An example of hybridization between the "discovering matrix" and the "9 windows" tools during ideation phases of interclustering projects

Julien Ambrosino, Jérémy Legardeur

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AN EXAMPLE OF HYBRIDIZATION BETWEEN THE "DISCOVERING MATRIX" AND THE "9 WINDOWS" TOOLS DURING IDEATION PHASES OF INTERCLUSTERING PROJECTS

J. Ambrosino and J. Legardeur

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1. Context of the competitiveness clusters

In France, following national strategic report [Blanc 2004], the "competitiveness clusters" policy started in 2005 to foster collaborative innovation projects that require numerous actors including especially industrials, local authorities and academics stakeholders. According to Porter, clusters are geographic concentration of businesses and institutional actors belonging to similar industries, linked to each other by cooperation and competition relations, called as well coopetition [Porter 1998]. The competitiveness clusters (or in french "Pôle de compétitivité") contribute to support ecosystems towards collaborative innovation projects that aim at bringing new knowledge, products or services… Their composition relies on three main pillars constituted of companies, research organisations and local authorities to foster innovations from national scale to European scale. One of their main actions is to bring a technical and financial expertise on project success capacity. Thus, the French government officially recognises that competitiveness clusters can label collaborative projects proposed by companies.

1.1 An emerging dimension: The interclustering

Collaborative projects between members of different clusters take an increasing part of the clusters strategies. Following the clusters typology developed by Cusin and Loubaresse [2015], clusters looking for the implementation of collaborative projects between clusters are in the expansion phase of their activities.

The competitiveness clusters policy was updated several times in order to adapt to the evolution of ecosystems. Recently, with the implementation of National Pact for Growth, Competitiveness and Employment [Ayrault 2012], some of the mature competitiveness clusters chose to diversify their activity to increase their ecosystem wealth. Among the current collaborative innovation projects, a specific trend called "interclustering" is distinguished and can be characterised according to different levels. For example, interclustering can be based on collaborative projects between clusters or between members of differents clusters.

Operationally, the first case involves clusters facilitators working together to promote a specific network or achieve actions dedicated to technology transfer for instance. The second case deals with cross-fertilisation oriented members of the clusters' projects in which actors from different clusters team up to lead an innovation project.

Since several years, the Aquitaine region in France has developed an integrated vision of the different clusters present on its territory [Cusin and Loubaresse 2015]. More globally at the national scale,

numerous collaborative innovation projects studied and proposed are at the frontier between two sectors of activities [Amisse et al. 2011].

This diversification oriented interclustering relations can lead to innovative projects: they can bring for example new technologies through markets or identify new usages ignored by technology providers. The AGRIPIR project [Mandaluniz et al. 2015] which aimed at the emergence of new interclustering projects thanks to the transfer of space technologies to mountain farming is a perfect example.

1.2 Possible solutions to foster emergence of interclustering projects

Without any special constraint or stimuli, it seems that meetings between group of people tend to be non-creative [Clark 1962]. In the highly dynamic environment of clusters, we have already promoted networkingthrough the animation of working groups with notably the World Café [Brown and Isaacs 2005] or Open Space methods [Owen 2008], both corresponding to a creeativity session animation during the development phase of the interclustering [Cusin and Loubaresse 2015]. Regarding the animation of clusters in the expansion phase, we have no knowledge of specific creativity techniques and tools to bring out collaborative innovation project ideas. Therefore, in order to stimulate new projects between the members of different clusters networks, the animation of creative meetings by hybridization of creativity methods and tools [Legardeur 2009] can be useful [Pialot 2009], [Tyl 2011], [Arnoux 2013], [Real 2015]. These creative workshops can lead to networking between participants and promote new projects' emergence. Participating actors are identified and invited prior the meeting based on the expertise and the knowledge of the clusters facilitators, aware of leading actors concerning the last technology and market trends.

In this article, we will focus on the animation of these interclustering creative workshops. We propose to illustrate how the hybridization based on the use of the 9 windows tool facilitates the design of the discovery matrix tool in order to foster the emergence of interclustering projects ideas.

