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Factors of Organizational Improvements in Creative Solution-Seeking Processes: The Tunisian SolLabs Experiment

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Abstract

This paper examines organizational factors enhancing creative problem-solving processes, using Tunisia's SolLab project as a case study. It emphasizes the importance of fostering creativity in organizational settings. The research reveals a cumulative learning effect across successive experiments, indicating improvement over time. The approach adapted to the Tunisian context by aligning with local expectations and including company employees in teams. However, some organizational adjustments, such as reducing reflection time, may have negatively impacted result quality. This research contributes to understanding how creative solution-seeking processes can be improved, potentially inspiring future experiments in this field. The findings could be valuable for organizations looking to enhance their innovation processes, particularly in cross-cultural or developing market contexts.

Keywords

Creativity, Problem-Solving, Cumulative learning, Contextual Adaptation, Organizational Factors, Tunisian SolLab Project

1. Introduction

Creativity is widely recognized as a cornerstone of organizational learning and innovation. The ability to cultivate an environment that nurtures and encourages the exploration of creative solutions is increasingly viewed as a critical factor in a company's success and long-term viability.

This work explores organizational factors that can enhance creative solution-seeking processes, using the Tunisian SolLab project (2019-2024) as a case study. This project, funded by the German Federal Ministry of Research, aimed to strengthen the link between business, science, and higher education in Tunisia. The research highlights the importance of fostering creativity in organizational settings, particularly in the context of developing economies like Tunisia. By studying the SolLab project, which brought together various stakeholders from business, academia, and research, the paper aims to uncover factors that contribute to effective creative problem-solving processes.

The structure of the paper is as follows. The next section provides the theoretical background of the analysis and details the main concepts that underpin the work performed. Section 3 specifies the methodology and implementation of the SolLab project in Tunisia. The fourth section focuses on the learning outcomes and enhancements observed throughout the SolLabs. The conclusion summarizes the key findings and proposes direction for future research.

2. Theoretical Background

This section establishes a comprehensive theoretical foundation for the process of exploring innovative solutions. At the core of this framework lies the concept of creativity, which is presented as a pivotal element in organizational learning. The main question is how to set up an environment that favors the exploration of creative solutions. Against this background, a specific experiment is presented which was developed within the scope of a German research project implemented in Tunisia. This experiment consisted of a series of events based on a hybrid approach to innovation processes.

2.1. Creativity and the Exploration of Solutions

Creativity is widely researched in the academic literature (see for instance Klijn and Tomic (2010) and Kaufman and Glăveanu (2019) for an overview). It can be approached from different perspectives such as psychology, economics, or management research. Scholars have described creativity by means of various models. Creativity can be seen as a mental process that allows the development of new ideas. Creativity may also be seen as a prerequisite to innovation. Finally, it is possible to define creativity in terms of the solutions generated. This view, which is adopted in this paper, has been proposed by Sternberg and Lubart (1999: p. 3) who consider creativity as "*the ability to produce work that is both novel* (i.e. *original*, *unexpected*) *and appropriate* (i.e. *useful*, *adaptive concerning task constraints*)".

"Finding a solution" from the viewpoint of an organization means that the organization is facing a problem to which it cannot respond immediately and/or easily for various reasons such as insufficient knowledge, insufficient resources, or insufficient time. In fact, even before trying something new, the organization is forced to learn how to do something new or different. This corresponds to the

issues explored by March (1991) linking exploration and exploitation in organizational learning. "Finding a solution" means to make better or modified use of what the organization already knows and/or to extend what it knows.

Nonaka et al. (2014) go a step further and propose a model of knowledge exploration and exploitation based on a triad relationship between tacit knowledge, explicit knowledge and phronesis (practical wisdom). Innovation emerges from a "*spiraling continuity of the conversion process*" (Nonaka et al., 2014: p. 139) as can be seen in **Figure 1**.

Figure 1. The conversion of tacit and explicit knowledge towards phronesis according to Nonaka et al. (2014) Adapted from Nonaka et al. (2014: p. 139).

