for ideation sessions which, without being improvisation, would be planned for short periods.

To reach that goal, our research question was: How to elaborate a componential creative process for short ideation sessions?

In chapter 1 of this thesis, we review the literature to define terminologies and introduce methodologies related to creativity, creativity tools, creative processes and innovation. In chapter 2, we elaborate the research question, its objectives and methodology. The latter aspect explains why this research was done during The 24 Hours also organized at ÉTS since 2010. In chapter 3, we explain how we selected creative processes and creativity tools for the experimentation and present our analysis of secondary data collected at ESTIA to create new creative components proposed and experiment. In chapter 4, we present the various tests of our experimentation during which we elaborated different versions of our componential creative process for short ideation sessions in 2012, 2013 and 2014. Chapter 5 is dedicated to

the interpretation of the results from 2012 to 2014, the discussion and comparison of those results, in order to propose, for the 2015 edition of The 24 Hours, the latest version of our componential creative process elaborated for short ideation sessions.

CHAPTER 1

REVIEW OF THE LITERATURE

1.1 Generalities on creativity

1.1.1 History of creativity

A glance of history shows us that, in the Judeo-Christian tradition, the early conception of creativity comes from the Book of Genesis in the Bible with the story of creation, including plants, animals and humankind by God, the only one able to generate (Boorstin, 1992, Clark Chadwick, 2008, p. 26-30). So, the belief was that humans were unable to create new things and their realizations were the product of the divine inspiration. Then, the verb "to create" and its derivatives as "creation" or "creator" were not always linked to human.

The *New World Encyclopedia* points that the ancient Greeks and Romans had the same belief. For them, the inspiration of the poets originated with the Muses, which were sorts of gods; and, according to Plato, an artist like a painter was merely an imitator of Nature. But, if the Greeks had no word for "creation", using only the expression "*poiein*" which meant "to make", the Romans had two words, "*creare*" and "*facere*", though the difference was not clear between both of them. And those peoples had no word to name their works of creation in architecture, music, arts, etc., which were bequeathed to us by history and demonstrated their creativity; their talent was considered as a work of *genius* (*New World Encyclopedia*, 2013).

Hence, many people think that the concept of creativity was missing in most ancient cultures, since whether in India and China for example the terms "discovery" or "mimicry" were employed to qualify forms of art[1] (Runco and Albert, 2010).

[1] For instance, the concept of creation from nothing was absent in the philosophy of Hindus, Confucius, Daoists and Buddhists (*New World Encyclopedia*, 2013).

However, archaeological researches have revealed a sense of creativity back to time immemorial in the history of humanity[2]. Heather Pringle states:

> Scientists long thought that early humans were stuck in a creative rut until some 40. 000 years ago, when their powers of innovation seemed to explode. But archaeological discoveries made in recent years have shown that our ancestors had flashes of brilliance far earlier than that. These findings indicate that the human capacity for innovation emerged over hundreds of thousands of years, driven by both biological and social factors (Pringle, 2013, p. 37).

Yet it was not until several centuries that the term creativity was associated with creation made by human. In the Renaissance, people believed in their freedom and their capacity to generate works emanating from themselves as creators. So, that word would have been used for the first time in 1623 to establish the difference between the creation of men and the one from nothing, of God or the gods. Baltasar Gracián (1601-1658), for example, viewed art as "the completion of nature, as it were, 'a second Creator'" (*New World Encyclopedia*, 2013). In the Age of Enlightenment (18th century), creativity had to do with imagination as far as the theorization of art was concerned.

The analysis made by Keith Simonton (2007) shows how creativity influenced the field of psychology in the 19th century. The author explains that science began to be seen as capable to explain creativity: The latter had ceased to be a gift from God, something which could merely be learned, described, classified and applied but not explained, "at least not scientifically". For instance, Charles Darwin (1809-1882) explained his own view of creativity in nature. In accordance with his theory of the evolution of species, there was no plan in the nature, no goal, and each species had to struggle in order to survive. Keith Simonton writes: "Creativity was thus granted a completely scientific explanation" (Simonton, 2007, p. 6), and psychologists speculated that the same "variation-selection" process is involved in the production of ideas in human mind.

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[2] Researches made in Sibudu cave in South Africa by the team of Lyn Wadley, archeologist of the University of the Witwatersrand, Johannesburg, South Africa, revealed 15 layers of material leaves, seeming to be a sort of an old bedding for 77. 000 years. Creativity appears here in the selection of the material from a tree known for its disease preventive properties, and to solve a problem, as we see further; about that tree, Wadley write: "Its crushed leaves are aromatic and contain traces of chemicals that have insecticidal and larvicidal properties against, for example, mosquitoes. Mosquito-borne diseases are endemic to many parts of Africa, and rural communities still use indigenous plants to dispel mosquitoes" (Wadley *et al*., 2011, p. 1390).

On the other hand, the Belgian mathematician Adolphe Quételet (1796-1874) was focusing his study on dramatists to check whether the probability of great plays in terms of quantity and quality is linked to the age of the producer or not. As far as creativity is concerned, Simonton concludes that Quételet "defined creativity according to observable behaviour, as gauged by the products generated by the creative process. In short, creativity was objectively quantified in terms of productivity" (Simonton, 2007, p. 7).

The interest on these few writers of the 19th century is the relationship that is established here between creativity and the notions of process and productivity, which it will be important to remember for the rest of our study. For the moment, we will notice that in general, the 19th century was the period which reserved the term creativity in art exclusively (*New World Encyclopedia*, 2013). The twentieth century transferred the concepts of arts to creativity in science, whether in psychology or psychoanalysis, areas that are not the subject of our research. Nevertheless, it is interesting to note that nowadays, the field of creativity has extended to several areas, whether in art such as literature, music, painting, film, etc. or in the area of productivity. This multi-dimensionality has led to various conceptions of creativity, each seeking to define it.

1.1.2 Concept difficult to define here

If it is evident that the etymology of "creativity" is the Latin word "*creo*" meaning "to create", "to do" (Finke, Ward and Smith, 2004, p. 4; Smith, 2012, p. 42), the definition of that term is neither easy nor unanimous. To begin, Aleinikov, Kackmeister and Koenig present a selection of more than 101 "best definitions", all of experts, however contradictory, and that it is up to the reader to judge (Pierre Kolp, 2009, p. 4). Nevertheless, according to the *Oxford Dictionaries: Language Matters* on the Web, "creativity" refers to "the use of imagination or original ideas to create something" (Oxford University Press, 2015a).

The first observation that can be made here is that creativity is the result of human, what the word "imagination" alluded to in the previous definition. That is why the *Merriam-Webster's* dictionary online quotes the example of "the remarkable creativity of local artists and artisans"; that book defines creativity as "the skill and imagination to create new things".

(Merriam-Webster, Incorporated, 2014). The second point is the link between creativity which is rooted in imagination, and ideas.

Therefore, at this level, we can define creativity as being, in a general rule, the capacity of an individual to use his imagination and ideas to create, that is to say, invent something or new ideas. However, the extension of creativity to other areas in modern days has resulted, as we said before, in a varied conception of this activity.

For instance, instead of “invent” or “create”, Pierre Kolp, for his part, uses the term “discover” or “find” when defining creativity. For him, creativity is “the ability to discover a new solution, original, for a given problem” (Pierre Kolp, 2009, p. 4, free translation from French). One may have the impression that the idea already existed and the creativity of a person would have just helped him to “un-cover” that reality which was hidden. Creativity arises here as to the scope of everyone, every individual being placed before a discovery potential to do, when confronted to a problem that requires a solution. The same impression emerges in the use of the term “recognition”, among others, by Franken, when he writes: “Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others” (Franken, 1993, p. 396). That may suppose that ideas already existed. The debate about creativity being equally divided between individuals is not the subject of this thesis and we will focus here rather on the other dimensions brought in both definitions of the authors: Problem, solution, communication and entertainment.

The prospect of Franken extends the possibilities of creativity in several domains, be it business, health, technology and other human relations or humanities that involve problem solving in one hand, or music, literature and, on the other hand, other arts where the entertainment industry is flourishing. In this view, the three aspects that are problem solving, communication and entertainment are to be taken equal in creativity. Franken summarizes his thinking by presenting each of these three aspects as “needs”, when indicating other three reasons that motivate people to be creative: “1. The need for novel, varied and complex stimulation, 2. the need to communicate ideas and values, 3. the need to solve problems”

(Franken, 1993, p. 396). This implies that, in order to be creative, a person has to demonstrate his capacity to vary his ideas which can have many possibilities or alternatives. He will also have to share them with others, and he should take pleasure in doing so.

Creativity does not refer only to the person who creates and is said “creative”, like a famous artist. As Weisberg explains, a work can be assigned the term “creative” depending on the value conferred on it, like a piece of art; this may suppose that, to be considered as creative, a product should have a material value. Creativity can also be the intellectual value that should be encouraged in a production team for example. Finally, creativity can be the general activity of creating (Weisberg, 1993, p. 4). An example of that is seen in the present thesis where creativity is the main subject.

The difficulty to define creativity is also seen in the debate surrounding its implications and contents. In his definition, Weisberg (2006, chap. 2) adds that creativity is not a coincidence: “Creativity entails the production of goal-directed novelty. Creativity results in the intentional production of new things, either ideas or physical objects”. Hence, novelty is wanted, provoked, therefore targeted, its main goal being the production. This view asserts programming at the base of all creativity, which is no longer the unique artist’s singular genius demiurge in his talent. Creativity is being worked and can be the prerogative of any good mind able to take the trouble.

In the meantime, Rehn and De Cock (2009, p. 222) deconstruct the concept of creativity by showing first that it does not necessarily imply novelty. For example, John Madea of Massachussett Institute of Technology (MIT) developed a simplicity based approach by offering companies (such as Phillips company that uses this approach) to create by reducing and simplifying, instead of developing and adding. The second deconstruction of Rehn and De Cock suggests that creativity does not always imply that the object is unique, even less original (Rehn and De Cock, 2009, p. 227). As proof, the painter Cézanne strove to paint several times the same view of Mont Saint-Victoire and use it as material for a multitude of works he created. According to their third deconstruction, creativity must remain neutral and free of ideological and moral context. That is why creativity also helps to develop weapons

and other methods of torture. Following this deconstruction, Rehn and De Cock (2009, p. 229) propose to adopt the definition of creativity outlined by Derrida, Brault and Naas:

> The answer must each time be invented, singular, signed, and each time only one time like the gift of a work, a giving of art and life, unique and, right up until the end of the world, played back, given back. To the impossible, I mean right up to the impossible (Derrida, Brault and Naas, 2001, p. 188).

Rehn and De Cock argue that when creativity brings novelty, this must be inherently valuable. They go in the direction of Bills and Genasi (2003), Cox (2005), Ford (1996) and Rickards and De Cock (1999), who agree on the fact that creativity involves the ability to achieve something new that has value or usefulness. However, creativity defined in this way is often seen as critical to the success of the organization.

That is why, for other researchers such as Runco and Ptrizker (1999) and Sternberg (1999), the definition of creativity should not include the concept of value. Weisberg (2009, p. 24) thinks that including that concept of value to the definition of creativity, whatever the meaning given to the term "value", would complicate this definition as to render it unusable. Moreover, the value of products may change over time: A new product that has value when created may be considered by some as a product of creativity, while it would not for others, thereafter it loses value.

Beyond its implications, the debate on the definition of creativity is also about its models. One aspect of creativity some authors address is that of "organizational creativity" which is, as its name suggests, in connection with an organization. According to Guilford (1950) and Nicholls (1972), organizational creativity is based on the members of an organization, while for Amabile (1988, 1996a), Ford (1996), Woodman *et al*. (1993), it refers to new strategies, new processes, services and organization products. Drazin *et al*. (1999) focus the definition of organizational creativity on that of the processes of an organization. Fisher and Amabile (2009) propose, for their part, an organizational creativity definition that emphasizes the production of ideas ahead of any novelty in the organization, that is to say, "the production of ideas for novel and appropriate (useful or valuable) products, services, processes or strategies in an organization" (Fisher and Amabile, 2009, p. 13).

1.1.3 What to retain?

Stating that the definition of creativity is a central topic of any research on this subject, Runco and Jaerger get down to make "corrections" to the way people develop creativity and try to define it. They argue that a "standard definition" of creativity "[…] is bipartite: Creativity requires both originality and effectiveness" (Runco and Jaerger, 2012a, p. 92). For many, originality is novelty, but according to the authors, whatever the meaning given to that novelty, whatever its appellations or synonyms, something cannot be creative if it is not "unusual, novel, or unique": In that case, it falls into the trivial and conventional.

However, originality is not sufficient, since some products which are original can be useless: "Originality can be found in a word salad of a psychotic and can be produced by monkeys on word processors". Therefore, a creative product should also be effective, an adjective that can be rendered as useful, fitting, appropriate. Effectiveness may also be labeled value, a sense which is more relevant in the field of economics where originality and value of products and ideas will depend on the laws of the current market (Runco and Jaerger, 2012a, p. 92). Runco and Jaerger think that the first to give that standard definition of creativity was Stein in 1953 (Stein, 1953, p. 311-322).

For Stein, "the creative work is a novel work that is accepted as tenable and useful or satisfying by a group in some point of time". So, the novelty and usefulness of a creative work depends on a given society or group in a given time. Stein emphasizes that novelty is not necessarily an invention from nothing, but it implies that "the creative product did not exist previously in precisely the same form" (Stein, 1953, p. 311). Then, a creative work or idea will have to break with the status quo or the traditional method. The author adds what follows about the nature of the problem and the persons who create :

> The extent to which a work is novel […] may well depend on the nature of the problem that is attacked, the fund of knowledge or experience that exists in the field at the time, and the characteristics of the creative individual and those of the individuals with whom he is communicating (Stein, 1953, p.311).

The creative process of Stein takes into consideration the immediate environment of the individual, be it the time, the space, the group, the nature of the problem, the sum of knowledge available by the individual and his environment, etc. Creativity appears to us here like the result of a commitment in a developed work that requires more than one condition of its realization, more than one tool. That is why, Stein warns, it should not be confused with the genius which is individual and inexplicable.

Like Runco and Jaerger, we will retain the definition of the creativity by Stein which is more suitable with our study of the means, that is to say, the tools and processes that are used by individuals and groups engaged, in a given environment, in the work of creativity. These means are labeled “methodologies” by some authors.

1.2 Methodologies of creativity

The literature of studies on creativity does not dwell on the definition of the “methodology of creativity” in particular, with this two terms associated. In most of the cases, when referred to a study, they are given for granted; for example, under their subtitle, one may immediately present the aspects of the means or the principles of an issue where creativity is involved. It will therefore be for us to go explore through these occurrences to come out the elements of a methodology of creativity.

To start, simply speaking, the *Cambridge Dictionaries Online* (Cambridge University Press, 2014a) defines the word “methodology” as being “a system of ways of doing, teaching, or studying something”. The *Collins English Dictionary* replaces the term “ways” in that definition by “methods”, when it presents the methodology as “the system of methods and principles used in a particular discipline”, or “a system of methods and principles for doing something” (Collins, 2014). For that last word, “method”, from which “methodology” originates for, the *Oxford Dictionaries: Language Matters* says it is “a particular procedure for accomplishing or approaching something, especially a systematic or established one.” (Oxford University Press, 2015b). Therefore, methodology will be a set of methods, that means, it encompasses different types of ways to do.

Specifically, researchers in creativity use the words “techniques”, “tools” or “processes” to define the means used to create. For example, focusing their study in some industries in U.K., Fuller, Warren and Norman tried to develop a methodology, “a conceptually grounded framework that […] can capture the emergence of novelty in the creative industries” (Fuller, Warren and Norman, 2011, p. 2, Henry and de Bruin, 2011, p. 79). Methodology can be understood as their own approach or procedure to carry out their study. This is the sense of methodology in the second chapter of our thesis, where we define the methods we used in order to conduct our research. But for this, we need to study first the aspects of the methods involved in creativity. That is what the authors cited above tried to understand in the methodologies of creativity in industries, when they studied “the emergence of novelty, that is, the process by which new products, services, business models and patterns of behaviour arise through creative acts” (Fuller, Warren and Norman, 2011, p. 2).

Then, we can say that the methodology in creativity involves a certain number of methods or procedures used to generate new ideas or products. Several other authors describe creative methodologies as strategies, or tools and processes that can help companies or groups improve their innovation potential.

1.2.1 Creativity tools

To define what a “creativity tool” is, we will start by defining a tool. The *Merriam-Webster* dictionnary online defines a tool as “something (as an instrument or apparatus) used in performing an operation or necessary in the practice of a vocation or profession < a scholar’s books are his *tools* >” (Merriam-Webster, Incorporated, 2015b). For Markman and Wood, a creativity tool is “a cognitive prosthetic that somehow increases the capability of individuals and groups. It enhances the ability of problem solvers to generate and develop ideas beyond their innate ad hoc processes” (Markman and Wood, 2009a, p. 19). When, for Sefertzi,

> Concrete creativity supporting techniques, including also computer-based support tools (artificial intelligence models, computer software idea processors, information systems, etc.), are developed to promote and generate creativity, to break fixed ideas, to stimulate imagination, as well as to define the conditions in which creativity takes place (the creative environment or climate) (Sefertzi, 2000, p. 3).

Creativity tools may be used to create products or services, solve problems or find new opportunities. In summary, Vidal says they can be used to: 1. Improve products or services; 2. Create new products or services; 3. Develop new strategies; 4. Generate many radical ideas; 5. Make creative leaps; 6. Widen the search for solutions; 7. Look at problems from different perspectives; 8. Solve everyday problems (Vidal, 2006c, p. 2).

Depending on authors, creativity tools are named "tools" (Harrington, Hofherr and Reid, 1997, p. 195, Reali, 2009), "creating tools" (Markman and Wood, 2009a, p. 19), "creativity tools" (Vidal, 2006c, p. 2, Manktelow *et al*, 2014a, Straker, 2015,), "creativity techniques" (Mattimore, 1994, p. 57, Carrier and Gélinas, 2011, p. 161), "techniques" (Miller, 1987, p. 64, McFadzean, 1998b, p. 131, Nemiro, 2004, p. 175, Scott, Leritz and Mumford, 2004, p. 362, Gogatz and Mondejar, 2005, p. 142, Clegg and Birch, 2007, p. 11), "techniques and tools" (de Bono, 1992b, Silverstein, Samuel and DeCarlo, 2009, p. vi) or "subprocesses" (Lubart, 2001, p. 299). We chose the terminology "creativity tools" for our research.

We found 615 creativity tools and stopped searching after that, since we had more creativity tools than required for the research (see appendix IV). However, we know that there were much more existing: it can be seen on Manktelow (Manktelow *et al*, 2015b) website where more than 900 had been collected.

To summarize the usefulness of creativity tools, we will apply the following quotation of de Bono talking about the specific creativity tool Lateral Thinking, to creativity tools in general:

> Creativity is not a mystical talent that some people have and others can only envy. [Creativity tools are] the type of creative thinking that can be learned, practiced, and used by everyone. Some people will be better at it than others, as with any skill. Learning [creativity tools] will not make everyone a genius, but it will supplement existing thinking skills with a valuable ability to generate new ideas (de Bono, 1992b, p. 310).

1.2.2 Creative Processes

The *Cambridge Dictionaries Online* gives this definition among others of the process: "A series of actions that you take in order to achieve a result" (Cambridge University Press, 2014b). The process here involves many actions, a chain of doings. But these actions may

happen naturally, and the process has the meaning of "a series of changes that happen naturally", according to the same dictionary. However, as far as industry is concerned, a process is understood as "a method of producing goods in a factory by treating natural substances" (Cambridge University Press, 2014b). In the meantime, The *Business Dictionary* gives this elaborate definition of the process:

> Sequence of interdependent and linked procedures which, at every stage, consume one or more resources (employee time, energy, machines, money) to convert inputs (data, material, parts, etc.) into outputs. These outputs then serve as inputs for the next stage until a known goal or end result is reached (*Business Dictionary*, 2014c).

Lubart (2001, p. 295) defines the creative process as the "sequence of thoughts and actions that leads to a novel, adaptive production". For Vidal, the creative process may present multiple aspects:

> The creative process […] is the way or manner in which a problem is solved. It is the process of bringing something new into being. It is the process of combining previously unrelated ideas or perceiving a new relationship from previously unrelated ideas. Whether solving problems alone or in a group, you really must have a guided process i.e. a plan or a map of the steps to be followed. This is especially so in a group due to the need to align the capabilities of the members in a positive way (Vidal, 2010, p. 412).

With these different perceptions of the creative process, one could say that, in a general rule, a creative process implies all transactions initiated and conducted in a conscious or unconscious order to lead to the creation of a product, whether a good or a service. The literature review allowed us to identify 39 creative processes; the oldest was designed in 1926 (see table 3.2, division headings 3.2.1.1). Creativity manuals do not give a standard definition of the creative process and the expression "creative thinking" is always used; both expressions are designed differently according to authors.

Such is the case of Weisberg (2006, chapter 2) for whom the creative thinking refers to "psychological means": "The creative process or creative thinking is the psychological means whereby such novelty is brought about." Therefore, the creative process is presented here as having its source in the psychology.

Creative Processes may also be understood within a system of classification.

We searched classification methods for creative processes. We found a classification made in function of creative processes phases proposed by Puccio and Cabra (2009a, p. 329) to classify Creative Problem Solving (CPS) processes. Lubart (2001) made an analysis of creative processes based on the Four-stage model created by Wallas in 1926. The stages used by Lubart are similar to the phases used by Puccio and Cabra. Nemiro (2004, p. 4) used a different method to classify creative processes: She proposed four approaches: 1. Intuitive, 2. linear, 3. intuitive and linear, and 4. componential. Her classification system allowed to classify almost all existing creative processes under those proposed four categories. Since Puccio and Cabra systems were made for CPS process, we found it not practical to extent their use to other types of creative processes. Lubart system was too vague to be useful. To Nemiro classification system we chose, we added a fifth type, "Other types" of creative processes. We explain below the categories of Nemiro's classification system.

1.2.2.1 Intuitive approach

The intuitive approach is seen as an involuntary creative process. Nemiro (2004) states:

> It involves a relatively rapid change in one's current way of thinking or perceiving. What occurs is a mental transformation that allows new ideas, meaning, or solutions to be suddenly discovered. There is little or no experience of a particular path one follows to a solution […]. The creative individual is often left to wonder "Where did the thought come from?" (Nemiro, 2004, p. 6)

Some processes meet the intuitive approach.

1.2.2.1.1 Wallas creative process (1926)

One of the first processes designed in the field of science was developed according to the intuitive approach in 1926 by Graham Wallas (1926, p. 80). Wallas relates that he was inspired by a presentation done by Hermann von Helmholtz, a famous German physicist, at a banquet in honor of his 70th birthday (Koenigsberger and Welby, 1906). Helmhotz explains:

> After previous investigation of the problem in all directions… happy ideas come unexpectedly without effort, like an inspiration. So far as I am concerned, they have never come to me when my mind was fatigued, or when I was at my working table. They came particularly readily during the slow ascent of wooded hills on a sunny day (Rignano, 1923, p. 267-268).

Helmotz had just given Wallas the first three stages of his creative process. The first step was the "preparation", during which the problem is discussed "in all directions". The second stage, during which Helmholtz did not knowingly think the problem, was called "incubation" by Wallas. And the third was the "illumination", the one where the happy idea appeared associated with psychological events that precede and accompany this apparition (see also Akin and Akin, 2008). A fourth step was added, the "verification", which comes from the work of the mathematician, physicist and philosopher French Henri Poincaré (1914, p. 54).

Poincaré explained the successive steps that enabled him to make two major mathematical discoveries: 1. Peparation, during which he conducted a systematic analysis of the problem; 2. Incubation, where he passed a day, first not to think, secondly to achieve a working related to his reservist military service. 3. Illumination: that came suddenly, giving him an immediate certainty. 4. Verification: during this step, he checked the validity of ideas and could establish the exact form of the mathematical discoveries solutions.

According to Torrance (1966), the Wallas creative process is the basis of most creativity training programs currently available.

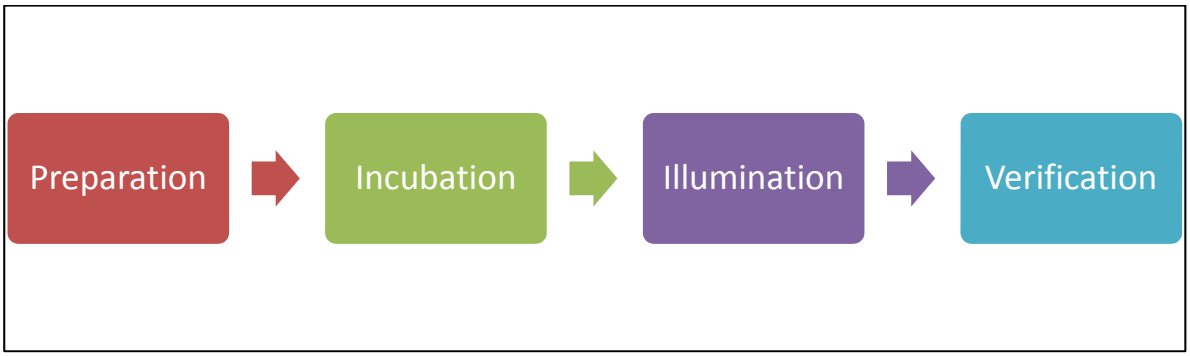


Figure 1.1 Wallas creative process represented
by the author of this thesis

According to Kaufman and Gronhaug (1988), psychological theories defining the creative process include, in general, distinct steps that occur in sequences, starting from the understanding of the problem to the development and selection of creative solutions. Thus, for Fisher and Amabile (2009), Wallas creative process is a "Compositional creativity". This is a standardized process properly describing the creative process of new products development in many organizations using a planned and rigorous process in stages.

1.2.2.1.2 "Convergent and divergent production" creative process of Guilford (1967)

According to Guilford (1967), two types of responses are given in general before a problem: They are based on convergent and divergent thinking. Carrier and Gélinas (2011, p. 141) define divergence as "the ability to open our creative spirit in all directions, eventually reaching original ideas." The convergence techniques are used to select ideas, both distinctive ideas and those appearing readily achievable (see figure 1.2).

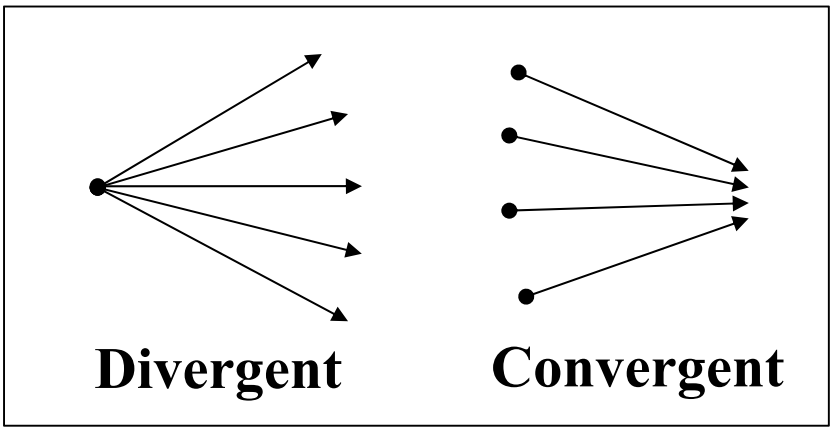


Figure 1.2 "Convergent and divergent production" process
Taken from Guilford (1967)

We will present and detail the Convergent and divergent production process of Guilford in the fourth chapter of this thesis where we classify and select creativity methodologies.

1.2.2.2 Linear approach

Creative processes developed from the linear approach consist of a series of logical steps that users carry one after the other. Nemiro (2004, p. 4-5) explains that, in this approach, the

creative process “is viewed as a logical problem-solving process […] through which an individual or teams move to define, clarify, and work on a problem and produce a solution to that problem.” The following processes correspond to this approach.

1.2.2.2.1 Osborn CPS creative process (1953)

One of the first creative processes designed according to the linear approach, the “Creative Problem Solving (CPS)”, was proposed by Osborn in 1953. It includes three stages and six phases (see table 1.1).

Table 1.1 CPS creative process
proposed by Osborn (1953)

Process Stage	Steps
1. Explore the Challenge	1. Objective Finding (identify the goal, wish or challenge)
	2. Fact Finding (gather the relevant data)
	3. Problem Finding (clarify the problems that need to be solved in order to achieve the goal)
2. Generate Ideas	4. Idea Finding (generate ideas to solve the identified problem)
3. Prepare for Action	5. Solution Finding (move from idea to implementable solution)
	6. Acceptance Finding (plan for action)

For over 50 years, since the advent of the CPS process of Osborn in 1953, many CPS process versions have been proposed: Osborn CPS of 1963 called “CPS Stream Lined”, the CPS of Parnes in 1967, that of Isaksen, Scott and Treffinger (1985) called “Basic Course”, the version *Simplex*® developed by Basadur in 1994, the one of Miller, Vehar and Firestein in 1996 with another version called “Plain language”, a 6.1 version of Isaksen, Dorval and Treffinger’s CPS in 2000 (Treffinger, Isaksen and Dorval, 2003, Isaksen, Dorval and Treffinger, 2010), and the “Thinking Skills Model” of Puccio, Murdock and Mance (2005).

1.2.2.2.2 "CPS Thinking Skills Model" of Puccio, Murdock and Mance (2005)

Puccio and Cabra (2009a) and Puccio, Murdock and Mance (2005) present another CPS process inspired by the CPS of Osborn and Parnes, the "CPS Thinking Skills Model". This CPS is designed to generate ideas that are creative and new. It was specifically developed for situations that require a change, a new way of thinking and a new approach. Creative thinking associated with the CPS helps to solve complex problems like poorly defined situations, those new or which have changed, the one ambiguous, situations such as missing information or those that are unable to establish what is relevant (see figure 1.3).

Figure 1.3 CPS Thinking Skills Model of Puccio, Murdock and Mance
Taken from Puccio, Mance and Murdock (2007, p. 119[3])

[3] The process was presented by the authors in 2005, but we took its illustration in Puccio, Mance and Murdock, 2007.

As Guilford (1967) represents it, the Thinking Skills model is composed of three phases and 6 steps, and, for every step, convergent and divergent times (see table 1.2).

Table 1.2 CPS Thinking Skills model's three phases and 6 steps
Taken from Guilford (1967)

3 PHASES	6 STEPS	2 TIMES
1. CLARIFICATION	1. Exploring the vision	Divergent
		Convergent
	2. Formulating challenges	Divergent
		Convergent
2. TRANSFORMATION	3. Exploring ideas	Divergent
		Convergent
	4. Formulating solutions	Divergent
		Convergent
3. IMPLEMENTATION	5. Exploring acceptation	Divergent
		Convergent
	6. Formulating a plan	Divergent
		Convergent

For Carrier and Gélinas (2011), respecting the divergent time (to generate ideas) and the convergent one (to realign ideas) found in every step of this CPS process is the key to get performance and success in using it. The six steps of this CPS will be developed in the second chapter of this thesis, which is devoted to methodological approaches that support the various analyzes of our research.

1.2.2.3 Linear and intuitive approach

Creative processes using both linear and intuitive approaches may allow obtaining very creative solutions in response to problems or everyday life situations. For Nemiro (2004, p. 8), "the key difference between the two ways of thinking is that in more linear views the creative process is sequential. In intuitive approaches to creative activity, the process is holistic. Thus the creative process is a combination of hard work, logic and intuitive insight." Several processes also meet this dual combined approach.

ThinkX creative process of Tim Hurson (2007) is an example of the linear and intuitive approach. It uses the stages of the CPS of the linear approach and the techniques of Project Mapping IDEF (i.e. "Mapping Integration Definition") that are similar to the steps of the intuitive creative process. It was designed for the National Aeronautics and Space Administration (NASA) (see figure 1.4).

Figure 1.4 ThinkX creative process of Hurson
Taken from *ThinkX* (Undated)

As figure 1.4 shows, this process consists of six steps: 1. What's going on? 2. What's the success? 3. What's the question? 4. Generate answers 5. Forge the solution 6. Align resources. All these steps will also be developed in the second chapter of this thesis.

1.2.2.4 Componential approach

The fourth approach, the componential one, is different from the first two, the intuitive and the linear approaches, by the fact that this process of creativity is only one component of the creative process. Here is what Eugene Gorny (2007b) says of the componential model:

> Componential model is […] an attempt to specify the set of abilities, skills, traits, dispositions, and / or processes that are involved in creative behaviour. This model suggests that creativity will be highest in that area where the three components

> (domain-relevant skills, creativity-related processes, and intrinsic task motivation) share their greatest overlap. In other words, people are most likely to be creative within their "creativity intersection". Identifying this intersection can be an important step towards creativity (Gorny, 2007b, online).

For Nemiro (2004), the componential approach helps, within a process, to represent the complexity of creativity even if the components of the processes proposed in this approach may vary according to their authors. And, according to her, this approach also provides added values "by providing components on which highly creative individuals and teams may be assessed and identified, and by providing areas in which training may be developed for creativity enhancement (Nemiro, 2004, p. 8)."

For the componential model of Amabile (1983, 1988, 1996a, 2013), here is what Michelini says: "The componential model of creativity includes all factors that contribute to creativity – persons factors as well as work environment variables" (Michelini, 2015, p. 12).

One example of process by componential approach is the Improvisational creative process for organizations of Fisher and Amabile (2009), which shall be developed in the second chapter of this thesis. For the moment, after this discussion on processes of creativity, we return to Vera and Crossan words quoted above stating that a process can lead to the novelty "but may succeed or fail" (Vera and Crossan, 2005, p. 205). This shows that a process can also be non-creative.

1.2.3 Non-creative processes

Non-creative processes are defined as those which create little new (Fisher and Amabile, 2009, p. 18). Among them, the algorithm takes an important place. Ruscio and Amabile associate the adjective "algorithmic" to the description of instructions that specify each step of actions to do and that are learned by heart (Ruscio and Amabile, 1999).

"The algorithmic execution", for Fisher and Amabile, is either executing a plan already drawn like a computer program, or a standard response. This process occurs when the innovation is low but the allotted time is short. When innovation is low, but the time is not restricted, the process is then called "algorithmic planning". Fisher and Amabile add :

> Algorithmic planning is like creating the list of procedures in a nuclear power plant for the operators to follow – the procedures to be written down are known (and often legislated) and the job of the actor is to record them as accurately as possible so that others may execute those instructions: their only concern is to express the plan so that it is executed without errors or violations (Fisher and Amabile, 2009, p. 18.)

Thus, although there are non-creative processes, we should avoid believing that creativity is totally absent from these processes; some non-creative processes help create.

There are also processes which help to create but show little or no creativity, even if they are important in separate domains in creativity and innovation. But, to what extend? What is the real border between creative processes and those that are not? Does that border exist? Is it real between the creative processes in general as the previous apparent nomenclature tends to lead one to believe? Those questions present some difficulties related to creative processes.

1.2.4. Criticism of creative processes

Creative processes have been developed in the field of drawing, painting, music and science. Yet, some authors argue that creativity does not follow a defined process, as Plsek (1996) warns. For him, creativity is not even seen as a process with specific stages by some experts. For example, for a philosopher like Wertheimer (1945), the process of creative thinking is part of thought which hardly lends itself to a division imposed by a model (Plsek, 1996). Vinacke (1952), for his part, denied that the arts employ some creative process whatsoever.

In the same vein, Lubart made a historical and cross-analysis of the processes of creativity which proved that systematization of these processes is not always admitted (Lubart, 2001, p. 295-308). He shows that the classic four-stages model of the creative process initiated by Wallas was based on a theory of introspective evidence experimented by French mathematician Henri Poincaré (1908-1985), who came to the conclusion that the creative process was the result of a conscious and subconscious alternative work resulting in illumination. Then, the four-stages model and its variants was shared with Catherine Patrick who tried to prove it in an empirical research made with artists, poets, laypeople and scientists (Patrick, 1937, quoted by Rothenberg and Hausman, 1996, p. 73-78), Guilford (1950) and other modern days researchers as Osborn (1953), Taylor (1959), Stein (1974),

Austin and Sutton (1974), Busse and Mansfield (1980), Cagle (1985), Sapp (1992), Goswami (1996), Amabile (1996a), to quote just a few of them (Lubart, 2001, p. 295-298).

However, Lubart continues, experts like Eindhoven and Vinacke (1952) argue that the experimentation and conclusions of Patrick were biased by "an a priori theoretical conception of the four-stages". Basing their experimentation on the work of artists and nonartists participants, they could not observe any evidence of a process of four stages, rather, they could see that creativity is different from one individual to another; then, "they described the creative process as a dynamic blend of processes that co-occur in a recursive way throughout the work". Ghiselin (1952-1985) also presented that stage-based model as "superficial". Many other authors (Israeli, 1962, 1981, Getzels and Csikszentmihalyi, 1976, Cawelti, Rappaport and Wood, 1991, p. 83-94, Goldschmidt, 1991, and Doyle, 1998) considered the creative process as complex, involving "a series of high-speed short interactions between productive and critical modes of thinking, as well as planning and compensatory actions" (Kharkhurin, 2012, p. 5).

Then, with researchers like Ochse (1990), Lubart (1994), Sternberg (1999), "subprocesses" such as problem finding, problem formulation, and problem redefinition were considered as being involved in creative process. Just to make a quick stop on the word "problem", Lubart defines it as being any "task that an individual seeks to accomplish" (Lubart and Mouchiroud, 2003, p. 127-128). As Runco and Pritzker illustrate it, an artist who expresses his feelings, a scientist whose duty is to understand a complex phenomenon, and any people who try to resolve conflicts, they "are all considered as engaged in problem solving" (Ward , 2011, p. 254-260). So, the problem seems to be the main motivation for any act of creativity. Therefore, it must be clearly identified. The authors consulted state that problem finding is at the beginning of any creative problem solving process (Ward , 2011).

Lubart (2001, p. 299-300) goes on in exposing other subprocesses. He argues that divergent thinking, "the process of generating many alternative ideas", was a subprocess evoked even by Guilford himself (1957), but also by Runco (1991) and Khandwalla (1993). Remote association by Mednick (1962) was a subprocess related to synthesis of information, such as

Bisociation studied by Koestler (1964), the subprocesses studied by Rothenberg (1979, 1986, and 1996): Janusian thinking, homospatial thinking or articulation; analogy, metaphor studied by Weisberg (1993), Ward, Smith and Vaid (1997); emotional resonance (Lubart and Getz, 1997), and feature mapping (Mumford *et al*., 1997). A long list of subprocesses can be quoted: "The process of forming idea combinations through random", the one of reorganizing information, analytic-evaluative processes, organizational problem solving, perception and information encoding, the one of forgetting, "which has been found to play a role in changing one's approach to a problem and overcoming initial mental blocks". Lubart concludes: "Some models that initially proposed a stage-based view of the creative process have been revised, reflecting more emphasis on subprocesses" (Lubart, 2001, p. 300).

However, some may point out that what are called here subprocesses are considered by others as full-fledged processes or as creativity tools. This shows even more the complexity of the study of creative processes, which requires the researcher to focus on a specific aspect in the study of creativity. Another complexity appears in some of the questions raised by Lubart, including that relating to the difference between the creative process and one that is not. He asks if the problem-solving is different when leading to a creative process or to the one non-creative. Are the models dichotomous? Or is there instead a continuum, a single basic process which yields "highly creative, moderately creative, slightly creative and noncreative"? He also raises the possibility that "the same sequence of thoughts and actions can lead to more or less creative or non-creative outcomes" (Lubart, 2001, p. 301). Lubart then warns that the studies that can help understand that difference between creative and non-creative processes are few: Guilford remains "vague" on that point, while, with the Componential model proposal of Amabile, "the response-generation phase is reduced in non-creative work to the rote execution of a pre-existing algorithm" (Lubart, 2001, p. 302). Other questions relating to creative processes remain: To what extent can the creative process be repeated to successive results? What would provoke that recursion? And, does the nature of the task influence the variability of a creative process? (Lubart, 2001, p. 304-305).

Of all presented creative processes, we retain, for our research purpose, Improvisational creative process for organizations proposed by Fisher and Amabile (2009) according to the

componential approach and CPS processes in the version proposed by Puccio, Murdock and Mance (2005), according to the linear approach, as we will explain it in the methodology section in chapter 2. But before that, we will have to define other terms linked to creativity, such as innovation, design, invention, and establish the relationship between all of them.

1.3 Innovation

As the title of this thesis indicates (elaboration of a componential creative process for short ideation sessions), the subject of this research concerns creativity. But since creativity is closely related to innovation, we explain the relation between those words to get a better understanding of creativity.

1.3.1 Many definitions of innovation

Here is how the international Organization for Economic Co-operation and Development (OECD) defines innovation: “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations” (OECD, Eurostat. 2005. p. 46).

This definition highlights the novelty in the proposed product. The novelty, however, may take two aspects. It may be an invention, meaning that the product has never existed on the market before; it appears as from nothing or as spontaneously. The novelty can also be an improvement, in the sense that an existing product or service has undergone one or more transformations that give it a different appearance than it had before. In addition, the novelty is not only on the material object; the product, which is a good or service, can be a process, a method, the latter affecting such marketing or even the practices within the company or outside of it (OECD, 1996, p. 32).

For Schumpeter (1934), innovation is the strategic stimulus to economic development, “The commercial or industrial application of something new – a new product, process or method of production; a new market or source of supply; a new form of commercial, business or financial organization” (Elliot, 1991, p. 43).

To all this, Manimala (1992) adds Finance management, human resources, organization and corporate culture, research and development, external agencies, etc. But, for Weisberg, novelty of products and services is not sufficient to define innovation; better, it remains subsidiary as long as the criteria of utility and success are not met. He writes: “An innovation is a new product that serves some purpose and that succeeds, to a degree that is acceptable, in doing so” (Weisberg, 2009, p. 25). It appears here that even if success is not necessarily loud, it must however be satisfactory, “acceptable”.

Groff, Bouchard and Aoussat (2003, p. 14), for their part, propose a definition directly from the roots of the Latin term *innovare*: “Based on the origins of the word innovation we can say that innovation is a structured approach around a process (thus controlled) and must achieve a result” (free translation).

1.3.2 Types of innovations

The second Edition of the *Oslo Manual* was talking about Technological product and process (TPP) innovations; in each case (product and process), the degree of novelty of the change was involved. It read: “TPP involves a series of scientific, technological, organisational, financial and commercial activities” (OECD*,* 1996, p. 31). Here is what can be read before:

> A technological product innovation is the implementation / commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer. A technological process innovation is the implementation / adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these (OECD, 1996, p. 9).

The technological product innovation involves the new products and improved ones. What are new on the technological product may be its characteristics or its uses: “Such innovations can involve new radically new technologies, can be based on combining technologies in new uses, or can derive from the use of new knowledge”. For the improved product, its “performance has been significantly enhanced or upgraded” (OECD, 1996, p. 32, for both quotations).

Brown and Scott (2011, p. 68), for their part, identify four types of innovations developed by Procter & Gamble (P&G).

The first type, sustaining innovation, brings a gradual improvement in products. Applied to products marketed by P&G, sustaining innovation adds a little more power of laundry cleaning detergents and better flavor to toothpaste, for example. For Brown and Scott, this type of innovation "provide[s] what P&G call 'er' benefits – better, easier, cheaper – that are important to sustaining share among current customers and getting new people to try a product" (Brown and Scott, 2011, p. 68)

The second type is business innovation, which uses creative marketing, packaging and promotional approaches to increase the existing offer (Brown and Scott, 2011, p. 68)[4].

The third type, transformational-sustaining, reframes existing categories of products. It usually makes significant changes and improvements of a different order to a market sector leading to major advances in market share (Brown and Scott, 2011, p. 69)[5].

The last type, Disruptive innovation, was first developed by Christensen (Bower and Christensen, 1995). This innovation process allows businesses to compete with an established leader in the industry which offers an innovative product by introducing a simpler competitive product, but more convenient and cheaper. Christensen and Raynor (2003b, p. 2) describe three critical elements that characterize this type of innovation (see figure 1.5).

[4] During the Winter Olympics in 2010, P&G introduced advertisements celebrating mothers. The campaign covered 18 brands and was seen by millions of consumers. It generated $ 100 million of revenue (Brown and Scott, 2011, p. 68).

[5] For example, during the recession of 2009, P&G introduced an anti-wrinkle cream called Olay Pro-X sold at 40 $ each. This cream was a great success because clinical trials showed that it was as effective as creams in the equivalent yield more expensive, and that it was more effective than the other more expensive anti-wrinkle cream sold by P&G (Brown and Scott, 2011, p. 69).

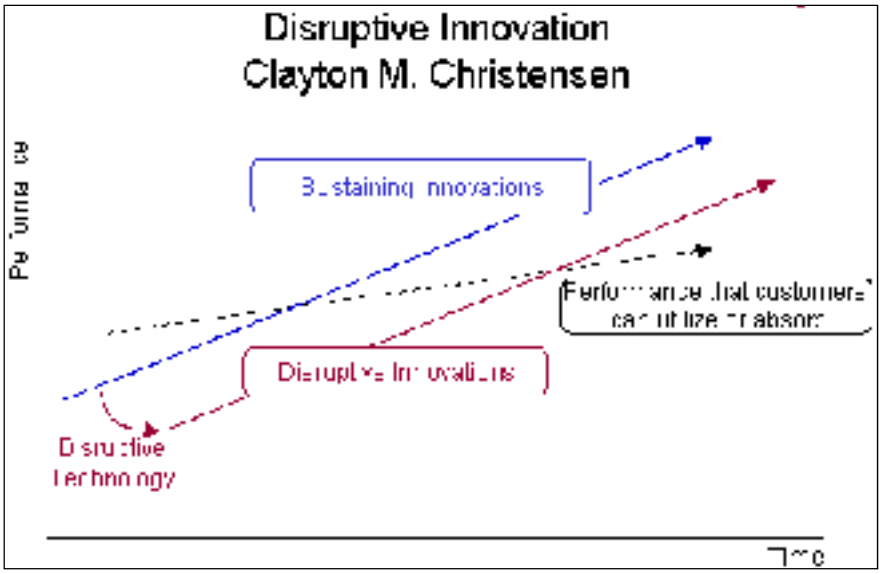


Figure 1.5 Disruptive innovation process
Taken from Christensen and Raynor (2003b, p. 2)

Figure 1.5 shows, first, a level of improvement that consumers can use or absorb, which is represented by the dotted line. Then, a level of improvement that goes beyond what consumers can use or absorb. The pace of technological progress usually exceeds the expectations of consumers. Leaders supply their customers who generate the most profit and focus their investments where profit margins are more attractive (*12manage*, 2011). The pace of progress is represented by the two solid lines. Christensen and Raynor establish the distinction between incremental innovation and disruptive innovation. Incremental innovation targets the most profitable customers with products with superior performance to previous models, either by a gradual improvement, or through a technological breakthrough, what disruptive innovation does not do :

> Disruptive innovations do not attempt to bring better products to established customers in existing markets. Instead, they introduce products and services that are not as good as existing products, but which are simpler, more convenient, and less expensive than existing items (Christensen, 2003b, p. 2).

This P&G's innovation presents completely different business opportunities. It allowed P&G to enter new markets with completely new products like Febreze and Swiffer[6].

Other types of innovations are found. Manimala, for example, introduces entrepreneurial innovation: "One could define 'entrepreneurial innovation' as the change in any aspect of an enterprise's design, products, services and / or operations that would enhance its competitive advantage" (Manimala, 2009, p. 120). Regarding Henderson and Clarke, they question the fact that innovation is only either incremental or radical and introduce the concept of architectural innovation:

> We define innovations that change the way in which the components of a product are linked together, while leaving the core design concepts (and thus the basic knowledge underlying the components) untouched, as "architectural" innovation. […]. It destroys the usefulness of a firm's architectural knowledge but preserves the usefulness of its knowledge about the product's components (Henderson and Clarke, 1990, p. 9-10).

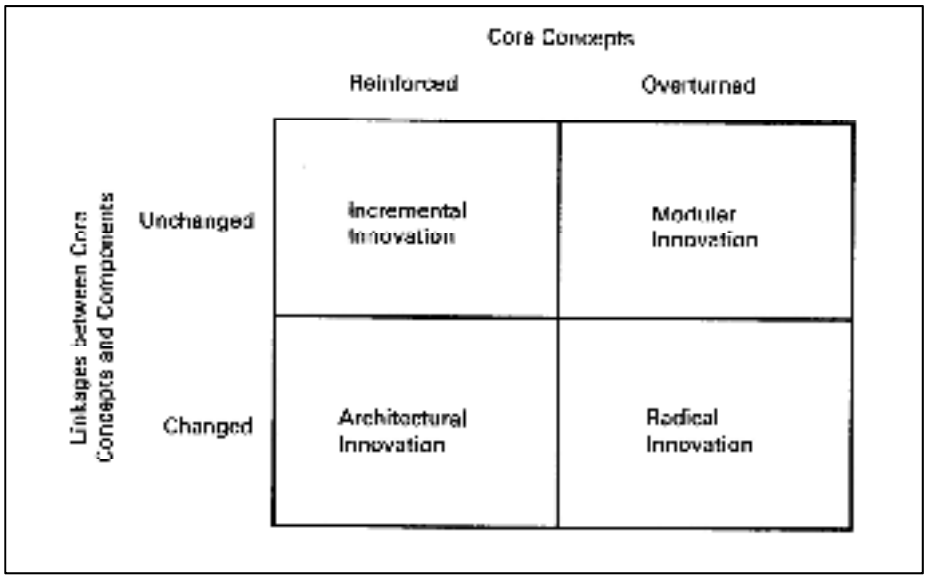


Figure 1.6 Architectural innovation
Taken from Henderson and Clark (1990)

[6] Febreze is the trademark of odorants to cool the air of the house and hide the smell of furniture fabrics (Procter & Gamble. 2015a). Swiffer is a trademark for single speed and easy to use equipment for scanning and wash floors, like feather dusters to dust the house (Procter & Gamble, 2015b).

These different types and definitions of innovation are quite precise and methodical. Then, the researcher who has to define his framework would know what direction to take. Thus, for example, the definition of innovation of the OECD (given above and renewed in OECD, 2005) was adopted by the Économie, Innovation et Exportations (EIE) ministry of Quebec. Under the heading "Research and Innovation: Resources" of its Website, here is what we read after the word "definition": "Quebec's innovation system is based on the model widely promoted by the OECD in the *Oslo Manual* and adapted in 1997 by the Science, Technology and Innovation Council (STIC) (*EIE*, 2014)" (free translation).

Like EIE, we will adopt the definition of innovation proposed by the *Oslo Manual*, a definition general and succinct. Its approach of novelty can be understood either as an invention, or as an improvement of an existing product; the innovator is not necessarily the creator out of nothing. Finally, this novelty is not restricted to single hardware products: The processes, methods, organization, place of work, labor relations, etc., are all concerned with innovation. Thus, this definition gives the researcher and the innovator an open field of investigation, and, therefore, different research opportunities for quality improvement.

1.3.3 Innovation Processes

Different innovation processes have been proposed, allowing many companies to improve their knowledge and innovation management. Groff (2009) states that one of the three pillars of innovation is creativity. Several other innovation processes support this point of view, like the Stage-Gate process created by Cooper and Edgett in 1988 (Edgett and Cooper, 2015). This process is also named Phase-Gate process (see figure 1.7).

Figure 1.7 Stage-Gate Innovation process
Taken from Sharif (2009)

The Phase-Gate innovation process is also called “Product delivery process”, “New product process”, “Gating system”, and “Product launch system” (Cooper and Kleinschmidt, 2001). Cooper defines it in the terms that follow:

> Stage-Gate, in simplest format, consists of [ ]: A series of stages – where the project team under-takes the work, obtains the needed information, and does the subsequent data integration and analysis followed by gates – where Go/Kill decisions are made to continue to invest in the project (Cooper, 2008, p. 3)[7].

The first stage of this process is the discovery stage. As Cooper, Edgett and Kleinschmidt explain,

> Ideas are fed to a focal person (normally the New Product Process Manager), who then carries the ideas to Gate 1 for an initial screening. Note that there is only one on ramp to the process – all new product and product improvement ideas go via this route. The only exception is “free time” or scouting projects, where the employee uses his / her own free time to progress the idea (in such a case, install a self-managed Gate 1 – the employee does his / her own initial screen) (Cooper, Edgett and Kleinschmidt, 2002, p. 3)

The discovery process takes ideas found initially to start the Stage-Gate process. Free time to progress the idea can be used, but it is not in this innovation process that ideas are found.

The Coupling innovation process is another model proposed by Rothwell and Zegveld (1985). The authors describe it as follows:

> [Coupling is] a logically sequential, though not necessarily continuous process, that can be divided into a series of functionally distinct but interacting and interdependent stages. The overall pattern of the innovation process can be thought of as a complex net of communication paths, both intra-organizational and extra-organizational, linking together the various in-house functions and linking the firm to the broader scientific and technological community and to the marketplace. In other words the process of innovation represents the confluence of technological capabilities and market-needs within the framework of the innovating firm (Rothwell and Zegveld, 1985, p. 50).

[7] The Stage-Gate innovation process is used in many companies like Exxon Chemicals, P&G, Du Pont, B.F. Goodrich, Corning Glass, the Royal Bank of Canada, and Lego (Cooper and Kleinschmidt, 2001, p. 6).

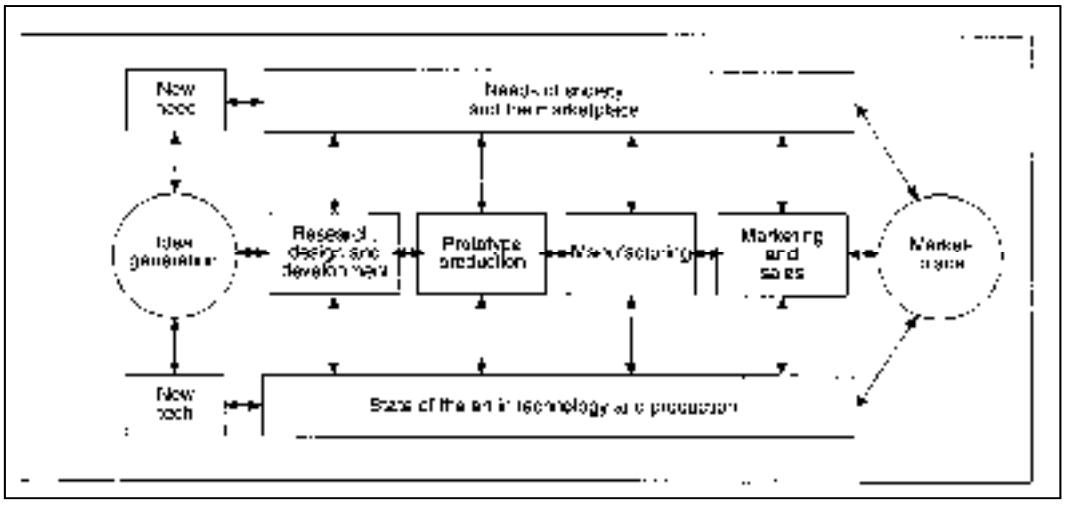


Figure 1.8 Coupling innovation process
Taken from Rothwell and Zegveld (1985)

Coupling process presents a set of steps that are not necessarily successive and which, though distinct, interact while being interdependent. The first step of this innovation process is "Idea generation", which again needs to be done.

We will also briefly consider two other concepts, which are taken into account in creativity-innovation: Design and invention.

1.4 Design and invention

Weisberg (2009, p. 25.) defines design as "the process whereby innovation is brought about. So the design process encompasses creativity (the generation of novelty) plus something more (the adjustment of that novelty so that it serves some specific purpose)". This definition shows that, for design, to achieve the goal, novelty of creativity must be relevant, well adjusted. Bruce and Bessant also put the design closely related to the goal of creativity, which is the satisfaction of human needs; design makes ideas become reality. They write :

> Design is essentially the application of human creativity to a purpose – to create products, services, buildings, organizations and environments which meet people's needs. It is the systematic transformation of ideas into reality and creative problem-solving capabilities are applied to deal with a particular challenge in a new way. (Bruce and Bessant, 2002, p. 38).

For Weisberg (2009, p. 25), invention and innovation mean the same thing: “Invention = innovation”. However, an invention is the first innovation of a given class of objects.

But, before the application of these processes in our analysis sample in the next chapter, it is important to make the link between innovation, creativity, and design, even with the invention, since these aspects are closely linked to creating products and services that strike the imagination of consumers while meeting their needs.

1.5 Creativity, innovation, invention, design and development of products

For Weisberg (2009), design includes creativity, which is included in invention, this one being included in innovation, the latter, in turn, being included in products development (see figure 1.9).

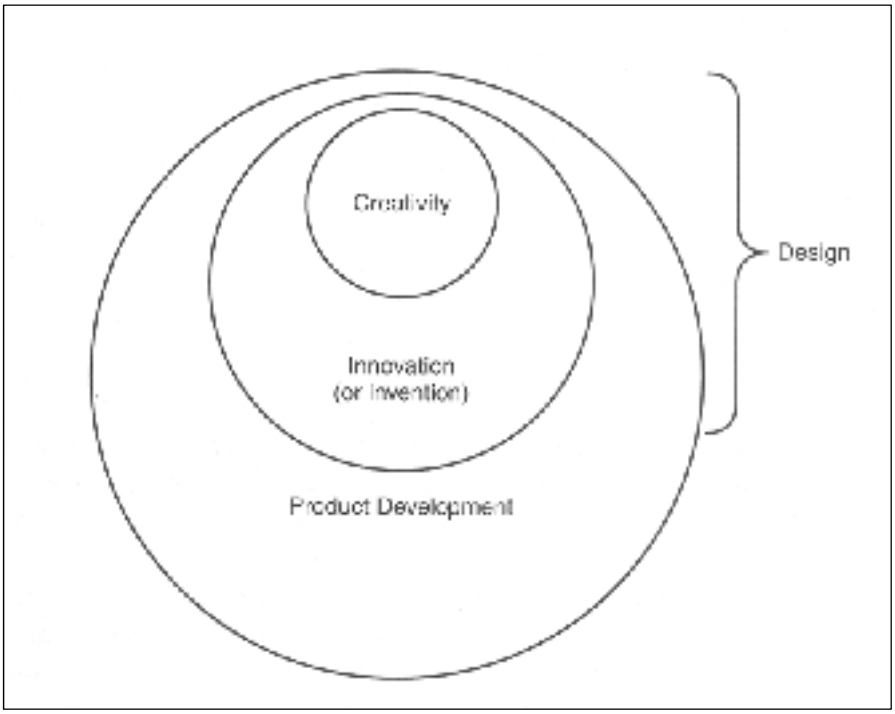


Figure 1.9 Relationship between creativity, innovation and design
Taken from Weisberg, (2009, p. 25.)

Groff, Bouchard and Aoussat (2003, p. 14) determine “three pillars” of innovation and open many more fields of innovation: Creativity (generation of novelties), value (of esteem, use and exchange) and socialization (control of change management).

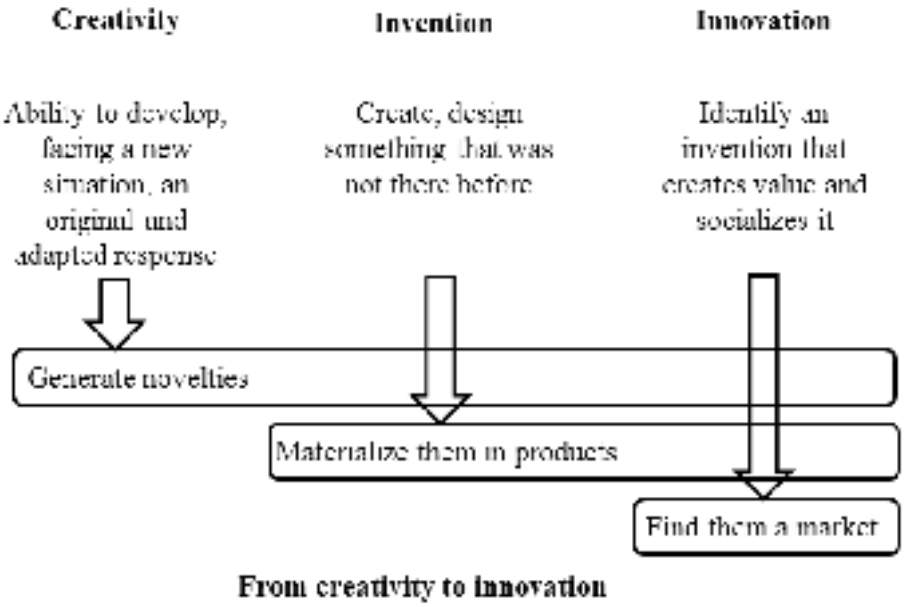


Figure 1.10 Relation between creativity, invention and innovation
Taken from Groff, Bouchard and Aoussat (2003, p. 14. Free translation)

1.6 Summary

In this first chapter, the history of creativity enabled us to explain that creativity is still a concept difficult to define because there are several definitions whose authors are not always unanimous. We chose the definition of Stein, for whom “The creative work is a novel work that is accepted as tenable and useful or satisfying by a group in some point of time” (Stein, 1953, p. 311).

To be creative, there are many methodologies. The latter word is rendered “techniques”, “processes”, “subprocesses”, “creating tools” or “tools”, etc, by authors. For our part, we retained “creativity tools” and “creative processes”. According to Markman and Wood, a creativity tool is “a cognitive prosthetic that somehow increases the capability of

individuals and groups. It enhances the ability of problem solvers to generate and develop ideas beyond their innate ad hoc processes" (Markman and Wood, 2009, p. 19). The review of literature allowed us to record 615 creativity tools among many. For the "creative process", we based on the definition of Lubart (2001, p. 295) and Vidal (2010, p. 412) for whom a creative process implies all transactions initiated and conducted in a conscious or unconscious order to lead to the creation of a product, whether a good or a service; we retained 39 creative processes. Nemiro's (2004) classification system helped us identify them according to four types: 1. Intuitive, with, as examples, Wallas creative process (1926) and Guilford Convergent and divergent production; 2. Linear, with the CPS creative process by Osborn (1953) and the CPS Thinking Skills Model of Puccio, Murdock and Mance (2005), that we used in this research, as examples; 3. Linear and intuitive, with the ThinkX creative process of Hurson (2007) also used in this research; 4. Componential, with the Improvisational creative process for organizations of Fisher and Amabile (2009), that we also used in our research.

There are also several non-creative processes, defined as processes which create little new (Fisher and Amabile, 2009, p. 18). So, we did not consider them in this research which we limited to creative processes.

At the end of the chapter, we presented the relationship between creativity and innovation processes: innovation processes like Stage-Gate (Edgett and Cooper, 2015) and the Coupling innovation process (Rothwell and Zegveld, 1985) for example need that one may develop ideas (a step which is the main role of a creative process) before starting the innovation process. In the same vein, Weisberg (2009) establishes the relationship between design, creativity, invention, innovation and the development of products: These elements fit into each other starting with the first which includes the second and so on.

CHAPTER 2

PROBLEM SETTING, ORIGINALITY, METHODOLOGY, LIMITS

2.1 In context

In this chapter, we present the problem statement, the research proposal, and the methodologies we used to create a componential creative process that we tested for short ideation sessions. It is intended to help users find creative ideas and solutions to problems in order to increase the effectiveness of innovation processes.

The tests were done during "The 24 Hours of Innovation" (The 24 Hours), an international innovation challenge developed by "École supérieure des technologies industrielles avancées" (ESTIA) in France and organized since 2007 by that university in Europe, and since 2010, also at École de technologie supérieure (ÉTS) of Montréal. The 24 Hours are explained in a next sampling subtitle of this chapter.

2.2 Problem setting

Tidd and Bessant (2013) found that, compared to larger firms, small and medium enterprises (SMEs) are usually limited by fewer resources, finances, skills associated to the innovation process and a shortage of time. These are some of the barriers in creativity and innovation in SMEs (Tidd and Bessant, 2013, Flinders, Lynch and Holden, 2010, OECD, 2010). According to OECD (2010, p. 4), "SMEs represent the majority of all businesses and employment. Across the OECD area, they account for approximately 99 per cent of all enterprises and two-thirds of employment". Therefore, following the authors quoted before in search of solutions to overcome barriers to creativity and innovation, we would also like to help SMEs with limited resources: In their quest of ideas, which is our main concern, innovators would need to be effective in the short time at their disposal.

2.2.1 Problem finding background

Several types of creative components have been developped to help creative people, teams and organizations to create during ideation sessions. Nemiro (2004, p. 4) presented a

classification of creative processes in four types. In the review of the literature, we presented the first type of creative processes, identified as the intuitive one, conceived by Wallas in 1926. Osborn in 1953 created a second type: A linear creative process named "The Creative Problem Solving (CPS) process". Appearing after the second type was the mix of linear and intuitive processes: ThinkX creative process made by Hurson in 2007 is an example of this new type (Hurson, 2012). In 2000, Amabile proposed the first componential creative process, the fourth type of creative processes (Amabile *et al*., 2002). There are several creative processes which cannot fit in this classification as shown in appendix II, like the TRIZ approach per example (Altshuller, 1996); we proposed a fifth type named "others" to regroup creative processes which could not be classified in Nemiro (2004) four types system.

Those creative processes cover all the steps required to realize an ideation session (as define the problem, generate ideas and find a solution), and some do more (implement the solution). When creative ideas are found during an ideation session involving creative processes (if used), innovation process may help creators to transform their best ideas found in a commercial product or service.

Creative processes are great to define what needs to be done in terms of steps, in order to realize an ideation session. However, steps define what needs to be done but not how to do it. They will tell you for example that you need to define the problem but not how to define it. This is where creativity tools become useful: They offer to creators different approaches on how to realize the selected creative process steps. Creativity tools were associated with specific creative process step (Basadur, 1994, Brightman, 1988, VanGundy, 1998, Clegg and Birch, 2007, Silverstein *et al*., 2009, Carrier and Gélinas, 2011, Mycoted, 2014 and Manktelow *et al.*, 2015a) while many of them could be used for more than one step like "Checklists[8]": This creativity tool could be used to generate ideas in a divergent phase and to choose the best ideas in a convergent one. It may be useful for two steps of the creative process, but it was not designed to define the problem: It is not a creative process. Creativity tools offer different approaches to define the problem, generate ideas and find solutions per

[8] A check list is a "comprehensive list of important or relevant actions, or steps to be taken in a specific order" (*Business Dictionary*, 2015). Checklists creativity tools are lists of points a creator needs to consider in ideation. There are numerous existing checklists available (see appendix IV fo examples of checklists creativity tools).

example, whether creators work alone or in groups. Osborn (1953) was one the first to present a creativity tool used actually worldwide, the Brainstorming.

With their Improvisational componential creative process for organizations, Fisher and Amabile (2009) consider that the traditional steps of the creative process were just a component: Other components were required to realize an ideation session. They added team's preparation, experience, motivation as well as risk management and work environment as creative components, which are required as the creative process steps, to find a creative solution when one needs to create in an improvisational session. This creative process is explained in the methodology part of this thesis (chapter 2).

However, no creativity tools were considered as components in Fisher and Amabile (2009) creative process. If we consider that their creative process was designed for organizations during improvisational ideation, we can understand that time becomes a prerogative: Time to learn how to use creativity tools, time to use them; one would not necessarly have that time when improvising to create, like in case of emergency or other non-planned situations.

Searching for a creative process that could be useful for short creative sessions in SMEs limited in resources, we could not find the expression "short ideation sessions" on the web, even with similar wordings like "small", "reduced ideation sessions". Then, how to define it?

The 24 Hours are a field of research for many researchers. During the event, teams have 24 consecutive hours to find a creative solution to a problem submitted by companies and researchers. They have to do an ideation session, some sort of prototyping (mostly numerical), financial and environmental analysis and a video presentation to demonstrate that their solution is the "best" creative answer to the problem submitted. Local and international juries will choose winners who have the most creative solutions. Team may not invest more than around eight hours on the total 24 hours allowed for the ideation session. This is an example of a short ideation session. For us, we define a short ideation as a session which is different of an improvisation in the way that it is planned; also, it could last between 5 minutes and 48 hours; less than five minutes would be associated with the Improvisational

creative process of Fisher and Amabile (2009) and more than 48 hours would match the current creative processes for ideation sessions. Therefore, our componential creative process would be designed for a specific duration of ideation. In our case, it would be 24 hours.

But we understand that we could not define precisely what kind of creative processes could be used on a specific period of time. The following figure 2.1 tries to represent our understanding of creative processes usage in function of time.

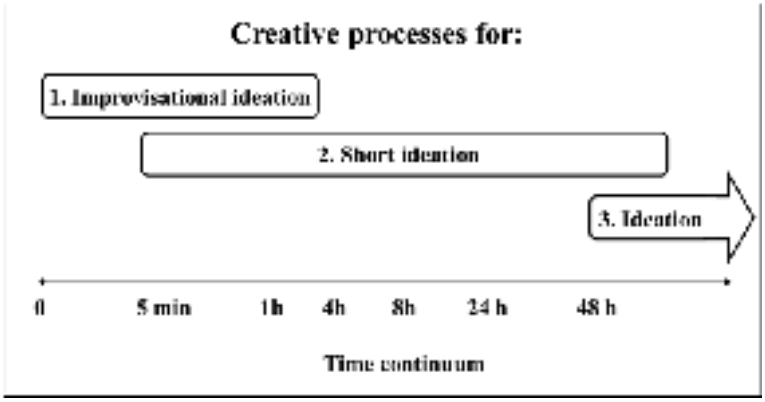


Figure 2.1 Creative processes usage in function of time

The difference between improvisational ideation and short ideation could be in the explanation given by Cunha, da Cunha and Kamoche (1999, p. 302): "If one is using a plan or a habit, then the action was conceived of before it unfolded, and the process is not improvisionnal". Refering to this definition, we would already understand that, without a planification, ideation is improvisation.

We found few creative processes where their authors integrated creative components like those associated by Fisher and Amabile (2009). In 1994, Min Basadur conceived and presented a simplified CPS process called "Simplex", which seeks to make less complex the problem solving by proposing a simplified step-by-step approach composed of eight stages (see figure 2.2).

Figure 2.2 Simplex method of Basadur
(*Basadur Applied Creativity*, 2015)

Basadur was one of the first creative process designer to add something new to CPS processes: Creativity tools were proposed for many process steps to facilitate the ideation process, as shown in table 2.1

Table 2.1 Simplex CPS process of Basadur 3 phases,
8 steps with integrated creativity tools

3 PHASES	8 STEPS	CREATIVITY TOOLS INTEGRATED
Problem formulation	Problem finding	PEST Analysis and CATWOE
	Fact finding	
	Problem definition	Drill Down, 5 Whys Technique, Cause and Effect Analysis et Root Cause Analysis
Solution formulation	Idea finding	Brainstorming, The Reframing Matrix et Random Input
	Evaluate & Select	Decision Tree Analysis, Paired Comparison Analysis, and Grid Analysis.
		Risk Analysis, Impact Analysis, Force Field Analysis, Six Thinking Hats and Use of NPVs and IRRs
Solution implementation	Plan	Project management techniques and change management
	Acceptance	
	Action	Kaizen

Creativity tools were the only other components used by Basadur. TRIZ author Altshuller (1996) was another one to propose some creativity tools to be used with his process, like the Nine Windows creativity tool (Cardus, undated). But here again, no other components were recommended.

We had the opportunity to analyse data collected from colleagues at ESTIA from 2007 to 2010 - 24 Hours competition. During those years, 782 participants of a total of 968 (80,79 % of all participants) filled their research questionnaire. Sixty nine percent of the 782 used only one creativity tool, among which the Brainstorming was used by an average of 97,30 %. Brainstorming faces virulent criticism from many researchers.

Schnetzler (2005, p. 79) states: “Classic Brainstorming, which you probably know well, is a meaningful and good technique – but only when it is carried out creatively”. Edward de Bono adds: “There are far too many practitioners out there who believe that creativity is just Brainstorming and being free to suggest crazy ideas. I intend to show that this is inadequate” (*The de Bono Group*, 2014, online). In the same vein, McFadzean (1998b) shows that other creativity tools produce better creative ideas.

Carrier and Gélinas (2011, p. 183) point out that Brainstorming divergence rules are hard to maintain during group sessions: Since it is an exploratory technique, “It is important to go beyond the purge of the first ideas for achieving the most creative phase of research ideas”. In the initial phase, ideas proposed are similar for groups working on the same subject. Second phase of ideas force participants to think differently, but without a good leader knowing well the creativity tool and its rules, the creativity reached may stay low.

Mullen, Johnson and Salas committed an article reporting the results of a meta-analysis demonstrating the “productivity loss in Brainstorming groups. The following patterns were observed: Generally, Brainstorming groups are significantly less productive than nominal groups, in terms of both quantity and quality” (Mullen, Johnson and Salas, 2010, p. 3).

For Markman and Wood (2009a, p. 0), one reason explaining this ineffiency is that Osborn’s Brainstorming “was focused more on group dynamics than on cognitive processing. While it

is certainly important that group members feel free to contribute ideas without fear of criticism, these rules are not alone sufficient to lead people to generate creative ideas".

2.2.2 Problem statement

Among the 39 creative processes we found, none was designed for short ideation sessions. The closer was the componential Improvisational creative process for organizations of Fisher and Amabile (2009). From those 39 creative processes, nine were componential, seven had a creativity tool component (table 2.2). Of those seven, one had also a team preparation component: The Virtual Team creative process from Nemiro (2004), but it was designed for virtual teams only. Amabile (1996a) componential theory of creativity and Fisher and Amabile (2009) Improvisational componential creative process had team preparation and other components but no creativity tools components.

Table 2.2 Features of the nine componential creative processes

Componential creative processes	**Short ideation sessions**	**Creativity tools component**	**Team preparation component**	**Other components**	**Virtual only**
Isaksen and Dorval (1993): Components of CPS (v5.0)		X			
Basadur (1994): Simplex		X			
Isaksen, Dorval and Treffinger (1994): Components Model (v5.1)		X			
Isaksen and Treffinger (1994) : CPS (v6.0)		X			
Amabile (1996a): Componential Theory of Creativity			X	X	
Isaksen, Dorval and Treffinger (1994): CPS Framework (v6.1)		X			
Nemiro (2004): Virtual Team		X	X		X
ACAD (2009): Creative Process		X			
Fisher and Amabile (2009): Improvisational componential creative process			X	X	

We did not find a componential creative process with creativity tools, team preparation and other components designed for short ideation sessions. To have one, we needed to modify existing creative processes or create one.

As demonstrated by Markman and Wood (2009a, p. 20), it is important "to develop tools to increase the effectiveness of innovation processes". Our aim was to allow participants to use a componential creative process containing all the creative components they needed to find creative ideas for market development or other needs (technology, marketing, cultural activities, etc.) and creative solutions to problems submitted.

Carrier and Gélinas (2011, p. 137) raise the importance of knowing how to choose and use the most appropriate creativity tools. It is hard to know how to do that when one has to select them from more than 615 found that do specific steps of a creative process, 39 creative processes (but none made for short ideation sessions) and various other components to prepare and manage the team, the risk, environment, etc.

In summary, given the fact that many participants of The 24 Hours used the Brainstorming, a creativity tool which, for many researchers, could be inefficient when used alone, we needed a componential creative process designed for short ideation sessions that participants would adopt and use to generate ideas productively in both quantity and quality. This componential creative process needed to have different components to fulfill the needs of participants when time to create is short. Two of those components would have to be a creative process, and creativity tools associated to the creative process step.

2.3 Research question

Considering the points synthetized in the problem statement, our research question is: How to elaborate a componential creative process for short ideation sessions?

2.4 Research objectives

The research objectives of this thesis are the following:

1. The componential creative process elaborated has to be helpful for participants to find creative ideas and creative solutions to problems during a short ideation session;

2. All components of the componential creative process elaborated have to be helpful for participants to find a creative solution to the problem defined during a short ideation session;

3. The componential creative process elaborated should be adopted and used by teams during short ideation sessions.

But how would we measure the helpfulness of our componential creative process for short ideation sessions and / or of its elements?

We did not want to engage this research on creativity measurement since: 1. There is no consensus among researchers on an evaluation method to evaluate creativity (Batey, 2012, p. 55); 2. It would have been almost impossible to evaluate creativity even if we had a standard method, considering that participants in our research work on different challenges selected on differebt sites. Participants in teams would need to work on the same challenge in order for us to evaluate how creative was their solution compared to the other teams at the same localizations (to work with the same parameters).

Considering that last fact, we did not find a quantitative method for the measurement. We chose instead a qualitative method to evaluate if the componential creative process elaborated was helpful or not for participants. Based on a general rule of evaluation, we attributed a percentage to the helpfulness of each of our three objectives: More than 50 % would be considered successful in this research.

2.5 Sample: The 24 Hours of Innovation

2.5.1 Presentation

As said before, The 24 Hours of Innovation is an international creativity competition invented by ESTIA in France (*ESTIA*, 2015). The first edition was done in 2007 at ESTIA. L'École de

technologie supérieure (ÉTS) of Montreal, Quebec, Canada, was invited to participate to this event in 2010, and since that year, Éts has organized its own event in Montreal (with a license to do so issued by ESTIA). In this competition, students are invited to work creatively during 24 consecutive hours to solve a problem submitted by companies and researchers. The 24 Hours at ESTIA continued to be done there since 2007 till now. The number of participants who participate since its beginning at ESTIA from 2007 to 2010 and at Montreal from 2010 to 2014 is described in appendix V.

Since 2012, students participate to win the local and international contest which has offered 10,000 $ in prizes at ÉTS (*Innokiz*, 2012). The event was done in collaboration with C2MTL from 2012 to 2014, an international conference on Commerce and Creativity held in Montreal (*C2MTL*, 2014).

In this event, as per rules elaborated by ESTIA, teams are created by the students who choose a problem to solve from a list of problems presented to them when the event starts (*ESTIA*, 2015). A problem could be chosen by one or many teams depending on the choices they made. All the sites are connected to a Web network allowing them to interact with each site. Participants work with their own computers, tablets, intelligent phones, 3D drawings and simulation software, etc. They can use audio-visual equipment furnished on site in order to make and upload on Youtube™ a two minutes video presentation of their solution. A local committee chooses the best projects and sends the winner project to an international committee which will choose the three best international projects from all the local winning projects. Money prizes are given to the winners.

During the 24 hours of the competition, teams work to find an innovative solution to the technical problem chosen. In many cases, the solution is a good idea of how to solve the technical problem, a 2D or 3D drawing of that good idea and, in some case, a 3D simulation of the idea.

The 2014 edition of The 24 Hours had 1121 participants, forming 177 teams from 28 sites in countries from North and South Americas, Europe, China and Africa.

2.5.2 Why choose The 24 Hours of Innovation?

We wanted, as the ultimate goal of this research, to help innovators from The 24 Hours but more specifically those of SMEs and companies to find more and better ideas during short ideation sessions. The first reflex would have been to do experimentation within SMEs and companies. It would have been interesting to find companies who would accept to realize an ideation session at the same time during a fixed number of hours on a selected number of challenges for all of them. In practice, this kind of condition may possibly be done in a multi-national company with many branches around the world, but it would be difficult with different companies because of obstacles like conflict of interest, competition, etc. So, we focused on The 24 Hours.

However, taking The 24 Hours as a sample may presents some disadvantages: Participants come from universities sites, not from companies. If we want to elaborate a componential creative process for short ideation sessions to be applied in companies, we will need to experiment it in companies, since environment, constraints, management and politics are different from what students live in universities. Teamwork could be different from a university to a company: We would need to compare. Composition of teams may also be different: In universities, students are in a group of ages similar that could be different in companies. Work experience of employees in companies may be different from what we could find in universities: Employees have, for many, more work experience, but probably less “new competencies” considering that students are learning every day while employees may have not followed training courses since a certain time. Also, their employee’s status and the hierarchy of the company may induct different reactions during teamworks. To synthetize, we may have different conditions that could change employees needs and appreciation of a componential creative process for short ideation sessions made for them.

Nonetheless, there were many advantages to do experimentation at The 24 Hours: With this event, we would know precisely the date when the experimentation would be done every year. The duration of the ideation session was clearly defined (24 Hours) and was the same every year. The challenges (approximately 20 per years) were also the same for every site for

a given years. Teams, wherever they were, started the competition at the same time and finished at the same time following the same rules. The number of participants are impressive: 882 in 2012, 1,000 in 2013 and 1,121 in 2014 (appendix V). Those participants were motivated to find a creative solution to the challenges they selected. They worked in a "controlled" environment during 24 consecutive hours[9]. Most of the places had a room big enough for the number of teams participating, with tables, chairs, boards, lights, heat/air conditioning, coffee machine, small gym mattresses to rest, etc. Most of the participants were adults, some were already professional engineers (studying in graduate programs), or with some years of experience in their undergraduate programs. All sites were connected to a Webex™ network to see their images and to communicate with other sites. All the teams submitted their solution at the same time in the same format: A two minutes video presenting their solutions. Evaluation criteria were the same for local and international juries.

Even if time was a constraint (24 hours), many participants filled our questionnaires. It would have been difficult to get this kind of controlled research environnement years after years in companies and be able to compare data from different years.

Considering the points above, we could say that The 24 Hours was a good experimental field that we could possibly not find if we were experimenting with companies. But the solutions we found would need to be also experimented in companies, in order to see if appreciation of the components of our componential creative process changes in relation with specific needs from one company to another.

2.6 Methodology

In this subtitle, we explain the different aspects of the methodology we used to conduct our research. Initially, this methodology was based on the work of authors who preceded us and we will dwell on some, as we announced in the previous chapter. Secondly, we detail the methodology of our own guide that we developed and which results from readings of our predecessors.

[9] Almost all participants worked during The 24 Hours from a participating sites located in a University with a professor as the responsible of the coordination of the event.

2.6.1 Predecessors approaches

2.6.1.1 Needs analysis approach

The first approach we decided to develop was based on needs analysis. This formal process considers the human elements in the requirements analysis to do (Smith, 2011, p. 415-427). It is used in engineering to understand what are the client's requirements, and in education to understand the gap between the actual and the desired situations regarding competencies required to perform a task for example. Applying this model to define what the needs of people who create are brings us in a chart with many choices to do and too many possible combinations to fulfill those needs.

Our methodology was also inspired by several sources. To elaborate a componential creative process for short ideation sessions, we needed a model of componential creative process; the componential creative process of Fisher and Amabile (2009) was our first source: It had the structure we needed. We had two possibilities to answer our research question: We could start for an existing creative process and modify it or we could build a brand new one, in order to elaborate a componential creative process for short ideation sessions.

The second source was from Carrier and Gélinas (2011), authors who propose to integrate creativity tools to specific phases of the creative process. We chose their approach because it contains many selection criteria to justify creativity tools to be associated with specific steps of creative processes. Inspired by them, we conceived a creativity tools selection system to help us associate creativity tools to steps of different creative processes experimented.

The third source was the creativity guide made by David Kelley, the founder of Ideo, a global design company created in 1978 in United States[10], and the Hasso Plattner Institute of design at Stanford University (called the d. school). For short ideation sessions, we found imperative to furnish a creativity guide component as a kind of user's manual to help participants to use the different components of the componential creative process elaborated. To our knowledge, no creative process comes with a "user's manual" (in our case, a creativity guide).

[10] "Ideo" is not an acronym (IDEO, 2015a; see also IDEO, 2015b about its founder).

2.6.1.2 Improvisational process for organizations of Fisher and Amabile (2009)

Theresa Amabile (1983) was interested in improvised creative process for organizations as part of her research in social psychology of creativity. Her componential creative process (1988, 1996a, p. 15) was one of the first processes proposed in this approach. It has similarities with the process proposed by Wallas (1926) and is defined in five stages:

1. The presentation of the problem or the identification of the task based on demand (stimulus) internal or external;

2. The preparation, the "building up and / or reactivating a store of relevant information and response algorithms";

3. The creation of ideas or the generation of a response, or in other words, "searching memory and the immediate environment to generate response possibilities";

4. The "response execution" (validation and communication): "Testing response possibilities against factual knowledge and other criteria";

5. The "outcome: Success, failure, or progress toward the goal".

However, while Simonton (1999) thinks that illumination plays a key role in the componential creative process, Amabile (1996a) combined the stages of incubation and illumination in another one which she defines as the stage of ideas generating.
In general, a process is not always carried out according to a strict sequence and can often require iterative cycles: A process can be performed in less than an hour, over several days, weeks or months depending on the context.

The Improvisational creative process for organizations proposed by Amabile and Fisher in 2009 focuses on improvisation and includes separate components such as great novelty, "divergence from prior action", and a short separation in time between design and production. However, it needs more than that to meet creativity requirements. The authors explain what follows:

> Improvisation requires one additional element to achieve the status of creativity. The action must not only be spontaneous and novel, it must also be appropriate, in order to meet the definition of creativity. […] Thus, we propose that all improvisational creativity includes one key element that has not been specified by improvisation theorists: Responsiveness to temporally proximate stimuli (Fisher and Amabile, 2009, p. 19).

Drawing on concepts of organizational creativity and componential creativity (Amabile, 1988, 1996a), improvisation concepts in organizations and on the new element "responsiveness to temporally proximate stimuli", Fisher and Amabile propose a preliminary model of Improvisational creative process for organizations. (See figure 2.3):

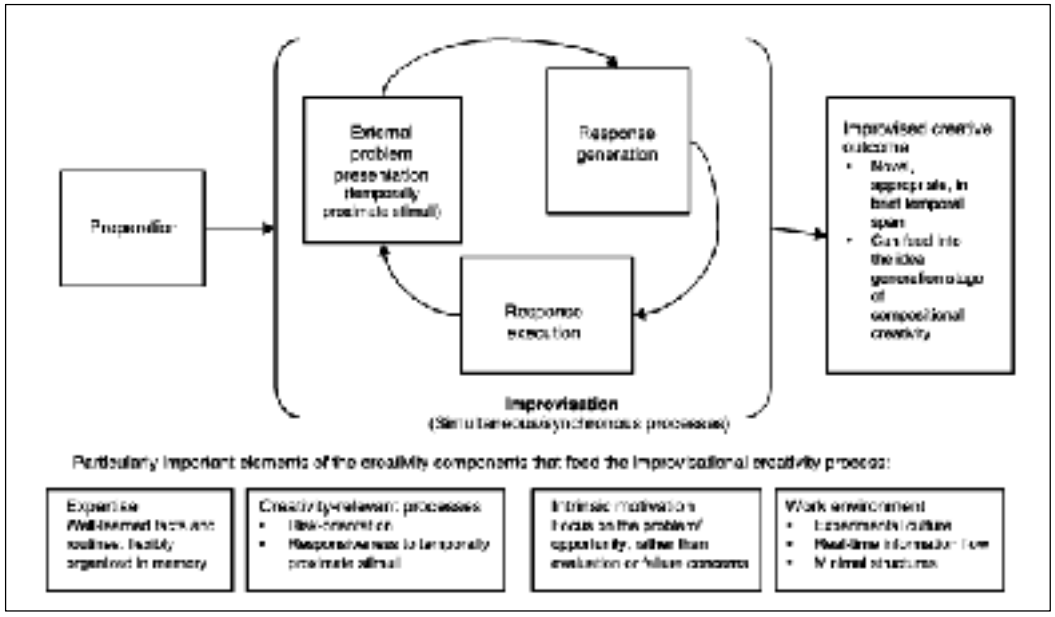


Figure 2.3 Improvisational creative process for organizations
of Fisher and Amabile (2009, p. 20.)

The authors explain improvisational creativity in the terms that follow:

> Actions responsive to temporally proximate stimuli, where the actions contain both a high degree of novelty and a low temporal separation of problem presentation, idea generation, and idea execution. Such actions are arrayed on a continuum, depending on the degree of novelty, the degree of temporal separation, and the degree of responsiveness to temporally proximate stimuli. When such actions occur in an organizational context, they are considered to be instances of organizational improvisational creativity (Fisher and Amabile, 2009, p. 19).

This model has two distinct features: first, preparation comes before the improvised creative process; secondly, the stages of problem presentation, response generation and execution occur simultaneously. We can focus on the components “preparation” and “improvisation”.

2.6.1.2.1 Preparation component

Preparation includes a series of elements that must be considered when a group of people needs ideas in response to a stimulus or a problem. Several elements are part of this component: The expertise of the team, the creative style of the participants, motivation, the teamwork, the leadership, the working environment and the support of the organization.

2.6.1.2.1.1 Expertise of the team

The stimulus or problem that required the mobilization of a team for the implementation of this ideation process will allow them to define the skills they need to build the team. So, they will have to choose or involve participants who have the required skills. They must get to know the participants and encourage those who have a large network of knowledge (education, experience, contact). Participants will be chosen in different areas that will be complementary (De Stobbeleir, de Clippeleer and Dewettinck, 2010).

In creativity, group knowledge (even if the group does not have all the knowledge) should allow it to have the elements to solve the problem, or create in the area where it is to create. If the group has too much expertise, the challenge may not be sufficient to maintain the motivation of its members. If it lacks knowledge about the challenge, expertise could become the weak link (Amabile, 1996a).

2.6.1.2.1.2 Creative style of the participants

The research we have carried out in 2012 and 2013[11] and from the secondary data collected form 2007 to 2010 led us to the conclusion that the majority of participants and managers do not know the creative style of team members. However, this information is important to gather since team of participants must be both different and complementary (Amabile, 1998; King and Anderson, 1992; West, 2002; West *et al.*, 2004). Creativity is born from the

[11] We introduced the first team preparation component in 2014.

confrontation of ideas: Therefore, the team would not be made of participants who are similar from the point of view of the profession and experience. But without knowledge of the creative style of the participants, creating a complementary team with varied creative styles will be difficult. On the individual level, research suggests that the outputs of creativity will be richer with creative people who: 1. Have a creative mind (De Stobbeleir, de Clippeleer and Dewettinck, 2010; Mostert, 2007; Feist, 1998; Oldham et Cummings, 1996); 2. Find it easy to absorb information (McCrea and Costa, 1997); 3. Prefer to solve problems creatively (Kirton, 1976, 1994); 4. Are open to new experiences (De Stobbeleir, de Clippeleer and Dewettinck, 2010; Feist, 1998); 5. Are able to combine autonomy and responsibility (De Stobbeleir, de Clippeleer and Dewettinck, 2010). This highlights the fact that people have to be autonomous in order to think outside the box.

Some researchers think that creativity is associated with introverted persons (Feist, 1999). For example, Taggar (2002) describes people extroverted as those who merely help employees produce creative outputs. Researchers think that, by combining personality traits to the stages of creative processes, people introverted have good skills to generate ideas while those extroverted will be very useful to convince leaders to adopt the idea (Rank, Pace and Frese, 2013; Shalley, Zhou and Oldham, 2004, Unsworth, Brown and McGuire, 2000).

When the time comes to realize the idea chosen, people who demonstrate flexibility and results orientation are particularly important; creativity is less important here (Amabile *et al*., 1996; De Stobbeleir, de Clippeleer and Dewettinck, 2010;. Sim *et al*., 2007; West, 2002; West *et al*., 2004).

2.6.1.2.1.3 Motivation

It is important to ensure that participants are motivated to take up the creative challenge proposed, to foster intrinsic motivation, passion and interest of people to do something, for the pleasure and satisfaction they derive from that (Amabile, 1985, 1997, 1998; Amabile *et al*., 1994). Also, they must integrate the team, build camaraderie, communication and sharing and ensure that they comply with their differences. In terms of extrinsic motivation from outside of the person (such as money), some scientists say it encourages creativity

(Eisenberger and Armeli, 1997; Eisenberger and Rhoades, 2001), while others claim that it interferes with it (Amabile, 1985, 1997, 1998; Amabile *et al*., 1994).

2.6.1.2.1.4 Teamwork

A team can be defined as a group of people interacting in order to gain or accomplish a common target, which implies a distribution of tasks and convergence of efforts of team members (Alaoui*,* Laferrière and Meloche, 1996). For them to interact, group members must at first know them all. Otherwise, there must be a time and an activity when they would learn about one another. It is important that they know the expertise and the type of work they all perform, that they have been chosen to work together because they are different and that difference enriches creativity. They thus accept differences, confrontation of ideas while respecting one another.

The complementarity of knowledge and expertise will be sought at the ideas generation stage. Participants must take account of their respective professional backgrounds which, put together, will allow them to find original ideas (De Stobbeleir, de Clippeleer and Dewettinck, 2010).

The complementarity of participants contact networks will be very useful to promote the idea. And as mentioned earlier, one or more participants focused on the tasks and the results will take care to discuss with the leaders to realize this idea.

2.6.1.2.1.5 Leadership

De Stobbeleir, de Clippeleer and Dewettinck (2010) stress on the importance of having a supportive leadership style and not a control leadership, in order to enable participants to be more creative (Amabile and Conti, 1999; Amabile *et al*., 1996; Madjar, Oldham and Pratt, 2002; Oldham and Cummings, 1996).

2.6.1.2.1.6 Working environment

According to De Stobbeleir, de Clippeleer and Dewettinck (2010), what is important in the work environment is that ideation team is physically isolated in order to concentrate on its duties; the rest has little impact on creativity.

2.6.1.2.1.7 Support of the organization.

The support of the organization, both from the point of view of its managers and the company, may allow the establishment of a work environment that fosters employees creativity (Amabile and Mueller, 2008; Paulus, 2008; West and Richter, 2004; Zhou, 2008). The organization can foster creativity in many ways (Amabile, 1998; Amabile *et al*., 2002) which may include:

1. Add a creative dimension to employees work objectives;

2. Encourage collaboration and communication and show perseverance to face difficult problems;

3. Ensure that the organization shares information with the team, that the team members share it between them and that the team shares information with the organization (this way reinforces the three components of creativity: Expertise, creative thinking and intrinsic motivation);

4. Ensure that the entire organization supports the creative work of project teams;

5. Ensure that the organization will offer collaboration with members of the project team as needed;

6. Ensure that conflicts and political problems do not come to infiltrate the creative work.

2.6.1.2.2 Creative process component

The component “Creative process” has three steps: 1. External problem or stimulus presentation; 2. Response generation; 3. Response execution.

2.6.1.2.2.1 Step 1 External problem or stimulus presentation

For this step, it is possible that there is no problem as such, rather, a need to create a new product or service, to identify a product or service that will go into business, or to develop again something which will boost the company for which participants work, etc. In the divergence mode, the problem will be defined, and then presented. For this, the information available or not should be established and those that are missing are to be sought and found. In situations of improvisation, this research will be limited since there is no time to act often.