2. Interclustering: A specific case of application to facilitate the emergence of projects ideas

With the aim of catalyzing the emergence of projects ideas in interclustering, our research works require the use of creativity tools facilitating collaboration between heterogeneous organisations with mutli-thematic expertise. Among the hundreds of existing creativity methods, 172 have been identified [Ngassa et al. 2003] and classified according to two categories [Shah et al. 2003]:

- The intuitive methods - which can be described as animation methods, which result depends on the involvement of the participants and their understanding of the problems proposed. The intervention of the facilitator with the participants allows to refocus thinking, explain the objectives of the method used and how it works. Six Thinking Hats and lateral thinking technics [De Bono 1970] can be cited as well as Brainstorming [Osborn 1953], 9 windows [Altshuller 1984], Design thinking [Faste et al. 1993], ...
- The more systematic methods - which can be designated as structuring methods, which result relies on the facilitator. The difficulty is for him to adapt to participants during the session. For instance, one can mention the following methods: Discovering matrix [Moles 1954], TRIZ [Altshuller 1984], ASIT [Horowitz 1999], C-K Theory [Hatchuel and Weil 2002]…

We think that the combination between tools of these two categories can help the clusters facilitators to elicit possible synergies and stimulate emergence of new projects. In particular, we selected the 9 windows (or 9 screens) tool proposed in TRIZ by Altshuller [1984] and the discovery matrix described by Moles [1954]. Those two tools were not initially designed to be used together but previous works on hybridization [Legardeur 2009] highlighted that the use of combination of several methods, tools and techniques is a more flexible and agile approach to support complex creativity and innovation processes. The emergence process is described in the following figure.
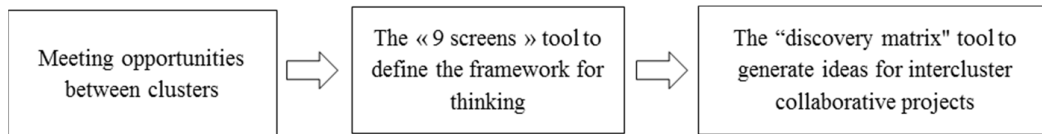
Figure 1. One part of the emergence process during interclustering meetings

2.1 The 9 screens tool (or 9 windows)

2.1.1 General introduction

The 9 screens psychological resolution tool situates the considered artefact in the entire temporal and systematic ecosystem by analysing its evolution [Altshuller 1984]. The 9 screens tool is usually represented by rectangles composed of 3 columns and 3 lines, each screen describing a system state.
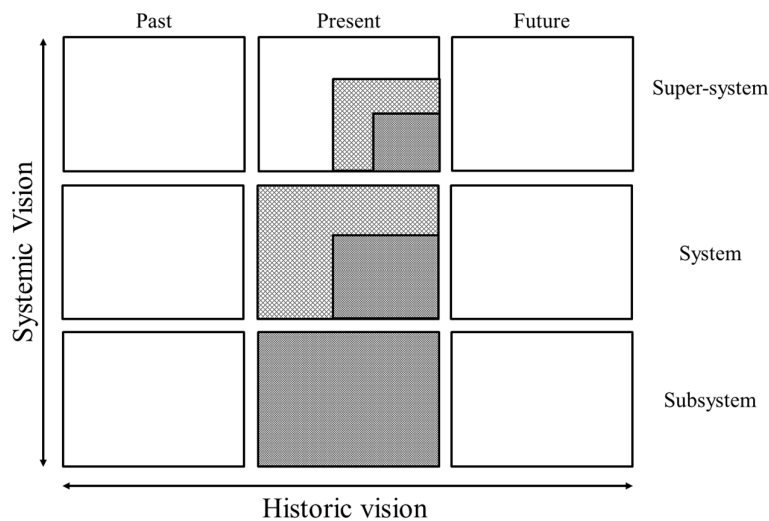

Figure 2. Representation of the 9 screens tool (or 9 windows) proposed in TRIZ

Thus, participants share their vision on the considered object or system while expanding it with new contributions. Chambon et al. [2011] highlight the benefits of the Altshuller's method:

- Practical and simplified frame to put the artefact back into context in the working group,
- Foster the emergence of evolution trends (by comparison past/present) that enables to plan essential characteristics of future systems by extrapolation,
- It is a means to detect problems (contradictions) by confronting the probable evolutions of super and subsystems.