Hence, in this view, taci and explicit knowledge form a continuum of knowledge. That is, by sharing tacit knowledge, for example by exposing it to another person in a team, it is possible to transform this tacit knowledge into explicit knowledge. Combining it with other explicit knowledge, again for example within a team, can lead to new explicit knowledge. The latter may then become tacit knowledge for some or several team members. It is in this sense that Nonaka et al. (2014) invoke the idea of spiraling knowledge transformation.

If one accepts the idea that such phenomena are indeed at work in organizations—and particularly in firms—the question easily arises as to whether certain factors, and more generally certain specific contexts, in particular favor the exploration of creative solutions.

2.2. Setting up an Environment Favoring the Exploration of Creative Solutions

The seminal works by Amabile (1988) on creativity and innovation in organizations provide a fundamental contribution to research on factors that impact these phenomena and processes within organizations (see Box 1).

Box 1: The qualities of environments that influence creativity according to Amabile (1988)

Qualities of environments that promote creativity

l) Freedom (74%)

2) Good project management (65%)

3) Sufficient resources (52%)

4) Encouragement (47%)

5) Various organizational characteristics such an atmosphere where innovation is prized and failure is not fatal (42%)

6) Recognition (35%)

7) Sufficient Time (33%)

8. A sense of challenge (22%)

9) Pressure understood as a sense of urgency (12%)

Qualities of environments that inhibit creativity

l) Various organizational characteristics, for instance inappropriate reward systems (62%)

2) Constraint such as a lack of freedom in deciding what to do or how to accomplish the task (48%)

3) Organizational disinterest (39%)

4) Poor project management (37%)

5) (tied rank) Evaluation (33%)

6) (tied rank) Insufficient resources (33%)

7) (tied rank) Time pressure (33%)

8) Overemphasis on the status quo (26%)

9) Competition (14%)

Note: The different factors are detailed in Amabile (1988: pp. 146-148). The ranking is initially based on the answers of 120 R&D scientists from over 20 different corporations. Numbers in parentheses indicate the percentage of scientists who mentioned the factor at least once. Multiple answers were possible.

Source: own compilation based on Amabile (1988)

In addition, Darbellay et al. (2014) insist on the role of the decompartmentalization of disciplines. In other words, an important prerequisite to creativity might be the ability to combine disciplinary insights with interdisciplinary understanding.

In an analysis on how creative teams can be encouraged to integrate a sustainable approach to technology, Neukam and Bollinger (2022) insist on the importance of psychological safety. They refer notably to Edmondson (1999: p. 354) who has defined psychological safety as "a shared belief held by members of a team that the team is safe for interpersonal risk taking". This form of safety seems to be

a prerequisite for trustful interactions allowing different perspectives to be crossed and knowledge to be shared.

Finally, according to the model of *effectuation* developed by Sarasvathy (2001), even negative contingencies can be turned into positive forces in a person's entrepreneurial career. Nevertheless Héraud and Muller (2016: p. 132) state that "*Pushing employees out of their comfort zone is sometimes given as a recipe for boosting creativity*; *it can work if applied to optimistic and resilient persons*, *but could lead to negative outcomes such as burnout syndrome if the organization still remains hierarchical at the same time* (*applying strict controls and asking for short run results*)." As a consequence, it seems important to them that creative persons can have some kind of fun in overcoming difficulties, "*because it is part of the game*".

2.3. The Goals Set to Tunisian SolLabs

The elements considered above have fed into a process of reflection designed to enable the emergence of new organizational approaches aimed at fostering the development of creative ideas for the benefit of private companies. The initial idea was to encourage "thinking out of the box" by specifically looking for human resources "out of the box", i.e. out of the companies searching for creative solutions to existing—and not so far solved—innovation-related problems. Furthermore, the idea was to test such an approach in a technically and economically challenging environment with very limited resources.

The opportunity arose through a project funded by the German Federal Ministry of Research involving two Fraunhofer institutes and the University of Applied Sciences of Kehl in cooperation with ENIT (the National Tunisian Engineering School based in Tunis). The overarching goal of the project[1], which started in 2019 and ended in 2024 was to contribute to and support the Tunisian research and innovation system in order to promote the emergence of innovative, market-driven solutions. The focus was on strengthening the link between business, science and higher education.