2.6.1.2.2.2 Step 2 Response generation

During this step, a lot of ideas should be generated and issued even if they seem crazy or unrealistic: Such ideas can give rise to other ideas which themselves will approach great ideas sought. This is a point were team preparation has great importance: Participants must not criticize in the mode divergence, ideas to avoid blocking the inspiration of the other participants. Targeted creativity tools were added in this research for this step to stimulate new ideas.

Once the ideas are issued, they will be combined, reworked, polished to generate a response to the problem identified in step 1, in convergence mode. It is possible to complete this step with more than one answer, but not too however: This would be an indication that the convergence work is not finished.

It is possible that the ideas generated call into perspective the response to a problem of the previous step. One main feature of this componential process is that it is made to works in iterative mode. One can therefore return to step 1 and even skip to step 3 at any time. This iterative dimension is particularly important in improvisation, given the fact that time is often restricted.

2.6.1.2.2.3 Step 3 Response execution

The third step consists in verifying the answer to ensure that it meets the problem of step 1. Several targeted tools have been proposed and added to this componential process to help participants achieve this work. In case of doubt, in an iterative mode, participants must return to step 2 of the creation of ideas and even review the results of step 1 if necessary. The output of this process of ideation will be a solution innovative that will be an action plan to transform the idea into innovation.

2.6.1.2.3 Other "particularly important elements" (Fisher and Amabile, 2009)

Fisher and Amabile (2009) propose that the Improvisational creative process for organizations be equipped with key elements to enrich it. These elements are inspired, among other, of the four elements each one must have in their componential creative process before this new Improvisational process for organizations; they are: Motivation, skills related to problem to resolve or idea to generate, thinking, heuristics and working styles, and work environment. In figure 2.3 presented before, those elements appear respectively in terms of Expertise, Creativity-relevant processes, Intrinsic motivation, and Work environment.

2.6.1.2.3.1 Expertise

Expertise is understood as "a large number of well-learned facts and routines that are both readily accessible and flexibly organized [prior to action]" (Fisher and Amabile, 2009, p. 20). Fisher and Amabile insist on the fact that improvisation occurs in times of crisis or in response to unexpected opportunities. Therefore, the organization would need to have more expertise composed of elements of knowledge and well understood routines that can help to improvise creatively.

2.6.1.2.3.2 Creativity-relevant processes

The creativity-relevant processes are the risk-orientation and the responsiveness to temporally proximate stimuli. For the first, the authors affirm that in time of crisis, it is important for a team to take risks in order to be more creative, rather than taking a well-known path if the latter is less creative.

For the second creativity-relevant process, the authors define temporally proximate stimuli as being "whatever relevant situational factors [that are] observable at or immediately before the moment of action" (Fisher and Amabile, 2009, p. 19). For instance, in a jazz band, every member plays something novel and appropriate, and the work of the entire group will produce something new and also appropriate. But improvisational creativity is perceived provided those proximate stimuli or different plays have been adapted to one another, thanks to the responsiveness of the members of the group who have been willing to adjust to what the others play.

2.6.1.2.3.3 Intrinsic motivation

Fisher and Amabile also think intrinsic motivation is needed in order to engage oneself in improvisation and persist with it. For them, and intrinsically motivated person will focus more on the presentation of the problem itself than on the evaluation, even if the latter issue is the reward or the punishment. It is in this sense that some researchers like Barret (1998) have suggested that people in the organization who create with improvisation will have an increased internal motivation not because of the success of the process, but because of the increased autonomy that improvisation gives them (Fisher and Amabile, 2009, p. 21).

2.6.1.2.3.4 Work environment

According to Cunha, da Cunha and Kamoche (1999), some environmental conditions are important to facilitate improvisational creativity in organizations: Experimental culture and minimal structures. An experimental culture promotes improvisation because it tolerates mistakes and even promotes them as an important stage in learning. This culture will also promote action and have a sense of emergency. In terms of minimal structures, the environment must put in place procedures which are flexible to facilitate improvisation.

Real-time information is another aspect of work-environment which is important to help improvisers to communicate. With other structures of communication, it increases the sources of ideas and solutions. But the concept of time is also important in other aspects.

2.6.1.2.4 About time

The improvisational creativity takes place in three organizational situations: 1. In response to an emerging crisis (Weick, 1993, Tedflow and Smith, 1989), 2. In response to an unexpected opportunity (Kahalas and Suchon, 1995), and 3. In connection with a compound process (Eisenhardt and Tabrizi, 1995, Sutton and Hargadon, 1996). Fisher and Amabile establish also the difference between the Improvisational creative process and the componential one. This is relative to the time available to generate a response to a problem and to the fact that the answer to the problem and the implementation of the solution may be done at the same time in the improvisational process.

According to Sawyer (2000), time also represents the difference between the improvisational creativity and the creativity of the products in the world of the arts. In 1968, Bailey (1993, p. 140-141) met the jazz saxophonist Steve Lacy who had to describe for him the difference between a composition and a musical improvisation : “In fifteen seconds the difference between composition and improvisation is that in composition you have all the time you want to decide what to say in fifteen seconds, while in improvisation you have fifteen seconds.” As seen in that answer, time of improvisation appears very small, whereas for a composition, an author will take all the time he needs to reach a result.

2.6.1.2.5 Attempt to define improvisation

Moorman and Miner (1998, p. 698) define improvisation as being “the degree to which the composition and execution of an action converge in time”. They think that improvisation and creativity are both concepts that “overlap” into each other, but they are distinct because many products created are not always improvised. The authors explain that improvisation must involve novelty and differs in some way from first established plans or imagined design (Moorman and Miner, 1998, p. 702). Cunha, da Cunha and Kamoche go in the same direction: When there is a design, planning or habit at the base of a process, there is no improvisation:

> Conception of action as it unfolds can only be claimed if response execution diverges in some way from prior plans and habits: If one is using a plan or a habit, then the action was conceived of before it unfolded, and the process is not improvisionnal (Cunha, da Cunha and Kamoche, 1999, p. 302).

Vera and Crossan (2004), for their part, think that improvisation is a creative process which generates creative products, "the creative and spontaneous process of trying to achieve an objective in a new way". They also talk of a team improvisation (Vera and Crossan, 2005, p. 205). This is the way it functions: The creative process is spontaneous; the team, without any planning, tries to achieve its objective in using a new way. For the authors, improvisation is creative because the process is to create novelty, what they call "novelty outcome". However, the success is not guaranteed: "A process […] is intended to generate novelty, but may succeed or fail" (Vera and Crossan, 2005, p. 205).

Cunha, da Cunha and Kamoche (1999, p. 302.) talk about organizational improvisation, which is "the conception of action as it unfolds, by an organization and / or its members, drawing on available cognitive, affective and social resources". But, for Crossan and Sorrenti (1997, p. 156), improvisation is an "intuition guiding action in a spontaneous way".

Fisher and Amabile also attempt to define improvisation:

> We define improvisation as actions with high novelty (divergence from prior actions) and low temporal separation of conception and execution. Improvisational actions are arrayed on a continuum, depending on the degree of novelty and the degree of temporal separation. When such actions occur in an organizational context, they are considered to be instances of organizational improvisation. (Fisher et Amabile, 2009, p. 16)

Fisher and Amabile state that the relationship between improvisation and creativity is not clear in the current literature. For them, improvisation is a process by which actions and creative products can be generated, but they state that it does not always lead to "true creativity – appropriate novelty" (Fisher and Amabile, 2009, p. 19). They show that the improvised creative process condenses a series of stages: Problem identification and idea generation are done simultaneously, while we hardly have time to collect data. The creative

process is actually one step: The answer to the problem and its realization when the problem occurs are at the same time; preparation must be done before the action begins.

Moreover, these authors highlight the time, like Sawyer (2000) who defined another creative process in which “there is little evidence of distinct stages across time” (Fisher and Amabile, 2009, p. 14). Fisher and Amabile combine time with action, the latter being the generation of the creative idea and its realization. Time and action must be simultaneous. When they do not coincide, improvisation disappears, giving way to the composition. The authors conclude:

> Clearly, these two types of action rarely occur in their pure forms; in practice, improvisation generally involves the execution of parts of previously composed material, and many compositions come about partially through moments of improvisation (Fisher et Amabile, 2009, p. 18).

2.6.2 Integration of creativity tools in the creative process

Our methodology second source of inspiration was the approach of Carrier and Gélinas (2011) which helped us to classify creativity tools and integrate them in a creative process.

During the literature review, we remarked that some authors have listed, presented and classified creativity tools (Miller, 1987, Brightman, 1988, Mattimore, 1994, Basadur, 1994, Prather and Gundry, 1995, Harrington, Hoffherr and Reid, Jr., 1998, McFadzean, 1998, VanGundy, 1998, Nemiro, 2004, Gogatz and Mondejar, 2005, Clegg and Birch, 2007, Silberstein, Samuel and DeCarlo, 2009, Carrier and Gélinas, 2011, Mycoted, 2014, Manktelow *et al.*, 2015a and Straker, 2015). However, Carrier and Gélinas (2011) had the most complete selection criteria explained. They are: Divergence creativity tools classification, convergence creativity tools selection, criteria to associate creativity tools to creative process steps, paradigm preserving, exploration strategy, challenge type, level of creativity and personal preference style. We used many of theses criteria to design a creativity tools selection system (We describe those selections in chapter 3).

2.6.3 Creativity guide approach

The third source of inspiration for our methodlogy was for the creativity guide component we wanted to create as a “manual instruction guide” for all the components of the componential creative process elaborated. This creativity guide was inspired by the Design Thinking Toolkit, second edition, proposed by Ideo company in 2014 (IDEO, 2015c). There were other creativity guides available (we found nine more: See appendix XVI), but preferred the Ideo guide for its approach related to creative process steps: The chapters of the Design Thinking Toolkit are: 1. Discovery; 2. Interpretation; 3. Ideation; 4. Experimentation; 5. Evolution. However, this interesting document has no less than 80 pages. It wa not made for short ideation sessions. We used it to get a more simple creativity guide.

2.6.4 Targeted creative processes

Several times in the first chapter, we mentionned that we will develop some creative processes in this second chapter: The CPS Thinking Skills Model of Puccio, Murdock and Mance (2005) and ThinkX of Tim Hurson (2007). We targeted these two creative processes as a possible base for the elaboration of our componential creative process for short ideation sessions.

2.6.4.1 Analysis of the CPS Thinking Skills Model of Puccio, Murdock and Mance (2005)

We recall that the CPS Thinking Skills Model is made up of three main phases: Clarification, transformation and implementation, and six steps associated with two stages or times per phase, convergence or divergence. Convergent and divergent responses are given facing a problem and are based on equally convergent and divergent thinking. Carrier and Gélinas (2011, p. 141) define divergence as “the ability to open our creative spirit in all directions, eventually reaching original ideas”. Convergence techniques are used to select ideas, distinctive or easily achievable.

2.6.4.1.1 Phase of clarification

It is common to see ideation teams find a solution to an ill-defined problem. Much effort can be wasted in this way. It is important to ensure that a problem is well defined by clarifying which is to be solved by this phase. For Carrier and Gélinas (2011, p. 122), "the clarification phase is to explore issues, gaps, wishes or goals to consider in order to select the most relevant challenge". If the vision of the problem is clear and ideation team knows exactly what to work on, participants can go directly to the phase of transformation. However, many experts recommend making anyway the phase of clarification: Very often, the real problem and priority should be clarified and established, although participants may have had the impression of having correctly identified the challenge up before (Carrier and Gélinas, 2011, p.122).

Step 1 Exploring Vision (issue, wish, goal)

Often, the team of ideation has an issue, a wish or a goal for which a solution must be found. The first stage of the clarification consists in expressing that issue in order to explore the vision. For Carrier and Gélinas (2011, p. 122), vision corresponds to "different gaps (problems, wishes and goals) to fill or goals to pursue, either because of their strategic importance, a willingness to change things for the future, opportunities to create, etc."

Time 1 Divergence

The first time of divergence is used to establish a broad picture of the different gaps to be filled or goals to pursue. It is recommended to put into perspective a broad range of subjects on which it would be possible to work. Therefore, all the elements and the results desired by the ideation process should be developed.

Time 2 Convergence

In the convergence time, the team has to review all of the vision statements made in divergence times of this phase in order to pick one that presents the priorities and emphasis. It may be necessary to reformulate statements or create a new one that reflects the

understanding of the present situation (Carrier and Gélinas, 2011, p. 123).

According to Isaksen, Dorval and Treffinger (2003), three criteria are required to recognize a problem, difficulty, a wish or a goal in the CPS process of creativity. One must: 1. Have decision-making authority to take the necessary decisions; a lack of power could cripple the team approaches; 2. Choose a problem, a trouble, a wish or a goal for which a solution can be found and implemented within a reasonable time and for which there is a will to act; 3. Choose a problem that will require team members to be creative to find the solution.

Step 2 Formulating Challenges

In this second step, the team must formulate the challenge to complete the clarification of the problem. The gap between the current situation and the desired future state should be identified at this stage.

Time 1 Divergence

Temptation is for participants to skip this step and start looking for creative ideas to solve the problem. Ideation team should not immediately seek the solution to the problem because the risk is great that it finds a solution to an ill-defined problem. Rather, they will explore the problem; dig the subject by transforming the chosen vision statement in many different challenges formulations in order to have multiple angles to address the challenge.

This time of divergence must be chosen with a problem, a trouble, a wish or a goal described from different angles, which allows considering the vision in a multitude of facets and perspectives.

Time 2 Convergence

This convergence time will allow the team to select which of the statements challenge better clarifies the expectations. The team will identify the formulation of the challenge that seems most relevant or close to the challenge, so the one that appears most promising to enter with force in the transformation phase and the search for ideas. For example, instead of saying:

“How can we prevent the escape of the oil slick?”, it requires rather reformulating the question as follows: “How can we protect the environment when pumping?”

For Miller, Vehar and Firestein (1996), a challenge may be “concise, clear and wide enough to make room for the imagination. It does not contain restrictive criteria to facilitate the opening of all possibilities and will be positively articulated to focus on what needs to be done, not what should be avoided” (Carrier and Gélinas, 2011, p. 124; free translation).

2.6.4.1.2 Phase of transformation

The previous phase, clarification, helped formulate a clear, understandable and concise challenge on which the team has agreed to find a solution. The current second phase of transformation will allow the team to generate many ideas in step 3, explore these and formulate a solution to step 4.

Step 3 Exploring Ideas

For Carrier and Gélinas (2011, p. 124), “at this stage, it is important to issue as many ideas as possible, and then select the most promising” (free translation). The team in search of a solution will have to issue the largest number of ideas in divergence. For Puccio and Cabra (2009a, p. 331), the important point of this stage of exploration vision “is to generate innovative ideas that address the challenges that impede progress toward the desired result”. However, the team will be careful to remain at the level of ideas in convergence time in this stage of exploration of ideas as shown, before they start the fourth step associated with the formulation of solutions.

Time 1 Divergence

As we mentioned before, the team must find many ideas as possible to solve the challenge. For this, participants must formulate these ideas by starting the statement with an action verb as “to do”, “to commit”, “to identify”, etc.

Time 2 Convergence

When the team deems it issued enough ideas, both in number and quality, and these ideas seem to allow it access to potential solutions, it will therefore be ready to start this second time of convergence where it will have to select the most promising ideas while promoting a selection that is both realistic and useful, and, ideally, most distinctive. Members must have the feeling of surpassing made ideas and overcome initial barriers that limited thinking.

Step 4 Formulating Solutions

The previous step must have allowed choosing a variety of ideas, not perfect, but which can afford to think of a solution by considering different and varied approaches. This fourth step will help to formulate a solution to the chosen challenge.

Time 1 Divergence

This time of divergence will help to develop the ideas emitted, improve them and bring out all their facets. Several creativity tools can help make this divergence work. Some ideas will raise concerns that it will be important to express and answer to. Others might be weak or problematic, it may be possible to shrink, delete or round them.

Time 2 Convergence

This convergence time can begin when the ideation team will feel that the work of developing ideas has been properly done with all the ideas considered in divergence times of this step. The team will have to choose ideas that can make a solution; it will therefore be important to select those which can compose the solution. In preparation for this convergence time, the team will also define the criteria by which ideas worked at divergent phase will be retained, combined, integrated or rejected. It is important that the team clearly establishes the evaluation criteria and selection of ideas for the choice associated with convergence to be made in accordance with criteria recognized of all.

2.6.4.1.3 Phase of implementation

Ideation team should attend this phase with a solution that is both realistic and new. This solution can be an amalgam of ideas selected and integrated into an innovative solution. Here is what Carrier and Gélinas (2011, p. 126) explain:

> [The solution adopted will] not only found to be interesting and appropriate to solve the challenge, but ideally, even offer an added value or additional gains. In other words [...], if successfully implemented, [it] is likely to be a response to the challenge and even a unique advantage (Carrier and Gélinas, 2011, p. 126. Free translation).

Step 5 Exploring Acceptance

As specified by Puccio and Cabra (2009a, p. 331), "having a great solution is not enough to succeed, especially if this solution means that others must accept change – a new way to perform, to think or to carry out work". The team must discuss the factors and consider the context to understand how the solution found can be adopted. These discussions should take place with members of the organization (employees, teams and managers) who will be affected or involved in the change that the solution will create. It is possible that, depending on the feedback received, changes are made to the solution and even the chosen challenge. So the team would better not unduly delay implementation of this phase since the results of this consultation may influence the solution (for example, by forcing the implementation of an iterative process) and the action plan that will follow. For Carrier and Gélinas (2011, p. 127), this essential step "refines the new solution, supports its chances of success and minimizes the risks" (free translation).

Time 1 Divergence

At this divergence time, the team must think about what could be the sources of support and resistance to the implementation of the solution. According to a study by Hiatt and Creasey (2008) with managers of 426 organizations from 59 countries, the biggest obstacle to change comes from employees and managers. Employees resist change if they are unsure of the reasons for the change or if they are afraid of associated impacts. Managers in turn resist if

they think they may lose control and power. The element that contributes most to the success of the change is to have an active and visible sponsorship of the leaders of the organization through the implementation of the solution.

Time 2 Convergence

The divergence time will have allowed identifying the sources of support and resistance possible, ways to “sell” a solution, etc. This convergence time must be used to identify all the factors that may affect or assist in the implementation of the solution. For Carrier and Gélinas (2011, p. 127), the final objective of this fifth step is to “achieve a particular action strategy to raise enthusiasm and reduce concerns”.

Step 6 Formulating a Plan

The team must now move from the solution to action.

Times 1 and 2 Divergence and Convergence

This divergence and convergence time is used to identify what to do and what is possible to do to implement the solution. The *Guide to the Project Management Body of Knowledge* (Project Management Institute, 2013) may be useful to define the steps and actions to be taken to establish a plan of action inspired by the project management. Project management can also provide valuable information on what to do and not do to successfully implement a solution. The study by Hiatt and Creasy (2008) identified the approaches to managing change recognized and used by 426 organizations consulted: Recommended approaches are those of Hiatt and Creasy (2008), Kotter and Cohen (2012), Bridges and Bridges (2009) and Conner (2006).

Convergence time helps to choose the essential steps of the action plan.

2.6.4.1.4 Group size and length of the process

The CPS process of creativity can be used alone or in groups of five to twelve people. Beyond these, the team will manage it by an experienced facilitator. The time allocated to the

ideation may vary from several hours to several days depending on the number of participants and the complexity of the project ideation.

2.6.4.1.5 Succes of the CPS Thinking Sills Model approach

For Puccio and Cabra (2009a), the success of the CPS approach mainly depends on the constant concern that participants must have in order to respect divergence time (idea generation) and convergence one (refocusing ideas) present at all stages of this process of creativity.

2.6.4.2 ThinkX of Tim Hurson (2007)

ThinkX creative process of Tim Hurson (2007) (see figure 1.4) is made as mentioned before, of 6 steps: 1. What's going on? 2. What's the success? 3. What is the question? 3. Generate answers 4. Forge solution 5. Align resources.

2.6.4.2.1 Step 1 What's going on?

This first step is to understand the problem that arises. For Hurson (2007), the team should avoid finding "a great answer to the wrong question, trap into which so many people and organizations fall" (*ThinkX*, undated). For this, the participants need to ask three questions that will help to define the problem (Manktelow *et al*, 2014b):

Question 1 What is the problem?

They should bring out all the questions relating to the problems in a divergence mode even if they think they know what the problem is. Then, in a convergence phase, they will group the various aspects to understand the dimensions of the problem that best represents the situation.

Question 2 What is its impact?

The participants will seek to define the impact of the problem or problems identified on themselves, the organization, customers, suppliers, competitors and other persons or groups for a given environment (Manktelow *et al*, 2014b).

Question 3 What information about the issues should we collect?

The participants must bring together all the information current and past (history, source, attempted solutions, those involved, in short: Who, what, when, where, why, how?, the 5W and H or Kipling Method) relating to the problem. They must also look for the missing information, the points to clear up, elements to understand, define and verify the facts relating to the issues and that the problems are not overstated or, conversely, underestimated.

2.6.4.2.2 Step 2 What's the success?

While Hurson (2007) states: "The secret of vision – imagine the future that you want so to establish measurable targets and clear success criteria" (*ThinkX*, undated), Manktelow *et al* (2014b) recommend writing the maximum future targets possible (in divergence mode) and then reduce the number to achieve a vision that is achievable and important for the team.

2.6.4.2.3 Step 3 What's the question?

Participants have to ask the right questions that will frame the challenge that their team is looking ahead. Learn to ask the right questions is often more important than answers. In divergence mode, they have to ask the questions that will solve the problem. Hurson (2007) points out that they "must find the questions that will accelerate the process of solving the problem. It is like when wanting to break a complex set of nodes, you get to find the right mesh that would allow you to undo the other nodes and find the solution to your problem" (*ThinkX*, undated).

2.6.4.2.4 Step 4 Generate answers

In this step, the team would not hesitate to produce the maximum possible solutions in divergence mode.

2.6.4.2.5 Step 5 Forge the solution

The solution will be found in convergence mode. Manktelow *et al*. (2014b) explain that this is to "evaluate the most promising solutions and compare them with measurable objectives

and success criteria identified in Step 2. Choose the solution that best meets these objectives and criteria".

2.6.4.2.6 Step 6 Align resources

In order to achieve the solution, an action plan, a project management or the use of an innovation process will develop the idea into innovation.

In summary, with the Improvisational process for organizations of Fisher and Amabile (2009) presented in the first chapter, the CPS Thinking Skills Model (2005) and ThinkX (2007) will be selected in chapter three. This selection will be inspired by Nemiro's classification system and additional criteria as explained in chapter three.

2.6.5 Creativity tools selection

Since we could not experiment all the 615 creativity tools we found, we needed a classification sytem to choose those to experiment. In order to do so, we analyzed the creativity tools classification systems existing, proposed by authors.

2.6.5.1 Divergence and convergence criteria

Brightman (1988), Puccio and Cabra (2009a), as well as Carrier and Gélinas (2011), agree on a first method of classification of creativity tools: Divergence and convergence tools based on convergent and divergent production creative process of Guilford (1967), and applied to creativity tools.

Carrier and Gélinas (2011, p. 141) define divergence as "the ability to open our creative spirit in all directions, eventually reaching original ideas". The technique of Brainstorming is the best known example of divergent creativity tool among entrepreneurs and businesses. Brightman (1988, p. 9) combines creativity with divergent thinking. For him, "creativity is exploratory, ideational, provocative and possibility seeking".

The choice of a divergence technique involves four skills ideas productions: These are related to their number, their categories, their accuracy and their rarity. To do this, four key

principles are involved, respectively: Fluidity, flexibility for a good variety of strategies, development leading to the refinement of the idea, and originality, to get out an idea from "evidences or the banal" (Carrier and Gélinas, 2011, p. 146).

For Brightman (1988, p. 9), convergence techniques are used to select the ideas, both distinctive ideas and those that appear readily achievable. He describes critical thinking associated with convergence as "goal-directed, logical, analytical, and seeks closure". However, for Carrier and Gélinas (2011, p. 141), the choice of a convergence tool must consider four factors: The diversity of ideas generated, the maturity of the idea, the value of ideas and the relevance of the final solution.

These elements will help to select ideas through a reconciliation process skillfully leading them all to the desired success, as in a "funnel effect". For this, five techniques can be combined with different tools:

1. Convergence intuitive creativity tools using for example intuition and self-interest to eliminate ideas and preserve the one with good potential to achieve, or approach of the most relevant;

2. Classification and clustering tools where the user will rely on the nature of ideas to recognize them;

3. Ideas building tools to improve ideas of value but which have not yet matured;

4. Tools to estimate the value of ideas that will help to see for example the feasibility and consistency of the ideas in business strategies;

5. Techniques and planning tools for a better structuring of ideas.

2.6.5.2 Linear or intuitive criteria

Miller (1987, p. 65) uses the Complementary specialization theory (Springer and Deutsch, 1998, p. 19) assigning skills and specific functions to each of the two hemispheres of the brain, to classify creativity tools. According to this theory, the left cerebral hemisphere is

oriented to the linear skills, logical, mathematical and verbal. Miller then offers a first category of methods associated with this hemisphere of the brain (Miller, 1987, p. 66): Linear techniques for ideas generation. Creativity tools classified under this category are sequential, structured, and ordered. The solutions are presented logically. For Miller, "linear methods take advantage of different ways of organizing known information to help you approach problem from new angles. They help focus your attention on where to look for innovations, often the key to finding the optimum solution(s)" (Miller, 1987, p. 66).

Take for example the creativity tool "Attribute listing" that Miller (1987, p. 74) classifies in linear techniques. Carrier and Gélinas describe it as being an "exploration matrix" promoting a directed research of ideas in a more analytical approach or of mere association. This tool uses "forms, functions, time or types of use that the different elements of a project, product or service can take" (Carrier and Gélinas, 2011, p. 188). To understand, in taking a catalog of three to six products at random, we must make an attribute listing by taking an attribute per product (Clegg and Birch, 2007, p. 102). The attributes for a product may be color, texture, the power source, functions, etc. Then, we must combine these attributes in the solution of the problem by imagining how the solution can use these attributes.

In terms of the right hemisphere, Complementary specialization theory highlights the skills associated with intuition, spatial representation, music and emotions. Miller (1987, p. 82-84) proposes a second category of creativity tools for the right hemisphere of the brain which refers to intuitive techniques for ideas generation. He writes:

> [Intuitive techniques] take advantage of our right-brain capability to perceive whole solutions in sudden leaps of logic. Our intuition is more fluent in images, sounds, and symbols than in words – as in our day and night dreams. Intuitive techniques take advantage of the superior insight often available in these images, sounds, and symbols (Miller, 1987, p. 82-84).

Miller classifies for example Brainstorming in that category.

Straker (2015) uses criteria somewhat different that could be associated with the linear and intuitive criteria chosen by Miller (1987). He classifies the 71 creativity tools using a different terminology (see table 2.4) :

Table 2.3 Logical vs psychological criterion of creativity tools classification
Taken from Straker (2015, online)

LOGICAL	X					PSYCHOLOGICAL
	1	2	3	4	5	

The creativity tool could be logical (indicated by an "X" in case 1), psychological ("X" in case 5), a mix more logical than psychological ("X" in case 2), a equal mix of logical and psychological ("X" in case 3), or a mix more psychological than logical ("X" in case 4). There is no indication for what the author means by "Logical" or "Psychological". But, in our creativity classification system, we considered the concept of linear tools to be similar to logical, and the one of intuitive, to psychological.

2.6.5.3 Individually and/or in groups, and by stimuli criteria

Meanwhile, VanGundy (1992, p. 123-143), classifies creative techniques in two ways. First, according to whether they are used individually and in groups, or in groups only. The individual techniques are those that help generate creative ideas used alone; however, they can also be used in group. In the same way, some group techniques can be used alone and other group techniques, in groups only.

The second way VanGundy categorizes creativity tools is the involvement of stimuli to help generate ideas. These stimuli can be connected or not to a problem: A stimulus may arise from items associated with the problem or a source unrelated to it. For example, to improve a desk lamp, we might choose to improve the deflector of this lamp to develop a new model of lamp. A stimuli unrelated to the lamp might be to use a golf club for ideas that can help improve the lamp: The lamp head could resemble the head of a golf iron, applied streaks of this head may be deflectors for a light installed inside the head.

Straker (2015) also uses the individual and group criterion to classify the creativity tools (table 2.5):

Table 2.4 Individual and group criterion of creativity tools classification
Taken from (2015)

INDIVIDUAL			X			GROUP
	1	2	3	4	5	

The creativity tool could be for individual (if an "X" mark is in the first of the five blank cases), group (the "X" in the fifth case), for both ("X" mark is in the third of the five blank cases), more for individual than group ("X" in the second case) or more for group than individual ("X" in the fourth case; these significations are from our understanding of this table since there is no indication on how to interpret it).

2.6.5.4 Creativity tools associated to creative process steps criteria

Clegg and Birch (2007, p. 13-14) classify creativity tools to be associated with a three stages creative process: 1. Define the problem; 2. Generate ideas; 3. Choose an idea and refine it.

Brightman (1988), VanGundy (1992), Basadur (1994), Clegg and Birch (2007), Carrier and Gélinas (2011) as well as sites specializing in creativity like *mycoted.com* (2014) and *creatingminds.org* (Straker, 2015) also propose a classification according to the creative process steps and the path of the creative project. Participants take into account the steps where they are in their creative process. They seek, therefore, either to clarify the challenge, that means to define it clearly by asking a number of questions regarding its opacity or its clarity, extent, engaging character, chances of achievement, the quality of efforts used so far to solve it, etc., to generate ideas, or to select them. To generate ideas, they might ask for example if they have enough, if these ideas are varied and have a chance of success or not. To select the ideas, they will question the variety of techniques they commonly use, their ability to recognize good ideas, if their results remain relevant.

2.6.5.5 Time usage criterion

Clegg and Birch (2007, p. 176-177) classify the methods for time usage criterion according to the time users have for a creativity tool. Times classification are: 10 minutes or less, 10 to 20 minutes, and 20 to 30 minutes. For each given time scale (e.g. 10 to 20 minutes), the creativity tools are presented in his book from the longest time (20 minutes) to the shortest (10 minutes).

Straker (2015) also uses this criterion. His scale to measure time is different from the one used by Clegg and Birch (2007), as shown in table 2.6 :

Table 2.5 Time usage approach of creativity tools classification
Take from (2015)

QUICK			X			LONG
	1	2	3	4	5	

Time can be quick, long or something between indicated by an “X” marked in one of the three blank cases between quick and long. There is no indication to describe what the author means by “Quick” or “Long”.

2.6.5.6 Level of expertise required criterion

Some creativity tools require a high level of expertise in a given field to be properly used; others require little or no expertise. For example, the creativity tool called “The Game” requires the most expertise according to Clegg and Birch (2007, p. 177), “a good knowledge of digital games to use it properly” (Clegg and Birch, 2007, p. 120). The creativity tool called “Hazard markers” requires the least expertise (Clegg and Birch, 2007, p. 177). This tool makes a list of all negatives points associated with ideas to make a selection of these ideas (Clegg and Birch, 2007, p. 166). Creativity tools are classified on a scale from 1 to 4: 1 for tools requiring less expertise, and 4, for those requiring more. For each scale, they are classified from the tool requiring more expertise on the scale to the one requiring the least.

2.6.5.7 Level of ideas generated criteria

The proposed classification scale for ideas generation is 1 to 4, level 4 corresponding to a creativity tool which helps to generate more ideas, and level 1, few ideas (Clegg and Birch, 2007, p. 179-180).

2.6.5.8 Problem solving criterion

The proposed classification scale for Problem solving is also from 1 to 4, 4 being the creativity tools which help to solve more problems and 1, which solve the least (Clegg and Birch, 2007, p. 180-181).

2.6.5.9 Fun factor criterion

Fun factor is an important criterion mentioned in the creativity tools classification system of Clegg and Birch (2007). This criterion also has four scales from 1 to 4, 4 always being the highest fun to use and 1 the lowest.

2.6.5.10 Random selection criterion

Random selection could allow a user or a user's system to select at random a creativity tool. For this selection criterion, Clegg and Birch (2007, p. 175) recommend choosing only among divergent creativity tools without adding convergent creativity ones to the list of choices. This reflects the fact that a convergent tool does not achieve the desired results a divergent tool provides (we cannot generate ideas with a tool to select one or a number of ideas). But we believe it could be useful for a user to choose by random a convergent tool when he wishes to do convergence.

2.6.5.11 Direction setting order

Clegg and Birch also classify creativity tools by direction setting order on a scale of 1 to 4: Creativity tools at the top (4) have the highest and those at the bottom of the list (1), the lowest (Clegg and Birch, 2007, p. 178-179).

2.6.5.12 Paradigm preserving, stretching and breaking criteria

McFadzean (1998b) proposes techniques to classify divergent creativity tools based on the expected result. For her, creativity tools can maintain the current paradigm (the way to create), stretch, or break it ("Paradigm preserving, Paradigm stretching, Paradigm breaking") (see figure 2.4).

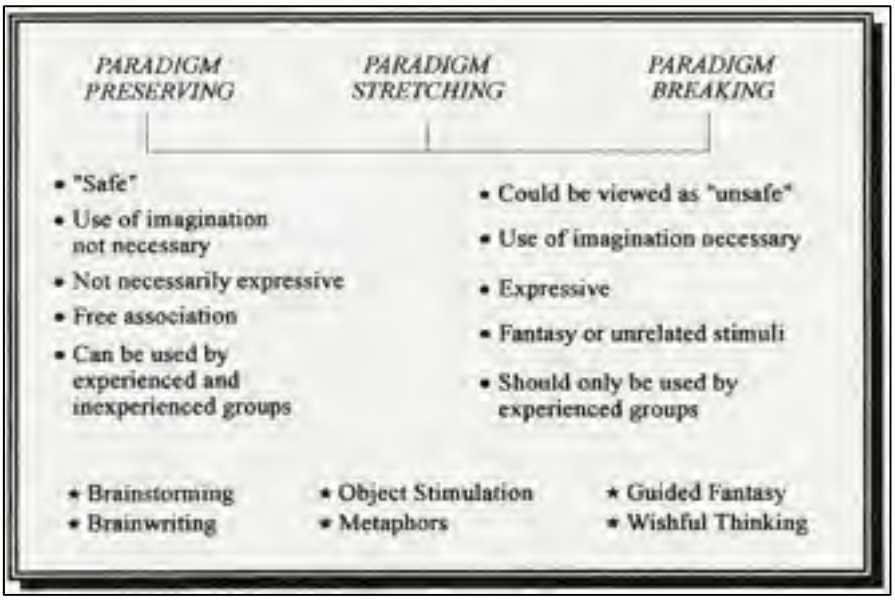


Figure 2.4 The creativity continuum
of McFadzean (1998b, p. 137)

Carrier and Gélinas (2011, p. 146-155) go in the same direction as McFadzean. They precise that many factors are included in the choice of creative tools: The level of creativity required by the challenge, the exploration strategy, the nature of the challenge, the path to take in the creative process, personnel style and cognitive preferences, convergence and divergence.

The challenges can be multiple facing a problem: Search a simple or complex idea, end a long fruitless search, breaking with the trivial, and ensure continuity. This is how a creative technique can be chosen "by the level of creativity required by the challenge" (Carrier and Gélinas, 2011, p. 146-155).

The techniques can have two different sources: First, they can go from the known to the unknown, i.e., the user will try to find solutions from the existing challenge. For example, the Brainstorming is used for a known problem. However, this first pole of discrepancy has the weakness that users have much to restrain in order not to be seduced by preconceived ideas of existing solutions to known problems. But, it has the advantage that, because the idea is known, a number of quick and reliable solutions are available to the user.

Then, users may choose to directly confront the unknown. The advantage of this second technique, which identifies the analog trip, is that the user escapes the strong temptation to use existing solutions of a known issue and thus limits his capacity and ability to increase his understanding of the problem. Moreover, the results obtained here are distinctive, different and new. Yet, they are difficult to reach; this is the first disadvantage of this technique. Then, to good convergence, it requires the user to have a pretty good ability to draw parallels with reality from scratch.

Carrier and Gélinas (2011) draw a parallel between this double source and the paradigm pattern of McFadzean (1998b). First, in Paradigm preserving, participants who do not have the habit of a process or are not familiar with the creative methods feel at ease. Moreover, these techniques are more accessible than others made from scratch, as they would be available in an existing problem. Above all, they contribute significantly to the improvement process. However, questions arise: Will users go beyond what is given to them as such? How far are they willing to consider and investigate emerging ideas that sometimes seem at first absurd? And since these techniques often give hope of revolutionary solutions, would they not disappoint when these solutions are not obtained?

Secondly, with the techniques that promote a stretching paradigm, the starting problem does not change even if the way to approach it is viewed from a different angle. The ideas are therefore developed from the original paradigm, either in the sense of maintaining, or in the one of the break.

Third, this is what Carrier and Gélinas say about the techniques that promote a complete break with the current paradigm:

> They can act in two ways to break the chains with the initial perception of the problem or challenge: Either they allow reformulating the challenge or problem in a whole new way, or they seek to identify a track radically different to confront or solve it. Both lead to a solution out with the kind of solutions that would otherwise have been considered. This approach is not suitable for all problems or challenges, but some require it must for a more radical exploration (Carrier and Gélinas, 2011, p. 147) (free translation).

Carrier and Gélinas were inspired by the classification of McFadzean (1998b) and Miller, Vehar and Firestein (2001) to develop the classification table that follows (table 2.7).

Table 2.6 Creative techniques classification of Carrier and Gélinas inspired of McFadzean and Miller(1998b), Vehar and Firestein (2001) classification
Taken from Carrier and Gélinas (2011, p.148. Free translation)

	← **Paradigm Preserving**	**Paradigm Stretching**	**Paradigm Breaking** →
Broad/Random Exploration Spectrum	• Brainstorming and its numeric versions, Post it™ and written • Mind map	• Metaphors and simple analogies • Forced relationships	• Imaginary/ analogical trip
Narrow or Pre-identified Exploration Spectrum	• Force-field analysis • Morphological Matrix	• SCAMPER • Wishful thinking	

In this classification, participants will have either to define the problem in terms entirely new, or to address it in a whole new approach. Carrier and Gélinas indicate that the creativity tools that stretch or break the paradigm are not relevant for any challenge. Participants will use them when they are in a deadlock for example, or when they want to highlight themselves in an unusual way.

Silverstein, Samuel and DeCarlo (2009) use similar criteria to classify their 50 creativity tools. They instead use terms like “outside-the-box” ideas or “wild and crazy” ideas to classify creativity tools different from those that preserve the paradigm. But since we dit not know the relation between these authors with McFadzean (1998b) classification system, we could not use their classification in this criteria.

2.6.5.13 Exploration strategy criteria

Carrier and Gélinas (2011, p. 149) explain that creativity tools use quite different exploration strategies to create, when they are used, quite distinctive ideas. For example, the Brainstorming approach is very different from a creativity tool which uses dreams and imagination to find ideas (like Guide Imagery, Straker, 2015): The resulting ideas will be very different. The authors then propose five groups to classify creativity tools:

1. Combination methods, a group in which creativity tools force different ideas to fusion or be combined to generate new ideas. For Carrier and Gélinas (2011, p. 149), “the challenge is to find a way to connect these elements in a way that generates meaning”;

2. Associative methods, with creativity tools that use similarities, analogies, symbols, comparisons and metaphors to generate new ideas;

3. Contradictory methods, where creativity tools question affirmation and bring group of participants to play with extreme and opposite ideas;

4. “Slacken off” methods with creativity tools without given direction, restriction in ideas, goals to reach; they give place to fantasy and imagination;

5. Dreams methods: Creativity tools without constraints (time, money, technology, realism) in their divergent phase; realisim reappear in the convergent phase.

We added another group for creativity tools that we were not able to classify in those five groups, and we named it “Manufacturing methods”. We used this group to classify creativity

tools associated with company like tools to take decision, create with graphics and matrix, decompose products, do reverse engineering, etc.

2.6.5.14 Other classification systems

Carrier and Gélinas (2001, p. 149) also classify creativity tools depending on the nature of the challenge. It could be to: 1. Elaborate a business strategic plan; 2. Identify new business opportunity; 3. Support total quality or continuous improvement process implementation; 4. Generate new product or service concept; 5. Solve conflicts. They demonstrate how this nature of the challenge criterion could be applied with 20 creativity tools (Carrier and Gélinas, 2011, p. 163-165).

They also propose to choose creativity tools considering our personnal style and cognitive preference based on Miller (1987). Innovationstyles® gives the following definition of Innovation Styles Profile (ISP):

> The "Innovation Styles Profile" is a personal self-assessment that reveals the style preferences and tendencies of you and those you work with. It comes complete with personalized feedback and coaching to enhance your own innovativeness and to develop the versatility you need to bring out the innovative best in others (Innovationstyles®, 2014).

The ISP of creativity tools users can be a modifier, a visionner, an explorer, or an experimenter. Depending on the ISP of the user, Carrier and Gélinas recommend three to four creativity tools per ISP (Carrier and Gélinas, 2011, p. 151-152).

Gogatz and Mondejar (2005, p. xi) classify creativity tools along tips and tricks considering 12 invisible barriers that prevent readers to access their level of natural creativity they had as children. Harrington, Hofherr and Reid, Jr (1997) choose the same objective: Give access to the reader's natural creativity but with a different approach. Their book is made of exercises, approaches and tools called "Mind expanders" to help individual or team to be creative as they were once.

Authors like Manktelow *et al*. (2015a), Mattimore (1994), *mycoted.com* (2014) website and Prather and Gundry (1995) give tips while explaining how to use creativity tools and, in some occasion, when and why.

We chose to use many authors' classification criteria (Miller, 1987, Brightman, 1988, Van Gundy, 1992, Basadur, 1994, Clegg and Birch, 2007, Carrier and Gélinas, 2011). We will meet in chapter 3 the classification made for this research by using the selection tools grid that we developed then.

We conclude this presentation on creativity tools selection by establishing with Carrier and Gélinas (2011, 146-155) that the choice of creative methods is neither random nor frozen. A method must be relevant, while based on the nature of the problem and the desired outcome. This choice also depends on the ease and the ability of people to use them. The authors add: "Selection techniques thus take into account a number of factors and will be challenged regularly along the way, especially to ensure a flexible approach adapted to both the challenge and the group."

2.6.5.15 Mini creativity tools

We created mini creativity tools that simplify existing creativity tools. In chapter 4 of this thesis, we will explain how and why they were made during the 2014 experimentation study.

2.6.5.16 Creativity tools summary

Table 2.8 presents the creativity tools classification criteria considered in our methodology to select tools for this research.

Table 2.7 Creativity tools classification criteria considered for the methodology

Creativity tools classification criteria	Basadur (1994)	Brightman (1988)	Carrier and Gélinas (2011)	Clegg and Birch (2007)	Gogatz and Mondejar (2005)	Harrington *et al.* (1997)	McFadzean (1998)	Mankteloww *et al.* (2015b)	Mattimore (1994)	Miller (1987)	Mycoted (2014)	Nemiro (2004)	Prather and Gundry (1995)	Silverstein *et al.* (2009)	Straker (2015)	VanGundy (1998)
Number of creativity tools per author	29	26	20	75	23	52	7	16	34	16	192	10	5	55	71	20
Divergence and convergence criteria		X	X													
For divergence tools																
• Fluidity		X														
• Flexibility for a good variety of strategies		X														
• Development for the refinement of the idea		X														
• Originality		X														
For convergence tools																
• Intuitive selection tools			X													
• Classification and clustering tools			X													
• Ideas building tools to improve ideas			X													
• Tools to estimate the value of ideas			X													
• Techniques and planning tools			X													
Linear or intuitive										X					X	
Individually and in groups															X	X
In groups only															X	X
stimuli related with a problem																X
Stimuli unrelated to a problem																X
Associated to creative process steps	X	X	X	X				X			X			X	X	X
Usage time				X											X	
Level of expertise required				X										X		
Level of ideas generated				X												
Problems solving				X												
Fun factor				X												
Random selection				X												
Direction setting order				X												
Paradigm preserving			X				X							X		
Paradigm stretching			X				X							X		
Paradigm breaking			X				X							X		
Exploration strategy			X													
Other classification systems			X		X	X		X	X		X		X			

In the next chapter 3, we select creativity tools; we explain what criteria we considered, why and how we used them in order to do that selection. But before that, we will have to presents the limits of our research.

2.7 Limits of the study

We decided to limit our research on several aspects. Regarding creativity processes, we were looking for the most known and wanted to have some in each type of the five types defined in section 3.2.1.1: Intuitive, linear types, linear and intuitive, componential and the category "Other types". Having more creative processes than required for our research, we had to stop searching for others when we reached the number 39.

Searching creative processes, we also found 20 non creative processes. Some of them had creative process steps added: We would had needed to study them to know if there was a difference between creative process and non creative process and to what extent, but we decided to focus on creative processes.

Also, there are a large number of creativity tools; we had to stop to look for when we found 615. To be able to complete this research, we limited them to 325.

We limited our study on creativity, without extending it to innovation processes, since we had a good problem statement related to creativity that may have an important impact on innovation.

We limited the experimentation sites to the ones of The 24 Hours; it would have been interesting to work with companies too. In 2011, we approached some of them in order to discuss that possibility. But since we were beginning our research, we did not have a clear idea on how to demonstrate companies that, at that stage, our research was interesting for them. Therefore, when pursuing our work with The 24 Hours, we realized the usefulness of our sample and decided to limit experiment on it. As explained in this chapter it would have been difficult to realize a research involving several companies wih the same subjects and constraints for several years.

We decided to limit the experimentation of creative processes to four types of creative processes without choosing a creative process in the fifth type, "Other types".

Since many research indicate that there is no standard creativity evaluation method recognized by creative specialists, we decided not to consider methods to evaluate creativity in this research.

The field related to team preparation is a vast domain of reseach in creativity, psychology, management, etc. We could have done a thesis research on the single aspect of teamwork, ezpertise or leadership in creativity. We included team preparation as a component of the elaborated componential creative process not before 2014, knowing that we could invest many research hours to refine the strategies adopted to that team preparation component. We limited our research to recommendations for essential team preparation elements.

Since we had researchers colleagues on eco innovation, risk management (added in 2014) and Big Data (added in 2015) in creativity, we did not study those elements nor insert them in the componential creative process we elaborated.

When we analyzed creativity tools with the classification system we created, we took the ratings given by different authors who analyzed creativity tools. We did not check the validity of those ratings, due to time of research we would have to invest.

2.8 Summary

In this second chapter, we set the problem: We needed an existing creative processes for short ideation sessions but none were made for that. Since this terminology (short ideation session) was not existant in the literature, we had to define it. We express our needs to use creative process defining what needs to be done (like “Define the problem”) without explaining how to do it (without tools or procedures to “define the problem” for example) in conjunction with creativity tools associated with creative process steps that explain how those steps could be realized “creatively” (how to generate ideas for example); so we needed a Componential creative process with at least two components (creative process and creativity tools).

We defined the actual problem with creative sessions as correlated in many creativity research: Different kind of organizations and individuals relied on Brainstorming to generate ideas since it is the most known creativity tools. We explained in this chapter the productivity loss during ideation session, both in quality and quantity (Mullen, Johnson and Salas, 2010, p. 3). Secondary data analysis made from ideation sessions realized during The 24 Hours from 2007 to 2010, 782 participants used mostly one creativity tools and this tool was the Brainstorming (for 97,30 %).

Considering this problem statement we defined our research question: How to elaborate a componential creative process for short ideation session? We explained our three research objectives and explained why we choose The 24 Hours as our fields of experimentation.

For the methodology, we chose the needs analysis approach. It was also inspired by creative process structures like the Componential creative process of Fisher and Amabile (2009) that we considered for its componential approach, the CPS Thinking Skills Model of Puccio, Murdock and Mance (2005) and ThinkX creative process of Hurson (2007). We retained too Carrier and Gélinas (2011) approach to integrate creativity tools to specific phases of the creative process. Those three creative processes were in fact the three creative processes selected in chapter three with a classification and selection systems created for the purpose of our research but could also be used for other purposes as explained in the Contributions and originality section of this research.

We have detailed criteria used by specialized authors in creativity tools to classify and select creativity tools with a classification and selection systems also created (chapter three).

We expressed and explained the limits of this study also in this chapter.

In the next chapter, we have classified and selected creativity processes from 39 existing processes and creativity tools from 615 existing creativity tools. We have also analyzed secondary data made at Estia from 2007 to 2010 during 24 Hours events to create data that were used during the experimentation made in 2014 to create a new component: A chronological guide.

CHAPTER 3

ANALYSIS, SELECTION, CHRONOLOGICAL APPROACH

3.1 Need of a selection to define steps

In chapter two, we reviewed the selection criteria chosen by authors to classify creative processes and creativity tools. In our review of the literature, we searched for creative processes made for short ideation sessions: We did not find a creative process with that kind of designation. We found only one creative process where time was a usage criteria: The Improvisational creative process for organizations of Fisher and Amabile (2009), designed for improvisation. But it does not mean that other creative processes could not work during short ideation sessions. We needed a selection of creative processes and creativity tools to experiment them during short ideation sessions. The first part of this third chapter of our thesis is aimed to present how we selected creative processes for our experiment.

The second part of the chapter is to select creativity tools to do our experiment. When we started to look for creativity tools, we did not know that there was such a quantity of creativity tools available. We stopped our review of the literature after we found 615 creativity tools. Many books of authors like Mattimore (1994), Clegg and Birch (2007) and Silverstein, Samuel and DeCarlo (2009) are devoted to recommend creativity tools, based on their own criterias to analyze them. But most of the creativity tools found were on creativity websites. Some made websites dedicated to creativity tools had also their own criterias of selection (like *mycoted.com*, 2014 and Straker, 2015), others were creativity consultants who offered creativity tools as part of their marketing strategies (like Reali, 2009 and Manktelow *et al*., 2015a). Some authors advanced that there were more than nine hundred of creativity tools existing (Manktelow *et al*., 2015b). Doing our research, we found new creativity tools but stopped collecting them since we had more creativity tools than required for our study.

The third part of this chapter is to define the steps to do during a creativity challenge like The 24 Hours. We thought that the steps done during this event could be the same during any short ideation session. We had the chance to be able to work with secondary data collected

by our colleagues from Estia, France, who collected them for their research during The 24 Hours from 2007 to 2010. Since ÉTS has a licence from Estia to organize this event in North America, the same rules are applied, with the same duration and type of participants. We analyzed the data of Estia to find what steps were done by all the teams and the winning ones during those years (2007 to 2010). We also wanted to know the time they allowed to those steps: We did these analyzes for winning teams and non-winning teams to see if there was a difference in their time management. We needed those data to elaborate a chronological guide to help teams manage their time. We thought this chronological guide would be useful when time is restricted like in short ideation sessions, and wanted to experiment it to know if it was a creative component to be added to a componential creative process (in chapter 4).

3.2 Creative processes classification and selection

3.2.1 Classification

3.2.1.1 Criteria

We had to define evaluation criteria in order to choose creative processes to experiment as part of this research. We were first inspired by Nemiro's (2004, p. 4) four types classification system as described in section 1.2.2 : 1. Intuitive types; 2. Linear types; 3. Linear and intuitive types; 4. Componential types. Then, to this classification, we added a fifth type named "Other types" for creative processes that could not be classified in the Nemiro four types classification. We thought it would be important to experiment at least one creative process from Nemiro (2004) classification, since we did not find any research mentioning which type we should use. Since some creative processes include the intuitive type, we could consider choosing one process in each of these types: Linear, linear and intuitive and componential. We were not sure to select a creative process at this point for the "Other types" category.

Our second evaluation criterion was time (time to use), since short ideation sessions were concerned; the third criterion was that the creative process needed to be easy to learn and use.

A fourth criterion was relative to the number of components in the creative process: We thought that, for short ideation sessions, we would need a creative process with at least two components, a creative process and creativity tools associated to its steps, but other creative components could be useful. We were searching creative processes with many components to experiment them and find which components could be useful and which could not. So, for the fourth criterion, we needed a creative process with many components.

The table 3.1 below summarizes the criteria defined for the selection of creative processes:

Table 3.1 Criteria to select creative processes for this research

#	Criteria
1	At least one creative process from Nemiro (2004) classification: Linear, linear and intuitive and componential. Maybe another one from "Other types" category
2	A creative process designed for a short ideation session
3	Easy to learn and to use
4	With many components

3.2.1.2 Change of classification of existing creative processes

We classified the 39 creative processes we found using Nemiro (2004) classifying system plus the "Other types" category. To help readers understand her system, Nemiro identified Wallas' (1926) creative process as an intuitive one, Basadur's (1994) Simplex, the CPS of Osborn (1963), Parnes (1981)[12], and Treffinger, Isaksen and Dorval (1994) as linear.

Isaksen and Treffinger (2004), for their parts, classified 13 creative processes as linear ones (Creative problem solving processes are, from their roots, linear processes). Puccio and Cabra (2009a) did a similar exercise, classifying eight CPS creative processes.

[12] In 1981, Sidney Parnes added creativity tools to the Osborn (1953) and Parnes five stages CPS process v. 2.2 (Treffinger and Isaksen, 2005, p. 344) without expressing the fact that creativity tools were integrated to the CPS creative process. It became Parnes CPS v.2.4 that continued to evolve from 1988 to 1992. Creativity tools added were a checklist for the first step (object finding), 5W and H for the second step (fact finding), another checklist for the third step (problem finding), Brainstorming tool for the fourth step (idea finding), an evaluation matrix for the fifth step (solution finding) and an action plan for the last step (acceptance finding).

Isaksen and Treffinger (2004), as well as Puccio and Cabra (2009a), did not mention Nemiro's (2004) creative process classification system when they classified CPS creative processes. Using Nemiro's classification, we proposed to modify the classification of all these authors for three CPS creative processes. So, we changed the classifying type for the CPS component process (v.5.0) created by Isaksen and Dorval (1993), Isaksen, Dorval and Treffinger (1994) Components model (v.5.1) and Isaksen and Treffinger (1994) CPS (v.6.0), from the linear type to the componential type (see table 3.2 below). Their creative components are effectively linear but they add other components in their process; this justifies, for us, the classification change for our research. Isaksen, Dorval and Treffinger (1994) Components model (v.5.1) was also identified by Nemiro (2004, p. 6) as a linear type. In the version 5.1, Isaksen, Dorval and Treffinger (1994) added what they called the metacomponents of Task Appraisal and Process Planning. Isaksen and Treffinger explained the importance of these two metacomponents added to the creative process component:

> Task Appraisal involves determining whether or not CPS is appropriate for a given task and whether modifications of one's approach might be necessary (Isaksen, 1995). During Task Appraisal, problem solvers consider the key people, the desired outcome, the characteristics of the situation, and the possible methods for handling the task. Task Appraisal enables them to assess the extent to which CPS might be appropriate for addressing a given task or for managing change in appropriate ways. Process Planning enabled problem solvers to identify their entry point into the framework, their pathway through the framework, and an appropriate exit point from the framework (Isaksen and Treffinger, 2004, p. 65).

We had a total of 13 creative processes classified from Nemiro (2004), Isaksen and Treffinger (2004), and Puccio and Cabra (2009a) works (see table 3.2). As mentioned above, we changed the classification of three other creative processes for a total of 16 processes. It means that we had to classify the remaining 22 other creative processes (from our total list of 38). We consulted many authors who described those creative processes to choose to wich type they belong (table 3.2).

In the classification presented, we had 5 intuitive creative processes, 18 linear, 7 componential and 4 "other types" creative processes.

Table 3.2 Thirty nine creative processes classified by type in chronological order

Creative processes	References																						
	ACAD (unrated)	Amabile and Mueller (2008)	Basadur (1994)	Carrier and Gélinas (2011)	de Bono Thinking Systems (2013)	Fisher and Amabile (2009)	Gabora (2005)	Hélie and Sun (2010)	Isaksen and Treffinger (2004)	Lubart (2001)	Mamktelow *et al.* (2015a)	Mycoted (2014)	Nemiro (2004)	Plsek (1996)	Prather and Gundry (1995)	Puccio and Cabra (2009)	Rajaei (1998)	Reali (2009)	Sieliset *al.* (2009)	Straker (2015)	Turner and Fauconnier (2008)	Vidal (2010)
Intuitive creative processes																						
Wallas (1926): Creative Process[a]	X			X						X			X	X								X
Guilford (1967): Convergent and divergent production				X						X					X					X		X
Barron (1988): Psychic Creation Model														X								
Fink et al. (1992): Geneplore model										X												
Gabora (2000): Honing theory							X															
Linear creative processes																						
Rossman (1931): Creativity Model										X				X								
Osborn (1953): The Original Model (v1.0)[b, c]				X					X	X				X		X						
Osborn (1963): CPS Stream Lined (v1.1)[a, b, c]									X				X			X						
Parnes (1967a): Osborn-Parnes (v2.0)[b, c]									X							X						
Parnes (1967b): Osborn-Parnes (v2.1)[c]									X													
Osborn-Parnes (1976): Five-Stage CPS Model (v2.2)[c]									X													
Koberg and Bagnall (1981): Universal Traveler Model														X								
Treffinger, Isaksen and Firestein (1983): CPS Version 2.3[c]									X													
Bandrowski (1985): Creative Strategic Planning														X								
Isaksen and Treffinger (1985): Basic Course (v3.0)[b, c]									X	X				X		X						
Parnes (1988, 1992): Visionizing(v2.4)[b, c]									X					X		X						
Fritz (1991): Process for Creation														X								
Treffinger and Isaksen (1992): CPS Components and Stages (v4.0)[c]									X													
Plsek (1997): Directed Creativity Cycle														X								
Leonard and Swap (1999): Process for Group Creativity																						X
Puccio, Murdock and Mance (2005): Thinking Skills Model				X												X		X				
Reali (2013): CPS Competencies Model																		X				
Linear and intuitive creative processes																						
Gordon (1961): Synectics				X							X	X							X	X		
Rajaei (1998): Epistemological Theory																	X					
Hudson (2008): Thinkx Productive Thinking Model											X	X						X		X		
Lieberman (2010: Reciprocal Model												X										
Componential creative processes																						
Isaksen and Dorval (1993): Components of CPS (v5.0)[f]									X													
Basadur (1994): Simplex[a, b, c]			X	X					X		X		X			X		X		X		
Isaksen, Dorval and Treffinger (1994): Components Model (v5.1)[d, e, f]									X				X			X						
Isaksen and Treffinger (1994) : CPS (v6.0)[f]									X													
Amabile (1996): Componential Theory of Creativity		X								X			X									
Isaksen, Dorval and Treffinger (1994): CPS Framework (v6.1)[e, f]									X							X						
Nemiro (2004): Virtual Team													X									
ACAD (2009): Creative Process	X																					
Fisher and Amabile (2009): Improvisional Componential Creative Proc.						X																
Other types of creative process																						
de Bono (1985)[g]: Six Thinking Hats				X	X							X								X		
Turner and Fauconnier (2002): Conceptuel Blending																					X	
Altshuller (2004): Triz				X							X								X	X		
Helie and Sun (2010): Explicit Implicit Interaction (Ell) Theory								X														

[a]: Type of creative process classified by Nemiro (2004)

[b]: Type of creative process classified by Puccio and Cabra (2009)

[c]: Type of creative process classified by Isaksen and Treffinger (2004)

[d]: Classification made by Nemiro (2004) changed following our analysis

[e]: Classification made by Puccio and Cabra (2009) changed following our analysis

[f]: Classification made by Isaksen and Treffinger (2004) changed following our analysis

[g]: Presented as a creative techniques by Straker (2015) and mycoted.com (2014).

3.2.2 Selection

We did not find any creative process with a classification, or a note advising that it was made or could be used for a short ideation session. The only creative process close to that expectation was the Improvisational creative process for organizations of Fisher and Amabile (2009). As mentioned in its title, it was designed for organizational improvisation. Time is different for an improvisation compared to a short ideation session: We retained this creative process for our methodology in chapter two (section 2.5.1.2.2**).** The term improvisation for Fisher and Amabile means that action must be "spontaneous". *Merriam-Webster's* online dictionary (Merriam-Webster, Incorporated, 2015a) gives the following definition for the word "spontaneous": "Doing things that have not been planned but that seem enjoyable and worth doing at a particular time". A short ideation session is a planned event, but could this componential process work for a short ideation session? One thing interesting for us is that it should not take long to learn it and to use it since it was designed for such a short period.

3.2.2.1 Quotation

We analyzed every creative process in table 3.2 to see how they met the criteria chosen for the selection. We cumulated the results on a scale of 0 to 1, 0 meaning that the process did not meet the criterion, and 1, that it met the criterion. When we gave a quote, we considered the quote attributed for all creative processes analyzed in table 3.2, to be able to compare the quote received for all creative processes analyzed. The maximum quote a creative process could receive was 3, since the first criterion was for the classification type: All the creative processes in table 3.2 met that criterion, so, it was not useful to quote them for that criterion.

3.2.2.1.1 Quotation for short ideation sessions criterion

Creative processes which met the short ideation sessions criterion received the quote 1; those which did not meet this criterion received the quote 0. In our case, only one creative process was designed for a shorter period of time. We gave the quote 0,5 to the Improvisitonal componential creative process for organization of Fisher and Amabile (2009) because it was made for improvisational sessions, that means, for a shorter period of time than required and that could have worked for short ideation sessions.

3.2.2.1.2 Quotation for “easy to learn and use” criterion

For the criterion “easy to learn and use”, we got inspiration from several authors. Clegg and Birch (2007, p. 176-177) measured what they called the “Running time” in minutes or the time it takes to use the different creativity tools they described. Straker (2015) gave a time period divided in five empty square units varying from “Quick”, when the first square unit is marked with an X, to “Long” when the fifth square is marked with an “X”.

We had the opportunity since 2010 to teach to college and university students and to adults how to use creative processes and creativity tools alone and in groups. We remarked that participants did not use the same time to learn a process or a tool depending on their experience to create, their skills, their motivation and the subject of their creation work. We found that, in general, creative processes could be more difficult to learn than creativity tools since they were more complex and rarely came with a creativity guide or information to explain them.

Therefore, we created a creativity guide to explain our participants how to use the different creative processes we proposed them: The creativity guide helped them to learn how to use a creative process, but, even then, it took time to learn that creative process in team. When the language used in a creative process is “academical” more than “practical”, participants in short ideation sessions may decide to stop the learning experience and use their own creative approach. An example of “academical language” is the following: For the Geneplore Model (appendix II), an intuitive creative process has two phases, the first phase being named “Generation of Preinventive Structures”; Dunn and Roppolo (2010, p. 9) explained that this phase is for generating ideas, during which an individual constructs mental representations called pre-inventive structures.

The representation and the complexity of the creative process is another element we considered when we analyzed the creative processes for the “easy to learn and use” criterion. Some creative processes could be easy to understand (see the Wallas creative process (1926), figure 1.1), others, hard (see the figure A.II.5 for the Conceptual Blending creative process of Fauconnier and Turner, 2008).

We did not find authors who analyzed how easy it was to learn and use creative processes. As said earlier, the time to use some creativity tools was analyzed by authors, but not for creative processes. We gave a quote of 0 when the terms used were hard to understand and when the process representation and structure was complex: The conceptual Blending creative process of Fauconnier and Turner (2008) was one with this quote. At the other hand of the spectrum, Wallas creative process would have received a quote of 1 (but we did not use it for reasons explained before).

3.2.2.1.3 Quotation for "with the most components" criterion

For the criterion "With the most components", we attributed 0,2 for each component added to the creative process. For example, Fisher and Amabile (2009) Improvisational componential creative process for organizations had five creative components added to the creative process: Preparation, expertise, creativity-relevant processes, intrinsic motivation and work environment. It was the creative process in table 3.2 with the most components. Quote 1 was attributed to it. A creative process with no component added received quote 0.

We made the selection for Nemiro (2004) classification types plus the category we added (other types). As mentioned above, we did not choose intuitive creative processes, since they are part of the type linear and intuitive (and of some linear creative processes); we decided to consider combined types (like linear and intuitive) since those processes have a kind of double creative process component.

3.2.2.2 Linear creative processes analysis and selection

As shown in table 3.3, we analyzed 18 linear creative processes using the three criteria established for the previous creative processes selection. The highest quote (0,45) is for Puccio, Murdock and Mance (2005) Thinking Skills Model with creativity tools integrated as proposed by Carrier and Gélinas (2011, p. 163). This linear creative process is also interesting because it has integrated the Guilford (1967) Convergent and divergent production intuitive creative process (Carrier and Gélinas, 2011, p. 121).

Table 3.3 Linear creative process analysis

Linear creative processes	1. Short ideation session	2. Easy to learn and use	3. With many components	Total
Rossman (1931): Creativity Model	0	0	0	0
Osborn (1953): The Original Model (v1.0)	0	0	0	0
Osborn (1963): CPS Stream Lined (v1.1)	0	0,25	0	0,25
Parnes (1967a): Osborn-Parnes (v2.0)	0	0	0	0
Parnes (1967b): Osborn-Parnes (v2.1)	0	0	0	0
Osborn-Parnes (1976): Five-Stage CPS Model (v2.2)	0	0	0	0
Koberg and Bagnall (1981): Universal Traveler Model	0	0,25	0	0,25
Treffinger, Isaksen and Firestein (1983): CPS Version 2.3	0	0	0	0
Bandrowski (1985): Creative Strategic Planning	0	0	0	0
Isaksen and Treffinger (1985): Basic Course (v3.0)	0	0	0	0
Parnes (1988, 1992): Visionizing(v2.4)	0	0	0,2	0,2
Fritz (1991): Process for Creation	0	0,5	0	0,5
Treffinger and Isaksen (1992): CPS Components and Stages (v4.0)	0	0,25	0	0,25
Plsek (1997): Directed Creativity Cycle	0	0	0	0
Leonard and Swap (1999): Process for Group Creativity	0	0	0	0
Puccio, Murdock and Mance (2005): Thinking Skills Model[a]	0	0,25	0,2	0,45
Reali (2013): CPS Competencies Model	0	0,25	0	0,25
[a]: Carrier and Gelinas (2011) proposed creativity tools to integrate to this creative process				

3.2.2.3 Linear and intuitive creative processes analysis and selection

With the analysis done in table 3.4, Hurson's (2007) ThinkX Productive Thinking Model was the linear and intuitive creative process selected with a quote of 0,45.

Table 3.4 Linear and intuitive creative process analysis

Linear and intuitive creative processes	1. Short ideation session	2. Easy to learn and use	3. With many components	Total
Gordon (1961): Synectics	0	0,25	0	0,25
Rajaei (1998): Epistemological Theory	0	0	0	0
Hurson (2007): ThinkX Productive Thinking Model[a]	0	0,25	0,2	0,45
Lieberman (2010: Reciprocal Model	0	0	0	0
[a]: Manktelow (2014b) proposed creativity tools to integrate to this creative process				

3.2.2.4 Componential creative processes analysis and selection

Fisher and Amabile's (2009) Improvisational componential Creative Process for Organizations was the creative process chosen with the highest quote (2,5). It was also this creative process that we chose in our methodology framework.

Table 3.5 Linear and intuitive creative process analysis

Componential creative processes	1. Short ideation session	2. Easy to learn and use	3. With many components	Total
Isaksen and Dorval (1993): Components of CPS (v5.0)	0	0,25	0,6	0,85
Basadur (1994): Simplex	0	0	0,6	0,6
Isaksen, Dorval and Treffinger (1994): Components model (v5.1)	0	0,25	0,6	0,85
Isaksen and Treffinger (1994) : CPS (v6.0)	0	0,25	0,6	0,85
Amabile (1996): Componential Theory of Creativity	0	0,5	1	1,5
Isaksen, Dorval and Treffinger (1994): CPS Framework (v6.1)	0	0,25	0,6	0,85
Nemiro (2004): Virtual team	0	0	1	1
ACAD (2009): Creative Process	0	0	0,6	0,6
Fisher and Amabile (2009): Improvisional componential CP	0,5	1	1	2,5

3.2.2.5 Other types of creative processes analysis and selection

We decided not to choose a creative process from the " Other types" processes. The only process that seemed interesting regarding the quotation was Altshuller's (2004) TRIZ process. The major problem with this creative process which has a different approach and creativity tools integrated is that, for the purpose of our research, it was not suitable for short ideation sessions. It required a relatively long training session to learn it and several creativity sessions to get used to it.

Table 3.6 Other types of creative process analysis

Other types of creative process	1. Short ideation session	2. Easy to learn and use	3. With many components	Total
de Bono (1985)[1]: Six Thinking Hats	0	0	0	0
Turner and Fauconnier (2002): Conceptuel Blending	0	0	0	0
Altshuller (2004): Triz	0	0	0,2	0,2
Helie and Sun (2010): Explicit Implicit Interaction (Ell) Theory	0	0	0	0

3.2.3 Creative processes selected for our research

The creative processes selected with the analysis done for this selection are the following:

Table 3.7 Creative processes selected and their quotations

Types	Creative processes	Quotes
Linear	Puccio, Murdock and Mance (2005): Thinking Skills Model	0,45
Linear and intuitive	Hurson (2007): ThinkX Productive Thinking Model	0,45
Componential	Fisher and Amabile (2009): Improvisational componential creative process for organizations	2,50

3.3 Creativity tools selection

In chapter 2, we considered different creativity tools classification systems as part of our methodology. In this chapter, we had to choose creativity tools in order to experiment them as a component of a creative process. We selected in section above three creative processes

(table 3.7): We needed to select creativity tools to associate them with the steps of those creative processes. We wanted to select creativity tools for the first year of experimentation (2012). Creativity tools selected for subsequent years were to be chose in function of the results of their usage by the participants.

3.3.1 Number of creativity tools to select

We had to decide how many creativity tools to choose. Manktelow (Manktelow *et al*., 2015a) proposed 15 creativity tools for Basadur (1994) Simplex creative process, a creative process not conceived for short ideation sessions. Carrier and Gélinas (2011, p. 163-164) recommend two sets of ten creativity tools for a generic five steps creative process again not made for short ideation sessions. Our first creative process chosen for 2012 was the three phases and six steps CPS Thinking Skills Model of Puccio, Murdock and Mance (2005). Considering that the participants who experimented the creative processes proposed in this research had 24 hours to define the problem, find a solution, make prototypes and present the solution, the minimum number of creativity tools would have been one per step for a total of six. If we take in account the divergent and convergent times, it would have been two per step for a total of twelve. Since many creativity tools are designed to do the divergent and convergent times using them, we chose arbitrarily three creative processes per phase (two steps per phase) which gave a total of nine creativity tools to select from the 234 creativity tools selected at the end of the first selection made, to start the experimentation in 2012 (table 3.8).

Table 3.8 Number of creativity tools chosen associated with phases and steps to start the experimentation in 2012

Phases	Steps	Times	Number of creativity tools to select
1. Clarification	1. Exploring the vision	Divergent	3
		Convergent	
	2. Formulating the challenges	Divergent	
		Convergent	
2. Transformation	3. Exploring ideas	Divergent	3
		Convergent	
	4. Formulating the challenges	Divergent	
		Convergent	
3. Implementation	5. Exploring acceptance	Divergent	3
		Convergent	
	6. Formulating a plan	Divergent	
		Convergent	

For us, nine creativity tools seemed adequate to start the experiment, because they were enough to give a choice to participants (only one choice per step would not give a choice). On the other hand, if there was too many creativity tools offered for a short ideation session, some participants may decide to go only with the creativity tools they know (the Brainstorming) considering the time they had.

Secondary data analysis of The 24 Hours participants from 2007 to 2010 (first heading of the next division of this chapter) showed that participants used less than one creativity tool per team. When they did use one, the creativity tool chosen was the Brainstorming. To meet the first objective of our research, which is we recall that "the componential creative process created has to be helpful for participants to find creative ideas and creative solutions to problems during a short ideation session", we needed to make participants try and use more

creativity tools. But for that, creativity tools had to be easy to use, require a short time to be used, made for specific steps to help complete those steps “creatively”.

So, we created a methodology to choose creativity tools meeting our requirements (detailed below) to be associated with the steps of creative processes (we selected one creative process for 2012 and three for 2013).

3.3.2 First set of selection criteria

We began the selection of the 615 creativity tools retained by defining what criteria we would consider.

We estimated the time needed to analyze those 615 creativity tools and decided, in accordance with our thesis director, to limit the number to around half of the tools (325). In order to define how we would select those 325 creativity tools, usage time would have been a good criteria (for a short ideation session). But in order to have an idea of the time it takes to learn and use the creativity tools, we would have to analyze all the 615. Random could have been a method of selection, but some creativity tools are too well known to be rejected.

Therefore, we started by selecting creativity tools we knew and those that were recommended by more than one author from specialized books and websites dedicated to creativity tools. We completed the selection by choosing those that could be associated with creative processes steps which did not have enough creativity tools chosen (appendix IV). We eliminated those which were the same but appeared with different names (31 duplicates) and those with only slight differences (60). This is how we reached the number of 234 creativity tools selected (appendix IV). But a second selection was needed to choose nine creativity tools for the 2012 experimentation.

3.3.3 Second set of selection criteria

We did not find authors who may had done a selection from all existing creativity tools. For our specific selection, we could not use all the classification criteria because several were proposed by unique authors and not used by others, or were applied to only a small selection

of creativity tools. Our review of litterature shows that there is no standard criteria existing to analyze and select creativity tools. This situation complicated the selection of the most appropriate creativity tools for a given creative process step used in a short ideation session. If authors sometimes use the same criteria of classification, there is a difference in their measurement system. We could neither establish nor test our own selection criteria since it is not the objective of our research, which would have complexified it.

To classify the 234 creativity tools selected, we indicated, for each creativity tool, who were the authors proposing the classification of it. When we had no classification corresponding, we read the instructions on how to use the creativity tool and then classified it. The selected criteria are shown in table 3.9 below.

Table 3.9 Criteria of the second set
of creativity tools selection

#	**Criterion**
1	Associated to creative process steps
2	Time usage
3	Alone or in group
4	Paradigm maintain, stretch or break
5	Linear or intuitive
6	Exploration strategy

Using existing selection criteria, we knew that the application of these criteria made by the different authors would not be the same.We understood that using their evaluation even if it was not standardized was not the ideal way to do, but to do otherwise would have required a lot of time that we could not consider for this part of our research. We wanted to obtain around nine creativity tools that we could associate with steps of three creative processes selected (in the previous section of this chapter) in function of specific requirements, to start the experimentation in 2012, even if the selection was not perfect.

Since we did not find a selection system to classify a large number of creativity tools, we created one. It would help to choose creativity tools, meeting the following requirements: 1. Suitable for a specific creative process step; 2. Requiring a short time of use; 3. Made to be used in group; 4. Maintining or stretching; 5. Linear. The system developed could be used for different purposes: In our case, it helped to obtain nine creativity tools to form a component for the componential creative processes elaborated and experimented in our research.

3.3.3.1 First criterion Associated with creative process steps

"Associated with creative process steps" was the most used selection criterion chosen by 9 authors on a total of 16 consulted (Brightman, 1988, VanGundy, 1992, Basadur, 1994, Clegg and Birch, 2007, Carrier and Gélinas, 2011, *mycoted.com,* 2014, Manktelow *et al.,* 2015a and Straker, 2015). These authors did not use the same steps of classification : Basadur used the three phases and eight steps of his Simplex, but other authors chose instead generic steps varying from three to five. For example, Clegg and Birch used three generic steps : 1. What's the question? 2. What's the answer? – to develop a solution; 3. What's the answer? – to choose an idea. Carrier and Gélinas (2011) used five generic steps and two times (divergent and convergent): 1. Clarification; 2. Ideas generation; 3. Reinforcement; 4. Selection; 5. Planification.

We applied the classification proposed by those eight authors to the six steps and two times (divergent and convergent) CPS Thinking Skills Model (2005) as shown in table 3.9. We chose this creative process because it was the first we experimented in 2012. Since it was the process with the most steps, it would be easier for years 2013 and 2014 to apply creativity tools selected to creative processes with less steps: Hurson (2007) ThinkX creative process had five steps and Fisher and Amabile (2009) componential creative process had only three. Steps from those two other creative processes were included in the six steps of the CPS Thinking Skills Model.

Authors who classified creativity tools with this criteria used, as mentioned above, from three to five steps. We had to apply them to a six steps process. Since those six steps could be regrouped in three phases (see table 1.3 in section 1.2.2.2.2): Clarification, transformation

and planification, we were able to classify creativity tools of each author at least in two of those three phases : Clarification and transformation.

3.3.3.2 Second criterion Time usage

Time usage was the second criterion, since it was chosen by two authors (Clegg and Birch, 2007 and Straker, 2015). Time given by these authors was to use the creative tools. We would also need the time to learn how to use the creative tools but this data was not available from authors consulted.

3.3.3.3 Third criterion Individuals or groups (or both)

We needed creativity tools made for groups since we rarely had individuals participating at The 24 Hours. Again, two authors used this criterion (VanGundy, 1992, p. 123-143 and Straker, 2015).

3.3.3.4 Fourth criterion Paradigm

We needed the paradigm criterion in order to select simple creativity tools: Secondary data analysis of The 24 Hours revealed that participants used less than one creativity tool from 2007 to 2010 (analysis done in heading 3.4.1 of this chapter). It means that the usual participants had few experience with creativity tools. We needed mostly “Preserving the paradigm” creativity tools and few “Stretching the paradigm”, but no “Breaking the paradigm”, since most participants did not have the experience and the time to use that kind of creativity tools.

Paradigm criteria was used by two authors (McFadzean (1998b, p. 137 and Carrier and Gélinas, 2011, p. 146-155).

3.3.3.5 Fifth criterion Linear or intuitive

We also wanted to know if creativity tools were linear or intuitive, in order to choose simple tools. This criterion was used by two authors (Miller, 1987, p. 65 and Straker, 2015).

3.3.3.6 Sixth criterion Exploration strategy

We chose a last criterion: We wanted to know the exploration strategy, the type of creativity tools, in order to do a good selection. It was only used by one author (Carrier and Gélinas (2011, p. 149) but we thought it would be useful during the selection to know what was the type of creativity tools, before their analysis.

This last criterion has six sub-criteria: 1. Combinatory; 2. Associative; 3. Contradictory; 4. "Slacken off"; 5. Manufacturing; 6. Dreams. When we started doing the analysis, all precedent criteria (1. Associated to creative process steps; 2. Time usage; 3. Paradigm; 4. Alone or in group; 5. Exploration strategy) gave an adequate classification and representation of a creativity tool, except the last one (exploration strategy). With the sub-criteria, we did not succeed describing correctly the type of creativity tools. Sub-criteria were too vague. For example, we would have to classify Brainstorm inspired techniques (Brainstorm, Brainwriting, Braindrawing, etc.) with checklists (series of points to check to find ideas) and tools like SCAMPER and MindMap in the sub-category "Slacken off".

To get better idea of the type of creativity tools to classify, we created 31 new sub-sub-categories. We used them during the first classification process (when we collected creativity tools) in order to get a better idea of the type of creativity tools classified. For example, the sub-category "Slacken off" had, at the end of the classification, six new sub-sub-categories: 1. Art; 2. Ask questions; 3. Brainstorm inspired; 4. Checklists; 5. Game approach; 6. Mind Map inspired. Those sub-sub-categories created were adequate in our point of view to classify the 193 creativity tools chosen. But, it was possible that for the analysis of all the creativity tools found, we may have ended up with more than 31 sub-sub-categories.

3.3.4 Creativity tools classification

We started by classifying the 234 selected creativity tools with the first selection criterion: Associated with a creativity step. As explained earlier, we chose the steps of the Thinking Skills Model CPS. We used the six steps of this process with the times "Convergent" and "Divergent" for each: It gave us the twelve following sub-criteria : 1D. Exploring the vision:

Divergent; 1C. Exploring the vision : Convergent; 2D. Formulating challenges: Divergent; 2C. Formulating challenges: Convergent; 3D. Exploring ideas: Divergent; 3C. Exploring ideas: Convergent; 4D. Formulating solutions: Divergent; 4C. Formulating solutions: Convergent; 5D. Exploring acceptance: Divergent; 5C: Exploring acceptance: Convergent; 6D. Formulating a plan: Divergent; 6C. Formulating a plan: Convergent.

For this classification, we used Microsoft Excel™ 2010 software. We ended up with twelve tables of creativity tools associated with the six steps and their two times each (divergent and convergent). Since many creativity tools could be used with more than one step, we had between 9 and 126 creativity tools per step (see table 3.10 and appendix IV):

Table 3.10: Number of creativity tools associated to creativity steps after applying the first criterion

Associated to creativity steps	Number of creativity tools associated
1D. Exploring the vision: Divergent	30
1C. Exploring the vision : Convergent	20
2D. Formulating challenges: Divergent	60
2C. Formulating challenges: Convergent	37
3D. Exploring ideas: Divergent	126
3C. Exploring ideas: Convergent	37
4D. Formulating solutions: Divergent	24
4C. Formulating solutions: Convergent	41
5D. Exploring acceptance: Divergent	13
5C: Exploring acceptance: Convergent	10
6D. Formulating a plan: Divergent	10
6C. Formulating a plan: Convergent	16

After this first classification phase, we made a second phase applying time usage classification: Inspired by Clegg and Birch (2007, p. 176-177), we attributed a time usage

quote between 1 to 5: 1 was the shortest time and 5 the longest. We obtained the following number of creativity tools (see appendix IV and table 3.11):

Table 3.11 Number of creativity tools obtained with criteria 1 and 2

Associated to creativity steps	**Criteria applied and number of creativity tools corresponding**	
	Criterion 1	**Criterion 2**
1D. Exploring the vision: Divergent	30	1
1C. Exploring the vision : Convergent	20	5
2D. Formulating challenges: Divergent	60	9
2C. Formulating challenges: Convergent	37	8
3D. Exploring ideas: Divergent	126	8
3C. Exploring ideas: Convergent	37	7
4D. Formulating solutions: Divergent	24	1
4C. Formulating solutions: Convergent	41	7
5D. Exploring acceptance: Divergent	13	3
5C: Exploring acceptance: Convergent	10	4
6D. Formulating a plan: Divergent	10	2
6C. Formulating a plan: Convergent	16	1

After these two selection phases, we made another selection for each step and time, as detailed below.

3.3.5 Creativity tools selection Step 1 Exploring the vision

For the first step “Exploring the vision”, the selection process created to select creativity tools gave us one creativity tool for the divergent time and five creativity tools for the convergent time.

3.3.5.1 Divergent time

For the divergent time, the creativity tool proposed by the selection process was "Target Future" (table 3.12):

Table 3.12 Creativity tools proposed by the selection process for step 1 "Exploring the vision", divergent time

Criteria		Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
Creativity tools		1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Target Future [e]	1	1											1	1	1	1			1	

Creativity tools evaluation from [e] Manktelow et al. (2015a).

Table 3.12 indicates that "Target Future" creativity tool had a time usage of one, meaning that this creativity tool was in the group that required the smallest amount of time to be used (see section 2.6.5.5 for time attribution scale), it could be use alone or in group, and could maintain the paradigm and have a linear approach. We chose this creativity tool to be associated with the step "Exploring the vision". This creativity tool could also be used for this step in convergent time to choose the vision.

3.3.5.2 Convergent time

As shown in table 3.13, to select the creativity tool for the step "Exploring the vision", convergent time, we made six sortings: 1. The creative process steps; 2. Time to use; 3. Group; 4. Maintain the paradigm; 5. Stretch the paradigm; 6. Break the paradigm. After those sortings, we had the choice of five creativity tools: They were all classified with the time all required to use, 10 minutes or less, and were fine for group creativity. "Target

future" creativity tool was already chosen and "Is – Is not" was our choice for the second step 'Formulating the challenges". "Pause" was classified as a creativity tool that "breaks the paradigm", so it was eliminated. We had two remaining choices: "Anonymous voting" or "The Kipling method". We prefered "The Kipling method" (also named 5W, 5W and H, 5W and 2H, etc.), a creativity tool useful to refine the vision. This creativity tool is also known as a creative problem solving tool used by consultants for Lean Kaizen (Bose, 2011, p. 328, Graban and Swartz, 2012, p. 320) and Six Sigma (Luneau *et al*, 2008, p. 67, Voehl *et al*., 2013, p. 551).

Table 3.13 Creativity tool proposed by the selection process for step 1 "Exploring the vision", convergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	**1D - Exploring the vision: Divergent**	**1C - Exploring the vision: Convergent**	**2D - Formulating challenges: Divergent**	**2C - Formulating challenges: Convergent**	**3D - Exploring ideas: Divergent**	**3C - Exploring ideas: Convergent**	**4D - Formulating solutions: Divergent**	**4C - Formulating solutions: Convergent**	**5D - Exploring acceptance: Divergent**	**5C - Exploring acceptance: Convergent**	**6D - Formulating a plan : Divergent**	**6C - Formulating a plan: Convergent**	**Time to use (1 to 5)**	**Alone**	**Group**	**Maintain**	**Stretch**	**Break**	**Linear**	**Intuitive**
1	Compass [b]			1										1	1	1	1			1	
2	How to [a, f]			1	1	1								1	0,5	1	1			1	1
3	Obstacle map [b]			1										1	1	1	1			1	
4	Is – Is not [a, e]		1	1	1		1		1					1	1	1	1			1	0
5	Do Nothing [b, f]			1										1	1	1		1		1	1
6	Purposing [a]			1										1	1	1		1		1	0,5
7	Reversal [a]			1	1	1								1	1	1		1		1	0,5
8	Up and down [b]			1										1	1	1		1		1	1
9	Provocation [a]			1		1		1						1	0,5	1		1		0,5	1
10	Shorts [b]			1										1	1	0			1	0	1

Creativity tools evaluation from [a] Straker (2015), [b] Clegg and Birch (2007), [e] Manktelow et al. (2015a) and [f] mycoted.com (2014).

3.3.6 Creativity tools selection Step 2 Formulating challenges

For this step, after applying six sortings, the selection process proposed ten divergent creativity tools and eight convergent.

3.3.6.1 Divergent time

The ten divergent creativity tools are all divergent tools useful to formulate challenges and to work in group (table 3.14). Four creativity tools maintain the paradigm, five others stretch it and the last one breaks it. Since we had already chosen two creativity tools for this step (Target future and the Kippling method), we needed a last creativity tool designed for divergent and convergent time for this step. So we made the selection after the analysis of the convergent time of this step.

Table 3.14 Creativity tool proposed by the selection process for step 2 "Formulating challenges", divergent time

Criteria		Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
Creativity tools		**1D - Exploring the vision: Divergent**	**1C - Exploring the vision: Convergent**	**2D - Formulating challenges: Divergent**	**2C - Formulating challenges: Convergent**	**3D - Exploring ideas: Divergent**	**3C - Exploring ideas: Convergent**	**4D - Formulating solutions: Divergent**	**4C - Formulating solutions: Convergent**	**5D - Exploring acceptance: Divergent**	**5C - Exploring acceptance: Convergent**	**6D - Formulating a plan : Divergent**	**6C - Formulating a plan: Convergent**	**Time to use (1 to 5)**	**Alone**	**Group**	**Maintain**	**Stretch**	**Break**	**Linear**	**Intuitive**
1	Anonymous Voting [f]		1		1		1		1					1		1	1			1	
2	Challenge [a, f]				1				1					1	1	1	1			1	0
3	Destination [a]				1									1	1	1	1			1	0
4	How to [a, f]			1	1	1								1	0,5	1	1			1	1
5	Is – Is not [a, e]		1	1	1		1		1					1	1	1	1			1	0
6	The Kipling method (5W1H) [a, d]		1		1		1		1					1	1	1		1		1	0,5
7	Reversal [a]			1	1	1								1	1	1		1			1
8	Pause [a]		1		1		1		1		1		1	1	0,5	1			1	1	0,5
Creativity tools evaluation from [a] Straker (2015), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015a) and [f] mycoted.com (2014).																					

3.3.6.2 Convergent time

From the eight creativity tools selected, only two could be used for the step "Formulating the challenges" in divergent and convergent times: "How to" and "Is – Is not". In the exploration strategy criterion, "How to" is classified as an associative strategy making word analysis, and as a "Slaken off strategy" (ask questions). The creativity tool "Is – Is not" is classified as a manufacturing strategy / a decomposition method and an "Is – Is not" type. Both creativity tools are simple: We prefered "Is – Is not", finding this tool more efficient in its convergent time to formulate the challenge.

Table 3.15 Creativity tool proposed by the selection process for step 2 "Formulating challenges", convergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	**1D - Exploring the vision: Divergent**	**1C - Exploring the vision: Convergent**	**2D - Formulating challenges: Divergent**	**2C - Formulating challenges: Convergent**	**3D - Exploring ideas: Divergent**	**3C - Exploring ideas: Convergent**	**4D - Formulating solutions: Divergent**	**4C - Formulating solutions: Convergent**	**5D - Exploring acceptance: Divergent**	**5C - Exploring acceptance: Convergent**	**6D - Formulating a plan : Divergent**	**6C - Formulating a plan: Convergent**	**Time to use (1 to 5)**	**Alone**	**Group**	**Maintain**	**Stretch**	**Break**	**Linear**	**Intuitive**
1	Compass [b]			1										1	1	1	1			1	
2	How to [a, f]			1	1	1								1	0,5	1	1			1	1
3	Obstacle map [b]			1										1	1	1	1			1	
4	Is – Is not [a, e]		1	1	1		1		1					1	1	1	1			1	0
5	Do Nothing [b, f]			1										1	1	1		1		1	1
6	Purposing [a]			1										1	1	1		1		1	0,5
7	Reversal [a]			1	1	1								1	1	1		1		1	0,5
8	Up and down [b]			1										1	1	1		1		1	1
9	Provocation [a]			1		1		1						1	0,5	1		1		0,5	1
10	Shorts [b]			1										1	1	0			1	0	1

Creativity tools evaluation from [a] Straker (2015), [b] Clegg and Birch (2007),[e] Manktelow et al. (2015a) and [f] mycoted.com (2014).

3.3.7 Creativity tools selection Step 3 Exploring ideas

For this step, after applying six sortings, the selection process proposed nine divergent creativity tools and eight convergent.

3.3.7.1 Divergent time

The classification system created allowed us to select 8 divergent creativity tools to explore ideas with a time usage of one. The creativity tools "Google Wonder Wheel" and "How to" could be used with groups while maintaining the paradigm (table 3.16). But, as discussed earlier, the secondary data analysis of The 24 Hours participants from 2007 to 2010 (next section in this chapter) showed that most of the participants used the Brainstorming. We could not offer other creativity tools to explore ideas than the Brainstorming, even if in time usage, it was rated four by Straker (2013) while stretching the paradigm.

Table 3.16 Creativity tool proposed by the selection process for step 3 "Exploring ideas", divergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Google Wonder Wheel					1								1	1	1	1			1	1
2	How to [a, f]			1	1	1								1	0,5	1	1			1	1
3	Provocation [a]			1		1		1						1	0,5	1		1		0,5	1
4	Reversal [a]			1	1	1								1	1	1		1		1	0,5
5	The level chain [b]					1								1	1	0		1		1	1
6	Absence Thinking [a]					1								1	1	1			1	1	0,5
7	Random Words [a, b, f]					1								1	0,5	1			1	0	1
8	Wishing [a]					1								1	0,5	1			1	0	1
9	SCAMMPERR [a, d, e, f]					1	1							2	1	1		1		1	0,5
10	Brainstorming [a, d, e, f]					1								4	0	1		1		0,5	1

Creativity tools evaluation from [a] Straker (2015), [b] Clegg and Birch (2007), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015a) and [f] mycoted.com (2014).

3.3.7.2 Convergent time

From the seven creativity tools designed to explore ideas in convergent time, our classification system proposed us four creativity tools that worked well with groups while maintaining the paradigm. As a second creativity tool to explore ideas, we decided to choose "SCAMMPERR". This was a complementary creativity tool that worked well with the Brainstorming, and that could be used in divergent and convergent times even if the time usage was rated at two (instead of one) and the paradigm was stretched. Since we expected that most of the participants were going to use the Brainstorming, it was interesting to see if they would use that complementary tool to work with the Brainstorming.

Table 3.17 Creativity tool proposed by the selection process for step 3 "Exploring ideas", convergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	**1D - Exploring the vision: Divergent**	**1C - Exploring the vision: Convergent**	**2D - Formulating challenges: Divergent**	**2C - Formulating challenges: Convergent**	**3D - Exploring ideas: Divergent**	**3C - Exploring ideas: Convergent**	**4D - Formulating solutions: Divergent**	**4C - Formulating solutions: Convergent**	**5D - Exploring acceptance: Divergent**	**5C - Exploring acceptance: Convergent**	**6D - Formulating a plan : Divergent**	**6C - Formulating a plan: Convergent**	**Time to use (1 to 5)**	**Alone**	**Group**	**Maintain**	**Stretch**	**Break**	**Linear**	**Intuitive**
1	Adoption Checklist [a]						1							1		1	1			1	
2	Advantages, Limitations and Unique Qualities [f]		1		1		1		1					1		1	1			1	
3	Anonymous Voting [f]						1							1	1	1	1			1	0
4	Circle of Opportunity [f]						1		1					1		1	1			1	
5	BulletProofing [f]		1		1		1		1					1	1	1		1		1	0,5
6	Checklists [k]						1		1					1	0	1		1		1	0,5
7	Analytic Hierarchy Process (AHP) [e]		1		1		1		1		1		1	1	0,5	1			1		1
8	SCAMMPERR [a, d, e, f]					1	1							2	1	1		1		1	0,5

Creativity tools evaluation from [a] Straker (2015), [b] Clegg and Birch (2007), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015a), [f] mycoted.com (2014) and [k] Cave (2003).

3.3.8 Creativity tools selection Step 4 Formulating solutions

For this step, after applying six sortings, the selection process proposed one divergent creativity tool and seven convergent.

3.3.8.1 Divergent time

For the divergent time of the Formulating solutions step, our classification system proposed a creativity tool named "Provocation", rated one for time usage, adequate for group and a "stretch the paradigm" type. From criterion six, "exploration strategy", "Provocation" creativity tool is a confrontation / provocation type. Since we had a last creativity tool to choose for the phase "Transformation" which included the steps "Exploring ideas" and "Formulating solutions", we chose the creativity tool after we made the selection on the convergent time (table 3.18).