2.1.2 Sequence for using the tool

This tool, depending mainly on the quality of the session animation, has its sequence of uses. It is performed in a dynamic way starting from the actual central system, then by describing the subsystems and finally the super-systems by orientating the questions to ask.

One of the solutions consists in describing the central column, then the one of the past (on the left side) before filling in the one of the future systems (on the right side). As underlined by Chambon et al. [2011], in spite of a lack of literature regarding the tool to complete the 9 screens tool, his work on formalisation of a micro-tool provides support to the facilitator and the working group when establishing 9 screens. Furthermore, he demonstrated that the representation of a tool can be achieved through questionnaires that lead to heterogeneous answers as well as functional, performance or even structural characteristics. Thus, even if the completion of the windows can be variously precise, they appear sufficient to define the frame of study.

The 9 screens tool by TRIZ is also one of the few creativity tools that results in defining in one step the temporal horizon in which the group must take place to start ideation. That is why its use at the beginning of the session enables to temporarily frame the group in its projection towards future.

2.2 The discovering matrix tool (or heuristic matrix)

2.2.1 General introduction

The discovering matrix tool proposed by A. Moles consists in seeking for interactions between the two lists compared to each other and then analysing the generated ideas [Moles and Caude 1970]. They are generated by an associative approach described by Jaoui [1994] based on the hypothesis that no association of ideas is left to chance and that associative chains have a certain logic.

This way of constraining thinking gives results during sessions when the crossing of lists acts as a constraint and progressively limits the area of research [Bonnardel 2009].

It is described by A. Moles as an "exploration of the range of possibilities in a methodological space in two dimensions", or as "a reflection grid constituting a very general method". It is generally represented by a double entry table, as shown in Table 1.

Table 1. Representation of the discovering matrix tool

List 1 / List 2	Item 1 *(list 1)*	Item 2 *(list 1)*	Item … *(list 1)*	Item n *(list 1)*
Item 1 *(list 2)*				
Item 2 *(list 2)*				
Item … *(list 2)*				
Item m *(list 2)*				

As regard to the sequence of uses of the discovering matrix tool, it requires to define in a first step the two lists and in a second step to choose the different items for each column and line. Then, the group is challenged about the possibilities of new ideas stimulated by the crossing of lines and columns.

As an example, does the crossing of item 1 from list 1 with item 1 from list 2 suggests a good idea? Those associative crossings structured by A. Moles have their roots in the association of ideas defined by A. Osborn, which is in other words the essential faculty in every process of production of ideas [Osborn 1959].

2.2.2 The design of the matrix to make interclustering collaborative projects emerge

Our previous research work and operational actions led us to simultaneously use those the 9 screens tool and the discovering matrix tool. These proposed links that can be established when building the matrix from the 9 screens tool has its theoretical genesis in O. Pialot's work. In the design process, the works related to the PST (Potential-System-Technology) approach developed by Pialot [2009] highlight the three central dimensions in the innovation process: Potential of new valuable proposition, Systems and Technology.

In addition, the French association of clusters France Clusters [Morsch et al. 2014] identifies 4 types of clusters: Markets, Technological, Sectorial and Business. Considering that the definition of those categories includes the same elements than those identified by O. Pialot, the use of those categories to make ideas emerge through the matrix appears relevant.