The experiment itself was preceded by a one-year preparatory phase, which allowed the identification of the limitations of the innovation systemin Tunisia:

- a gap between science/research and economic development, meaning that new (technological) concepts are only rudimentarily transferred from research to the private sector.
- an untapped potential of (creative) employment opportunities for young graduates, combined with unemployment, demotivation and underutilization of their creative capacity.
- an untapped potential in communication and exchange between higher education and the private sector and a moderate integration of private sector innovation-related needs into higher education programs.

[1]Project ID: BMBF—Verbundprojekt Solution Labs Tunesien (SolLabTUN)—Förderkennzeichen: 01DH20028B.

This led to the development of a new approach that aims to address the systemic shortcomings identified above. The Solution Labs approach that will be presented in the following has been identified as a promising model to be tested.

3. The Tunisian SolLabs Experiment

This section details the methodological approach adopted. Then, it compares SolLabs to other innovation-fostering approaches in order to highlight its own specificities. At the end of this section, the variables selected for the exploration of the factors potentially impacting the organizational improvements of the Tunisian SolLabs experiment are detailed.

3.1. The Methodological Approach Adopted

A SolLab can be described as "a multi-day event to develop creative solutions to business challenges in the innovation process". It is an approach aiming to collaborate in multidisciplinary teams composed of many members with different backgrounds in order to develop solutions to concrete innovation problems proposed by companies. The Tunisian teams were made up of participants previously selected by the organizers of the SolLabs events on the basis of various criteria, including motivation, presumed creativity, academic and professional backgrounds (engineering, business management, social sciences, arts, architecture, etc.). Most participants were master's students, doctoral candidates or young professionals. Each SolLab was, therefore, based on the recruitment and selection of around 15 participants—called "talents"—to form three groups composed of five talents. One or two coaches were assigned to each of the teams to supervise the teams, generally without directly contributing to the solution development process with ideas, as the generation of solutions is considered to be exclusively the task of the team members. Coaches may support with tools and instruments for structuring problems and solutions, open up new perspectives in problem solving, or solve conflicts or disagreements between the team members.

In parallel, pre-selected Tunisian companies interacted with the organizing team to identify the real problems they were facing, and for which they needed new and creative ideas. These problems were called "Challenges" and could be technical, organizational or related to firms' business models. Usually, all three dimensions were present to varying degrees. The companies participating in the solution labs could be either from the manufacturing or service sector.

The basic assumption behind SolLabs is that the diversity in terms of Talents and Challenges would support a high level of creativity for solving the challenges. Each team was assigned a challenge, and the three teams worked in parallel for five days (in general from Monday until Friday). One of the special features was that the SolLab generally lasted a week, during which time the talents were housed in the same place (e.g. hotel). In principle, all the talents, coaches and organizing team spent their all the day together from the moment they woke up until they went to bed, including meals, and coffee breaks. As such, the SolLab constituted

for each team a form "physical and temporal frame" to experiment and try out. It was a physical, emotional and mental "safe space".

Teams worked in dedicated rooms (one room per team), and a large room served as a gathering point for briefings and collective presentations involving all three teams. The methodology developed within the project scope was based on a specific program for each day. First, the participants of each group were familiarized with the methodology and the company's problems to be addressed and then started working in creative small groups. The interdisciplinary teams developed proposals and visualized their approaches and presented them to the other groups and experts from the participating companies or outside such as university or public government experts for discussion. Feedback loops allowed ideas to be refined and restructured. This process was supported by targeted moderation and if necessary and/or useful external expertise. At the end of the solution lab (day 5), there was a formalized (in written and/or graphic form) presentation of the solution developed collectively. It was at this final stage that the results were presented and made available to the companies that proposed the challenges. The relevance and quality of the solutions developed could then be assessed.

Five SolLabs were performed in the frame of the project funding by the German Federal Ministry of Research between 2021 and 2023. A sixth SolLab was organized at the beginning of 2024 after the end of the project and is included in the analysis (see the section below entitled "Variables selected for the analysis" and the variables' label "Tunisian coaches only"). At the time of writing of this article a seventh SolLab was organized in 2024 which is not covered by the analysis.

Figure 2 displays the typical sequencing of a SolLab which was performed over 5 days between the 13th and the 17th of November 2023.