Table 3.18 "Provocation" creativity tool proposed by the selection process for step 4 "Formulating solutions", divergent time

Criteria		Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
Creativity tools		1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Provocation [a]			1		1		1						1	0,5	1		1		0,5	1
Creativity tools evaluation from [a] Straker (2015).																					

3.3.8.2 Convergent time

Three creativity tools had a time usage rated quote one, group type, while maintaining the paradigm: "Anonymous voting", "Challenge" and "Yellow Box". Two creativity tools had

almost the same ratings except for the paradigm (break instead of maintain): The “Kipling method” and “Voting”. Kippling method was chosen for phase one, “Clarification”, step one, “Exploring the vision”, times divergent and convergent. After analyzing the sixth criterion (appendix IV), we chose the creativity tool “Yellow Box” for its voting system done in team.

Table 3.19 Creativity tool proposed by the selection process for step 4 “Formulating solutions”, convergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Anonymous Voting [f]		1		1		1		1					1		1	1			1	
2	Challenge [a, f]				1				1					1	1	1	1			1	0
3	Yellow box [d]						1		1					1		1	1			1	
4	The Kipling method (5W1H) [a, d]		1		1		1		1					1	1	1		1		1	0,5
5	Voting [a]						1		1					1	0	1		1		1	0,5
6	Pause [a]		1		1		1		1		1		1	1	0,5	1			1	0	1
7	Remembrance [a]								1					1	1	0,5			1	0	1
Creativity tools evaluation from [a] Straker (2015), [d] Carrier and Gélinas (2011) and [f] mycoted.com (2014).																					

3.3.9 Creativity tools selection Step 5 Exploring acceptance

For this step, after applying six sortings, the selection process proposed nine divergent creativity tools and eight convergent.

3.3.9.1 Divergent time

Our selection system proposed three creativity tools with a time usage of two (no creativity tool had a rating of one). Only one of those three creativity tools was a “maintain the paradigm” type: “Using experts”. This tool could also be used for convergent type (table

3.20). After consulting its description (Mycoted, 2014), we found that this creativity tool involved to do expert interview. This was not feasible, considering The 24 Hours context where we are not always able to involve clients or experts to discuss solutions[13]. A second choice offered by *mycoted.com* was the creativity tool "Delphi" that uses expert survey. We decided to do the classification for convergent time before selecting a creativity tool[14].

Table 3.20 Creativity tool proposed by the selection process for step 5 "Exploring acceptance", divergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	**1D - Exploring the vision: Divergent**	**1C - Exploring the vision: Convergent**	**2D - Formulating challenges: Divergent**	**2C - Formulating challenges: Convergent**	**3D - Exploring ideas: Divergent**	**3C - Exploring ideas: Convergent**	**4D - Formulating solutions: Divergent**	**4C - Formulating solutions: Convergent**	**5D - Exploring acceptance: Divergent**	**5C - Exploring acceptance: Convergent**	**6D - Formulating a plan : Divergent**	**6C - Formulating a plan: Convergent**	**Time to use (1 to 5)**	**Alone**	**Group**	**Maintain**	**Stretch**	**Break**	**Linear**	**Intuitive**
1	Using Experts [f]							1	1	1	1			2	1	1	1				1
2	Role-play [a]					1				1				2	0	1		1		0,5	1
3	Rubber-ducking [a]	1		1		1		1		1		1		2	1	0,5		1		1	0,5
10	Delphi Method [a]	1		1						1				5		1		1		1	0,5
Creativity tools evaluation from [a] Straker (2015) and [f] mycoted.com (2014).																					

3.3.9.2 Convergent time

For the convergent time (table 3.21), our selection system proposed one creativity tool, "Pause", with a time usage rating of one, good for group, but with a "break the paradigm" rating: We did not choose it. Next choices were "Dotmocracy" and "Using Experts" with a time rating of two, suitable for groups, while maintaining the paradigm. "Dotmocracy" is a

[13] Clients are companies representants who propose challenges submitted to participants for The 24 Hours.
[14] Delphi method (Dalkey and Helmer, 1963, Gordon and Helmer, 1964, Helmer and Rescher, 1958, Sackman, 1974, Somerville, 2008a and Hsu and Sanford, 2007) is designed to try to understand the future and make predictions from a technological and scientific point of view. Since we used it in a creative process, we decided to classify it as a creativity tool to simplify the approach.

decision making / manufacturing type creativity tool (criterion six). We needed a creativity tool for divergent and convergent times: "Dotmocracy", as indicated in criterion six (exploration strategy), is for convergent time only. "Using experts" was discussed in divergent time above. The last choice was "Force field analysis", rated two for time usage, good for groups, and which stretches the paradigm. Considering the criterion six, we found that this creativity tool is a "Is – Is not" / manufacturing type of tools. The problem with it is that participants may use it without exploring acceptance outside their own group, analyzing the forces for and against a solution by their own.

Since we had the opportunity to teach how to use "Delphi" to engineering students at ÉTS[15], we thought it could be useful to use it considering that experts could be found in a group of participants doing The 24 Hours. It had a time rating of five, adequate for groups, while stretching the paradigm (table 3.20). We chose "Delphi" creativity tool for the phase three: Implementation, step five: Exploring acceptance.

Table 3.21 Creativity tool proposed by the selection process for step 5 "Exploring acceptance", convergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	**1D - Exploring the vision: Divergent**	**1C - Exploring the vision: Convergent**	**2D - Formulating challenges: Divergent**	**2C - Formulating challenges: Convergent**	**3D - Exploring ideas: Divergent**	**3C - Exploring ideas: Convergent**	**4D - Formulating solutions: Divergent**	**4C - Formulating solutions: Convergent**	**5D - Exploring acceptance: Divergent**	**5C - Exploring acceptance: Convergent**	**6D - Formulating a plan : Divergent**	**6C - Formulating a plan: Convergent**	**Time to use (1 to 5)**	**Alone**	**Group**	**Maintain**	**Stretch**	**Break**	**Linear**	**Intuitive**
1	Pause [a]		1		1		1		1		1		1	1	0,5	1			1		1
2	Dotmocracy [o]		1		1		1		1		1		1	2		1	1			1	
3	Using Experts [f]							1	1	1	1			2	1	1	1				1
4	Force-field Analysis [a]						1		1		1			2	1	0,5		1		1	0,5
Creativity tools evaluation from [a] Straker (2015), [f] mycoted.com (2014) and [o] Wenger (2014).																					

[15] We taught how to use Delphi in production management and financial analysis courses: "Production Management (GPA 548)" in 2012 and "Cost-effectiveness of automation project (GPA 786)" in 2013.

3.3.10 Creativity tools selection Step 6 Formulating a plan

For this step, after applying six sortings, the selection process proposed two divergent creativity tools and two convergent. The shortest time usage creativity tools were rated two for both times (divergent and convergent).

3.3.10.1 Divergent time

Our selection system proposed two creativity tools: "Action plan[16]" and "Rubber ducking". Both had a time usage of two, suitable for groups, but "Action plan" maintained the paradigm while "Rubber ducking" stretched it (table 3.22). "Action plan" was also selected for convergent time. We chose it as the second creativity tool for phase 3: Implementation, and the first for this step.

Table 3.22 Creativity tool proposed by the selection process for step 6 "Formulating a plan", divergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Action plan [d]											1	1	2	1	1	1			1	0
2	Rubber-ducking [a]	1		1		1		1		1		1		2	1	0,5		1		1	0,5
3	PMI [f]											1	1	5	1	1	1			1	
Creativity tools evaluation from [a] Straker (2015), [d] Carrier and Gélinas (2011) and [f] mycoted.com (2014).																					

[16] "Action plan" is not really a creativity tool but more a strategy to elaborate a plan of action. To simplify the approach and the classification, we categorized it as a creativity tool.

3.3.10.2 Convergent time

Our selection system proposed two creativity tools: "Action plan", a creativity tool already chosen, and "Dotmocracy", a creativity tool analyzed for the precedent step (Exploring acceptance). Since "Dotmocracy" is a tool for convergent time only, we preferred, as our last creativity tool, to select the Project Management Method ("PMI") accredited by the Project Management Institute (Project Management Institute, 2013) [17] (see table 3.23). This method had a time rating of five, was suitable for groups, maintained the paradigm and could be used in divergent and convergent times. We chose it because many engineers participants learned how to use it in their undergraduate engineering program.

Table 3.23 Creativity tool proposed by the selection process for step 6 "Formulating a plan", convergent time

	Criteria	Associated to creative process steps													Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Action plan [d]											1	1	2	1	1	1			1	0
2	Dotmocracy [o]		1		1		1		1		1		1	2		1	1			1	
3	PMI [f]											1	1	5	1	1	1			1	
Creativity tools evaluation from [d] Carrier and Gélinas (2011), [f] mycoted.com (2014) and [o] Wenger (2014).																					

3.3.11 Creativity tools selection made for year 2012 experimentation

We ended up this selection process with a selection of nine creativity tools using our creativity tools selection system (table 3.24).

[17] "PMI" is not really a creativity tool but, to simplify the approach and the classification, we categorized it as such.

Table 3.24 Creativity tools selected to start the experimentation in 2012 associated with phases and steps of CPS Thinking Skills Model

Phases	Steps	Times	Creativity tools selected
1. Clarification	1. Exploring the vision	Divergent /convergent	Target future
		Divergent /convergent	Kippling method
	2. Formulating the challenges	Divergent	Is / Is not
		Convergent	
2. Transformation	3. Exploring ideas	Divergent	Brainstorming
		Convergent	SCAMMPERR
	4. Formulating challenges	Divergent	The Yellow Box
		Convergent	
3. Implementation	5. Exploring acceptance	Divergent	Delphi
		Convergent	
	6. Formulating a plan	Divergent /convergent	Action plan
		Divergent /convergent	PMI

3.4 Chronological guide data

We created a new component for our componential creative process in 2014: A chronological guide. This new component was designed to help participants manage the time allowed to do all activities that needed to be done from the ideation session till the presentation of their solution based on the winning team data. To create this chronological guide, we had the opportunity, as said before, to reuse data collected by professor Jérémie Legardeur from 2007 to 2010 during The 24 Hours at ESTIA in France. We also compared data of winning teams and non-winning teams for that purpose. The steps included in the chronological guide were inspired by the life cycle steps followed by 2007 to 2010 teams (table 3.25).

Table 3.25 Content of the chronological guide created for the 2014 componential creative process

Time	#	Steps
Before 0 h	1	Team preparation
0 to 1 h	2	Choose the challenge
1 to 3 h	3	Define the problem
	4	Generate ideas
3 to 5 h	5	Eco innovate
5 to 7 h	6	Find the solution
7 h	7	Creative survey to fill
8 to 10 h	8	Financial analysis
10 to 14 h	9	Prototyping
12 to 21 h	10	Produce the video
21 h	11	Upload the video
22 to 24 h	12	Local jury selection
24 to 26 h	13	International jury selection

The secondary data analysis helped us to know how much time it would take for participants to use each step and when they should start steps described in the chronological guide.

3.4.1 Studies done during The 24 Hours of Innovation

We had the opportunity to reuse data from ESTIA, an approach named “secondary data”. For Heaton (2008, p. 1) secondary analysis “involves the use of existing data, collected for the purposes of a prior study, in order to pursue a research interest which is distinct from that of the original work; this may be a new research question or an alternative perspective on the original question.” The data were collected during The 24 Hours at ESTIA from 2007 to 2010. Secondary data have several adantages. For Stewart and Kamins (1993, p. 1), it “offers relatively quick and inexpensive answers to many questions and is almost always the point of departure for primary research”; it gives also the possibility of exploring current themes like

The 24 Hours via data that was collected in the past (Goodwin & O'Connor, 2006, p. 374). For Szabo & Strang (1997, p. 66), "this method is cost-effective, decreases respondent burden, and is a useful research method for students."

Legardeur, Choulier & Monnier collected these primary data to develop new projects evaluation methods for The 24 Hours (Legardeur, Choulier & Monnier, 2010, p. 177). We used their data for a different purpose: To create the chronological guide.

ESTIA organizers had been able to interest most of the participants to fill their survey in the 2007 to 2010 24 Hours (table 3.26).

Table 3.26 Participation to research survey at ESTIA from 2007 to 2010

	Years				
	2007	2008	2009	2010	Total
# of participants who fill the research survey	154	176	244	208	782
Total # of participants to the event	200	250	250	268	968
% of participation to research survey	77,00 %	70,40 %	97,60 %	77,61 %	80,79 %

From the 968 participants who competed, 782 filled the research survey, which represented 80,79 % of all participants. These original datas had a good quality considering the rate of completion and their provenance: Participants came from 43 universities, 10 companies and one college (appendix A.XI.1). They were from France, Canada, England, Finland, USA, Spain, Italy and Senegal.

3.4.1.1 Questionnaire used at ESTIA

An hourly questionnaire in the form of a Web based application was made to investigate how students create during The 24 Hours. For Legardeur, Choulier and Monnier (2010), this proposed media had the advantage to procure a dynamic environment stimulating participants to report their project progress. The same questionnaire was used from 2007 to

2010. Every hour (for 24 hours), participants had to indicate what phase[18] they were doing from a list of nine chosen phases plus one phase named "others" for activities or phases not listed (figure 3.1).

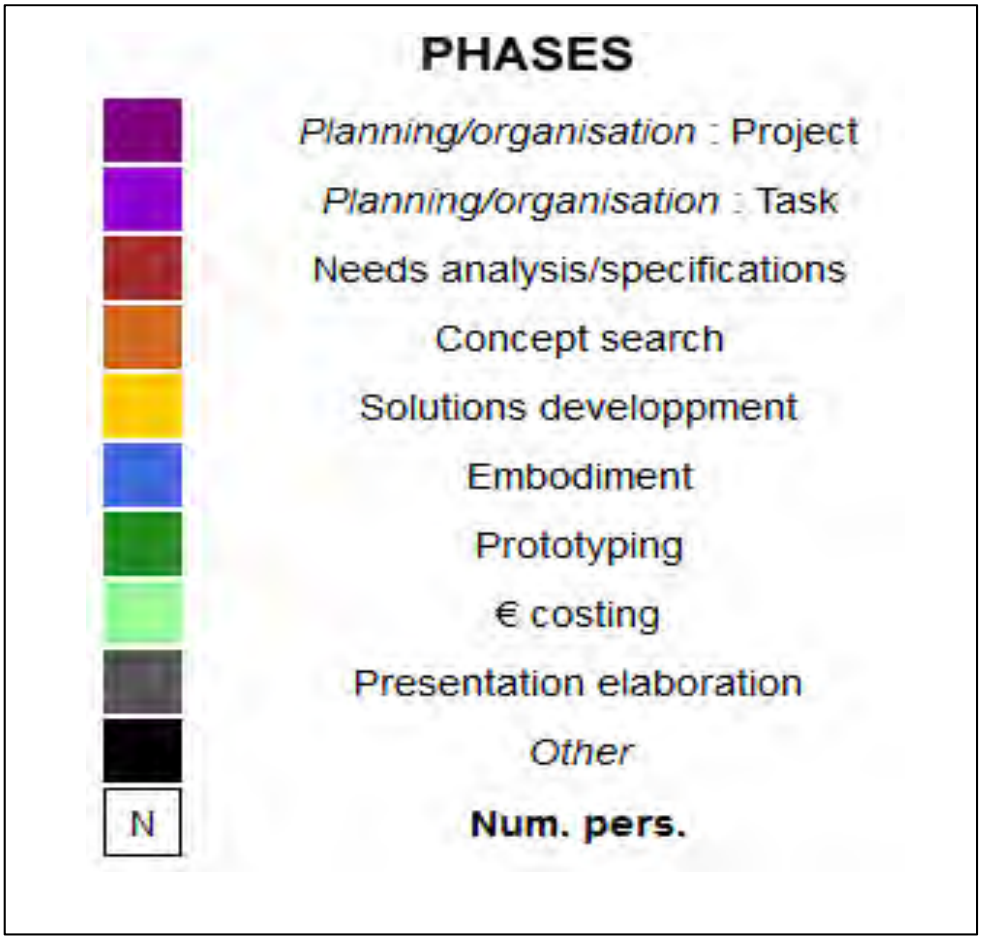


Figure 3.1 Ten phases used for the different activities done (2007-2010)
Taken from Legardeur (2009, p. 52)

Those phases were adapted from project life cycle steps. For Legardeur, Choulier and Monnier (2010, p. 179), "the aim was to expose to the participants examples of product design phases from which they [could] express how they consider[ed] the innovation design process".

[18] Authors of those secondary data use the term "phase" to describe what we called in our research "steps".

The hourly questionnaire is illustrated in table 3.27. Participants first had to indicate on which phase they were working from a choice of ten phases: 1. Planning / organisation: Project; 2. Planning / organisation: Task; 3. Needs analysis / specifications; 4. Concept search; 5. Solutions development; 6. Embodiment; 7. Prototyping; 8. € costing; 9. Presentation elaboration; 10. Other. Secondly, they had to indicate as shown in table 3.27 on what they were working. They had the following choice: Overall product, specific part, functionality, design, emotional factors. Thirdly, they could indicate with what method or tools they worked on what they worked during that specific hour. It was the place to specify softwares, creative processes and creativity tools used. They could add comments for each of these three points (table 3.27).

Table 3.27 Example of a hourly questionnaire filled by a participant

Phase Needs analysis/specifications	Comments «Phase»	Comments «On what?»	Comments «Method/Tool»
On what? _	H=2 information search	H=2 , information search on solar trees, organic solar panels, energy storage, wind energy trees	H=2
Method/Tool WEB			

Using a color code as shown in figure 3.2, the data collected were translated on a graphic that could be seen on The 24 Hours ESTIA website by the participants of the team during the event. These graphics gave to the participants an hourly progress report for them, the researchers and the other participants (Legardeur, Choulier and Monnier, 2010, p. 178). Numbers in colored squares[19] indicate how many students of the team worked on the specified phase, and numbers on the left, how many phases they were working on during a specific hour (figure 3.2).

[19] The number in colored squares were introduced in 2008: For 2007, this information was not available.

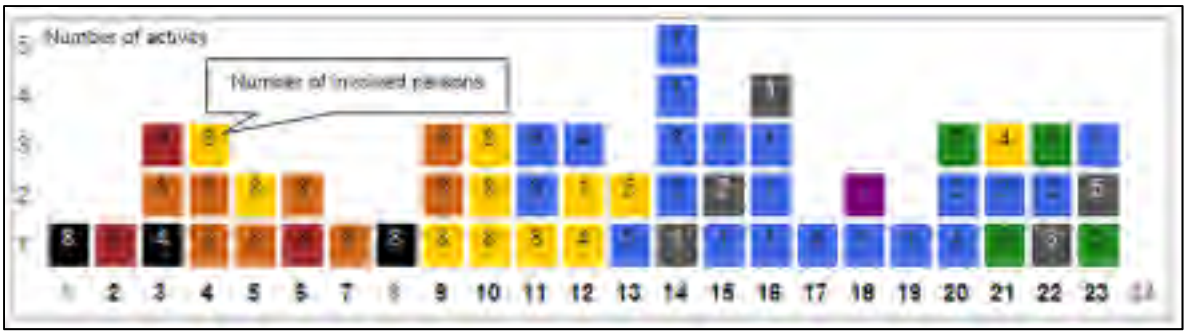


Figure 3.2 An example of the graphic made from questionnaires filled by participants
Taken from Legardeur, Choulier and Monnier (2010, p. 179)

3.4.1.2 Phases used compared to creative process steps

The nine project life cycle inspired steps could be compared with creative process steps like the CPS Thinking Skills Model of Puccio, Murdock and Mance (2005), a creative process we experimented with 24 Hours participants at ÉTS event in 2012 and 2013. This process is composed of three phases and six steps (table 3.28).

Table 3.28 Phases and steps of the CPS Thinking Skills Model
Taken from Puccio, Murdock and Mance (2005)

3 PHASES	6 STEPS
1. CLARIFICATION	1. Exploring the vision
	2. Formulating challenges
2. TRANSFORMATION	3. Exploring ideas
	4. Formulating solutions
3. IMPLEMENTATION	5. Exploring acceptation
	6. Formulating a plan

We could compare those 6 steps with the steps used by The 24 Hours participants at ESTIA to see the correspondence between those two processes.

Table 3.29 Comparison of the CPS Thinking Skills six steps model and The 24 Hours ten steps process used

Steps	**Project life cycle steps**		**CPS Thinking Skills Model**	**Steps**
1	Planning organization: Project		Formulating a plan	6
2	Planning organization: Task			
3	Needs analysis: Specification		Explorating the vision	1
			Formulating challenges	2
4	Concept Search		Exploring ideas	3
5	Solution development		Formulating solutions	4
6	Embodiment			
7	Prototyping			
8	Costing			
9	Presentation elaboration		Exploring acceptation	5
10	Other			

The phases 1 and 2, planning organization project and task, could be compared to the CPS step 6, except that in the case of The 24 Hours, the planning is done for the event. The CPS step 6 is proposed to plan what a team should do to push further a solution found. Step 3 done at ESTIA (need's analysis) is well included in CPS steps 1 and 2 (exploring the vision, formulating a challenge). Step 4, concept search, is like CPS step 3, exploring ideas. Steps 5 6, 7 and 8 give more details than the CPS step 4 do, formulating a solution, but they are associated to it. Finally, step 9, presentation elaboration, is a phase of CPS step 5 exploring acceptation.

3.4.1.3 Winning and non-winning teams

Many prizes were defined and attributed from 2007 to 2010 to recognize solutions created by teams as shown on the following table 3.30:

Table 3.30 Type of prizes allowed to winning teams
from 2007 to 2010

Winners category	**2007**	**2008**	**2009**	**2010**	**Categories chosen**
First place	X	X	X	X	X
Second place		X	X	X	X
Third place		X	X	X	X
Best concept	X		X		
Technology Prize	X		X		
Creativity + technology prize		X			
Prototype Prize	X	X	X	X	X
Design Prize	X	X			
Fun prize	X	X			
Best presentation	X				
Animation VR				X	
Futuristic vision		X			
"Coup de coeur"		X	X	X	X
ecoinnovation			X		
Environment				X	
House work			X		
Marketing		X		X	
Invention				X	
Video				X	
Disruptive prize				X	
Number or prizes attributed	7	10	9	11	5

During those years, ESTIA attributed between seven to eleven prizes to reward teams. Between all those, we chose five types of prizes to be considered as the winning teams to compare to the results of the other teams. We chose only five because the type of prizes attributed changed from 2007 to 2010, and we found that only five types were similar. We chose prizes named "First place" and "Prototype prizes". For years 2008 to 2010, we retained prizes named "Second place", "Third place" and "Coup de cœur" (which means favorite); those three last types of prizes were not used during the first year of The 24 Hours (2007). To have the same number of winning teams (five) in 2007, we chose from that year, three other

categories: Best concept, Technology and Best presentation prizes. We analyzed secondary data to compare what those five winning teams had done versus what all the other teams had done (a category that we named, for the purpose of our study, “non-winning teams”).

3.4.2 Results of the analysis

The data was collected by the ESTIA research committees and were made available without usage restriction on the ESTIA website from 2007 to 2012[20]. We collected those secondary data and analyzed them to compare the following points for winning and non-winning teams during The 24 Hours (see appendix XI for the data):

1. Number of participants per team;
2. Creative process used: Linear or non-linear;
3. Percentage of teams who used creativity tools;
4. Number of creativity tools used;
5. Types of creativity tools used;
6. Time allowed to the different phases during The 24 Hours;
7. Cost analysis done, at what time;
8. Prototyping done, what kind, at what time.

Those different points allowed us to understand the differences and similarities between winning and non-winning teams. Those results were the base of the chronological guide component, a part of the componenial creative process for short ideation sessions.

3.4.2.1 Number of participants per team

Participants may work alone, in small or large teams varying from one to eleven participants (the biggest teams had 11 participants). From 2007 to 2010, 968 participants registered to compete in the ESTIA 24 Hours. From that number, 782 filled the questionnaires (80,79 %). They formed 105 teams. The mean number of participants per team was 7,61(figure 3.3). Winning teams had 8,05 participants (mean value) and non-winning teams, 7,48, a difference of 0,57 participant (7,62 %).

[20] The ESTIA 24 Hours website was redone in 2013 on those data were removed from the new website.

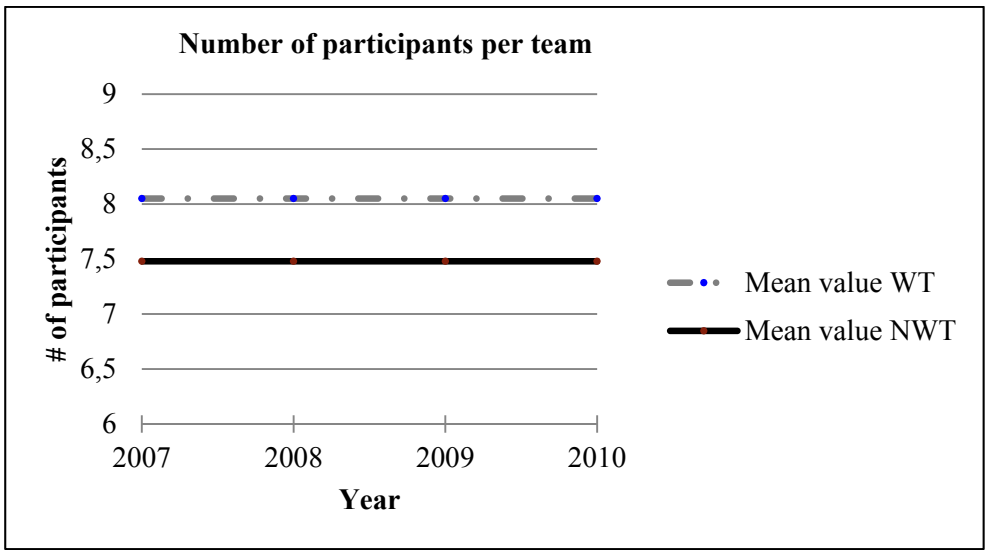


Figure 3.3 Number of participants per team from 2007-2010

3.4.2.2 Creative process used Linear or non-linear

Participants had the choice to do the project life cycle steps proposed linearly from step one to step nine or non-linearly, that means, doing iterations when needed. Since they had to report their activities hourly using this type of creative process, 98,57 % used it based on the reports done (table 3.31).

Table 3.31 Creative process usage from 2007 to 2010

Elements	Year				Total
	2007	2008	2009	2010	
WT	80,00 %	40,00 %	80,00 %	80,00 %	
Mean value WT					70,00 %
NWT	64,29 %	50,00 %	36,67 %	55,00 %	
Mean value NWT					51,49 %
Difference WT - NWT					18,51 %
All T: Creative Process use	100,00 %	100,00 %	94,29 %	100,00 %	
Mean value All Teams					98,57 %

Considering the data for all the teams from 2007 to 2010 (figure 3.4), we found that 75,00 % of Winning Teams used the project life cycle steps proposed non-linearly, meaning that the other 25,00 % used it linearly. Regarding Non-Winning Teams, 51,49 % used it non-linearly. The difference in this type of usage (non-linear) is 18,51 %.

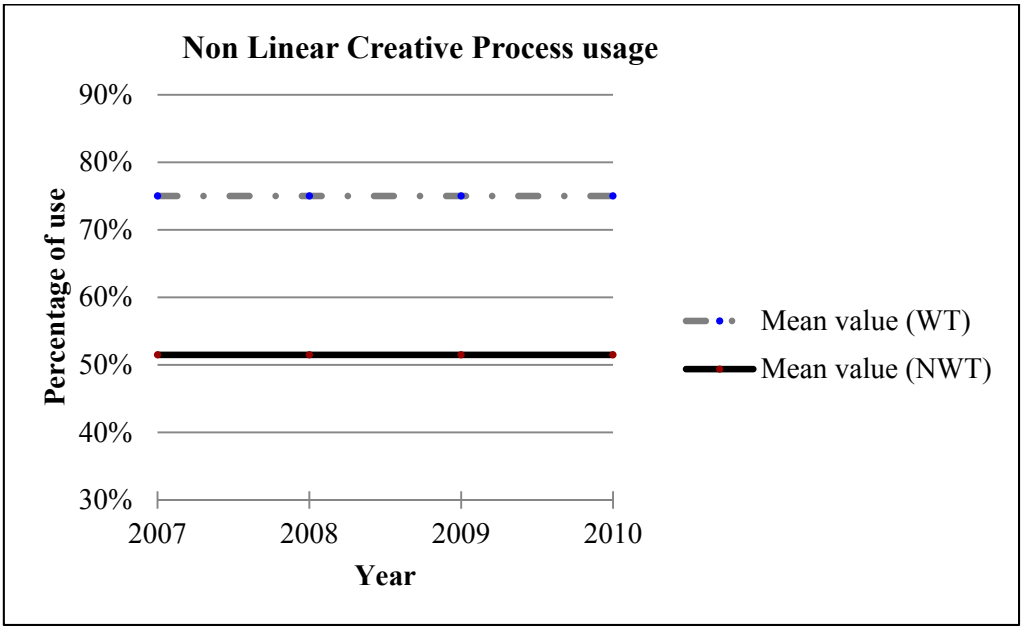


Figure 3.4 Creative process and non-linear type usage from 2007 to 2010

3.4.2.3 Percentage of teams which used creativity tools

We found that 69,7 % of the teams used at least one creativity tool during the competition, from 2007 to 2010. There was almost no different usage of creativity tools between winning and non-winning teams, since 70,0 % of the winning teams used at least one creativity tool, compared to 68,6 % of non-winning teams which did the same.

3.4.2.4 Number of creativity tools used

The teams which used creativity tools reported to have used only one. Only one team of the 105 which participated from 2007 to 2010 reported using two creativity tools in 2009.

3.4.2.5 Types of creativity tools used

Considering only the teams which reported to have used at least one creativity tool, we found that 97,30 % of them chose the Brainstorming. The only other tool used by 2,70 % of the teams was the Mind Mapping.

3.4.2.6 Time allowed to complete the different phases

Winning and non-winning teams had almost the same time working during The 24 Hours: 16,25 hours for the winning teams on the data available from 2008 to 2010[21] at ESTIA[22], and 16,10 hours for the non-winning teams. For each phase, we analyzed how many hours winning teams and non-winning teams took to complete it (table 3.32):

Table 3.32 Comparison of the time allowed by winning and non-winning teams to complete the different phases from 2008 to 2010

#	Phases	Winning Teams	Non-Winning Teams	Differences
		(hours)	(hours)	(hours)
1	Planning organization: Project	0,27	0,34	-0,07
2	Planning organization: Task	0,36	0,21	0,15
3	Needs analysis: Specification	1,40	1,73	-0,34
4	Concept Search	2,43	2,26	0,17
5	Solution development	2,80	4,44	-1,64
6	Embodiment	2,40	1,22	1,18
7	Prototyping	1,66	1,40	0,26
8	Costing	0,38	0,12	0,26
9	Presentation elaboration	2,14	2,71	-0,56
10	Other	2,40	1,82	0,58
	Total	16,25	16,25	0,00

[21] As mentioned before, ESTIA teams did not indicate in 2007 how many participants were working on the different phases: We could not use 2007 data regarding the analysis of time allowed to the different phases.
[22] The number of hours of The 24 Hours of Innovation was 24 hours at ESTIA, but only 22 hours at ÉTS: Due to the fact that ÉTS added an international jury evaluation which had to work after the 24 regular hours, they had to reduce the time. So, the local jury would produce its results within the 24 hours.

The main difference we found between the two types of teams regarding the time allowed per phase was for the phases “Solution development” and “Embodiment”. In a product life management cycle (PLM) from which those phases were proposed (Legardeur, Choulier and Monnier, 2010, p. 179), the phase “Embodiment” describes the phase “embodiment design”, meaning what follows:

> A part of the design process in which, starting from the principle solution or concept of a technical product, the design is developed in accordance with technical and economic criteria and, in the light of further information, to the point where subsequent detail design can lead directly to production (Pahl *et al*. (2007, p. 227).

During this phase, scale drawings could be made and reviewed. A technical and economic evaluation of the solution is done (Pahl *et al*. (2007, p. 227). Evidently, participants of the 24 Hours did not realize a complete embodiment design since they did not have the time for that, but they could evaluate their solution and, doing so, refine their solution.

If we consider only the phases linked to “Embodiment design”, from phase five “Solution development” to phase eight “Costing”, we can remark that winning teams and non-winning teams allowed almost the same amount of time to complete them (table 3.33):

Table 3.33 Phases linked to embodiment design (2008-2010)

#	Phases	Winning Teams (hours)	Non-Winning Teams (hours)	Differences (hours)
5	Solution development	2,80	4,44	-1,64
6	Embodiment	2,40	1,22	1,18
7	Prototyping	1,66	1,40	0,26
8	Costing	0,38	0,12	0,26
	Total	7,25	7,19	0,06

Winning teams invested less time to develop the solution (1,64 hour less) and used that time to do more “Embodiment” (1,18 hour), “Prototyping” (0,26 hour more) and “Costing” (0,26 more).

3.4.2.7 Prototyping done, what kind, at what time

From 2007 to 2010, 72,5 % of winning teams and 66,36 % of non-winning teams did prototyping, a difference of 6,14 %. When they did it, 93,10 % of winning teams and 97,06 % of non-winning teams chose simulation and CAD tools to do their prototypes, a difference of 3,96 %. Winning teams started to do prototyping after 9,1 hours; 1,58 hour sooner than non-winning teams (which started prototyping after 10,68 hours of work).

3.4.2.8 Cost analysis done, at what time

From 2007 to 2010, 47,50 % of winning teams and 29,37 % of non-winning teams did a cost analysis, a difference of 18,13 %. When done, cost analysis was almost at the same time: Starting at 13,92 hours for winning teams and 14,17 hours for non-winning teams (15 minutes later).

3.4.2.9 Other observations

Observing the way teams divided work to small groups of participants, we found that most of them used the Charrette method. For Clayton, Kunz and Fischer (1998),

> [Charette] is actually the French word for "cart." Its architectural meaning originated in the traditions of the Ecole des Beaux Arts. To allow a student to work on a project until the last possible moment, the student's friends would load the student and his drawing board into a cart and deliver him and his project to the jury. The student continued to work "en charrette" to apply the finishing touches to the project. The Charrette Test Method employs a short but intensive design problem and compares the performance of several designers in undertaking the problem using various carefully defined design processes (Clayton, Kunz and Fischer, 1998, p. 2-3).

Participants from a group forms smaller groups which have specific phases to do on part of the work they have to do, in order to find a creative solution to the challenge chosen. For Manktelow (Manktelow *et al*., 2015a), "The Charette Procedure allows for maximum participation in idea generation, without compromising the quality or effectiveness of the Brainstorming". We also observed participants at ÉTS using Charrette method in the same way. It is a useful method in short ideation sessions where work is often intensive.

We also remarked that 64,00 % of the teams (from 2008 to 2010) had communicated with the client or an expert to discuss about the creative project.

As discussed earlier, the analysis and results from the secondary data collected from 2007 to 2010 were used to build the chronological guide added to the componential creative process elaborated, version 2014. Creativity tools selection was used for the tools component and creative processes selection, for the creative process component, all components of the componential creative process designed and experimented in chapter four.

3.5 Summary

Since we needed to select creative processes and creativity tools for our experimentation made from 2012 to 2013, we searched selection systems for that purpose in the literature, without success; so, we created them.

The classification and selection system for creative process for the 39 creative processes found when doing the litterature review in chapter one was inspired of Nemiro (2004) four types classifying system (see the summary of chapter 1), to which we added a category for "other types" of creative processes that could not be classified with Nemiro's system, like TRIZ (Altshuller, 2004) for example. We created criteria in regards of our specific needs for this research: "Easy to learn and use", "made for short ideation sessions" and "with many components". We applied quotes for these criteria and selected with them, three creative processes: CPS Thinking Skills Model of Puccio, Murdock and Mance (2005), Linear and intuitive ThinkX creative process from Hurson (2007) and componential Improvisationnal creative process for organizations from Fisher and Amabile (2009).

We also created a classification system based on existing criteria from many researchers (described in chapter 2) in order to classify 615 creativity tools found. We limited our first selection to 325 creativity tools based on two criteria. The first was that the creativity tool should be recommended by more than one specialized authors, and the second criteria was our own knowledge of creativity tools. From those 325, we removed duplicate and similar ones to finish with 234 creativity tools (appendix IV). That was the first phase.

For our second creativity tools selection phase, we tried to use an existing standard quotation system made by authors who had analyzed creativity tools. Since there was no standard, we had to develop one. We refined in some cases criteria (like the “exploration strategy” criterion) and defined specific ones meeting our research objectives: Creativity tools had to be made for creative process steps, they had to require the shortest time to be used, could be used in groups maintaining (first choice) and stretching (second choice) the paradigm, and had to be a linear type (see chapter 2 for the definition of those criteria). We applied this selection system on the 234 creativity tools for six general creative process steps for divergent and convergent times to select nine creativity tools for our first Componential creative process elaborated and experimented in 2012 (chapter 4).

Our analysis of secondary data made during The 24 Hours from 2007 to 2010 by Jérémy Legardeur at ESTIA gave us the following informations that helped us to create the first chronological guide component added to the componential creative process elaborated in this research. In summary, the findings are the following:

1. Winning teams had 8,05 participants per team (division headings 3.4.2.1);

2. 98,57 % of participants did ideation with a process similar to a linear CPS creative process (division headings 3.4.2.2), but 75,00 % of winning teams used it non-linearly (division headings 3.4.2.2);

3. 70,00 % of winning teams used creativity tools (division headings 3.4.2.3); those which did, used only one creativity tool (division headings 3.4.2.4); that tool was the Brainstorming at 97,30 % (division headings 3.4.2.5);

4. Winning teams invested almost the same time (7,25 hours) to find a solution and mature it (phases 5 to 8) as non-winning teams but differently: They invested less time to do phase 5: Solution development (1,64 hour less) but more for phase 6: Embodiment (1,18 hour more), phase 7: Prototyping (0,26 hour more) and phase 8: Costing (0,26 hour more) (division headings 3.4.2.6). In other words, they invested less time to choose a solution and more to mature it than non-winning teams;

5. 72,50 % of winning teams made prototypes using simulation and CAD tools (93,10 %) at hour 9 (division headings 3.4.2.7);

6. 47,50 % of winning teams did phase 8: Costing after 14 hours (division headings 3.4.2.8);

7. Most of the teams used the Charette method (division headings 3.4.2.9) to divide the work in order to be more efficient;

8. 64,00 % of the teams communicated with the client or an expert to discuss about the creative project (division headings 3.4.2.9);

In chapter four, we have elaborated and experimented three Componential creative processes (from 2012 to 2014) based on the selection made in this chapter.

CHAPTER 4

CREATIVE PROCESSES: DESIGN, EXPERIMENTATION

4.1 Reminder of the research status

The analysis of the secondary data made by ESTIA researchers from 2007 to 2010 that we made in chapter 3 of this research showed us that most participants who filled the questionnaires (80,79 %) used the proposed project life cycle steps. We demonstrated that those steps were similar to the one of the CPS Thinking Skills model creative process (of Puccio, Murdock and Mance, 2005). We discussed the fact that ESTIA participants had to follow those steps since the questionnaire structure did not give them other choices: From those who filled the ESTIA questionnaires, 98,57 % used it. In this chapter 4, we experiment different types of creative processes that we chose among the 39 existing in chapter 3 of this research and that participants were free to use or not. Doing that, we try to find what participants used or did not use. We found that existing creative processes were not designed for a short ideation session like The 24 Hours of Innovation. So, we created a new creative process (a component type) and experimented it.

Regarding other creative components, 70,00 % of ESTIA participants (who filled questionnaires) used creativity tools from 2007 to 2010. When they did so, they used only one creativity tool, the Brainstorming. In our experiment in chapter 3, we proposed many creativity tools chosen among the 615 existing, in order to know if participants would use more creativity tools as it was the case from 2007 to 2010, and which one. We created a new type of creativity tools made of simplified existing ones (we called them “mini creativity tools”) since many creativity tools were not “packaged” to be used in short ideation sessions.

From the ESTIA questionnaire, we could not know if they had used other creative components since it was not made for that purpose. In chapter 2, we chose the creative component as part of our methodology for this research. We chose the Improvisational componential creative process of Fisher and Amabile (2009) for its component approach, by which the steps of the traditional creative process become a component of their componential

creative process. For us, the Improvisational componential process of Fisher and Amabile seems to be the most complete creative process, because it contains many creative components like team preparation and risk management. Even so, no creativity tools were included. We experimented other creative components like team preparation, risk management, eco design tool, creativity guide and chronological guide to find out that participants appreciated to use many of those different creative components. We had many other creative components in the componential creative process we had created and experimented them.

Our field of experiment for primary data results from 2012 to 2014 is The 24 Hours organized by ÉTS at Montreal with sites of participants on four continents.

4.2 2012 experiment on creativity tools and processes

In 2012, all the data we found in relation with creative processes and tools used in a short ideation session were secondary data collected by ESTIA researchers during The 24 Hours from 2007 to 2010. Even there, participants did not use a creative process but steps adapted from a life cycle process. We have demonstrated the similarities between this life cycle process with the CPS Thinking Skills Model of Puccio, Murdock and Mance (2005) in chapter 3. In that same chapter 3, we have done a selection of creative processes to experiment them. But, as explained, we did not find creative processes specifically made for short ideation sessions. We selected creativity tools to experiment, having an idea of the time they needed to be learned and used from analysis made by many researchers.

4.2.1 Creative process

We wanted to test a complete Creative Problem Solving process version as explained in chapter 3, describing how we chose the creative process for the creativity guide. So we chose the Thinking Skills Model of Puccio, Murdock and Mance (2005), which is a three phases and six steps linear process.

As discussed earlier, for each step (among the 6) of the process, there were two times: a convergent time and a divergent one. Carrier and Gélinas represented this association as shown in table 4.1.

Table 4.1 Divergent and convergent times of Guilford (1967) associated with the six steps of the CPS Thinking Skills Model as reproduced by Carrier and Gélinas (2011, p. 121.)

3 PHASES	6 STEPS	2 TIMES
CLARIFICATION	Exploring the vision	Divergent
		Convergent
	Formulating challenges	Divergent
		Convergent
TRANSFORMATION	Exploring ideas	Divergent
		Convergent
	Formulating solutions	Divergent
		Convergent
IMPLEMENTATION	Exploring acceptation	Divergent
		Convergent
	Formulating a plan	Divergent
		Convergent

We have demonstrated the analogies of this CPS version with the process used by the participants at ESTIA from 2007 to 2010 in chapter 3. We knew that 85,00 % of the winners teams had used this kind of process in a non-linear way (15,00 % in a linear way) and supposed that the participants of the 2012 edition may decide between those two approaches.

We thought it would be useful for participants to use the convergent and divergent times of Guilford (1967), included in the CPS Creative Thinking Skills model.

4.2.2 Creativity tools

We had a total of nine creativity tools proposed, associated with the steps and times of those steps (table 4.2).

Table 4.2 Nine creativity tools associated with steps and times in 2012

6 STEPS	TIMES PER STEPS	CREATIVITY TOOLS PROPOSED
1. Exploring the vision	Divergent/convergent	Target future
	Divergent/convergent	5W and H
2. Formulating challenges	Divergent/convergent	Is - Is not
3. Exploring ideas	Divergent	Brainstorming
	Convergent	SCAMMPERR
4. Formulating solutions	Convergent	The Yellow Box
5. Exploring acceptation	Divergent/convergent	Delphi
6. Formulating a plan	Divergent/convergent	Action plan
	Divergent/convergent	Project management

Those creativity tools were selected from the list of creativity tools classified and explained in the third chapter of this research.

Since it was our first experimentation, we decided to experiment only three componential components: A creative process, creativity tools associated with the creative process steps and a creativivty guide explaining how to use the creative process, the nine creativity tools and the creative process used in conjunction with the creativity tools associated (appendix III). We wanted to know if participants would use those creative components and if so, would the components help them to find creative solutions in a short ideation session done during The 24 Hours? We named this selection “The Componential Process - Basic Version” (figure 4.1).

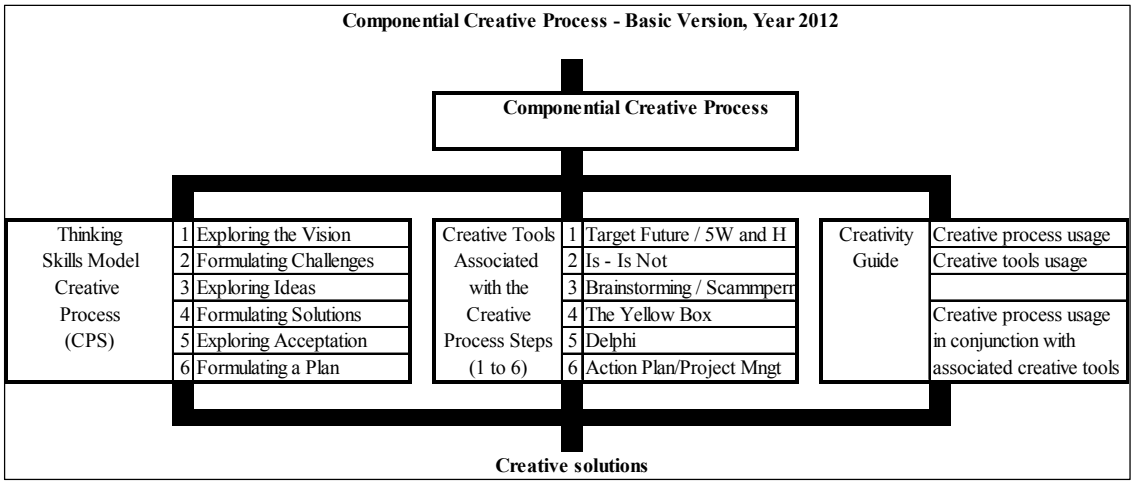


Figure 4.1 Content of the 2012 componential creative process – Basic version

The creative process, creativity tools and the creativity guide were available on a website in French. But only the creativity guide was also available in English.

4.2.3 Questionnaires and Website data

We had several means of collecting data in 2012: Nine questionnaires and websites data collected by *Wordpress*™ Stats and *Innokiz*™ collaborative Web platform (appendices VI and XII). ÉTS ambassadors at Antel site in South America also helped us collecting data.

4.2.3.1 Questionnaires

Questionnaires and consent forms were numerically created using Google Forms™ and accessible on the Web. Results were automatically compiled on Google™. We received an approval for the ethical plan submitted to the ÉTS Ethical Review Board (appendix I). For 2012, researchers agreed to try questionnaires every three hours, representing 9 questionnaires from hour 0 to hour 24 (0h, 3h, 6h, 9h, 12h, 15h, 18h, 21h and 24h). The 3h questionnaire is found in appendix VI.

4.2.3.2 Website data

On May 2012, we were able to know the number of views for the Creativity guide page in French and English, the creative process page in French and the creativity tools page in

French too, with *Wordpress*™ Stats[23]. Participants had to register on *Innokiz*™ Web platform. The number of views will give us an idea on how a specific web page was consulted during the month of the competition (table 4.3).

4.2.4 Publicity

To the participants who registered on *Innokiz*™, we sent the consent form, questionnaires Web address and an invitation to use the creativity guide on the Web from which hyperlinks were given to access the creative process and creativity tools pages. This guide was also publicized on the main 24 Hours Website and on *Innokiz*™ Web platform.

4.2.5 Results

4.2.5.1 Web data

In 2012, we had 882 participants from 17 sites around the world who registered (data collected by the *Innokiz*™ website). From the *Wordpress*™ Stats site, we found that the creativity guide page was viewed 122 times as shown in appendix XI. The creative process page was viewed 96 times, and the creativity tools page, 48 times.

Table 4.3 2012 Creativity guide, creative process and creativity tools web consultation results

Consultation Results May 2012	**Number of views per language**		**Total number of views**
	French	**English**	
Creativity Guide	84	38	122
Creative process	96	-	96
Creativity tools	48	-	48

[23] For *Wordpress*™, "a view is counted when a visitor loads or reloads a page. A visitor is counted when we see a user or browser for the first time in a given period (day, week, and month)". Their statitistic tool does not allow knowing the number of visitors for a specific article on a page (like the creativity tool pages for example) (*Wordpress.com*, 2015).

We did not expect such a low consultation of the creativity guide, creative process and creativity tools wep pages: We had no questions on our questionnaires to know why participants did not use it. We made group interviews at the end of the event (hour 24) with the four teams at ÉTS and the 12 teams at Antel site in Uruguay, representing 92 participants (10,43 % of all participants) and asked them why they had not used the creative process and creativity tools associated. They told us that they did not have time during the competition to learn how to use the creative process and to use it afterward. It was the same reason for the creativity tools, which, for most of them, were not known. Participants knew how to use Brainstorming; they used it. Some also knew how to use Mind Map and Project management as shown on the 2012 questionnaire results.

4.2.5.2 Questionnaire

We used the questionnaire completed at hour 3 on which participants described the creativity tools and processes they used during their ideation session. We had 66 teams (representing 439 participants, 49,77 % of all participants) who filled that questionnaire. Participants mentioned that they used the creativity tools Brainstorming, Mind Map and Triz. Regarding the use of a creative process, participants did not mention that they used the CPS creative process proposed. They also used Project Management to plan the work. We were not able to collect representative data to know how many used those tools[24].

At the 24th hour, we discussed with teams in Montreal and at the Antel site in South America (16 teams of 136 participants) to know why participants at those sites did not use the creative process and tools of the creativity guide. They told us in summary that they did not know those tools and processes and did not have time to learn them considering that they just had 24 hours to find a creative solution to the problem chosen.

[24] The choice of answers for the question relative to creativity tools and processes was open questions. Results obtained were considered not valid compared with the results of previous years. As an example, Brainstorming was used by 20,27 % of the participants. This creativity tool was used in previous years by more than 90 % of the participants.

4.2.5.3 Analysis of the results

Many reasons may explain why the creative process and creativity tools were not used: We should have translated the creative process and creativity tools page in English. But the fact that only 38 participants consulted the English version of the creativity guide, indicated us that it would not have really changed the results by much. We may have done more publicity to let participants know that this componential creative process was available: Montreal and Antel site participants may have known the existence of this componential creative process due to the fact that researchers and ambassadors were at their sites. Would they knew about it if somebody from our research organizations would have not told them? We do not know. But what we knew was that time to learn and use creativity tools and process was a problem in a context of a short ideation session. Regarding the time it takes to learn how to use the creative process and tools, would a coach that could teach them how to use those creative components during the event solved that problem? We decided to try that solution during the 2013 event.

4.3 2013 Componential Creative Process – Extended version

Knowing that many participants did not, firstly, use the componential creative process made, secondly, consult the creativity guide, and thirdly, use the two creative components made available (a CPS creative process and creativity tools associated), we still thought this componential creative process made contained components which could help The 24 Hours participants to find creative solutions during short ideation sessions. Lack of choice could also be a reason of those results. For 2013, we modified the componential creative process – basic version made, by adding two other creative processes following our plan of implementation decided in 2012: To the CPS linear process, we had an intuitive creative process and a componential creative process (figure 4.2).

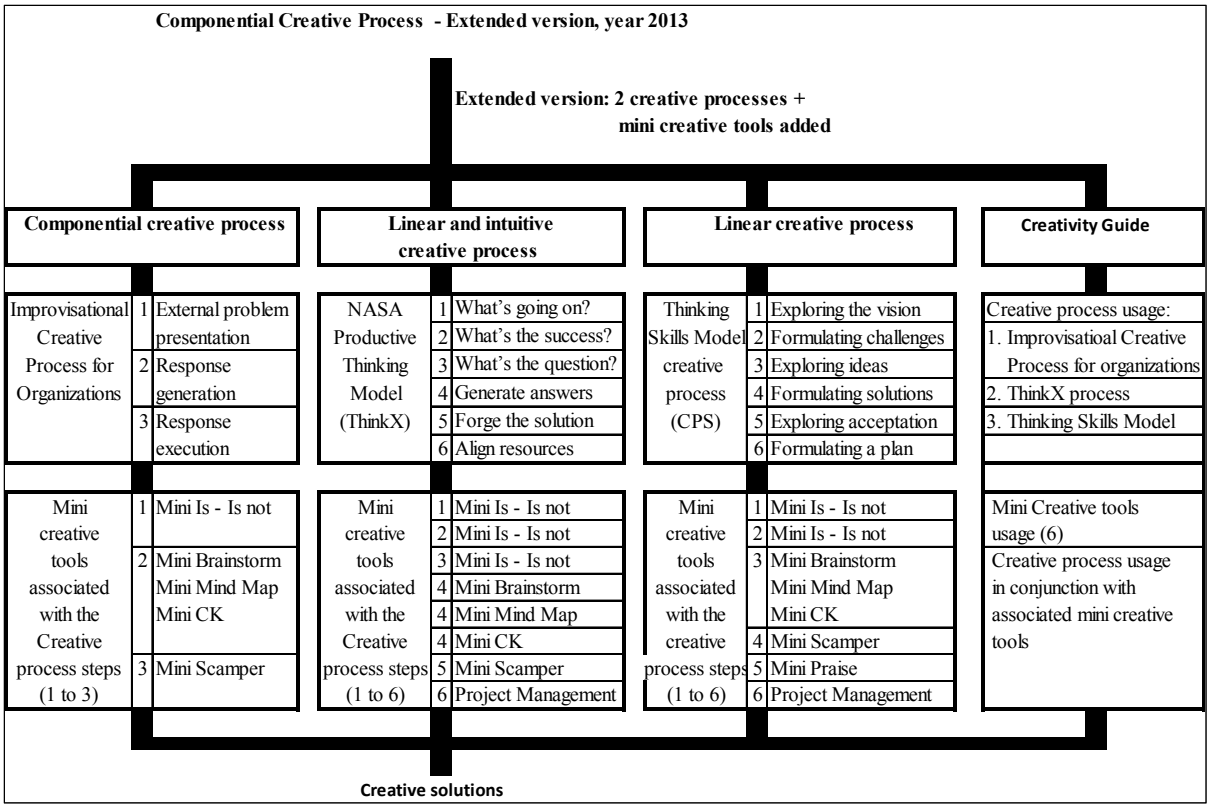


Figure 4.2 2013 componential creative process – Extended version

4.3.1 Creative processes

To the CPS Thinking Skills, we added the Productive Thinking Model (ThinkX) created by Hurson in 2007. It is not a creative process made for short ideation sessions. As explained in chapter 3, we did not find a creative process especially designed for short ideation sessions.

We also chose the componential creative process of Fisher and Amabile (2009). As explained in the methodology section of chapter 2, the creative process is considered as one of the components of this process, which was created for improvisation, an ideation session duration shorter than what we defined in this research (three to eight hours duration during The 24 Hours).

This componential creative process has many other components: Preparation, expertise, risk-relevant processes, intrinsic motivation and work environment, but no creativity tools associated. For 2013, we retained only the creative process component and added creativity

tools and a creativity guide. We thought creative processes and tools were the most important components to help participants in 2013.

4.3.2 Mini creativity tools created

In 2012, participants told us that the time required to learn and use creativity tools was too long for them. So, we searched, from the list we analyzed, some that would require less time. But this new list of creativity tools would have been composed of tools unknown to most of the participants. We were not sure they would be used by participants. A new list without known creativity tools like Brainstorming, Brainwriting, Mind Map and other "classic" creativity tools did not sound like the best ideas for colleagues and participants we consulted. So, we decided instead to try to simplify creativity tools, removing what could be cut in their explanation or steps in order to make them easier to learn and use without affecting their efficiency (table 4.4). We named this new category of creativity tools, "mini creativity tools". We added a short video to those mini creativity tools to explain how to use them.

We compare in table 4.4 the explanation content of one mini creativity tool (mini statement) with the one of the original creativity tool named "Problem Statement" (all the mini creativity tools are detailed in appendix VIII) to demonstrate how we have created them.

Table 4.4 Mini creativity tools compared to the original creativity tools (2013)

Creativity tool	**Mini creativity tool**
Problem Statement (Straker, 2015) When to use it How to use it: 7 steps procedure An example of a problem solved with it How it works: a synthesis of this creativity tool 2.25 Microsoft Word™ equivalent pages of explanation	**Mini statement** A 4:39 minutes video explaining it How does it Work: Resume of the 7 steps 0,5 Microsoft Word™ equivalent pages of explanation

We created six mini creativity tools. We associated them with the steps of the three creative processes proposed, as illustrated in figure 4.3.

Linear creative process		
Thinking Skills Model creative process (CPS)	1	Exploring the vision
	2	Formulating challenges
	3	Exploring ideas
	4	Formulating solutions
	5	Exploring acceptation
	6	Formulating a plan
Mini creative tools associated with the creative process steps (1 to 6)	1	Mini Is - Is not
	2	Mini Is - Is not
	3	Mini Brainstorm Mini Mind Map Mini CK
	4	Mini Scamper
	5	Mini Praise
	6	Project Management

Linear and intuitive creative process		
NASA Productive Thinking Model (ThinkX)	1	What's going on?
	2	What's the success?
	3	What's the question?
	4	Generate answers
	5	Forge the solution
	6	Align resources
Mini creative tools associated with the Creative process steps (1 to 6)	1	Mini Is - Is not
	2	Mini Is - Is not
	3	Mini Is - Is not
	4	Mini Brainstorm
	4	Mini Mind Map
	4	Mini CK
	5	Mini Scamper
	6	Project Management

Componential creative process Creative process component		
Improvisational Creative Process for Organizations	1	External problem presentation
	2	Response generation
	3	Response execution
Mini creative tools associated with the Creative process steps (1 to 3)	1	Mini Is - Is not
	2	Mini Brainstorm Mini Mind Map Mini CK
	3	Mini Scamper

Figure 4.3 Mini creativity tools proposed for the steps of the three creative processes in 2013

Half of the six mini creativity tools were associated with the "ideas generation" step of the creative processes: We noted that, the years before, participants used creativity tools for this step; mainly, Brainstorming, Mind Map and CK.

For the steps equivalent to "generate solutions", we proposed a shorter version of the original Scamper creativity tools (Scammperr used the year before was an enriched version of Scamper). For the steps associated with vision, challenge and problems definition, we proposed just one mini creativity tool: A simplified version of Is – Is not. We kept project management since it was used the years before to plan projects and solutions. Since many engineers had followed courses on project management in their undergraduate study, we did not make a mini project management tool of it.

4.3.3 Creativity guide

We developed again a creativity guide with, this time, an explanation on how to use the three creative processes chosen, the six mini creativity tools created, and the creativity tools in association with each creative process explained in the creativity guide (appendix XV).

For the ThinkX creative process, we explained mainly the linear part in the creativity guide without adding explanations for its intuitive counterpart. This creative process composed of the linear and intuitive types would have become too complex to understand if we had decided to explain both. We had the opportunity to teach that creative process to students before The 24 Hours. We found that teaching it without explaining the intuitive part was a good way to learn it: The intuitive part is added naturally when students start to use it. It is also the way Tim Hurson, the inventor of ThinkX, presents it (*ThinkX*, undated).

4.3.4 Questionnaires and data

We had several means to collect data in 2013: A questionnaire every hour of the 24 and Website data collected by *Wordpress*™ Stats and *Innokiz*™ collaborative Web platform (see appendix XI).

4.3.4.1 Questionnaires

ESTIA researchers collected data every hour: In 2013, we had new members in our teams doing research and collecting data. We decided to do hourly numerical questionnaires: A version in French and another one in English. We also changed our way to collect data: We asked that each team named a secretary to fill the research questionnaires instead of asking every one in the team to do so. We renewed the ethical plan submitted to the ÉTS Ethical Review Board, valid this time for 2013 and 2014 competitions (appendix I).

For the first questionnaire, we asked team leaders and ambassadors to: 1. Coach their team on how to use the creativity guide, tools and processes; 2. Observe teams which had decided to use the guide without coaching; and / or 3. Observe teams which had used their own approach. We gave to team leaders and ambassadors the possibility to fill those questionnaires numerically or on a paper form. We made training sessions a week before the

24 Hours to teach ambassadors and some team leaders from ÉTS who had organized teams to participate at the event on how to use the Componential creative process – Extended version, and we explained them how to fill questionnaires to facilitate data collection. We had five participants (researchers) who joined a team to participate to The 24 Hours at ÉTS to coach team members when required. We had also two researchers trained to teach the creativity guide in other sites: One in South America and the other in China.

4.3.4.2 Web data

As in 2012, *Wordpress*™ Stats gave us the number of views for the Creative process page, mini creativity tools pages and creativity guide in French and English languages on May 2013. Participants had to register on *Innokiz*™ Web platform to be able to participate to the competition.

4.3.5 Publicity

To the participants registered to *Innokiz*™, we sent them again in 2013 the consent form and questionnaires, Web addresses and an invitation to use the creativity guide on the Web. The guide was also publicized on the main 24 Hours of Innovation website and on *Innokiz*™ Web platform.

4.3.6 Results

4.3.6.1 Web data

In 2013, we had around 1000 participants from 17 sites around the world registered to participate at The 24 Hours from the data collected by the *Innokiz*™ website. The creativity guide page was viewed 153 times according to *Wordpress*™ Stats tool, a result which was similar to the one of 2012 where the creativity guide was viewed 122 times. Mini creativity tools page was seen 142 times, approximately three times more than in 2012 where this page was viewed 48 times. Creative processes page was consulted only 45 times, around two times less than the 96 times of 2012.

Table 4.5 2013 web data consultation results

Consultation Results May 2012	Number of views per language		Total number
	French	English	of views
Creativity Guide	109	44	153
Creative process	45	-	45
Mini creativity tools	101	41	142

4.3.6.2 Questionnaires

We used the 9th hour questionnaire (see appendix VI), a summary of the creativity methodologies used. It was filled by 20 secretaries representing 162 participants (table 4.6).

Table 4.6 Creative methodologies analysis of their use by the participants in 2013

Creative methodologies used by 19 teams	Total
Creative Guide used	15 No[a]
Creative process	8
Mini Brainstorm	9
Mini Mind Map	6
Mini Statement	5
Mini Praise	3
Mini Is - Is not	2
Mini Scamper	2
Mini CK	1
Sub total Mini creative tools	2,69[b]
Mini creative tools helped	
Brainstorm	6
Mind Map	2
Project management	2
Scamper	1
Sub total creative tools	0,67[c]
Total mini and creative tools	1,90[d]

Comments

[a] The number of teams who consulted the creative guide was 2; 15 teams didn't consult it.

[b] Mean value of the number of mini creative tools used by the teams who used them.

[c] Mean value of the number of creative tools used by the teams who didn't used mini creative tools.

[d] Mean value of the total number of creative tools used (creative and mini creative tools) by the teams.

Table 4.6 summarizes the data collected from 20 secretary's teams who filled the questionnaires.

Only 2 teams on a total of 17 (11,76 %) consulted the creativity guide. For the mini creativity tools page, 14 teams on 20 (70,00 %) consulted it. Teams which consulted that page used a mean of 2,69 mini creativity tools compared to 0,67 tools for the 6 teams that did not use mini creativity tools but, instead, classic ones like Brainstorming. From those 14, 9 (64,29 %) found that the mini creativity tools helped them to achieve their creative activities. A total of 18 teams on the 20 that filled questionnaires (90,00 %) used creativity tools.

Regarding the type of creativity tools used, we grouped in table 4.7 the creativity tools used by their popularity for the 20 teams that filled the questionnaires.

Table 4.7 Creativity tools classified by their popularity in 2013

Type	Mini creativity tools	Creativity tools	Total	% of teams which used them
Brainstorm	9	6	15	75,00
Mind Map	6	2	8	40,00
Problem statement	5	0	5	25,00
Praise	3	0	3	15,00
Scamper	3	0	3	15,00
Is – Is not	2	0	2	10,00
Project management	-	2	2	10,00
CK	1	0	1	5,00

Regarding the 3 creative processes, 8 teams on 20 (40,00 %) indicated that they used a creative process without mentioning which one; 4 teams that used a creative process used it with mini creativity tools and 4 other without. So, from the 14 teams that used mini creativity tools, only 4 (28,57 %) used them in association with a creative process. We did not know if they consulted the creative processes page or the creativity guide or the mini creativity tools page, since we did not know which creative processes they used.

We found that 92,16 % of the 15 questions asked in the questionnaire were filled and received many comments.

At the end of the competition, we discussed with coaches of teams in Montreal and ambassadors at the Antel site in South America and in China (19 teams of 160 participants) in order to have a feedback on the creativity guide, the creative processes and mini creativity tools usage by their participants. In summary, they told us that the publicity of those guide and methodologies was deficient and ambiguous: Probably a reason why the creativity guide was not used. Participants found creative processes too long to use even after coaching. Mini creativity tools were well received, participants told us that they were easy to learn and use.

4.3.6.3 Accuracy of our sampling size

We used the Sampling size calculator of the National Statistical Services of the Australian Bureau of Statistics (Government of Australia, Undated) for the Web questionnaire. Our sampling size of 162 participants for a population of 1000 gave us, for a confidence level of 95 %, a standard error of 0,07074 considering a proportion of 0,5. This calculation was done considering that we had a simple random sampling, which Statistics Canada (2014) defines valid when “each member of a population has an equal chance of being included in the sample”.

4.3.6.4 Analysis of the results

We probably found a good solution for the time restraints when we created and proposed mini creativity tools. Fourteen teams on 20, which filled the questionnaire, consulted that page and used a mean number of 2,69 creativity tools compared to only 0,67 creativity tool for those who did not consult it. The difference may be explained by the fact that participants had learned to use new creativity tools. Considering that we proposed them seven creativity tools among which many participants probably knew at least one or two creativity tools (Brainstorm, Mind Map and Project management technique[25]), they may have decided to try

[25] Project management technique is not a creativity tool. Since it is considered as a tool to help formulating a plan, we did not make a special category for that tool and prefered to add it to the creativity tool.

one or two new creativity tools. It is interesting at this stage of our experimentation to see that those mini creativity tools were used.

If we take into account that the mini creativity tools Web page was viewed 142 times, does that mean that just a few participants looked that mini creativity tools pages? An explanation could be that participants used just a few number of computers to consult them. But at this stage, we cannot explain that difference in these data. The verbal feedback made by participants of 19 teams from sites in ÉTS (Canada), Antel (Uruguay) and Utseus University (China) at the end of The 24 Hours of year 2013 was good: They found those mini creativity tools easy to learn and use.

With those results and their interpretation, we decided to propose again, in 2014, mini creativity tools at the place of creativity tools to get more results that may clarify that divergence in the data.

Results for creative process usage was quite confusing: The creative process was only consulted 45 times but 8 teams on 20 (40,00 % of the participants) told us that they used a creative process. The questionnaire results did not mention which one they used. From those 8 teams, 4 used them with mini tools associated and 4 without. A possible explanation of the difference usage expressed in the results may be that some participants may not know the difference between creative processes and creativity tools. We made this observation when we gave a creativity management course to around 50 graduate students at ÉTS in 2012 and 2013. Most of the participants in that course did not know the difference between creativity tools and creative processes before the course.

Verbal feedback from the teams at the end of the event was similar to the verbal feedback of 2012 regarding creative process: Those proposed took too much time to be learned and used. Coaching was not a solution to the problem.

4.4 2014 Componential creative processes elaboration

4.4.1 A different approach

In 2014, following the results obtained in 2012 and 2013, we decided to modify our approach. Instead of using existing creative processes and creativity tools, we elaborated a new componential creative process inspired by the Improvisational creative process for organizations of Amabile and Fisher (2009) made for improvisational creativity sessions with components required for a short ideation session, and by Basadur CPS Simplex creative process (1994). Since the componential creative process created by Fisher and Amabile used as a methodology for this research, we decided in 2014 to experiment a team preparation component in our componential creative process to know how useful The 24 Hours participants would find it. We continued to propose creativity tools associated with creative processes as Basadur (1994) had done, except that, in our case, it was mini creativity tools.

We added a new component never seen in any creative process consulted: A chronological guide component. We will explain its use in the appropriate heading.

As in previous creative processes experimented, we maintained the creativity guide component to facilitate the usage of all creative process components (figure 4.4). Again, this component was not part of creative processes reviewed in this research. We recall that participants told us in 2012 and 2013 that creative processes were too long to learn. Without a creativity guide, they would need to search instructions on the web on how to use them, since creative processes knowned do not usually come with instructions. Again, the time factor is an important justification for this second new component created (the creativity guide) and added again in the componential creative process in 2014. But for those components, the best judge to determine if they should be part of a componential creative process remain the participants: They would tell us if we were right or wrong regarding those new components added.

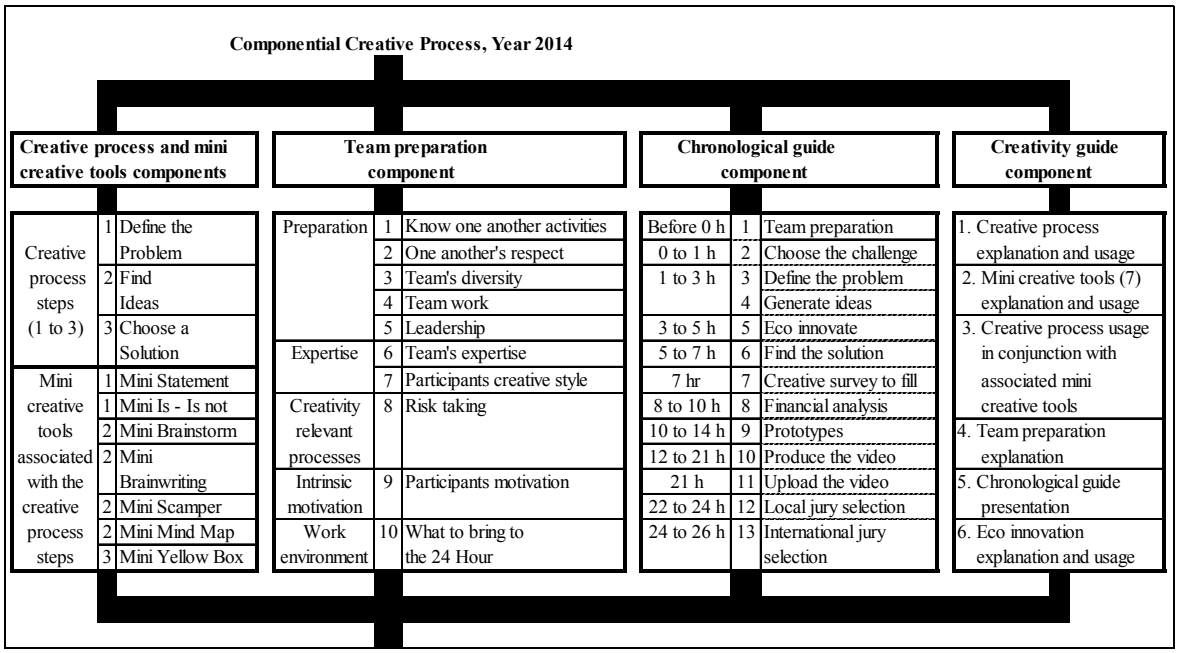


Figure 4.4 Content of the componential creative process elaborated in 2014

4.4.2 Creative process component

During years 2012 and 2013, we tried existing creative processes even if we knew that they were not specifically made to be used in short ideation sessions. In 2013, we made mini creativity tools as a creative component to be used and many participants used them (90,00 %, from the questionnaire data). But creative processes from 2012 till 2014 did not seem to be useful[26]. From 2007 to 2010, ESTIA data indicate that most of the participants followed life cycle steps similar to a linear creative process. Whitout a questionnaire structured with those life cycle steps, we do not know if they would have used it.

When we gave creativity course to undergraduate and graduate students from 2010 to 2013, we found that participants intuitively did three steps when they wanted to find a creative solution to a problem: Define the problem, find ideas and choose the solution. The advantage from our point of view of expressing those three steps in a creative process is that team members will know on which steps they were working. We explained them that it was more efficient to know who was working on what step of the process than letting participants work

[26] The creative process page was consulted by 10,88 % of the participants in 2012 and 4,50 % in 2013.

on those steps without a “structure” process. Without a creative process in a team, some participants may work to define the problem when others would be already working on a solution without knowing that the problem definition is not yet clarified. We thought a creative process was useful especially in short ideation sessions, but we may have been wrong. To clarify that point, we proposed again a modified creative process component.

We decided to propose a three phases creative process based on the creative process component of the improvisational creative process for organizations of Amabile and Fisher (2009) but with simplier sentences. The creative process component elaborated was the simpliest one proposed during The 24 Hours (table 4.8):

Table 4.8 Sentences change made at the Improvisational creative process for organizations in 2014

Fisher and Amabile (2009) componentail creative process steps	**The creative process steps used in 2014 in the componential process proposed**
1. External Problem Presentation	1. Define the Problem
2. Response Generation	2. Find Ideas
3. Response Execution	3. Choose a solution

4.4.3 Mini Creativity tools component

Since creativity tools are mostly appreciated to find ideas, we decided to propose seven mini creativity tools for the following steps: Two to “Define the problem”; four mini creativity tools to “Find ideas”, and one to “Choose a solution” (see figure 4.5).

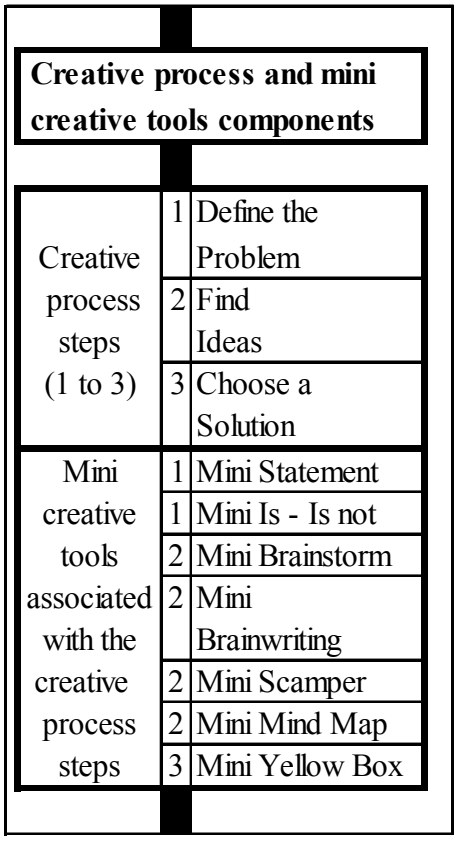


Figure 4.5 Mini creativity tools associated with three process steps in 2014

4.4.4 Chronological guide

As said previously, the chronological guide was a new component we brought in 2014. We never saw this kind of component in any creative process we consulted. Data was inspired by secondary data analysis of ESTIA researchers from 2007 to 2010 in chapter 3 (figure 4.6). We noticed that, from 2010 to 2014, many teams finished the competition knowing that their time management was faulty: Per example, too much time was spent to choose the challenge and not enough to present the solutions or too much time for the ideation session and not enough for the presentation. Since many participants attended The 24 Hours for the first time every year, we taught that a chronological guide could help them to manage their project. For us, this chronological guide component is justified considering that our componential creative process is made for short ideation sessions where time is a critical factor.

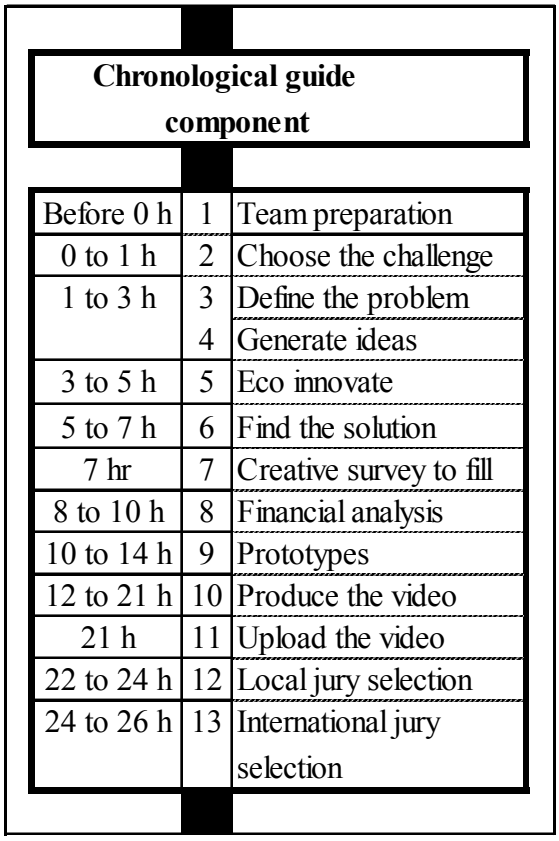


Figure 4.6 Steps included in the chronological guide in 2014

The steps included in the chronological guide were inspired by the life cycle steps followed by 2007 to 2010 winning teams and by the organizing team members experience since 2010 at ÉTS. It does not mean that teams had to do all the steps of the chronological guide; it was a proposal knowing that teams do whatever they wanted. Steps could be done by all the team members or by some of them, depending on their project planification. They were the following:

4.4.4.1 Team preparation

Team preparation refers to the team preparation components included in the componential creative process (presented below). This component helps participants to become a team. Normally, team preparation is done before the event but for teams not prepared or made just

before the event starts, it could be done during The 24 Hours. In that last case, it may take an hour or less.

4.4.4.2 Choose the challenge

As explained in chapter 2 of this thesis, participants of The 24 Hours have to choose a challenge to work on from a list of around 20 challenges presented during the first 15 minutes of the event. Choosing a challenge is important: Team members need to have the expertise and experience in order to be able to find a creative solution to a problem. They need to choose a challenge that they could solve "creatively" to have a chance to win the competition. The creativity guide had explanations for participants on this step.They needed time to make a good choice but could not spend too much time for that. We suggested them to take an hour to do it.

4.4.4.3 Define the problem

The 24 Hours organization teams gave a short explanation of the challenge at the beginning of the event. Teams needed to define the problem so that all team members would understand it the same way. For that, they may discuss with a representative of the company which proposed the problem. The creative process, mini creativity tools associated with this step and the creativity guide are creative components available to help participants to do this step. Teams may also take only a part of the problem considering the time allowed to find a creative solution (24 hours).

4.4.4.4 Generate ideas

To generate ideas, team participants may do ideation session in the team, in small teams or alone, using mini creativity tools. They may search ideas on the Web, in books, discuss with other participants teams, etc. They needed to generate a list of ideas with enough creative ideas to do the next step. The creative process and mini creativity tools associated to this step and the creativity guide are creative components made available to help participants to do this step. We suggested two hours to define the problem and generate ideas.

4.4.4.5 Eco innovate

We invited participants to eco innovate following an eco-innovation process created by the Ph.D. Student of ÉTS Ahmed Cherifi (appendix XIII), based on the TRIZ creative process. The method uses different tables to help participants include environmental concepts. So, they could modify ideas found on the previous step. We suggested two hours for that.

4.4.4.6 Find the solution

With ideas generated and eco innovation done, participants had to choose what they thought would be the best solution. They may consult the client representative and the evaluation criteria that The 24 Hours international judges committee used to evaluate solutions proposed by the participants. The creative process and mini creativity tool associated with this step and the creativity guide were creative components made available. We suggested two hours.

4.4.4.7 Creative survey to fill

We asked teams members to name a secretary to represent their teams. At the 7^{th} hour, we asked those secretaries to fill research questionnaires made by the researchers like us who used The 24 Hours as an experimental field. Questionnaires were available on the Web and the acceptance form gave explanation on how to use the data collected with them.

4.4.4.8 Financial analysis

The solution found could seem interesting, but could not be the best choice if we considered the financial aspect. We proposed to do a financial analysis to make sure that their chosen solution was feasible and, if not, to review their solution. In 2014, we did not have tools or guide to help them do this step. We suggested two hours for this step.

4.4.4.9 Prototypes

To mature their solution and demonstrate that their solution was creative and feasible, making a prototype was useful. Participants could use 2D and 3D software or make a prototype using materials like cardboard. In 2014, we did not have tools or guide to help them do this step. We suggested four hours for this step.

4.4.4.10 Produce the video

As explained in chapter 2 of this thesis, teams had to do a two minutes video to present their solution. In 2014, we did not have tools nor a guide to help them do this step. We suggested nine hours for that.

4.4.4.11 Upload the video

Uploading the video on Youtube™ Web site was an important step to do at the right time since it could take time. The ÉTS 24 Hours Web site gave explanation on how to do it. We recommended to do that not later than the 21st hour.

4.4.4.12 Local jury selection

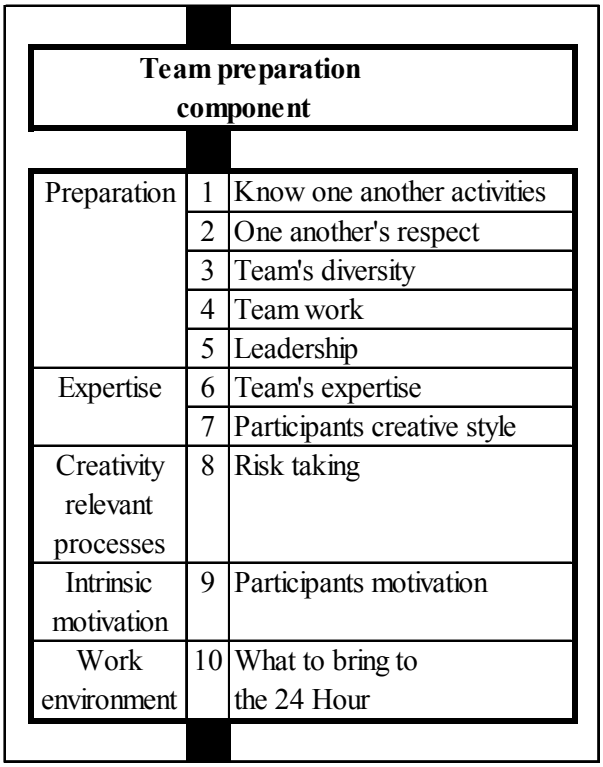
Local jury selection step included in this guide was only to inform the participants that local juries would begin their selection at the hour 22 to define the three best local prizes. Local organizations sent the first prize winning team video URL to the international organization at ÉTS as per instruction given on the ÉTS 24 Hours website.

4.4.4.13 International jury selection

The international jury started to select the best projects at the 24th hour at ÉTS for a process planned to last till the 26th hour.

4.4.5 Adaptation of the team preparation component of Fisher and Amabile (2009)

Team preparation is a creative component considered essential for Fisher and Amabile (2009, p. 20), like the creative process shown in chapter 2, figure 2.3. In the "Team preparation component" of the Componential creative process that we proposed to The 24 Hours participants in 2014, we included the following elements that we will explain to undestand why we chose them: 1. Know one another activities; 2. One another's respect; 3. Team's diversity; 4. Team work; 5. Leadership (see figure 4.6). In the creativity guide, we gave short advice regarding each of these points (appendix XV).



Team preparation component		
Preparation	1	Know one another activities
	2	One another's respect
	3	Team's diversity
	4	Team work
	5	Leadership
Expertise	6	Team's expertise
	7	Participants creative style
Creativity relevant processes	8	Risk taking
Intrinsic motivation	9	Participants motivation
Work environment	10	What to bring to the 24 Hour

Figure 4.7 Other creative process components and elements included in the 2014 creativity guide

The team preparation component of the Improvisational creative process for organizations of Fisher and Amabile (2009) regroups, we recall, five creative components, as shown in figure 4.7: Preparation, expertise, creativity-relevant processes, intrinsic motivation and work environment. For us, those components could also be regrouped, since they were all related to team preparation. That would facilitate the learning and usage of our own componential creative process. Then, as already seen in figure 4.4, our componential creative process had five components: Creative process, mini-tools, team preparation, chronological guide and creativity guide. We did not want it to have ten components.

In addition to Fisher and Amabile, the previous elements of the team preparation components came from other researchers like Woodman, Sawyer and Griffin (1993), Amabile *et al*. (1994), Amabile (1996a, 1996b, 1998, 2012), Amabile *et al*. (1996), Perkins Rodriguez (2002), Zhou and Shalley (2003), Amabile and Khaire (2008), De Stobbeleir, De Clippeleer and Dewettinck (2010), Hennessey and Amabile (2010) and Burroughs *et al*. (2011).

We included explanations for the team preparation component in the creativity guide (appendix XV), which were a synthesis of lectures made in the form of precise advice. So, for the element “Know one another activities” for example, we gave participants the following advice: “If team members do not know one another, do an activity to help them get to know, to trust and to work together”.

Risk management component was conducted by Thierry Zagre, PhD. Student at ÉTS, specializing in this domain with his thesis research.

4.4.6 Creativity guide component of the componential process

In 2013, only 15,30 % of the participants consulted the creativity guide website. At the end of the competition in 2013, participants in Montreal, Antel site in South America and in China (19 teams of 160 participants) told us in summary that the publicity of the creativity guide and its content was deficient and ambiguous. In 2014, we redid it completely. Figure 4.8 presents the first version (see appendix XV for the complete version).

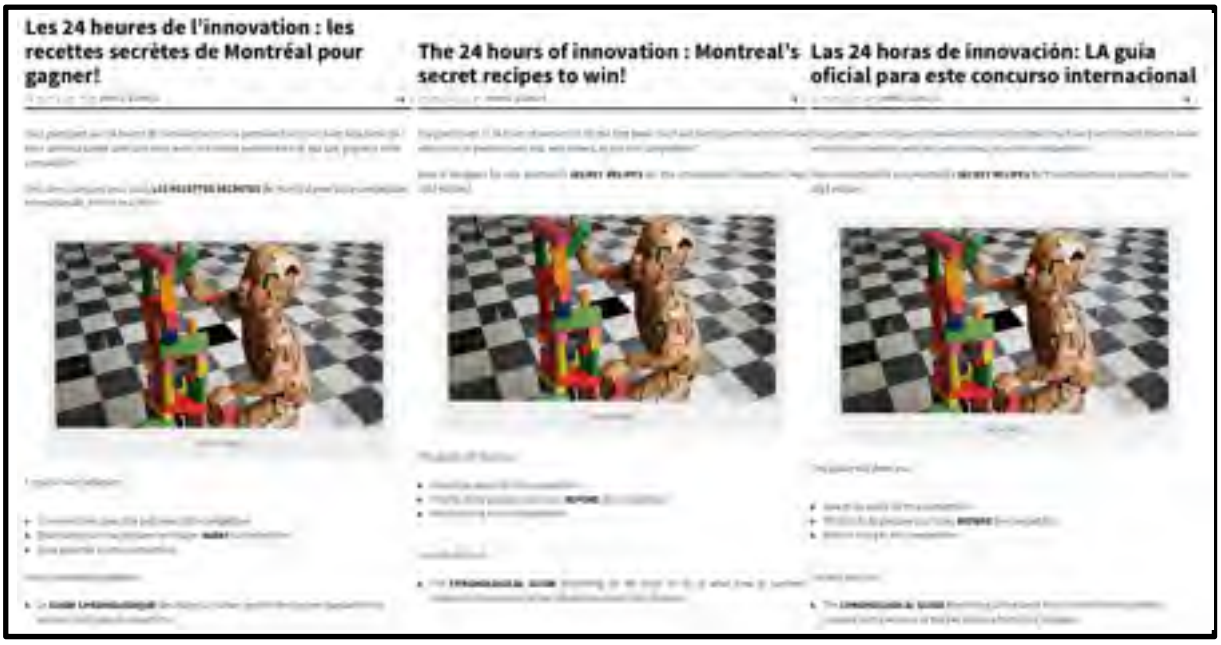


Figure 4.8 French, English and Spanish versions
of the first page of the 2014 creativity guide

The creativity guide had the following sections[27]:

1. How to be ready for this competition;
2. What to do to prepare your team before the competition;
3. What to bring to this competition;
4. The chronological guide;
5. Creative process and mini creativity tools (accessible by hyperlinks to distinct web pages to reduce the size of the creativity guide);
6. Eco conception guide (also accessible by hyperlink to a distinct web page);
7. Creativity questionnaires link.

We invited participants to consult the guide by e-mail five days before the event. As shown in figure 4.8, the creativity guide was available on a Web platform in French, English and, new in 2014, in Spanish. The guide was also publicized on *The 24 Hours* Website (which was also available in French, English and Spanish).

4.4.7 Questionnaires and Website data

We had several means to collect data in 2014: Two types of questionnaires, and website data collected by *Google Analytics*™, *Wordpress*™ *Stats* and *Agorize*™ website.

4.4.7.1 Questionnaires

For the year 2014, we decided to create two types of questionnaires (appendix VI): A first one (paper form and numerical) was to be filled by teams leaders at ÉTS and by a group of seven ambassadors who were at seven universities in Asia, Europe, North and south America (see table 4.9), and a second type of questionnaire to be filled numerically by the participants of The 24 Hours at the seventh hour. Those questionnaires were available in French and English.

[27] At the end of the creativity guide, we also put creative approach videos from École polytechnique de Montréal research colleagues.

Table 4.9 24 Hours sites participants in 2014

Continent	**Country (City) - University**
South America	Uruguay (Montevideo) – University *of* Montevideo Peru (Lima) – Pontifical Catholic University of Peru (PCUP)
Europe	Germany (Munich) – Technical University of Munich (TUM) Denmark (Aarhus) –Aarhus Universtiy
Asia	China (Shanghai) – Sino-European School of Technology of Shanghai University (UTSEUS)
North America	West Virginia (Morgantown) – West Virginia University United States, Florida (Melbourne) – Florida Tech

For the first questionnaire, we asked teams' leaders and ambassadors to:

1. Coach their team on how to use the componential creative process elaborated for 2014;

2. Observe the team which had decided to use the 2014 componential creative process without coaching;

3. Observe the teams which had used their own approach. We made training sessions a week before The 24 Hours to teach ambassadors and some teams leaders from ÉTS how to use the 2014 componential creative process, and we explained them how to fill the questionnaire to facilitate data collection.

4.4.7.2 Website data

With *Google Analytics*™, we were able to know the number of pageviews and unique pageviews[28]: in 2014, the creativity guide in French, English and Spanish was also analyzed

[28] For *Google*, "A *pageview* is defined as a view of a page on your site that is being tracked by the Analytics tracking code. If a user clicks reload after reaching the page, this is counted as an additional pageview. If a user navigates to a different page and then returns to the original page, a second pageview is recorded as well. […] A *unique pageview* […] aggregates pageviews that are generated by the same user during the same session. A

with *Google Analytics*™ (Respectively: Dubois, 2014b, c, a). With *Wordpress*™ *Stats*, we were able to know the number of views of the creative process page and the mini tools page in French, English and Spanish on May 2014. Pageviews for *Google Analytics*™ were identical to views for *Wordpress*™ *Stats*[29].

Unique pageviews are not visitors: *Google Analytics*™ defined two other categories on its statistics: Sessions that are "an estimate of the percentage of first time visits" and users that "had at least one session within the selected date range. Includes both new and returning users" (*Google*, 2015). Users represent visitors, but again, it may not be exactly the number of visitors, depending on the way *Google Analytics*™ calculates it (see appendix XII). But for our study, users, estimated with pre-calculated data, would be adequate for our estimation of the number of visitors. Unfortunately, *Google Analytics*™ does not give the users' statistics for pages, only for days, months or years. To see the difference between all those categories, the following table 4.10 gives the statistics calculated by *Google Analytics*™ for the month of May 2014 for *Substance ÉTS* website (English version) :

Table 4.10 *Google Analytics*™ statistics for *Substance ÉTS*
English version, for the categories calculated on May 2014

Categories	**Statistics**
Pageviews	5445
Unique pageviews	4666
Sessions	3240
Users	2287

unique pageview represents the number of sessions during which that page was viewed one or more times" (*Google*, 2015). As far as the total number is concerned, *IndianaTech* also says that, according to *Google Analytics*, a "pageviews is the total number of pages viewed. Repeated views of a single page are counted" and a "unique pageviews is the number of visits during which the specified page was viewed at least once. A unique pageview is counted for each *page URL + page Title* combination" (*IndianaTech*, 2015).

[29] For *Wordpress*, pageviews are "counted when a visitor loads or reloads a page" (*Wordpress.com*, 2015).

Participants had to register to the web platform *Agorize*™, which allowed us know how many participants attended The 24 Hours.

4.4.8 Publicity

The 2014 creativity guide presenting the componential creative process elaborated was available in French, English and Spanish versions five days before and during the event on The 24 Hours main website, on ÉTS website, ÉTS scientific news platform *Substance ÉTS*, on ÉTS and *Substance ÉTS Facebook*™ sites, on ÉTS and *Substance ÉTS Twitter*™ sites, on *Google+*™ *Substance ÉTS* site, on *Télé ÉTS*, a TV network placed near escalators at ÉTS university and in *Interface*, a webnews journal at ÉTS.

We would have liked to publish this guide earlier, but since this 2014 componential creative process had many new components (chronological guide, team preparation, mini creativity tools, eco-innovation guide, videos and a creativity guide) published on many platforms in French, English and Spanish, we were a bit short in time. We knew that the date of publication may have an impact on components usage like the component for team preparation for example.

4.4.9 Results

4.4.9.1 Web data

We had 1121 participants registered to participate at The 2014 24 Hours from the data collected by the *Agorize*™ website. Using web data from *Google Analytics*™, the creativity guide had 861 pageviews and 728 unique pageviews in May 2014 from the French, English and Spanish pages. The mini tools pages (French, English and Spanish) were viewed 471 times and creative process pages, 228 times, according to Worpress™ Stats (table 4.11).

Table 4.11 Consultation results on May 2014 from *Google Analytics*™ and *Worpress*™ *Stats*

Consultation Results May 2014	**French**	**Eng.**	**Spa.**	**Total**	**2012 total**
Creativity Guide pageviews (from *Google Analytics*™)	378	193	290	861	153
Creativity Guide unique pageviews (from *Google Analytics*™)	317	172	239	728	
Creative Process page (from *Worpress*™ Stats)	156	38	34	228	96
Mini Creativity tools page (from *Worpress*™ Stats)	228	93	150	471	48

The number of views (or pageviews) for the creativity guide was 861, results that were 5,63 times higher than in 2012 (with 153). We had an increase too in 2013 for creative process (2,38 times higher) and mini creativity tools page (9,81 times higher) compared to 2012. This increase on those three creative components was also visible in the questionnaires, as explained in figure 4.11.