Thus, the dimensions identified for the design by O. Pialot are used for the emergence of more generic project ideas thanks to the construction of the discovering matrix tools. The first step of construction being the formalisation of lists, the PST approach suggests the establishment of lists according to the three following axis:

- Market, need, identified user vision (notion indexed by the Potential of new valuable proposition dimension),
- Function, concept, use (notion indexed by the System dimension),
- Technologies, means, processes used (notion indexed by the Technology dimension).

Then, we need to select two of the three lists to be associated. The fact of not selecting one of the lists does not mean that the items are excluded but rather that they are segmented to eventually be added to the items of the other selected lists.

In the context of collaborative work between clusters, which is the frame of the PhD thesis performed by one of the author since 2014, we have experimented several times the articulation of those two tools. We can mention in particular one meeting between actors of Aerospace Valley – competitiveness cluster in Aeronautics, Space and Embedded Systems – and the members of TIC Santé cluster – specialised in connected health. In this case, a list of Needs and a list of Technologies, potentially interesting for innovative applications, have been selected to provide the discovering matrix tool.

Table 2. Standard discovering matrix experimented to foster emergence of interclustering projects

Technologies / Needs		Already used in the relevant sector			Used in other sectors			
		n°1	n°2	n°3	n°1	n°2	n°3	n°4
Current	n°1		Idea 12					
	n°2							
	n°3							
Latent	n°1							
	n°2							

The matrix is used to collect needs from one of the clusters and compare them to technologies already used by the same cluster and technologies with high innovation potential coming from the other cluster. The notion of need is taken in a broad sense as current needs and future needs which horizon is defined by the the 9 screens tool, as shown in Table 2. At the crossing of the second technology and the first need selected, as illustrated with idea 12 designation, emerge an idea of concept which involves the second technology to respond to the first need.

2.3 Genesis of linkages between tools

The use of those two tools has been inspired by A. Moles's observations [Moles and Caude 1970] which identified for the same problem three resolution methods listed in the Table 3. Each of those identified methods corresponds to the shift from one box to another in the 9 screens tool to move from the present system to the future one.

Table 3. Methods described by A. Moles and the corresponding interpretation into the 9 screens tool

Methods	Refurbishment method	Translation method	Method to apply a theory
Characteristics described by A. Moles	The problem is not reformulated Partial revisions are identified Improvements are synthesised and integrated	Problem(s) are reformulated Exchange at different functional, hierarchical and cultural levels	The problem is formulated as a wholeness Zooming out from the problem, it fosters a more theoretical approach
Representation of the corresponding interpretation of the method in the 9 screens tool (G. Altshuller)			

Problem resolution methods described by A. Moles and their interpretation through the 9 screens tool show causal links between A. Moles and A. Osborn. Thereby, links between the 9 screens tool and the discovering matrix tool are noticeable.

3. The completion of the discovering matrix tool thanks to the 9 screens tool

3.1 A methodical completion

The completion phase of the discovering matrix tool presented in Table 1 has been established in close collaboration with the clusters facilitators and the research team. It is a step requiring a global vision of the interactions opportunities between clusters. In order to help clusters facilitators in defining the discovering matrix tool lists, it appears interesting to identify the links between the two tools to prefill in the matrix during the ideation phase.

The identification of those links enables the preparation of the discovering matrix from the 9 screens tool if the answers of the questions panel questioned are reformulated according to needs and technologies related to the system. Columns "past"" and "present" from the 9 screens tool correspond to the first columns of technologies used in the sector in correspondence with the current needs. The last column of the 9 screens tool describing the future system is at the crossing of latent needs lines. Furthermore, the crossing of needs with technologies used in other sectors enriches the clusters and competitiveness clusters diversification strategy.

According to the classification proposed in the Figure 3, the 6 screens proposed at the left in the 9 screens tool can be used to complete the top left panel of the discovering of matrix boxes. This part of the discovering matrix provides a historical view until today project ideas that have been launched or may be with the current state of knowledge, ie current market needs versus technological opportunities already known.