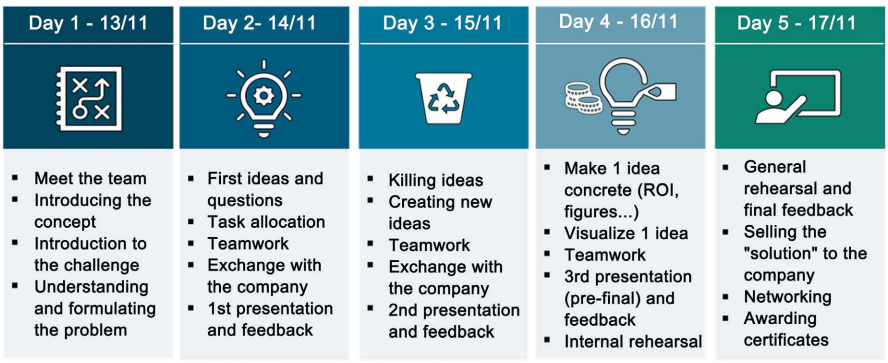

Figure 2. An example of the planning and contents of a typical Tunisian SolLab in 2023. Source: own illustration.

3.2. Comparing SolLabs to Other Innovation-Fostering Approaches

The methods and approaches with the objective of creating ideas and generating innovative solutions innovation vary widely, starting from fast events of creativity to more systematic and long-term approaches. In the following, three distinct approaches are explored: hackathons, the classical innovation approach, as it is

implemented by organizations, and Solution Labs. In this way, we show how solution labs are different from hackathons and classical innovation processes.

A hackathon is a fast-paced, intensive event typically lasting one to two days. Hackathons are usually organized over a weekend and consist of coders, makers, domain experts, entrepreneurs and others collaborating to produce prototype solutions to a set of challenges. At the end of the hackathon, a jury announces the winning prototypes based on the quality of the solution with respect to how it fits to the challenge. In the case of commercially-oriented hackathons, the jury evaluates the potential of the developed solution to be launched as a marketable product (Perng et al., 2018; Falk et al., 2022). Thus, a hackathon brings together diverse teams, often composed of individuals from outside the organization, to tackle predefined challenges. Participants collaborate intensely to generate innovative solutions within a short timeframe, while leveraging their different backgrounds and expertise. The competitive element inherent to hackathons fosters a sense of urgency and encourages participants to think outside the box. However, the time constraint can limit the depth of exploration and refinement of ideas.

In contrast to the rapid pace of hackathons, the classical innovation process is a methodical, long-term process. It is typically conducted within the confines of the organization and involves a closed group of internal stakeholders. Certainly, it can also involve a set of suppliers or customers with whom the company operates as well as further external organizations (i.e. universities and research centers, consultants, etc.). This innovation approach generally consists of three phases: ideation, prioritization and selection, and implementation (Goffin and Mitchell, 2016). The final phase (implementation) usually, but not necessarily, includes research and development. Collaboration among team members is essential, but the focus is on leveraging internal (and sometimes external) expertise and resources to drive innovation. Internal competition is, however, often less emphasized, as teams work together and align their efforts to develop a new product or a technology.

Solution Labs represent a hybrid approach to innovation that aims to achieve a balance between the intensity of hackathons and classical innovation processes. From a conceptual perspective, Solution Labs can be seen as an attempt to combine "non-expert knowledge" (see for instance Pollok et al., 2021) with "experiential learning" (in the meaning of Esola and Sullivan, 2021).

Experiential learning, as understood in the context of Esola and Sullivan's (2021) work, is a process of learning through direct experience and reflection. The key elements of this approach include notably hands-on experience (participants engage in concrete, real-world activities or simulations that relate to the subject matter), reflection (participants critically analyze and reflect on their experiences, connecting them to theoretical concepts and previous knowledge) and active experimentation (application of the newly formed ideas to new situations).