4.4.9.2 Questionnaires

The paper questionnaire composed of 69 questions was filled by seven teams' leaders and four of the seven ambassadors (South America and China) representing 119 members of 13 teams. With it, we were able to collect data for 10,62 % of all the participants. The second type of questionnaire (numerical) was not used. Thanks to ambassadors and teams'leaders we trained, 86,73 % of the 69 questions were filled and received many comments, as table 4.12 allows to observe.

Table 4.12 Number of questions filled by teams in 2014 first questionnaire

Completed questionnaire (69 questions)	**Type of teams**													**Results**	
	1. Coached						2. Observed					3. Own Approach		Mean	%
Team #	1	2	3	4	5	6	7	8	9	10	11	12	13	59,85	86,73
# of questions answered	69	64	68	60	57	69	39	39	69	55	68	52	69		

4.4.10 Accuracy of our sampling size

We used again the Sampling size calculator of the Australian Bureau of Statistics (Government of Australia, Undated); our sampling size of 119 for a population of 1121 gave, for a confidence level of 95 %, a standard error of 0,04354 considering a proportion of 0,5 (considering also that we had a simple random sampling; Statistics Canada, 2014).

4.4.11 Creativity guide component consultation results

Data collected were a synthesis of the appreciation and usage made of the five creative components of our new componential creative process. We had, we recall, three types of teams: 1. Coach; 2. Observe without coaching; 3. Which uses their own approach. The survey was also made and filled by teams leaders and ambassadors.

We found that 86,55 % of the 119 participants surveyed with the first questionnaire had used the creativity guide component. From that pourcentage, 100 % of those coached and observed decided to use it (table 4.13).

Table 4.13 Creativity guide consultation results in 2014

Types of teams	Number of team members	Consult the creativity guide	Creativity guide helped	Creative process helped	Mini creative tools helped	Chrono-logical guide helped	Team pre-paration helped
1.Coach	54	54	54	36	35	54	54
2.Observe	49	49	49	29	29	29	49
3.Own approach	16	0	0	0	0	0	0
Total	119	103	103	65	64	83	103
% of all the members		86,55%	86,55%	54,62%	53,78%	69,75%	86,55%
Those who consult the creativity guide			100,00%	63,11%	62,14%	80,58%	100,00%

The participants mentioned that the creativity guide component helped all of them (100 %). They also indicated which component (classified by their preference in table 4.14) of the

componential creative process helped them. These data were made for the teams coached and the ones which observed who used the creativity guide[30].

Data from *Google Analytics*™ indicated that the creativity guide webpage was consulted 861 times in May 2014, reflecting that this web page was consulted by many participants.

Table 4.14 Creativity guide components which helped the participants in 2014

Components	Components helped them, per type of teams (in %)		
	Coached	Observed	Total
Creativity guide	100,00	100,00	100,00
Team preparation	100,00	100,00	100,00
Chronological guide	100,00	59,18	86,55
Creative process	66,67	59,18	63,11
Mini creativity tools	64,82	59,18	62,14

Team preparation and creativity guide components were considered as the most important (100 %), followed by the chronological guide component (86,55 %), the creative process component (63,11 %) and the mini creativity tools component (62,14 %).

We had many questions in the questionnaire (Appendix VI) to understand precisely how the creative process, mini creativity tools, team preparation and chronological guide components helped the participants whose results were analyzed in the following sections.

4.4.12 Creative process component usage results

As shown in table 1.15, the creative process was found helpful by 63,11 % of the participants coached or observed who consulted the creativity guide. This part of the questionnaire was made to see if participants had used a creative process during the event and if not, why. If they used it, we wanted to know if the creative process helped them to create.

[30] We did not consider in this table the teams which used their own approach since they did not consult or use the componential creative process elaborated and presented in the creativity guide.

Results indicate that 62 of the 72 participants who consulted the creative process page (87,5 %) used the creative process proposed. Considering that two other teams used another creative process, a total of 82 participants used a creative process, representing 68,91 % of all participants (tables 4.15 and 4.16).

Table 4.15 Creative process component results in 2014

Types of teams	Number of team members	Consult the creative guide	Consult creative process page	Use the creative process proposed	Didn't use a creative process	Why not used: Missing time	Why not used: Missing interest	Why not used: Other process	Why not used: Other reasons	Creative process helped
1.Coach	54	54	35	26	19	9	8	9	10	18
2.Observe	49	49	29	29	20	0	10	10	0	30
3.Own approach	16	0	8	8	8	0	8	0	0	8
Total	119	103	72	63	47	9	26	19	10	56
% of all the members		86,55%	60,50%	52,94%	39,50%	7,56%	21,85%	15,97%	8,40%	47,06%
Consult the creativiy guide		100,00%	62,14%	53,39%	37,86%	23,08%	46,15%	48,72%	25,64%	75,00%
Consult the creative process page			100,00%	87,50%	12,50%	19,15%	25,00%	40,43%	21,28%	77,78%

A look at the last point of table 4.15: “Creative process helped [to create]” shows that only 47,06 % of all participants said yes. But those who consulted the creativity guide said that the creative process helped them at 75,00 %, and at 77,78 % for those who consulted the creative process component webpage, a percentage higher than the general question asked in previous heading (4.4.11) asking if creative process helped (63,11% who said yes). Most of the participants who did not find that the creative process helped came from teams coached (table 4.16), representing almost half of the group (17 of the 35 who used a creative process).

Table 4.16 Analysis of the satisfaction to use a creative process in 2014

Component Creative process	Coached	Observed	Own approach	Total
Used the creative process proposed	26	29	8	63
Used other creative processes	9	10	0	19
Total usage of creative processes % of all members	35 64,82 %	39 79,59 %	8 50,00 %	82 68,91 %
Creative processes helped % of all members	18 33,33 %	30 61,23 %	8 50,00 %	56 47,06 %
Difference of participants who used a creative process and did not mention it was helpful for them	17 31,48 %	9 18,37 %	8 50,00 % (did not use)	33 27,73 %

In 2014, we asked participants who did not use creative processes to explain why they did not use it. We asked them to choose three possible reasons: missing time, missing interest or other reasons, with a space to write the reason. Results are shown in table 4.17.

Table 4.17 Possible reasons for not using a creative process in 2014

	Number of participants' answers			
Reasons	Coached	Observed	Own approach	Total
Difference of participants who used a creative process and did not mention it was helpful for them	17	9	8	34
Missing time	9	0	0	9 26,47 %
Missing interest	8	10	8	26 76,47 %
Other reasons	10	0	0	10 29,41 %

The main reason given for not using a creative process was because they were missing interest (76,47 %), approximately three times more than time missing. Even if they had the possibility to write what was the other reason, participants did not mention it.

4.4.13 Mini creativity tools usage

We designed this part of the questionnaire regarding mini creativity tools to know if participants used them, if they found them helpful to create and which mini creativity tools they used. Our results (in table 4.18) indicate that 83 of participants consulted their page (69,75 % of all the participants), but only 54 found they were helpful (65,07 %). There were no questions in the questionnaire to try to understand why the rest of the participants did not find mini creativity tools helpful in general. Instead, they were asked, for each mini creativity tool, the reason why they had not used it, with three choices: Missing time, missing interest or other, with a space to write a comment for each reason (see table 4.18).

Table 4.18 Mini creativity tools results survey in 2014

Types of teams	# of team members	Consult the Creative Guide	Consult Creative Tools page	Mini Creative Tools helped	Use Mini State-ment	Use Mini Brain-storm	Use Mini Brain-writing	Use Mini Mind Map	Computer Mini Mind Map	Use Mini Scamper	Mean # of Mini Creative Tools used
1.Coach	54	54	54	35	26	54	26	37	**0**	0	2,67
2.Observe	49	49	29	19	10	39	29	39	0	9	2,80
3.Own approach	16	0	0	0	0	16	8	0	0	0	1,50
Total	119	103	83	54	36	109	63	76	0	9	
% of all the members		86,55%	69,75%	45,38%	30,25%	91,60%	52,94%	63,87%	0,00%	7,56%	2,54
Those who consult the Mini Tools page				65,06%	43,37%	100,00%	66,27%	79,52%	0,00%	10,84%	

Table 4.18 shows that participants who decided to use their own approach (teams of the type 3) also used mini creativity tools, but more probably creativity tools of the same name, since they indicated that they did not consult the mini creativity tools page. As explained earlier, the mini creativity tool is a simplified version of a creativity tool. For that reason, we did not make a difference between mini creativity tools and the creativity tools (like mini Brainstorming and the Brainstorming creativity tools for example) when we compiled the results. All the mini creativity tools proposed were used but at different levels, as seen in table 4.19 which shows the preference of the participants.

Table 4.19 Mini creativity tools classified in order of preference of users in 2014

Mini creativity tools	Coached	Observed	Own approach	Total
1. Mini Brainstorm	54	39	16	109
% of all participants	100,00 %	79,59 %	100,00 %	91,60 %
% of the participants who consulted the mini creative page	100,00 %	100,00 %	Not consulted	100,00 %
2. Mini Mind Map	37	39	0	76
% of all participants	68,52 %	79,59 %	0,00 %	63,87 %
% of the participants who consulted the mini creative page	68,52 %	100,00 %	Not consulted	79,52 %
3. Mini Brainwriting	26	29	8	63
% of all participants	48,15 %	59,18 %	50,00 %	52,94 %
% of the participants who consulted the mini creative page	48,15 %	100,00 %	Not consulted	66,27 %
4. Mini Statement	26	10	0	36
% of all participants	48,15 %	20,41 %	0,00 %	30,25 %
% of the participants who consulted the mini creative page	48,15 %	34,48 %	Not consulted	43,37 %
5. Mini Scamper	0	9	0	9
% of all participants	0,00 %	18,37 %	0,00 %	7,56 %
% of the participants who consulted the mini creative page	0,00 %	31,04 %	Not consulted	10,84 %

As shown, the Brainstorming creative technique and the mini Brainstorming proposed are the tools preferred by the participants (91,60 %). They made many comments related to the mini creativity tools.

4.4.13.1 Mini Brainstorm

Only 10 participants did not use the mini Brainstorming without explaining why. Those partipants were all from the same group: Observed team. From those who used it, 18 found that it took too much time, while 10 found it fun to use. Regarding the number of ideas produced, 9 teams on 12 which used it wrote that they generated from 5 to 30 ideas with this mini creativity tool, for a mean number of 23 per team.

4.4.13.2 Mini Mind Map

From the 119 participants who consulted the mini creativity tools page, 76 used the Mini Mind Map, while 43 decided not to use it. The reason given was the miss of interest for 24 participants, the miss of time for 10, while 9 others decided to use a Microsoft Excel™ page to rank the ideas generated with the other creativity tools. We offered in the mini creativity page the possibility to use a free software called Freemind™ instead of a whiteboard. No participants used it: Twenty nine preferred to use the whiteboard, 24 missed interest, 16 missed time and no comments from the others.

4.4.13.3 Mini Brainwriting

Sixty three participants used mini brainwriting and 56 did not: Nine missed interest, 8 chose another tool and 39 did not explain why. Five teams said they found from 3 to 100 ideas with this mini creativity tool, results which give a mean number of 32 ideas per team.

4.4.13.4 Mini Statement

Mini Statement was the only creativity tool proposed to do the process step “Define the problem”. Survey’s results indicate that 36 participants used it, while 83 did not: Twenty seven used other tools, 27 others missed time, 9 missed interest and the rest (20) did not explain why. Of the 27 who used other tools, 9 used the Kipling Method (Möller *et al.*, 2014) also known as 5W or 5W and H, 8 others used a creativity tool unknown for the ambassador with them (a Chinese creativity tool) and the last 10 made no comments.

4.4.13.5 Mini Scamper

Mini Scamper was used by 9 participants, meaning that 110 (among the 119) did not use it: Thirty three missed interest, 19 missed time, 19 chose other tools and 39 did not mention why. For the 19 who used other tools, the creativity tool ASIT (Advanced Systematic Inventive Thinking, a TRIZ inspired tool invented by Roni Horowitz, 1999) was chosen by 10 participants, while the other 9 did not mention which creativity tool they chose instead.

4.4.13.6 Number of Mini creativity tools used

To count the number of mini creativity tools used, we took into account the type of other mini creativity tools used as reported in the survey completed by teams' leaders and ambassadors (table 4.20).

Table 4.20 Number of mini creativity tools used per type of teams in 2014

Creative tools	**Types of teams**												
	1. Coached						**2. Observed**					**3. Own approach**	
Team #	1	2	3	4	5	6	7	8	9	10	11	12	13
Mini Brainstorm	x	x	x	x	x	x	x	x	x		x	x	x
Mini Brainwriting		x		x		x			x	x	x	x	
Mini Mind Map	x		x		x	x		x	x	x	x		
Mini Statement				x	x	x					x		
Mini Scamper									x				
Kipling method	x												
ASIT			x										
Excel		x											
Other tools													2
Total	3	3	3	3	3	4	1	2	4	2	4	2	3
Mean	3,17						2,60					2,50	

The number of mini creativity tools used for coached teams was the highest with a mean of 3,17 per team for the six in this category (54 participants). The five teams observed (49 participants) used 2,60 creativity tools, and those with their own approach, 2,50.

4.4.14 Team preparation component usage

It was the first time in our research that we proposed to participants to use a team preparation component. With this part of the questionnaire dedicated to that component, we wanted to know what elements of the team preparation were helpful for participants. We understood that they heard about the componential creative process elaborated only five days before the beginning of the event, meaning that for many, it was when coaches and colleagues told them about it at the beginning of The 24 Hours. Since we recommended them to start to do team preparation before the event, this component was offered too late. We made the survey considering that it could have been done before the event or during it (table 4.21).

Table 4.21 Data from the survey of 2014
for team preparation component

Types of teams	Number of team members	Consult the creativity guide	Team preparation preparation component helped	Prepare the team done	Creativity guide helped to prepare the team	Multi-discipline team made	Expertise know-ledge shared in team	Leader-ship discus-sed in team	Members of the team knowwn	Members of the team not known	Activity Done for members not known	Articles done of Past 24h Editions helped	What to bring for this event helped
1.Coach	54	54	54	54	45	28	54	45	45	9	9	37	17
2.Observe	49	49	49	40	10	29	40	40	39	10	10	29	10
3.Own approach	16	0	0	8	0	0	16	8	8	8	8	16	0
Total	119	103	103	102	55	57	110	93	92	27	27	82	27
% of all the members		86,55%	86,55%	85,71%	46,22%	47,90%	92,44%	78,15%	77,31%	22,69%	100,00%	68,91%	22,69%
Those who consult the creativity guide			100,00%	91,26%	53,40%	55,34%	91,26%	82,52%	81,55%	18,45%	100,00%	64,08%	26,21%

Table 4.22 presents 10 elements related to team preparation for which eight questions were asked. Having 10 elements meaned that several elements were not analyzed in that questionnaire. We retained these five (not shaded in table 4.22) among the ten for the analysis: Know one another activities (number 1), Team's diversity (number 3), Leadership (number 5), Team's expertise (number 6) and What to bring to The 24 Hours (number 10).

Considering the number of questions (69 in the questionnaire) and the fact that team preparation component was new, we chose what for us seemed the most important to control. Ideally, we would have had questions for each element, that means, a questionnaire of 75 to 80 questions. But too many questions could have discouraged users to participate in the research or they could have answered fewer questions. Therefore, we chose the five important elements quoted previously, in order to help us measure if team preparation was

helpful and appreciated: We did not know if the way we presented it was adequate in a short ideation session like The 24 Hours.

Table 4.22 Number of questions asked in 2014 for the team preparation component

#	Elements	Questions asked	Type of teams			Total
			1. Coached	2.Observed	3. Own approach	
			54	49	16	119
	The team preparation component	2	54 100,00%	49 100,00%	0 0,00%	103 86,55%
1	Know one another activities	2	9 100%	10 100%	8 100%	27 100%
2	One another's respect					
3	Team's diversity	1	28 51,85%	29 59,18%	0 0,00%	57 47,90%
4	Teamwork					
5	Leadership	1	45 83,33%	40 81,63%	8 50,00%	93 78,15%
6	Team's expertise	1	54 100,00%	40 81,63%	16 100,00%	110 92,44%
7	Participants creative style					
8	Risk taking					
9	Participants motivation					
10	What to bring to The 24 Hours	1	17 31,48%	10 20,41%	0 0,00%	27 22,69%
	Total	8				
	Mean		73,33%	68,57%	50,00%	68,24%

All the participants who consulted the creativity guide also consulted “Prepare the team component” section and those 103 participants found its elements helpful. Only the group with their own approach did not consult it. All the participants coached and observed and only half (8) of those with their own approach did team preparation. We analyze below participants’ answers for the five elements for which questions were asked.

4.4.14.1 Know one another activities

We asked the participants these two questions: Did the team members know one another before The 24 Hours? If not, did they do an activity for that? Ninety three members (77,31 %) knew one another. For those who did not (10, representing 22,69 % of the members of the three types of teams: Coached, observed and own approach) did activities to know one another.

4.4.14.2 Team's diversity

We asked in the questionnaire if participants created a multidisciplinary team after reading the guide team; 51,85 % of the members of teams coached and 59,18 % of teams observed created multidisciplinary teams, while teams with their own approach did not answered.

4.4.14.3 Leadership

We asked participants if they had agreed on the leadership style to implement. Teams coached had at 83,33 % and those observed at 81,63 %, while teams with their own approach had agreed at a percentage of 50,00 %.

4.4.14.4 Team's expertise

We asked participants the following question: "Have the members of the team discussed among themselves the expertise of everyone?" All participants of teams coached and with their own approach have answered yes, and 81,63 % of the teams observed had too.

4.4.14.5 What to bring to The 24 Hours

"What to bring to The 24 Hours" was found useful by only 31,48 % of teams coached and 20,41 % of those observed; no participants with their own approach found it useful.

4.4.14.6 Usefulness of the team preparation component

Data show that 73,33 % of the participants coached, 68,57 % of those observed and 50,00 % using their own approach also used elements of team preparation. This reflects the results of table 4.24 where 86,55 % of the participants found that team preparation helped, even if the

usage percentage was lower. We have classified the components used in the guide by their total popularity for the participants.

Table 4.23 Popularity of the team preparation components in 2014

Components		Components which helped them (in %)		
	Coached	Observed	Own approach	Total
Activity for members not known	100,00	100,00	100,00	100,00
Expertise shared	100,00	83,33	100,00	91,26
Prepare the team	100,00	81,63	50,00	85,71
Leadership discussed	83,33	81,63	50,00	78,15
Results of the past 24 Hours editions	68,52	59,18	100,00	68,91
What to bring for this event	31,48	20,40	0,00	22,69

Risk taking was not part of our research, since it was analyzed by Thierry Zagré, a PhD. Student participant of our team of researchers, as previously mentioned.

4.4.14.7 Results of the past 24 Hours editions

In table 4.23 above, we have the element “Results of the past 24 Hours editions”, which appeared in two articles on past 24 Hours editions. The first one summarized the results of 2011 and the second one reported how a team had lived the event in 2013 (see appendix X). “Results of the past 24 Hours editions” was in the creativity guide but not included in the team preparation component, where it should have been: It helped participants to prepare themselves, since 68,91 % of participants found those results useful.

4.4.15 Chronological guide usage analysis

As previously shown, the chronological guide was used by 80,58 % of the participants who consulted the creativity guide (table 4.13, heading 4.4.11). The teams that used their own approach (type 3) filled the questionnaire even if they did not consult the creativity guide.

Table 4.24 is a synthesis of the results of all the teams except teams 7 and 8 whose members, from a high school, were at ÉTS for The 24 Hours for only seven hours (from 9:00 a.m. to 4:00 p.m.); so, we did not consider their data since all the other teams had done 24 hours.

Table 4.24 Synthesis of the 2014 chronological results

Chronological guide			**Data analysis (for 11 of the 13 teams)**	**Type of data**
Hours	**Steps**	**Recommandations**		
Before 0 hre	Team preparation		84,62 %	% yes
0 to 1 hr	Choose the challenge	# of hours?	1,55	Mean
1 to 3 hr	Define the problem	Minimum 0,5h to define it	2,8	Mean
		At what time? (in 24h time)		
	Generate ideas	# of hours?	3,125	Mean
		At what time? (in 24h time)		
		Take just a part if the problem is too big	53,85 %	% all
		Talk to the clients or	70,00 %	% yes
		Take informations	70,00 %	% yes
		Draw your ideas	80,00 %	% yes
3 to 5 hr	Eco innovate			
5 to 7 hr	Find the solution	# of hours?	3,81	Mean
		At what time? (in 24h time)		
7 hr	Creative survey to fill			
8 to 10 hr	Financial analysis		90,00 %	% yes
		# of hours?	1,17	Mean
		At what time? (in 24h time)	13,60 to 14,80	Mean
10 to 14 hr	Prototypes		89 %	% yes
		2D	62,50 %	% yes
		3D	50,00 %	% yes
		Others	37,50 %	% yes
		# of hours?	3,67	Mean
		At what time? (in 24h time)	12 to 15,67	Mean
12 to 21 hr	Produce the video	# of hours?	5,5	Mean
		At what time? (in 24h time)	14 to 20,29	Mean
21 hr	Upload the video	At what time? (in 24h time)	20,42	Mean
22 to 24 hr	Local jury selection			
24 to 26 hr	Int'l jury selection			

It was the first time to our knowledge that a chronological guide for The 24 Hours of Innovation was defined and proposed as a guide for Montreal and ESTIA participants. The chronological guide reflects what participants had done from hour 0 to 21. They had 18 questions in the questionnaire regarding the chronological guide. We analyzed the data for each block of hours proposed. Type of data in table 4.24 indicates what represents the result of the data analysis. "% yes" means that the data analysis is the percentage of participants who answered yes to the question asked regarding a step or a recommendation. For example, 84,62 % of the participants said that they did team preparation before 0 hr. Mean type of data is the mean of the data for a step or a recommendation: For example, teams took a mean of 1.55 hour to choose the challenge in the block of hours "1 to 3 hr". "% all" indicates the percentage for all the participants to do a step or a recommandation. For example, 53,85 % of all participants took just a part (of the problem) if the problem was too big, for the step "Generate ideas" in the block of "1 to 3 hr".

Time allowed for each step was estimated from the secondary data analysis of winning teams by ESTIA from 2007 to 2010 (chapter 3) and from experience gained in following teams doing The 24 Hours organized at ÉTS from 2010 to 2014.

4.4.15.1 Before 0 hr: Team preparation

Regarding team preparation, 84,62 % told us that they did it before 0 hr, approximately the same result as shown in table 4.21 (85,71 %).

4.4.15.2 0 to 1 hr: Choose the challenge

To choose the challenge, teams used 1,55 hour instead of 1 hour as estimated. We have to mention that we had, at the Montreal site, an Internet network problem that took 1 hour to solve, but we did not see a difference of time with participants who were at other places. We still believed that teams should not exceed one hour to choose their challenge. If a team is prepared, choosing the challenge will be done faster and easily since its members would have already known the expertise and the creative style of each of them.

4.4.15.3 1 to 3 hrs: Define the problem and generate ideas

We estimated 2 hours to define the problem and generate ideas: It took the teams a mean time of 2,8 hours for the first and 3,13 hours for the second, for a total of 5,93 hours (almost three times more). As stated further in the last subtitle of this chapter including propositions arising from our interpretation of the results of our research, we will review those previous results in the 2015 componential creative process.

4.4.15.4 3 to 5 hrs: Eco innovate

As we already said, the time allowed to eco innovate was not a part of our research; it was managed by researcher Ahmed Cherifi.

4.4.15.5 5 to 7 hrs: Find the solution

Find a solution took 3,81 hours instead of 2 planned, almost twice the time allowed. For The 24 Hours 2015 edition, we will review the previous results to make sure that the time allowed is adequate.

4.4.15.6 7 hrs: Fill creative survey

As mentioned earlier, participants did not fill the digital questionnaire at the 7th hour; they chose, intead, to fill the paper questionnaire for the teams coached and observed. It is possible that the formulation “Creative survey to fill” was not clear for them. Based on these facts, the team of researchers using those results will have to define a strategy for 2015.

4.4.15.7 8 to 10 hrs: Financial analysis

It is interesting to note that 90 % of the teams passed 1,17 hour (one hour early estimated) doing a financial analysis. If we compare that result with the data compiled from 2007 to 2010, where only 30,19 % of teams did this step, it is a significant difference.

4.4.15.8 10 to 14 hrs: Prototypes

Another interesting point is that 89,00 % of the teams did prototypes in 2014, compared to 72,50 % of winning teams and 66,36 % of non-winning teams from 2007 to 2010. They took 3,67 hours (mean value) for that, 1,84 more time than estimated.

4.4.15.9 21 hrs: Produce the video

Producing the video took the teams 5,50 hours instead of the 9 hours estimated. It will be another result to pay attention to for The 24 Hours 2015 edition.

4.4.15.10 12 to 21 hrs: Upload the video

We recommended to upload the video at the 21st hour: Teams did it at a mean value of 21,42 hours. This step was very important in order for teams to be part of the evaluation made by the different juries. We were pleased to see that all the teams which sent us their questionnaires filled uploaded their video in time for the evaluation.

4.5 Summary

The first year of experimentation during The 24 Hours organized by ÉTS was 2012. We elaborated a first version of our Componential creative process composed of three components: A creative process, nine creativity tools associated to steps of the creative process and a creativity guide to explain how to use them. That year, we decided to experiment the CPS Thinking Skills Model creative process of Puccio, Murdock and Mance (2005; presented in chapter 2 and selected in chapter three) with a classification and selection system created for creative processes and nine creativity tools (selected in chapter 3) with a second classification and selection system created but this time for creativity tools. Participants found both of them too long to learn in a short ideation session like The 24 Hours competition.

Following the results of 2012, we modified in 2013 the Componential creative process elaborated. Instead of offering one creative process, we proposed to participants a choice of three creative processes: We kept the CPS Thinking Skills Model of Puccio, Murdock and

Mance (2005) and added the Linear and intuitive ThinkX creative process of Hurson (2007), and the Improvisational creative process for organizations of Fisher and Amabile (2009; all of them are presented in chapter 2 and selected in chapter 3). We created mini creativity tools, a simplified version of some creativity tools requiring less than five minutes to learn; we modified the creativity guide to explain how to use those components. We trained ambassadors and researcher's colleagues on how to use the Componential creative process and asked them to coach participants in Montreal and several sites around the world. Participants mentioned again in questionnaires that creative processes were too long to learn, but 40,00 % used a creative process. Mini creativity tools that we also created were found helpful by 64,29 % of the participants.

In 2014, we modified again the Componential creative process but instead of using existing creative processes for the creative process component, we created one (a simple three steps) inspired by the one made by Fisher and Amabile (2009) Improvisational creative process for organizations. We proposed again mini creativity tools associated with the steps of the creative process. We introduced that years two new components: A team preparation component to advise participants how to prepare a team for a short ideation session based on the work of Fisher and Amabile (2009) and many other researchers. We also proposed a chronological guide to help them manage their time regarding activities made for the time allowed (24 hours). This third version of our Componential creative process was found helpful: From the participants who consulted the creativity guide (86,55 % of people participating to our research), 100,00 % of them found this component helpful; the same number was observed for the helpfulness of the team preparation component; 86,55 % found that the chronological guide was helpful, 63,11 % had the same feeling for the creative process and 62,14 %, for the mini creativity tools.

In chapter five, we interpreted the results from 2012 to 2014, discussed and compared them, and proposed the 2015 version of our Componential creative process.

CHAPTER 5

INTERPRETATION AND DISCUSSION

5.1 Evolution of our componential creative process for short ideation sessions

We review in this last chapter the results for each component of our componential creative process for short ideation sessions. Considering the results from 2007 to 2010, its project started in 2010 (the first edition of The 24 Hours at ÉTS) and it evolved till 2014. We reconsider here all the components conceived for our componential creative process: Creative process, mini creativity tools, chronological guide, team preparation and creativity guide. Then, we present the version of the componential creative processes for short ideation sessions conceived for The 24 Hours session of May 26th to 27th 2015 organized by ÉTS.

5.5.1 Review of creative process component 2012 - 2014

Curiously, the creative process was one of the least appreciated components of our componential creative process: Recalling the results in table 4.14, we observe that only 63,11 % of the participants who consulted the creativity guide found it helpful in 2014. With the mini creativity tools (62,14 % of the participants who found them helpful), these two components were less privileged behind the creativity guide and the team preparation (with 100 % each) and the chronological guide (86,55 %).

We thought first that the creative process and creativity tools (in our case, the mini creativity tools) would be the most appreciated components since they were made specifically for creative sessions. If we consider the definition of a process given by Vidal, that “way or manner in which a problem is solved [by] bringing something new”, we recall, the process should be much more important than what we obtained. For Vidal, people, “whether solving problems alone or in a group, […] must have a guided process i.e. a plan or a map of the steps to be followed. This is especially so in a group due to the need to align the capabilities of the members in a positive way” (Vidal, 2010, p. 412). But participants showed little interest to this specific creative process.

From 2012 to 2014, we experimented four creative processes classified by Nemiro (2004) as shown in table 5.1.

Table 5.1 Annual usage comparison of four creative process classified by Nemiro (2004)

	2012	**2013**	**2014**
CPS linear process	Thinking Skills Model (2005)	Thinking Skills Model (2005)	
Linear and intuitive process		ThinkX (2007)	
Componential process		Improvisational creativity on organizations (2009)	Componential creative process for short ideation sessions (2014)
Usage results	No usage mentioned	40,00 % use a creative process without identifying which one	63,11 % of the participants who consulted the creativity guide found it helpful

The first experiment was made with the CPS Thinking Skills Model (2005) which includes the Convergent and divergent creative process, an intuitive type. Participants did not use it in 2012. We experimented it again in 2013 with ThinkX (2007), a linear and creative process, and the Improvisisational creative process for organizations (2009), which is componential.

In 2013 , participants did not use the creative process due to lack of time, even after they had been coached. That year, 60 % of the participants did not use it. We knew that the linear creative process (Thinking Skills Model) and the intuitive and linear one (ThinkX) were not made for short ideation sessions; it is also not easy to find instructions on the way to use them and, even in that case, they take to much time to be learned, according to the participants. Also, applying all their steps takes too much time: Depending on the creative process chosen, more than 24 hours may be needed to habilitate a team to use it.

On the other hand, we believed in 2013 that the componential creative process for organisations of Fisher and Amabile (2009) could be adopted by more participants than it

was, considering that this creative process is one of the simplest creative processes we found with its three phases corresponding to what participants have to do. In 2014, we changed the sentences of those those steps to try to make them even clearer: 1. Define the problem; 2. Find ideas; 3. Choose the solution.

For us, we still think that this process is easy to use. It does not need to be learned since participants have to do the three steps in any ideation session. But the weakness of this last point is that participants may think it is not useful to propose it since it is so simple. In fact, the componential creative process is useful because it helps the team to understand that each step needs to be done, to know who is doing what at what time (regarding steps of the process), and to define what activities participants should do to complete the steps or to work in conjunction on the next step when required.

Yet, participants did not use it. Looking closely to the componential creative process elaborated in 2014, we now think that we found why teams may not need to use this component: The three steps of the creative process component were also steps of another component, the chronological guide, consulted by 86,55 % of the participants who consulted the creativity guide. This chronological guide will also be subjected to interpretation, discussion, comparison and will be submitted to propositions, after the mini creativity tools.

5.5.2 From creativity tools to mini creativity tools component 2013 – 2014

In 2014, we proposed seven mini creativity tools associated with three creative process steps. As discussed in the creative process component above, mini creativity tools were found helpful by 62,14 % of the participants who consulted the creativity guide. We do not know exactly why this component held this position, even if 62,14 % could be considered as adequate. We would like to find a way to make them more attractive and helpful than they were in 2014. Mini creativity tools were an adaptation of creativity tools submitted to survey the years before.

Considering that a creativity tool is “a cognitive prosthetic that somehow increases the capability of individuals and groups [and] enhances the ability of problem solvers to generate

and develop ideas beyond their innate *ad hoc* processes" (Markman and Wood, 2009a), it should be essential in short ideation sessions where time is a constraint; but how?

In 2013, we proposed creativity tools associated with the nine steps of the CPS Thinking Skills model creative process. Participants did not mention that they used this creative process. Creativity tools data were not relevant for them: Considered by participants also too long to learn and use. Considering those comments, we introduced seven mini creativity tools in 2013, associated with the steps of three creative processes (which had from 3 to 6 steps). A total of 18 teams on 20 (90,00 %) used a combination of creativity tools and mini creativity tools, but only 64,29 % of the teams found them helpful.

Table 5.2 is a compilation of creativity tools and mini tools used in 2013 and 2014, for "Define the problem" specific step. To be able to compare data, we considered the number of teams that used each creativity tool and corresponding mini creativity tools per year (Brainstorming and mini Brainstorming for 2012 for example).

Table 5.2 Most used creativity / mini creativity tools
associated with steps in 2013 and 2014

Creative / mini creativity tools associated with the steps	**2013**	**2014**	**Total**	
Step1: Define the problem				
Problem statement (mini creativity tool)	5 of 20	4 of 13	9 of 33	27,27 %
Is – Is not (mini creativity tool)	2 of 20	N.A.	2 of 20	10,00 %
Kippling method (creativity tool)	1 of 20	N.A.	1 of 20	5,00 %
Step 2: Find ideas				
Brainstorming (both types)	15 of 20	12 of 13	27 of 33	81,82 %
Brainwriting (mini creativity tool)	N.A.	7 of 13	7 of 13	53,85 %
Mind Map (both types)	8 of 20	8 of 13	16 of 33	48,49 %
ASIT (creativity tool only)	N.A.	1 of 13	1 of 13	7,69 %
CK (mini creativity tool only)	1 of 20	N.A.	1 of 20	5,00 %
Step 3: Choose the problem				
Praise (mini creativity tool only)	3 of 20	N.A.	3 of 20	15,00 %
SCAMPER (both types)	3 of 20	1 of 13	4 of 33	12,12 %

Secondary data from ESTIA show that participants used 0,80 creativity tool during The 24 Hours from 2007 to 2010. The mean numbers of creative / mini creativity tools used in 2012 and 2013 are presented in table 5.3:

Table 5.3 Mean numbers of creative / mini creativity tools used in 2012 and 2013

	2013	2014	Total
Mean number of mini creativity tools used per team which used them	2,69 for 14 teams	2,85 for 13 teams	2,77 for 27 teams
Mean number of creativity tools used per team which did not use mini creativity tools	0,67 for 6 teams	N.A.	0,67 for 6 teams
Gain			413,43%

Results clearly show that the number of creativity tools used by the teams which used mini creativity tools is higher (a gain of 413,43 % in this research).

5.5.3 2014 chronological guide component for time management

As mentioned, 86,55 % of the participants found the chronological guide helpful. A chronological guide is important because time management is crucial in short ideation sessions: If participants take too much time on steps to do, they would not finish at time; if they do not take enough time on steps, they will finish earlier than expected. Time lost could have helped them to find different ideas or solutions or refine their solution, prototype, presentation, etc. The chronological guide, inspired of the work of winning teams of ESTIA 24 Hours from 2007 to 2010, and ÉTS 24 Hours from 2012 and 2013, helped participants to compare their time management and adjust their planning during and after each step. It also reminded them all the steps they had to do in order to present a solution containing the points the different juries were to evaluate (creativity of their solution, eco innovation, feasibility and prototype demonstrated, etc.). But, for further use, we will make changes on it.

5.5.4 2014 team preparation component shortened

The team preparation component added to our componential creative process in 2014 composed of ten elements was found helpful by 100,00 % of the participants who consulted the creativity guide. Yet, teams could not use it to prepare themselves since this creativity guide was made available just five days before The 24 Hours started. Therefore, questions were asked in our research questionnaire for only five of the ten elements of this component :

68,24 % of the participants did those five elements. Team preparation component will also be enriched for The 24 Hours 2015 edition.

5.5.5 Creativity guide component

The creativity guide was a new component added for the first time in 2012. We had not found before authors adding this component to creative processes. Yet, without a creativity guide, creative components like the creative process and creativity tools could pratically not be learned and consequently, not be used. Our creativity guide evolved from the three iterations done in 2012, 2013 and 2014 (appendix XV).

The creativity guide was found the most useful component of our componential creative process elaborated in 2014, like team preparation component: 100,00 % of participants who consulted them found each of them helpful. The creative guide will be published earlier on the web for The 24 Hours editions to come in 2015.

5.2 Propositions for 2015

For the 24 Hours 2015 edition, we worked to produce a componential creative process for short ideation sessions which will have three main components: 1. Team preparation, 2. Chronological guide. 3. Creativity guide.

For team preparation, we add to its ten initial elements, the “Results of the past 24 Hours editions”. Namely, three articles giving to participants informations and results on 2011, 2013 and 2014 editions. It should be available a couple of weeks before the event; they would be read like the rest of the preparation required, but to the team’s liking.

For the 2015 chronological guide, we will merge two other components in it: The creative process and mini creativity tools since the creative process component steps are included in it, and that the chronological guide has more steps and recommendations, with time period indicated. Participants will not need to consult a component that has only a part of the steps already found in the chronological guide. The creative process steps now in the chronological

guide, we think that it will be more useful for participants to indicate in this component what mini creativity tools they should use.

We will propose to use a total of nine mini creative tools: Three to define the problem (step 1), three to find ideas (step 2) and three to choose the problem (step 3). We are wandering if teams will use more mini creativity tools if we propose them more from which they could choose. The mini creativity tools in our 2015 chronological guide are presented in table 5.4.

Table 5.4 2015 mini creativity tools chosen following experiment analysis

2015 Creative / mini creativity tools associated with the steps
Step1: Define the problem
Problem statement (mini creativity tool)
Is – Is not (mini creativity tool)
Kippling method (creativity tool)
Step 2: Find ideas
Brainstorming (both types)
Brainwriting (mini creativity tool)
Mind Map (both types)
Step 3: Choose the problem
Praise (mini creativity tool)
SCAMPER (both types)
Yellow Box (Mini creativity tool)

For project management that we announced in chapter 4 (footnote 24) to be proposed to participants, we intend to invite them to do that if they know it. But since it is a complex course, we do not intend to explain it; we neither integrate it in our list either. In order to help participants to be ready for the competition, the creativity guide has to be put online several weeks before The 24 Hours of May 26 to 27 2015 (see appendix XV).

Componential Creative Process, Year 2015

Creativity guide component

1. Team preparation explanation

2. Chronological guide presentation

Team preparation component

Preparation	1	Know each other activities
	2	Each other's respect
	3	Team's diversity
	4	Teamwork
	5	Leadership
Expertise	6	Team's expertise
	7	Participants creative style
Creativity Relevant Processes	8	Risk taking
Intrinsic Motivation	9	Participants motivation
Work Environment	1 0	What to bring to the 24 Hour

Chronological Guide component

Before	Prepare the team
0 to 1 hr	Select a challenge
1 to 3 hr	Define the problem with **Mini statement** **Mini Is - Is not** **Mini 5W and H**
3 to 6 hr	Generate ideas with **Mini Brainstorm** **Mini Brainwriting** **Mini Mind Map**
6 to 8 hr	Eco innovate with **Mini EcaTRIZ**
8 to 12 hr	Find the solution with **Mini Scamper** **Mini Praise** **Mini Yellow Box**
12 to 14 hr	Assess feasability
12 to 17 hr	Prototyping
12 to 18 hr	Prepare your presentation
18 to 21 hr	Submit your presentation
22 to 24 hr	Local jury selection
24 to 26 hr	International Jury selection

Figure 5.1 2015 componential creative process for short ideation sessions

5.3 Summary

In this chapter, we have interpreted the results from 2012 to 2014, discussed and compared them and proposed the 2015 version of our componential creative process. We reviewed each component of the Componential creative process we elaborated from 2012 to 2014, starting with the creative process component. We explained that 63,11 % of the participants to this research who consulted the creativity guide found it helpful. In 2012, participants did not use it, and in 2013, only 40,00 % did: Results demonstrated that creative processes proposed were too long to learn considering the time allowed for the short ideation session (24 hours).

In 2012, we proposed nine creativity tools selected in chapter 3 based on criteria explained in chapter 2. Since they were associated with steps of the CPS creative process proposed in 2012, a process not used by participants, they did not use the creativity tools either, for the same reason: Too long to learn how to use them. We created mini creativity tools in 2013 (chapter 4) that were used in combination of creativity tools that participants knew (like Brainstorming and Mind Map for example) by 64,29 % of the participants. In 2014, the mini creativity tools component was found helpful by 62,14 % of the participants who consulted the creativity guide.

We proposed to merge these two components (creative process and mini creativity tools) in the chronological guide component in 2015 since the creative process steps are included in the nine steps of the chronological guide that was created and introduced for the first time in 2014, a component found helpful by 86,55 % of the participants who consulted the creativity guide.

The team preparation component was also a new component introduced in 2014 based on the work of Fisher and Amabile (2009) and many other researchers as listed in chapter 4. This component was appreciated by all the participants (100 %) who consulted the creativity guide. Since it was introduced in part in 2014, we propose, for 2015, to present ten elements for this component (see figure 5.1).

The last component reviewed was the creativity guide which is a kind of the “user’s manual” of our 2015 componential creative process. We started to introduce this component in 2012. It has changed three times and became a component found helpful by all the participants (100%) in 2014.

Wtith the merge of three components proposed (the creative process and mini creativity tools components merged in the chronological guide) our 2015 Componential creative process will have only three components : Team preparation, creativity guide and chronological guide.

CONCLUSION

After our review of literature in the first chapter of our thesis which focused on generalities like the attempt to define creativity, a concept with no standard definition, the consideration of different methodologies in that domain, and the link between creativity and innovation, design and invention, we presented, in chapter 2, our research question which was: How to elaborate a componential creative process for short ideation sessions? This question was running to our problem statement which emerged from two considerations.

The first consideration was the observation made by analysts on the barriers encountered by Small and medium enterprises (SMEs), related to resources: Finances, skills and time associated to the innovation process which were all limited. By our research focusing on creativity, we would contribute helping these SMEs and companies be more productive in generating ideas with the limited time resource at their disposal.

The second consideration was related to our research sample. Facing many difficulties when we tried to conduct our research within companies, we decided to work with the annual international competition named The 24 Hours of Innovation (The 24 Hours). Even if this has the disadavantage of making the survey among students of universities instead of companies employees, the main advantage is that we could have a controlled research environment (fixed duration, annual renewal, same rules, same challenge subjects, to name but a few).

To begin our experiment, we used secondary data collected by researchers of ESTIA, a University in France, from 2007 to 2010, during The 24 Hours; this competition is also organized at ÉTS in Montreal with the same rules (from 2010 till now).

Secondary data analysis revealed that participants used, at a percentage of 69,70 %, only one creativity tool during that competition: The Brainstorming. However, researchers like Mullen, Johnson and Salas (2010), Markman and Wood (2009a) argued that groups who use the Brainstorming during an ideation session are inneficient. Secondary data analysis also showed that 98,57 % used a process similar to a creative process “as the way or manner in

which a problem is solved" as Vidal (2010, p. 412) defines the creative process. We had here the opportunity to help participants to be more creative, both in quantity and quality during ideation sessions if we could find a way to make them use more than one creativity tool following a creative process. But how?

Based on the works of Amabile (1996a) and Fisher and Amabile (2009), we needed a creative process which would be componential with at least two components: Creative processes and creativity tools, since participants used very few creativity tools as observed from the secondary data (98,57 % for the Brainstorming and the rest for Mind Map). In our componential creative process, we also needed a kind of creative user's manual to explain how to use the first two components that we named "the creativity guide component".

Componential creative processes can have other components like team preparation, risk and work environment management, but we were not sure if they were essential in short ideation sessions. To begin the experiment, we thought that three components (creative process, creativity tools and creativity guide) were adequate for good results expected.

The last part of our research question was related to time: Participants at The 24 Hours do an ideation session shorter than what classical creative processes do. No time usage is attributed to creative process except for the Improvisional Creative Process for Organization of Fisher and Amabile (2009) made for improvisation or unplanned creative sessions. The creative processes we found required several hours of training; several hours is all what participants have to create. In another hand, we could not find the expression "short ideation sessions" in the literature nor on the Web. Therefore, for us, a short ideation session would mean that the short time is planned, lasting from 15 minutes to 48 hours, and our componential creative process would be used for a duration of ideation which is defined.

We used a simple general method to measure our success or not of our componential creative process: More than 50 % would be considered successful for each of this three objectives our our research : 1. The componential creative process would have helped participants finding creative ideas and solutions; 2. All its components would have helped also to find a creative

solution to the problem defined; and 3. It should have been adopted and used by teams during the short ideation session.

To elaborate a componential creative process for short ideation sessions, we would have first needed to use or adapt an existing componential creative process for short ideation sessions. Among the 39 creative processes that we found, nine were componential but none was made for short ideation sessions. To choose the most suitable, we classified and selected, in the third chapter of this thesis, the ones found, according to their three types and based on the system of Nemiro (2004) that we adapted. These types were componential (with the Improvisonal creative process for organizations from Fisher and Amabile, 2009), linear (the CPS Thinking Skills Model of Puccio, Murdock and Mance, 2005) and linear and intuitive (the ThinkX creative process of Hurson, 2007).

Secondly, we needed creativity tools since many authors suggest to associate them to creative process steps. We retained 615 creativity tools among those existing and also classified them according to our own system elaborated, based on authors who analyzed creativity tools, since we found no selection system available. Hence, we selected nine creativity tools from the 615 we had, to fulfill our needs.

Chapter 4 of our thesis reports our experiment from 2012 to 2014. The first version of our componential creative process for short ideation sessions in 2012 had three components: The creative process component, the CPS Thinking Skills Model (2005), nine creativity tools associated with the steps of the CPS creative process and a creativity guide to explain how to use these components.

Sixty six teams (representing 49,77 % of all participants) participated to our research that year: Participants did not use the Creative process during The 24 Hours. They mentioned using three creativity tools: Brainstorming, Mind Map and Triz. From those, Brainstorming was the only creativity tool that we recommended in our creativity guide component. The creative process and the creativity tools proposed in our componential creative process were new for the participants, and they found that learning them would have taken too much time.

They also pointed that the componential creative process elaborated was not well presented and publicized.

In 2013, we proposed a new componential creative process with the same three components, a creative process, creativity tools and a creativity guide, but with different contents. The creative process component offered a choice of three creative processes: 1. The same linear CPS creative process Thinking Skills Model (2005); 2. The linar and intuitive ThinkX creative process (2007); and 3. The creative component process of the creative process for organizations (2009). We wanted to give to participants the choice between three possible approaches for the componential creative process.

Since creativity tools took too much time to be learned and used in 2012, we designed mini creativity tools inspired of modified creativity tools. We created a set of six mini creativity tools that we associated with steps of the three creative processes. We also changed the presentation of the creativity guide and did more publicity. We trained 20 leaders and ambassadors before the event on how to use the componential creative process and their components; they were to coach also their teams at ÉTS and around the world on the usage of the components of our componential creative process.

Twenty teams representing 162 participants filled the research questionnaire which give for a confidence level of 95 %, a standard error of 0,07074 considering a proportion of 0,5. Creative process components was used by 40,00 % of the teams without mentioning which one they preferred. Regarding creativity tools (regrouping mini creativity tools and creativity tools), 90,00 % of the teams used them and 64,29 % found them helpful, the first “succesful” component of the componential creative process. Teams which consulted mini tools guide used 2,69 creativity tools during the ideation session. The creativity guide was consulted by only two teams. At the 24th hour of the event, discussion with teams leaders and ambassadors helped us to understand the results: Creative processes were still too long to learn and use even with the coaching; the creativity guide was deficient and ambiguous, whereas mini creative tools were easy to learn and use.

From the 2013 componential creative process elaborated, we kept only the mini creativity tools. Inspired by the three steps of the Organizational creative process for organizations of Fisher and Amabile (2009), we developed a three steps creative process component. We completely revamped the creativity guide and created a short guide in three languages (we had the Spanish version in 2014). We had a team preparation component inspired again by Fisher and Amabile creative process to see if participants would find it useful: Discussions held with many teams in 2014 let us think it would.

Based on ESTIA winning teams secondary data analysis from 2007 to 2010, data collected and experience acquired from 2010 to 2014, we conceived a new component: A chronological guide, to give teams members a guide of the time to allow to steps. Our 2014 version of the componential creative process for short ideation sessions had five components: The same three components as in the 2013 version: creative process, mini creative tools and creativity guide, plus two new components, team preparation and chronological guide.

We had, like in 2013, teams leaders and ambassadors trained to use the components of our componential creative process. 119 persons participated in our research in 2014, giving for a confidence level of 95 %, a standard error of 0,04354 considering a proportion of 0,5. The creativity guide was consulted by 86,55 % of them. All those who consulted it found it helpful (100 %). Those who consulted the creativity guide component found the following other components helpful: Team preparation (100 %), chronological guide (86,55 %), creative process (63,11 %) and mini creative tools (62,14 %).

In chapter 5, we have interpreted the results from 2012 to 2014, discussed and compared them and proposed the 2015 version of our componential creative process. We may have found the reason why creative process and mini creative tools components were appreciated but not as much as the other components: The creative process steps were in fact part of the nine steps to follow in the chronological guide as well as the mini creative tools. In 2015, we proposed to merge these two components (creative process and mini creative tools) in the chronological guide component. We made adjustements to the components and experimented

the componential creative process for short ideation sessions composed of three components: Chronological guide, team preparation and creativity guide that will be experimented durong the 2015 edition of The 24 Hours.

Considering the experimentation made and the results obtained from 2012 to 2014, we could evaluate if we succeded to elaborate a componential creative process for short ideation sessions. The third objective of this research was that the componential creative process elaborated should be adopted and used by teams during short ideation sessions: 70,25 %[31] of all participants to our research in 2014 found the five components of our componential creative process for short ideation sessions helpful. The third objective was attained.

Our second objective was that all components of the componential creative process elaborated had to help participants to find a creative solution to the problem defined during a short ideation session. As results presented three paragraphs above show, all components exceeded the percentage of 50 % fixed: The second objective was attained.

Since all our components were helpful, we may conclude that we also reached our first objective which was that the componential creative process elaboarted had to be helpful to find creative ideas and creative solutions to problems during a short ideation session.

In short, to our research question: “How to elaborate a componential creative process for short ideation sessions?”, the answer can be: “By elaborating a five components creative process for short ideation sessions”. This componential creative process had many new components: Mini creativity tools created with simplified creativity tools, a chronological guide with time management guide for recommended steps, a simplified creative process component, a team preparation component and a simple and clear creativity guide. The success of our componential creative process for short ideation sessions was that its components presented steps guide to do an ideation session in respect of the time allowed.

[31] In table 4.13 (chapter 4), we considered the pourcentage of all the members who found helpful the five components of our 2014 componential creative process for short ideation sessions to calculate the percentage of 70,25 %.

In sum, we believe that our research presents original points that are as much a contribution to research in general.

CONTRIBUTIONS AND ORIGINALITY

The main contribution of our research was our creation of a new componential creative process with five components in 2014: A creativity guide component, a creative process component, mini creativity tools, team preparation and a chronological guide components (figure 4.3 in section 4.4.1). The 2014 version was modified to reach a three components version in 2015 (figure 5.1 in section 5.2). This research demonstrate its usefulness for short ideation session with participants doing an innovation event of 24 hours.

We had several secondary contributions from this research we oriented towards short sessions of ideation: Firstly, that proved to be a new temporal type of creativity sessions. So far, the creative process was used for either unplanned time which is improvisation, or for a time without constraints. This new temporal creativity session type led us define also new methodologies designed for short ideation sessions, with new types of creative processes and creativity tools.

Secondly, as far as creative processes are concerned, the elaboration of our creative process needed to select among many existing. For that, we had to create a creative process selection system since we did not find any. Nemiro's four types classification system helped us to define a new category of creative processes classification that we named "Other types", which included all creative processes we were not able to classify with Nemiro's approach. Depending on user's predefined selection criteria, our system combines classification and selection and provides a creative process based on the user's needs. It allowed us to reach a classification table for 39 creative processes (see table 3.3, section 3.2.2.2.). This classification and selection system for creative processes was never met before in researchers works.

Thirdly, for the same reason as the one of creative processes, we also created a classification and selection system for creativity tools: Depending on his needs, the user selects the quotes assigned to each of his criteria and our system selects and offers him the best creativity tools corresponding to his ratings. So, we proposed new standards criteria that could be applied in

future research on creativity tools. With our system, we were able to select nine creativity tools among the 615 we had initially, to do our 2012 experiment.

Fourth, most of the creativity tools, as creative processes, are not designed for short ideation sessions. We had to change existing creativity tools in a simplified version that we named "Mini creativity tools" that could be learned in five minutes or less in order to be used when time for creativity is restraint (sections 4.3.2 and 4.4.3).

Fifth, we found many existing creativity guides but they were used as standalone guides. Moreover, no one was a component of a creative process. We created a creativity guide added to a creative process as a component of it. This component was appreciated by 100 % of users who consulted it and, without exception, told it helped them create (see sections 4.4.1 and 4.4.11, and table 4.13).

The last contribution is that, since neither creative processes nor creativity tools had a chronological guide component (they were not made for short ideation sessions), we created and experimented a new component chronological guide in 2014 (sections 4.4.4 and table 4.14). It was appreciated by 86,55 % of participants at The 24 Hours.

In terms of the originality of our research, we could focus on our choice of The 24 Hours as a framework. Before us, other researchers used this same The 24 Hours: In France, Jérémy Legardeur, Denis Choulier and Bernard Monnier collected data from 2007 to 2010 to develop new projects evaluation methods for this competition (Legardeur, Choulier and Monnier, 2010, p. 177); at École de technologie supérieure of Montreal, Luz-Maria Jimenez designed and experimented a "collaborative information and communication technology platform to support creativity in innovation activities", based on The 24 Hours, as part of her Ph.D. thesis in 2013 (Jimenez, 2013); also, Ahmed Cherifi experimented an "innovative ecoconception method to support creativity" in his Ph.D thesis in 2015, also requiring the participation of The 24 Hours attendants. Among many advantages, we recall that The 24 Hours offer an unusual experimental framework that would be difficult to meet with companies. Yet, this competition is a mere sample for research that may benefit these companies. Therefore, as

the work of our predecessors, our experiment of a new creative process at The 24 Hours, whose ultimate goal is to be used mainly in companies, is an example of the kind of collaborative work a University could do for industry.

RECOMMENDATIONS AND FURTHER RESEARCH

The actual version of our componential creative process for short ideation session is for 24 hours. We will need to create a componential creative processes for all specific short period of times defined in this research (5 min, 10 min, 15 min, 30 min, 1h, 2h, 4h, 6h, 8h, 12h and 48h) and experiment them in Universities and companies. Companies and organizations will then be able to use our componential creative process adapted to the time allocated by them to their short ideation sessions.

We would like to select and experiment creative processes of the categorie “Other types” (the fifth category of creative processes) that we did not consider for this research: Would we be able to create an efficient creative process component with them? It would also be interesting to experiment a process with a different approach like TRIZ for example, a process that we could try to adapt for a short ideation session.

We also need to experiment the componential creative processes for short ideation sessions for all specific hours in different type of companies (startup, very small organizations, small companies, medium companies, large companies) and in different types of companies: Technology (aerospace, transport, electronics, computer science, health technology, etc.), health, arts, music, graphic, games, law, banks, finance, marketing, publicity, etc..

In a research article, we will need to refine and propose a standard classification system for creativity tools, and then, reclassify all existing creativity tools. With those classifications, we could select creativity tools for all specific short period of time defined for the componential creative process or for other use.

We will need to refine our creative processes selection system by establishing specific possible criteria and ratings for them. With that improvement, this system could be used by researchers needing a specific creative process.

We would like to create more mini creativity tools for steps of our componential creative process that could “respect, stretch and break the paradigm”. Experimented users may want

to choose different approaches of mini creativity tools to create. We will need to experiment all mini creativity tools to define them precisely (time to learn, to use, etc.).

Research should be made on a creativity evaluation method recognized by creative specialists to be added to our componential creative process to allow users appreciate the efficiency of their ideation sessions.

As mentioned in chapter 2, the field related to teamworks is a vast domain in creativity, psychology, management, etc. We would need to upgrade the team preparation component with recommandations issued from the most recent research in that field.

We will have to find the best eco innovation, risk management and Big Data components for short ideation sessions, comparing researchers' works in those domains.

We would like too to adapt the componential creative processes to non creative processes and different systems used in companies for innovation, quality management, or systems like PLM, Six Sigma, Lean, etc. The componential creative process for short ideation sessions could become a module or "plug in" to be used with those systems. We will need for that to do research to compare creative and non creative processes.

From our paper version of the componential creative processes for short ideation sessions, we would like to create interactive software versions for PC, Mac, Tablet PC, Ipad, Android Phone, Blackberry Phone and IPhone to facilitate its use and adoption. It could also be incorporated in existing collaboration software systems available on the market as a third parties software.

We would like to approach the ISO/TC 279 – Innovation management standards in development to see how we could adapt our componential creative process for short ideation sessions to comply with this standard. Our componential creative process for short ideation session could help companies to meet this new standard.

When experimenting our chronological guide component in 2014, we noted that it could possibly become a creative tension tool for creativity sessions. We need to realize research in this direction too.

Finally, we think that the software version of the componential creative process for short ideation sessions could become more interactive and, with the addition of an artificial intelligence “component”, it could be used as a creative process finding creative solutions autonomously, coupled with a Big Data software to explore the net in search of ideas for specific keywords, confronting ideas, doing bisassociation, using biomimetics and other creativity tools and approach. We would really like to pursue our research in this domain as part of a post-doc or in a different structure for example.

APPENDIX I

ÉTS Ethical consentment plans

A.I.1 2011

ÉTS
Le génie pour l'industrie

Comité d'éthique de la recherche
École de technologie supérieure

Date : 10 novembre 2011

OBJET : **Titre du projet :** Analyse des activités et le support pour les équipes qui réalisent des projets innovateurs lors de la compétition internationale des 24 h de l'innovation.

Responsable du projet : Mickaël Gardoni

Décision : APPROBATION FINALE

Monsieur,

Les modifications et précisions demandées par le CÉR dans sa lettre du 4 novembre 2011 ayant été apportées adéquatement, votre projet peut aller de l'avant.

Veuillez agréer, Monsieur, l'expression de mes sentiments les meilleurs. Veuillez toutefois noter que cette approbation n'est valable que pour une année. Vous devrez donc annuellement demander le renouvellement de l'approbation au Comité, sans quoi le projet sera considéré comme terminé. Dans la perspective où il devait être terminé, vous devrez fournir un rapport final suivant le modèle disponible sur la page Internet de l'ÉTS. Ce rapport est attendu pour le 31 mai 2013, soit environ 6 mois après la fin du présent certificat.

Veuillez agréer, Monsieur, l'expression de mes sentiments les meilleurs.

Caroline Chartrand, M.Sc.
Secrétaire
Comité d'éthique de la recherche

A.I.2 2012

Comité d'éthique de la recherche
École de technologie supérieure

Date : 22 mai 2012

Objet : **Titre du projet :** Analyse des activités lors d'utilisation de méthodologies ou des outils pour la stimulation de la compétition internationale 24h d'innovation et autre activités de recherche (Modification)

Responsable du projet : Mickael Gardoni

Décision : APPROBATION FINALE

Monsieur,

Les modifications et précisions demandées par le CÉR dans sa lettre du 18 mai 2012 ayant été apportées adéquatement, votre projet peut aller de l'avant.

Veuillez agréer, Monsieur, l'expression de mes sentiments les meilleurs.

Caroline Chartrand, M.Sc.
Secrétaire
Comité d'éthique de la recherche

c.c. : Claude Bédard, doyen de la recherche
Paul Gervais, président du CÉR de l'ÉTS

A.I.3 2013

Le génie pour l'industrie

Comité d'éthique de la recherche
École de technologie supérieure

Date : 27 novembre 2013 — Modification

CÉRIT : **Titre du projet :** Analyse des activités lors d'utilisation de méthodologies ou des outils pour la stimulation de la compétition internationale 24h d'innovation et autre activités de recherche

Responsable du projet : Mickael Gardoni

Décision : APPROBATION FINALE

Monsieur,

Les modifications et précisions demandées par le CÉR dans sa lettre du 7 novembre dernier ayant été apportées adéquatement, votre projet peut aller de l'avant.

Veuillez agréer, Monsieur, l'expression de mes sentiments les meilleurs.

Caroline Chartrand, M.Sc.
Coordonnatrice
Comité d'éthique de la recherche

c.c. : Claude Bédard, doyen de la recherche
[illegible], président du CÉR de l'ÉTS

APPENDIX II

Other creative processes

A.II.1 "Synectics" creative process of Gordon and Prince (1961)

Mycoted (2014) presents Synectics as being based on a simple concept of solving creative problems and thoughts with which ideas are generated and results evaluated (*mycoted.com* / *synectics*). According to Carrier and Gélinas, the analogy is involved here at different levels:

> First formulate the problem in the form of questions to identify an analogy to the problem, and that can evoke a potential solution to better detach from the current situation. […]The analogy comes then to help reformulate the problem from a completely new angle. […]Working from the challenge now formulated differently, one will seek a potentially adaptable solution to the problem originally posed. (Carrier and Gélinas, 2011, p. 111) (Free translation[32]).

This creative process (Figure A.II.1) was put in place after the analysis of several thousand creativity sessions (Nolan, 2003).

[32] "Formuler d'abord le problème sous forme de questions pour identifier une analogie au problème rencontré et qui puisse évoquer une solution potentielle dans le but de mieux se détacher de la situation actuelle. […] L'analogie vient ensuite aider à reformuler le problème sous un angle totalement nouveau. […] En travaillant à partir du défi maintenant formulé autrement, on cherchera une solution potentiellement adaptable au problème initialement posé" (Carrier and Gélinas, 2011, p. 111).

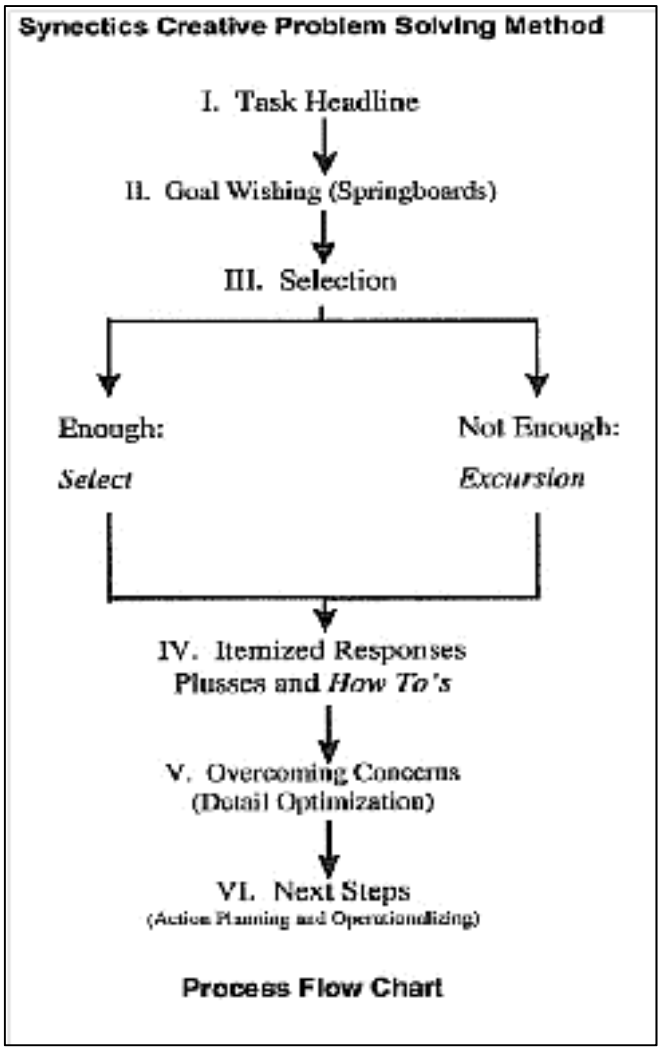


Figure A.II.1 Synectics creative process
Taken from Gordon and Prince (1961)

Paul Plsek (1996) also presents the model of Koberg and Bagnall (1981) which is similar. Plsek writes:

> Again, notice that ideation, the traditional focus of creative thinking tools such as Brainstorming, is proceeded and followed by deliberate analytical and practical thinking. Also note the importance that Koberg and Bagnell place on accepting the situation as a personal challenge. This is consistent with the research into the lives of great creators that illustrates the importance of focusing and caring deeply. (See, for example, Weisberg 1993, Wallace and Gruber 1992, Gardner 1994, and Ghiselin 1952.) Finally, note that the final step of this model support the notion of continuous innovation (Paul Plsek, 1996).

We reproduce here the table in which he presents the process of Koberg and Bagnall.

Table A.II.1 Koberg and Bagnall's Universal Traveler Model
Taken from Plsek (1996)

Koberg and Bagnall's Universal Traveler Model
Accept the situation (as a challenge)
Analyze (to discover the "world of the problem")
Define (the main issues and goals)
Ideate (to generate options)
Select (to choose among options)
Implement (to give physical form to the idea)
Evaluate (to review and plan again)

A.II.2 "TRIZ" creative process of Artshuller (2004)

A different type of creative process called Triz, a russian acronym meaning "Theory of Inventive Problem Solving", was conceived by the Russian engineer Genrich Artshuller (Artshuller, 2004). He analyzed 40,000 patents and found that 95 % of those had many characteristics and common points (Aznar, 2005). From his study, Artshuller has regrouped 40 base principles and 8 laws of evolution for technical systems (Carrier and Gélinas (2011).

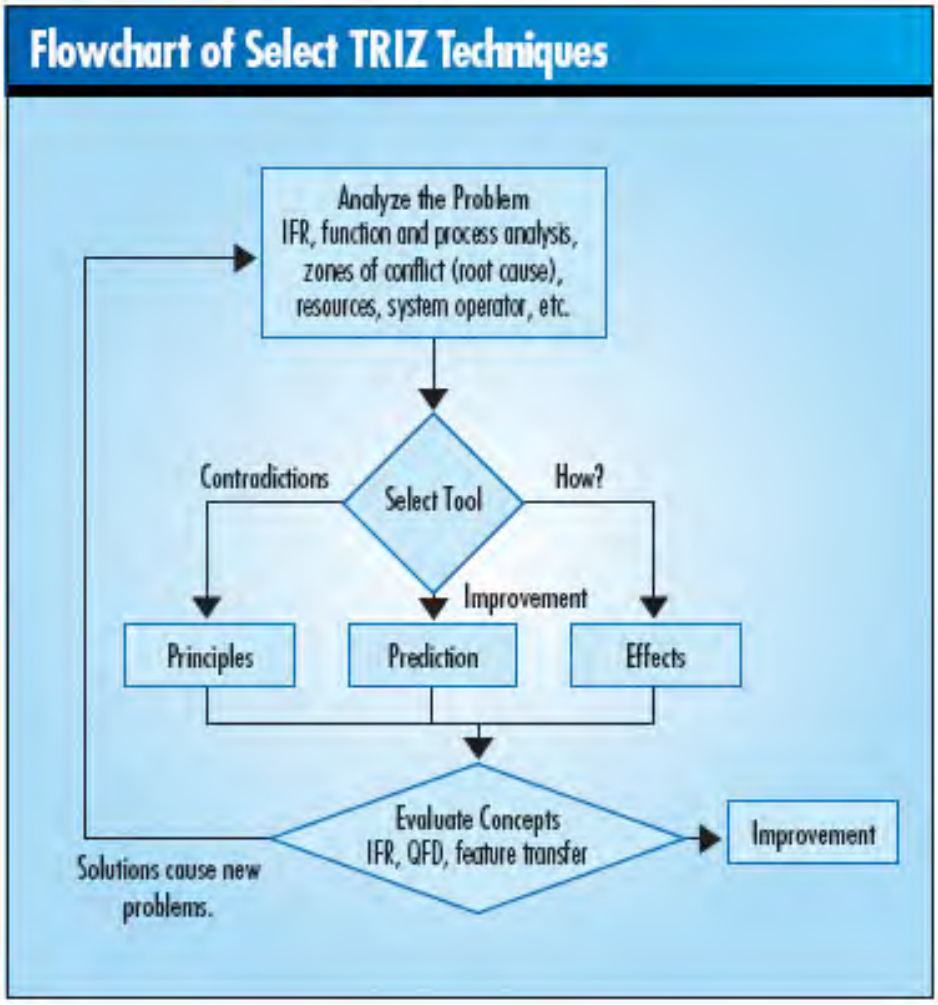


Figure A.II.2.1 Triz general logogram illustrating many Triz tools
Taken from Domb (Undated)

Carrier and Gélinas (2011, p. 112) help to understand the aspects of the previous figure:

> The principles are the mechanisms that could be called technical analogies - generic and transferable to help solve other problems - for imagining and systematically solve similar contradictions in the context of other technical challenges. As for laws, they refer to what governs every essential technical system. So, one will be continuously inspired to optimize the process or processes that you want the most efficient and requiring the least amount of resources. (Carrier and Gélinas, 2011, p. 112) (Free translation[33]).

[33] "Les principes représentent des mécanismes que l'on pourrait qualifier d'analogies techniques – génériques et transférables pour aider à résoudre d'autres problèmes – servant à imaginer et à résoudre systématiquement des contradictions similaires dans le cadre d'autres défis techniques. Quant aux lois, elles renvoient à ce qui régit de façon incontournable tout système technique. On s'en inspirera donc en permanence pour optimiser le ou les processus, que l'on veut le plus efficace et requérant le moins de ressources possibles" (Carrier and Gélinas, 2011, p. 112).

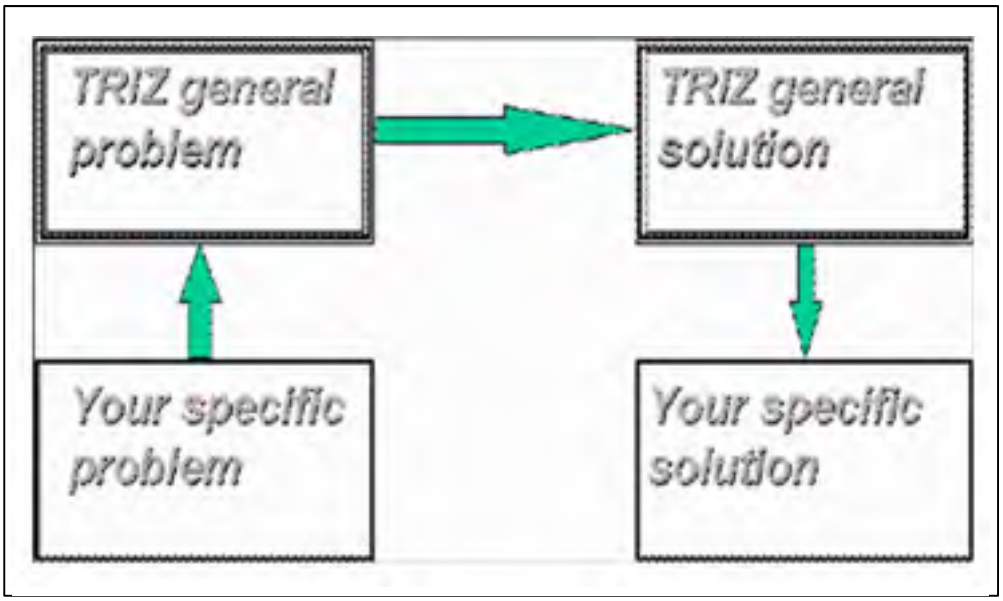


Figure A.II.2.2 Triz general model of Artshuller
Taken from *The TRIZ Journal* (1996)

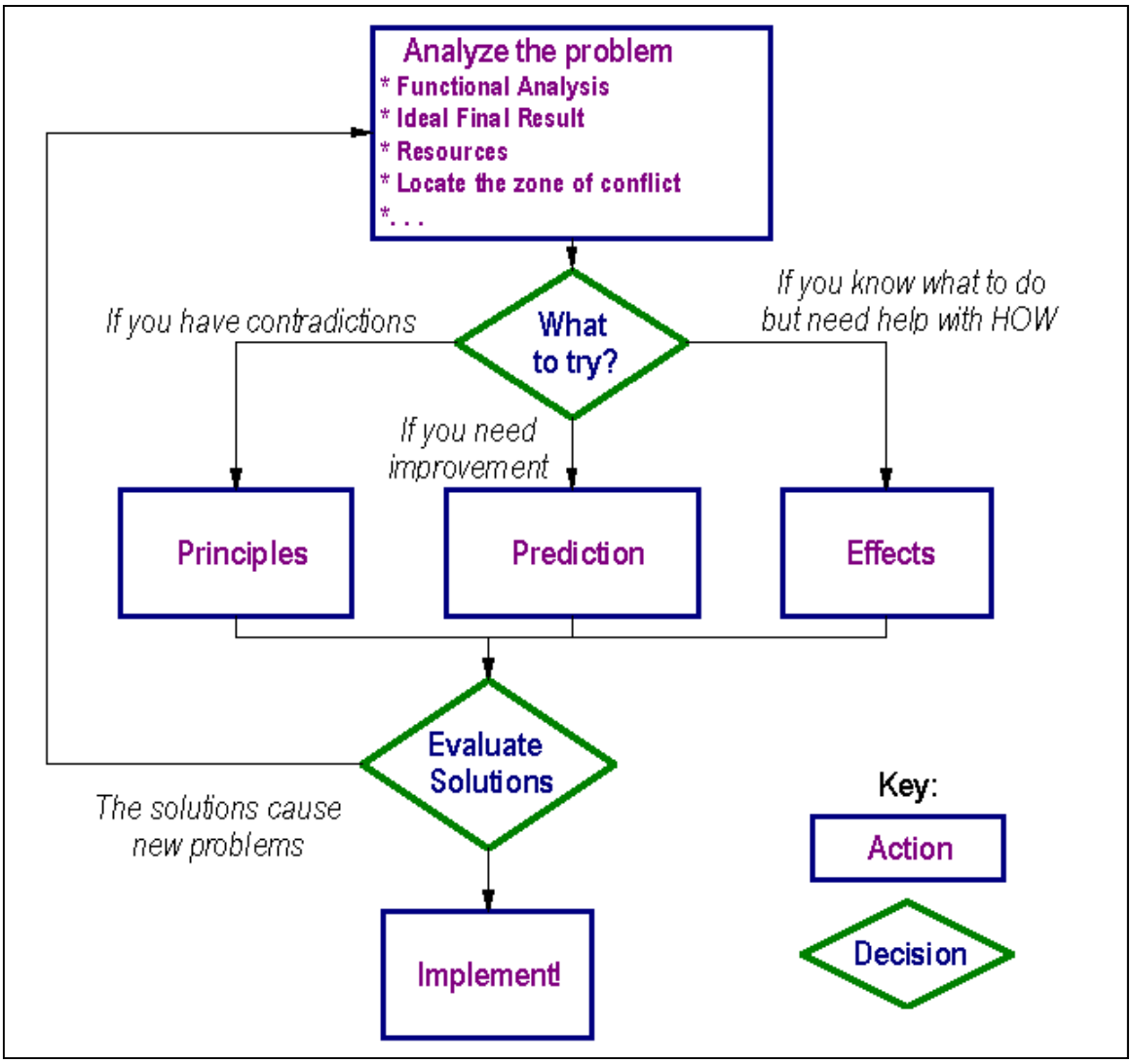


Figure A.II.2.3 General Triz logigram illustrating different tools of Triz
Taken from Artshuller (2004). The "S-Field Analysis" (used for difficult problems) and "ARIZ", the Inventive Problem Solving Algorithm, are not illustrated here.

A.II.3 Geneplore Model creative process of Finke *et al.* (1992)

In 1992, Finke *et al.* proposed the Geneplore Model creative process in which creativity takes place in two phases. The first phase is generating ideas, during which an individual constructs mental representations called pre-inventive structures. The second phase is the exploratory one, in which these structures are used to find creative ideas. According to Dunn and Roppolo (2010), this process occurs under the constant effect of the constraints of the product or service to develop (See figure A.II.4).

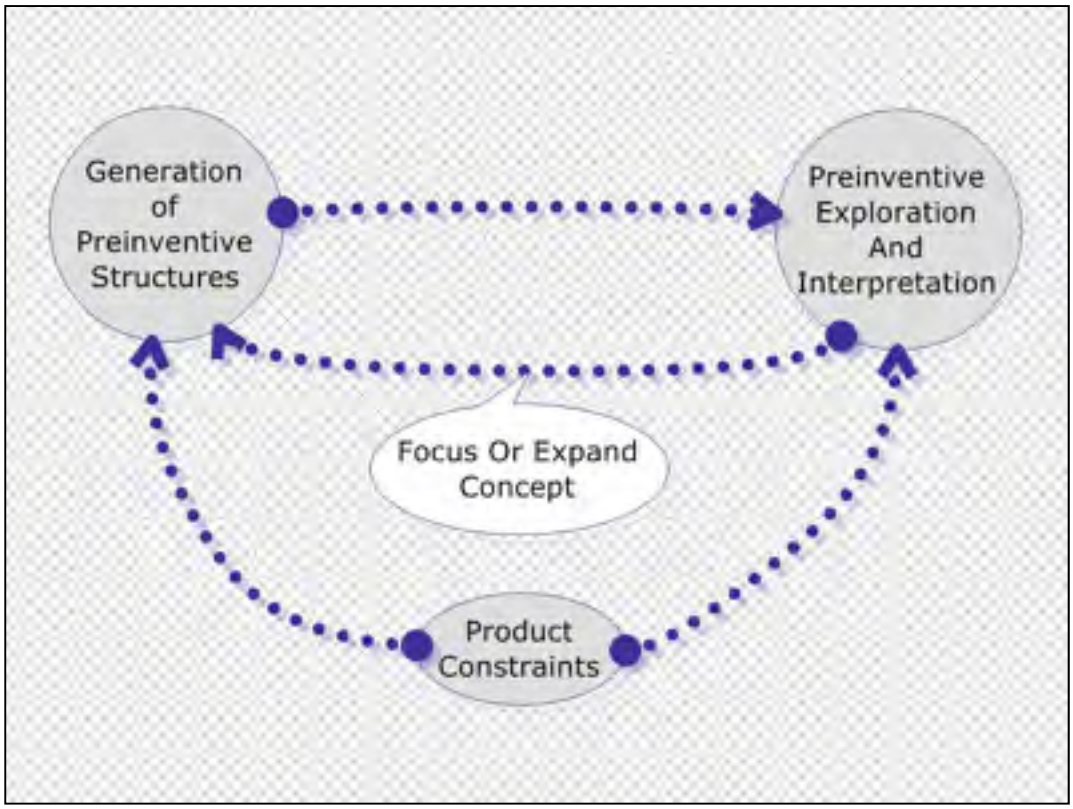


Figure A.II.3 Geneplore Model
Taken from Finke *et al*. (1992)

In order to understand the Geneplore Model process of creativity, Dunn and Roppolo (2010) propose an analogy to grow flowers from seed. Seed envelopes represent the pre-inventive structure. For the flowers to grow, the constraints of the product to be considered should take into account the size of the pot, climate and sunshine. The generative process would consist of various combinations attempts experienced in the past in relation to the soil, types of flowers, the amount of water, light, etc. Seed germination process would be part of the generative process. The success would take the form of a combination of products, processes and variables that have allowed plants to grow and flourish.

A.II.4 Conceptual Blending creative process of Fauconnier and Turner (2008)

The Conceptual Blending (figure A.II.5) of Gilles Fauconnier and Mark Turner (2008) consists "to construct a partial match between two inputs, to project selectively from those inputs into a novel "blended" mental space, which then dynamically develops emergent structure".

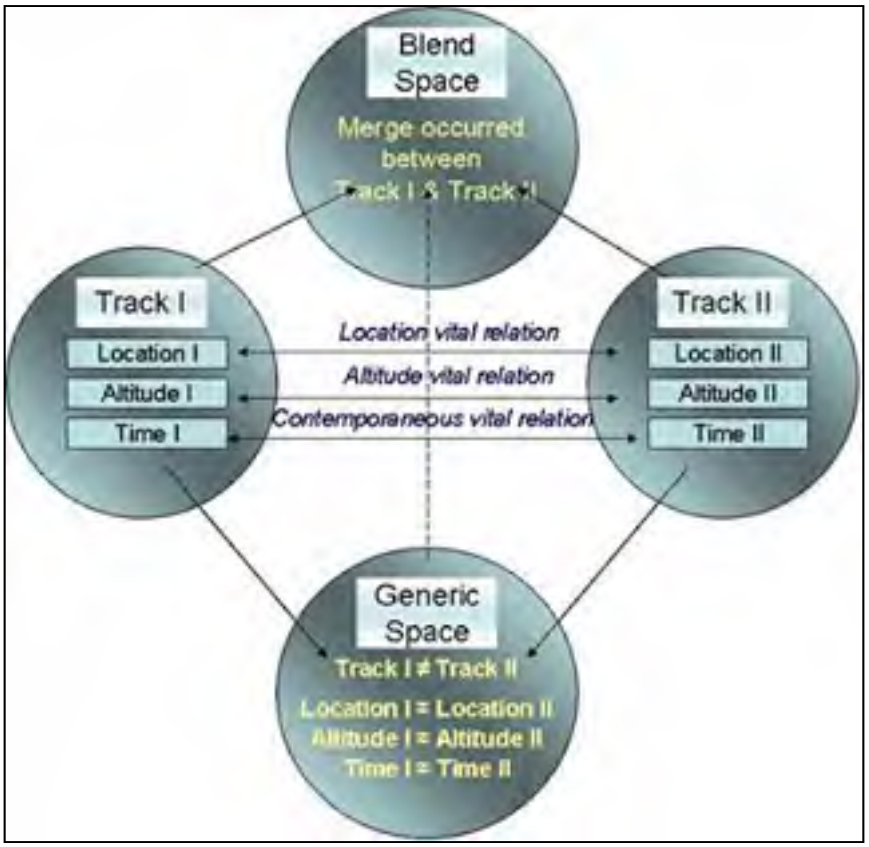


Figure A.II.4 Conceptual Blending of Fauconnier and Turner
Taken from Ozkan *et al*. (2004, p. 84)

A.II.5 Explicit-Implicit Interaction (EII) creative process of Helie and Sun (2010)

For Helie and Sun, the concept of Explicit-Implicit Interaction process (EII) is mainly based on five basic principles: coexistence and difference between explicit and implicit knowledge, simultaneous involvement of implicit and explicit processes in most tasks, redundant representation of implicit and explicit knowledge, explicit and implicit integrating of the results of processes, the iterative process (and possibly bidirectional) treatment (See figure A.II.5).

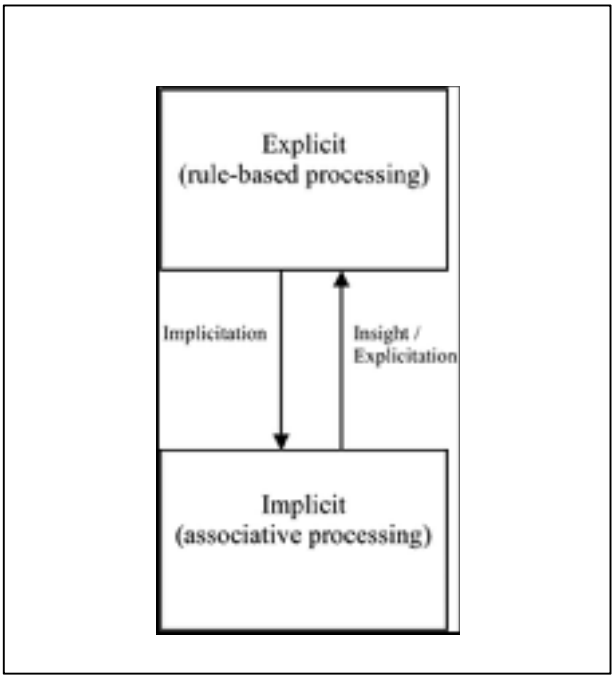


Figure A.II.5 Explicit-Implicit Interaction (EII)
Taken from Helie and Sun (2010)

A.II.6 Honing Theory creative process of Liane Gabora (2005)

The Honing Theory creative process of Liane Gabora has 7 stages is based on the theories of creativity (See figure A.II.6).

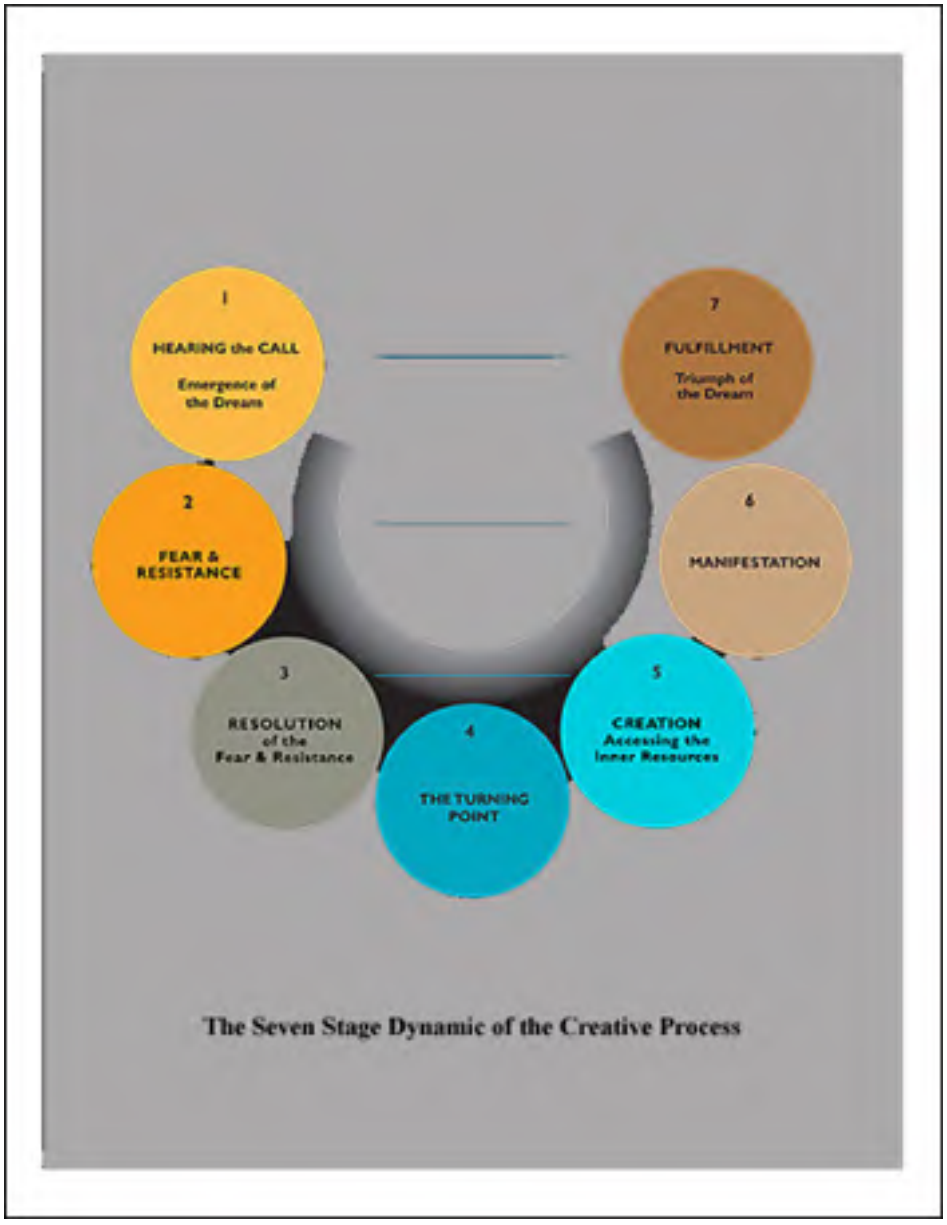


Figure A.II.6 Honing Theory of Gabora
Taken from *Creativityland.inc* (2010)

A.II.7 "Six Thinking Hats" tool of Edward de Bono (2010)

The "Six Thinking Hats" method which uses in its components the linear approach and the intuitive approach is seen by some authors as a creativity tool that can be used as a process. The six caps (except the red one, see table A.II.8) of this method can be combined with creative processes of the linear approach; the white hat and the red one can be associated with the process steps of the intuitive approach.

Table A.II.7 The Six Thinking Hats tool of de Bono
Taken from Kappeleris (2015)

COLOURED HAT	THINK OF	DETAILED DESCRIPTION
	***White paper***	The white hat is about data and information. It is used to record information that is currently available and to identify further information that may be needed.
	***Fire and warmth***	The red hat is associated with feelings, intuition, and emotion. The red hat allows people to put forward feelings without justification or prejudice.
	***Sunshine***	The yellow hat is for a positive view of things. It looks for benefits in a situation. This hat encourages a positive view even in people who are always critical.
	***A stern judge***	The black hat relates to caution. It is used for critical judgement. Sometimes it is easy to overuse the black hat.
	***Vegetation and rich growth***	The green hat is for creative thinking and generating new ideas. This is your creative thinking cap.
	***The sky and overview***	The blue hat is about process control. It is used for thinking about thinking. The blue hat asks for summaries, conclusions and decisions.

APPENDIX III

Creativity tools associated with creative processes steps

A.III.1 Creativity tools selection

As we said in our thesis, we identified to date 615 creativity tools, among which we have classified 234 in order to optimize their usage according to the needs of their users and produce a creativity guide. In the context of this creativity guide that we produced, we have selected creativity tools associated with creative processes steps we retained for 2012-2013.

A.III.2 Selection criteria

Chosen creativity tools and in this appendix have the following characteristics:

1. They are used depending on the divergence or convergence;
2. They are associated with one of the steps of the creative processes shown in the previous appendix. Therefore, during the ideation sessions, they must be used with the creative process;
3. They are easy to learn and use;
4. Most of the creativity tools can be used with more than one creative process;
5. They facilitate the achievement of the corresponding step and improve outputs.

A.III.3 Creativity tools assigned to the three selected creative processes in 2012-2013

The current Appendix presents 10 creativity tools assigned to the steps of the three creative processes we selected. These tools are:

1. Target Future
2. 5W and H
3. Is – Is not
4. Drive
5. Brainstorming
6. SCAMMPERR
7. Yellow Box
8. Delphi
9. Action Plan
10. Project Management

A.III.3.1 Target Future

This creativity tool is recommended for the creative processes steps described below:

CPS Thinking Skills Model
Phase 1: Clarification
Step 1: Exploring the vision
Time: Divergence and convergence;

ThinkX NASA Productive Thinking Model
Step 2: What's the success?
Time: Divergence and convergence

Presentation and operation
Relatively simple, Target Future was invented by Hurson (2007), the creator of ThinkX creative process. Manktelow *et al.* (2014b) propose to use this tool beginning by writing down all possible future targets and then select those that are important and achievable.

A.III.3.2 5W and H

5W and H (W for What, Why, When, Where, Who, and H for How) is recommended for the steps of the following processes:

CPS Thinking Skills Model
Phase 1: Clarification
Step 2: Formulating challenges
Time: Divergence and convergence

ThinkX NASA Productive Thinking Model
Step 2: What's the success?
Time: Divergence and convergence

Presentation and operation
5W and H creativity tool was invented in 1902 by Rudyard Kipling in "The Elephant Child" poetic tale for children (Sharp, 2002):

> I keep six honest serving-men
> (They taught me all I knew);
> Their names are What and Why and When
> And How and Where and Who […] (R. Kipling, 1912, p. 83.)

5W and H is also called the Kipling method in honor of its creator. According to Möller *et al.* (2014), it allows you to explore an issue or extend ideas by asking questions using the interrogative pronouns of the letters W and H. These questions, "What", "Where", "When", "How", "Why" and "Who" will challenge perceptions of time and force to raise new questions, leading to see the problem from different angles.

Straker (2015) proposes to broaden the issues by adding a word:

Why not?
What time?
What place?
Who can?
Where else?

Or to ask a planned sequence of questions, such as:

What is the problem?
Where is it?
When did it happen?
Why does this happen?
How can you fix it?
Who do you need to get involved?
When will you know that you solved the problem?

Smith (2014) proposes to associate the questions with locations, sequences, people, and means:

Location:	Where is it done?
	Why is it done?
	Where else could it be done?
	Where should it be done?
Sequence:	When is it done?
	Why is it then?
	When can it be done?
	When to do?
Person:	Who is the person?
	Why does the person do it?
	Who else could do it?
	Who should do it?
Means:	How is it done?
	Why is it done this way?
	Otherwise, how could it be done?
	How should it be done?

A.III.3.3 Is – Is not

This creativity tool with a time of divergence and convergence is recommended for the stages of the creative processes described below:

CPS Thinking Skills Model
Phase 1: Clarification
Step 2: Formulating challenges
Time: Divergence and convergence

ThinkX NASA Productive Thinking Model
Step 1: What's going on?
Time: Divergence and convergence;

Componential creative process for organization
Step 1: External problem presentation
Time: Divergence and convergence.

Equipment required: large sheets of paper and pencils or colored markers or whiteboard.

Presentation and operation
Hohmann presents this tool in these words:

> An approach to simplify and focus on problem solving, very useful to define what is part of the (scope of) the problem at hand and clarify the input data. Overall, it is to discriminate what is included in the analysis and problem solving and what should be excluded (Hohman, 2012) (Free translation).

This tool works by developing a matrix consisting of at least two columns "Is" and "Is not" and four lines Who, What, Where and when (Hohman, 2012). It is possible to add columns, for example to identify data and documents, describe the possible causes and future actions as in table A.III.3.3 below (Hoerl and Snee, 2002; Hohman, 2012).

The matrix developed will enable to show whether the chosen problem is too small, appropriate or too large for work of ideation. If it is too big, the problem may perhaps consist in several. If it is too small, other elements may perhaps be added. Once the size of the problem is clarified, the matrix "Is - Is not" will help define it. His statement must be crystal clear, simple, and easy to understand. A simple way to check whether the statement meets the criteria is to have it read by many people and ask them what they understand (Britz *et al.*, 2000; Hoerl and Snee, 2002; Hohman, 2012 ; Smith and Adams, 2001).