The brighter part of the table allows for cross systematically technologies used in other sectors included in the matrix of discovering with current and latent needs. This cross-sector opportunity - diversification - is an important issue for competitiveness clusters and clusters with strong technological content among their members. Operationally, we notice that the diversification strategy is readily highlighted thanks to the use of the discovering matrix and the columns "technologies used in other sectors".

Finally the brightest part on the lower left side, where the potential crossing are at stake with the latent needs and the current needs, may establish interesting axes to optimize existing processes with other technologies.
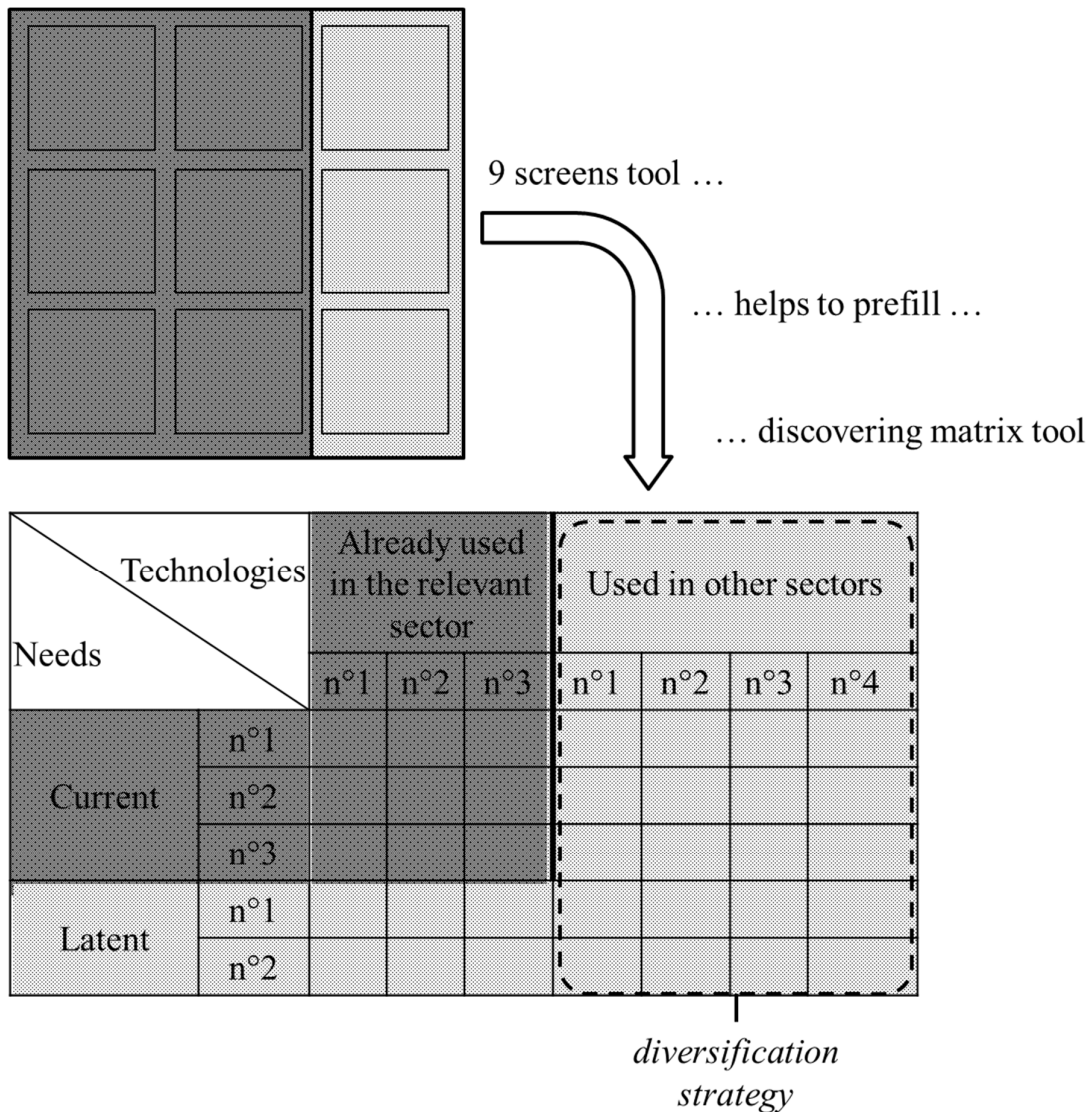
Figure 3. Correspondence for the completion of the discovering matrix tool from the 9 screens tool and highlighting the diversification strategy

3.2 A use case example

In our case studies of applications, we animated different creativity sessions with 9 screens and discovering matrix tools, including a session focused on the use of new communication technologies that do not emit electromagnetic waves [Aerospace Valley 2015] - in order to anticipate changes in regulations aimed at restricting their use in the French hospitals [Assemblée Nationale 2015].

Figure 4 gives an extract from a real use case example implementing the 9 screens and the discovering matrix tools fostering the emergence of collaborative innovation projects.

In this case study, the results were encouraging. In 2 hours and with 22 participants, these tools combined with the animation of this session supported the emergence of more than 60 ideas of collaborative innovation projects.

The table content in the figure:

9 screens tool (top left grid):

wired network into the hospital	networks wireless communication via electromagnetic and radio waves in the hospital	hospitals and home hospitalization networks
landline telephones	mobile phone, touchpad, computers	smartphones, care machines, connected rooms
telephone cables	transceiver WIFI / Bluetooth / broadband over Power Line / radio waves	GNSS chips / LiFi / ultrasonics waves / ultrasonic sensors

the information provided during the "9 screens tool" animation facilitate the completion of rows and columns in advance in "discovering matrix tool": this could improve the ideation start phase

Discovering matrix tool:

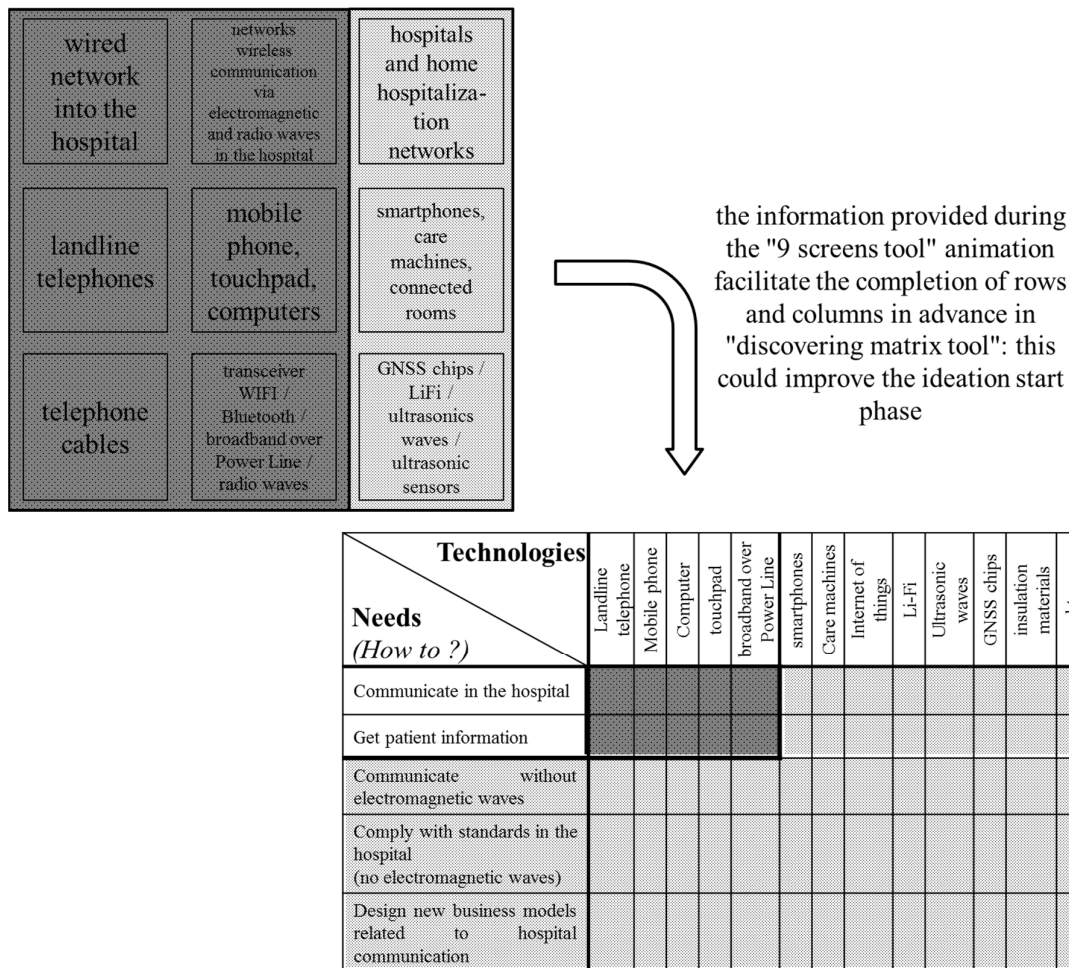| Technologies / Needs (How to ?)	Landline telephone	Mobile phone	Computer	touchpad	broadband over Power Line	smartphones	Care machines	Internet of things	Li-Fi	Ultrasonic waves	GNSS chips	insulation materials	ohters
Communicate in the hospital													
Get patient information													
Communicate without electromagnetic waves													
Comply with standards in the hospital (no electromagnetic waves)													
Design new business models related to hospital communication													