Table A.III.3.3 Example of "Is – Is not" matrix
from a case study by Hoerl and Snee
Taken from Clark, Gordon (2008)
(No known restriction usage)

	Is	Is Not	Possible Causes	Further Action
Where	Johnstown Plant	Centerville Plant	Equipment (pillers), inspection procedures, fruit variety	Interview plant management
What	Pit fragments less than 1/16"	No fragments larger than 1/16"	Improperly maintained pillers, piller performance data Line speeds	Analyze maintenance logs and production records
When	Production after July 30	Production before July 30	Change in fruit characteristics Pitter performance	Analyze maintenance logs, production records, and fruit characteristics
Who	Smith, Abbot Farms	All other farms	Soft fruit	Measure fruit softness

A.III.3.4 Drive

This creativity tool with a time of divergence and convergence is recommended for the stages of the creative processes described below:

ThinkX NASA Productive Thinking Model
Step 1: What's going on?
Time: Divergence

Presentation
This creativity tool is actually a list of questions whose first English letters correspond to the acronym "DRIVE". Manketelow (2014b) describes these questions:

Do:	What do you want the solution to do?
Restrictions:	What must the solution absolutely do?
Investment:	What resources are available? What can you invest in the solution? How much time do you have?
Values:	What are the values this solution must meet or incorporate?

Essential outcomes: What defines success in this case? How do you measure it?

A.III.3.5 Brainstorming

Brainstorming is recommended for the stages of the creative processes described below:

CPS Thinking Skills Model
Phase 2: Transformation
Step 3: Exploring Ideas
Time: Divergence

ThinkX NASA Productive Thinking Model
Step 4: Generate answers
Time: Divergence

Componential creative process for organization
Step 2: Response generation

Presentation
Created in 1953 by Alex Osborn, the author of the CPS linear creative process, Brainstorming is the best-known creativity tool most often used worldwide (de Bono, 1992b; McFadzean, 1998b; Schnetzler, 2005). The dictionary gives this definition of Brainstorming :

> Process for generating creative ideas and solutions through intensive and freewheeling group discussion. Every participant is encouraged to think aloud and suggest as many ideas as possible, no matter seemingly how outlandish or bizarre. Analysis, discussion, or criticism of the aired ideas is allowed only when the Brainstorming session is over and evaluation session begins (*Business Dictionary*, 2014).

Operation
Participants emit ideas a secretary registers Post It ™ pasted on a wall. A facilitator is useful to encourage the issuance of ideas and recall the operating rules (below) (Bachelet 2012; Carrier and Gelinas, 2011; Cournoyer, 2014b; Manktelow *et al*, 2014b; Straker, 2014):

1. No censorship, think freely without negative review
2. Equality: all ideas have the same value
3. Evolution: use the ideas of others to make them evolve
4. Consideration: respect for others, no judgment
5. Recording: any note or record (movie, writing)
6. Discipline: one idea at a time
7. Originality: every idea deserves to be set

Euipment required: pencils and Post It ™ to record ideas.

A.III.3.6 SCAMMPERR

SCAMMPER is recommended for the stages of the creative processes described below:

CPS Thinking Skills Model
Phase 2: Transformation
Step 3: Exploring ideas
Time: Convergence

ThinkX NASA Productive Thinking Model:
Step 4: Generate answers
Time: Convergence

Componential creative process for organization:
Step 2: Response generation
Time: Convergence

Table A.III.3.6 Illustration of the creativity tool SCAMMPERR
Taken from Mycoted (2014)

SCAMMPERR stands for	
S	**Substitute** – components, materials, people
C	**Combine** – mix, combine with other assemblies or services, integrate
A	**Adapt** – alter, change function, use part of another element
M	Magnify – Make it enormous, longer, higher, overstated, added features
M	Modify – increase or reduce in scale, change shape, modify attributes (e.g. colour)
P	Put to one another
E	Eliminate – remove elements, simplify, reduce to core functionality
R	Rearrange – change the order, interchange components, change the speed or other pattern
R	Reverse – turn inside out or upside down.

Presentation
SCAMMPERR is an English acronym whose letters are the 9 appearing in figure above. It was invented by Robert F. Eberle in 1972. He was inspired by a series of 83 issues sent by Alex Osborn (Eberle, 1972; Jarrard, 2014). This convergent creativity tool is used well complementarity to Brainstorming.

Operation
SCAMMPER is used in a checklist that allows you to ask questions about the ideas found using each of the nine terms of the figure. These questions will help find creative ideas for new products development by improving the ideas found (Carrier and Gélinas, 2011; Cournoyer, 2014a; Kilbride, 2003; Manktelow *et al*., 2014a; Mycoted, 2014a; Training Course Material, 2013)**.** For each idea, the participants will ask whether it is possible to substitute something in the idea found, to combine ideas, adapt them, etc.

Equipment
Large sheets of paper and markers of different colors.

A.III.3.7 Yellow Box

Yellow Box is recommended for the stages of the creative processes described below:

CPS Thinking Skills Model
- Phase 2: Transformation
- Step 4: Formulating solutions
- Time: Convergence

ThinkX NASA Productive Thinking Model
- Step 4: Generate answers
- Time: Convergence

Componential creative process for organization
- Step 3: Response execution
- Time: Convergence.

Presentation
Yellow Box was created by the consultant in creativity Mark Raison (*Creative Wallonia*, 2014; Raison, 2014). Here is how the website *Yellow Ideas* explains this tool: "Yellow box is a simple evaluation technique, quick and efficient which allows to simply classify ideas through color coded and especially to avoid creadox[34] in not losing along the way the boldest and most original ideas" (*Yellow Ideas*, 2012. Free translation).

Operation
The ideas found should be written on Post IT™ and numbered from 1 to X. Participants are given a card containing twelve stickers (brand Herma Reference No. 1851) of four different colors, each one corresponding to one idea. In fact, there are four kinds of ideas: The blue, green, red, and yellow (*Yellow Ideas*, 2012). They have to read all of the issued ideas and assign to each a corresponding color signifying respectively what is indicated in table A.III.3.7. This table contains a fifth color which was added by Carrier and Gélinas (2011):

[34] "When people want to develop new ideas, they most often think out of the box in the Brainstorming or divergent phase. However, when it comes to convergence, people often end up picking ideas that are most familiar to them. This is called a 'creative paradox' or a 'creadox'". Nitya Wakhlu, 2011.

Table A.III.3.7 Six color Yellow Box
Taken from Carrier and Gélinas (2011)

	Quick and easy idea to implement
	Improvement – implementation: it may ask some effort
	Very different idea of the usual ways of doing
	Visionary idea that can be difficult to implement
	Idea candid, trustful, which may progress to a new approach

Participants should read the ideas expressed on the sticker and write the number of the ideas they like as ranked corresponding to the colors. They cannot put more than one sticker per idea restraint. Whenever possible, they should allocate 48 stickers to the ideas expressed (or 60 stickers, if they prefer the five color classification system proposed by Carrier and Gélinas (2011)).

When all participants have finished reading the ideas, they can stick their stickers on Post IT ™. On a table of four columns (or five, corresponding to the four or five color grading ideas), participants will place the ideas which have obtained more than 3 or 4 votes. The group then selects two ideas of each color they develop to improve them. After developing these 8 or 10 ideas, they select the idea or ideas representing the best solution (Carrier and Gélinas, 2011; Reason, 2014).

Equipment required
Large sheets of paper and markers of different colors; Brand color of stickers Herma reference No. 1851 or something similar.

A.III.3.8 Delphi

Delphi is recommended for the stages of the creative processes described below:

CPS Thinking Skills Model
Phase 3: Implementation
Step 5: Exploring Acceptation
Time: Divergence and convergence

Presentation
Delphi was created by Olaf Helmer, Nicholas Rescher, Norman Dalkey and others of RAND Corporation in the 1950's (*Rand Corporation*, 1967). The name Delphi refers to the predictions or oracles made in the city of Delphi in Greece in the 2nd century BC (Gordon, 1994). This method was conceived in order to try to understand the future and make

predictions in scientific and technological domains (Dalkey and Helmer, 1963; Gordon and Helmer, 1964; Helmer and Rescher, 1958; Sackman, 1974; Somerville, 2008). In 1967, it was described in these terms: "The Delphi method solicits the opinions of experts through a series of carefully designed questionnaires interspersed with information and opinion feedback in order to establish a convergence of opinion" (*Rand Corporation*, 1967).

> The method entails a group of experts who anonymously reply to questionnaires and subsequently receive feedback in the form of a statistical representation of the "group response", after which the process repeats itself. The goal is to reduce the range of responses and arrive at something closer to expert consensus. The Delphi Method has been widely adopted and is still in use today (*Rand Corporation*, 2014).

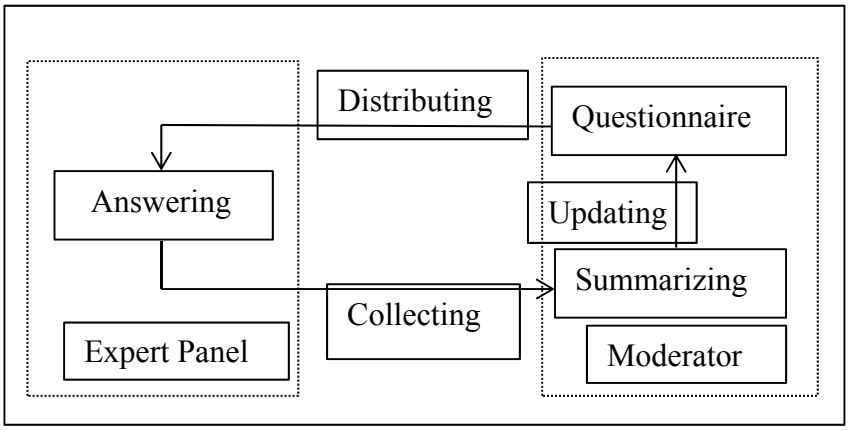


Figure A.III.3.8.1 The procedure of a Delphi Survey
Taken from Yao and Liu (2006, p. 2)
No restrictions usage known)

According to Gordon and Helmer (1964), and Sackman (1974), the Delphi method may include the following:

> A questionnaire whose elements can be designed by the moderator, panelists or both; it may include open-ended questions or not;
>
> Measurement scales quantitative or qualitative;
>
> Two more rounds of questioning of experts;
>
> Comments: they are issued at every turn as textual or statistical information usually involving a measure of central tendency and a measure of dispersion;
>
> Individual responses to items made anonymously;
>
> An iterative feedback until reaching a consensus and as determined by the moderator;

Participants do not answer questions face to face and can be dispersed geographically; Those who have given higher or lower values may be asked to justify their answers in writing.

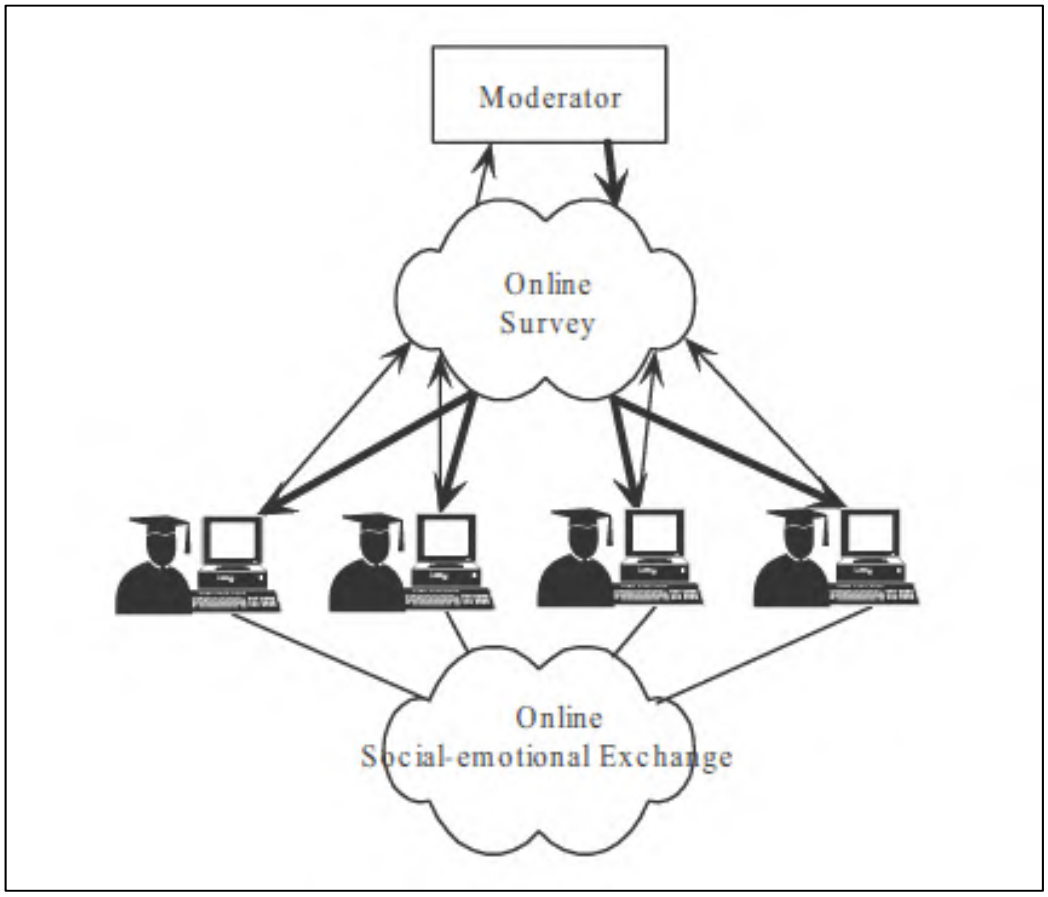


Figure A.IV.3.8.2 General Representation of a process achieved with Delphi
Taken from Lindqvist and Nordänger (2007, p. 3.)

“E-Delphi” digital tool

The Delphi method has the main disadvantage the length of time of realization. Time is required to build the questionnaires sent by mail, to take the experts to complete the questionnaires and return them by mail, not to mention the fact that Delphi often requires more than a round of questions (Chou, 2002). The digital version of “E-Delphi” or “Real-time Delphi” (Wiersma and Jurs, 2005; Chou, 2002) on the Web accelerates the management of the round of questions, as shown in figure A.III.3.8.3.

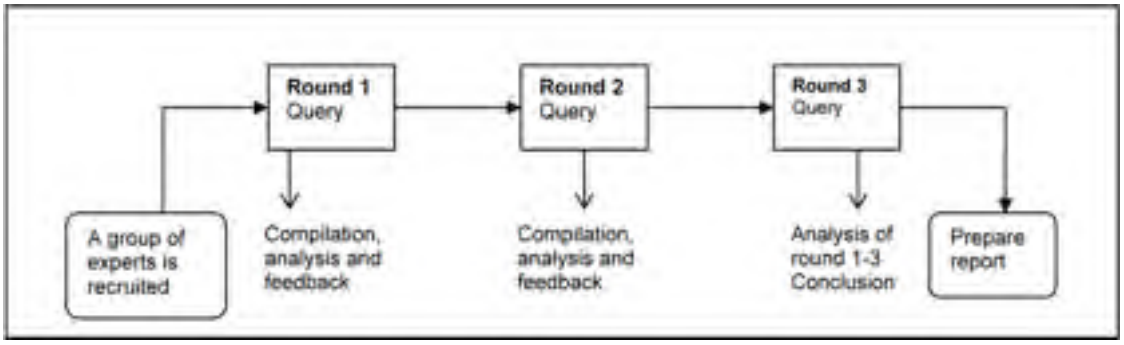


Figure A.III.3.8.3 E-Delphi Web comunication mode
Taken from Yao and Liu (2006, p. 3.)

A.III.3.9 Action Plan and Project Management

Action plan and Project management are not creativity tools. They are among the tools to be used to implant the idea retained. They are recommended for the steps of creative process described below:

CPS Thinking Skills Model
Phase 3: Implementation
Step 6: Formulating a plan
Time: Divergence and convergence

ThinkX NASA Productive Thinking Model
Step 6: Align resources
Time: Divergence and convergence

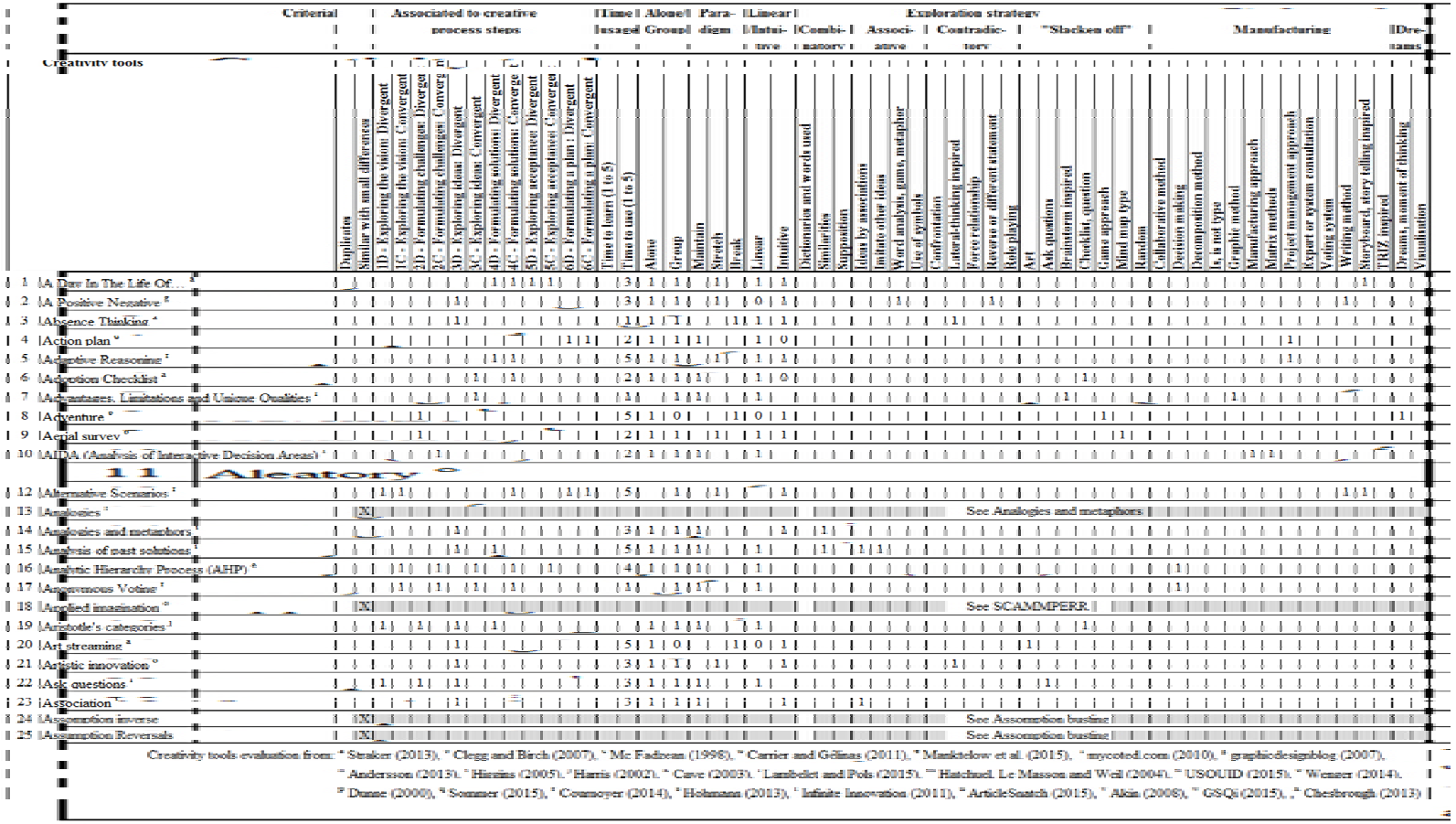
Presentation
For Carrier and Gélinas (2011), the action plan "aims to identify the steps and actions to be taken to complete a project, a challenge or solve a problem". It is recommended for ideation projects of low to moderate magnitude. For a project of greater magnitude, it is recommended to develop a project management plan using a method established, like the Project Management Body of Knowledge (PMI, 2013).

Operation
Carrier and Gélinas (2011) propose, for a simple action plan, to do it in four steps:
1. In divergence time, Brainstorming to explore all actions that must be performed to implant the idea;
2. In convergence time, make a selection of key actions that will be retained;
3. Group ideas according to their completion time (short, medium and long term) and arrange them in a logical order of realization;
4. Analyze each of the actions to define responsibilities, success criteria, deadlines, etc.

APPENDIX IV

Creativity tools selection process

A.IV.1 Creativity tools: First set of selection from 615 to 325 creativity tools



Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mankiewicz et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2015), [i] Hiemins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USOUID (2015), [o] Wenner (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holsmans (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013)

No.	Creativity tools	Criteria: Duplicates	Criteria: Similar with small differences	Associated to creative process steps: 1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time usage: Time to learn (1 to 5)	Time usage: Time to use (1 to 5)	Alone/Group: Alone	Alone/Group: Group	Paradigm: Maintain	Paradigm: Stretch	Paradigm: Break	Linear/Intuitive: Linear	Linear/Intuitive: Intuitive
26	Assumption Smashing	X																						
27	Assumption Surfacing [r]		X																					
28	Assumption-busting [a, r]					1		1									2	1	1		1		1	1
29	Attribute analysis	X																						
30	Attribute domain matrix		X																					
31	Attribute Listing [a, c, e, r]					1		1									2	1	1	1			1	0
32	Axiomatic design [o]			1	1	1	1										4	1	1	1			1	
33	Backwards Forwards Planning [r]					1	1										2	1	1		1		1	
34	Basecamp	X																						
35	Basic Associative Process [o]							1									3	1			1			1
36	Beachhead [o]							1									4		1			1		1
37	biognosis (voir bionic)	X																						
38	bio-inspiration (voir bionic)	X																						
39	Biomimetics [i]							1									3	1	1		1			1
40	biomimicry	X																						
41	Bionical creativity engineering (voir bionic)	X																						
42	Bionics	X																						
43	Block busting [j]							1									3		1		1			1
44	Blocking	X																						
45	Bodystorming [r]		X																					
46	Borrowed Genius [o]							1									3	1	1			1		1
47	Boundary Examination [t]			1		1											3	1	1	1			1	
48	Boundary Relaxation [r]			1	1	1	1										3	1	1	1			1	
49	Braindrawing [a]							1									3	1	1			1	0	1
50	Brainmapping [a]							1									2		1		1		1	1

No.	Creativity tools	Exploration strategy – Combinatory: Dictionaries and words used	Combinatory: Similarities	Combinatory: Supposition	Associative: Ideas by associations	Associative: Imitate other ideas	Associative: Word analysis, game, metaphor	Associative: Use of symbols	Contradictory: Confrontation	Contradictory: Lateral-thinking inspired	Contradictory: Force relationship	Contradictory: Reverse or different statement	Contradictory: Role playing	"Slacken off": Art	"Slacken off": Ask questions	"Slacken off": Brainstorm inspired	"Slacken off": Checklist, question	"Slacken off": Game approach	"Slacken off": Mind map type	"Slacken off": Random	Manufacturing: Collaborative method	Manufacturing: Decision making	Manufacturing: Decomposition method	Manufacturing: Is, is not type	Manufacturing: Graphic method	Manufacturing: Manufacturing approach	Manufacturing: Matrix methods	Manufacturing: Project management approach	Manufacturing: Expert or system consultation	Manufacturing: Voting system	Manufacturing: Writing method	Manufacturing: Storyboard, story telling inspired	Manufacturing: TRIZ inspired	Dreams: Dreams, moment of thinking	Dreams: Visualisation
26	Assumption Smashing										See Assumption busting																								
27	Assumption Surfacing [r]										See Assumption busting																								
28	Assumption-busting [a, r]			1																															
29	Attribute analysis										See Attribute listing																								
30	Attribute domain matrix										See Attribute listing																								
31	Attribute Listing [a, c, e, r]																						1												
32	Axiomatic design [o]																									1	1								
33	Backwards Forwards Planning [r]																																		
34	Basecamp										See Beachhead																								
35	Basic Associative Process [o]				1																														
36	Beachhead [o]																																	1	
37	biognosis (voir bionic)										See Biomimetics																								
38	bio-inspiration (voir bionic)										See Biomimetics																								
39	Biomimetics [i]				1														1																
40	biomimicry										See Biomimetics																								
41	Bionical creativity engineering (voir bionic)										See Biomimetics																								
42	Bionics										See Biomimetics																								
43	Block busting [j]			1																															
44	Blocking										See Block busting																								
45	Bodystorming [r]										See brainstorming																								
46	Borrowed Genius [o]												1																						
47	Boundary Examination [t]						1																												
48	Boundary Relaxation [r]																							1											
49	Braindrawing [a]													1		1																			
50	Brainmapping [a]															1									1										

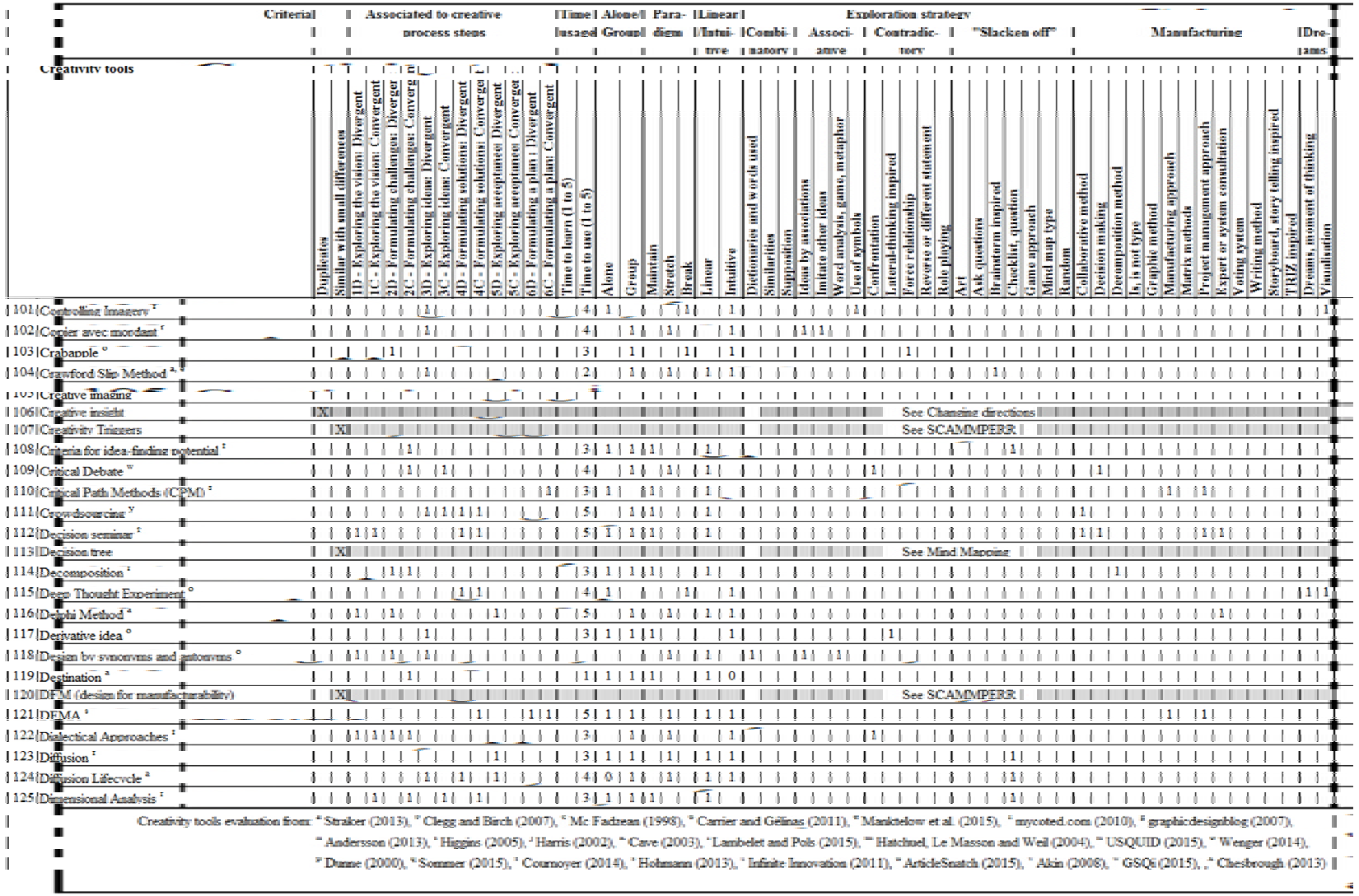
Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013)

	Criteria			Associated to creative process steps												Time usage		Alone/Group		Paradigm			Linear/Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Diverger	2C - Formulating challenges: Converg	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Converge	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Converge	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Supposition	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
51	BrainSketching [f]		X																															See brainwriting																									
52	Brainstorm with Doodle		X																															See brainstorming																									
53	Brainstorm with Mind Map		X																															See brainstorming																									
54	Brainstorming [a, d, e, f]							1									4	0	1		1		1	1															1																			
55	Brainwriting [a, e, f]							1									2	0	1		1		1	1															1															1				
56	Brainwriting 6-3-5		X																															See brainwriting																									
57	Brainwriting game [f]		X																															See brainwriting																									
58	Brainwriting pool		X																															See brainwriting																									
59	Breakdown [a, f]																3	1	1	1			1	0																																		
60	Browsing [f]					1		1									4	1	1		1		1	1																1																		
61	Brutethink [f]							1									3	1	1		1			1	1									1																								
62	Bug Listing [f]							1									3	1	1		1			1																1																		
63	BulletProofing [f]								1		1						3	1	1	1			1																1	1																		
64	Bunches of Bananas [f]							1									3		1		1			1									1																									
65	Buzz Groups [n]			1		1		1									3		1	1			1	1																				1														
66	Card Story Boards [f]							1									3	1	1	1			1																									1										
67	Cartoon Story Board [f]							1									3	1	1		1			1													1											1										
68	Catalogue KickStart [f]							1									5	1	1		1		1	1					1									1		1																		
69	CATWOE [a, f]					1	1			1	1						2	1	1	1			1	0																1																		
70	Causal diagram [o]					1											5	1	1		1			1																								1										
71	Causal loop diagram [v]																																																									
72	Causal Mapping [f]	X																																See Cognitive map																									
73	Challenge [a, f]						1				1						1	1	1	1			1	0																1																		
74	Challenge facts [t]							1									3	1	1		1		1	1											1																							
75	Changing directions [u]							1									3	1	1		1		1	1											1																							

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013)

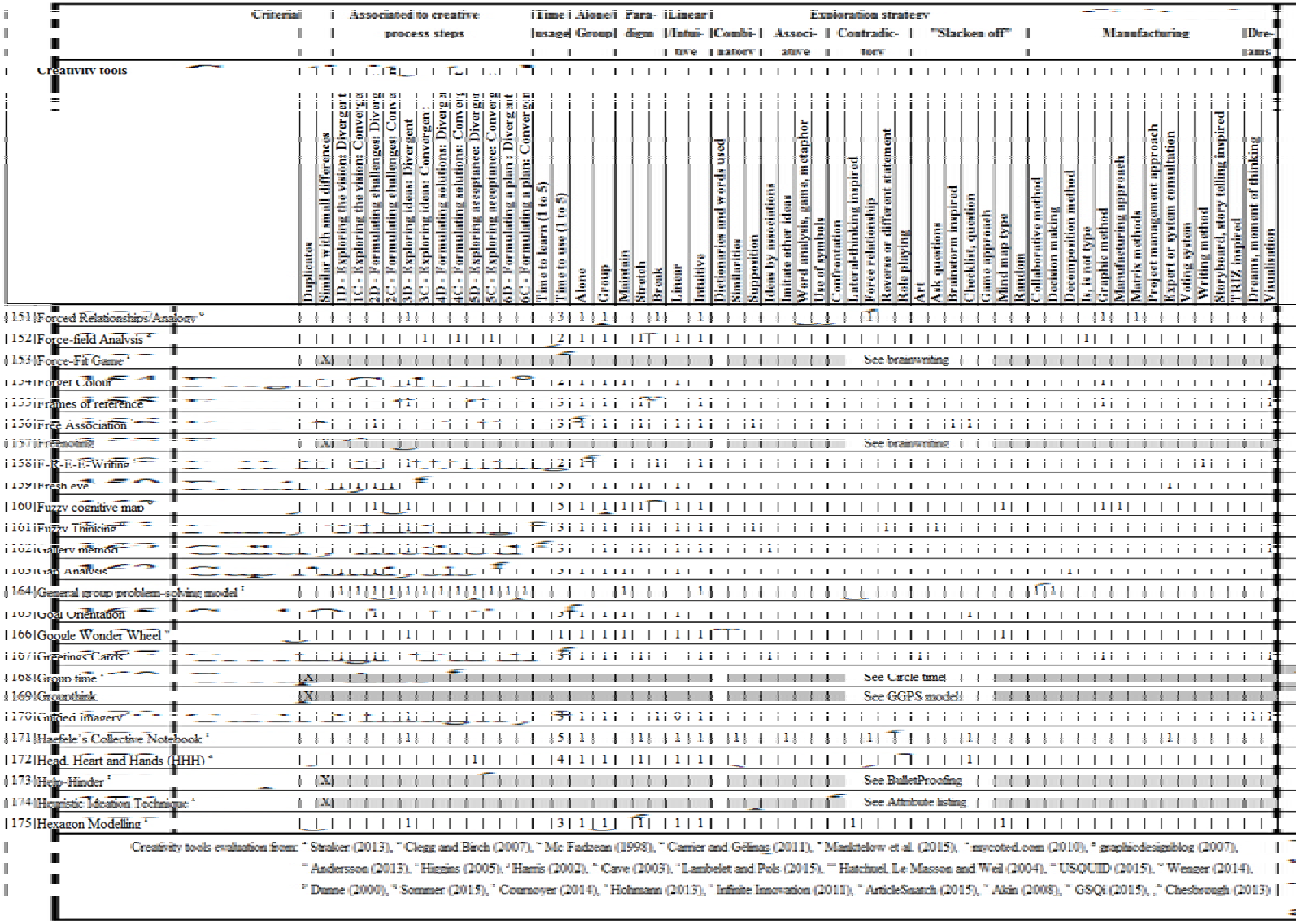
	Creativity tools	Criteria: Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan : Divergent	6C - Formulating a plan: Convergent	Time usage: Time to learn (1 to 5)	Time to use (1 to 5)	Alone/Group: Alone	Group	Paradigm: Maintain	Stretch	Break	Linear/Intuitive: Linear	Intuitive	Combinatory: Dictionaries and words used	Similarities	Supposition	Associative: Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Contradictory: Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	"Slacken off": Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Manufacturing: Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams: Dreams, moment of thinking	Visualisation
76	Checklists[k]								1		1						3		1	1			1																		1																	
77	Cherry Split[i]	X																																	See Attribute Listing																							
78	Chunking[a]					1	1			1	1						2	1	1	1			1	0																						1												
79	Circle of Opportunity[i]			1	1	1	1	1	1								3		1		1			1										1							1							1										
80	Circle Time[r]					1	1	1	1								4		1	1			1	1															1					1														
81	Circular Response method		X																																See Buzz groups																							
82	C-K theory (concept-knowledge theory)[m]							1	1	1	1						4	1	1		1		1	1															1									1										
83	Clarification[r]					1	1										3	1	1	1			1															1		1																		
84	Clark's 22 method		X																																See Buzz groups																							
85	Classic Brainstorming[i]	X																																	See brainstorming																							
86	COCD Box[r]								1		1						3		1	1			1																					1	1													
87	Cocktail Party[w]			1		1											4		1	1			1	1																				1														
88	Cognitive map[q]							1										1	1		1			1																								1										
89	Cognitive mapping[q]					1											5	1	1		1			1																								1										
90	Comic story board	X																																	See Cartoon storyboard																							
91	Comparison tables																																																									
92	Compass[a]					1											1	1	1	1			1																	1																		
93	Component Detailing[i]							1									3		1		1		1	1																						1		1										
94	Computer-assisted discovery[v]							1									3	1	1	1				1									1																									
95	Concept Fan[i]					1		1									2	1	1	1			1												1													1										
96	Concept Screening[a]								1		1						3	1	2	1			1	0																					1													
97	Consensus Mapping[i]													1	1		5		1	1			1																					1	1			1										
98	Constrained BrainWriting[z]		X																																See brainwriting																							
99	Context Map[a]																2	1	1	1			1	0																																		
100	Contradiction analysis[i]							1									4	1	1		1		1																																	1		

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013)


Criterial
Associated to creative process steps
Time
Alone/Group
Para-digm
Linear/Intuitive
Combinatory
Exploration strategy
Associative
Contradictory
"Slacken off"
Manufacturing
Dreams
Creativity tools
Duplicates
Similar with small differences
1D - Exploring the vision: Divergent
1C - Exploring the vision: Convergent
2D - Formulating challenge: Diverge
2C - Formulating challenge: Converg
3D - Exploring ideas: Divergent
3C - Exploring ideas: Convergent
4D - Formulating solutions: Divergent
4C - Formulating solutions: Converge
5D - Exploring acceptance: Divergent
5C - Exploring acceptance: Converge
6D - Formulating a plan : Divergent
6C - Formulating a plan: Convergent
Time to learn (1 to 5)
Time to use (1 to 5)
Alone
Group
Materials
Stretch
Break
Linear
Intuitive
Dictionaries and words used
Similarities
Supposition
Ideas by associations
Imitate other ideas
Word analysis, game, metaphor
Use of symbols
Confrontation
Lateralthinking inspired
Force relationship
Reverse or different statement
Role playing
Art
Ask questions
Brainstorm inspired
Checklist, question
Game approach
Mind map type
Random
Collaborative method
Decision making
Decomposition method
Is, is not type
Graphic method
Manufacturing approach
Matrix methods
Project management approach
Expert or system consultation
Voting system
Writing method
Storyboard, story telling inspired
TRIZ inspired
Dreams, moment of thinking
Visualization
101 Controlling Imagery [7]
102 Copier avec mordant [5]
103 Crabapple [6]
104 Crawford Slip Method [2, 5]
105 Creative imaging
106 Creative insight
See Changing directions
107 Creativity Triggers
See SCAMMPERR
108 Criteria for idea-finding potential [7]
109 Critical Debate [10]
110 Critical Path Methods (CPM) [7]
111 Crowdsourcing [9]
112 Decision seminar [7]
113 Decision tree
See Mind Mapping
114 Decomposition [7]
115 Deep Thought Experiment [6]
116 Delphi Method [4]
117 Derivative idea [6]
118 Design by synonyms and antonyms [6]
119 Destination [3]
120 DFM (design for manufacturability)
See SCAMMPERR
121 DFMA [3]
122 Dialectical Approaches [7]
123 Diffusion [7]
124 Diffusion Lifecycle [2]
125 Dimensional Analysis [7]
Creativity tools evaluation from: [4] Straker (2013), [10] Clegg and Birch (2007), [5] Mc Fadzean (1998), [3] Carrier and Gélinas (2011), [6] Manktelow et al. (2015), [1] mycoted.com (2010), [2] graphicdesignblog (2007),
[7] Andersson (2013), [8] Higgins (2005), [9] Harris (2002), [11] Cave (2003), [12] Lambelet and Pols (2015), [13] Hatchuel, Le Masson and Weil (2004), [14] USQUID (2015), [15] Wenger (2014),
[16] Dunne (2000), [17] Sommer (2015), [18] Cournoyer (2014), [19] Hohmann (2013), [20] Infinite Innovation (2011), [21] ArticleSnatch (2015), [22] Akin (2008), [23] GSQ6 (2015), [24] Chesbrough (2013)

	Creativity tools	Criteria		Associated to creative process steps												Time usage		Alone/Group		Paradigm			Linear/Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
		Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Supposition	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
126	Disney Creativity Strategy [a]							1		1	1			1	1		5	1	1		1		1	1								1														1					1						1	
127	Do an Image Search on Google [g]							1									3	1	1	1			1	1																								1										
128	Do Nothing [b, r]					1											1	1	1		1		1	1			1							1																								1
129	Doodling [a, r]							1									2	1	1			1	0	1																								1										
130	Dot voting	X																																See Dotmocracy																								
131	Dotmocracy [o]				1		1		1		1		1		1		2		1	1			1																						1													
132	Double-Entry A-Ha! Method (DEAM) [o]							1									2	1		1			1	1																								1						1				
133	Drawing [r]							1									2	1	1		1	1		1													1											1						1				
134	Enterprise 2.0 [o]							1									4		1	1			1	1																				1														
135	Escape Thinking [r]	X																																See Lateral thinking																								
136	Essay Writing [i]							1									2	1			1		1	1																														1				
137	Essence [a]							1									2	1	1		1		1	1		1		1	1											1																		
138	Estimate-Discuss-Estimate [r]		X																															See Delphi method																								
139	Evolution [u]							1									2		1	1			1	1				1																														
140	Exaggeration [r]	X																																See Osborn's checklist																								
141	Excursions [r]							1									4		1			1		1																				1													1	1
142	Factors in selling ideas [r]												1		1		4	1	1	1			1																	1									1									
143	False Faces [r]		X																															See Assumption busting																								
144	False Rule [t]							1									4	1	1			1		1								1	1	1																								
145	Fishbone Diagram [r]					1	1										4	1	1	1	1		1	1																						1		1	1									
146	Five Ws and H [r]	X																																See The Kipling method																								
147	Flow charts [r]					1	1										4	1	1	1	1		1								1																	1	1									
148	Focus Groups [r]			1	1	1	1			1	1	1	1				5		1	1			1	1																				1					1									
149	Focusing [r]							1									3	1	1			1		1																																	1	1
150	Forced Conflict [a]					1											2	1	1		1		1	1								1		1																								

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), , [x] Chesbrough (2013)


Criteria
Associated to creative process steps
Time usage
Alone Group
Para-digm
Linear
Intuitive
Combinatory
Associative
Exploration strategy
Contradictory
"Slacken off"
Manufacturing
Dreams
Creativity tools
Duplicates
Similar with small differences
1D - Exploring the vision: Divergent
1C - Exploring the vision: Convergent
2D - Formulating challenges: Divergent
2C - Formulating challenges: Convergent
3D - Exploring ideas: Divergent
3C - Exploring ideas: Convergent
4D - Formulating solutions: Divergent
4C - Formulating solutions: Convergent
5D - Exploring acceptance: Divergent
5C - Exploring acceptance: Convergent
6D - Formulating a plan : Divergent
6C - Formulating a plan: Convergent
Time to learn (1 to 5)
Time to use (1 to 5)
Alone
Group
Maintain
Stretch
Break
Linear
Intuitive
Dictionaries and words used
Similarities
Suppression
Ideas by associations
Imitate other ideas
Word analysis, game, metaphor
Use of symbols
Confrontation
Lateral-thinking inspired
Force relationship
Reverse or different statement
Role playing
Art
Ask questions
Brainstorm inspired
Checklist, question
Game approach
Mind map type
Random
Collaborative method
Decision making
Decomposition method
Is, is not type
Graphic method
Manufacturing approach
Matrix methods
Project management approach
Expert or system consultation
Voting system
Writing method
Storyboard, story telling inspired
TRIZ inspired
Dreams, moment of thinking
Visualization
151 Forced Relationships/Analogy *
152 Force-field Analysis *
153 Force-Fit Game *
154 Forget Colour
155 Frames of reference
156 Free Association
157 Freewrite
158 F-R-E-E-Writing *
159 Fresh eye
160 Fuzzy cognitive map *
161 Fuzzy Thinking
162 Gallery method
163 Gap Analysis
164 General group problem-solving model *
165 Goal Orientation
166 Google Wonder Wheel *
167 Greetings Cards *
168 Group time *
169 Groupthink
170 Guided imagery *
171 Haefele's Collective Notebook *
172 Head, Heart and Hands (HHH) *
173 Help-Hinder *
174 Heuristic Ideation Technique *
175 Hexagon Modelling *
See brainwriting
See brainwriting
See Circle time
See GGPS model
See BulletProofing
See Attribute listing
Creativity tools evaluation from: * Straker (2013), ** Clegg and Birch (2007), *** Mc Fadzean (1998), **** Carrier and Gélinas (2011), ***** Mauktelow et al. (2015), ****** mycoted.com (2010), ******* graphicdesignblog (2007), ******** Andersson (2013), ********* Higgins (2005), ********** Harris (2002), *********** Cave (2003), ************ Lambelet and Pols (2015), ************* Hatchuel, Le Masson and Weil (2004), ************** USQUID (2015), *************** Wenger (2014), **************** Dunne (2000), ***************** Sommer (2015), ****************** Counsover (2014), ******************* Hohmann (2013), ******************** Infinite Innovation (2011), ********************* ArticleSnatch (2015), ********************** Akin (2008), *********************** GSQi (2015), ************************ Chesbrough (2013)

	Creativity tools	Criteria		Associated to creative process steps												Time usage		Alone/Group		Paradigm			Linear/Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
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176	High Thinktank [o]							1									4	1				1		1						1																											1	
177	Highlighting [z]		X																													See KJ - Method																										
178	Historical examination [u]							1									3	1	1	1			1															1		1																		
179	How to [a, z]					1	1	1									1	1	1	1			1	1						1								1																				
180	How-How Diagram [a, z]									1	1			1	1		3	1	1		1		1	1				1										1										1										
181	Human needs [J]			1		1		1		1								1	1	1			1																	1																		
182	Idea Advocate [z]		X																													See Dialectical Approaches																										
183	Idea Box [z]		X																													See Morphological Analysis																										
184	Idea card method [z]		X																													See brainwriting																										
185	Idea Generator		X																													See brainwriting																										
186	Idea List of Ways to Improve Something [J]							1									3	1	1	1			1	1																1																		
187	Ideal Final Result [z]	X																														See Triz																										
188	Ideas bank [H]							1									3	1	1	1			1	1				1	1															1								1						
189	IdeaToons [K]							1									3	1	1			1	1	1													1									1		1										
190	Image Association [o]							1									3	1	1		1			1				1																				1										1
191	Imagery for Answering Questions [z]								1								3	1				1		1			1																					1										
192	Imagery Manipulation [z]																3	1				1		1							1						1											1				1					1	1
193	Image-Streaming [o]							1									4	1				1		1						1																		1									1	1
194	Imaginary Brainstorming [z]		X																													See brainstorming																										
195	Imitation [K]							1									3	1	1		1		1	1					1																													
196	Implementation Checklists [z]														1		3		1	1			1																	1																		
197	Implementation Checklists1 [z]		X																													See CheckList																										
198	Implementation Checklists2 [z]		X																													See CheckList																										
199	Improved Nominal Group Technique [z]		X																													See Nominal Group Technique																										
200	Improvements to [J]							1									3	1	1		1		1	1			1																															

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Marktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013)

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201	Improvisation [o]							1									3	1	1		1		1	1																				1														
202	In the realm of the senses		X																														See Sensanation																									
203	Incubation [a, r]							1									5	1	0		1		0	1																																		
204	Interpretive structural modeling [r]		X																														See Paired Comparison																									
205	Inverse brainstorming		X																														See brainstorming																									
206	Is – Is not [a, r]				1		1		1		1						1	1	1	1			1	0																							1											1
207	Ishikawa Diagram	X																															See Fishbone diagram																									
208	Keep Scrapbooks and Sketchbooks [g]							1									5	1	1		1			1				1	1								1											1										1
209	Keeping a Dream Diary [r]							1									5	1				1		1																																	1	
210	KJ-Method [r]								1								3	1	1		1		1					1																	1			1										
211	Laddering [r]							1									3	1	1		1		1	1																						1												
212	Lateral thinking [a]					1		1									4	0	1			1		1									1																									
213	Listing [r]		X																														See Attribute listing																									
214	Listing Pros and Cons [r]						1		1		1						3	1	1	1			1																	1					1													
215	Living Labs [o]											1					5		1		1		1	1																				1														
216	Lotus Blossum Technique [a]							1									3	1	1		1		1	1																								1										
217	Mental maps	X																															See Mind Mapping																									
218	Metaphors [b, c, d]							1									3	1	1		1			1				1		1																												
219	Mindmapping [a, d, r]							1									4	1	1		1		1	1																		1						1										
220	Mitsubishi brainstorming technique		X																														See brainstorming																									
221	Modeling [a]							1									3	1	1		1		1	1													1																					
222	Moment of Truth (MoT) Analysis [a]					1	1					1					4	1	1	1			1													1													1									
223	Moodboards [g]							1									3	1	1		1			1				1																				1										1
224	Morphological Analysis [a]							1									4	1	1		1		1	1										1																								
225	Morphological Forced Connections [r]		X																														See Circle of opportunity																									

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	Creativity tools	Duplicate	Similar with small difference	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestion	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
226	Multiple Redefinition [j]			1		1											3	1	1	1			1																	1																		
227	Multi-voting [j]	X																																See Dotmocracy																								
228	Negative brainstorming		X																															See BulletProofing																								
229	Negative Selection [a]								1								2	1	1		1		1	1																					1					1								
230	Nominal Group Technique [a, j]							1	1								2	0	1		1		1	1															1																			
231	NUF Test [a, f]								1								2	1	1	1			1	0																					1													
232	Object Simulation [s]																				1																																					
233	Obstacle map [s]					1											1	1	1	1			1																																			
234	Open Innovation [a]							1									4		1		1		1	1																				1					1									
235	Osborn's original checklist [j]	X																																See Osborn's checklist																								
236	Osborn's Checklist [j]																																																									
238	Outside in [g]					1											2	1	0			1	0	1																																	1	
239	Paired Comparison [j]								1		1						3	1	1		1		1	1																					1					1								
240	Paraphrasing Key Words [j]		X																															See Play-On-Words																								
241	Pause [a]				1		1		1		1		1		1		1	1	1			1		1																																	1	
242	Pearson's Collective Notebook [j]		X																															See Haefele's Collective Notebook																								
243	Periscope learning	X																																See Borrowed genius																								
244	PEST analysis [a]								1		1		1				4	1	1		1		1	1																					1					1		1						
245	PESTLE analysis		X																															See Pest Analysis																								
246	Phillips 66 method		X																															See Buzz groups																								
247	Philosophical idea [a]							1									3	1	1	1				1									1																									
248	Physical attributes [j]			1		1		1		1								1	1	1			1																	1																		
249	Pin Cards [j]	X																																See brainwriting																								
250	PINC Filter [a]								1								4	1	1		1		1	1																1					1					1								

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251	Play-on-words [j]						1									2	1			1			1																														1				
252	PMI [f]												1	1		5	1	1	1			1																												1							
253	Positives, Negatives [a, f]				1		1		1		1						2	1	1		1		1	1																							1											
254	Post-Up [e]							1									3	1	1		1		1	1															1																			
255	Potential Problem Analysis [f]		X																															See BulletProofing																								
256	Praise [g]										1						3	1	1		1		1	1																1										1								
257	Problem Statement [a, f]					1	1										2	1	1		1		1	1																																		
258	Product improvement checklist		X																															See CheckList																								
259	Progressive buzz sessions		X																															See Buzz groups																								
260	Project Evaluation and Review Technique [e]														1		4	1		1			1																										1		1							
261	Provocation [a]					1		1		1							1	1	1		1		1	1								1																										
262	PSI [e]						1	1									3	1	1		1		1	1				1						1																								
263	Purposing [e]					1											1	1	1		1		1	1																1																		
264	Q-Sort [f]								1		1						3	1	1		1		1	1																					1					1								
265	Random Stimuli [f]							1									3	1	1		1			1				1						1						1								1										
266	Random input [e]		X																															See Random stimuli																								
267	Random juxtaposition		X																															See Random stimuli																								
268	Random Picture		X																															See Random stimuli																								
269	Random Words [a, b, f]							1									1	1	1			1	0	1	1																		1															
270	Rawlinson Brainstorming [f]		X																															See brainstorming																								
271	Remembrance [e]										1						1	1	1			1	0	1																																	1	1
272	Reversal [e]					1	1	1									1	1	1		1		1	1											1																							
273	Reverse brainstorming [b, e]							1									3	1	1		1		1	1											1				1																			
274	Reverse Planning [e]														1		4	1	1		1		1	1											1																							1
275	Revolutionary idea [e]							1									3	1	1	1				1									1																									

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mindtools et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Landsheer and Pois (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2015), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQS (2015), [x] Chesbrough (2015) and [y] Martin (2015)

No.	Criteria / Creativity tools	Duplicates	Similar with small differences	Associated to creative process steps												Time usage		Alone/Group		Paradigm			Linear/Intuitive	
		Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
276	Rightbraining [a]							1									2	1	1			1	0	1
277	Role-play [a]							1				1					2	0	1		1		1	1
278	RoleStorming [f]		X																					
279	Rubber-ducking [a]			1		1		1		1		1		1			2	1	1		1		1	1
280	SCAMMPERR [a, d, e, f]							1	1								2	1	1		1		1	1
281	SCAMPER [a]		X																					
282	Sensanation [a]							1									3	1	1		1		1	1
283	Serendipitous discovery [a]							1									3	1	1		1			1
284	Shorts [b]					1											1	1	0			1	0	1
285	Six Thinking Hats [a]							1									3	0	1		1		1	1
286	Snowball Technique [d]		X																					
287	Speeding Diffusion [a]								1								3	1	1	1			1	
288	Storyboarding [a, d]				1		1			1		1		1	1		4	1	1		1		1	1
289	Swap sort [a]								1		1						2	1	1	1			1	
290	SWOT Analysis [b, f]										1						3	1	1		1		1	1
291	Symbiotic idea [a]							1									3	1	1	1				1
292	Synectic [d]								1								4		1		1		1	1
293	Targeted innovation [a]							1									3	1	1	1				1
294	Take a break [a]							1									2	1	1			1	0	1
295	Talk streaming [a]							1									4	1	0			1		1
296	Target Future [a]			1	1												1	1	1	1			1	
297	The Bucky Fuller Linking Approach [a]							1									4	1	1			1	1	1
298	The five senses [y]			1		1		1		1								1	1	1			1	
299	The Golden Egg [y]					1											4	1	1		1		1	1
300	The Hundred Dollar Test [a]								1								1	1	1	1			1	0

No.	Creativity tools	Exploration strategy: Combinatory			Associative				Contradictory					"Shaken off"							Manufacturing													Dreams	
		Dictionaries and words used	Similarities	Suggestion	Idea by association	Imitate other idea	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask question	Brainstorm inspired	Checklist question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
276	Rightbraining [a]																								1									1	
277	Role-play [a]												1																						
278	RoleStorming [f]	See brainstorming																																	
279	Rubber-ducking [a]																												1						
280	SCAMMPERR [a, d, e, f]														1		1																		
281	SCAMPER [a]	See SCAMMPERR																																	
282	Sensanation [a]																1																		
283	Serendipitous discovery [a]				1																														
284	Shorts [b]																															1		1	
285	Six Thinking Hats [a]								1				1																						
286	Snowball Technique [d]	See KJ - Method																																	
287	Speeding Diffusion [a]																1																		
288	Storyboarding [a, d]																																		
289	Swap sort [a]																						1		1		1								
290	SWOT Analysis [b, f]																					1					1								
291	Symbiotic idea [a]										1																								
292	Synectic [d]		1		1																														
293	Targeted innovation [a]									1																									
294	Take a break [a]																																	1	
295	Talk streaming [a]																																		
296	Target Future [a]			1																															
297	The Bucky Fuller Linking Approach [a]										1																								
298	The five senses [y]																1																		
299	The Golden Egg [y]											1																							
300	The Hundred Dollar Test [a]																					1													

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2015), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

No.	Criteria			Associated to creative process steps												Time range		Alone/Group		Paradigm			Linear/Intuitive		Exploration strategy																																	
																									Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dichotomize and words used	Similarities	Separation	Ideas by associations	Imitate other idea	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
301	The Kipling method (5W1H) [a, g]				1		1		1		1						1	1	1		1		1	1																1																		
302	The lord claim [b]							1									1	1	0		1		1	1	1																		1															
303	The Six Basic Questions	X																																See Five W and a H																										
304	Time slices [e]					1											2	1	1		1		1	1																															1			
305	Unconscious Problem Solving		X																															See Incubation																										
306	Unfolding [d]					1	1	1									3	0	1		1		1	1																				1								1						
307	Up and down [l]					1											1	1	1		1		1	1												1																						
308	Use of drawing	X																																See Act streaming																										
309	Using Experts [f]									1	1	1	1				2	1	1	1				1																												1						
310	Value Analysis [a]									1	1						4	1	0	1			1	0																									1									
311	Value Brainstorming [j]		X																															See brainstorming																										
312	Verbal checklist for creativity		X																															See CheckList																										
313	Visioning [a]			1													3	1	1		1		1	1																																		1
314	Visual Brainstorming [j]		X																															See brainstorming																										
315	Visual Metaphor [g]							1									3	1	1		1		1	1						1												1						1										
316	Voting [a]								1		1						1	0	1		1		1	1																													1					
317	Voting with dots	X																																See Dotmocracy																										
318	Why method	X																																See Laddering																										
319	Why not? [x, d]							1		1							4	0	1		1		1	1			1						1																									
320	Wishing [a]							1									1	1	1			1	0	1																																	1	1
321	Wishful thinking [s, d]			1	1	1	1															1					1																														1	
322	Word association [a]							1									3	1	1		1			1				1		1																												
323	Working the Discontinuity Principle [g]							1									3	1	1			1	1	1			1						1	1																								
324	Write streaming [a]							1									4	1	0			1	0	1																														1				
325	Yellow box [g]								1		1						1		1	1			1																						1								1					

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Minkinow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2006), [j] Harris (2002), [k] Cave (2001), [l] Lambolez and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Coursaye (2014), [s] Holzmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] OSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

326	7 Step Model	351	Deadlines	376	Fuzzy QFD	401	Lateral and Vertical Thinking
327	76 Standard Solutions	352	Design Failure Mode and Effects Analysis	377	Gordon/little technique	402	Lateral Thinking for Management (1971)
328	Back to the customer	353	Design of Experiments	378	Group decision support systems	403	Limericks and parodies
329	Back to the sun	354	Design Scorecards	379	Guided Fantasy "	404	Lineup or "Stand Where You Stand"
330	Be a warrior when selling your ideas	355	Direct analogies	380	Harvesting	405	Lion's den
331	Benchmarking	356	Discrete Event Simulation	381	Heuristic definition	406	Listening to music
332	Best practices	357	Dramatizing Discussion	382	Hit matrix	407	Listing complaints
333	Bounce it off someone else	358	Draw a picture of the problem	383	Holistic design methodology	408	Look at What Else Your Target Market Might Buy
334	Camelot	359	Drawing Discussion	384	How to Have A Beautiful Mind (2004)	409	Manipulative verbs
335	Cause and effect diagram	360	Dynamic Format	385	How to Have Creative Ideas (2007)	410	Matrice morphologique
336	Cause and effect matrix	361	Edison's Idea File	386	Idea bits and racking	411	Measurement System Analysis
337	ChangingMinds	362	Einsteinian and Socratic Methods	387	Idea board	412	Metaphorical thinking
338	Children Solving Problems (1972)	363	Escape	388	Idea Harvesting and Treatment	413	Metaplan Information Market
339	Cognitive style	364	Establish idea sources	389	Idea notebook	414	MindTouch TCS
340	Collaborative Play	365	Ethnography	390	Idea triggers	415	Mirror a Shape
341	Concept Tree	366	Evaporating cloud	391	Innovation committee	416	Mistake proofing
342	Conflicts (1985)	367	Evoked Sidebands	392	Innovation Financial Management	417	Moka theory
343	Conjoint Analysis	368	Evolutionary idea	393	Input-output	418	Monitor weak signals
344	Consensus building	369	Examine it with the senses	394	Intercompany innovation group	419	Morphological Forced Connections
345	Control Plan	370	Experience kit	395	Inventive machine	420	Morphological Matrix
346	Crazy	371	Functional Analysis	396	Jigsaw	421	Mutual Listening
347	Creative challenge	372	Function Deployment Model	397	Jobs scoping	422	NAF
348	Creative leaps	373	Function Structure	398	Jobs to be done	423	Name possible uses
349	Creativity circle	374	Future Positive (1979)	399	King of the mountain	424	NHK method
350	De Bono techniques	375	Fuzzy AHP	400	Koinonia	425	Nine windows

426	NLP (Neuro-Linguistic Programming Techniques)	451	Pmtop	476	Random Website	501	Schema-based reasoning
427	Nominal Interacting Technique	452	Phases Potentials and Concerns	477	Reapplication	502	Schemata
428	Notebook	453	Po: Beyond Yes and No (1972)	478	Receptivity to Ideas	503	Scripts
429	Observer and Merged Viewpoints	454	Po: Beyond Yes and No (1973)	479	Reciprocal Model	504	Sculptures
430	Open ended problem solving	455	Positive and Negative Space	480	Redefining a problem or opportunity	505	SDI
431	Opportunity searches	456	Poster Tour	481	Reframing Values	506	Search & Reapply
432	Organized random search	457	Practical Thinking (1971)	482	Relatedness	507	Search Conference
433	Other Peoples Definitions	458	Preliminary Questions	483	Relational Words	508	Separation Principle
434	Other Peoples Viewpoints	459	Problem Centred Leadership	484	Relaxation	509	Sequential Attributes Matrix
435	Outcome Expectations	460	Problem Inventory Analysis - PIA	485	Rephrase the question	510	Serendipitous discovery
436	Over the Wall	461	Problem reversal	486	Resource optimization	511	Serious Creativity
437	Panel Consensus	462	Process Behavior Chart	487	Responding to someone else	512	SIL method
438	Patterns	463	Process Capability	488	Restrict your Design	513	Similarities and Differences
439	PDCA	464	Process Map/Value Stream Map	489	Reversal-dereversal	514	SIMILARITY-BASED REASONING
440	Performance and Perception Expectations	465	Productive Thinking Model	490	Reverse engineering	515	Simple Rating Methods
441	Personal Balance Sheet	466	Progressive Hurdles	491	Reverse inventing	516	Simplex
442	Personal analogies	467	Progressive Revelation	492	Reversing hidden assumptions	517	Simply Waking Up With the Answer
443	Phillips 66 (discussion 66)	468	Project Charter	493	Revolution	518	Sipoc Map
444	Philosophical idea	469	Provocation and movement	494	Revolutionary idea	519	SIT (Systematic Inventive Thinking)
445	Photo exercises	470	Psychological tool	495	Rewrite objectives in different ways	520	Six sigma
446	Picture stimulation	471	Push Matrix	496	Robust design	521	Sleeping downstairs on it
447	Pictures as Idea Triggers	472	Quality Circles	497	Rolling in the grass of ideas	522	Snowballing
448	Piloting	473	Quality function deployment	498	Rousing Stations	523	Socratic Method
449	Pin Cards	474	Racing against phantom competitors	499	Rule induction algorithms	524	SODA
450	PIPS	475	Randomness	500	Scenario writing	525	Soft Systems Method

526	Southbeach notation	551	Taught Helplessness	576	Three Doors	601	What pattern exist ?
527	Squeeze and stretch	552	Teaching Thinking (1976)	577	Thril	602	Who Are You
528	Stakeholder Analysis	553	Technology Monitoring	578	TILMAG	603	Why I Want To Be King Of Australia (1999)
529	Stakeholder Management	554	Technology Today (1971)	579	TKJ method	604	Why why diagram
530	Sticking Dots	555	The 7X7 technique	580	TOC	605	Why Why Why
531	Stimulus Analysis	556	The 18th Hole	581	Toolbuilder	606	Wideband delphi
532	Story Writing	557	The adequate	582	Transactional Planning	607	Windtunnel
533	Strategic Assumption Testing	558	The Dog-Exercising Machine(1970)	583	Trend prediction	608	Win-Win Finder
534	Strategic Choice Approach	559	The Eagle	584	Trigger concept	609	WOIS
535	Strategic Management Process	560	The Exquisite Corpse	585	Trigger Method	610	Wonder Wheel
536	Structure Abstraction	561	The fcb grid	586	Trigger Sessions	611	Work Cell Analysis
537	Successive Element Integration	562	The focused-object technique	587	Toy of War	612	Wordpower
538	Suggestion program	563	The Greatest Thinkers (1976)	588	Unified Structured Inventive Thinking	613	Working with Dreams and Images
539	SuperGroup	564	The Happiness Purpose (1977)	589	Use of drawing	614	Workouts and othe group approaches
540	SuperHeroes	565	The journalistic Six	590	Uses for	615	Write More Freely and Effectively
541	Symbiotic idea	566	The Melville Pattern	591	Using Crazy Ideas		
542	Synectique visuelle	567	The ury (Matsumura Yasuo) method	592	Using What We Know		
543	Synthesis	568	The Napoleon technique	593	USIT (Unified Systematic Inventive Thinking)		
544	Systematic design	569	The Outrageous Idea	594	Value Engineering		
545	Systematic Inventive Thinking	570	The screening matrix for ideas	595	Value quotient		
546	Switching Roles	571	The Six Types of Socratic Questions	596	Visualising a Goal		
547	Tactics: The Art and Science of Success (1985)	572	The two-words technique	597	Visualization		
548	Take five	573	The Wisdom of crowds	598	Walk in the Woods		
549	Talking Pictures	574	The Zombie	599	What do you know ?		
550	Targeted innovation	575	Think Tank	600	What if ... ?		

A.IV.2 Creativity tools: Duplicates and similar removed (234 creativity tools)

	Criteria			Associated to creative process steps												Time usage		Alone/ Group		Paradigm			Linear /Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Definition and words used	Similarities	Separation	Ideas by associations	Build on other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
1	A Day In The Life Of…[a]									1	1	1	1				3	1	1		1		1	1																																1			
2	A Positive Negative[f]							1									3	1	1		1		0	1						1						1																			1				
3	Absence Thinking[a]							1									3	1	1			1	1	1									1																									
4	Action plan[d]													1	1		2	1	1	1			1	0																												1							
5	Adaptive Reasoning[f]									1	1						5	1	1		1		1	1																												1							
6	Adoption Checklist[a]								1		1						2	1	1	1			1	0																	1																		
7	Advantages, Limitations and Unique Qualities[f]								1								1		1	1			1																	1									1										
8	Adventure[b]					1											5	1	0			1	0	1																		1																1	
9	Aerial survey[a]					1											2	1	1		1		1	1																			1																
10	AIDA (Analysis of Interactive Decision Areas)[f]						1										2	1	1	1			1																										1	1								
11	[illegible][g]																																																									
12	Alternative Scenarios[f]			1	1						1			1	1		5		1		1			1																														1	1			
13	Analogies and metaphors[i]							1									3	1	1	1				1		1																															
14	Analysis of past solutions[i]							1		1							5	1	1	1			1			1		1	1																												
15	Analytic Hierarchy Process (AHP)[a]				1		1		1		1		1				4	1	1	1			1																						1													
16	Anonymous Voting[f]				1		1		1		1						1		1	1			1																						1													
17	Aristotle's categories[f]			1		1		1		1								1	1	1			1																	1																		
18	Art streaming[d]							1									5	1	0			1	0	1													1																					
19	Artistic innovation[a]							1									3	1	1		1			1									1																									
20	Ask questions[j]			1		1		1									3	1	1	1			1															1																				
21	Association[j]							1									3	1	1	1				1				1																													
22	Assumption-busting[a, f]					1		1									2	1	1		1		1	1			1																														
23	Attribute Listing[c, d, e, f]					1		1									2	1	1	1			1	0																						1												
24	Axiomatic design[a]			1	1	1	1										4	1	1	1			1																										1	1								
25	Backwards Forwards Planning[f]					1	1										2	1	1		1		1																																		

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mankelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2001), [l] Lambelet and Polo (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Courtoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

No.	Criteria / Creativity tools			Associated to creative process steps												Time usage		Alone/ Group		Paradigm			Linear /Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
		Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestions	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	A, B and type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
26	Basic Associative Process [w]							1									3	1			1			1				1																														
27	BrainBread [a]							1									4		1			1		1																																	1	
28	Biomimetics [j]							1									3	1	1		1			1				1														1																
29	Block busting [j]							1									3		1		1			1			1																															
30	Borrowed Genius [w]							1									3	1	1			1		1												1																						
31	Boundary Examination [l]			1		1											3	1	1	1			1							1																												
32	Boundary Relaxation [l]			1	1	1	1										3	1	1	1			1																								1											
33	Brainforming [c]							1									3	1	1			1	0	1													1		1																			
34	Brainmapping [a]							1									2		1		1		1	1															1									1										
35	Brainstorming [a, d, e, f]							1									4	0	1		1		1	1															1																			
36	Brainwriting [d, e, f]							1									2	0	1		1		1	1															1															1				
37	Breakdown [e, f]																3	1	1	1			1	0																																		
38	Browsing [f]					1		1									4	1	1		1		1	1																1																		
39	Brutethink [f]							1									3	1	1		1			1	1									1																								
40	Bug Listing [f]							1									3	1	1		1			1																1																		
41	BulletProofing [f]								1		1						3	1	1	1			1																1	1																		
42	Bunches of Bananas [f]							1									3		1		1			1									1																									
43	Buzz Groups [h]			1		1		1									3		1	1			1	1																				1														
44	Card Story Boards [f]							1									3	1	1	1			1																									1										
45	Cartoon Story Board [f]							1									3	1	1		1			1													1											1										
46	Catalogue KickStart [t]							1									5	1	1		1		1	1					1									1		1																		
47	CATWOE [e, f]					1	1			1	1						2	1	1	1			1	0																1																		
48	Causal diagram [a]					1											5	1	1		1			1																								1										
49	Causal loop diagram [a]																																																									
50	Challenge [e, f]						1				1						1	1	1	1			1	0																1																		

Creativity tools evaluation from: [a] Straker (2011), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Polo (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holemann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] QSQI (2015), [x] Chesbrough (2013) and [y] Martin (2015).

No.	Creativity tools (Criteria)	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time to learn (1 to 5)	Time usage: Time to use (1 to 5)	Alone/Group: Alone	Alone/Group: Group	Paradigm: Maintain	Paradigm: Stretch	Paradigm: Break	Linear/Intuitive: Linear	Linear/Intuitive: Intuitive
51	Challenge facts [j]							1									3	1	1		1		1	1
52	Changing directions [a]							1									3	1	1		1		1	1
53	Checklists [w]								1		1						3		1	1			1	
54	Chunking [d]					1	1			1	1						2	1	1	1			1	0
55	Circle of Opportunity [f]			1	1	1	1	1	1								3		1		1			1
56	Circle Time [j]					1	1	1	1								4		1	1			1	1
57	C-K theory (concept-knowledge theory) [m]							1	1	1	1						4	1	1		1		1	1
58	Clarification [j]					1	1										3	1	1	1			1	
59	COCD Box [i]								1		1						3		1	1			1	
60	Cocktail Party [n]			1		1											4		1	1			1	1
61	Cognitive map [k]							1										1	1		1			1
62	Cognitive mapping [k]					1											5	1	1		1			1
63	Comparison tables [f]																							
64	Compass [g]					1											1	1	1	1			1	
65	Component Detailing [f]							1									3		1		1		1	1
66	Computer-assisted discovery [p]							1									3	1	1	1				1
67	Concept Fan [j]					1		1									2	1	1	1			1	
68	Concept *Screening* [e]								1		1						3	1	2	1			1	0
69	Consensus Mapping [f]													1	1		5		1	1			1	
70	Context Map [d]																2	1	1	1			1	0
71	Contradiction analysis [f]							1									4	1	1		1		1	
72	Controlling Imagery [f]							1									4	1				1		1
73	Copier avec mordant [f]							1									4		1		1			1
74	Crabapple [u]					1											3		1			1		1
75	Crawford Slip Method [h, x]							1									2		1		1		1	1

No.	Creativity tools	Combinatory: Dictionaries and words used	Combinatory: Similarities	Combinatory: Suggestion	Associative: Identify by associations	Associative: Imitate other ideas	Associative: Word analysis, game, metaphor	Associative: Use of symbols	Contradictory: Confrontation	Contradictory: Lateral thinking inspired	Contradictory: Force relationship	Contradictory: Reverse or different statement	Contradictory: Role playing	"Slacken off": Art	"Slacken off": Ask questions	"Slacken off": Brainstorm inspired	"Slacken off": Checklist, question	"Slacken off": Game approach	"Slacken off": Mind map type	"Slacken off": Random	Manufacturing: Collaborative method	Manufacturing: Decision making	Manufacturing: Decomposition method	Manufacturing: Is is not type	Manufacturing: Graphic method	Manufacturing: Manufacturing approach	Manufacturing: Matrix methods	Manufacturing: Project management approach	Manufacturing: Expert or system consultation	Manufacturing: Voting system	Manufacturing: Writing method	Manufacturing: Storyboard, story telling inspired	Manufacturing: TRIZ inspired	Dreams: Dreams, moment of thinking	Dreams: Visualisation
51	Challenge facts [j]											1																							
52	Changing directions [a]											1																							
53	Checklists [w]																1																		
54	Chunking [d]																						1												
55	Circle of Opportunity [f]										1							1							1										
56	Circle Time [j]															1					1														
57	C-K theory (concept-knowledge theory) [m]															1									1										
58	Clarification [j]														1		1																		
59	COCD Box [i]																				1	1													
60	Cocktail Party [n]																				1														
61	Cognitive map [k]																								1										
62	Cognitive mapping [k]																								1										
63	Comparison tables [f]																																		
64	Compass [g]																1																		
65	Component Detailing [f]																						1		1										
66	Computer-assisted discovery [p]									1																									
67	Concept Fan [j]											1													1										
68	Concept *Screening* [e]																					1													
69	Consensus Mapping [f]																				1	1			1										
70	Context Map [d]																																		
71	Contradiction analysis [f]																																1		
72	Controlling Imagery [f]							1																											1
73	Copier avec mordant [f]				1	1																													
74	Crabapple [u]										1																								
75	Crawford Slip Method [h, x]															1																			

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Anderson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria			Associated to creative process steps														Time usage		Alone/ Group		Paradigm			Linear /Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words card	Similarities	Suggestion	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
76	Creative imaging [i]																																																							
77	Criteria for idea finding potential [f]						1										3	1	1	1			1																	1																		
78	Critical Debate [a]						1		1								4		1		1		1									1													1													
79	Critical Path Methods (CPM) [f]														1		3	1		1			1																										1		1							
80	Crowdsourcing [t]							1	1	1	1						5		1	1			1																					1														
81	Decision seminar [f]			1	1					1	1						5	1	1	1			1																					1	1						1	1						
82	Decomposition [f]					1	1										3	1	1	1			1																							1												
83	Deep Thought Experiment [a]									1	1						4	1				1		1																																	1	1
84	Delphi Method [a]			1		1						1					5		1		1		1	1																												1						
85	Derivative idea [a]							1									3	1	1	1				1									1																									
86	Design by synonyms and antonyms [a]			1		1		1													1		1		1			1		1																												
87	Destination [d]						1										1	1	1	1			1	0																																		
88	DFMA [t]										1			1	1		5	1	1		1		1	1																									1		1							
89	Dialectical Approaches [f]			1	1	1	1										3		1		1			1								1																										
90	Diffusion [f]											1					3	1	1		1		1	1																1																		
91	Diffusion Lifecycle [a]							1		1		1					4	0	1		1		1	1																1																		
92	Dimensional Analysis [f]				1		1		1		1						3	1	1	1			1																	1																		
93	Disney Creativity Strategy [f]							1		1	1			1	1		5	1	1		1		1	1								1														1					1						1	
94	Do an Image Search on Google [t]							1									3	1	1	1			1	1																								1										
95	Do Nothing [k, f]					1											1	1	1		1		1	1			1							1																								1
96	Doodling [k, f]							1									2	1	1			1	0	1																								1										
97	Dotmocracy [a]				1		1		1		1		1		1		2		1	1			1																						1													
98	Double-Entry A-Ha! Method (DEAM) [a]							1									2	1		1			1	1																								1						1				
99	Drawing [f]							1									2	1	1		1	1		1													1											1						1				
100	Enterprise 2.0 [a]							1									4		1	1			1	1																				1														

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mankelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007),
[h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015),
[o] Wenger (2014), [p] Dinner (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQs (2015),
[x] Chesbrough (2013) and [y] Martin (2015).

	Criteria			Associated to creative process steps												Time usage		Alone/ Group		Paradigm			Linear /Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slerken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Deliberate and words used	Similarities	Supposition	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is it red type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
101	Essay Writing							1									2	1			1		1	1																														1				
102	Essence							1									2	1	1		1		1	1		1		1	1											1																		
103	Evolution							1									2		1	1			1	1				1																														
104	Excursions							1									4		1			1		1																				1													1	1
105	Factors in selling ideas												1		1		4	1	1	1			1																	1									1									
106	False Rule							1									4	1	1			1		1								1	1	1																								
107	Fishbone Diagram					1	1										4	1	1	1	1		1	1																						1		1	1									
108	Flow-charts					1	1										4	1	1	1	1		1								1																	1	1									
109	Focus Groups			1	1	1	1			1	1	1	1				5		1	1			1	1																				1					1									
110	Focusing							1									3	1	1			1		1																																	1	1
111	Forced Conflict					1											2	1	1		1		1	1								1		1																								
112	Forced Relationships/Analogy							1									3	1	1			1		1										1														1		1								
113	Force-field Analysis								1		1		1				2	1	1		1		1	1																							1											
114	Forget Colour							1									2	1	1	1			1																									1										1
115	Frames of reference							1									3	1	1		1			1																								1										1
116	Free Association					1											3	1	1		1		1	1			1												1	1																		
117	F-R-E-E-Writing							1									2	1				1		1																														1				
118	Fresh eye			1	1	1	1										3		1		1		1																													1						
119	Fuzzy cognitive map					1		1									5	1	1	1	1		1	1																		1						1	1									
120	Fuzzy Thinking							1									3	1	1		1		1	1			1								1			1																				
121	Gallery method							1									3		1		1		1	1				1																														1
122	Gap Analysis			1		1											3	1	1	1			1																							1												
123	General group problem-solving model			1	1	1	1	1	1	1	1	1	1	1	1					1				1																				1	1													
124	Goal Orientation					1											3	1	1	1			1																	1																		
125	Google Wonder Wheel							1									1	1	1	1			1	1																		1																

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No.	Criteria / Creativity tools			Associated to creative process steps												Time usage		Alone-Group		Paradigm			Linear/Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
		Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Solutions and words tied	Similarities	Suggestion	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
126	Greetings Cards [f]			1		1											3	1	1		1			1				1									1											1										1
127	Guided Imagery [d]							1									3	1	1			1	0	1																																	1	1
128	Haefele's Collective Notebook [i]							1									5	1			1		1	1		1			1					1						1												1						
129	Head, Heart and Hands (HHH) [a]											1					4	1	1		1		1	1																1																		
130	Hexagon Modelling [f]							1									3	1	1		1		1	1									1									1																
131	High Thinktank [m]							1									4	1				1		1						1																											1	
132	Historical examination [a]							1									3	1	1	1			1															1		1																		
133	How to [a, f]					1	1	1									1	1	1	1			1	1						1								1																				
134	How-How Diagram [a, f]									1	1			1	1		3	1	1		1		1	1				1										1										1										
135	Human needs [j]			1		1		1		1								1	1	1			1																	1																		
136	Idea List of Ways to Improve Something [j]							1									3	1	1	1			1	1																1																		
137	Ideas bank [g]							1									3	1	1	1			1	1				1	1															1								1						
138	IdeaToons [k]							1									3	1	1			1	1	1													1									1		1										
139	Image Association [s]							1									3	1	1		1			1				1																				1										1
140	Imagery for Answering Questions [j]								1								3	1				1		1			1																					1										
141	Imagery Manipulation [j]																3	1				1		1							1						1											1				1					1	1
142	Image Streaming [r]							1									4	1				1		1						1																		1									1	1
143	Imitation [q]							1									3	1	1		1		1	1					1																													
144	Implementation Checklists [f]														1		3		1	1			1																	1																		
145	Improvements to [j]							1									3	1	1		1		1	1			1																															
146	Improvisation [s]							1									3	1	1		1		1	1																				1														
147	Incubation [a, f]							1									5	1	0		1		0	1																																		
148	Is – Is not [a, f]				1	1	1		1		1						1	1	1	1			1	0																						1	1											1
149	Keep Scrapbooks and Sketchbooks [g]							1									5	1	1		1			1				1	1								1											1										1
150	Keeping a Dream Diary [j]							1									5	1				1		1																																	1	

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wengin (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Commoyve (2014), [s] Holmann (2013), [t] Infinity Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQs (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria			Associated to creative process steps												Time usage		Alone/ Group		Paradigm			Linear /Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Deformation and/or combined	Similarities	Opposition	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	5 W tool type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Using system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
151	KJ-Method [f]								1								3	1	1		1		1					1																	1			1										
152	Laddering [f]							1									3	1	1		1		1	1																						1												
153	Lateral thinking [a]					1		1									4	0	1			1		1									1																									
154	Listing Pros and Cons [f]						1		1		1						3	1	1	1			1																	1					1													
155	Living Labs [n]											1					5		1		1		1	1																				1														
156	Lotus Blossom Technique [a]							1									3	1	1		1		1	1																								1										
157	Metaphors [b, c, d]							1									3	1	1		1			1				1		1																												
158	Mindmapping [a, d, f]							1									4	1	1		1		1	1																		1						1										
159	Modeling [d]							1									3	1	1		1		1	1													1																					
160	Moment of Truth (MoT) Analysis [d]					1	1					1					4	1	1	1			1													1													1									
161	Moodboards [g]							1									3	1	1		1			1				1																				1										1
162	Morphological Analysis [a]							1									4	1	1		1		1	1										1																								
163	Multiple Redefinition [f]			1		1											3	1	1	1			1																	1																		
164	Negative Selection [h]								1								2	1	1		1		1	1																					1					1								
165	Nominal Group Technique [a, f]							1	1								2	0	1		1		1	1															1																			
166	NUF Test [a, i]								1								2	1	1	1			1	0																					1													
167	Object Stimulation [f]																				1																																					
168	Obstacle map [k]					1											1	1	1	1			1																																			
169	Open Innovation [x]							1									4		1		1		1	1																				1					1									
170	Osborn's Checklist [f]																																																									
171	Outside in [k]					1											2	1	0			1	0	1																																	1	
172	Paired Comparison [j]								1		1						3	1	1		1		1	1																					1					1								
173	Pause [a]				1		1		1		1		1		1		1	1	1			1		1																																	1	
174	PEST analysis [e]								1		1		1				4	1	1		1		1	1																					1					1		1						
175	Philosophical idea [k]							1									3	1	1	1				1									1																									

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Currier and Gellman (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dumas (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQs (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria			Associated to creative process (step)												Time usage		Alone/Group		Paradigm			Linear/Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Materials	Models	Brand	Linear	Intuitive	Dictionaries and word related	Similarities	Supposition	Ideas by associations	Include other ideas	Word analysis, games, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask question	Brainstorm inspired	Checklist question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is it tool type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
176	Physical attributes [i]			1		1		1		1								1	1	1			1																	1																		
177	PINC Filter [a]								1								4	1	1		1		1	1																1					1					1								
178	Play-on-words [g]							1									2	1			1			1																														1				
179	PMI [f]													1	1		5	1	1	1			1																												1							
180	Positives, Negatives [a, j]				1		1		1		1						2	1	1		1		1	1																							1											
181	Post-Up [d]							1									3	1	1		1		1	1															1																			
182	Praise [d]										1						3	1	1		1		1	1																1										1								
183	Problem Statement [a, j]					1	1										2	1	1		1		1	1																																		
184	Project Evaluation and Review Technique [a]														1		4	1		1			1																										1		1							
185	Provocation [a]					1		1		1							1	1	1		1		1	1								1																										
186	PSI [a]						1	1									3	1	1		1		1	1				1						1																								
187	Purposing [a]					1											1	1	1		1		1	1																1																		
188	Q-Sort [f]								1		1						3	1	1		1		1	1																					1					1								
189	Random Stimuli [d]							1									3	1	1		1			1				1						1						1								1										
190	Random Words [a, b, c]							1									1	1	1			1	0	1	1																		1															
191	Reasonableness [a]										1						1	1	1			1	0	1																																	1	1
192	Reversal [d]					1	1	1									1	1	1		1		1	1											1																							
193	Reverse brainstorming [a, a]							1									3	1	1		1		1	1											1				1																			
194	Reverse Planning [a]														1		4	1	1		1		1	1											1																							1
195	Revolutionary idea [a]							1									3	1	1	1				1									1																									
196	Rightbraining [a]							1									2	1	1			1	0	1																								1									1	
197	Role-play [a]							1				1					2	0	1		1		1	1												1																						
198	Rubber-ducking [a]			1		1		1		1		1		1			2	1	1		1		1	1																												1						
199	SCAMMPERR [a, b, c, j]							1	1								2	1	1		1		1	1														1		1																		
200	Sensanation [h]							1									3	1	1		1		1	1																1																		

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] QSQs (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria			Associated to creative process steps												Time usage		Alone/ Group		Paradigm			Linear /Intuitive	
	Creativity tools	Duplicates	Similar with small difference	1B - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2B - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3B - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4B - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5B - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6B - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
201	Serendipitous discovery [a]							1									3	1	1		1			1
202	Shorts [b]					1											1	1	0			1	0	1
203	Six Thinking Hats [a]							1									3	0	1		1		1	1
204	Spreading Diffusion [a]								1								3	1	1	1			1	
205	Storyboarding [a,d]				1		1			1		1		1	1		4	1	1		1		1	1
206	Swap sort [a]								1		1						2	1	1	1			1	
207	SWOT Analysis [b,c]										1						3	1	1		1		1	1
208	Symbiotic idea [a]							1									3	1	1	1				1
209	Synectic [a]								1								4		1		1		1	1
210	Targeted innovation [a]							1									3	1	1	1				1
211	Take a break [a]							1									2	1	1			1	0	1
212	Talk streaming [k]							1									4	1	0			1		1
213	Target Future [a]			1	1												1	1	1	1			1	
214	The Bucky Fuller Linking Approach [a]							1									4	1	1			1	1	1
215	The five senses [y]			1		1		1		1								1	1	1			1	
216	The Golden Egg [y]					1											4	1	1		1		1	1
217	The Hundred Dollar Test [a]								1								1	1	1	1			1	0
218	The Kipling method (5W1H) [a,e]				1		1		1		1						1	1	1		1		1	1
219	The level chain [a]							1									1	1	0		1		1	1
220	Time slices [a]					1											2	1	1		1		1	1
221	Unfolding [a]					1	1	1									3	0	1		1		1	1
222	Up and down [a]					1											1	1	1		1		1	1
223	Using Experts [f]									1	1	1	1				2	1	1	1				1
224	Video Analysis [a]									1	1						4	1	0	1			1	0
225	Visioning [a]			1													3	1	1		1		1	1

	Criteria	Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Dictionaries and words used	Similarities	Separation	Ideas by associations	Isolate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	In a net type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
201	Serendipitous discovery [a]				1																														
202	Shorts [b]																															1		1	
203	Six Thinking Hats [a]								1				1																						
204	Spreading Diffusion [a]																1																		
205	Storyboarding [a,d]																																		
206	Swap sort [a]																						1		1		1								
207	SWOT Analysis [b,c]																					1					1								
208	Symbiotic idea [a]										1																								
209	Synectic [a]		1		1																														
210	Targeted innovation [a]									1																									
211	Take a break [a]																																	1	
212	Talk streaming [k]																																		
213	Target Future [a]			1																															
214	The Bucky Fuller Linking Approach [a]										1																								
215	The five senses [y]																1																		
216	The Golden Egg [y]											1																							
217	The Hundred Dollar Test [a]																					1													
218	The Kipling method (5W1H) [a,e]																1																		
219	The level chain [a]	1																		1															
220	Time slices [a]																															1			
221	Unfolding [a]																				1								1						
222	Up and down [a]												1																						
223	Using Experts [f]																												1						
224	Video Analysis [a]																									1									
225	Visioning [a]																																		1

Creativity tools evaluation from: [a] Smalley (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommers (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015)

	Criteria			Associated to creative process stages												Time usage		Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	Duplicates	Similar with small differences	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to learn (1 to 5)	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
226	Visual Metaphor [g]							1									2	1	1		1		1	1
227	Voting [a]								1		1						1	0	1		1		1	1
228	Why not? [a]							1		1							4	0	1		1		1	1
229	Wishing [a]							1									1	1	1			1	0	1
230	Wishful thinking [c, d]			1	1	1	1															1		
231	Word association [g]							1									5	1	1		1			1
232	Working the Discontinuity Principle [a]							1									5	1	1			1	1	1
233	Write storming [a]							1									4	1	0			1	0	1
234	Yellow box [a]								1		1						1		1	1			1	

	Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
Creativity tools	Dictionaries and words used	Similarities	Superposition	Ideas by associations	Isolate other ideas	Word analysis, games, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
226 Visual Metaphor [g]						1												1						1										
227 Voting [a]																													1					
228 Why not? [a]			1					1																										
229 Wishing [a]																																	1	1
230 Wishful thinking [c, d]			1																														1	
231 Word association [g]				1		1																												
232 Working the Discontinuity Principle [a]			1					1	1																									
233 Write storming [a]																														1				
234 Yellow box [a]																					1								1					

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] McFadzean (1998), [d] Cantoy and Gillies (2011), [e] Minkirshov et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2017), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Landwehr and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2009), [q] Sommer (2015), [r] Courneya (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSearch (2015), [v] Akin (2009), [w] GSQI (2015), [x] Clarbrough (2013) and [y] Martin (2015)

A.IV.3 Second set of selection from 234 creativity tools

Criteria: Associated to creative process steps; Time usage; Alone/Group; Paradigm; Linear/Intuitive

No.	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Duration (1 to 5)	Alone	Group	Paradigm: Maintain	Paradigm: Stretch	Paradigm: Break	Linear	Intuitive
1	Target Future	1	1											1	1	1	1			1	
2	Rubber-ducking	1		1		1		1		1		1		2	1	1		1		1	1
3	Ask questions	1		1		1								3	1	1	1			1	
4	Boundary Examination	1		1										3	1	1	1			1	
5	Boundary Relaxation	1	1	1	1									3	1	1	1			1	
6	Buzz Groups	1		1		1								3		1	1			1	1
7	Circle of Opportunity	1	1	1	1	1	1							3		1		1			1
8	Dialectical Approaches	1	1	1	1									3		1		1			1
9	Fresh eye	1	1	1	1									3		1		1		1	
10	Gap Analysis	1		1										3	1	1	1			1	
11	Greetings Cards	1		1										3	1	1		1			1
13	Multiple Redefinition	1		1										3	1	1	1			1	
14	Visioning	1												3	1	1		1		1	1
15	Axiomatic design	1	1	1	1									4	1	1	1			1	
16	Cocktail Party	1		1										4		1	1			1	1
18	Alternative Scenarios	1	1						1			1	1	5		1		1			1
19	Decision seminar	1	1					1	1					5	1	1	1			1	
21	Delphi Method	1		1						1				5		1		1		1	1
22	Focus Groups	1	1	1	1			1	1	1	1			5		1	1			1	1
23	Aristotle's categories	1		1		1		1							1	1	1			1	
25	Design by synonyms and antonyms	1		1		1												1		1	
25	General group problem solving model	1	1	1	1	1	1	1	1	1	1	1	1				1				1
27	Human needs	1		1		1		1							1	1	1			1	
28	Physical attributes	1		1		1		1							1	1	1			1	
29	The five senses	1		1		1		1							1	1	1			1	
30	Wishful thinking	1	1	1	1														1		

Criteria: Exploration strategy

No.	Creativity tools	Combinatory: Definitions and words used	Combinatory: Similarities	Combinatory: Suppositions	Associative: Idea by association	Associative: Imitate other ideas	Associative: Word analysis, game, metaphor	Associative: Use of symbols	Contradictory: Confrontation	Contradictory: Lateral-thinking inspired	Contradictory: Force relationship	Contradictory: Reverse or different statement	Contradictory: Role playing	"Shaken off": Art	"Shaken off": Ask questions	"Shaken off": Brainstorm inspired	"Shaken off": Checklist, question	"Shaken off": Linear approach	"Shaken off": Mind map type	"Shaken off": Random	Manufacturing: Collaborative method	Manufacturing: Decision making	Manufacturing: Decomposition method	Manufacturing: In trend type	Manufacturing: Graphic method	Manufacturing: Manufacturing approach	Manufacturing: Matrix methods	Manufacturing: Project management approach	Manufacturing: Expert or system consultation	Manufacturing: Voting system	Manufacturing: Writing method	Manufacturing: Storyboard, story telling inspired	Manufacturing: TRIZ inspired	Dreams: Dreams, moment of thinking	Dreams: Visualization
1	Target Future			1																															
2	Rubber-ducking																												1						
3	Ask questions														1																				
4	Boundary Examination						1																												
5	Boundary Relaxation																							1											
6	Buzz Groups																				1														
7	Circle of Opportunity										1							1							1										
8	Dialectical Approaches								1																										
9	Fresh eye																												1						
10	Gap Analysis																						1												
11	Greetings Cards				1									1											1										1
13	Multiple Redefinition																1																		
14	Visioning																																		1
15	Axiomatic design																									1	1								
16	Cocktail Party																				1														
18	Alternative Scenarios																														1	1			
19	Decision seminar																				1	1						1	1						
21	Delphi Method																												1						
22	Focus Groups																				1					1									
23	Aristotle's categories																1																		
25	Design by synonyms and antonyms	1			1		1																												
25	General group problem solving model																				1	1													
27	Human needs																1																		
28	Physical attributes																1																		
29	The five senses																1																		
30	Wishful thinking			1																														1	

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mantzaris et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dorner (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015)

No.	Criteria / Creativity tools	Associated to creative process steps: 1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time to use (1 to 5)	Alone/Group: Alone	Group	Paradigm: Maintain	Stretch	Break	Linear/Intuitive: Linear	Intuitive
1	Anonymous Voting [f]		1		1		1		1					1		1	1			1	
2	Target Future [a]	1	1											1	1	1	1			1	
3	Is – Is not [a, e]		1	1	1		1		1					1	1	1	1			1	0
4	The Kipling method (5W1H) [a, f]		1		1		1		1					1	1	1		1		1	1
5	Pause [a]		1		1		1		1		1		1	1	1	1			1		1
6	Democracy [a]		1		1		1		1		1		1	2		1	1			1	
7	Positives, Negatives [a, f]		1		1		1		1					2	1	1		1		1	1
8	Boundary Relaxation [f]	1	1	1	1									3	1	1	1			1	
9	Circle of Opportunity [f]	1	1	1	1	1	1							3		1		1			1
10	Dialectical Approaches [f]	1	1	1	1									3		1		1			1
11	Dimensional Analysis [f]		1		1		1		1					3	1	1	1			1	
12	Fresh eye [f]	1	1	1	1									3		1		1		1	
13	Analytic Hierarchy Process (AHP) [a]		1		1		1		1		1			4	1	1	1			1	
14	Axiomatic design [p]	1	1	1	1									4	1	1	1			1	
15	Storyboarding [a, d]		1		1			1		1		1	1	4	1	1		1		1	1
16	Alternative Scenarios [f]	1	1						1			1	1	5		1		1			1
17	Decision seminar [f]	1	1					1	1					5	1	1	1			1	
18	Focus Groups [f]	1	1	1	1			1	1	1	1			5		1	1			1	1
19	General group problem-solving model [f]	1	1	1	1	1	1	1	1	1	1	1	1				1				1
20	Wishful thinking [a, d]	1	1	1	1														1		

No.	Creativity tools	Exploration strategy – Combinatory: Dictionaries and words used	Similarities	Suggestion	Associative: Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Contradictory: Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	"Slacken off": Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Manufacturing: Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams: Dreams, moment of thinking	Visualisation
1	Anonymous Voting [f]																					1													
2	Target Future [a]			1																															
3	Is – Is not [a, e]																							1											
4	The Kipling method (5W1H) [a, f]																1																		
5	Pause [a]																																	1	
6	Democracy [a]																					1													1
7	Positives, Negatives [a, f]																							1											
8	Boundary Relaxation [f]																							1											
9	Circle of Opportunity [f]										1							1							1										
10	Dialectical Approaches [f]								1																										
11	Dimensional Analysis [f]																1																		
12	Fresh eye [f]																												1						
13	Analytic Hierarchy Process (AHP) [a]																					1													
14	Axiomatic design [p]																									1	1								
15	Storyboarding [a, d]																																		
16	Alternative Scenarios [f]																														1	1			
17	Decision seminar [f]																				1	1						1	1						
18	Focus Groups [f]																				1					1									
19	General group problem-solving model [f]																				1	1													
20	Wishful thinking [a, d]			1																														1	

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Diane (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holzmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

No.	Criteria / Creativity tools	Associated to creative process steps: 1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time to use (1 to 3)	Alone/Group: Alone	Group	Paradigm: Maintain	Stretch	Break	Linear/Intuitive: Linear	Intuitive	Exploration strategy – Combinatory: Dictionaries and words used	Similarities	Suggestion	Associative: Idea by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Contradictory: Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	"Stocken off": Art	Ask questions	Brainstorm inspired	Checklist questions	Game approach	Mind map type	Random	Manufacturing: Collaborative method	Decision making	Decomposition method	Is a tool type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams: Dreams, moment of thinking	Visualisation
1	Compass [b]			1										1	1	1	1			1																	1																		
2	How to [a, f]			1	1	1								1	1	1	1			1	1						1								1																				
3	Is – Is not [a, e]		1	1	1		1		1					1	1	1	1			1	0																							1											
4	Obstacle map [g]			1										1	1	1	1			1																																			
5	Do Nothing [b, f]			1										1	1	1		1		1	1			1							1																								1
6	Purposing [d]			1										1	1	1		1		1	1																1																		
7	Reversal [a]			1	1	1								1	1	1		1		1	1											1																							
8	Up and down [c]			1										1	1	1		1		1	1												1																						
9	Provocation [a]			1		1		1						1	1	1		1		1	1								1																										
10	Shorts [b]			1										1	1	0			1	0	1																																1		1	
11	Aerial survey [b]			1										2	1	1		1		1	1																		1																
12	Assumption-busting [a, f]			1		1								2	1	1		1		1	1			1																															
13	Attribute Listing [a, d, e, f]			1		1								2	1	1	1			1	0																						1												
14	Backwards Forwards Planning [f]			1	1									2	1	1		1		1																																			
15	CATWOE [a, f]			1	1			1	1					2	1	1	1			1	0																1																		
16	Chunking [a]			1	1			1	1					2	1	1	1			1	0																						1												
17	Concept Fan [f]			1		1								2	1	1	1			1												1													1										
18	Forced Conflict [d]			1										2	1	1		1		1	1								1		1																								
19	Outside in [b]			1										2	1	0			1	0	1																																		1	
20	Problem Statement [a, f]			1	1									2	1	1		1		1	1																																		
21	Rubber-ducking [d]	1		1		1		1		1		1		2	1	1		1		1	1																												1						
22	Time slices [g]			1										2	1	1		1		1	1																																1			
23	Ask questions [i]	1		1		1								3	1	1	1			1															1																				
24	Boundary Examination [f]	1		1										3	1	1	1			1							1																												
25	Boundary Relaxation [f]	1	1	1	1									3	1	1	1			1																								1											

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Maaktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambolet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Robinson (2013), [t] Infinite Innovation (2011), [u] ArticleSearch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

Criteria: Associated to creative process steps / Time usage / Alone/Group / Paradigm / Linear/Intuitive

	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
26	Buzz Groups [a]	1		1		1								3		1	1			1	1
27	Circle of Opportunity [f]	1	1	1	1	1	1							3		1		1			1
28	Clarification [f]			1	1									3	1	1	1			1	
29	Crabapple [a]			1										3		1			1		1
30	Decomposition [f]			1	1									3	1	1	1			1	
31	Dialectical Approaches [f]	1	1	1	1									3		1		1			1
32	Free Association [f]			1										3	1	1		1		1	1
33	Fresh eye [f]	1	1	1	1									3		1		1		1	
34	Gap Analysis [f]	1		1										3	1	1	1			1	
35	Goal Orientation [f]			1										3	1	1	1			1	
36	Greetings Cards [f]	1		1										3	1	1		1			1
37	Multiple Redefinition [f]	1		1										3	1	1	1			1	
38	Unfolding [h]			1	1	1								3	0	1		1		1	1
39	Automatic design [b]	1	1	1	1									4	1	1	1			1	
40	Browsing [f]			1		1								4	1	1		1		1	1
41	Circle Time [f]			1	1	1	1							4		1	1			1	1
42	Cocktail Party [m]	1		1										4		1	1			1	1
43	Fishbone Diagram [f]			1	1									4	1	1	1	1		1	1
44	Flow charts [f]			1	1									4	1	1	1	1		1	
45	Lateral thinking [k]			1		1								4	0	1			1		1
46	Moment of Truth (MoT) Analysis [k]			1	1					1				4	1	1	1			1	
47	The Golden Egg [f]			1										4	1	1		1		1	1
48	Adventure [b]			1										5	1	0			1	0	1
49	Causal diagram [b]			1										5	1	1		1			1
50	Cognitive mapping [b]			1										5	1	1		1			1

Exploration strategy: Combinatory / Associative / Contradictory / "Slacken off"

	Creativity tools	Dictionaries and words used	Similarities	Suggestion	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random
26	Buzz Groups																			
27	Circle of Opportunity										1							1		
28	Clarification														1		1			
29	Crabapple										1									
30	Decomposition																			
31	Dialectical Approaches								1											
32	Free Association			1												1	1			
33	Fresh eye																			
34	Gap Analysis																			
35	Goal Orientation																1			
36	Greetings Cards				1									1						
37	Multiple Redefinition																1			
38	Unfolding																			
39	Automatic design																			
40	Browsing																1			
41	Circle Time															1				
42	Cocktail Party																			
43	Fishbone Diagram																			
44	Flow charts							1												
45	Lateral thinking									1										
46	Moment of Truth (MoT) Analysis												1							
47	The Golden Egg											1								
48	Adventure																	1		
49	Causal diagram																			
50	Cognitive mapping																			

Exploration strategy: Manufacturing / Dreams

	Creativity tools	Collaborative method	Decision making	Decomposition method	Is it not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
26	Buzz Groups	1														
27	Circle of Opportunity					1										
28	Clarification															
29	Crabapple															
30	Decomposition			1												
31	Dialectical Approaches															
32	Free Association															
33	Fresh eye									1						
34	Gap Analysis			1												
35	Goal Orientation															
36	Greetings Cards					1										1
37	Multiple Redefinition															
38	Unfolding	1								1						
39	Automatic design						1	1								
40	Browsing															
41	Circle Time	1														
42	Cocktail Party	1														
43	Fishbone Diagram			1		1	1									
44	Flow charts					1	1									
45	Lateral thinking															
46	Moment of Truth (MoT) Analysis						1									
47	The Golden Egg															
48	Adventure														1	
49	Causal diagram					1										
50	Cognitive mapping					1										

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Poh (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

Criteria				Associated to creative process steps												Time usage		Alone/ Group		Paradigm			Linear/ Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Stacked off"							Manufacturing													Dreams	
	Creativity tools			1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent		Ease to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestion	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
51	Delphi Method [a]			1		1						1					[illegible]		1		1		1	1																												1						
52	Focus Groups [b]			1	1	1	1			1	1	1	1				[illegible]		1	1			1	1																				1					1									
53	Fuzzy cognitive map [a]					1		1									[illegible]	1	1	1	1		1	1																		1						1	1									
54	Aristotle's categories [i]			1		1		1		1								1	1	1			1																	1																		
55	Design by synonyms and antonyms [e]			1		1		1													1		1		1			1		1																												
56	General group problem-solving model [f]			1	1	1	1	1	1	1	1	1	1	1	1					1				1																				1	1													
57	Human needs [j]			1		1		1		1								1	1	1			1																	1																		
58	Physical attributes [j]			1		1		1		1								1	1	1			1																	1																		
59	The five senses [v]			1		1		1		1								1	1	1			1																	1																		
60	Wishful thinking [n, q]			1	1	1	1															1					1																														1	

Creativity tools evaluation from: [a] Stoilov (2015), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2015), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2002), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQs (2015), [x] Cherbrough (2013) and [y] Martin (2015).

No.	Criteria / Creativity tools	Associated to creative process stages: 1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time to use (1 to 3)	Alone/Group: Alone	Group	Paradigm: Maintain	Stretch	Break	Linear/Intuitive: Linear	Intuitive
1	Anonymous Voting [f]		1		1		1		1					1		1	1			1	
2	Challenge [a, f]				1				1					1	1	1	1			1	0
3	Destination [a]				1									1	1	1	1			1	0
4	How to [a, f]			1	1	1								1	1	1	1			1	1
5	Is – Is not [a, c]		1	1	1		1		1					1	1	1	1			1	0
6	The Kipling method (5W1H) [a, g]		1		1		1		1					1	1	1		1		1	1
7	Reversal [d]			1	1	1								1	1	1		1			1
8	Pause [e]		1		1		1		1		1		1	1	1	1			1	1	1
9	AIDA (Analysis of Interactive Decision Areas) [f]				1									2	1	1	1			1	
10	Backwards Forwards Planning [f]			1	1									2	1	1		1		1	
11	CATWOE [a, f]			1	1			1	1					2	1	1	1			1	0
12	Chunking [a]			1	1			1	1					2	1	1	1			1	0
13	Democracy [a]		1		1		1		1		1		1	2		1	1			1	
14	Positives, Negatives [a, f]		1		1		1		1					2	1	1		1		1	1
15	Problem Statement [a, f]			1	1									2	1	1		1		1	1
16	Boundary Relaxation [f]	1	1	1	1									3	1	1	1			1	
17	Circle of Opportunity [f]	1	1	1	1	1	1							3		1		1			1
18	Clarification [f]			1	1									3	1	1	1			1	
19	Criteria for idea-finding potential [f]				1									3	1	1	1			1	
20	Decomposition [f]			1	1									3	1	1	1			1	
21	Dialectical Approaches [f]	1	1	1	1									3		1		1			1
22	Dimensional Analysis [f]		1		1		1		1					3	1	1	1			1	
23	Fresh eye [f]	1	1	1	1									3		1		1		1	
24	Listing Pros and Cons [f]				1		1		1					3	1	1	1			1	
25	PSI [a]				1	1								3	1	1		1		1	1

No.	Creativity tools	Exploration strategy – Combinatory: Distortions and words used	Similarities	Suggestion	Associative: Ideas by associations	Imitate other ideas	Word analysis, games, metaphor	Use of symbols	Contradictory: Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	"Slacken off": Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Manufacturing: Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams: Dreams, moment of thinking	Visualization
1	Anonymous Voting [f]																					1													
2	Challenge [a, f]																1																		
3	Destination [a]																																		
4	How to [a, f]						1								1																				
5	Is – Is not [a, c]																							1											
6	The Kipling method (5W1H) [a, g]																																	1	
7	Reversal [d]											1																							
8	Pause [e]																1																		
9	AIDA (Analysis of Interactive Decision Areas) [f]																									1	1								
10	Backwards Forwards Planning [f]																																		
11	CATWOE [a, f]																1																		
12	Chunking [a]																						1												
13	Democracy [a]																					1													
14	Positives, Negatives [a, f]																							1											
15	Problem Statement [a, f]																																		
16	Boundary Relaxation [f]																							1											
17	Circle of Opportunity [f]										1							1							1										
18	Clarification [f]														1		1																		
19	Criteria for idea-finding potential [f]																1																		
20	Decomposition [f]																						1												
21	Dialectical Approaches [f]								1																										
22	Dimensional Analysis [f]																1																		
23	Fresh eye [f]																												1						
24	Listing Pros and Cons [f]																1					1													
25	PSI [a]				1						1																								

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Maukrelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2000), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

Criteria		Associated to creative process steps												Time usage	Alone/ Group		Paradigm			Linear/ Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	1D – Exploring the vision: Divergent	1C – Exploring the vision: Convergent	2D – Formulating challenges: Divergent	2C – Formulating challenges: Convergent	3D – Exploring ideas: Divergent	3C – Exploring ideas: Convergent	4D – Formulating solutions: Divergent	4C – Formulating solutions: Convergent	5D – Exploring acceptance: Divergent	5C – Exploring acceptance: Convergent	6D – Formulating a plan: Divergent	6C – Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestion	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
26	Unfolding [d]			1	1	1								3	0	1		1		1	1																				1								1						1
27	Analytic Hierarchy Process (AHP) [e]		1		1		1		1		1			4	1	1	1			1																						1													
28	Axiomatic design [m]	1	1	1	1									4	1	1	1			1																										1	1								
29	Circle Time [f]			1	1	1	1							4		1	1			1	1															1					1														
30	Critical Debate [n]				1		1							4		1		1		1									1													1													
31	Fishbone Diagram [f]			1	1									4	1	1	1	1		1	1																						1		1	1									
32	Flow charts [f]			1	1									4	1	1	1	1		1								1																	1	1									
33	Moment of Truth (MoT) Analysis [e]			1	1					1				4	1	1	1			1													1													1									
34	Storyboarding [a, d]		1		1			1		1		1	1	4	1	1		1		1	1																																		
35	Focus Groups [f]	1	1	1	1			1	1	1	1			5		1	1			1	1																				1					1									
36	General group problem-solving model [f]	1	1	1	1	1	1	1	1	1	1	1	1				1				1																				1	1													
37	Wishful thinking [c, d]	1	1	1	1														1					1																														1	

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mankelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Anderson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lombelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Courseyer (2014), [s] Holzmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

No.	Creativity tools	Associated to creative process steps: 1B - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2B - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3B - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4B - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5B - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6B - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time to use (1 to 3)	Alone/Group: Alone	Group	Paradigm: Maintain	Stretch	Break	Linear/Intuitive: Linear	Intuitive
1	Google Wonder Wheel [w]					1								1	1	1	1			1	1
2	How to [a, f]			1	1	1								1	1	1	1			1	1
3	Provocation [a]			1		1		1						1	1	1		1		1	1
4	Reversal [a]			1	1	1								1	1	1		1		1	1
5	The level chain [l]					1								1	1	0		1		1	1
6	Absence Thinking [a]					1								1	1	1			1	1	1
7	Random Words [a, b, f]					1								1	1	1			1	0	1
8	Wishing [a]					1								1	1	1			1	0	1
9	Assumption-busting [a, f]			1		1								2	1	1		1		1	1
10	Attribute Listing [a, b, e, f]			1		1								2	1	1	1			1	0
11	Bodystorming [a]					1								2		1		1		1	1
12	Brainwriting [a, e, f]					1								2	0	1		1		1	1
13	Concept Fan [f]			1		1								2	1	1	1			1	
14	Crawford Slip Method [b, e]					1								2		1		1		1	1
15	Doodling [e, f]					1								2	1	1			1	0	1
16	Double-Entry A-Ha! Method (DEAM) [e]					1								2	1		1			1	1
17	Drawing [f]					1								2	1	1		1	1		1
18	Essay Writing [f]					1								2	1			1		1	1
19	Essence [a]					1								2	1	1		1		1	1
20	Evolution [a]					1								2		1	1			1	1
21	Forget Colour [a]					1								2	1	1	1			1	
22	F-R-E-E-Writing [f]					1								2	1				1		1
23	Nominal Group Technique [e, f]					1	1							2	0	1		1		1	1
24	Play-on-words [g]					1								2	1			1			1
25	Rightbraining [a]					1								2	1	1			1	0	1

No.	Creativity tools	Exploration strategy – Combinatory: Deformation and words used	Similarities	Suggestion	Associative: Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Contradictory: Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	"Slacken off": Art	Ask questions	Brainstorm inspired	Checklist question	Game approach	Mind map type	Random	Manufacturing: Collaborative method	Decision making	Decomposition method	In a card type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams: Dreams, moment of thinking	Visualisation
1	Google Wonder Wheel [w]																		1																
2	How to [a, f]						1								1																				
3	Provocation [a]								1																										
4	Reversal [a]											1																							
5	The level chain [l]	1																		1															
6	Absence Thinking [a]									1																									
7	Random Words [a, b, f]	1																		1															
8	Wishing [a]																																	1	1
9	Assumption-busting [a, f]			1																															
10	Attribute Listing [a, b, e, f]																						1												
11	Bodystorming [a]															1									1										
12	Brainwriting [a, e, f]															1															1				
13	Concept Fan [f]											1													1										
14	Crawford Slip Method [b, e]															1																			
15	Doodling [e, f]																								1										
16	Double-Entry A-Ha! Method (DEAM) [e]																								1						1				
17	Drawing [f]													1											1						1				
18	Essay Writing [f]																														1				
19	Essence [a]		1		1	1											1																		
20	Evolution [a]				1																														
21	Forget Colour [a]																								1										1
22	F-R-E-E-Writing [f]																														1				
23	Nominal Group Technique [e, f]															1																			
24	Play-on-words [g]																														1				
25	Rightbraining [a]																								1									1	

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holzmann (2013), [t] Infinite Innovation (2011), [u] ArticleSearch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

No.	Criteria			Associated to creative process steps												Time usage		Alone/Group		Paradigm			Linear/Intuitive		Exploration strategy																																	
																									Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools			1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent		Time frame (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestion	Idea by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask question	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	5W type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
26	Role-play [d]							1				1					2	0	1		1		1	1												1																						
27	Rubber-ducking [d]			1		1		1		1		1		1			2	1	1		1		1	1																												1						
28	SCAMMPERR [a, c, e, f]							1	1								2	1	1		1		1	1														1		1																		
29	Take a break [a]							1									2	1	1			1	0	1																																	1	
30	A Positive Negative [d]							1									3	1	1		1		0	1						1					1																			1				
31	Analogies and metaphors [i]							1									3	1	1	1				1		1																																
32	Artistic innovation [w]							1									3	1	1		1			1									1																									
33	Ask questions [j]			1		1		1									3	1	1	1			1															1																				
34	Association [i]							1									3	1	1	1				1				1																														
35	Basic Associative Process [m]							1									3	1			1			1				1																														
36	Biomimetics [j]							1									3	1	1		1			1				1														1																
37	Block busting [j]							1									3		1		1			1			1																															
38	Borrowed Genius [b]							1									3	1	1			1		1												1																						
39	Brainstorming [b]							1									3	1	1			1	0	1													1		1																			
40	Brutethink [f]							1									3	1	1		1			1	1									1																								
41	Bug Listing [f]							1									3	1	1		1			1																1																		
42	Bunches of Bananas [f]							1									3		1		1			1									1																									
43	Buzz Groups [b]			1		1		1									3		1	1			1	1																				1														
44	Card Story Boards [f]							1									3	1	1	1			1																									1										
45	Cartoon Story Board [f]							1									3	1	1		1			1													1											1										
46	Challenge facts [b]							1									3	1	1		1		1	1											1																							
47	Changing directions [b]							1									3	1	1		1		1	1											1																							
48	Circle of Opportunity [f]			1	1	1	1	1	1								3		1		1			1										1							1							1										
49	Component Detailing [f]							1									3		1		1		1	1																						1		1										
50	Computer-assisted discovery [a]							1									3	1	1	1				1									1																									

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Fels (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sennier (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [z] Martin (2015).

	Criteria	Associated to creative process steps												Time usage	Alone/ Group		Paradigm			Linear/ Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools:	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestion	Ideas by association	Imitate other ideas	Word analysis, games, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
51	Derivative idea [a]					1								3	1	1	1				1									1																									
52	Do an Image Search on Google [g]					1								3	1	1	1			1	1																								1										
53	Focusing [f]					1								3	1	1			1		1																																	1	1
54	Forced Relationships/Analogy [f]					1								3	1	1			1		1										1														1		1								
55	Frames of reference [f]					1								3	1	1		1			1																								1										1
56	Fuzzy Thinking [a]					1								3	1	1		1		1	1			1								1			1																				
57	Gallery method [f]					1								3		1		1		1	1				1																														1
58	Guided Imagery [a]					1								3	1	1			1	0	1																																	1	1
59	Hexagon Modelling [f]					1								3	1	1		1		1	1									1									1																
60	Historical examination [f]					1								3	1	1	1			1															1		1																		
61	Idea List of Ways to Improve Something [j]					1								3	1	1	1			1	1																1																		
62	Ideas bank [m]					1								3	1	1	1			1	1				1	1															1								1						
63	IdeaToons [k]					1								3	1	1			1	1	1													1									1		1										
64	Image Association [a]					1								3	1	1		1			1				1																				1										1
65	Imitation [h]					1								3	1	1		1		1	1					1																													
66	Improvements to [j]					1								2	1	1		1		1	1			1																															
67	Improvisation [a]					1								3	1	1		1		1	1																				1														
68	Laddering [f]					1								3	1	1		1		1	1																						1												
69	Lotus Blossom Technique [a]					1								5	1	1		1		1	1																								1										
70	Metaphors [a, c, d]					1								5	1	1		1			1				1		1																												
71	Modeling [a]					1								5	1	1		1		1	1													1																					
72	Moodboards [g]					1								5	1	1		1			1				1																				1										1
73	Philosophical idea [a]					1								5	1	1	1				1									1																									
74	Post-Up [a]					1								5	1	1		1		1	1															1																			
75	PS2 [a]				1	1								5	1	1		1		1	1				1						1																								

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	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suggestion	Idea by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	In a net type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
76	Random Stimuli [f]					1								3	1	1		1			1				1						1						1								1										
77	Reverse brainstorming [b, f]					1								3	1	1		1		1	1											1				1																			
78	Revolutionary idea [g]					1								3	1	1	1				1									1																									
79	Sensanation [g]					1								3	1	1		1		1	1																1																		
80	Serendipitous discovery [f]					1								3	1	1		1			1				1																														
81	Six Thinking Hats [i]					1								3	0	1		1		1	1								1				1																						
82	Symbiotic idea [g]					1								3	1	1	1				1										1																								
83	Targeted innovation [g]					1								3	1	1	1				1									1																									
84	Unfolding [k]			1	1	1								3	0	1		1		1	1																				1								1						
85	Visual Metaphor [d]					1								3	1	1		1		1	1						1												1						1										
86	Word association [d]					1								3	1	1		1			1				1		1																												
87	Working the Discontinuity Principle [g]					1								3	1	1			1	1	1			1					1	1																									
88	Beachhead [g]					1								4		1			1		1																																	1	
89	Brainstorming [a, d, e, i]					1								4	0	1		1		1	1															1																			
90	Browsing [f]			1		1								4	1	1		1		1	1																1																		
91	Circle Time [f]			1	1	1	1							4		1	1			1	1															1					1														
92	C-K theory (concept-knowledge theory) [m]					1	1	1	1					4	1	1		1		1	1															1									1										
93	Contradiction analysis [f]					1								4	1	1		1		1																																	1		
94	Controlling Imagery [f]					1								4	1				1		1							1																											1
95	Copier avec mordant [l]					1								4		1		1			1				1	1																													
96	Diffusion Lifecycle [k]					1		1		1				4	0	1		1		1	1																1																		
97	Enterprise 2.0 [n]					1								4		1	1			1	1																				1														
98	Excursions [f]					1								4		1			1		1																				1													1	1
99	False Rule [f]					1								4	1	1			1		1								1	1	1																								
100	High Thinktank [g]					1								4	1				1		1						1																											1	

Creativity tools evaluation from: [a] Stralow (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mankelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015)

No.	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
101	Image-Streaming [A]					1								4	1				1		1
102	Lateral thinking [A]			1		1								4	0	1			1		1
103	Mindmapping [A, E, F]					1								4	1	1		1		1	1
104	Morphological Analysis [A]					1								4	1	1		1		1	1
105	Open Innovation [A]					1								4		1		1		1	1
106	Talk streaming [A]					1								4	1	0			1		1
107	The Bucky Fuller Linking Approach [A]					1								4	1	1			1	1	1
108	Why not? [A]					1		1						4	0	1		1		1	1
109	Write streaming [A]					1								4	1	0			1	0	1
110	Analysis of past solutions [J]					1		1						5	1	1	1			1	
111	Art streaming [A]					1								5	1	0			1	0	1
112	Catalogue KickStart [F]					1								5	1	1		1		1	1
113	Crowdsourcing [?]					1	1	1	1					5		1	1			1	
114	Disney Creativity Strategy [J]					1		1	1			1	1	5	1	1		1		1	1
115	Fuzzy cognitive map [K]			1		1								5	1	1	1	1		1	1
116	Haefele's Collective Notebook [F]					1								5	1			1		1	1
117	Incubation [A, J]					1								5	1	0		1		0	1
118	Keep Scrapbooks and Sketchbooks [J]					1								5	1	1		1			1
119	Keeping a Dream Diary [J]					1								5	1				1		1
120	Aristotle's categories [J]	1		1		1		1							1	1	1			1	
121	Cognitive map [K]					1									1	1		1			1
122	Design by synonyms and antonyms [K]	1		1		1												1		1	
123	General group problem-solving model [F]	1	1	1	1	1	1	1	1	1	1	1	1				1				1
124	Human needs [J]	1		1		1		1							1	1	1			1	
125	Physical attributes [J]	1		1		1		1							1	1	1			1	
126	The five senses [?]	1		1		1		1							1	1	1			1	

Exploration strategy:

No.	Creativity tools	Combinatory: Dictionaries and words used	Combinatory: Similarities	Combinatory: Supposition	Associative: Ideas by association	Associative: Imbue other ideas	Associative: Word analysis, game, metaphor	Associative: Use of symbols	Contradictory: Confrontation	Contradictory: Lateral-thinking inspired	Contradictory: Forced relationship	Contradictory: Reverse or different statement	Contradictory: Role playing	"Slacken off": Art	"Slacken off": Ask questions	"Slacken off": Brainteaser inspired	"Slacken off": Checklist, question	"Slacken off": Game approach	"Slacken off": Mind map type	"Slacken off": Random	Manufacturing: Collaborative method	Manufacturing: Decision making	Manufacturing: Decomposition method	Manufacturing: In itself type	Manufacturing: Graphic method	Manufacturing: Manufacturing approach	Manufacturing: Match methods	Manufacturing: Project management approach	Manufacturing: Expert or system consultation	Manufacturing: Voting system	Manufacturing: Writing method	Manufacturing: Storyboard, story telling inspired	Manufacturing: TRIZ inspired	Dreams: Dreams, moment of thinking	Dreams: Visualization
101	Image-Streaming [A]						1																		1									1	1
102	Lateral thinking [A]									1																									
103	Mindmapping [A, E, F]																		1						1										
104	Morphological Analysis [A]										1																								
105	Open Innovation [A]																				1					1									
106	Talk streaming [A]																																		
107	The Bucky Fuller Linking Approach [A]										1																								
108	Why not? [A]			1					1																										
109	Write streaming [A]																														1				
110	Analysis of past solutions [J]		1		1	1																													
111	Art streaming [A]													1																					
112	Catalogue KickStart [F]					1									1		1																		
113	Crowdsourcing [?]																				1														
114	Disney Creativity Strategy [J]								1														1					1						1	
115	Fuzzy cognitive map [K]																		1						1	1									
116	Haefele's Collective Notebook [F]		1			1					1						1												1						
117	Incubation [A, J]																																		
118	Keep Scrapbooks and Sketchbooks [J]				1	1								1											1										1
119	Keeping a Dream Diary [J]																																	1	
120	Aristotle's categories [J]																1																		
121	Cognitive map [K]																								1										
122	Design by synonyms and antonyms [K]	1			1		1																												
123	General group problem-solving model [F]																				1	1													
124	Human needs [J]																1																		
125	Physical attributes [J]																1																		
126	The five senses [?]																1																		

Creativity tools evaluation from: [A] Straker (2013), [B] Clegg and Birch (2007), [C] Mc Fadzean (1998), [D] Cirrier and Gélinas (2011), [E] Mankelow et al. (2015), [F] mycoted.com (2010), [G] graphicdesignblog (2007), [H] Andersson (2013), [I] Higgins (2005), [J] Harris (2002), [K] Cave (2003), [L] Lambrechts and Pols (2015), [M] Hatchuel, Le Masson and Weil (2004), [N] USQUID (2015), [O] Wragge (2014), [P] Dunne (2000), [Q] Sommer (2015), [R] Courreyve (2014), [S] Hohmann (2013), [T] Infinite Innovation (2011), [U] ArticleSnatch (2015), [V] Alon (2008), [W] GSQi (2015), [X] Chesbrough (2013) and [Y] Martin (2015).

	Criteria	Associated to creative process steps												Time usage	Alone/ Group		Paradigm			Linear/ Intuitive		Exploration strategy																																	
																						Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	1B - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2B - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3B - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4B - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5B - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6B - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Easy to use (1 to 3)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Definitions and words used	Similarities	Suggestions	Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
1	Adoption Checklist[a]						1							1		1	1			1																1									1										
2	Advantages, Limitations and Unique Qualities[f]		1		1		1		1					1		1	1			1																						1													
3	Anonymous Voting[f]						1							1	1	1	1			1	0																					1													
4	Circle of Opportunity[f]						1		1					1		1	1			1																						1								1					
5	BulletProofing[f]		1		1		1		1					1	1	1		1		1	1																1																		
6	Checklists[b]						1		1					1	0	1		1		1	1																													1					
7	Analytic Hierarchy Process (AHP)[c]		1		1		1		1		1		1	1	1	1			1		1																																	1	
8	Is – Is not[h, k]		1	1	1		1		1					1		1		1			1										1							1							1										
9	Circle Time[f]						1		1					2	1	1	1			1	0																1																		
10	C-K theory (concept-knowledge theory)[m]		1		1		1		1		1		1	2		1	1			1																						1													
11	COCD Box[i]						1		1		1			2	1	1		1		1	1																							1											
12	Concept Screening[d]		1		1		1		1					2	1	1	1			1	0																							1											1
13	Critical Debate[n]						1							2	1	1		1		1	1																					1					1								
14	Crowdsourcing[o]					1	1							2	0	1		1		1	1															1																			
15	Dimensional Analysis[f]						1							2	1	1	1			1	0																					1													
16	Democracy[p]		1		1		1		1					2	1	1		1		1	1																							1											
17	Force-field Analysis[e]						1		1					2	1	1	1			1																							1		1		1								
18	SCAMMPERR[a, b, e, f]					1	1							2	1	1		1		1	1														1		1																		
19	General group problem-solving model[f]						1		1					3	1	1	1			1																1	1																		
20	Imagery for Answering Questions[f]						1		1					3		1	1			1																	1																		
21	KJ-Method[f]						1		1					3		1	1			1																					1	1													
22	Listing Pros and Cons[g]						1		1					3	1	2	1			1	0																					1													
23	Negative Selection[e]		1		1		1		1					3	1	1	1			1																	1																		
24	Nominal Group Technique[e, f]						1							3	1				1		1			1																					1										
25	NUF Test[h, f]						1							3	1	1		1		1					1																	1			1										

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Cassier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Anderson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dumo (2000), [q] Sommers (2015), [r] Crossover (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQ (2015), [x] Cheltrough (2013) and [y] Martin (2015).

	Criteria			Associated to creative process steps												Time usage		Alone/ Group		Para-digm			Linear/ Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Stacken off"							Manufacturing													Dreams	
	Creativity tools			1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent		Time to use (1 to 5)	Alone	Group	Mainstream	Stretch	Break	Linear	Intuitive	Dictionaries and words used	Similarities	Suppositions	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Inverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Pressure, moment of thinking	Visualization
26	Paired Comparison [f]						1		1		1						2	1	1	1			1																	1					1													
27	Pause [a]								1		1						3	1	1		1		1	1																					1					1								
28	PEST analysis [a]								1		1						3	1	1		1		1	1																					1					1								
29	PINC Filter [a]								1								3	1	1	1			1																	1																		
30	Positives, Negatives [a, f]				1		1		1		1		1				4	1	1	1			1																						1													
31	Q-Sort [f]					1	1	1	1								4		1	1			1	1															1					1														
32	Spreading Diffusion [a]							1	1	1	1						4	1	1		1		1	1															1									1										
33	Swap sort [a]						1		1								4		1		1		1									1													1													
34	Synectic [g]								1		1		1				4	1	1		1		1	1																					1					1		1						
35	The Hundred Dollar Test [j]								1								4	1	1		1		1	1																1					1					1								
36	The Kipling method (5W1H) [a, j]								1								4		1		1		1	1		1		1																														
37	Voting [a]							1	1	1	1						5		1	1			1																					1														
38	Yellow box [g]			1	1	1	1	1	1	1	1	1	1	1	1					1				1																				1	1													

Creativity tools evaluation from: [a] Straker (2011), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Anderson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lenhelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] UNQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommers (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2015) and [y] Martin (2015).

No.	Criteria / Creativity tools	Associated to creative process steps: 1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time usage: Time in use (1 to 5)	Alone/Group: Alone	Group	Paradigm: Materials	Stretch	Break	Linear/Intuitive: Linear	Intuitive
1	Provocation [a]			1		1		1						1	1	1		1		1	1
2	CATWOE [a,f]			1	1			1	1					2	1	1	1			1	0
3	Chunking [a]			1	1			1	1					2	1	1	1			1	0
4	Rubber-thinking [a]	1		1		1		1		1		1		2	1	1		1		1	1
5	Using Experts [f]							1	1	1	1			2	1	1	1				1
6	A Day In The Life Of… [a]							1	1	1	1			3	1	1		1		1	1
7	How-How Diagram [a,f]							1	1			1	1	3	1	1		1		1	1
8	C-K theory (concept-knowledge theory) [m]					1	1	1	1					4	1	1		1		1	1
9	Deep Thought Experiment [n]							1	1					4	1				1		1
10	Diffusion Lifecycle [d]					1		1		1				4	0	1		1		1	1
11	Storyboarding [a,g]		1		1			1		1		1	1	4	1	1		1		1	1
12	Value Analysis [a]							1	1					4	1	0	1			1	0
13	Why not? [d]					1		1						4	0	1		1		1	1
14	Adaptive Reasoning [f]							1	1					5	1	1		1		1	1
15	Analysis of past solutions [i]					1		1						5	1	1	1			1	
16	Crowdsourcing [x]					1	1	1	1					5		1	1			1	
17	Decision seminar [f]	1	1					1	1					5	1	1	1			1	
18	Disney Creativity Strategy [f]					1		1	1			1	1	5	1	1		1		1	1
19	Focus Groups [f]	1	1	1	1			1	1	1	1			5		1	1			1	1
20	Aristotle's categories [j]	1		1		1		1							1	1	1			1	
21	General group problem-solving model [j]	1	1	1	1	1	1	1	1	1	1	1	1				1				1
22	Human needs [j]	1		1		1		1							1	1	1			1	
23	Physical attributes [j]	1		1		1		1							1	1	1			1	
24	The five senses [u]	1		1		1		1							1	1	1			1	

No.	Creativity tools	Exploration strategy – Combinatory: Dictionaries and words used	Similarities	Suggestion	Associative: Ideas by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Contradictory: Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	"Slacken off": Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Manufacturing: Collaborative method	Decision making	Decomposition method	In, In and type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams: Dreams, moment of thinking	Visualization
1	Provocation								1																										
2	CATWOE																1																		
3	Chunking																						1												
4	Rubber-thinking																												1						
5	Using Experts																												1						
6	A Day In The Life Of…																															1			
7	How-How Diagram				1										1										1										
8	C-K theory (concept-knowledge theory)															1									1										
9	Deep Thought Experiment																																	1	1
10	Diffusion Lifecycle																1																		
11	Storyboarding																																		
12	Value Analysis																									1									
13	Why not?			1					1																										
14	Adaptive Reasoning																											1							
15	Analysis of past solutions		1		1	1																													
16	Crowdsourcing																				1														
17	Decision seminar																				1	1						1	1						
18	Disney Creativity Strategy								1														1					1						1	
19	Focus Groups																				1					1									
20	Aristotle's categories																1																		
21	General group problem-solving model																				1	1													
22	Human needs																1																		
23	Physical attributes																1																		
24	The five senses																1																		

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Cantier and Gelinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Anderson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2005), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holmium (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2017) and [y] Martin (2015)

	Criteria	Associated to creative process steps												Time usage	Alone/ Group		Paradigm			Linear/ Intuitive	
	Creativity tools	1D – Exploring the vision: Divergent	1C – Exploring the vision: Convergent	2D – Formulating challenges: Divergent	2C – Formulating challenges: Convergent	3D – Exploring ideas: Divergent	3C – Exploring ideas: Convergent	4D – Formulating solutions: Divergent	4C – Formulating solutions: Convergent	5D – Exploring acceptance: Divergent	5C – Exploring acceptance: Convergent	6D – Formulating a plan: Divergent	6C – Formulating a plan: Convergent	Time to use (1 to 3)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Autonomous Voting [f]		1		1		1		1					1		1	1			1	
2	Challenge [a, j]				1				1					1	1	1	1			1	0
3	Yellow box [d]						1		1					1		1	1			1	
4	The Kipling method (5W1H) [a, f]		1		1		1		1					1	1	1		1		1	1
5	Voting [b]						1		1					1	0	1		1		1	1
6	Panic [a]		1		1		1		1		1		1	1	1	1			1	0	1
7	Remembrance [a]								1					1	1	1			1	0	1
8	Adoption Checklist [a]						1		1					2	1	1	1			1	0
9	CATWOE [a, b]			1	1			1	1					2	1	1	1			1	0
10	Chunking [a]			1	1			1	1					2	1	1	1			1	0
11	Dotmocracy [a]		1		1		1		1		1		1	2		1	1			1	
12	Force-field Analysis [a]						1		1		1			2	1	1		1		1	1
13	Is – Is not [a, e]		1	1	1		1		1					2	1	1	1			1	0
14	Positives, Negatives [a, f]		1		1		1		1					2	1	1		1		1	1
15	Swap sort [a]						1		1					2	1	1	1			1	
16	Using Experts [f]							1	1	1	1			2	1	1	1				1
17	A Day In The Life Of … [b]							1	1	1	1			3	1	1		1		1	1
18	BulletProofing [j]						1		1					3	1	1	1			1	
19	Checklists [a]						1		1					3		1	1			1	
20	COCD Box [l]						1		1					3		1	1			1	
21	Concept Screening [a]						1		1					3	1	2	1			1	0
22	Dimensional Analysis [f]		1		1		1		1					3	1	1	1			1	
23	How-How Diagram [a, f]							1	1			1	1	3	1	1		1		1	1
24	Listing Pros and Cons [j]				1		1		1					3	1	1	1			1	
25	Paired Comparison [g]						1		1					3	1	1		1		1	1
26	Praise [g]								1					3	1	1		1		1	1

	Criteria	Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Dictionaries and words used	Similarities	Superposition	Chain by associations	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	A, in and type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
1	Autonomous Voting [f]																					1													
2	Challenge [a, j]																1																		
3	Yellow box [d]																					1								1					
4	The Kipling method (5W1H) [a, f]																1																		
5	Voting [b]																													1					
6	Panic [a]																																	1	
7	Remembrance [a]																																	1	1
8	Adoption Checklist [a]																1																		
9	CATWOE [a, b]																1																		
10	Chunking [a]																						1												
11	Dotmocracy [a]																					1													
12	Force-field Analysis [a]																							1											
13	Is – Is not [a, e]																							1											1
14	Positives, Negatives [a, f]																							1											
15	Swap sort [a]																						1		1		1								
16	Using Experts [f]																												1						
17	A Day In The Life Of … [b]																															1			
18	BulletProofing [j]															1	1																		
19	Checklists [a]																1																		
20	COCD Box [l]																				1	1													
21	Concept Screening [a]																					1													
22	Dimensional Analysis [f]																1																		
23	How-How Diagram [a, f]				1										1										1										
24	Listing Pros and Cons [j]																1					1													
25	Paired Comparison [g]																					1					1								
26	Praise [g]																1										1								

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gelinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Poh (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akan (2008), [w] QSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

Criteria		Associated to creative process steps												Time usage	Alone/ Group		Paradigm			Linear/ Intuitive	
No.	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
26	Q-Sort[f]						1		1					3	1	1		1		1	1
27	SWOT Analysis[h, i]								1					3	1	1		1		1	1
28	Analytic Hierarchy Process (AHP)[e]		1		1		1		1		1			3	1	1	1			1	
29	C-K theory (concept-knowledge theory)[m]					1	1	1	1					4	1	1		1		1	1
30	Deep Thought Experiment[n]							1	1					4	1				1		1
31	PEST analysis[e]						1		1		1			4	1	1		1		1	1
32	Value Analysis[e]							1	1					4	1	0	1			1	0
33	Adaptive Reasoning[f]							1	1					5	1	1		1		1	1
34	Alternative Scenarios[f]	1	1						1			1	1	3		1		1			1
35	Crowdsourcing[f]					1	1	1	1					5		1	1			1	
36	Decision seminar[f]	1	1					1	1					5	1	1	1			1	
37	DFMA[e]								1			1	1	5	1	1		1		1	1
38	Disney Creativity Strategy[f, j]					1		1	1			1	1	5	1	1		1		1	1
39	Focus Groups[f]	1	1	1	1			1	1	1	1			5		1	1			1	1
40	General group problem-solving model[f]	1	1	1	1	1	1	1	1	1	1	1	1				1				1

Exploration strategy		Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
No.	Creativity tools	Dictionaries and words used	Similarities	Suggestion	Ideas by associations	Isolate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask question	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
26	Q-Sort[f]																					1					1								
27	SWOT Analysis[h, i]																					1					1								
28	Analytic Hierarchy Process (AHP)[e]																					1													
29	C-K theory (concept-knowledge theory)[m]															1									1										
30	Deep Thought Experiment[n]																																	1	1
31	PEST analysis[e]																					1					1		1						
32	Value Analysis[e]																									1									
33	Adaptive Reasoning[f]																											1							
34	Alternative Scenarios[f]																														1	1			
35	Crowdsourcing[f]																				1														
36	Decision seminar[f]																				1	1						1	1						
37	DFMA[e]																									1		1							
38	Disney Creativity Strategy[f, j]								1														1					1						1	
39	Focus Groups[f]																				1					1									
40	General group problem-solving model[f]																				1	1													

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSearch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria	Associated to creative process steps												Time usage	Alone/ Group		Para- digm			Linear/ Intui- tive	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time in use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Using Experts [f]							1	1	1	1			2	1	1	1				1
2	Role-play [d]					1				1				2	0	1		1		1	1
3	Rubber-ducking [a]	1		1		1		1		1		1		2	1	1		1		1	1
4	A Day In The Life Of… [a]							1	1	1	1			3	1	1		1		1	1
5	Diffusion [f]									1				3	1	1		1		1	1
6	Diffusion Lifecycle [a]					1		1		1				4	0	1		1		1	1
7	Head, Heart and Hands (HHH) [d]									1				4	1	1		1		1	1
8	Moment of Truth (MoT) Analysis [a]			1	1					1				4	1	1	1			1	
9	Storyboarding [a, d]		1		1			1		1		1	1	4	1	1		1		1	1
10	Delphi Method [a]	1		1						1				5		1		1		1	1
11	Focus Groups [f]	1	1	1	1			1	1	1	1			5		1	1			1	1
12	Living Labs [n]									1				5		1		1		1	1
13	General group problem-solving model [t]	1	1	1	1	1	1	1	1	1	1	1	1				1				1

	Criteria	Exploration strategy: Combi- natory			Associ- ative				Contradic- tory					"Slacken off"							Manufacturing													Dre- ams	
	Creativity tools	Dictionaries and words used	Similarities	Suggestion	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is in/not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
1	Using Experts [f]																												1						
2	Role-play [d]												1																						
3	Rubber-ducking [a]																												1						
4	A Day In The Life Of… [a]																															1			
5	Diffusion [f]																1																		
6	Diffusion Lifecycle [a]																1																		
7	Head, Heart and Hands (HHH) [d]																1																		
8	Moment of Truth (MoT) Analysis [a]												1													1									
9	Storyboarding [a, d]																																		
10	Delphi Method [a]																												1						
11	Focus Groups [f]																				1					1									
12	Living Labs [n]																				1														
13	General group problem-solving model [t]																				1	1													

Creativity tools evaluation from: [a] Strakos (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Mankelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Anderson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lamberlin and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hohmann (2013), [t] Infinite Innovation (2011), [u] ArticleSearch (2015), [v] Akin (2008), [w] GSQI (2015), [x] Chesbrough (2013) and [y] Martin (2015).

Criteria				Associated to creative process steps												Time usage	Alone/ Group		Paradigm			Linear/ Intuitive		Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools			1D – Exploring the vision: Divergent	1C – Exploring the vision: Convergent	2D – Formulating challenges: Divergent	2C – Formulating challenges: Convergent	3D – Exploring ideas: Divergent	3C – Exploring ideas: Convergent	4D – Formulating solutions: Divergent	4C – Formulating solutions: Convergent	5D – Exploring acceptance: Divergent	5C – Exploring acceptance: Convergent	6D – Formulating a plan: Divergent	6C – Formulating a plan: Convergent	Time factor (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Relevance and words used	Similarities	Suggestion	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is in tool type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
1	Pause [a]				1		1		1		1		1		1	1	1	1			1		1																																	1	
2	Democracy [b]				1		1		1		1		1		1	2		1	1			1																						1													
3	Using Experts [f]									1	1	1	1			2	1	1	1				1																												1						
4	Force-field Analysis [a]								1		1		1			2	1	1		1		1	1																							1											
5	A Day In The Life Of… [e]									1	1	1	1			3	1	1		1		1	1																															1			
6	Analytic Hierarchy Process (AHP) [e]				1		1		1		1		1			4	1	1	1			1																						1													
7	Factors in selling ideas [f]												1		1	4	1	1	1			1																	1								1										
8	PEST analysis [e]								1		1		1			4	1	1		1		1	1																					1					1		1						
9	Focus Groups [f]			1	1	1	1			1	1	1	1			5		1	1			1	1																				1					1									
10	General group problem-solving model [j]			1	1	1	1	1	1	1	1	1	1	1	1				1				1																				1	1													

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Cantier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Landolt and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Duane (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Hofmann (2015), [t] Infinite Innovation (2011), [u] ArticleSearch (2015), [v] Akin (2008), [w] DSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria	Associated to creative process steps												Time usage	Alone/ Group		Para-digm			Linear/ Intui-tive		Exploration strategy: Combi-natory			Associ-ative				Contradic-tory					"Starting off"							Manufacturing													Dre-ams	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive	Deliberate and words used	Similarities	Suggestion	Ideas by associations	Induce other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral-thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Game approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is-is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualization
1	Action plan [l]											1	1	2	1	1	1			1	0																											1							
2	Rubber-ducking [x]	1		1		1		1		1		1		4	1	1		1		1	1																												1						
3	How-How Diagram [k, l]							1	1			1	1	3	1	1		1		1	1				1										1										1										
4	Storyboarding [e, d]		1		1			1		1		1	1	4	1	1		1		1	1																																		
5	Alternative Scenarios [f]	1	1						1			1	1	5		1		1			1																														1	1			
6	Consensus Mapping [f]											1	1	5		1	1			1																					1	1			1										
7	DFMA [s]								1			1	1	5	1	1		1		1	1																									1		1							
8	Disney Creativity Strategy [f]					1		1	1			1	1	5	1	1		1		1	1								1														1					1						1	
9	PMI [f]											1	1	5	1	1	1			1																												1							
10	General group problem-solving model [f]	1	1	1	1	1	1	1	1	1	1	1	1				1				1																				1	1													

Creativity tools evaluation from: [a] Szalkor (2011), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2015), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cavy (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Duarte (2000), [q] Sommer (2015), [r] Cournoyer (2014), [s] Holzmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

	Criteria	Associated to creative process steps												Time usage	Alone/Group		Paradigm			Linear/Intuitive	
	Creativity tools	1D - Exploring the vision: Divergent	1C - Exploring the vision: Convergent	2D - Formulating challenges: Divergent	2C - Formulating challenges: Convergent	3D - Exploring ideas: Divergent	3C - Exploring ideas: Convergent	4D - Formulating solutions: Divergent	4C - Formulating solutions: Convergent	5D - Exploring acceptance: Divergent	5C - Exploring acceptance: Convergent	6D - Formulating a plan: Divergent	6C - Formulating a plan: Convergent	Time to use (1 to 5)	Alone	Group	Maintain	Stretch	Break	Linear	Intuitive
1	Action plan [k]											1	1	2	1	1	1			1	0
2	Dotmocracy [a]		1		1		1		1		1		1	2		1	1			1	
3	Critical Path Methods (CPM) [f]												1	3	1		1			1	
4	How-How Diagram [e, f]							1	1			1	1	3	1	1		1		1	1
5	Implementation Checklists [f]												1	3		1	1			1	
6	Factors in selling ideas [f]										1		1	4	1	1	1			1	
7	Alternative Scenarios [f]	1	1						1			1	1	5		1		1			1
8	Consensus Mapping [f]											1	1	5		1	1			1	
9	DFMA [l]								1			1	1	5	1	1		1		1	1
10	Disney Creativity Strategy [f]					1		1	1			1	1	5	1	1		1		1	1
11	General group problem solving model [f]	1	1	1	1	1	1	1	1	1	1	1	1				1				1
12	Pause [e]		1		1		1		1		1		1	1	1	1			1		1
13	PMI [f]											1	1	5	1	1	1			1	
14	Project Evaluation and Review Technique [e]												1	4	1		1			1	
15	Reverse Planning [e]												1	4	1	1		1		1	1
16	Storyboarding [e, g]		1		1			1		1		1	1	4	1	1		1		1	1

	Criteria	Exploration strategy: Combinatory			Associative				Contradictory					"Slacken off"							Manufacturing													Dreams	
	Creativity tools	Dictionaries and words used	Similarities	Suggestion	Ideas by association	Imitate other ideas	Word analysis, game, metaphor	Use of symbols	Confrontation	Lateral thinking inspired	Force relationship	Reverse or different statement	Role playing	Art	Ask questions	Brainstorm inspired	Checklist, question	Case approach	Mind map type	Random	Collaborative method	Decision making	Decomposition method	Is, is not type	Graphic method	Manufacturing approach	Matrix methods	Project management approach	Expert or system consultation	Voting system	Writing method	Storyboard, story telling inspired	TRIZ inspired	Dreams, moment of thinking	Visualisation
1	Action plan [k]																											1							
2	Dotmocracy [a]																					1													
3	Critical Path Methods (CPM) [f]																									1		1							
4	How-How Diagram [e, f]				1										1										1										
5	Implementation Checklists [f]																1																		
6	Factors in selling ideas [f]																1									1									
7	Alternative Scenarios [f]																														1	1			
8	Consensus Mapping [f]																				1	1			1										
9	DFMA [l]																									1		1							
10	Disney Creativity Strategy [f]								1														1					1						1	
11	General group problem solving model [f]																				1	1													
12	Pause [e]																																	1	
13	PMI [f]																											1							
14	Project Evaluation and Review Technique [e]																									1		1							
15	Reverse Planning [e]											1																							1
16	Storyboarding [e, g]																																		

Creativity tools evaluation from: [a] Straker (2013), [b] Clegg and Birch (2007), [c] Mc Fadzean (1998), [d] Carrier and Gélinas (2011), [e] Manktelow et al. (2015), [f] mycoted.com (2010), [g] graphicdesignblog (2007), [h] Andersson (2013), [i] Higgins (2005), [j] Harris (2002), [k] Cave (2003), [l] Lambelet and Pols (2015), [m] Hatchuel, Le Masson and Weil (2004), [n] USQUID (2015), [o] Wenger (2014), [p] Dunne (2000), [q] Sommer (2015), [r] Courmoyer (2014), [s] Holmann (2013), [t] Infinite Innovation (2011), [u] ArticleSnatch (2015), [v] Akin (2008), [w] GSQi (2015), [x] Chesbrough (2013) and [y] Martin (2015).

APPENDIX V

Number of participants at The 24 Hours of Innovation

Table A.V History of the participation at The 24 Hours of Innovation Organized at Montreal and ESTIA

Year	Main site	Number of participants	Remarks
2007	ESTIA	200	ESTIA Season 1
2008	ESTIA	250	ESTIA Season 2
2009	ESTIA	250	ESTIA Season 3
2010	ESTIA	268	ÉTS has participated at this edition for the first time
2010	ÉTS	32	ESTIA Season 4 - First Montreal edition of ÉTS as participants during the ESTIA 24h
2011	ÉTS		Second Montreal edition organized for he first time by ÉTS
2011	ESTIA	Not publish	ESTIA Season 5 - Third Montreal edition as participant at ESTIA 24h edition
2012	ÉTS	882	Fourth Montreal edition with C2MTL partnership
2012	ESTIA	Not publish	ESTIA Season 6 - Fifth Montreal edition as participant at ESTIA 24h edition
2013	ÉTS	1000	Sixth Montreal edition with C2MTL partnership
2013	ESTIA	Not publish	ESTIA Season 7 - Seventh Montreal edition as participant at ESTIA 24h edition
2014	ÉTS	1121	Eigth Montreal edition with C2MTL partnership
2014	ESTIA		ESTIA Season 8 - Ninth Montreal edition as participant at ESTIA 24h edition
2015	ÉTS		Ninth Montreal edition with C2MTL partnership

APPENDIX VI

Questionnaires

A.VI.1 2012 3rd hour numerical questionnaire

Recherche sur les activités faites aux 24H de l'innovation - 3H - 24 hours of innovation / 3H de l'innovation

TROISIÈME HEURE -SVP Décrivez vos activités heure par heure pendant la 0H et la 3H
TERCERA HORA - Por favor Describa sus actividades por hora durante la 0H y 3H
THIRD HOUR- Please, describe activities between 0H to 3H

*Obligatoire

Courriel - svp de ne pas utiliser un courriel hotmail, msm ou live *

Team name - Nom de l'équipe

Nombre de su équipo

Sujet de travail choisi (No.#)

Tema escogido (No.#)

Project Stage & Activities - Étape du projet et activités - Etapa del proyecto y actividades

Quelle(s) étape(s) du projet (1 à 5) et quelle(s) activité(s) vous avez personnellement faites. Cocher les activités (x à la fin) que, lorsque les correspondant à votre implication dans le projet ces 3 dernières heures. -- Escoja el(los) etapa(s) y la(s) actividades realizadas durante esta etapa de proyecto

1. Planification du Projet / Project Planning	2. Planification des tâches / Task Planning	3. Analyse de besoins / Needs Analysing	4. Recherche de concepts / Concepts searching	5. Proposition de solutions / Solution Proposal

	1. Planification du Projet / Project Planning	2. Planification des tâches / Task Planning	3. Analyse des besoins / Needs Analysing	4. Recherche de concepts / Concepts searching	5. Proposition de solutions / Solutions Proposal
a. Je propose des idées de solution / I propose solution ideas					
b. Je réalise la planification / I define the planning					
c. Je gère les tâches des membres de l'équipe / manage tasks of team members					
d. Je choisis les solutions / I chose or reject solutions					
e. J'agis ou réagis pour que le projet avance en des solutions au respect du temps alloué / I act or react to converge in time					
f. Je définis en tout ou en partie les critères d'évaluation des solutions / I define (part of) the method for evaluation					
g. Je change l'équipe relativement au temps consacré au développement des solutions considérées / I change the team					

	1. Planification du Projet / Project Planning	2. Planification des tâches / Task Planning	3. Analyse des besoins / Needs Analysing	4. Recherche de concepts / Concepts searching	5. Proposition de solutions / Solution Proposal
in developing or stopping the development of solution					
h. L'interpréter / définir les besoins du client / Define or interpret the client brief	○	○	○	○	○
i. L'interpréter / définir les règles et limites du projet / I interpreted rules and restrictions	○	○	○	○	○

Décrivez svp. si vous avez réalisé d'autres activités - Describe if you have done other activities --

Describa por favor si ud ha realizado otras actividades

Pendant ces 3h, indiquez quels outils et logiciels vous avez utilisés -- During those 3 hours, indicate what tools and softwares you have used -- *

Durate estas 3h, indique cuales herramientas o software fueron utilizadas

- ☐ Skype - Webex - video conference
- ☐ Cartes conceptuelles - mind mapping
- ☐ Dessin - Paint
- ☐ Moteur de recherche Internet
- ☐ Visionner photos, images ou vidéos
- ☐ CAO - CAD
- ☐ Consulter des sites d'innovation - méthodes
- ☐ Consulter le guide des activités sur Inookiz - La guía de actividades en Inookiz

- Autre :

Pendant ces 3h, indiquez quels dispositifs vous avez utilisés -- During those 3 hours, indicate what dispositives you have used -- *

Durante estas 3h, indique cuáles dispositivos fueron utilizados

- Ordinateur portable - Computador portatil
- Ordinateur bureau - Computador de oficina
- Ipad ou Tablette PC
- Mobile - Celular
- Écran tactile - Pantalla tacti
- Autre :

Pendant ces 3h s.v.p. indiquez avec combien de personnes vous avez eu une interaction ? – During those 3 hours, indicate with how many peoples have you interact? – *

Durante estas 3h, por favor senale con cuantas personas tuvo una interaccion

- 0
- 1 à 3
- Plus de 3+
- Tout l'équipe
- Expert interne
- Expert externe
- Public - Público
- Autre :

Pendant ces 3h, combien des idées avez -vous proposée ? *

Cuantas ideas ud ha propuesto?

- 0
- 1 à 3
- [illegible]
- [illegible]
- [illegible]
- [illegible]

CRITIQUE OUTILS - À cette étape, quels outils, logiciels ou systèmes d'information ont été essentiels pour faire votre projet pendant ces 3H ? -- During those 3H, what tools, software or information Systems were so critical to go ahead with your project? *

Que utiles o herramientas informaticas fueron criticas para desarrollar su proyecto en estas 3H?

CRITIQUE K- Quels connaissances, informations, outils de créativité, méthodes, processus ont été essentiels pour faire votre projet pendant ces 3H? During those 3 hours, what knowledge, informations, tools, creativity tools, process, softwares, etc. has been critical to hlp you to go ahead with your project? *

Que conocimientos y herramientas quisiera tener para completar su trabajo?

IDEAL environment - Quels connaissances et outils auriez-vous aimés avoir pour compléter votre travail? - What knowledge and tools would you like to have to work with? *

Qué conocimientos y herramientas quisiera tener para completar su trabajo?

Envoyer

N'envoyez jamais de mots de passe via Google Forms.

A.VI.2 2013 9th hour numerical questionnaire

Électronique 2013 - 9e heure

En cas de difficulté pour afficher ou envoyer ce formulaire, remplissez-le dans Google Forms.

Creativity questionnaire (hour 9)

This research questionnaire on creativity try to understand the types of activities that members of your team have done hour by hour. It is easy to complete and should be completed at all hours by the secretary of the team.

Indicate the types of activities carried out and, if applicable, the creative process and tools (see the creativity guide and Mini tools at http://etsinnovation.wordpress.com/sites-dinnovations/)

Have you done the activity "ORGANISATION/PLANNING : PROJECT"?

- Yes
- No

How many peoples have participate to this activity ?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Did you used the following processes and tools for this activity?

- ☐ Creative process
- ☐ Project management
- ☐ Mini statement
- ☐ Mini is / is not
- ☐ Mini brainstorm
- ☐ Mini scamper
- ☐ Mini mindmap
- ☐ Mini C-K
- ☐ Mini yellow box

- [ ] Mini praise
- [ ] Other

Comments for that activity?

Have you done the activity "ORGANISATION/PLANNING : TASK"?

- ( ) Yes
- ( ) No

How many peoples have participate to this activity?

1	2	3	4	5	6	7	8	9	10
( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

Did you used the following processes and tools for this activity?

- [ ] Creative process
- [ ] Project management
- [ ] Mini [illegible]
- [ ] Mini [illegible]
- [ ] Mini brainwriting
- [ ] Mini scamper
- [ ] Mini mindmap
- [ ] Mini OK
- [ ] Mini yellow box
- [ ] Mini praise
- [ ] Other

Comments for that activity?

Have you done the activity "NEEDS ANALYSIS"?

- Yes
- No

How many peoples have participate to this activity?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Did you used the following processes and tools for this activity?

- [ ] Creative process
- [ ] Project management
- [ ] Mini statement
- [ ] Mini is / is not
- [ ] Mini brainstorm
- [ ] Mini example
- [ ] Mini mindmap
- [ ] Mini OK
- [ ] Mini yellow box
- [ ] Mini praise
- [ ] Other

Comments for that activity?

Have you done the activity "CONCEPT SEARCH"?

- Yes
- No

How many peoples have participate to this activity?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Did you used the following processes and tools for this activity ?

- [ ] Creative process
- [ ] Project management
- [ ] Mini interview
- [ ] Mini ishikawa
- [ ] Mini brainstorm
- [ ] Mini scamper
- [ ] Mini mindmap
- [ ] Mini CK
- [ ] Mini yellow box
- [ ] Mini praise
- [ ] Other

Comments for that activity?

Have you done the activity "SOLUTION DEVELOPMENT"?

- Yes
- No

How many peoples have participate to this activity?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Did you used the following processes and tools for this activity?

- [ ] Creative process
- [ ] Project management
- [ ] Mini statement
- [ ] Mini issue map
- [ ] Mini brainstorm
- [ ] Mini scamper
- [ ] Mini mindmap
- [ ] Mini CR
- [ ] Mini yellow box
- [ ] Mini pause
- [ ] Other

Comments for that activity?

Have you done the activity "DIMENSIONNING"?

- Yes
- No

How many peoples have participate to this activity?

1	2	3	4	5	6	7	8	9	10

Did you used the following processes and tools for this activity?

- [ ] Creative process
- [ ] Project management
- [ ] Mini statement
- [ ] Mini issue map
- [ ] Mini brainstorm
- [ ] Mini scamper

- [ ] Mini mindmap
- [ ] Mini OK
- [ ] Mini yellow box
- [ ] Mini praise
- [ ] Other

Comments for that activity?

Have you done the activity "PROTOTYPING?"

- ( ) Yes
- ( ) No

How many peoples have participate to this activity?

1	2	3	4	5	6	7	8	9	10
( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

Did you used the following processes and tools for this activity?

- [ ] Creative process
- [ ] Project management
- [ ] Mini storyboard
- [ ] Mini 6-3-5 method
- [ ] Mini brainstorm
- [ ] Mini scamper
- [ ] Mini mindmap
- [ ] Mini OK
- [ ] Mini yellow box
- [ ] Mini praise
- [ ]

A.VI.3 2014 Paper questionnaire

Observation/evaluation chart – 24 hours of innovation 7th edition, May 27th and 28th 2014

We ask you to make 3 observations / evaluations **WITH A COPY OF THIS CHART** per team. These observations could be made around the third hour, 7 hours and 10 hours.

The questions are simple and easy to complete. Do not forget to write their comments if they do comments.
Name of person completing this form: _____
Date: _____
Local time: Observation 1_____ Observation 2_____ and 3 _____
University name: _____
Name of the team observed: _____ Challenge #: _____
Name of persons interviewed: _____
_____
_____
_____
There are 3 types of teams to watch: choose appropriate category corresponding to the observed team (make a circle around the appropriate number):

1. The team that uses creative processes and tools that you or someone else has coached (for processes, tools, etc.).
2. Team that uses creative processes and tools that you or someone else have not coached
3. Team that uses its own methods for this challenge

If you have more than three teams at your site, we would ask you to choose one team from each category and observe / evaluate only 3 teams. Naturally, if there is only one or two teams, observe / evaluate those number of teams.
Thank you very much to collect these datas. We ask you to give us back those data sheets when you'll return at ÉTS. These data will help us produce the best guides and tools for the next edition of the 24 hours!
Mario Dubois for the research committee - 24h of innovation

24h of innovation Guide

Questions	Check the answer	Comments
Did they consult the 24h guide (the secret recipes of Montreal) on the website of	o Yes o No	

Substance ETS?		
If so, did this guide have helped them to be prepared for the 24h?	o Yes o No	
If so, what parts of the guide they have found useful? (Please, take their comments on this guide, the creative process, mini tools and ecodesign guide)	o What to do to get ready? o What to do to prepare the team before 24 hours? o What to bring to the competition? o The Chronological Guide o The process of creativity recommended o Mini creativity tools o The ecoconception tools o The videos associated with mini creativity tools o Videos fot the ecoconception tools o Processes and Tools from colleagues of HEC Poly	
Have they done readings in preparation?	o Yes o No	
Did they read the articles written on previous editions?	o Yes o No	

Team preparation

Questions	Check the answer	Comments
Is the team prepared before the 24 hours?	o Yes o No	
If so, does the 24h guide have helped them to be prepared?	o Yes o No	
Have they created a multidisciplinary team after reading the guide?	o Yes o No	

Does the team have discussed among themselves the expertise of everyone?	o Yes o No	
Do they have agreed on the leadership style to implement?	o Yes o No	
Questions	**Check the answer**	**Comments**
Does the team members knew each other before the 24h?	o Yes o No	
If not, did they do an activity to get to know?	o Yes o No	If yes, which?

Creative process

Questions	**Check the answer**	**Comments**
Did they consult the Web guide for the creative process?	o Yes o No	
Did they use the creative process recommended in the 24h guide?	o Yes o No	
If so, is that process helped them to better create?	o Yes o No	
If not, for what reasons did they not used it?	o Lack of time o Lack of interest o Other	Detail if other
Did they used another creative process?	o Yes o No	If yes, which?
Other aspects regarding the process?		

Mini creativity tools

Questions	**Check the answer**	**Comments**
Did they consult the Web guide for the mini creativity tools?	o Yes o No	
Did they use the mini tool «Problem statement»?	o Yes o No	

If so, does that tool help them to define the problem?	o Yes o No	
If not, why?	o Lack of time o Lack of interest o Other	Detail if other
Comments on this tool		
Did they use the «Brainstorming»?	o Yes o No	
If so, how many ideas created?		

Questions	Check the answer	Comments
If not, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
Comments on this tool		
Did they use the «Brainwriting»?	o Yes o No	
If so, how many ideas created?		
If not, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
Comments on this tool		
Did they use the «Mindmapping»?	o Yes o No	
If so, how many ideas created?		
If so, did they use the Mind-mapping software?	o Yes o No	
If not, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
Comments on this tool		
Did they use SCAMPER?	o Yes o No	
If so, how many ideas reworked?		

If not, why?	o Lack of time o Lack of interest o Other tools used	
Comments on this tool		

Ecoconception tools

Questions	Check the answer	Comments
Did they consult the Web guide for the ecoconception tools?	o Yes o No	
if so, did they create an analysis matrix?	o Yes o No	
If they have consulted the guide and have not produced the analysis matrix, why did they have not done it?	o Manque d'intérêt o Manque de temps o Ne sait pas comment la faire o Autres	Detail if other
If they have not consult the guide, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
If they have created an analysis matrix, which parameters have they improved?		

Chronological guide

Questions	Check the answer	Comments
Did they take time to define the problem?	o Yes o No	
If yes, how long have they spent to define it?	o Yes o No	
Did they need to reduce the size of the problem?	o Yes o No	
Did they talk to the client?	o Yes o No	
Did they take information on the client, on their needs?	o Yes o No	
Did they have quickly illustrated their ideas generated to better	o Yes o No	

understand which to choose?		
How long did they spend to choose the problem?		
How long to generate ideas?		What time to what time?
How long to find solutions?		What time to what time?
How many solutions selected for further work?		What time to what time?

At the 7th hour, remind them to complete the questionnaire on creativity and the questionnaire on risk!		Thanks!!

Questions	Check the answer	Comments
Did they do a financial analysis?	o Yes o No	What time to what time?
Did they do prototypes?	o Yes o No	What time to what time?
How?	o 2D o 3D o Other	Detail if other
What time to what time?		
At what time did they start to do the video?		
At what time did they finish their 24h?		

A **BIG** thanks!!!

APPENDIX VII

Example of 2014 Paper Questionnaire filled

Observation/evaluation chart – 24 hours of innovation
7th edition, May 27th and 28th 2014

We ask you to make 3 observations / evaluations **WITH A COPY OF THIS CHART** per team. These observations could be made around the third hour, 7 hours and 10 hours.

The questions are simple and easy to complete. Do not forget to write their comments if they do comments.

Name of person completing this form: ___

Date: 28 mai 2014

Local time: Observation 1_____ Observation 2_____ and 3 _____

University name: ETS

Name of the team observed: ___ ___ Challenge #: 14

Name of persons interviewed: _____

_____

_____

_____

There are 3 types of teams to watch: choose appropriate category corresponding to the observed team (make a circle around the appropriate number):

1. The team that uses creativity processes and tools that you or someone else has coached (for processes, tools, etc.).
2. Team that uses creative processes and tools that you or someone else have not coached
3. Team that uses its own methods for this challenge

If you have more than three teams at your site, we would ask you to choose one team from each category and observe / evaluate only 3 teams. Naturally, if there is only one or two teams, observe / evaluate those number of teams.

Thank you very much to collect these datas. We ask you to give us back those data sheets when you'll return at ÉTS. These data will help us produce the best guides and tools for the next edition of the 24 hours!

Mario Dubois for the research committee - 24h of innovation

24h of innovation Guide

Questions	Check the answer	Comments
Did they consult the 24h guide (the secret recipes of Montreal) on the website of Substance ETS?	● Yes ○ No	
If so, did this guide have helped them to be prepared for the 24h?	● Yes ○ No	
If so, what parts of the guide they have found useful? (Please, take their comments on this guide, the creative process, mini tools and ecodesign guide)	○ What to do to get ready? ○ What to do to prepare the team before 24 hours? ○ What to bring to the competition? ● The Chronological Guide ○ The process of creativity recommended ● Mini creative tools ○ The ecoconception tools ○ The videos associated with mini creative tools ○ Videos fot the ecoconception tools ○ Processes and Tools from colleagues of HEC Poly	
Have they done readings in preparation?	○ Yes ● No	
Did they read the articles written on previous editions?	● Yes ○ No	

Team preperation

Questions	Check the answer	Comments
Is the team prepared before the 24 hours?	○ Yes ● No	
If so, does the 24h guide have helped them to be prepared?	○ Yes ○ No	
Have they created a multidisciplinary team after reading the guide?	● Yes ○ No	
Does the team have discussed among themselves the expertise of everyone?	○ Yes ● No	
Do they have agreed on the leadership style to implement?	○ Yes ● No	

Questions	Check the answer	Comments
Does the team members knew each other before the 24h?	● Yes ○ No	
If not, did they do an activity to get to know?	○ Yes ○ No	If yes, which?

Creative process

Questions	Check the answer	Comments
Did they consult the Web guide for the creative process?	● Yes ○ No	
Did they use the creative process recommended in the 24h guide?	● Yes ○ No	Some of them
If so, is that process helped them to better create?	● Yes ○ No	
If not, for what reasons did they not used it?	○ Lack of time ○ Lack of interest ○ Other	Detail if other
Did they used another creative process?	○ Yes ● No	If yes, which?
Other aspects regarding the process?		

Mini creative tools

Questions	Check the answer	Comments
Did they consult the Web guide for the mini creative tools?	● Yes ○ No	
Did they use the mini tool «Problem statement»?	○ Yes ● No	
If so, does that tool help them to define the problem?	○ Yes ○ No	
If not, why?	● Lack of time ○ Lack of interest ○ Other	Detail if other
Comments on this tool		
Did they use the «brainstorming»?	● Yes ○ No	
If so, how many ideas created?	≈5	

Questions	Check the answer	Comments
If not, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
Comments on this tool		
Did they use the «Brainwriting»?	● Yes o No	
If so, how many ideas created?	~3	
If not, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
Comments on this tool		
Did they use the «Mindmapping»?	● Yes o No	
If so, how many ideas created?		
If so, did they use the Mind-mapping software?	o Yes ● No	
If not, why?	o Lack of time o Lack of interest o Other tools used	Detail if other
Comments on this tool		
Did they use SCAMPER?	● Yes o No	
If so, how many ideas reworked?	1-2	
If not, why?	o Lack of time o Lack of interest o Other tools used	
Comments on this tool		

Ecoconception tools

Questions	Check the answer	Comments
Did they consult the Web guide for the ecoconception tools?	○ Yes ● No	
if so, did they create an analysis matrix?	○ Yes ○ No	
If they have consulted the guide and have not produced the analysis matrix, why did they have not done it?	○ Manque d'intérêt ○ Manque de temps ○ Ne sait pas comment la faire ○ Autres	Detail if other
If they have not consult the guide, why?	○ Lack of time ● Lack of interest ○ Other tools used	Detail if other
If they have created an analysis matrix, which parameters have they improved?		

Chronological guide

Questions	Check the answer	Comments
Did they take time to define the problem?	● Yes ○ No	
If yes, how long have they spent to define it?	○ Yes ○ No	3 hr
Did they need to reduce the size of the problem?	● Yes ○ No	
Did they talk to the client?	○ Yes ● No	
Did they take information on the client, on their needs?	○ Yes ● No	
Did they have quickly illustrated their ideas generated to better understand which to choose?	● Yes ○ No	
How long did they spend to choose the problem?		1hr
How long to generate ideas?	2 hr	What time to what time?
How long to find solutions?	3 hr	What time to what time?
How many solutions selected for further work?	3/4	What time to what time?

At the 7th hour, remind them to complete the questionnaire on creativity and the questionnaire on risk!		Thanks!!

Questions	Check the answer	Comments
Did they do a financial analysis?	● Yes ○ No	What time to what time? 18 - 20 pm
Did they do prototypes?	● Yes ○ No	What time to what time? 22 - 23 pm
How?	○ 2D ○ 3D ● Other	Detail if other Google Apps
What time to what time?		[illegible]
At what time did they start to do the video?		22h ~~[illegible]~~
At what time did they finish their 24h?		6 am

Other paper questionnaires can be available upon request.

APPENDIX VIII

Details of the mini creativity tools[35]

A.VIII.1 Mini tools

MINI TOOLS ASSOCIATE TO THE CREATIVE PROCESS PHASE	
MINI STATEMENT	TO ANALYZE THE PROBLEM
MINI IS /IS NOT	TO ANALYZE THE PROBLEM
MINI BRAINSTORM	TO FIND IDEAS
MINI BRAIWRITING	TO FIND IDEAS
MINI SCAMPER	TO FIND IDEAS
MINI MIND MAP	TO FIND IDEAS

A.VIII.1.1 MINI STATEMENT

What you think is the problem may differ **GREATLY** from what the problem is…

VIDEO https://www.youtube.com/watch?feature=player_embedded&v=rzl2Vy8KWNg

Materials: Pencils and paper, whiteboard

How does it work? This mini tool will allow you to define **MORE CLEARLY** the problem to be solved. Start with the context of the problem by analyzing:

- the **data** of the problem you **have and don't have**
- all the circumstances for which the problem occured
- the **environment** of the problem
- actors and stakeholders involved
- components of the product
- any other relevant information to define the problem

In solving the problem, what **weakness**, difficulty and other **negative** element will you reduce or eliminate? Will you create **positive** elements with your solution? Which? Is the problem **too big** to be considered as a whole for this project? (Is that a group of problems?)

[35] These pages are a copy of an article retrieved from *Innovations de l'Éts et d'ailleurs*, Undated. https://etsinnovation.wordpress.com/mini-tools/ >

Should you just take **a part** of it? Which one? Is it too **small**? Would it be better to add items?

KISS: Your problem statement should be **CLEAR** and **SIMPLE** and **EASY TO UNDERSTAND** for those who will read it. Perform tests: Ask several people to read it and ask them what they understand!

A.VIII.1.2 MINI BRAINSTORM

Materials: Pens and « Post-It ™ » to record ideas

How does it work? Simply generate the **largest possible number of ideas** without trying to judge them. Starting from the problem statement, participants expressed ideas and a secretary writes them on « Post It ™ » stuck on a wall. A facilitator is useful to encourage the issuance of ideas and explain to the participants the rules:
1. No censorship: Think freely without negative criticism;
2. Equality: All ideas are of equal value;
3. Consideration: Respect others, no judgment;
4. Registration: Register or note all ideas;
5. Discipline: One idea after another one;
6. Originality: Each idea should be stated.

VIDEO https://www.youtube.com/watch?feature=player_embedded&v=g6DkgCxJWrU

A.VIII.1.3 MINI BRAINWRITING (OR 6-3-5 METHOD)

The technique is simple: It involves 6 participants (could be more or less) who sit in a group and are supervised by a moderator. Each participant thinks up 3 ideas every 5 minutes. The ideas are written down on a worksheet and passed on to the next participant. The participant reads the ideas and uses them as inspiration for more ideas. Participants are encouraged to draw on others' ideas for inspiration, thus stimulating the creative process. After 6 rounds in 30 minutes the group has thought up a total of 108 ideas.

VIDEO https://www.youtube.com/watch?feature=player_embedded&v=-Dz7S4IOT2E

A.VIII.1.4 MINI SCAMPER

SCAMPER stands for:

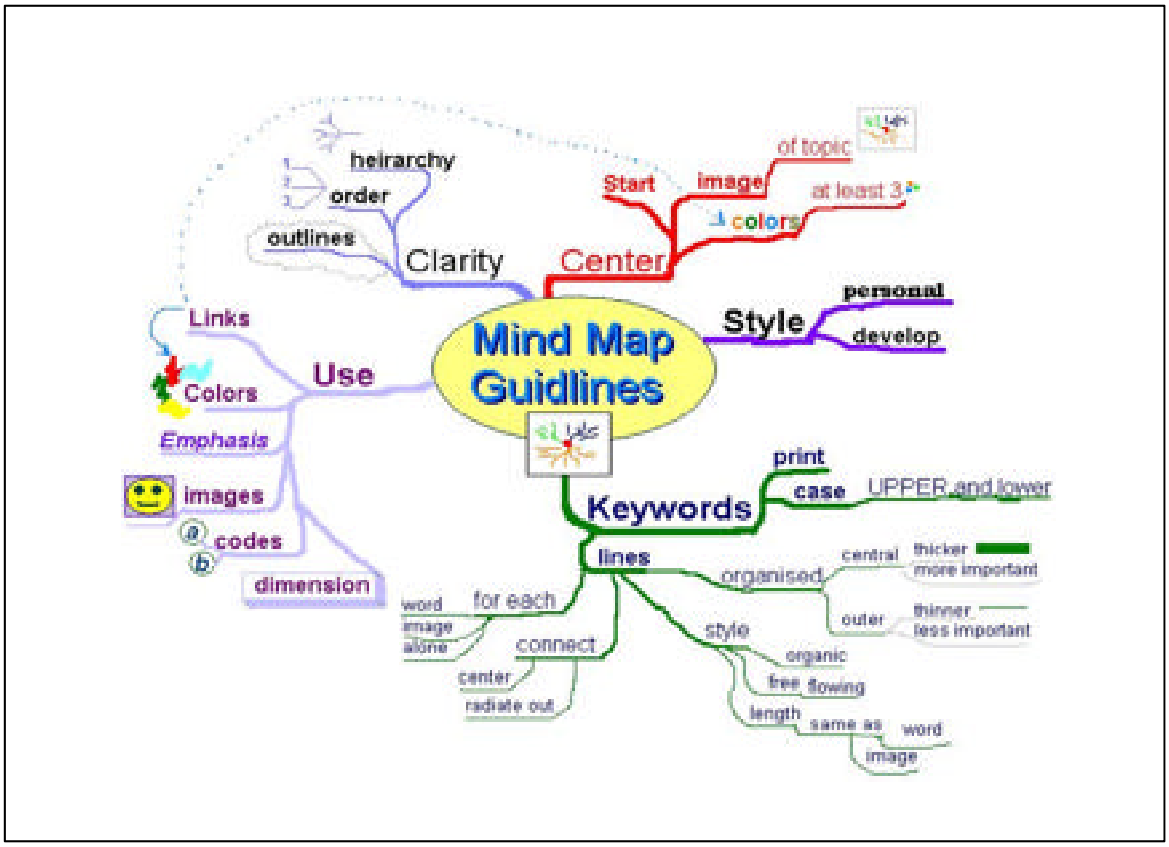
- Substitute.
- Combine.
- Adapt.
- Modify, magnify or miniaturise
- Put to another use.
- Eliminate.
- Reverse or re-arrange

You use this mini tool by asking questions about the ideas found **using each of the seven terms above**. These questions will help you to find creative ideas and improve the ideas found. It works very well with ideas from a **MINI BRAINSTORM**.

VIDEO https://www.youtube.com/watch?feature=player_embedded&v=4wZ5wV5dPZc

2 software programs to do mind mapping : The first and the second proposed.

A.VIII.1.5 MINI MIND MAP



Source : http://upload.wikimedia.org/wikipedia/commons/2/26/MindMapGuidlines.JPG

Materials needed: Large sheets of paper and markers of different colors – free software *FreeMind*

How does it work? Register at the center of the sheet the problem or issue to solve (in image and words). Then draw **color branches** radiating in all directions with the **main ideas** in the form of drawings and keywords. These branches in turn radiate to **secondary ideas**, image and keyword, etc..

Very useful after a « Brainstorming » to work on the components of a product or system.

A.VIII.2 Other mini tools

A.VIII.2.1 MINI IS / IS NOT

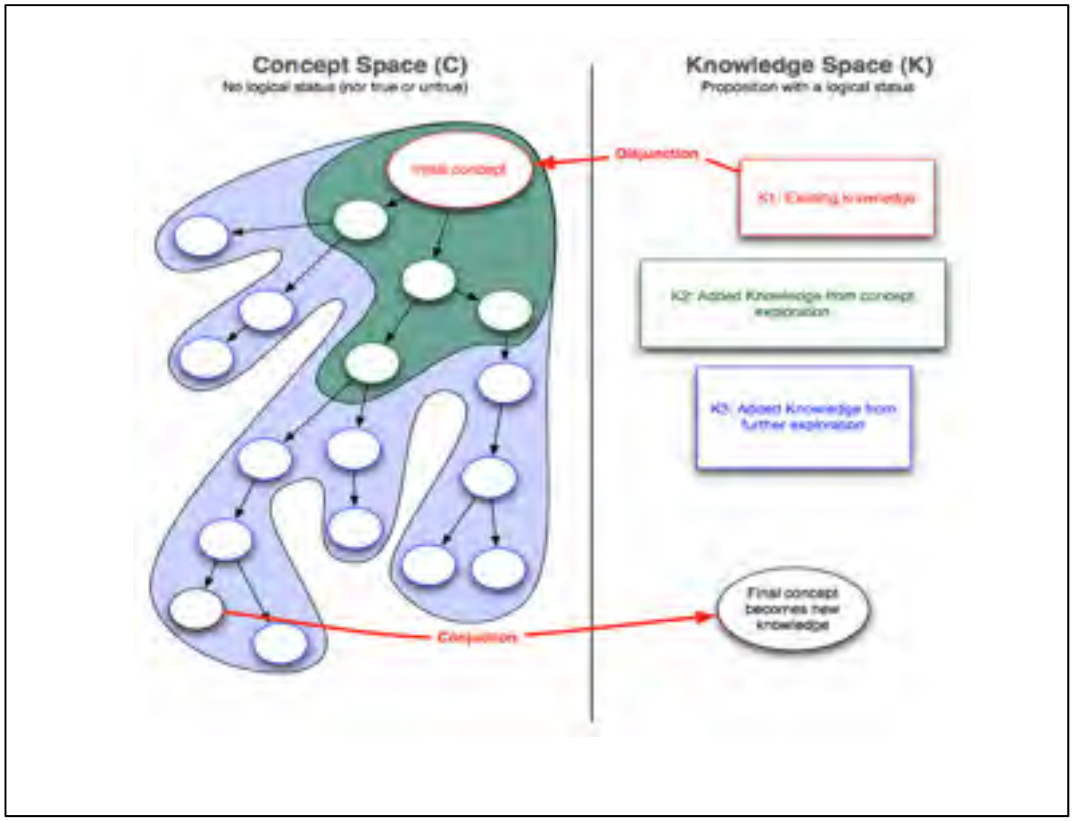
Materials: Large sheets of paper and markers of different colors or whiteboard

How does it work? Make a chart similar to the chart above. Write the problem statement and define **WHO**, **WHAT**, **WHERE** and **WHEN** that is and is not. Analyze the possible causes and actions to take for the future.

Is the problem **too big** to be considered as a whole for this job? (Is it a group of problems?) Should you just **take a part**? Which one? Is it **too small**? Would it be better to add items?

KISS: With the elements wrote in this table, try to define more clearly the problem. Your problem statement should be **CLEAR**, **SIMPLE** and **EASY TO UNDERSTAND** for those who will read it. Experiment: Ask several people to read it and ask them what they understand.

A.VIII.2.2 MINI CK



Source: http://upload.wikimedia.org/wikipedia/en/0/0a/CK_Diagram.png (CC)

Materials: Large sheets of paper and markers of different colors or whiteboard

How does it work? On the left side you have the **concepts (C)**: you start at the top of the problem or topic to develop. You then add the concepts (creative ideas) to solve the problem one after the other one **plotting the link** between these ideas. For each idea emitted, you must write on the right side of the drawing, the **knowledge (K)** needed to develop the idea described. These may be existing knowledge (**old K**), knowledge that « crazy » ideas for example can make us reuse knowledge or ideas for wich new knowledge must be found. New ideas need new knowledge (**new K**). The new knowledge acquired will allow these ideas to become a real solution. **New knowledge** is the source of the **new concepts** wanted!

A.VIII.2.3 MINI YELLOW BOX

Required materials per participant: Blue, green, red, yellow and pink pens – ideas written on « Post IT ™ »

How does it work? MINI TOOL **to classify** the ideas generated – each participant will make a **small colored circle** on the sticker (Post IT) of the idea.

	Quick and easy idea to implement
	Improvement – installation may require some effort
	Idea very different from usual ways to do
	Visionary idea that can however be difficult to implement
	Ingenuous idea (naïve) that can develop a new approach

Classify ideas **under a color** depending on the number of points obtained for the same color and group consensus. Then ask yourself:

	How can we develop this idea?
	How can we implement quickly this idea?
	How can we make people accept this idea?
	How can we make this idea feasible?
	How could we mature this idea to make a solution of it?

A.VIII.2.4 MINI PRAISE

Materials: Worksheet and ideas generated

How does it work? Three aspects:

1. List the **positive aspects** of ideas
2. Describe the **potential gains** that could provide ideas if successfully implemented
3. Express **fears** that the idea generate

This mini tool allows to develop ideas to **improve their potential** for success.

Steps

1. Make a first spontaneous choice of the best ideas. Then make a second choice of some intriguing and original ideas that could be difficult to implement.
2. Starting with the intriguing and original ideas, complete a worksheet by idea
    1. **Positive aspects:** List ALL the benefits of the idea discussed
    2. **Potential gains:** ideally try to identify fifteen actual or potential benefits resulting from the implementation of an idea
    3. **Fears:** Rephrase each fear in question. For example, « we do not have the budget for a communication campaign » to « How can we find a budget for it and how can we do if for free? »
    4. **For each concern** transformed into question, conduct a session generating ideas to solve this problem
    5. **Select** the group or the best idea(s) as a result of this activity

APPENDIX IX

Results analyzis of questionnaires

Creative methodologies	Teams																				Total
	1	2[a]	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Creative Guide used	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No				Yes	15 No[b]
Creative process						X	X		X			X	X		X				X	X	8
Mini Is - Is not									X						X						2
Mini Brainstorm	X					X		X	X		X				X		X	X		X	9
Mini Mind Map			X		X	X				X					X		X				6
Mini CK															X						1
Mini Scamper																	X			X	2
Mini Praise						X									X	X					3
Mini Statement						X			X					X	X		X				5
Sub total Mini creative tools	1	0	1	0	1	4	0	1	4	1	1	0	0	1	6	1	4	1	0	2	2,69[c]
Mini creative tools helped	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes			Yes	
Brainstorm	X		X	X						X		X	X								6
Mind Map	X												X								2
Scamper			X																		1
Project management										X							X				2
Sub total creative tools	2	0	2	1	0	0	0	0	0	2	0	1	2	0	0	0	1	0	0	0	0,67[d]
Total mini and creative tools	3	0	3	1	1	4	0	1	4	3	1	1	2	1	6	1	5	1	0	2	1,90[e]

Comments

[a] They never saw the creative guide

[b] The number of teams who consulted the creative guide was 2; 15 teams didn't consult it.

[c] Mean value of the number of mini creative tools used by the teams who used them.

[d] Mean value of the number of creative tools used by the teams who didn't used mini creative tools.

[e] Mean value of the total number of creative tools used (creative and mini creative tools) by the teams.

APPENDIX X

Summary of the past 24 Hours editions[36]

A.X.1 Results of the 2011 edition[37]

Source: Mario Dubois

24 hours of innovation: Winners from the 4th edition
24 Mar 2014 By Mario Dubois

The lead photo shown here was taken when the award was presented by Mr. Mickaël Gardoni, a professor at ÉTS who also organized the event, and Mr. Vincent Dugré, Director of the "Pôle d'excellence québecois en transport terrestre" [Quebec Centre for Excellence in Ground Transportation]. They are pictured awarding a prize to two ÉTS students whose team earned second place in this international contest.

The 24 Hours of Innovation location at the Quebec City Convention Centre

The 24 Hours of Innovation event was hosted by Montreal's École de technologie supérieure. It is an international competition open to university students from a variety of disciplines and universities around the world. What is unique about this contest is that it takes place over 24

[36] All these appendices are copies of pages on the website *Substance Éts* (< http://substance-en.etsmtl.ca/ >
[37] Retrieved from < http://substance-en.etsmtl.ca/24-hours-innovation-winners-4th-edition/ >

consecutive hours. The 4th edition of this international event took place at 11 different locations worldwide, starting at 10 a.m. on November 22, 2011. All watches were synchronized and the contest closed just 24 hours later!

VIDEO:
https://www.youtube.com/watch?list=PL6D2B80CCCF9185DF&v=Bb7mnyBGO6Y&feature=player_embedded

Using a crowdsourcing website, all registered teams started by selecting one of the 23 challenges put forward by industry stakeholders or university researchers. After choosing their challenge, they had to get their creative juices flowing and find innovative solutions—within 24 hours! Each team concluded their work by filming a three-minute video summarizing their solution. A local jury at each contest site selected the best local project. These local winners made up the 2011 selection that went on to be evaluated by an international jury. Then, from the "Centre des congrès de Québec" [Quebec City Convention Centre], this jury chose the three best projects of this edition. The winning teams were awarded with grants.

Members of the international jury working with participating students
Source: Mario Dubois

More than 300 students participated in this edition, which was led by Mickaël Gardoni, a professor in ÉTS's Automated Production Engineering department. The project was managed from the Quebec City Convention Centre as part of the "Partenariat Innovation 2011" [Innovation Partnership 2011] an industry show organized by the sponsors of the 4th edition of the 24 Hours of Innovation. These partners included: Pôle d'excellence québecois en transport terrestre, Groupe CTT and Technopôle défense – sécurité.

Students from Montreal's École de technologie supérieure hard at work!
Source: Mario Dubois

The 4th edition of ÉTS's 24 Hours of Innovation brought together students from 12 universities in North America, South America, Europe and Africa—and new for 2011, a high school from Reunion Island.

[toggle title="Participating universities, sites and schools"]

Canada
3 Universities and 2 sites

École de technologie supérieure (ÉTS) de Montréal

École Polytechnique de Montréal

Université McGill

Sites in Canada: Hall from Montreal's École de technologie supérieure and the Centre des congrès de Québec during the Salon Partenariat Innovation 2011, organized by our sponsors during the 24h.

France
5 Universities with competition sites in each University

École Supérieure des Technologies Industrielles Avancées (ESTIA)

Université de Technologie de Belfort-Montbéliard (UTBM)

Université de technologie Compiègne (UTC)

Institut Supérieur de l'Électronique et du Numérique (ISEN)

École Supérieure d'Ingénieurs Paris-Est Marne-la-Vallée (ESIPE)

Belgique
One University, site for the competition

HEC Université de Liège – École de Gestion en Belgique (HEC-ULg)

Île de la Réunion
One school, site for the competition

Lycée LISLET-GEOFFROY

Sénégal
One University, site for the competition

Université de Ziguinchor

Burkina Faso
One University, site for the competition

Université de Ouagadougou

Colombie
One University, site for the competition

Université Nationale de Colombie

Winners – International Competition
VIDEO
https://www.youtube.com/watch?feature=player_embedded&v=iYrzQ6UDeGg

1st Prize: The ESTIAZip team from ESTIA in France. They worked on Problem 9, which involved designing a new type of zipper, which was proposed by Groupe CTT from Quebec, Canada. This team also won the local competition in ESTIA.

The winning team of the ESTIA (France)
Source: Mario Dubois

2nd Prize: The ÉTS team, which was made up of two students working from the Paternariat Innovation event and five others located at UTBM in France, as part of a student exchange for the competition. These students worked together—although from a distance—on Problem 12, which involved designing augmented reality 3D glasses suitable for all people, a topic suggested by ISEN Lille.

VIDEO:
https://www.youtube.com/watch?list=PL610E4EDE43D0ECA1&v=30xqATDDWqY&feature=player_embedded

This team also won the "Our Favourite" award from the City of Quebec and first place at the UTBM local competition.

Working out of UTBM, here are five members of the ÉTS team
that won second place. They are pictured with the organizers of the competition
at the UTBM location
Source: Mario Dubois

3rd Prize: Students from the 1 LLG team from Lycée Lyslet-Geoffroy in Reunion Island. They worked on Problem 13, which involved designing a device that adjusts the angle of sun panels throughout the day in accordance with the sun's position so that a maximum amount of power is captured. This topic was tabled by the same institution, the Lycée Lislet-Geoffroy.

VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=cASTfeQ2958

The winning team from Lycée Lyslet-Geoffroy
Source: Mario Dubois

Winners – local competition
In addition to the three international winners who were part of the eight 2011 finalists presented to the international jury, five other teams won the local contests organized at their respective locations. Here they are:

- From the Institut Supérieur de l'Électronique et du Numérique (ISEN) in France, the Duffy Deck team opted to work on Problem 5, which involved designing a pontoon boat that could link up with other similar boats to create a large floating party or to travel together. This team won the local competition at their location.

VIDEO : https://www.youtube.com/watch?feature=player_embedded&v=2aTsau4N2JM

- The La Fourmilière team from the University of Liège's Management School in Belgium (HEC-ULg). They tackled the same problem as the Duffy Deck team from ISEN. This team won their local competition for the HEC-ULg location. The video below showcases their solution:

VIDEO : https://www.youtube.com/watch?feature=player_embedded&v=2-3C4hi8J6Q

- The BEAUTC team from the Compiègne Technological University (UTC) won their local competition for their design of a hybrid boat (solar/electric or other combined energy source) that could turn into a pontoon boat.

- The Les Zombilistes team from ÉTS in Montreal, Quebec, Canada won the local contest for the Montreal area.

- The Heenok team from École Supérieure d'Ingénieurs Paris-Est Marne-la-Vallée (ESIPE) in France won the local ESIPE contest with its solution for tibia prosthesis. https://www.youtube.com/watch?feature=player_embedded&v=Y7a8ITE54OM

VIDEO https://www.youtube.com/watch?feature=player_embedded&v=Y7a8ITE54OM

Picture references

The images appearing here are courtesy of the 24 Hours of Innovation organizing committee, CC licence.

A.X.2 Article explaining how a team had lived the event in 2013[38]

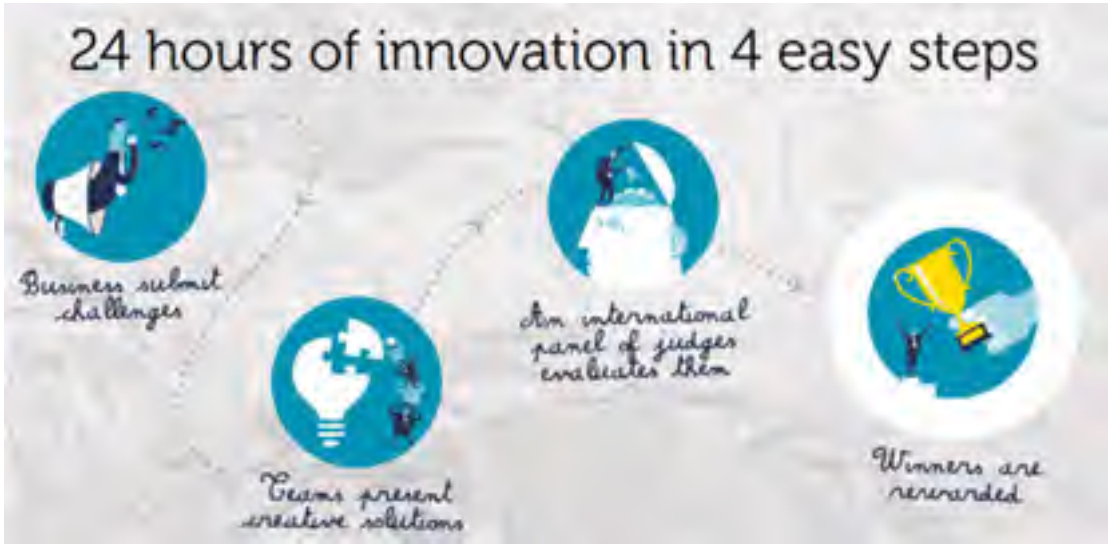
Source: Mario Dubois

The 24 Hours of Innovation, an Insider's Perspective

17 Apr 2014 By Andree Harvey

In May 2013, I had the privilege of participating in the 24 Hours of Innovation, an international competition organized by ÉTS in which students from around the world have to find creative solutions to problems presented by businesses.

[38] Retrieved from < http://substance-en.etsmtl.ca/24-hours-innovation-insiders-perspective/ >.



My team was called "QF Connection" (for Quebec-France Connection, as the team was made up of people from Quebec and France). The team members included ÉTS students Yohann Hernandez, Fred Scherer, Jean-Philip Poulin, Maria Ramoul and Charles Vanelslande. Abdelaziz El-mohri also joined our group, working with us remotely.

Here's the story of our epic experience, told hour by hour.

Initial preparations

Yohann Hernandez, who had participated in the 2012 edition of the competition, created a private Facebook group on April 9 and sent out an invitation: "Who wants to participate in the 24 Hours of Innovation with me?" Nine people responded and a discussion ensued. Who would do the 2D graphic design? The video editing? Who would bring what? We needed colour Post-Its, pencils, computers, a video camera and a regular camera.

Our first in-person meeting was held at the ÉTS cafeteria. It was a chance for us to get to know one another and iron out more details. Of the nine people originally recruited, seven decided to embark on the adventure.

Yohann led the meeting. Since it was his second time participating in the contest, he wanted to share his past experience with us. "Last year, my team wasted far too much time choosing a challenge and then coming up with ideas." Yohann hoped that in trying again in 2013, he would be able to improve his performance. His goal was nothing short of leading a team to victory!

Thus, the schedule for the day of the competition was carefully planned. This is how we planned to use our time:

1. Spend a maximum of one hour discussing the challenges and choosing one;
2. Complete the ideation period by noon, at latest;

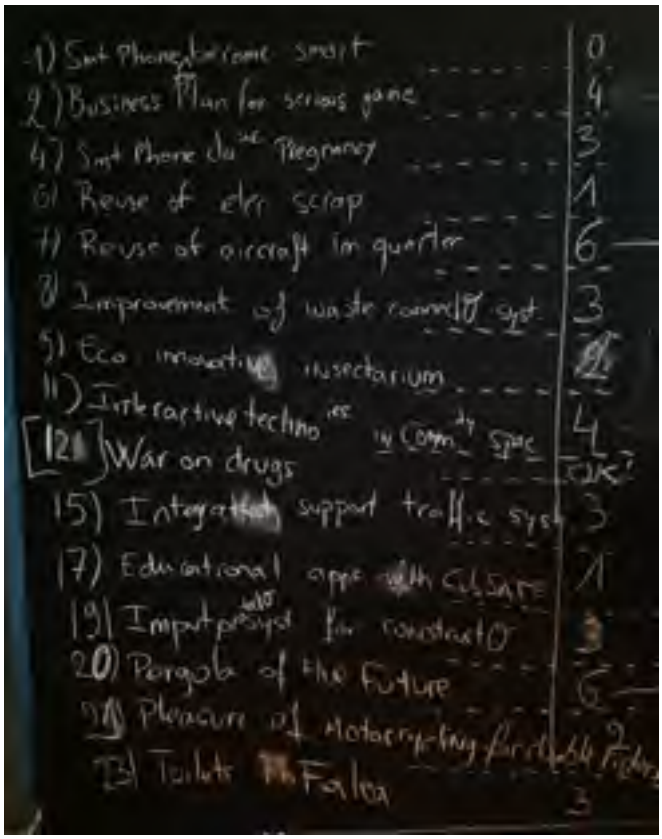
3. Create the 3D modelling and video script from 12 p.m. to 6 p.m.;
4. Start making the video at 6 p.m., at latest. Aim to complete the video by midnight.

May 22 – D Day
8 a.m.: The team gets set up.
We meet up at the Arsenal, where C2MTL, the mecca of creativity, is taking place. For the second year in a row, the site offers a designated work space for one of the teams participating in the 24 Hours of Innovation (the other teams are working in ÉTS' atrium).

We were anxious when we headed into the space that would be our creative environment for the next 24 hours. And there was a surprise waiting for us! The walls were painted black so that we could write on them with chalk, and the seats were turquoise and lime-coloured cardboard cubes. It looked like a games room! We reorganized the space to get more comfortable and set ourselves up properly. Pencils and coloured Post-Its were spread across the table, laptops were plugged in. We were ready!

Source: Mario Dubois

9 a.m.: The challenges are unveiled
Professor Mickaël Gardoni, the head organizer of the competition, initiates a video conference to announce the challenges proposed by approximately 15 businesses. The topics are extremely varied, ranging from creating a green pergola to designing a mobile application for pregnant women.



Source: Mario Dubois

10 a.m.: A challenge is selected

We took the time to analyze each of the challenges and to perform some online research. Once all the team members were ready, we proceeded to a vote. We ended up choosing the submission from Bombardier: "Using an old Bombardier aircraft, reuse as many parts as possible to create urban installations in the Innovation District." Our task would be recover old aircraft components and use them to make urban installations in Montreal's Innovation District, where ÉTS is located.

Source: Mario Dubois

11 a.m.: Brainstorm!
Yohann declares the Brainstorming session officially open. Our Brainstorming rules are taped to the wall as a reminder to us all.

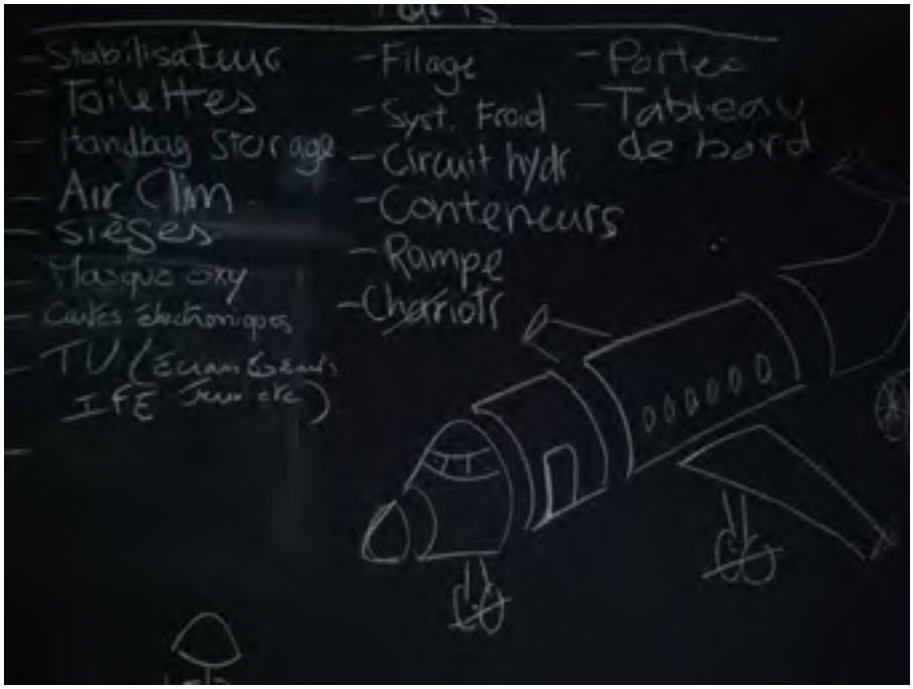
I suggest the Post-It storm approach. Each participant writes as many ideas as possible—one on each Post-It—for a 10-minute period. When time is up, we take turns sticking our Post-Its to the wall and explaining our ideas to the group. My proposal is accepted unanimously. Go!

Source: Mario Dubois

12 p.m.: Key ideas categorized

Once all our Post-Its are up and our ideas have been presented, the group categorizes the ideas by theme. Three main themes become evident: Urban furniture, public spaces and technical aspects.

Some group members (those with better concept-development skills) get to work sketching a multi-purpose space, while others (the more technical folks) produce drawings of the aircraft parts.



Source: Mario Dubois

2 p.m.: Putting ourselves in the users' shoes
The group decides to change our perspective for a moment and envision two different people enjoying the space: the first is a single 32-year old woman who lives in the neighbourhood and the second is a 40-year old man who works in the area. We try to think of what they do morning, noon and night (including cocktail hour) and we plot it all on the blackboard. We call the scenario "A Day in the Life of…"

With this work complete, we try to link the different steps in the scenario to the ideas we have categorized by theme and the various parts of an aircraft. For example, the seats from the plane will be used in a movie theatre, the wings will act as the foundation for a community garden, the cabin will be cut in half and used to create a patio environment, etc.

Source: Mario Dubois

6 p.m. to 12 a.m.: Video production
Tasks are assigned to various team members. While Yohann and I create the video screenplay and script, Fred, Charles and Maria sketch the sequenced plans, and Philip produces the 3D images.

Since we don't have a graphic designer on our team, Abdelaziz El-mohri, a friend of Maria's, is called in for assistance. He produces the artwork from Algeria.

Midnight to 3 a.m.: Last call
The clock strikes twelve, and the video is still not finished. We work into the wee hours of the night refining the text, recording the narration (Maria volunteers for this) and to edit the video.

3 a.m.: The final video is uploaded on YouTube
Three hours off our planned schedule (we were aiming to finish by midnight), we call it a wrap and entitle our work "A Day in the Sky."
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=T5qraKQTsjg

3 a.m. to 8 a.m.: A well-deserved rest
Team members head home to get some rest and a bite to eat before the announcement of the results, which will take place in just a few hours.

Source: Mario Dubois

9 a.m.: The international panel deliberates
The participants meet up once again at Arsenal, where the international panel of judges will announce the winners of the competition. Their decision is based on five criteria, for a total of 100 points: Analysis of scientific and technical information (30 points); innovation and creativity (30 points); quality of the presentation (20 points); environmental responsibility (20 points).

10 a.m.: And the winners are…
QF Connection ranks first among the teams from Montreal! However, the team doesn't earn one of the top three international awards.

Source: Mario Dubois

The post-mortem

In the days that follow, the group hypothesizes on our final ranking. “I think we lost points for environmental responsibility and the clarity of the presentation,” I said. “The winning ideas were the simplest ones,” observed Yohann. Fred reminded us of a rule that he learned during a knowledge management course on innovation given by Professor Mickaël Gardoni: “The leading teams usually spend 10 to 12 hours working on a dozen ideas before narrowing it down to the best idea.”

Last word

The last word was Yohann’s: “I am definitely game for participating a third time. I want to win first place at ÉTS and worldwide!” We wish him the best of luck.

A.X.3 Results of the 2014 edition[39]

Source: Mario Dubois

24 hours of innovation: The international winners from the 7th edition at ETS!
3 Jun 2014 By Mario Dubois

Header picture with West Virginia University Winning team: Asmaa Rahali, Mohammad Milad Naderi and Sylvain Dégué of ETS, and Joshua Kurnot, Fares Alblouwy and Kristin Krumenacker of West Virginia.

Source: Mario Dubois

[39] Retrieved from < http://substance-en.etsmtl.ca/24-hours-innovation-international-winners-7th-edition-ets/ >.

This article will give you informations regarding the winning teams of this event. You could also see **the list and the videos of the international and local winning team** on the Agorize site and the list of **all the solutions found for each project** again, on the Agorize site. If you are not already registered, you will need to do so for this last aspect (click on **"I want to compete"** button to do so). As a member, you will be able to see **all the videos done for each challenge** by selecting a challenge, then clicking on the tab "VIDEO" on the challenge page.

The 7th edition of the **24h of innovation** organized by the École de technologie supérieure (**ETS**) in Montreal, was held on 27th and 28th, May 2014. The event, a concept from **ESTIA**, was one more time a great success with **1,121 participants** enrolled in approximately **177 teams** located in **28 sites** worldwide, including:

- **3** sites in North America
- **9** locations in South America
- **8** sites in Europe
- **7** sites in Africa
- **1** site in Asia

Source: Mario Dubois

The team from the Technical University of Munich (TUM) in which Edris Hakimzada, Marie-Pier Diotte and Mayer Mathieu Girouard are integrated.

For the third year, the 24 hours of innovation was simultaneously conducted on the site of the International **C2MTL** Montreal Conference on trade and creativity.

Creativity in action at C2MTL!
Source: Mario Dubois

This article presents the **international winners** of this international event. Following shortly, a second paper will present all the proposed solutions for the 19 challenges.

ETS students abroad and international students at ETS!

New this year: **21 students** from ETS flew around the world to represent the ETS and participate with students from countries targeted sites for the 24h of innovation. To lather their nominations for this role as representatives, students had to prepare a short one-minute video demonstrating their sense of creativity and interest in this event. This video demonstrates their creative sense.
VIDEO https://www.youtube.com/watch?feature=player_embedded&v=E96w31fEXDg

In addition, **10 students** from universities of Peru, the United States, Germany and Denmark came to experience the 24 hours on site at ETS in Montreal.

International participants and sponsors of the ETS during a visit to Montreal
Source: Mario Dubois

All of these participants had a significant **cultural experience** as they were asked to join students from visited sites and form teams with them to solve one of the **19 challenges** proposed by the partners of this event. Thanks to the leaders of various international locations who organized the event on these sites (local to work, participants, logistics) and even accommodation for some pampered!
VIDEO https://www.youtube.com/watch?feature=player_embedded&v=Ep0iTPJ7Rt8

We met the students of ETS on their return trip: what have they learned from this experience? Fun, giggles galore, a warm welcome, new friends and, following the 24 hours, the chance to discover new horizons …

Hanen Garcia from ETS to the discovery
of the forgotten sacred city of Machu Picchu, Peru
Source: Mario Dubois

Platforms, websites, guides and tools

For this 7th edition, the **website of the event** was completely redone in three languages (**French**, **English** and **Spanish**). In addition, the competition also benefited from **a new platform** "**Agorize**" offering a virtual and collaborative dedicated to creating innovative challenges workspace. Don't forget the excitement caused by the **24 hours Facebook site**!

A team of the Pontifical Catholic University of Peru (PUCP)
including among others Hanan Garcia, Francis Louvel
and Benoit Archambault from ETS
Source: Mario Dubois

Other novelties: research team of **Mickaël Gardoni**, the head of 24h at ETS, designed a Montreal **"secret recipes"** guide available in French, English and Spanish, containing essential data and information for 24 participants, including:

- How to get ready for this competition
- What to do to prepare yourself **BEFORE** team competition
- What to bring to this competition
- **CHRONOLOGICAL GUIDE** steps to perform, inspired by the winning teams from 2007 through 2013
- Processes, creative mini tools and an ecoconception guide
- Tools and processes of creativity offered by our colleagues HEC-POLY

A team from the University of Aarhus in Denmark consisting of
Simon Castonguay, Martine Blouin and Bettina Thimot of ETS
Source: Mario Dubois

The winners are …

Each team produced **a video** that lasts about 2 minutes explaining their proposal to solve the problematic chosen from the 19 challenges, thus offering creative solutions. Every **local jury** chose the **three best videos** on their website before the end of 24 hours.

Team from Florida Institute of Technology (FIT) in which
Vincent Pesant, Jonathan Pierrat and Yannick Kuminunch joined
Source: Mario Dubois

The best video of each site was selected and submitted to an international jury who chose the best 3 videos and the best continental video for North America, South America, Europe, Africa and Asia. As for last year, several teams chose to be part of "**SWAT TEAMS**" who agree to work on an imposed challenge. **Three special awards** were granted to them.

Lorena Escadon, Pierre-Antonie Laine and Guillaume Grillon
with their team partners at the University of Montevideo, Uruguay
Source: Mario Dubois

The three winning projects of the International Jury

First prize: the West Virginia University in the United States

Imagine, three students from the ETS **without 24h experience** (Asmaa Rahali, Mohammad Milad Naderi and Sylvain Dégué), which did not know each others, coordinated by Asmaa, decided to go to West Virginia University in the United States, a new site, to form a team with three participants, Joshua Kurnot, Fares Alblouwy and Kristin Krumenacker who had never heard of the 24h before! How did Asmaa made it? **Above all, the team**: a game of **bowling** with his 2 teammates of the ETS to get to know each others. Then a **Skype** was done before leaving with the ETS participants for West Virginia to get to know each others and then, the Monday before the event, doing activities on the U.S. site. The chemistry was created, add a **dash of creativity** and this is the result!
VIDEO https://www.youtube.com/watch?feature=player_embedded&v=fTwkYboUlZw

Then, who will dare say that inexperienced teams can not win!

Teamwork at West Virginia!
Source: Mario Dubois

This team won the competition by offering an innovative solution to the challenge # 17: how to make more attractive stairs.

Second Prize: University of Sino-European Technology Shanghai University (UTSEUS) in China
A team of ETS coordinated by Samuel Rispal, founder of the student club **DÉCLIQ** at ETS, wins the second prize with fellow students of UTSEUS. Team Arc-en-Ciel So-Jump, a SWAT TEAM, has chosen the challenge imposed # 7 seeking to reduce the width of the poles supporting huge circus tents, to propose an innovative solution as explained in this video:
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=TWnSLDY1Gh4

And that's not all: the team also won the **Asian continent prize** AND the **second prize** as a SWAT TEAM!

Samuel Rispal, Jérémy Méjane and Jeason Blair with their colleagues
from UTSEUS university in Shagnghai
Source: Mario Dubois

Third Prize: University of Technology of Belfort-Montbéliard (UTBM) in France
Third place went to the team of T-ANT composed of students Ayoub Rachdi Clement Perrard, Florianne Moulin, Fabien Dirand, Hervé Coutier and Florian Sutter. The team offered a creative solution to the challenge # 17: how to make stairs more attractive.
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=pPUMm6r41aM

The winning projects by continent

North America
The team **Inters** ETS of École de technologie supérieure in Montreal composed of students Maxime Gauthier Bourbonnais, Olivier Bourbonnais , Gabriel Duquette, Frederic Daneau, Pascal Mollicone, Gregory Belhumeur and Jean-Daniel Minville won this award with an innovative solution to challenge # 13: how to make intersections streets safer.

South America
The team Sixnovation from the Universidad Nacional del Sur in Argentina consists of students Alfredo Goni, Luis Maenza, Frederico Matzkin, Hernan Riffo, Alan Roht and Gabriel Salat won this award by offering a solution to the challenge # 17 seeking to make stairs more attractive.

VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=7Q-m94CwrXg

Europe
Team Double mix of the Graduate School of Engineering of the University Paris-Est Marne-la-Vallée (**ESIPE**) in France chose Challenge # 10: how to manage diabetes in the future. For their solution, they won the Europe International Award.
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=rqyAq6rRlNQ

Africa
Team Red drones from M'Hamed BOUGARA University of Boumerdes (**UMBB**) in Algeria won the continent of Africa prize for the proposed solution to the challenge # 2: how to have a clean neighborhood. Here is their solution:
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=3s_Q2UTxQcQ

SWAT TEAMS Prizes

The first SWAT TEAM prize was won by the team "Error404GroupNotFound" from the University M'Hamed BOUGARA Boumerdes (UMBB) in Algeria. Those students have accepted the imposed challenge # 8: How to increase the number of spectators inside a circus canvas. Here is their solution:
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=hjzZ91wx_I0

As mentioned previously, the team Arc-en-Ciel So-Jump from the University of Sino-European Technology Shanghai University (UTSEUS) China won the SWAT TEAM second prize for their solution to challenge # 7 and also earned the second international prize (see above) and the Asian continental prize.

SWAT TEAM third prize was awarded to the team Victorious from a university located in Bogota, Colombia. The team worked on the challenge imposed # 7 to reduce the width of the poles supporting huge circus tents. Here is the video:
VIDEO: https://www.youtube.com/watch?feature=player_embedded&v=Ym4IAin5TdY

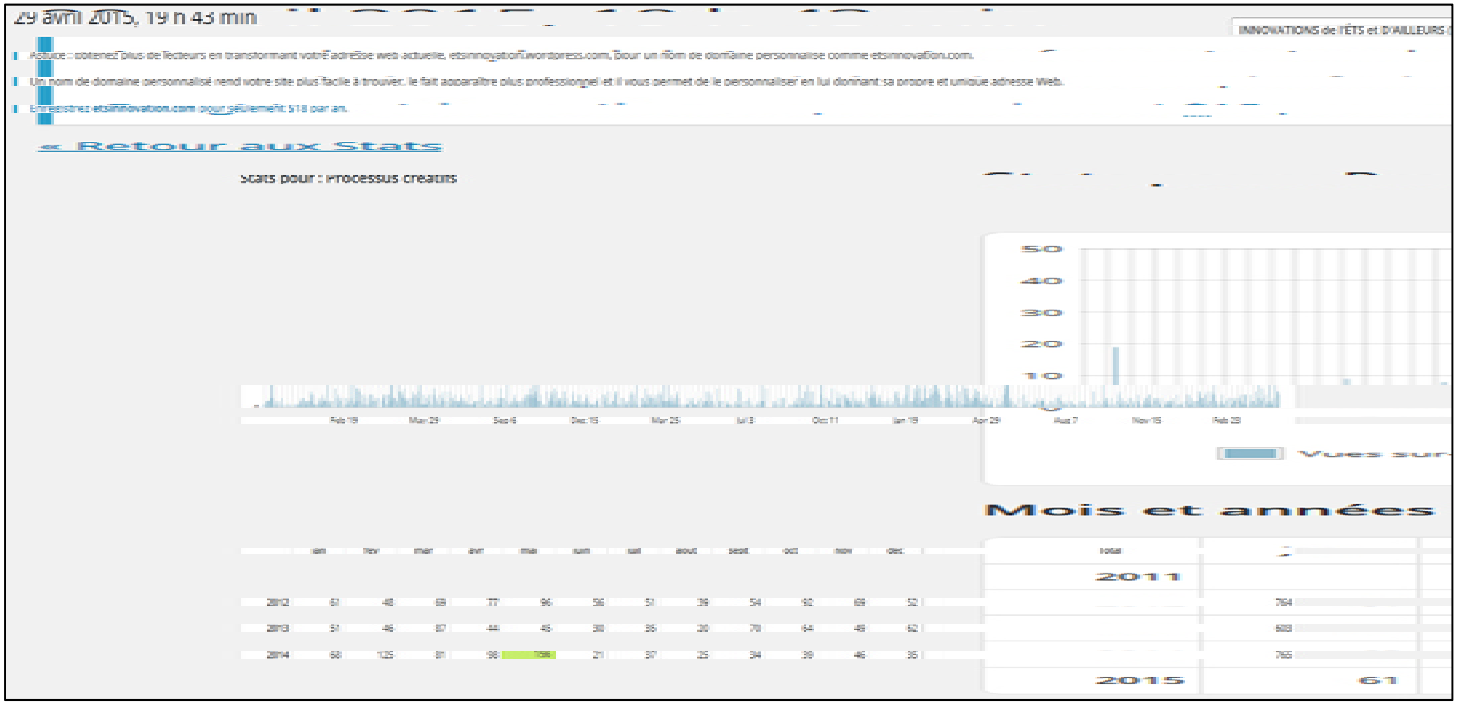
And local winners of the competition are …

You will find the **winners established by the local jury** at the following link.
http://24h-innovation.agorize.com/en/challenges/les24h-de-linnovation-results?models_locale=

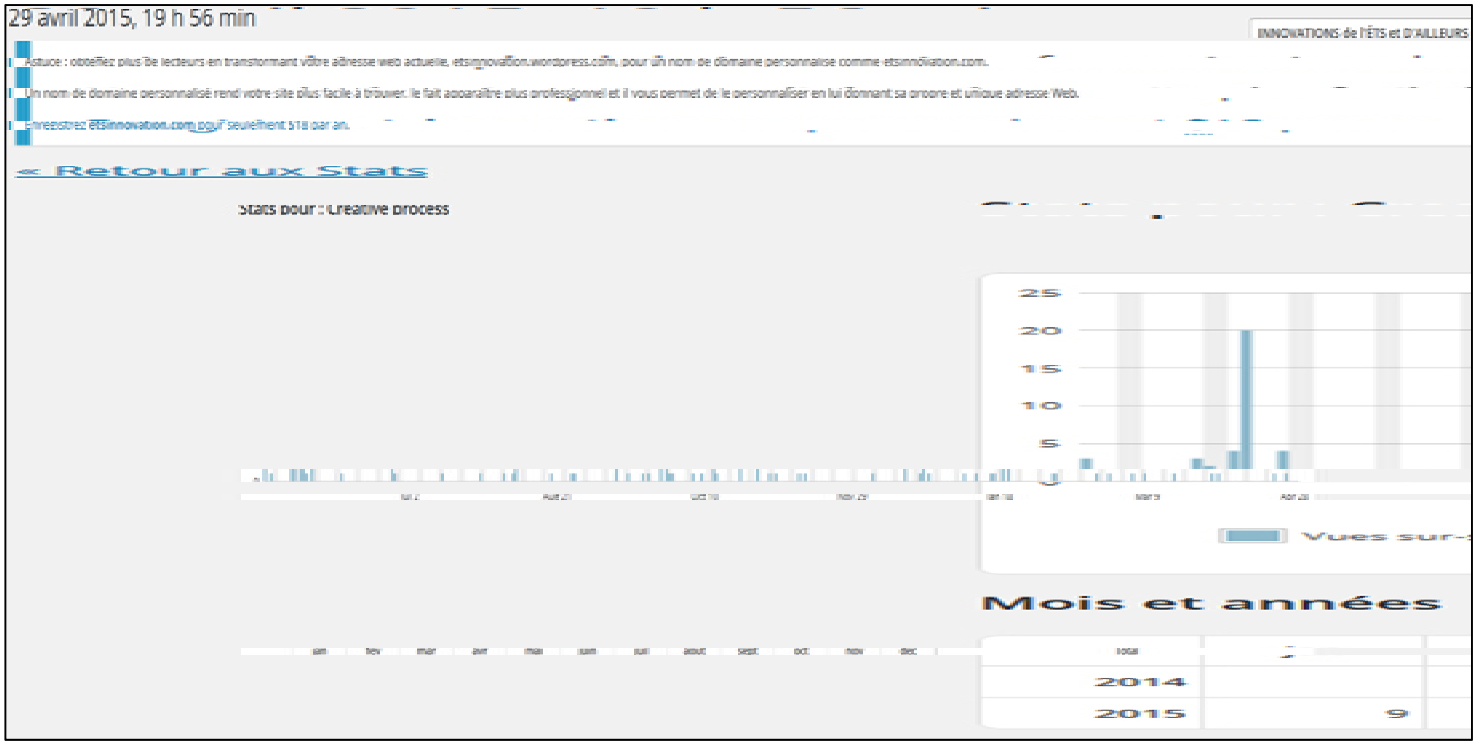
APPENDIX XI

Data collected by *Wordpress Stats* and *Google Analytics*

A.XI.1 Wordpress stats – Creative process – French – 2012 to 2014

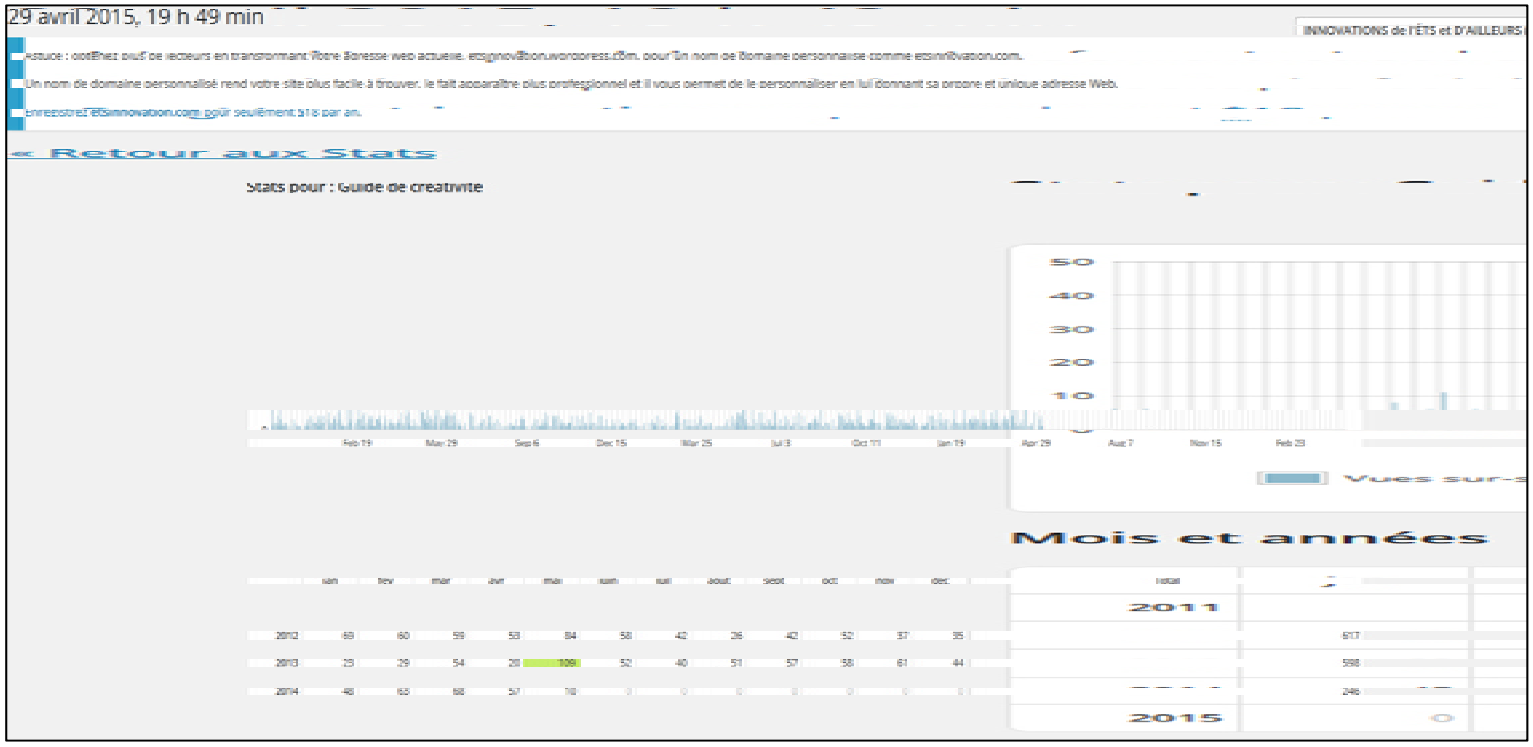


A.XI.2 Wordpress – Creative process – English 2014

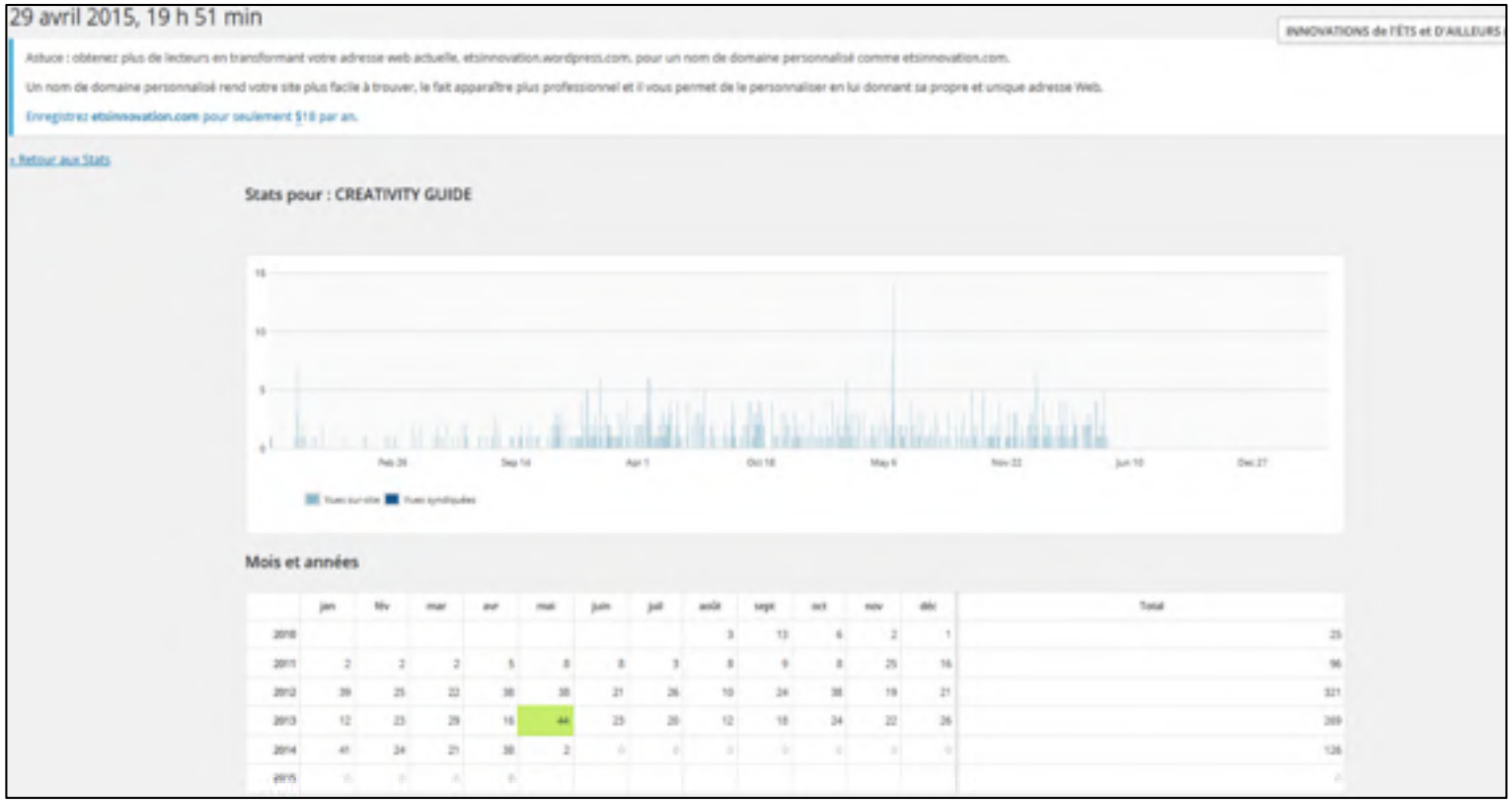


A.XI.3 Wordpress stats – Creative process – Spanish –2014

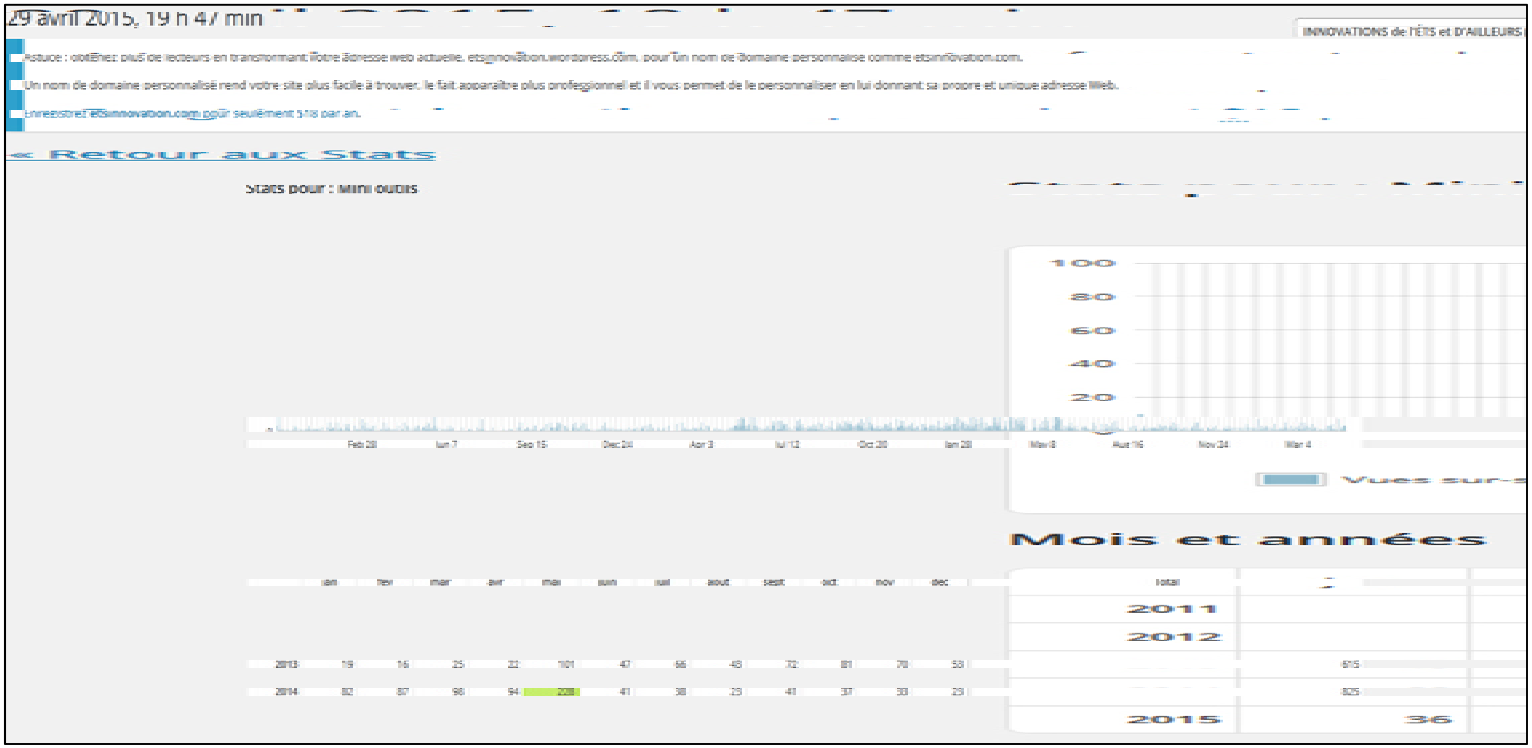
A.XI.4 Creativity guide – French – 2012 to 2014



A.XI.5 Creativity guide – English – 2012 to 2014

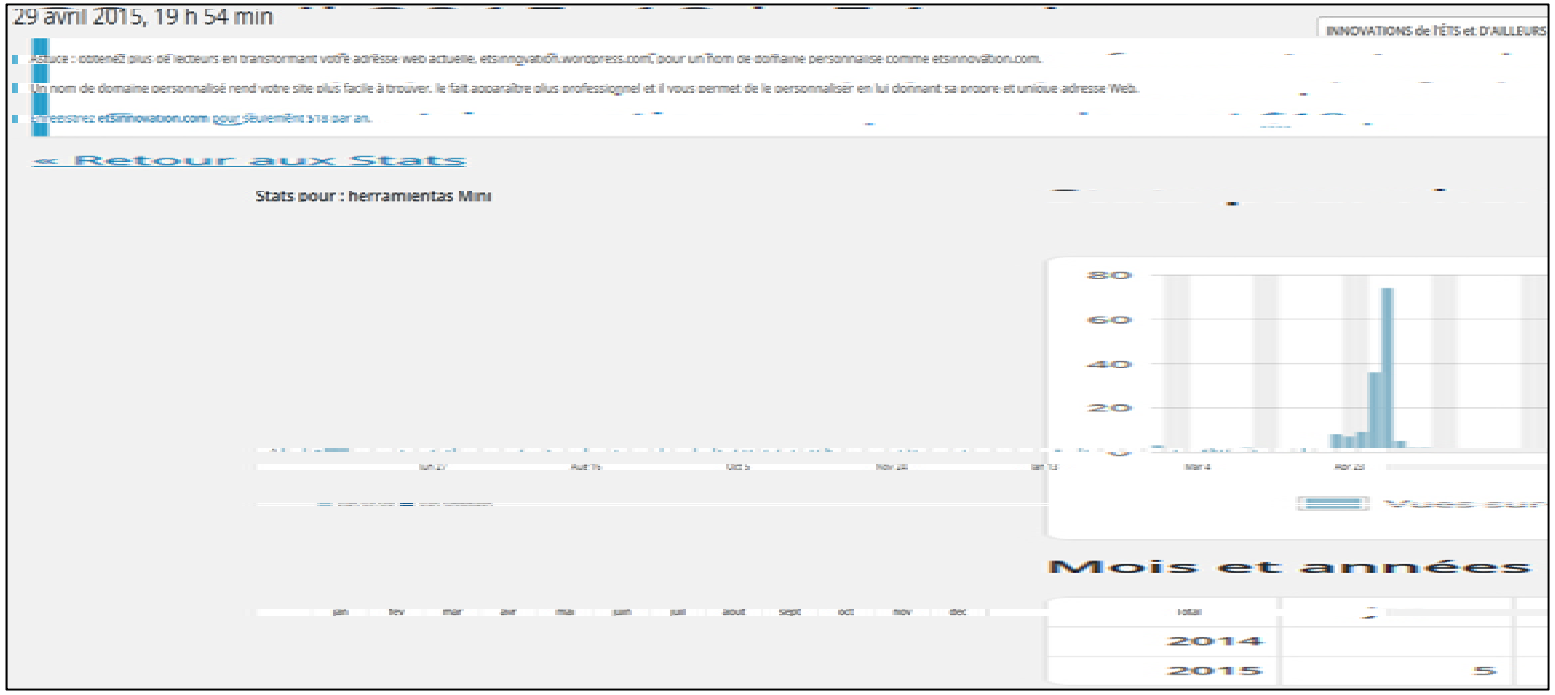


A.XI.6 Mini creativity tools – French – 2013 to 2014

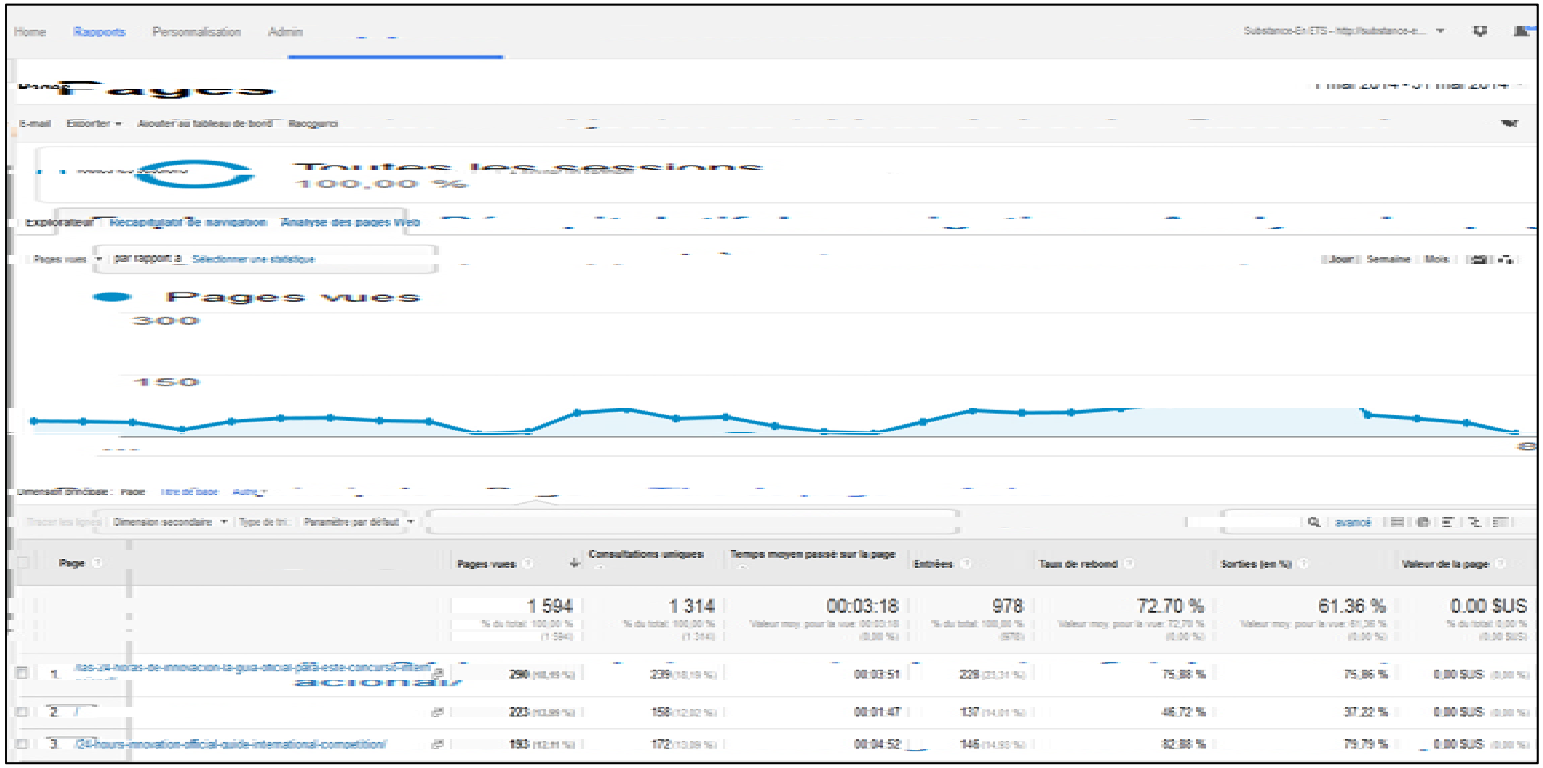


A.XI.7 Mini creativity tools – English – 2013 to 2014

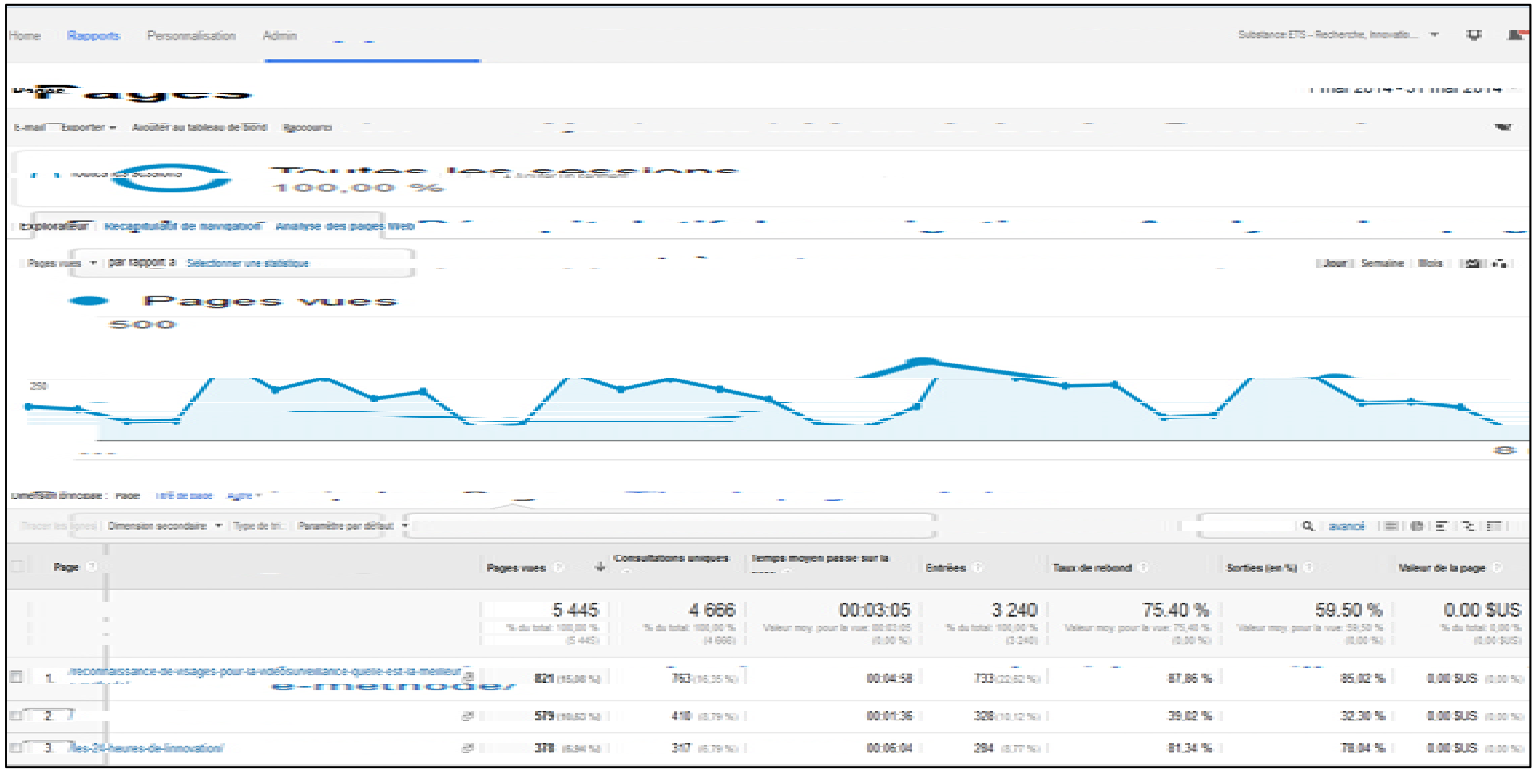
A.XI.8 Mini creativity tools – Spanish – 2014



A.XI.9 Google Analytics – Creativity Guide – English – Spanish – 2014 stats



A.XI.10 Google Analytics – Creativity Guide – French – 2014 stats



APPENDIX XII

Google Analytics way calculation of visitors and views[40]

"How the Users metric is calculated"

Reports may use one of two Users calculations.

At a glance

The *Users* metric shows how many users viewed or interacted with your content within a specific date range.

Google Analytics uses two different techniques for calculating *Users* for different kinds of report requests. As a result, there can be discrepancies in *Users* in different reports.

In depth

Background

In order to quickly serve data to your reports, Analytics creates a set of unsampled, pre-aggregated data tables, which are updated on a daily basis. (For more information on how this works, read how sampling works.) The pre-aggregated data tables are well equipped to handle common reporting requests, including changes to the date range in standard reports. For example, when you request a report, Analytics looks up each metric in the pre-aggregated data tables and serves those results to your reports. If you adjust the date range from *August 1 - August 31* to *August 1 - September 1*, Analytics looks up each metric in the September 1 pre-aggregated data table and adds the new data to the existing total.

This works well for most metrics. Many metrics, like *Pageviews* or *Screenviews*, are simple additive counts over days. However, *Users* is based on more complicated calculations. Instead of simply adding (or subtracting) processed data from the pre-aggregated tables, Analytics must recalculate *Users* for each date range that you select in a report. For example, if a user visits a website on August 31 and on September 1, Analytics recognizes this user as a single user over the course of these two days. If you change your date range from *August 1 - August 31* to *August 1 - September 1*, Analytics can't simply add the difference to the value of Users you see in your reports because this number is based on a complicated calculation, and not just added to the running total in the pre-aggregated data tables. Instead, the metric has to be calculated on the fly each time you request it in your reports.

To address this challenge, there are two calculations for *Users*. The optimal calculation is selected depending on the report being viewed.

Calculation 1: Pre-calculated data

This calculation relies only on the number of sessions in the given date range and the time of each session. (This is determined by technology managed on the device, like a web browser, and is often referred to as the client-side time.) Because the result of this calculation can be added to the pre-aggregated data tables, Analytics can reference the table to quickly retrieve and serve this data in a report, including when you change the date range.

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[40] Retrieved from Google. 2015. "How the Users Metric is Calculated". Online. < https://support.google.com/analytics/answer/2992042?hl=en >. Accessed January 3, 2015.

Calculation #1 is used exclusively in reports when the only dimension is a time frame, like the Date, Week of Year, or Month of Year. This means that you only see it in the Audience Overview report when no Segments are applied, or in a custom report where one of these date dimensions is the only applied dimension. When viewing *Users* over any non-date dimension, Analytics uses a second table, described below, in order to calculate Users on the fly.

Although this calculation can quickly deliver unsampled data, it does have some disadvantages. It relies on number of sessions and client-side time, so if a user's client-side time is incorrect, or if you are using a reporting view that filters out some sessions from a user (instead of all users), the data can be inconsistent.

In order to get around any potential inaccuracies, you can create a custom report with a non-date dimension that will be the same across sessions for users (e.g., Browser, Operating System, or Mobile Device). This forces Analytics to use Calculation #2, instead.

Calculation 2: Data calculated on the fly

Calculation 2 is based on the way you assign, collect, and store persistent data about your traffic. There are many solutions you can implement to customize this, but the most common way this data is going to be assigned and stored is through cookies managed via a web browser.

Calculation #2 requires heavy computation over large data sets, so it always references data in the raw session tables and not the pre-aggregate tables. Calculation #2 takes more time than Calculation #1 to process and serve data to your reports because the values are calculated on the fly; Analytics can’t simply look up and deliver data that’s already been processed and stored in the pre-aggregate tables. The calculation happens each time you make a request for it. Note that if certain conditions are met, this may induce sampling, but *Google Analytics* Premium account users can access unsampled reports.

Calculation #2 is used in custom reports and allows for the calculation of *Users* over any dimension, like Browser, City, or Source.

Note that for some dimensions, like *Source* or *Medium*, it’s possible that the same unique user can be in multiple buckets (for example, if a user visits from organic search and paid search in the same date range). For this reason, when viewing *Users* over such a dimension, the sum of the rows should not add up to the total.

APPENDIX XIII

Ahmed Cherif Eco innovation process

Guide écoconception

Introduction

Nous vous proposons 5 vidéos qui vont vous aider à faire de l'écoconception pour le développement de votre produit ou service. Vous trouverez par la suite de plus amples informations sur cette méthode

Les vidéos

CAPSULE D'INTRODUCTION

[youtube http://www.youtube.com/watch?v=vTOBOfT89ZA]

CAPSULE A : Consommation des matériaux

[youtube http://www.youtube.com/watch?v=ZkNBy3JgkpQ]

CAPSULE B : CONSOMMATION ÉNERGÉTIQUE

[youtube http://www.youtube.com/watch?v=vsjuxm1WxfY]

CAPSULE C : Rejets générés problématiques

[youtube http://www.youtube.com/watch?v=tlxCEojCSjU]

CAPSULE D : Comment améliorer les paramètres d'usage sans impact environnemental

[youtube http://www.youtube.com/watch?v=hfLVIPAQ2Wo]

CAPSULE E : Comment améliorer l'appropriation de l'écoconception

[youtube http://www.youtube.com/watch?v=EV9FOigi1Ew]

Le guide

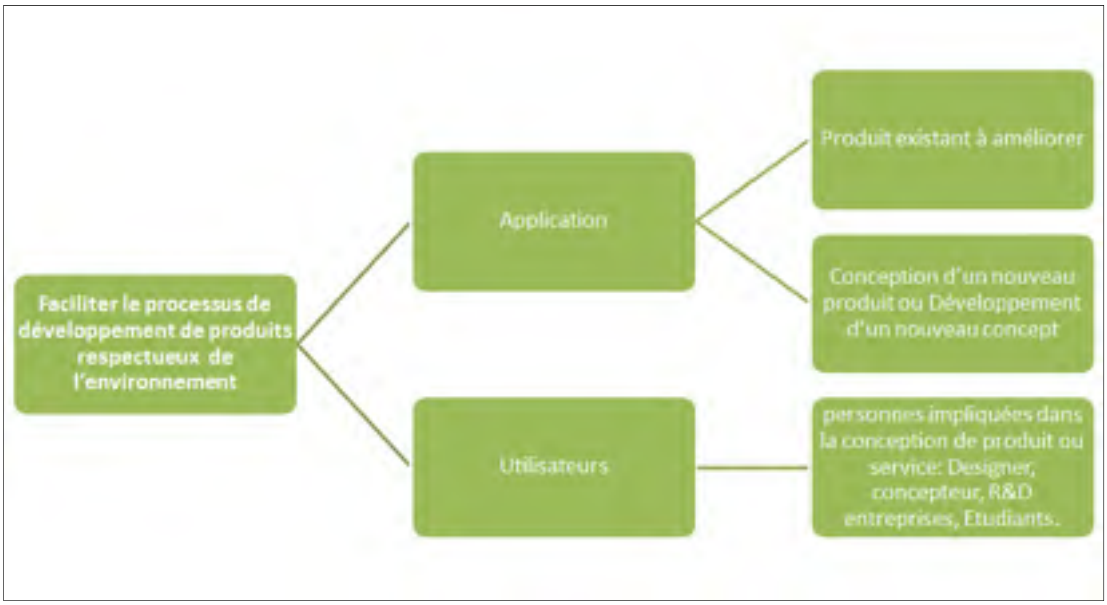
Ce guide a pour objectif de faciliter le développement de processus et produits plus respectueux de l'environnement. Cet outil permettra au designer ou au concepteur de faire une approche dans la démarche d'écoconception.

Ce guide s'inspire de ECOFAIRE OUTIL. Il s'adresse à toutes les personnes impliquées dans le processus de conception d'un produit ou service : concepteur, designer, R et D entreprises, enseignant et étudiant.

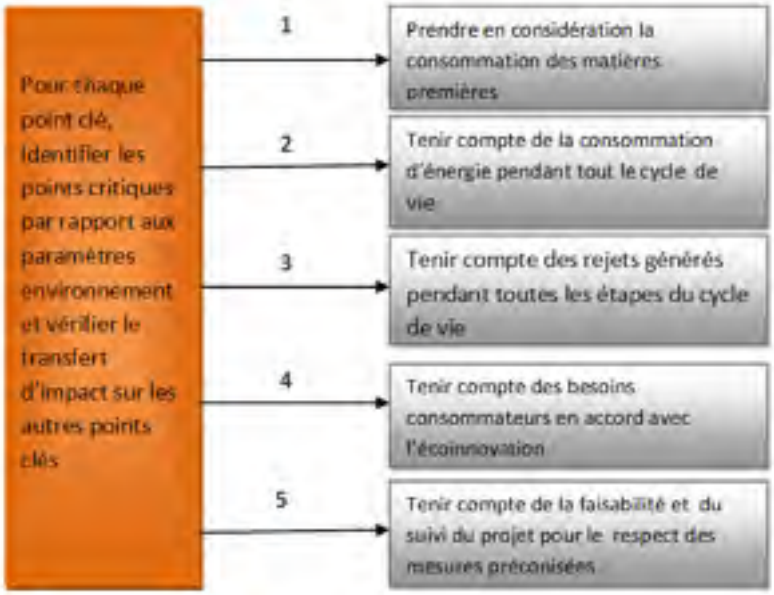
Toute personne qui s'intéresse à l'écoconception (non ou peu initiée à cette approche) peut utiliser cet outil.

Cette démarche peut s'appliquer à un produit existant à améliorer, la conception d'un nouveau produit ou le développement d'un nouveau concept.

OBJECTIFS DU GUIDE



Points clés à prendre en considération et pour lesquels il faudra poser des questions



Les 5 points clés

Point clé 1 Consommation en MP	Numéro	Oui	Non	NA	Commentaires
Est-ce que les matériaux qui entrent dans la composition du produit présentent une évaluation environnementale favorable?	1				
L'utilisation de composants toxiques dans le produit est elle évitée?	2				
Le produit utilise t-il des matières premières renouvelables	3				
Le produit est-il composé de matériaux recyclables ?	4				
Les composants constituant le produit sont-ils séparables, une association de matériaux indissociables sont-elles évitées ?	5				
La mise en oeuvre de matières premières dont la provenance est connue pour poser problème est-elle évitée à l'étape de la fabrication produit ?	6				
Les composants et les sous-composants du produit sont-ils issu d'un seul matériau ?	7				
Les matériaux constitutifs des pièces du produit sont-ils recyclables ?	8				

Point clé 2 Consommation d'énergie	Numéro	Oui	Non	NA	Commentaires
Pour la fabrication du produit et de ses composants, utilise-t-on des technologies de production qui sont non énergivores?	9				
Est-ce que la consommation d'énergie pour la fabrication du produit ou de ses composants est réduite grâce à une optimisation du process ?	10				
Est-ce qu'on peut utiliser des énergies d'origine renouvelable pour la fabrication du produit et de ses composants ?	11				
Des ressources énergétiques disponibles sur site sont-elles utilisées pour la fabrication du produit et de ses composants ?	12				
Est-ce que le produit consomme le minimum d'énergie possible par unité de service rendu ?	13				
Est-ce qu'un procédé de fonctionnement efficace sur le plan énergétique a été choisi pour le produit ?	14				
Est-ce que les consommables mis en oeuvre lors de l'utilisation sont gérés en circuit fermé (réutilisés ou recyclés) ?	15				
La production de déchets durant la phase d'utilisation est-elle évitée ou au moins minimisée ?	16				

Point clé 3 Rejets	Numéro	Oui	Non	NA	Commentaires
Ces technologies de fabrication minimisent-elles les déchets et les émissions ?	17				
La fabrication des produits ou de leurs composants engendre-t-elle des quantités relativement faibles de déchets ou d'émissions ?	18				
Les déchets provenant de la phase de fabrication peuvent-ils être réutilisés ou recyclés ?	19				
Est-ce que les impacts sur l'environnement consécutifs aux émissions, aux effluents ou au bruit en phase d'utilisation, peuvent être évités ou au moins réduits ?	20				

Point clé 4 Réponse aux besoins consommateurs (Ergonomie, Bruit, odeur)	Numéro	Oui	Non	NA	Commentaires
a-Est-ce que le produit répond bien aux besoins réels de l'utilisateur ? sentiments particuliers de joie	21				
Est-ce que le produit est simple d'utilisation et est ce que son fonctionnement sera correctement expliqué ?	22				
Le produit est-il conçu de manière ergonomique ? est il d'utilisation facile pour un individu à mobilité réduite?	23				
Est-ce que le produit est adaptable aux différents utilisateurs et aux différentes façons de l'utiliser ?	24				
L'espace nécessaire au produit hors utilisation est-il réduit ?	25				
Est-ce que le produit requiert beaucoup d'opérations avant et après son utilisation ? Le temps nécessaire pour la préparation, le nettoyage ou le stockage est-il réduit (produit facilement monté, nettoyé, démonté, stocké) ?	26				
Le produit présente-t-il une qualité de fonctionnement élevée ? Fonctionne-t-il également sans défaillance dans des conditions non optimales ?	27				
Est-ce que le produit est conçu de manière multi-fonctionnelle et peut-il répondre dans le cadre de son utilisation à plusieurs fonctions différentes ?	28				
L'entretien est-il possible avec des outils standardisés ?	29				
Est-ce que les pièces de rechange indispensables à la réparation sont facilement disponibles ?	30				
Est-ce que le produit est conçu pour une longue durée de vie, est-il adapté aux contraintes d'une utilisation prolongée ?	31				

Point clé 5 Faisabilité et réalisation du projet	Numéro	Oui	Non	NA	Commentaires
Est-ce qu'un emballage est prévu et comporte un marquage d'identification du matériau ou une notice explicative sur le mode d'élimination le plus approprié ?	32				
Est-ce qu'un moyen de transport à moindres impacts sur l'environnement est utilisé pour la distribution du produit ?	33				
Est-ce que le produit est sûr lors de son utilisation ? Présente-t-il des dispositifs de protection visant à prévenir, même en cas d'accident, les dommages à l'environnement ?	34				
Est-ce que le produit dispose d'indications complètes concernant son contenu en substances dangereuses ?	35				
Est ce que les risques environnementaux liés à une mauvaise utilisation du produit peuvent être évités ? Est-ce que les mesures à prendre et les instructions pour favoriser un comportement adéquat sont données ?	36				
Est il prévu que le produit dispose d'une structure intuitivement démontable ou y a-t-il un guide technique pour le démontage ?	37				
h-Existe-t-il des possibilités et des incitations en vue de collecter les déchets issus de la phase d'utilisation ?	38				
i-L'entreprise qui sera en charge de la fabrication est elle préparée à l'écoconception?	39				

Pondération des impacts environnementaux

L'addition en horizontale donnera la pondération selon l'étape et verticale selon l'aspect environnemental.
Note=3 : Impact important
Note=2 : Impact moyen
Note=1 :Impact faible
Note=0 :Impact inexistant ou inconnu

Aspect environ / Cycle de vie	Consommation de matériaux	Consommation Energie	Rejets	Service rendu et facilité d'utilisation	Total
Conception et préfabrication					
Fabrication					
Utilisation					
Transport et emballage					
Fin de vie					
Total					

Résultats de l'évaluation environnementale

	Aspects environnementaux*	Etapes du cycle de vie*	Recommandations
Très importants			
Importants			
Secondaires			

Aspects environnementaux :consommation matériaux, Energie, rejets, service rendu par le produit,

Etapes cycle de vie*:Préfabrication, fabrication, transport, usage,fin de vie

Solutions envisagées

Etapes du cycle de vie	Questions	Stratégie a adopter	exemples
Besoins,Fonction	Comment le système du produit rempli t il les besoins sociaux	Développement d'un nouveau concept : •innovation •usage partagé du produit	Photocopieur modulaire
Matériaux	Quelle quantité d'énergie et de types matériaux utilisés	Choix de matériaux peu impactant (renouvelable, recyclable…)	Pull en fibre polaire,
Transport	Quel types d'emballage et quels moyens de transport à utiliser	Réduction d'utilisation des matériaux d'emballage (Poids, volume, rotation) et mode de transport le moins énergivore	Combiner : Transport combiné rail, route
Fabrication	Quel type de procédé est utilisé	Optimisation des techniques de production (diminuer l'énergie, les déchêts Etc…	Exemples d'écoprocédés
Usage	Quantité d'énergie, quels types de consommables requis, maintenance	Structure modulaire pour la réparabilité et la maintenance, moins consommateur d'énergie	Radio à énergie manuelle, réparer le produit au lieu de le jeter
Fin de vie	Devenir du produit en fin de vie (recyclable? réutilisable?…	Réutilisation , refabrication etc…	Exemple de refabrication appareils photo Kodak

Source :C.Abrassard.2011

APPENDIX XIV

Secondary data from ESTIA

A.XIV.1 Year 2007

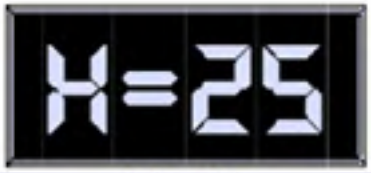
Les 24h de l'innovation

Saison 4 - 2010
22 octobre [14h] - 23 octobre [14h]
ESTIA, Bidart, France

www.24h.estia.fr

Les 24h de l'innovation - Saison 1 :
L'Évènement, Heure par Heure.

20 Oct 2007 | 15:00:00



14:00 > 15:00

001 -

Projet : Accessoire pour Boardshort (Sujet n°7 - Quicksilver)

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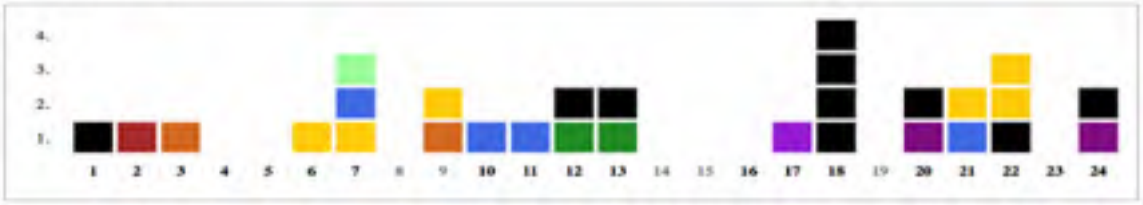
Processus de créativité :

002 -

Projet : Valise Anti-taxe (Sujet n°27 - Quicksilver)

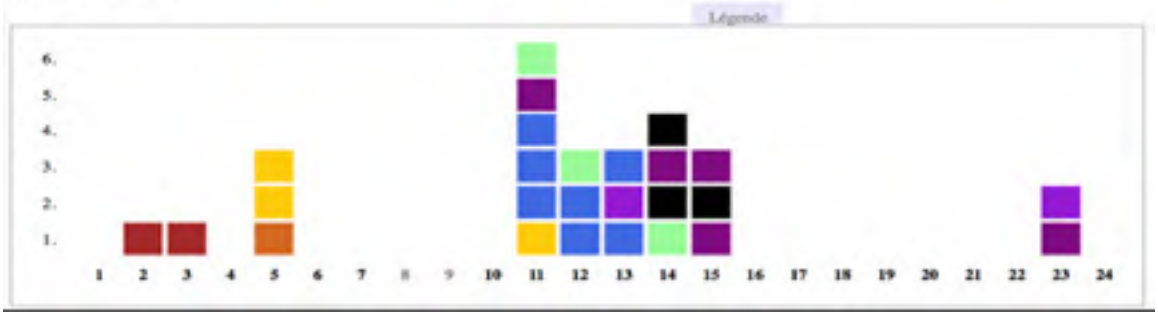
Processus de créativité :



003 -

Projet : Flexboardz sur glace (Sujet n°1 - Patrick Pierron, Flexboard)

Processus de créativité :



004 -

Projet : Etanchéité du sac de golf (Sujet n°9 - Quicksilver)

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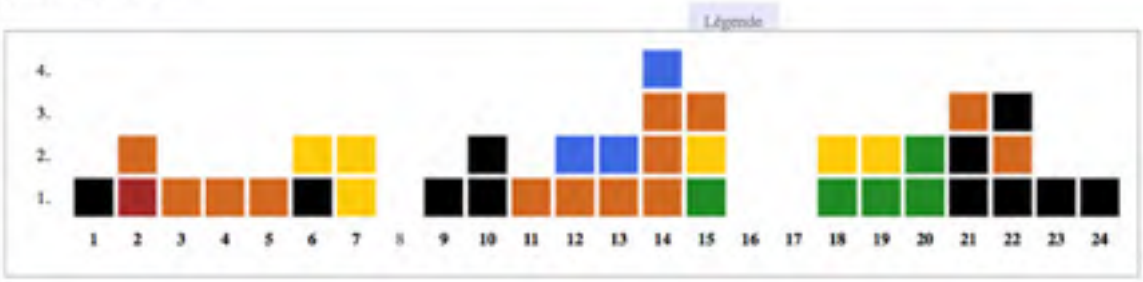
Processus de créativité :



005 -

Projet : Porte ski-snow (Sujet n°3 - Emilie Chapotot, LIPSI-ESTIA)

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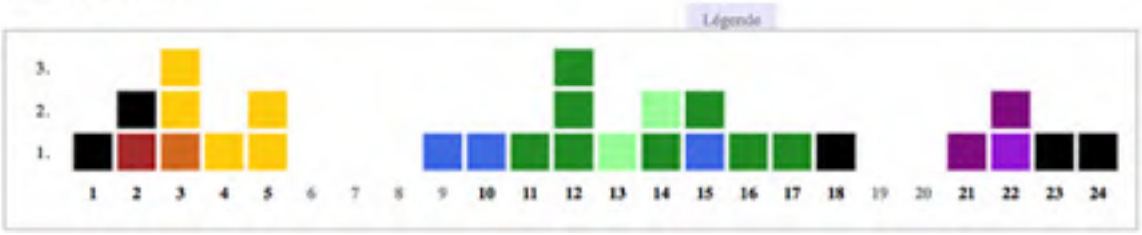
Processus de créativité :



006 -

Projet : Création d'un porte ski/snowboard pratique et original (Sujet n°3 - Emilie Chapotot, LIPSI-ESTIA)

Processus de créativité :

007 -

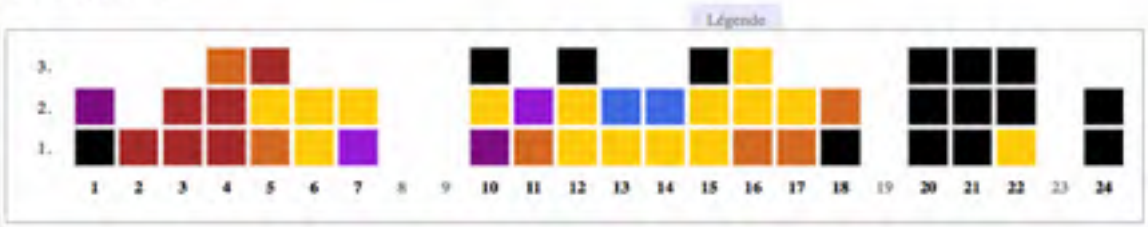
Projet : NRJ Shoes (Sujet n°10 - Romain Leclerc, ESTIA 2009)

Processus de créativité :

008 -

Projet : Turbomoteur d'hélico (Sujet n°25 - TURBOMECA)

Processus de créativité :



009 -

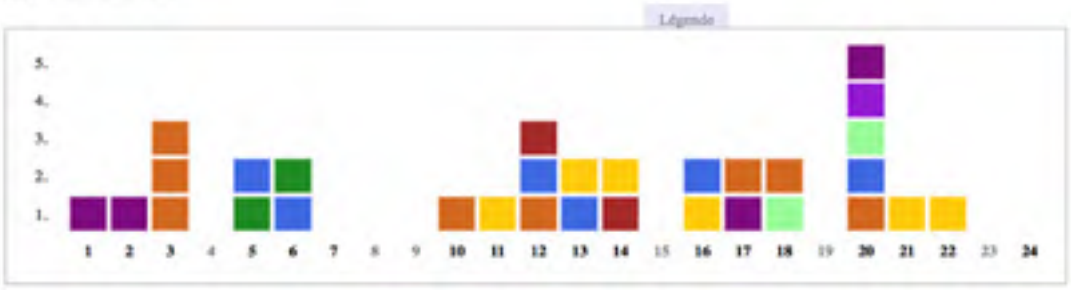
Projet : Accessoire pour boardshort (Sujet n°7 - Quicksilver)

Processus de créativité :

010 -

Projet : Bracelet communiquant (Sujet n°22 - Dorguloff)

Processus de créativité :



011 -

Projet : Transmission VTT (Sujet n°26 - Vincent Tourey, BRDC)

Processus de créativité :

012 -

Projet : Boardbag innovant (Sujet n°4 - Rip Curl)

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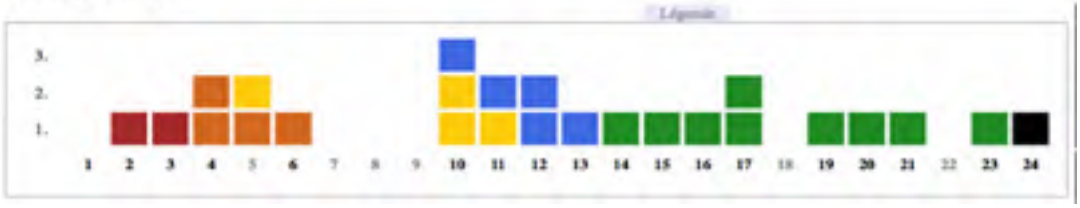
Processus de créativité :



013 -

Projet : Système de fermeture pour poche médicale (Sujet n°18 - BBRAUN)

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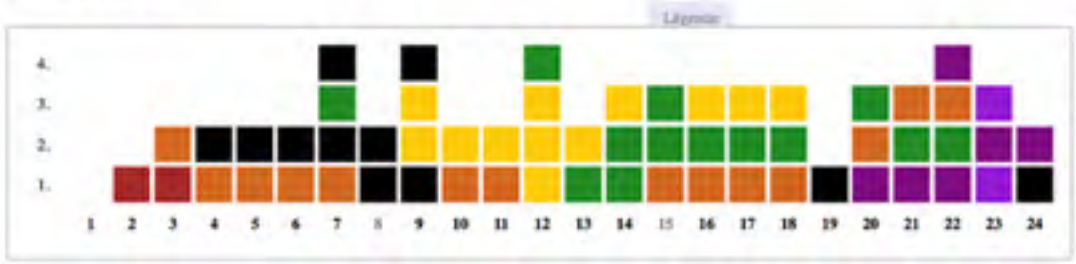
Processus de créativité :



014 -

Projet : Ecomediascoop (Sujet n°12 - Quicksilver)

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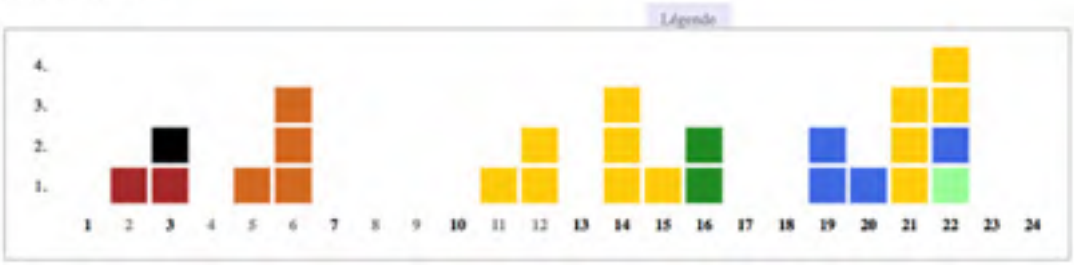
Processus de créativité :

015 -

Projet : La nouvelle génération de boardbags (Sujet n°4 - Rip Curl)

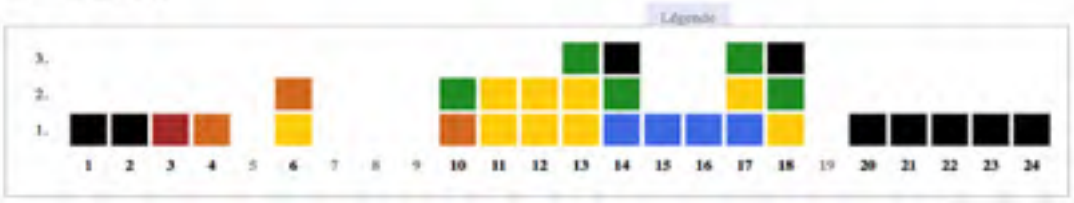
Processus de créativité :



016 -

Projet : Eco surf attitude (Sujet n°11 - Quicksilver)

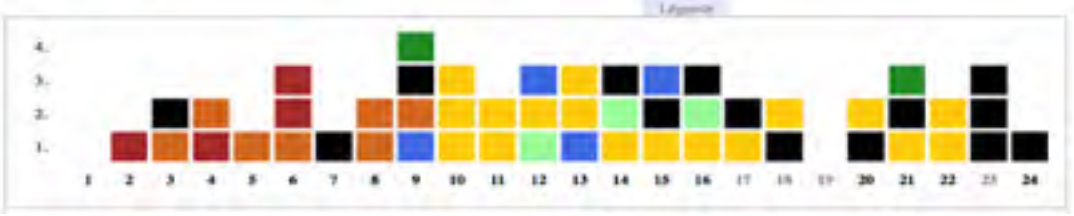
Processus de créativité :



018 -

Projet : Find Remote Control (Sujet n°20 - Fred Stock, Club de la Glisse, Anglet)

Processus de créativité :



022 -

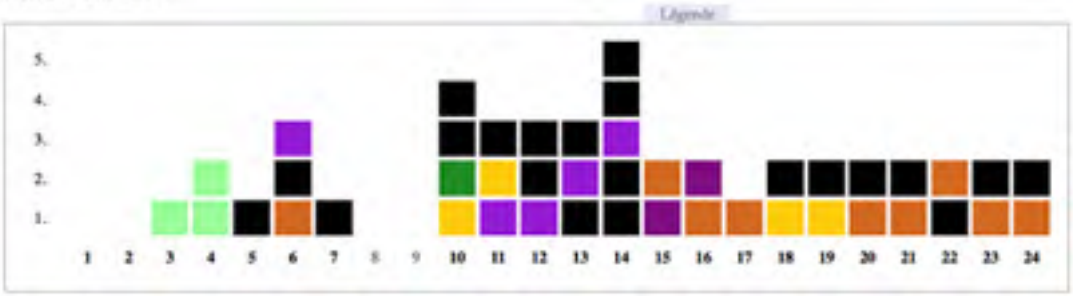
Projet : Transmission VTT (Sujet n°26 - Vincent Tourey, BRDC)

Processus de créativité :

025 -

Projet : Organisation d'un atelier de réparation des pièces (Sujet n°24 - TURBOMECA)

Processus de créativité :



A.XIV.2 Year 2008

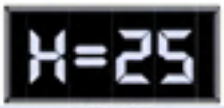
Les 24h de l'innovation

Saison 4 - 2010
22 octobre [14h] - 23 octobre [14h]
ESTIA, Bidart, France

www.24h.estia.fr

Les 24h de l'innovation - Saison 2 :
L'Évènement, Heure par Heure.

18 Oct 2008 | 15:00:00

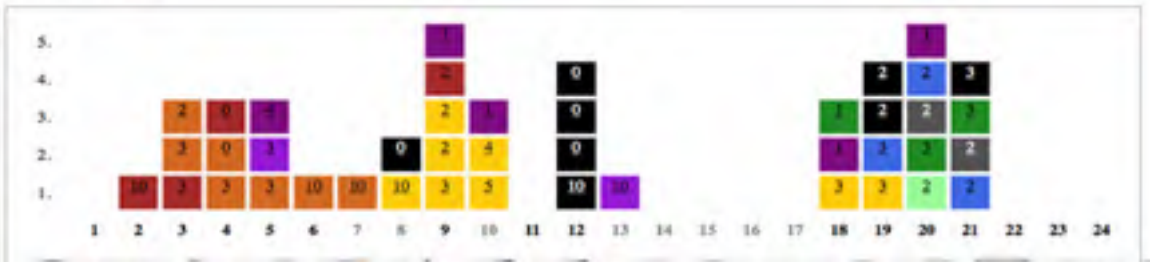


14:00 > 15:00

001 -

Projet : Antivol-VTT

Processus de créativité :



002 -

Projet : Luge modulable

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Processus de créativité :

003 -

Projet : Agence de demain du Crédit Agricole, un lieu de vie et d'échange

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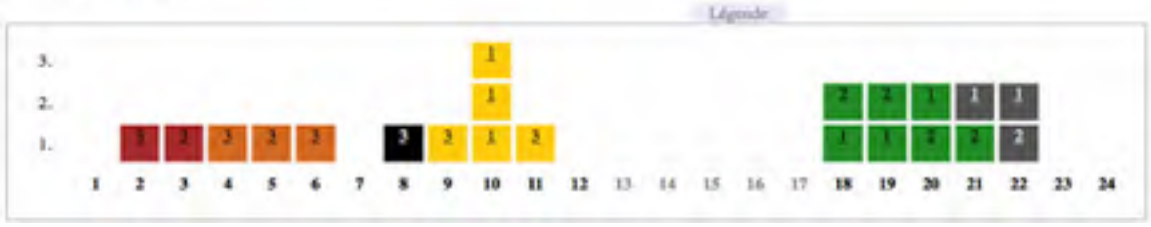
Processus de créativité :



004 -

Projet : Thermographie appliquée à l'inspection des ouvrages sous-marins

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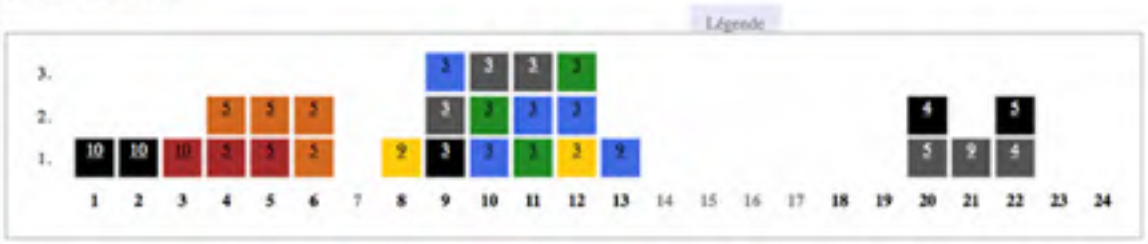
Processus de créativité :



005 -

Projet : L'espadrille du futur

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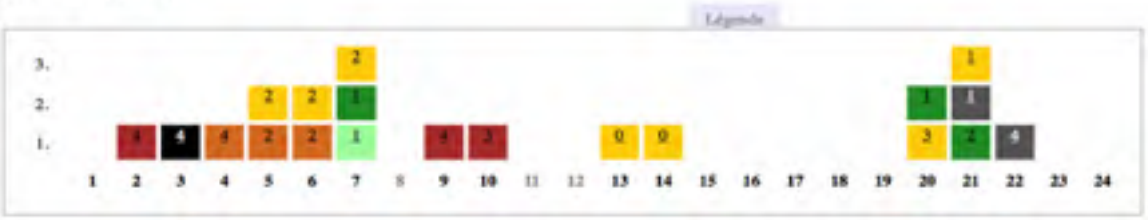
Processus de créativité :



006 -

Projet : Casque Pliable

Processus de créativité :

007 -

Projet : Flexbike vélo transformeur

Processus de créativité :

008 -

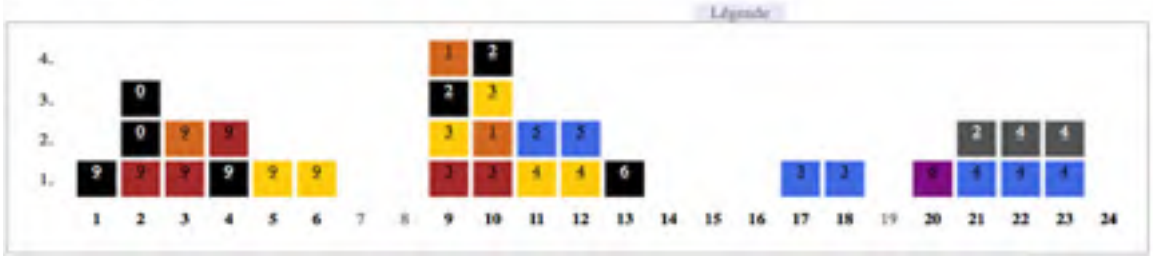
Projet : Homme-bar mobile

Processus de créativité :

009 -

Projet : Appareil de dilatation pour un rail de Translohr

Processus de créativité :



010 -

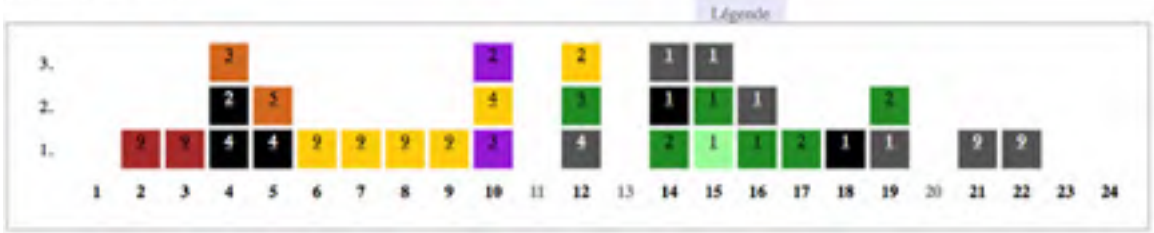
Projet : Projet SNCF

Processus de créativité :

011 -

Projet : Surf en ville

Processus de créativité :



012 -

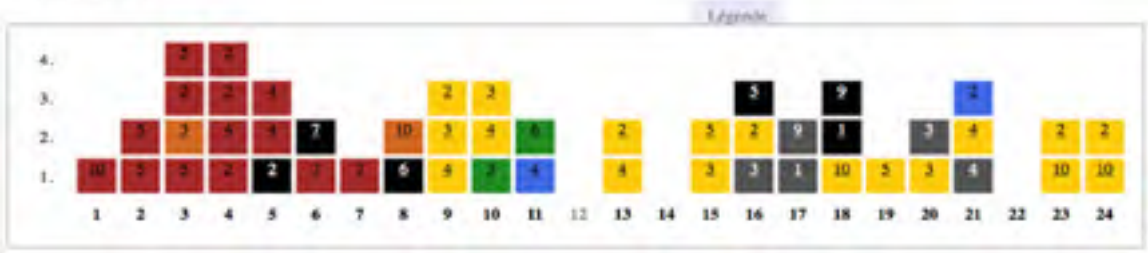
Projet : Véhicule inclinable à trois roues

Processus de créativité :

013 -

Projet : Un chariot robotisé pour camera TV

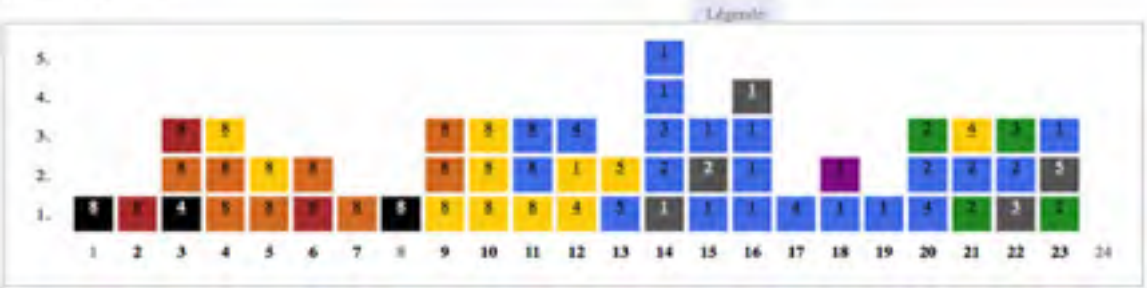
Processus de créativité :



014 -

Projet : Antivol innovant intégré pour VTT

Processus de créativité :



015 -

Projet : Incroyable Jugulaire

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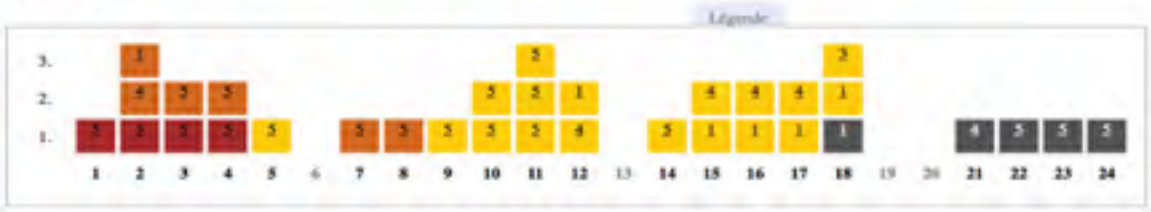
Processus de créativité :



016 -

Projet : Un flowrider transportable et moins cher

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Processus de créativité :

017 -

Projet : Le puzzle helmet

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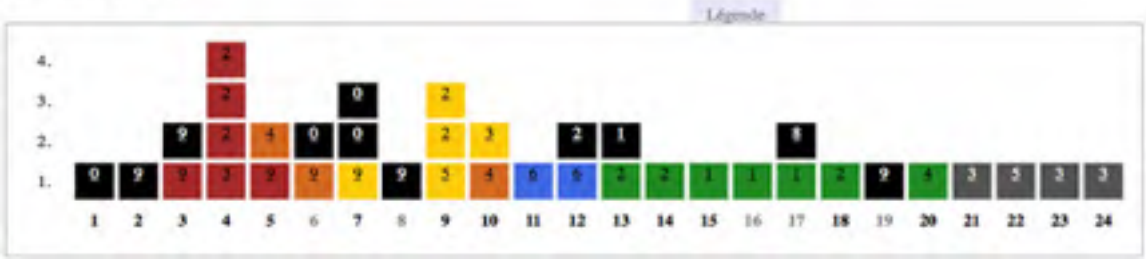
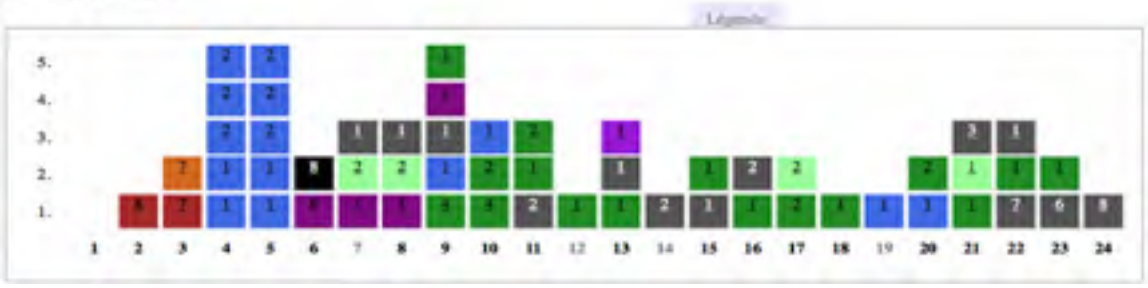
Processus de créativité :



018 -

Projet : Système de détection pour les enfants oubliés

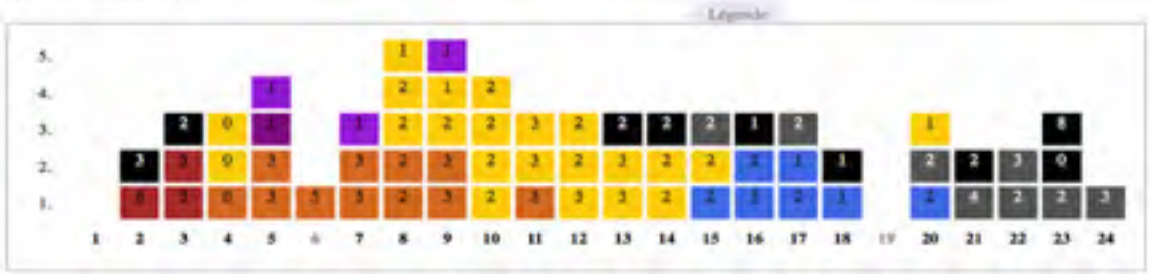
Processus de créativité :



019 -

Projet : Casque Masque rétractable

Processus de créativité :



021 -

Projet : Terminal mobile léger pour suivi de flotte

Processus de créativité :

022 -

Projet : Freedom

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Processus de créativité :

023 -

Projet : Boards de surf et recyclage

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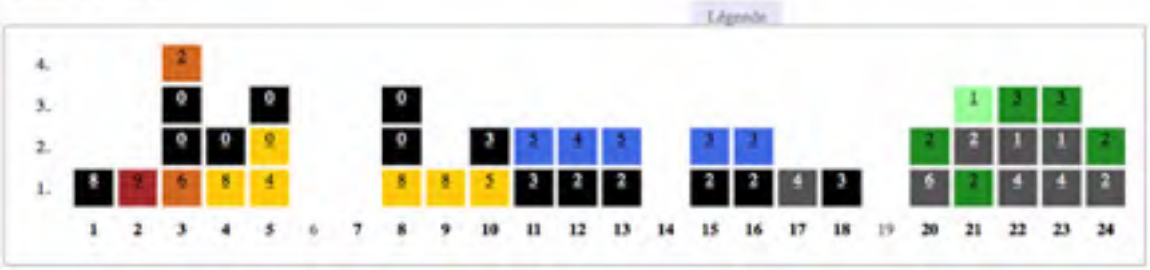
Processus de créativité :



024 -

Projet : Freins Flexboardz

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Processus de créativité :

025 -

Projet : Surf et Travail

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Processus de créativité :

026 -

Projet : Comment communiquer avant, pendant, et après un match de rugby de l'Aviron Bayonnais ?