Figure 4. Correspondence for the completion of the discovering matrix tool from the 9 screens tool

3.3 Towards new impacts when facilitating a session

During the facilitation of creativity session, the knowledge of such links between the two tools enables the redefinition of questions asked in 9 screens to orientate and interact with participants in a dynamic "needs", "technologies" or "functions" according to the type of lists selected. The questions currently asked in the 9 screens tool seem to destabilise some of the participants. In the aim of interclustering collaborative projects emergence, links previously highlighted could be used as a base work to define modalities of a semi-directed interview leading to the methodical completion of the 9 screens tool.

4. Conclusion

In the context of work between clusters on a physical meeting format, the objective of the cluster facilitators is to allow participants members to meet themselves and exchange. Ideally, this collaboration can take shape around an innovation project. One of the strategies of the competitiveness clusters and clusters that have a strong pool of technology expertise is to diversify the applications of their innovative technologies to other sectors.

Operationally, we decided in the ongoing work with the Aerospace Valley competitiveness cluster, use the tools and methods of creativity to facilitate the animation of these projects emerging sessions.

The use of hybridization methods and tools of creativity allows the facilitator to adapt to participants and to the advancement of the ideation process.

With this in mind, the 9 screens tool and the discovering matrix are two tools to share information around the theme and then to generate ideas very fluidly with participants. The work presented in this paper seek to highlight the causal links that the facilitator can be establish between the two tools in order to facilitate completion of the discovering matrix using information obtained by the 9 screens tool. These links are highlighted in case the two lists used for the discovering of matrix is based on the triptych: market, technology and function.

At the level of the participants, The main advantage is that after the use of 9 screens, the facilitator does not need to solicit them again on the same aspects, but he gets the information obtained to incorporate them when he designed the discovering matrix. This animation dynamic enables not breaking with the guiding thread of thought of the participants but to follow it smoothly.

Thereafter the work presented here, it seems crucial to experiment with different types of semi-structured interviews to respond appropriately to the tool 9 screens by directing the questions and themes lists to market, technology and function. In our use case, these are the main axes of association of ideas for the emergence of innovative interclustering collaborative projects when using the discovering matrix tool.

Acknowledgments

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Julien Ambrosino, PhD. Student
ESTIA - Bordeaux University, Science and Technology
70 Rue d'Ornon, 33170 Gradignan, France
Email: ambrosino@aerospace-valley.com

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