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Processus de créativité :

A.XIV.3 Year 2009

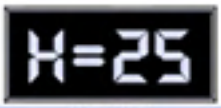
Les 24h de l'innovation

Saison 4 - 2010
22 octobre [14h] - 23 octobre [14h]
ESTIA, Bidart, France

www.24h.estia.fr

Les 24h de l'innovation - Saison 3 :
L'Événement, Heure par Heure.

24 Oct 2009 | 15:00:00



14:00 > 15:00

001 -

Projet : The Mars Bike (Ronan Bariou, ORBEA)

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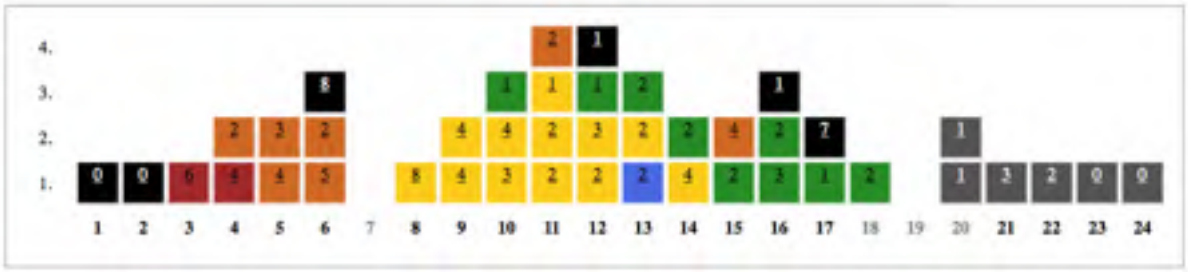
Processus de créativité :

Légende



002 -

Projet : Imaginez une nouvelle génération d'école d'ingénieurs (Marilu Faurisson, ALTEN)

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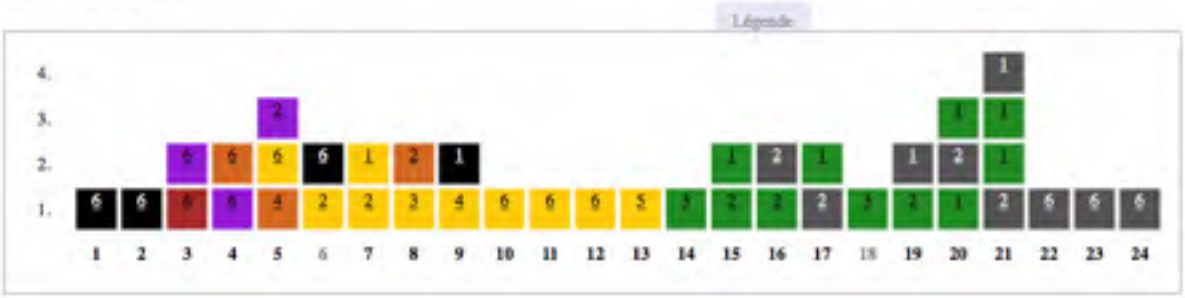
Processus de créativité :



003 -

Projet : Quel serait la nouvelle génération d'un site de recrutement pour ALTEN ? (Marilu Faurisson, ALTEN)

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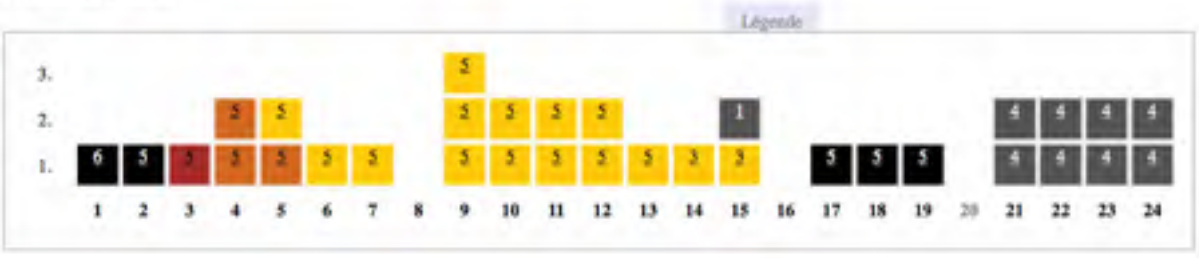
Processus de créativité :



004 -

Projet : Un test de forme « aquagliss » pour Biarritz, capitale Sport Santé (Bernard Crepel, Du flocon à la vague / Quiksilver)

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Processus de créativité :

006 -

Projet : La tenue du futur pour les fêtes de Bayonne et Pampelune (Romain Ripert, Ttilika)

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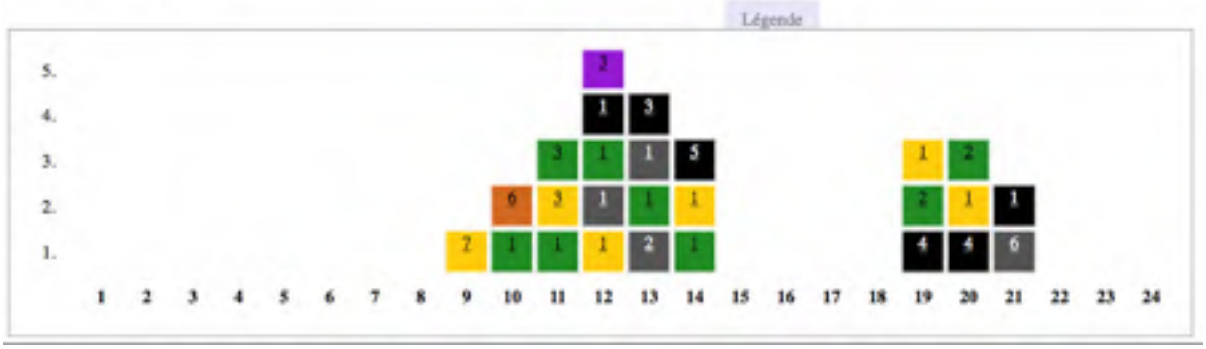
Processus de créativité :



007 -

Projet : Créer une agence Crédit Agricole pour les jeunes, avec les jeunes ! (Marie-Agnès Brugat, Crédit Agricole)

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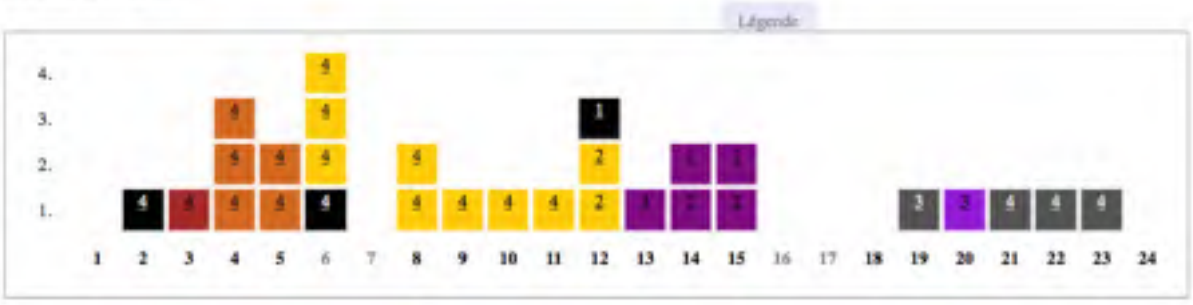
Processus de créativité :



009 -

Projet : Un refroidisseur de panneaux solaires photovoltaïques (Sébastien Bême, Solar Consulting)

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Processus de créativité :

010 -

Projet : Concevoir un support rigide et ajustable pour placer avec précision une webcam filmant un écran de téléphone mobile (Rafaël Cerezo-Martin, Néoma

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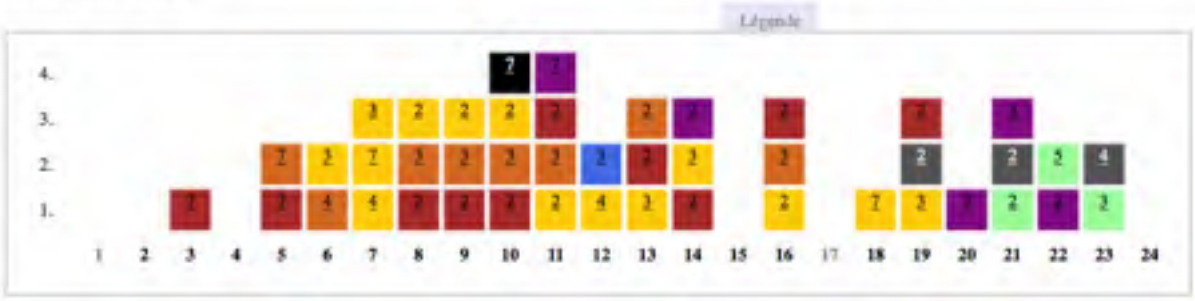
Processus de créativité :



011 -

Projet : Création d'une bouteille « Sobieski » avec de nouvelles fonctions surprenantes et innovantes (Natalia Kupianskaya, Groupe Belvédère)

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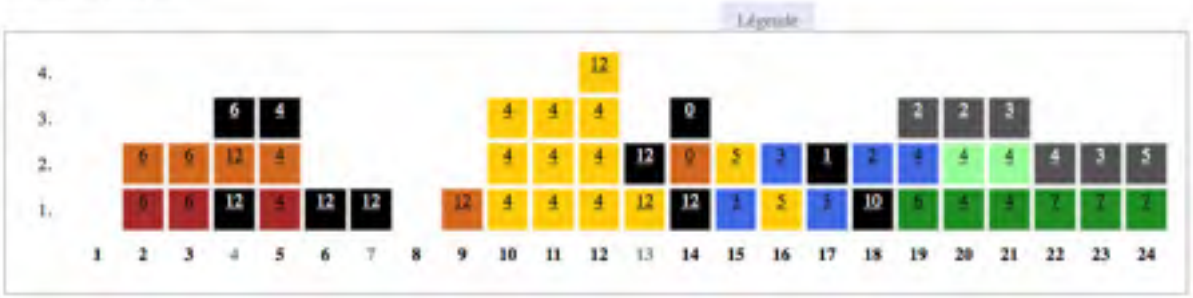
Processus de créativité :



012 -

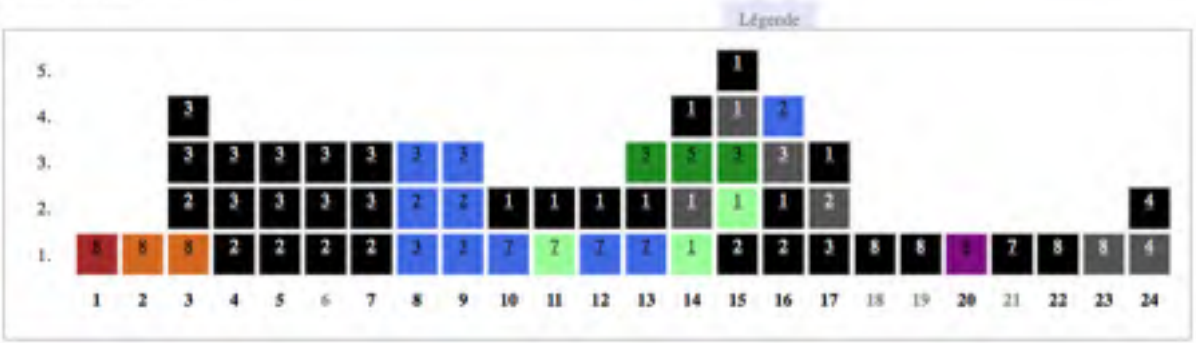
Projet : Vital-abdos (Sylvan Denouille, Sport Contrôle)

Processus de créativité :

013 -

Projet : Un arbre solaire & éolien (E. Jalenques, N. Coudroy, ESKAL)

Processus de créativité :



014 -

Projet : Le covoiturage facile au sein d'une zone d'activités (Jean-Pierre JOIGNANT, REZO 21)

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Processus de créativité :

015 -

Projet : Projet de banc de calibration de machine de test accélérométrique (P. Gardères, E. Balpe, GARTEC)

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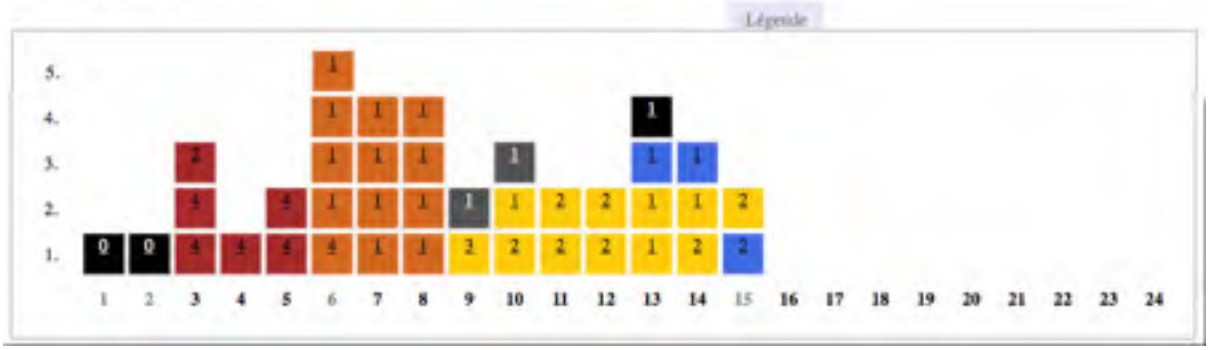
Processus de créativité :



016 -

Projet : Transposer un produit Quicksilver en service (Anaïs Vepierre, Quiksilver)

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Processus de créativité :

017 -

Projet : Des chaussures démontables / modulables (Anaïs Vepierre, Quiksilver)

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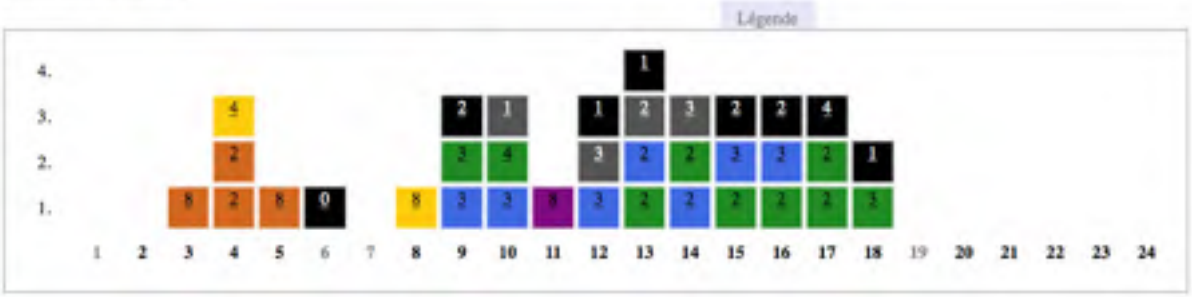
Processus de créativité :



018 -

Projet : Trouver une solution chauffante écologique pour aller surfer ou nager (Anaï Vepierre, Quiksilver)

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Processus de créativité :

019 -

Projet : Comment sensibiliser et impliquer les salariés d'une entreprise au développement durable ? (Olivier Pouilhes, Calli Atlantique)

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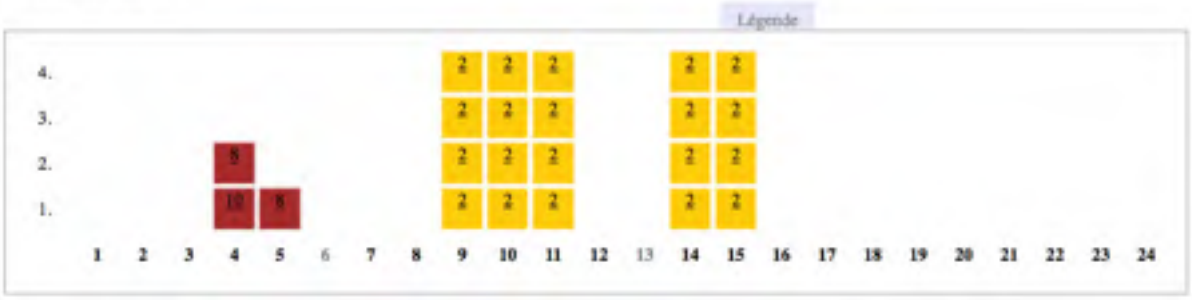
Processus de créativité :



020 -

Projet : Nouvelle vision du contrôle du trafic aérien (Areski Hadjaz, Thalès Air System)

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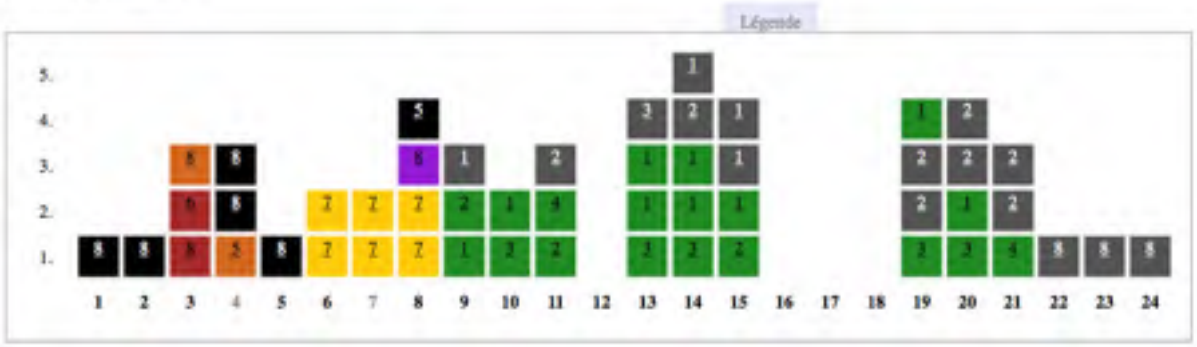
Processus de créativité :



021 -

Projet : Que faire avec la méthode « Compressed/compressive sensing » pour des applications robots terrestres, drones aériens, robots envoyés dans l'es Aérodrones)

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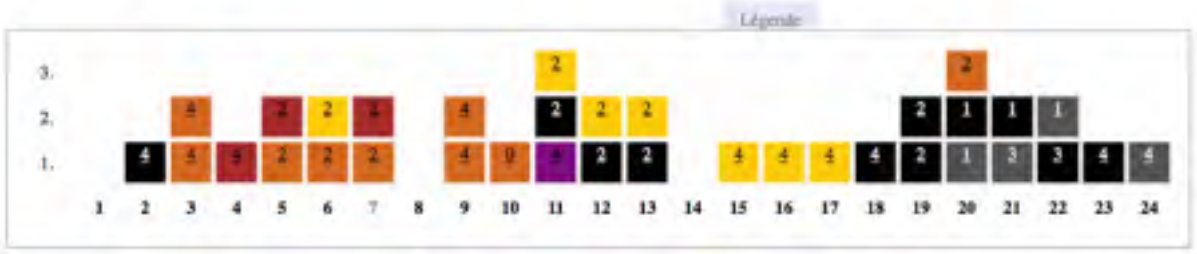
Processus de créativité :



022 -

Projet : La Mobilité plaisir des personnes à mobilité réduite (Pierre Landru, Eco & Mobilité)

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Processus de créativité :

023 -

Projet : Génération électrique dans une conduite d'injection d'eau sous pression (Paulo Roberto Crespo, TOTAL)

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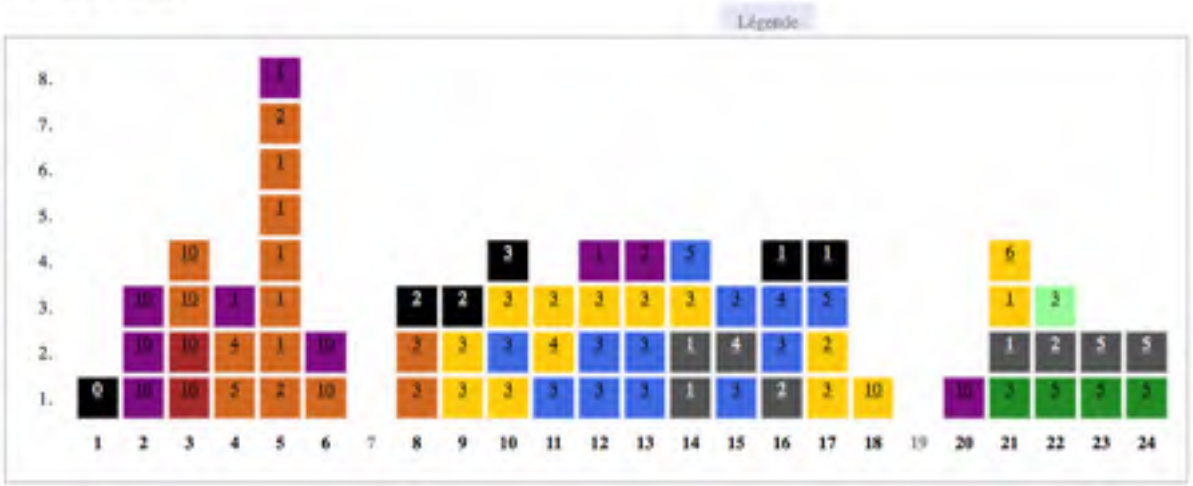
Processus de créativité :



024 -

Projet : La station service du futur (Vincent Lebarchenbon, TOTAL)

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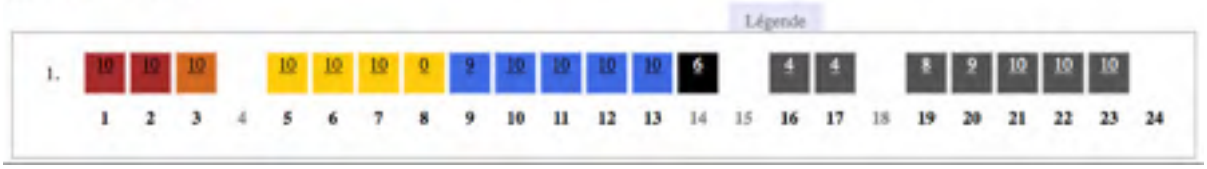
Processus de créativité :



025 -

Projet : Comment des nanotechnologies peuvent réduire les venues d'eau dans les gisements pétroliers ? (Philippe Coffin, TOTAL)

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Processus de créativité :

026 -

Projet : Conception d'un système de fixation escamotable et flexible pour bruleur de montgolfière (Alexis Bruggeman, Altisph'Air)

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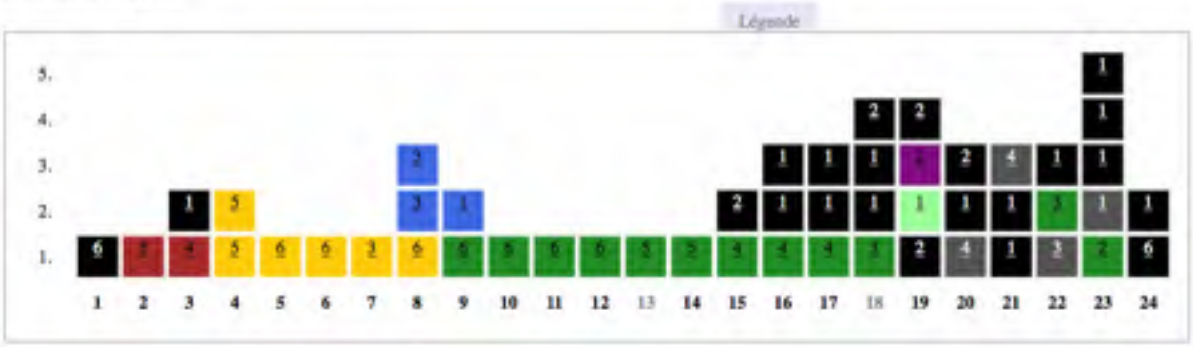
Processus de créativité :



027 -

Projet : Définir des solutions aux problèmes structurels, thermiques, acoustiques, sécurité feu, de l'Ecomodule (module nomade d'habitation en éc ECOMODULES)

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Processus de créativité :

028 -

Projet : Développer des concepts futuristes (année 2020) pour un espace de travail en R&D (Sven Schimpf, FRAUNHOFER)

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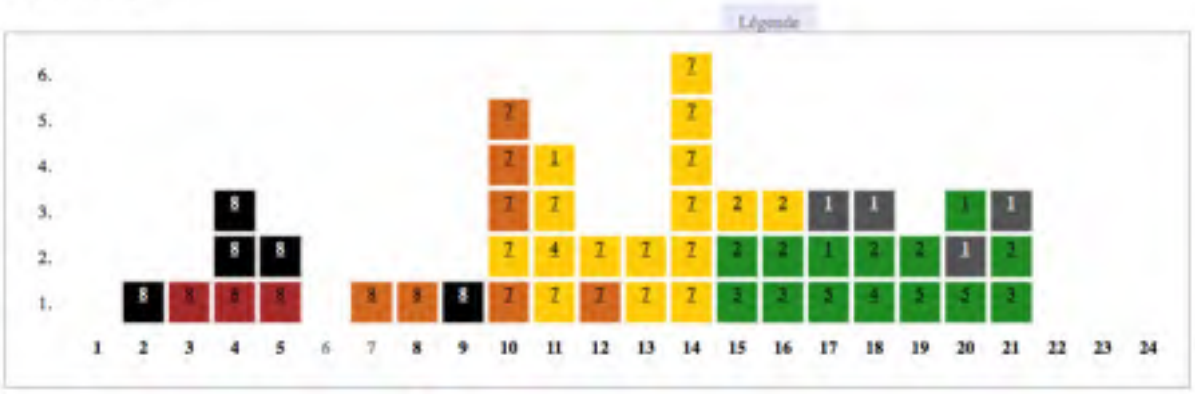
Processus de créativité :



029 -

Projet : Mise en forme d'un tube carbone dans un surf (Jean-Pierre Stark, Stark Surfboard)

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Processus de créativité :

030 -

Projet : Concevoir un système d'ancrage de panneaux de signalisation sans béton (Michel Desport, SIGNATURE)

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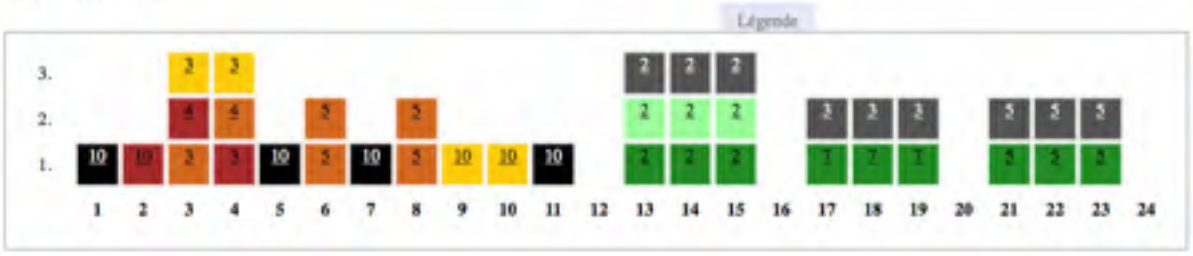
Processus de créativité :



031 -

Projet : Concevoir un parcours sportif pour Biarritz, capitale Sport Santé (E. Vanz, Centre d'Activité Physique Adaptée)

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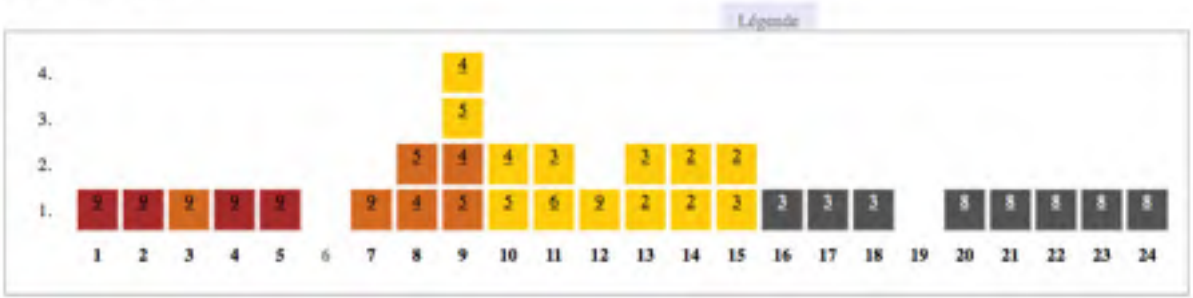
Processus de créativité :



032 -

Projet : Que faire avec 0,12m3 à bord d'une automobile ? (Charles Bocquet, FPK)

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Processus de créativité :

033 -

Projet : Concevoir un système d'ancrage de panneaux de signalisation sans béton (Michel Desport, SIGNATURE)

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Processus de créativité :

034 -

Projet : Create a new bottle with innovative and surprising functions for wines and spirits (Natalia Kupianskaya, Groupe Belvédère)

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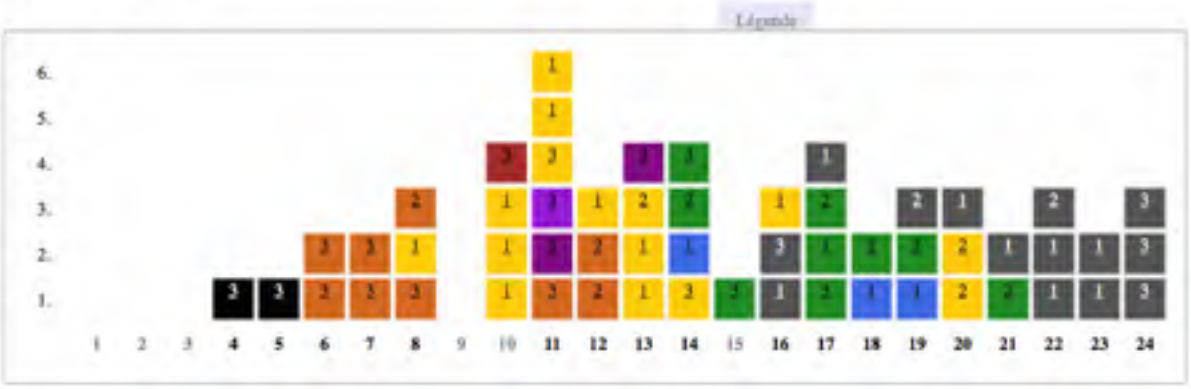
Processus de créativité :



035 -

Projet : Solar and windmill tree (E. Jalenques, N. Coudroy, ESKAL)

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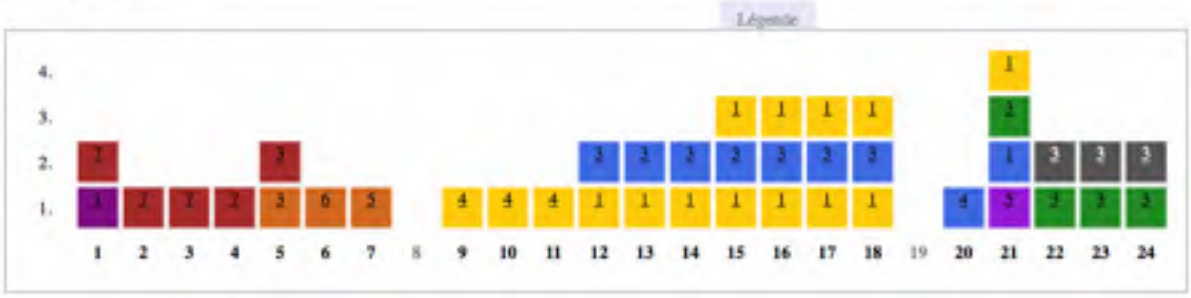
Processus de créativité :



A.XIV.4 Year 2010

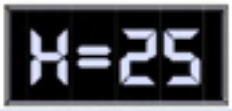
Les 24h de l'innovation

Saison 4 - 2010
22 octobre [14h] - 23 octobre [14h]
ESTIA, Bidart, France

www.24h.estia.fr

Les 24h de l'innovation :
L'Événement, Heure par Heure.

23 Oct 2010 | 15:00:00



14:00 > 15:00

001 -

Projet : Smart Bike

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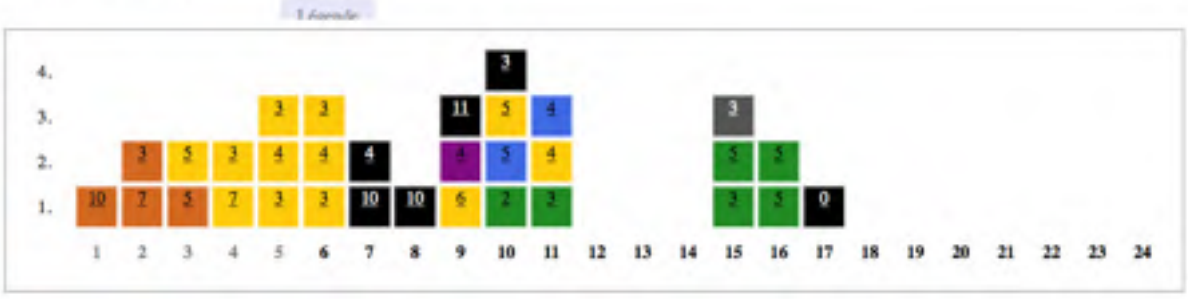
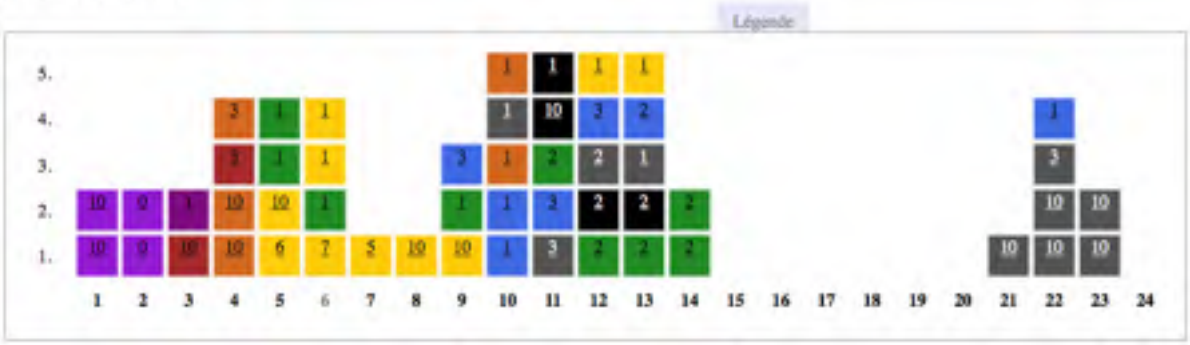
Processus de créativité :



002 -

Projet : Étude de faisabilité et conception d'une débroussailleuse adaptable sur quad

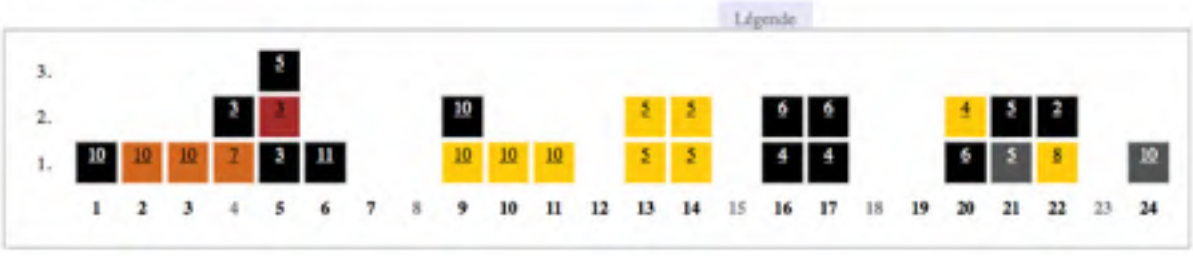
Processus de créativité :



003 -

Projet : WIZBII

Processus de créativité :



004 - SportyJOB

Projet : AG SPORT CONSULTING

- Pablo MURGA *(Mondragón Unibertsitatea)*
- Aitor OTXOA *(Mondragón Unibertsitatea)*

Processus de créativité :

005 -

Projet : Who is my boss, men?

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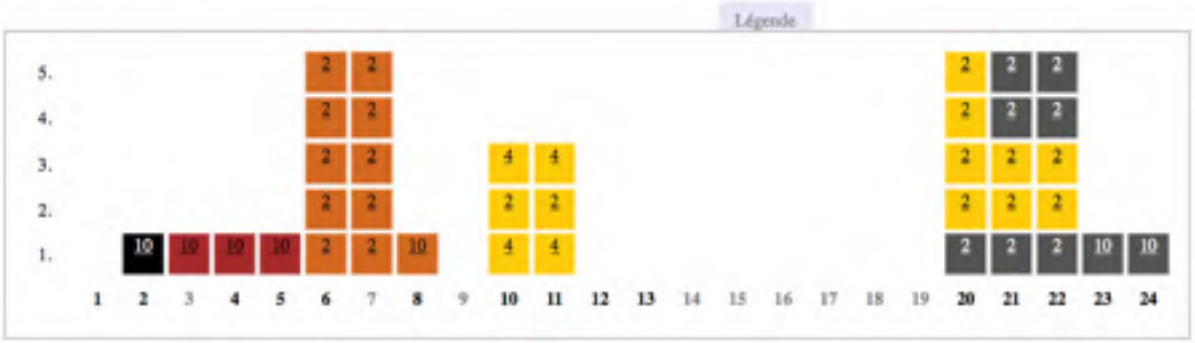
Processus de créativité :



006 -

Projet : Orbea energy harvesting from bicycling

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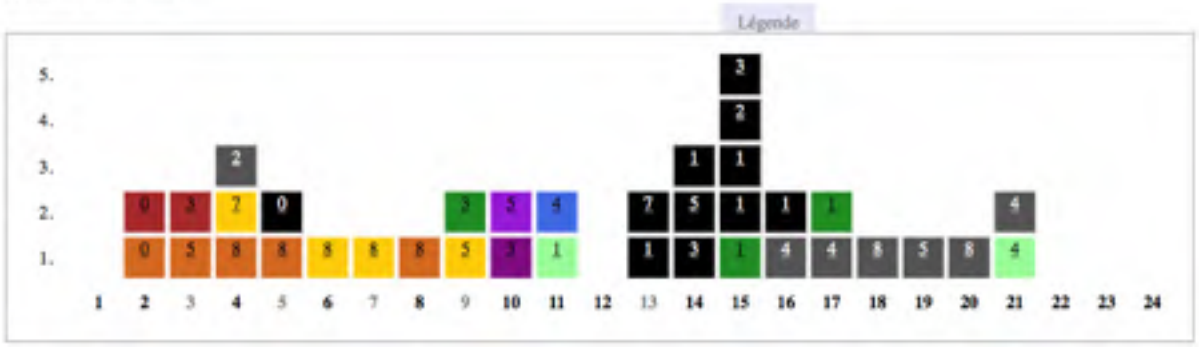
Processus de créativité :



007 -

Projet : Coiffe en bois pour fusée EADS ASTRIUM

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Processus de créativité :

008 -

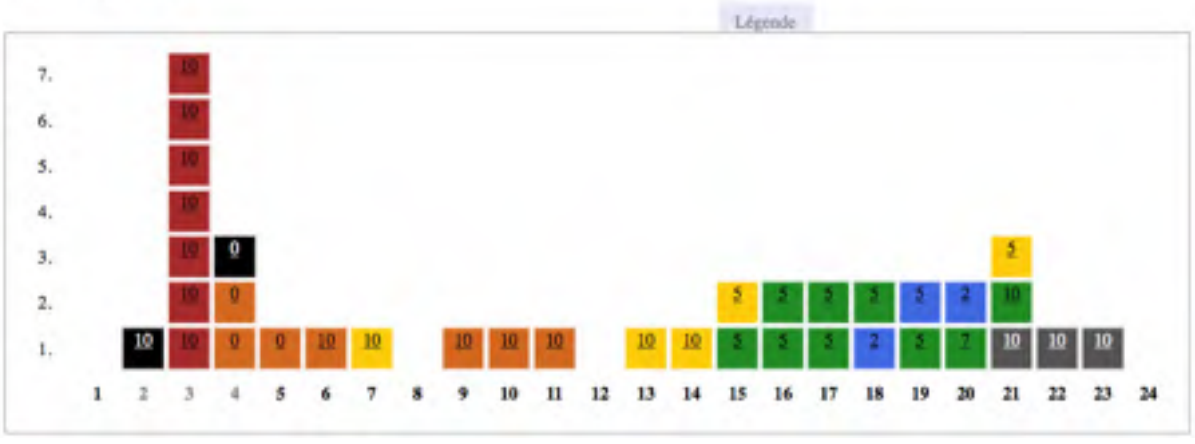
Projet : Vélo en libre service

Processus de créativité :

009 -

Projet : Créer un objet de bureau qui donne le réflexe et l'envie d'être éco-citoyen au quotidien afin d'être fier et exemplaire

Processus de créativité :



010 -

Projet : The Tract'human Nautic

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Processus de créativité :

011 -

Projet : Flying over 2050

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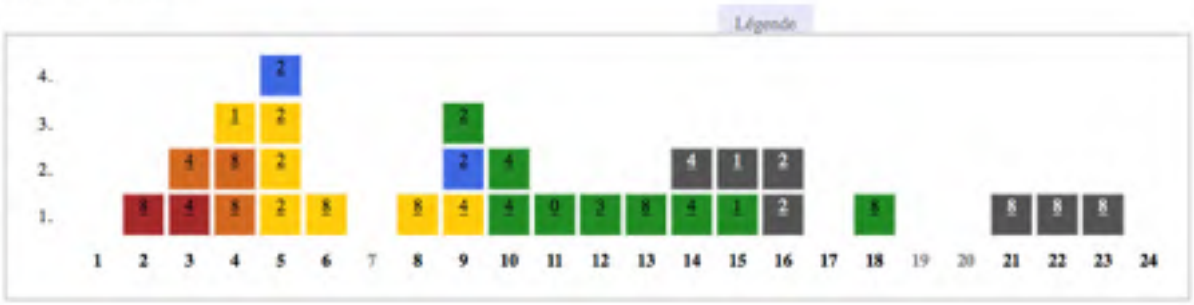
Processus de créativité :

012 -

Projet : Voiture pour professionel

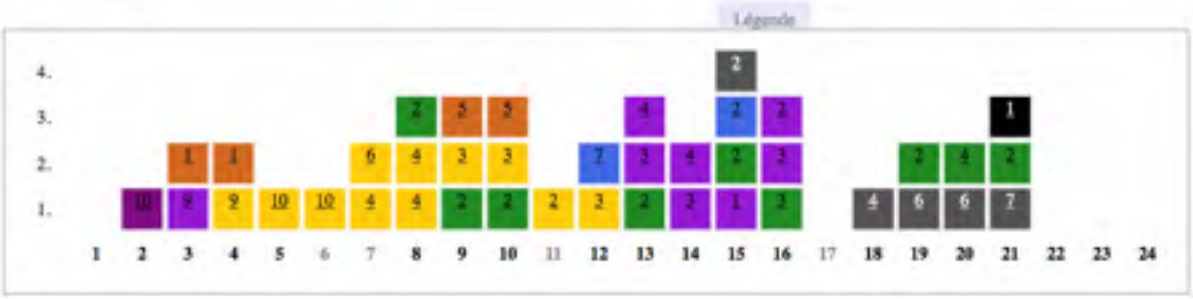
Processus de créativité :



013 -

Projet : Solution innovantes pour le développement de systèmes de mini/micro-drones pour l'aide aux missions operationnelles.

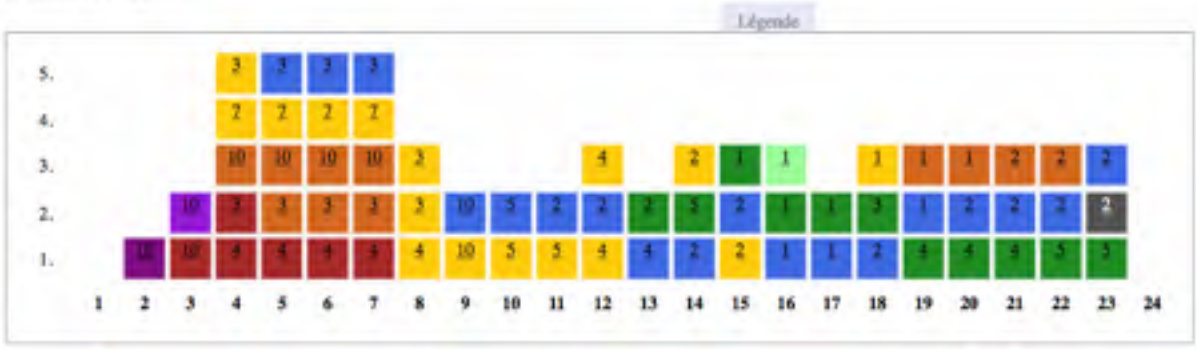
Processus de créativité :



014 -

Projet : Bar modulable

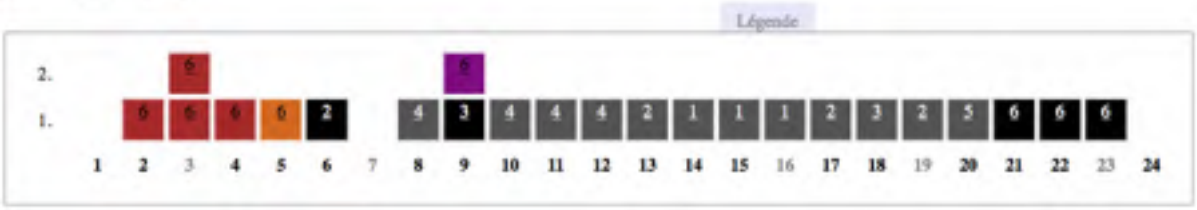
Processus de créativité :



015 -

Projet : Changing energy for better living

Processus de créativité :



016 -

Projet : Le lacet Quiksilver

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Processus de créativité :

017 -

Projet : Plancha du futur

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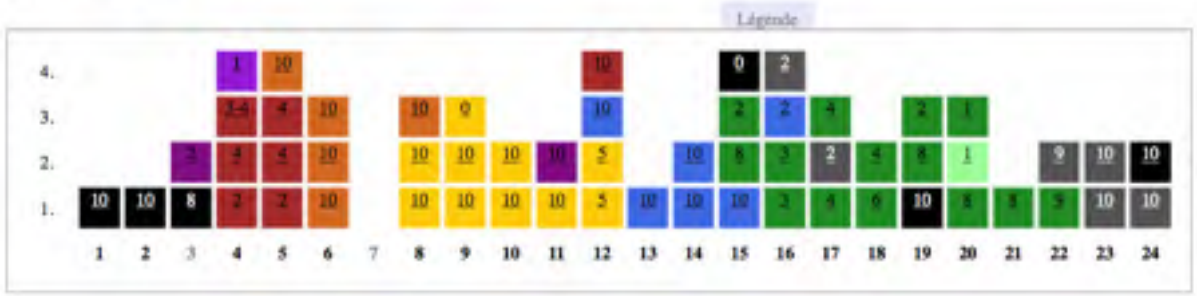
Processus de créativité :



018 -

Projet : Une interface universelle pour la simulation de téléphones portables depuis un ordinateur

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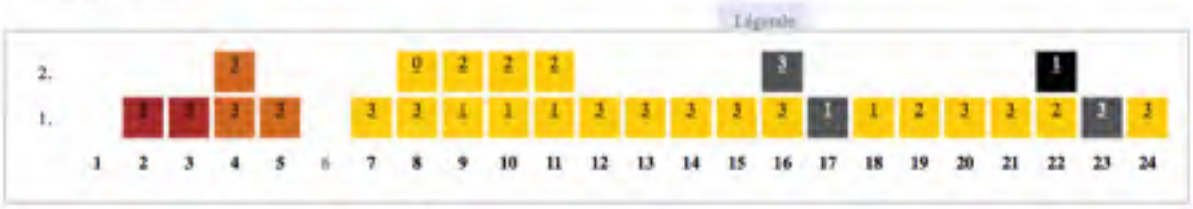
Processus de créativité :



019 -

Projet : Le Bus du Futur

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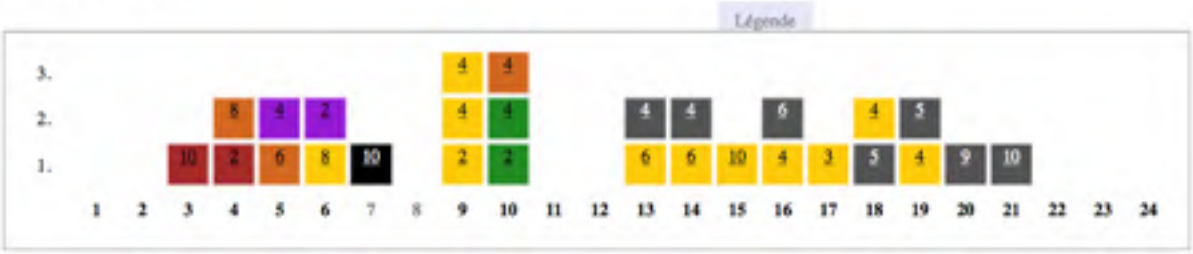
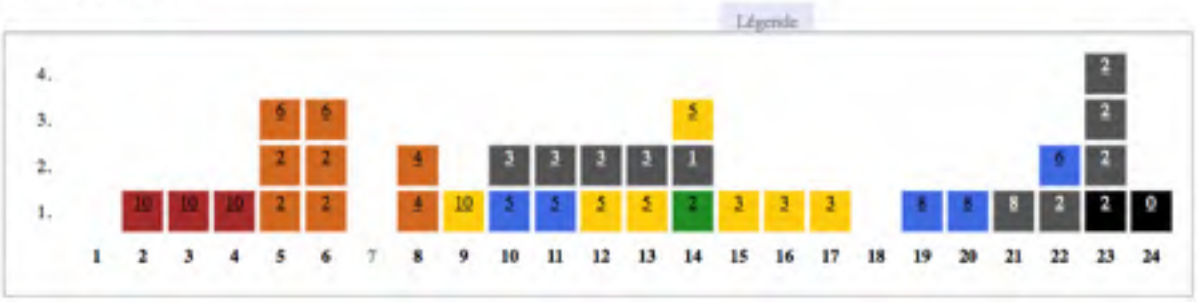
Processus de créativité :



020 -

Projet : Développer un système sûr et étanche pour conserver sa clef sur soi pendant qu'on surfe

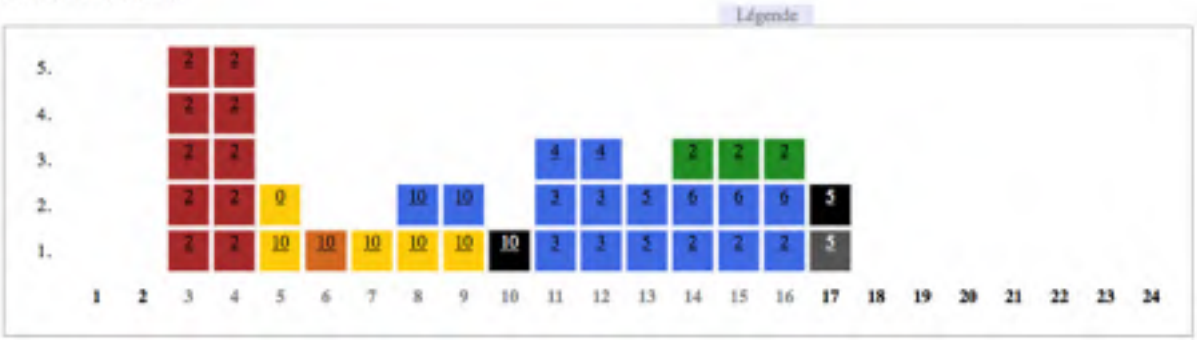
Processus de créativité :



021 -

Projet : Sorky

Processus de créativité :



022 -

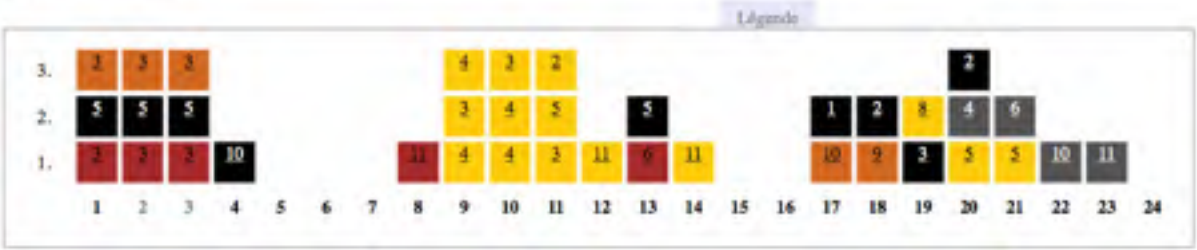
Projet : Cap science: restructurer l'espace

Processus de créativité :

023 -

Projet : Comment limiter l'usage de la voiture et rendre la 2ème voiture inutile, dans un quartier excentré

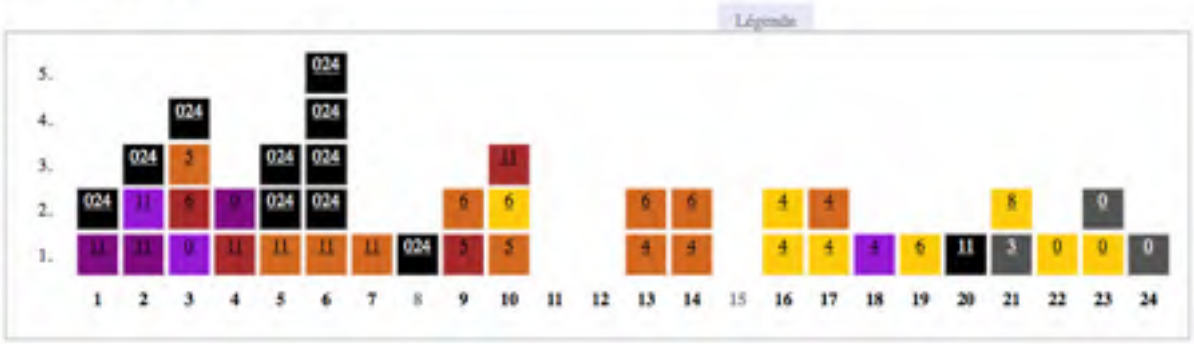
Processus de créativité :



024 -

Projet : Services innovants destinés aux appareils aéronautiques à décollage vertical pour 2050

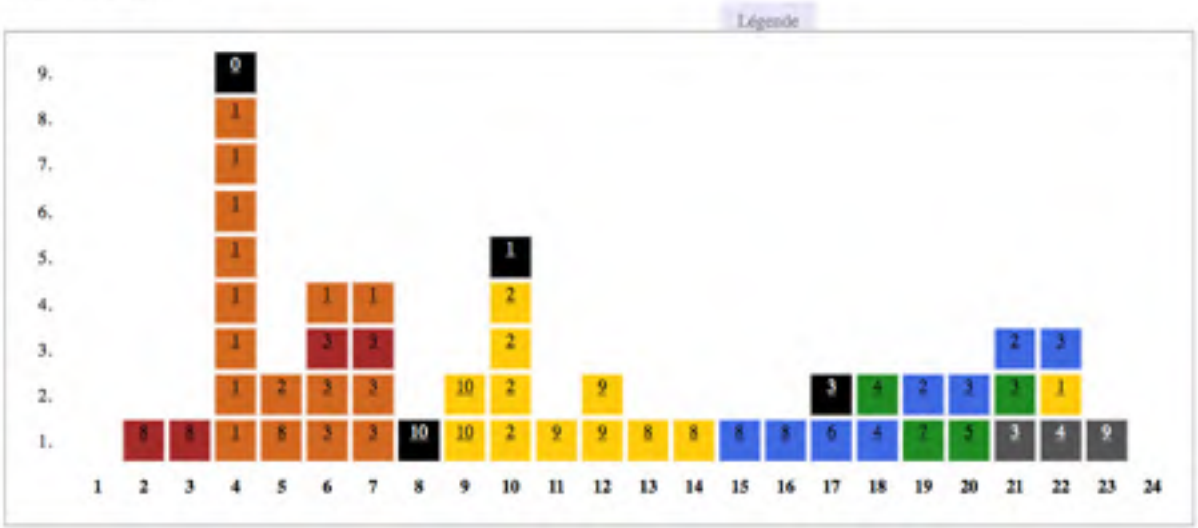
Processus de créativité :



025 -

Projet : CarBevCooler

Processus de créativité :



026 -

Projet : Vie maritime

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Processus de créativité :

APPENDIX XV

Evolution of the creativity guide

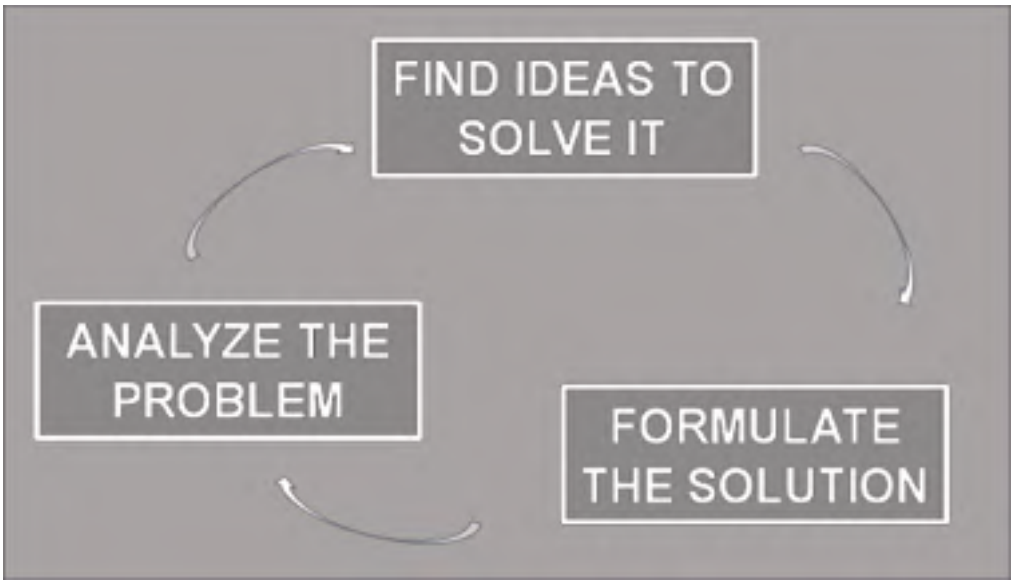
A.XV.1 2012

This digital creativity guide does not exist anymore.

A.XV.2 2013

A.XV.2.1 English version – Creativity Guide 2013

Use an iterative creative process...



Source: Mario Dubois

... till you find THE SOLUTION!!!

OTHER COMPONENTS

THE TEAM

- You must quickly establish the required **LEADERSHIP** style: leadership of one person? share leadership? Talk with the team.
- If team members do **NOT KNOW** each others, do an activity so they get to know

EXPERTISE / SKILLS

- Take time to talk as a group to know **EXPERTISE** of each team member
- **PROMOTE** the experiences of each other
- Make them **PARTICIPATE** and **MOTIVATE** the team members!

Knowledge of the group (even if the group does not have all the knowledge) should allow to have the elements to **SOLVE** the problem or create in the appropriate domain. If the team lacks knowledge, then the expertise could become the **WEAK LINK**...

Lack of expertise?

- Find **NEW** members
- Use the members' knowledge **NETWORK**
- Find **EXPERTS**

CREATIVE APPROACH

- The team must be composed of creative people who accept **DIFFERENCE**, ideas **CONFRONTATION** while **RESPECTING** each others.
- You must have in the team people who can **COMBINE** existing ideas to create.

Team members should be:

- able to get away from status quo (think differently)
- able to take risks (emit crazy **IDEAS** and have a certain naivety)
- able to **TURN** a problem upside down and **COMBINE** knowledge from apparently unrelated areas
- Demonstrate persistence when faced with difficulties

MOTIVATION

- We must inspire the **MOTIVATION** of team members
- People are more **CREATIVE** when motivated by the interest, satisfaction and challenge of the work and the project.

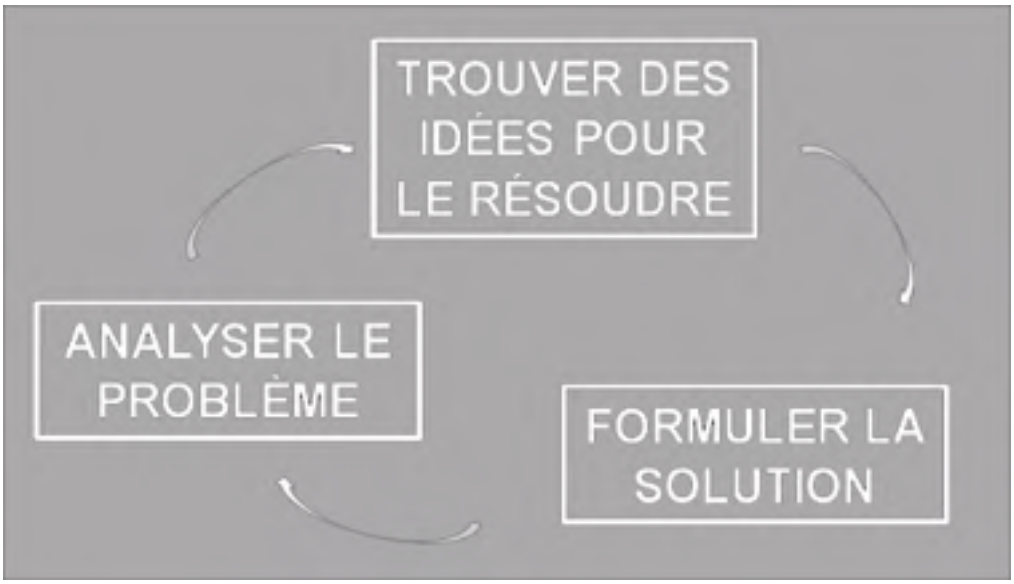
MINI TOOLS OF CREATIVITY

Check the "MINI TOOLS" tab to find **FAST** and **EFFECTIVE** creative tools to use with the creative process proposed.

Mini tools, **USEFUL** when **TIME** is running out ...

A.XV.2.2 French version – Guide de créativité 2013

Utilisez un processus de créativité ITÉRATIF…



Source: Mario Dubois

... jusqu'à ce que la solution soit la MEILLEURE selon vous.

D'AUTRES COMPOSANTES :

L'ÉQUIPE

- Il faut établir rapidement le style de **LEADERSHIP** requis : leadership d'une personne? partagé? En parler avec l'équipe.
- Si les membres de l'équipe ne se **CONNAISSENT PAS**, faites une activité pour qu'ils apprennent à se connaître.

EXPERTISES / CONNAISSANCES

- Prenez le temps d'échanger en groupe pour connaître les **EXPERTISES** de chaque membre de l'équipe
- **VALORISEZ** les expériences des uns et des autres
- Faites **PARTICIPER** et **MOTIVER** les membres de l'équipe!
- Les connaissances du groupe (même si le groupe n'a pas toutes les connaissances) doivent permettre d'avoir les éléments pour **RÉSOUDRE** le problème ou créer dans le domaine voulu. Si le groupe manque de connaissances relatives au défi à relever, l'expertise pourrait devenir le maillon **FAIBLE**…

Manque d'expertise?

- Trouver de **NOUVEAUX** membres
- Utiliser le **RÉSEAU** de connaissances des membres
- Trouver des **EXPERTS**

APPROCHE CRÉATIVE

- L'équipe doit être composée de personnes créatives qui acceptent la **DIFFÉRENCE**, la **CONFRONTATION** des idées tout en se **RESPECTANT**
- Il faut avoir dans l'équipe des gens capables de **COMBINER** des idées existantes pour créer.

Il faut être :

- capable de s'**ÉLOIGNER** du statu quo (penser différemment)
- capable de prendre des risques (émettre des **IDÉES SAUGRENUES** et avoir une certaine **NAÏVETÉ**)
- capable de **VIRER** un problème à l'envers et de **COMBINER** des connaissances de domaines apparemment sans lien entre eux
- Démontrer de la persévérance face aux difficultés

MOTIVATION

- Il faut susciter la **MOTIVATION** des membres de l'équipe
- Les personnes sont + **CRÉATIVES** lorsqu'elles sont motivées par l'intérêt, la satisfaction et le défi que représentent le travail et le projet.

MINI OUTILS DE CRÉATIVITÉ

Consultez l'onglet «**MINI OUTILS**» pour trouver des outils de créativité rapides et efficaces à utiliser avec le processus de créativité proposé.
Des mini outils, très utile quand le **TEMPS** est compté...

A.XV.3 2014 Complete version in French, English and Spanish

A.XV.3.1 Creativity Guide – 2014 – English

You participate in 24 hours of innovation for the first time? You have participated? Want to know what to do to perform well and, who knows, to win this competition?
Here is designed for you, Montreal's **SECRET RECIPES** for this international competition, May 2014 edition!

Taken from epSos.de, CC licence, source

This guide will show you:

- How to be ready for this competition
- What to do to prepare your team **BEFORE** the competition
- What to bring to this competition

You will also find:

- The **CHRONOLOGICAL GUIDE** describing all the steps to do at what time to perform, inspired by the winners of the 24h editions from 2007 till today
- Tools and creative process proposed by our colleagues at HEC-POLY

We will ask you to give us feedback on your approach to help us to constantly improve our strategies and tools made for you.

The book “Creative Confidence” from Tom and David Kelley
Taken from the Google+ of Creative Confidence, source

How to be ready for this competition

- Read articles written on **2011** and **2013** editions of the 24h: it will allow you to initiate yourself to this event

- Read the preface and introduction of the book "Creative confidence" (**PDF**) written by Tom and David Kelley (David is the founder of the firm **Ideo global design agency** and the "**Hasso Plattner Institute of design**" at the University of Stanford)

- Watch this video that explains the basics associated with creative problem solvin

- Invite your friend (s) to join you to attend the 24 competition

- Multidisciplinary team is **VERY CREATIVE**! Try to form a team of people with expertise in different fields (engineering, marketing, business, law, arts, music, etc..). Do not forget that creativity comes from "SHOCK" of ideas! And to create shocks, nothing better than people who have different points of view

Image from the site investintunisia.com, no usage restriction, source

- Many tools are available to help you find **THE BEST** creative solution to the problem your team chooses to solve for this competition. You can learn to use it. **NOW**: you will be well equipped to help your team perform. These tools are:
  - a **creative process** useful to understand the important stages of creativity
  - some **mini creative tools** that are easy to learn and use quickly, associated with the creative process steps
  - a simple **Eco-innovation guide** that allows you to reduce the environmental footprint of your solution approach sought by the jury of this competition

- **easy to fill questionnaires** that allow us to understand how you create, to improve our strategies and tools proposed: **creativity questionnaire**.

What to do to prepare your team BEFORE the competition

The team is an essential part of a creative work that stands out and can make the difference to find **THE RIGHT** solution among the possible solutions. How to prepare a team? According to several specialists consulted, here's what to do:

- The team must be composed of creative people who accept the difference, the confrontation of ideas while **RESPECTING EACH OTHERS!** This is how ideas are sparks!

Image from AZRainman, CC licence, source

- Knowledge of the group (even if the group does not have all the knowledge) must allow the team to solve the problem
- Team members must have and use a large knowledge **NETWORK** (education, experience, contact)
- They must be able to take **RISKS**: issuing crazy ideas and have a certain naivety. Often a crazy idea opens up new avenues leading to very creative solutions

Knowing when to take risk..
from Marco Antonio Torres, CC licence, source

- Beware of leaders who take **ALL THE PLACE!** If this happens, take a break and fix the problem quickly in private
- Make sure that participants work as a team and are all involved. If this is not the case, find a way to involve those who don't participate
- If team members do not know each others, do an activity to help them get to know, to trust and to working together
- The team members need to know the **EXPERTISE** and professional experience of the other members to properly use this expertise

What to bring to this competition
You need:

- **COMFORTABLE** clothes!
- A small inflatable **PILLOW**
- Toothbrush and toothpaste
- Food (evening, night, breakfast...)
- Camera, computer, headphones and a good microphone (for voice recording)
- Music!
- Your **CREATIVITY!**

A.XV.3.2 The chronological guide inspired by the winners of The 24 Hours from 2007 till today

Don't forget : it's a 24 hours challenge including the local jury work for your **2 MINUTES VIDEO**. So, in fact, you have **22 HOURS** to work!

Hours	Steps	Tools / strategies	Recommandations
Before 0	Is your team well prepared?	See above « **WHAT TO DO TO PREPARE YOUR TEAM** »	If not, hurry up: you're late!!
0 to 1	Choose your challenge	Taking in account what you **LIKE**, the **STRENGHTS / EXPERIENCES** of your team	Choose with team members your challenge trying to understand **WHAT IS THE PROBLEM** and **WHAT THE CUSTOMER WANTS**
1 to 3	Define the problem Generate ideas	Use the recommended **CREATIVE PROCESS** and **MINI CREATIVE TOOLS**: • Creative Process • Problem statement • Brainstorm • Brainwriting • SCAMPER • Mindmap	• Minimum **0,5h** to define the problem • If the problem is too big, take just a part of it that you can solve in 24h • **TALK TO THE CLIENTS** or **TAKE INFORMATIONS** • It's an iterative process • Don't **FALL IN LOVE** with your idea!! • **DRAW YOUR IDEAS!** Do rough sketches/ drawings on paper, cardboard, white board

Here is the hyperlinks to get the **CREATIVE PROCESS** and the **MINI CREATIVE TOOLS** recommended.

From Ell Brown, CC licence, source

Hours	Steps	Tools / strategies	Recommandations
3 to 5	**ECOINNOVATE!**	Use Ecoconception tool	You will be **EVALUATE** on this environmental aspect
5 to 7	Find the **SOLUTION**	• **PROBLEM STATEMENT** tool has helped you to define the problem • **SCAMPER** was great to refine your ideas	Does the solution solve in a **CREATIVE WAY** the problem? If not, rethink the problem and/or generate new ideas (it's an iterative process)
7	**YOUR FEEDBACK!!**	• Creative survey • Risk analysis survey!	Quick survey **TO HELP US** to better define your needs!

Here is the hyperlink to the recommended **Ecoconception guide** and the questionnaires: **creativity questionnaire**.

A well deserved break!
From diamond-mind , CC licence, source

Hours	Steps	Tools / strategies	Recommandations
8 to 10	Financial analysis	Is your solution **DOABLE?**	Analyze the costs, feasibility, risks If it is debatable, do better!
10 to 14	Prototypes	Dessin / simulation 2D, 3D Prototype papier, carton que vous allez filmer	You must demonstrate to the jury that this is **THE** solution and it is doable!
12 to 21	Produce the video		• Sound, images, animation • See winning videos of previous years
21	• Upload your video on Youtube • Send the URL		**DON'T FORGET** to put in your video the name of your university, your team name, and the # of your challenge
22 to 24	The local jury will choose the best projets		
24 to 26	The international jury will choose the best projects		

Good luck to all!

Images references

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- [Img7] Image from diamond-mind , CC licence, source.

A.XV.3.3 Creativity guide – 2014 – french

Vous participez aux 24 heures de l'innovation pour la première fois? Vous avez déjà participé? Vous aimeriez savoir quoi faire pour avoir une bonne performance et, qui sait, gagner à cette compétition?

Voici donc, conçues pour vous, **LES RECETTES SECRÈTES** de Montréal pour cette compétition internationale, édition mai 2014!

De epSos.de, licence CC, source

Ce guide vous indiquera :

- Comment faire pour être prêt pour cette compétition
- Quoi faire pour vous préparer en équipe **AVANT** la compétition
- Quoi apporter à cette compétition

Vous y trouverez également :

- Le **GUIDE CHRONOLOGIQUE** des étapes à réaliser, inspiré des équipes gagnantes des éditions 2007 jusqu'à aujourd'hui
- Des outils et processus de créativité proposés par nos collègues de HEC-POLY

Nous allons vous demander de nous donner un feedback de votre démarche à quelques moments pour améliorer constamment nos stratégies et outils.

Le livre « Creative Confidence » des auteurs
Tom et David Kelley
Du site Google+ de Creative Confidence, source

Comment faire pour être prêt pour cette compétition

- Lire les articles écrits sur les éditions précédentes des éditions **2011** et **2013** : ça va permettre de vous initier aux 24h
- Lire la préface et l'intro du livre «Creative confidence» (**PDF**) de Tom et David Kelley (David est le fondateur de la firme de design global **Ideo** et du «**Hasso Plattner Institute of design**» à l'université de Stanford)
- Regarder cette vidéo qui explique les éléments de base associés à la résolution créative de problèmes
- Invitez vos amis(es) à se joindre à vous pour participer aux 24h
- La pluridisciplinarité est **TRÈS CRÉATIVE!** Essayez de vous former une équipe de personnes qui ont des expertises dans des domaines différents (génie, marketing, affaires, droit, arts, musique, etc.). N'oubliez pas que la créativité provient du **CHOC** des idées! Et pour créer des chocs, rien de mieux que des personnes qui ont des points de vue différents.

Du site investintunisia.com, sans restriction d'usage, source

- De nombreux outils sont disponibles pour vous aider à trouver **LA MEILLEURE** solution créative au problème que votre équipe choisira de résoudre pour cette compétition. Vous pouvez apprendre à vous en servir **MAINTENANT** : vous serez bien outillé pour aider votre équipe à performer. Ces outils sont :
    - un **processus de créativité** simple utile pour comprendre les étapes importantes de la créativité
    - quelques **mini-outils de créativité** qui s'apprennent et s'utilisent rapidement et qui sont associés aux étapes du processus de créativité proposé
    - un **guide d'écoconception** qui vous permet de réduire l'empreinte environnemental de votre solution, démarche recherch;é par le jury de cette compétition

- Un **questionnaire facile à remplir** qui nous permet de comprendre comment vous créez, pour améliorer nos stratégies et outils : **CRÉATIVITÉ** et **RISQUES**!

Quoi faire pour vous préparer en équipe AVANT **la compétition**

L'équipe est une composante essentielle d'un travail de créativité qui se démarque et qui peut permettre de trouver LA solution parmi les solutions possibles. Comment vous préparer en équipe? Selon plusieurs spécialistes consultés, voici ce qu'il faut faire :

- L’équipe doit être composée de personnes créatives qui acceptent la différence, la confrontation des idées tout en se **RESPECTANT!** C'est de cette façon que les idées jaillissent!

de AZRainman, licence CC, source

- Les connaissances du groupe (même si le groupe n’a pas toutes les connaissances) doivent permettre d’avoir les éléments pour solutionner le problème;
- Il faut avoir et utiliser le grand **RÉSEAU** de connaissances (éducation, expérience, contact) des personnes de l’équipe;
- Les membres de l'équipe doivent être capable de prendre des **RISQUES** : d'émettre des idées saugrenues et d’avoir une certaine naïveté. Bien souvent, une idée saugrenue ouvre de nouvelles pistes menant à des solutions très créatives.

Il faut savoir prendre des risques...
de Marco Antonio Torres, licence CC, source

- Attention aux leaders qui prennent **TOUTE LA PLACE!** Si cette situation se produit, il faut prendre une pause et régler le problème en privé rapidement
- Il faut s'assurer que les participants travaillent en équipe et participent tous. Si ce n'est pas le cas, trouver une façon d'impliquer ceux qui participent peu
- S'ils ne se connaissent pas, il faut prévoir un temps et une activité pour qu'ils apprennent à se connaître, à se faire confiance, à travailler ensemble
- Les membres de l'équipe doivent connaître l'**EXPERTISE** et l'expérience professionnelle des autres membres pour bien utiliser cette expertise

Quoi apporter à cette compétition

Il vous faut :

- des vêtements **CONFORTABLES**!
- Un petit **OREILLER** gonflable
- Brosse et pâte à dents
- De la nourriture (soirée, nuit, dej...)
- Caméra, ordinateur, écouteurs, un bon micro (pour enregistrer la voix)
- De la musique!
- Votre **CRÉATIVITÉ!!**

Le guide chronologique des étapes à réaliser, inspiré des équipes gagnantes des éditions 2007 jusqu'à aujourd'hui

N'oubliez pas : les 24 Heures de l'innovation incluent l'appréciation de votre vidéo d'une durée de **2 MINUTES** par les juges locaux. Vous n'avez que **22 HEURES** pour cette compétition!

Heure	Étapes	Outils / stratégies	Recommandations
Avant 0	Votre équipe est-elle préparée?	Voir ci-dessus «**COMMENT PRÉPARER VOTRE ÉQUIPE**»	Si non, faites-vite : vous êtes en retard!!
0 à 1	Choisissez votre défi	En fonction de vos **GOÛTS** et des **FORCES / EXPÉRIENCES** des membres de l'équipe	Choisissez en équipe votre projet en cherchant à bien **COMPRENDRE** le problème et ce que désire le client
1 à 3	Définir le problème Générer des idées	Utiliser le **PROCESSUS** et les **MINI OUTILS DE CRÉATIVITÉ** recommandés : • Processus créatif • Problem statement • Brainstorm • Brainwriting • SCAMPER • Mindmap	• Minimum **0,5h** à définir le problème • **PARLEZ AU CLIENT** ou **PRENEZ DES INFORMATIONS** • Le problème est trop gros? Prenez seulement une partie que vous pouvez résoudre en 24h! • C'est un processus itératif • Ne tombez pas **EN AMOUR** avec vos idées!! • **ILLUSTRER!!** : des esquisses, dessins sur papier, carton, tableau

Voici les hyperliens pour trouver LE PROCESSUS DE CRÉATIVITÉ et LES MINI OUTILS DE CRÉATIVITÉ recommandés!

Le moment d'une pause pour recharger les batteries?
De artemtation, domaine public, source

Heure	Étapes	Outils / stratégies	Recommandations
3 à 5	**ÉCOINNOVER!**	Utiliser les outils d'écoconception	Vous serez **ÉVALUÉ** sur cet aspect environnemental
5 à 7	Trouver la **SOLUTION**	• Problem statement vous a aidé à définir le problème • SCAMPER vous a aidé à raffiner vos idées générées	Est-ce que la solution résout de **FAÇON CRÉATIVE** le problème? Si non, repensez le problème et/ou générer de nouvelles idées (processus itératif)
7	**VOTRE FEEDBACK!!**	• Questionnaire créatif • Questionnaire risqué	Quelques questionnaires **RAPIDES À REMPLIR** pour nous aider à mieux vous aider!

Voici l'hyperlien pour les OUTILS D'ÉCOCONCEPTION et les **QUESTIONNAIRES** recommandés relatifs à la CRÉATIVITÉ et aux RISQUES!

Une pause bien méritée!
De diamond-mind , licence CC, source

Heure	Étapes	Outils / stratégies	Recommandations
8 à 10	Analyse financière	Est-ce que votre solution est **RÉALISABLE?**	Analyser les coûts, la faisabilité, les risques Si c'est discutable, améliorez!
10 à 14	Prototypes	Dessin / simulation 2D, 3D Prototype papier, carton que vous allez filmer	Il faut démontrer au jury que c'est **LA** solution **WOW** et qu'elle est faisable!
12 à 21	Scénariser et réaliser la vidéo		• Son, images, animation • Des exemples de projets gagnants
21 à 22	• Téléchargez votre vidéo sur Youtube • Envoyer le lien URL		**NE PAS OUBLIER** d'indiquer dans le titre de votre vidéo votre université, le nom de votre équipe et le numéro du défi choisi.
22 à 24	Le jury local évalue les meilleurs projets		
24 à 26	Le jury international évalue les meilleurs projets		

Allez, bonne chance à tous!!
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A.XV.3.4 Creativity Guide – 2014 – Spanish

Digital version does not exist anymore.

A.XV.4 2015 Iteration of the creativity guide

A Creativity Guide for Short Ideation Sessions

Editor's Note

We have put together a Creativity Guide for short ideation sessions. It can be tailored to the amount of time you have available (between 5 minutes to 48 hours). What's the purpose of this guide? Our research has shown that, to our knowledge, there is no other creative process

designed for short ideation sessions. This Creativity Guide fills this void and is one component of a three-part creative process.

Why have a Creativity Guide?

This Creativity Guide was designed to help businesses, professionals, professors, students or essentially anyone with short ideation sessions lasting 5 minutes to 48 hours. It can help you make the most of ideation sessions and enable you to come up with great ideas potentially leading to an innovative solution (a marketable product or service). Or it might just help you create in emergencies, improvisation or during short of planned ideation sessions.

The ideas presented during these sessions are useful for resolving problems, developing products and services, or creating just for fun. They can be applied in various fields (technology, arts and culture, medical, legal, financial, business, etc.). The easy-to-use guide was designed for teamwork, but it can also be useful for individuals working on their own. It is also designed for co-creation and co-design sessions with or without a facilitator.

Part 1: The Creativity Guide

This guide is one component of a three-part creative process for short ideation sessions. The three parts are:

1. Creativity Guide: Designed as an introduction to the other components of the creative process;
2. Team Preparation: Describes how to prepare yourself or your group prior to holding a short ideation session;
3. A Step-by-Step Guide: Includes all the chronological steps you must go through, including how to do them, hour by hour. It gives you access to a creative toolbox to take you through the steps of the step-by-step guide.

This three-part creative process for short ideation sessions was tested and developed following thirteen 24-hour ideation sessions that took place during the 24 Hours of Innovation competition held at ÉTS in Montreal (2010 to 2014) and at ESTIA in France (2007 to 2014).
https://www.youtube.com/watch?v=8eFtkZTY0TU

Part 2: Team Preparation

The value of bringing together the right people for your team and adequately preparing them becomes evident during short ideation sessions. For instance, if you conduct an eight-hour ideation session alone, you will be able to complete eight hours of ideation. However, if a team of eight conducts and eight-hour ideation session, you will be able to complete 8 x 8 hours = 64 hours of ideation. If the team is efficient and coordinated, its creative time will be multiplied by eight.

A study was carried out on the ideation work conducted by the winning teams of the 24 Hours of Innovation competitions from 2007 to 2010. It found that the winning teams had an average of eight participants. People have the option of working alone, but doing so makes it much harder to come up with a result comparable to that of a team of eight during short ideation sessions.

Another important aspect of teamwork: Ideas (including the best ones) are born from a **clash of ideas.** You have to be able to compare your ideas with the sometimes disconcerting ideas of your peers, while maintaining mutual respect and accepting that your ideas may not be in line with one another.

In order for a team with several participants to be effective, coordinated and respectful of others who think differently, you have to prepare **BEFORE** the ideation session. Jumping into an ideation session unprepared is a little like entering a car race without knowing if your driver is the best in the group with an unprepared racecar—particularly if you're in a competition, such as the 24 Hours of Innovation. You can still compete, but it will be unnecessarily stressful and your chances of winning are not very good!
[youtube width="560" height="315" video_id="8eFtkZTY0TU"]

Team preparation essentials:

1. Allow team members to get to know each other
2. Ensure they understand the importance of mutual respect
3. Create a diverse team with participants from different fields
4. Make sure the team works as a team
5. Ensure that the chosen leader and their leadership style are accepted by the team
6. Enable participants to become familiar with each other's areas of expertise
7. Discuss the creative styles of each participant
8. Take risks as a team
9. Ensure that participants feel motivated
10. Prepare the work environment

Why have a Step-by-Step Guide?

The Step-by-Step Guide is designed to help you plan your work as an individual or as a team. It indicates the approximate amount of time that should be allotted for the different steps in the process. We have developed step-by-step guides for ideation sessions totalling 5 minutes, 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 8 hours, 16 hours, 24 hours and 48 hours. They should help you make the most of the time you have available. The steps and the allotted time for each step are adjusted based on the total length of the ideation session.

The Step-by-Step Guide below is tailored to a 24-hour ideation session. As such, it is applicable specifically to the 24 Hours of Innovation competition.

From Justin14, licence CC, source

Creative Toolbox

Bought from Istock: Copyrights

The Step-by-Step Guide also contains a Creative Toolbox with:

- Quick creativity jump-starters that require less than 5 minutes of learning each;
- A green innovation approach allowing you to create in an environmentally responsible manner;
- A guide for using Big Data during the ideation process;
- An approach for managing the risks presented by your ideas;
- A simple feasibility analysis method;
- A method of creating a basic business plan;

- Tools for making 2D and 3D prototypes;
- A method for visualizing your ideas so that you can understand them better and share them;
- Tools for presenting your final idea in a presentation or video.

The items in the Creative Toolbox are recommended at various points in the Step-by-Step Guide. For more detailed explanations on the steps and the toolbox, please refer to the following documents: STEPS, TOOLBOX.

Part 3: The Step-by-Step Guide

The chronological guide consists of ten steps. We recommend that you perform the first three linearly (one after the other, either to prepare your team before the ideation session, choose the challenge and define the problem). Thereafter, you are free to perform the steps in this guide linearly or not. Remember, the creative process is iterative!

HOUR	STEP	TOOLBOX
Prior to starting	Prepare the team	See above:"Team Preparation"
0 to 1	Select a challenge	Base you choice on: • Team member expertise • Team diversity • Team interest
1 to 3	Define the problem	• Short statement • Short "Is / Is not" • Short 5W and H • Big Data • Visualization
3 to 6	Generate ideas	• Mini *Brainstorm* • Mini *Brainwriting* • Mini *Mind Map* • *Big Data* • Visualisation
6 to 8	Green Innovation	Green innovation method
8 to 12	Find a solution	• Quick scamper • Quick praise • Big Data • Visualization

WE	RECOMMEND	THAT YOU DO THE FOLLOWING ACTIVITIES IN SMALL GROUPS
12 to 14	Assess feasibility	• Feasibility analysis tools • Basic business plan
12 to 17	Prototyping	• Simple tools • 2D tools • 3D tools • 3D printing
12 to 18	Prepare your presentation	• Presentation tools • Video editing tools • Audio management tools • Other tools
18 to 22	Submit your presentation	• List of things **TO REMEMBER** when submitting your presentation • Procedure for uploading videos onto YouTube
22 to 24		Evaluation and presentation of local prizes
24 to 28		Evaluation and presentation of international prizes

Please note that the items in the toolbox will become clickable (links will be added) as articles are published on the various topics. For more on this, we encourage you to read the following article:

How to enhance team creativity for the 24 hours of innovation challenge!
At the end of this event, we will post a report on the 24 Hours of Innovation, 2015 edition.

Reference - Images

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APPENDIX XVI

Existing creativity guides

#	Title	Authors, date	Summary
1	A 12-Step Guide to Fostering Your Creativity	Kelli Shaver, April 12, 2011	Web article, 12 creativity tips
2	The Little But Really Useful Guide to Creativity	*Leo Babauta, August 5, 2009*	Web article, creativity tips
3	The guide to creativity	Josh Linkner, February 16, 2011	Five steps process, few creativity tools, 18 pages.
4	Sparking creativity in teams: An executive's guide	Marla M. Capozzi, Renée Dye, and Amy Howe, April 2011	Web article, creativity tips
5	The Minimalist Guide to Creativity	Kevin Wood	Web article, creativity tips
6	Innovation & Creativity Toolkit	Andy Green	Four PDF : 1 Fundamentals, 2. Creativity tools, 3. Creative writing and 4, People managing
7	How to Become a Creative Badass - A 9 Step Guide to Mastering the Creative Process	Jeff Fajans, October 6, 2014	Creative advice and creative process (PDF)
8	Design thinking for educators, version 2	Ideo, 2015	80 pages toolkit (PDF)
9	Stanford D School: Use our methods	Stanford University, 2015	Design Thinking approach

Web links for these creativity guides

1. http://mashable.com/2011/04/12/creativity-guide/
2. http://zenhabits.net/the-little-but-really-useful-guide-to-creativity/
3. http://joshlinkner.com/images/2012/02/Disciplined-Dreaming-Menefesto.pdf
4. http://www.mckinsey.com/insights/strategy/sparking_creativity_in_teams_an_executives_guide
5. http://www.lifehack.org/articles/productivity/the-minimalist-guide-creativity.html
6. http://www.cipr.co.uk/content/policy-resources/policy/best-practice-guides/innovation-creativity-toolkit

7. http://www.createlearnlive.com/blog/2014/10/6/how-to-become-a-creative-badass
8. http://www.designthinkingforeducators.com/
9. http://dschool.stanford.edu/use-our-methods/

APPENDIX XVII

Some non-creative processes

A.XVII.1 Chronological order

1945	How to solve it. George Pólya.
1949	FMEA (Failure mode and effects analysis). U.S. Department of Defense.
1949	FMECA (Failure mode, effects, and criticality analysis). U.S. Department of Defense.
1950	PDCA (Plan-do-check-act). W. Edwards Deming.
1960	OODA (Observe, Orient, Decide, Act). John Boyd.
1965	Problem Solving and Decision Making. Kepner-Tregoe.
1966	QFD (Quality Function Deployment). Yoji Akao.
1966	SSM (Soft Systems Methodology). Gwilym Jenkins.
1980	CBR (Case-Based Reasonning). Roger Schank.
1980-1990	GROW Process. Graham Alexander *et al*.
1980-1990	Appreciative Inquiry. David Cooperrider.
1985	8D (Eight Disciplines Problem Solving). Ford Motor Company.
1986	DMAIC (Define, Measure, Analyze, Improve, Control). Motorola.
1987	Solutions, a guide to problem solving. Phillips and Bergquist.
1990	RPR (Rapid Problem Resolution) problem diagnosis. Advance7.
1997	Incident and Problem Investigation. Charles H. Kepner and Matthys J. Fourie.
1998	SIMILAR Process. A. Terry Bahill and Bruce Gissing.
2012	The problem definition process. Dwayne Spradlin.

A.XVII.2 Undated

DMAIIC	(Define, Measure, Analyze, Improve, Innovate and Control). Motorola.
DFSS	(Design for Six Sigma). Motorola.
IDOV	(Identify, Design, Optimize, Verify). Motorola.
DDICA	(Design, Develop, Initialize, Control and Allocate). Motorola.
DMADV	(Design, Measure, Analyzed, Design Improve Alternative and Verify Design). Motorola.
OPDCA	(Observe-Plan–do–check–act). W. Edwards Deming.

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Dubois, Mario, Ahmed Cherifi, Samuel Rispal and Mickaël Gardoni. 2015. "Classification and Selection Methods Proposed for Creative Processes". In *Creativity Research Journal*. Submittted May 2015.

Cherifi, Ahmed, Mario Dubois, Mickaël Gardoni and Abdelaziz Tairi. 2015a. "Methodology for Innovative Ecodesign Based on TRIZ". In *International Journal of Interactive Design and Manufacturing*. [PDF]. Online. < http://link.springer.com/article/10.1007%2Fs12008-014-0255-y#page-1 >.

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