This is close to the concept of Creative Problem-Solving (CPS) skills, as elucidated by Amran et al. (2019). CPS encompasses the ability of individuals to

generate innovative and effective solutions to complex problems. These skills are intrinsically linked to an individual's existing knowledge, comprehension, and problem-solving abilities, which are applied across diverse situations. The development and application of CPS skills are influenced by various factors, including cognitive processes, environmental conditions, and personal attributes. In both formal and informal learning environments, the cultivation of creative solutions within group settings has become an essential component of the learning process. Collaborative knowledge sharing among individuals facilitates the production of high-impact alternatives, thereby enhancing the overall problem-solving capacity. Moreover, the group dynamics inherent in collaborative CPS provide a stimulus that can catalyze more creative thought processes among participants.

Lasting for approximately one week (typically five days), Solution Labs provide a structured framework for ideation and implementation. Importantly, they involve both internal and external stakeholders, thus blending the diverse perspectives of participants from within and outside the organization. Unlike hackathons, a Solution Lab does not let teams compete against each other, thus fostering collaboration and knowledge sharing. This format allows for the exploration of innovative ideas within a constrained yet flexible timeframe, while facilitating both creativity and implementation.

In sum, the choice of innovation approach depends on factors such as the urgency of the challenge, the desired level of collaboration, and the resources available. While hackathons offer rapid ideation and diverse perspectives, the Solution Lab approach combines structured processes with collaboration, while the classical innovation processes prioritize thorough research and internal expertise. Each approach has its strengths and limitations, thus highlighting the importance of selecting the right method based on specific innovation goals and organizational context. In this regard, Table 1 provides an overview of the main characteristics of these three approaches.

Table 1. Overview of the main of the three approaches considered.

Characteristics	**Hackathon**	**Classical innovation approach**	**SolLabs**
Duration	1 - 2 days	Long-term	5 days
Participants	External to the organization	Internal	Internal and external to the organization
Competition between participants	Yes	Rare	No
Structured process	Less structured	Highly structured	Structured
Focus	Rapid ideation, creativity, prototyping	Ideation, prioritization, implementation (through R&D)	Ideation and execution
Collaboration	Intensive collaboration between group members	Intensive internal coordination and collaboration and less intensive external collaboration	Intensive collaboration between group members, and potentially across groups

Source: Own Conception.

The Tunisian Solution Lab experiments tried to encompass most of the principles detailed above to provide an environment fostering creativity within teams in a very specific framework.

3.3. Variables Selected for the Analysis

Regarding the different theoretical elements considered in the first section of the paper—notably Amabile (1988), Nonaka et al. (2014) and Sarasvathy (2001)—different indicators were selected to follow the different organizational variations, which were introduced over the six performed SolLabs. These variations constitute objective measures, e.g., an on-site visit was organized or not, the duration of the SolLab was four or five days, etc.

However, it is far more difficult to limit the degree of subjectivity when it comes to determining quality in terms of the results produced by a group. There is no pre-established metric that can erase all traces of subjectivity when it comes to different aspects such as diagnosis, generation, and similar properties (cf. notably Cropley and Cropley, 2008). Nevertheless, indications of quality can be recognized with a substantial level of agreement by different observers, and can be used to judge the amount and kind of creativity. For this reason, the analysis seeks to investigate the possible impact of the organizational variations introduced over time, based on three perspectives for assessing the quality of the results: 1) those of the companies that proposed the challenges, 2) those of the coaches who supervised the group work, and 3) those of the team participants.

Based on the literature, previous experience in conducting SolLabs in Germany and France and the research question of developing an efficient approach for the Tunisian context, a total of ten variables has been selected for operationalizing the analysis. They are rooted in the overall rationale of the project to juxtapose different approaches and to assess them through the different types of people and organisations involved in the SolLabs in order to be able to obtain insight for subsequent SolLabs. In detail, the variables aim to address the issues listed hereafter.

- Cost argument: Since the implementation of a SolLab requires a certain budget, we asked whether a shortened duration produces comparable results and tested to conduct SolLabs in four and five days (variable DUR).
- Client embedding: Deviating from the original approach and the fact that SolLabs were a new format in the Tunisian context, the question was put forward (by Tunisian clients) if company staff could actively be involved in the working groups of young talents. Clear advantages were seen in the inputs of challenge-related background knowledge and the direct validation of ideas by company experts. On the other hand, this involvement could hamper the independent development of creative ideas "out of the box" through young talents. For testing this issue, variable EMP indicates whether company staff actively worked with the working groups of young talents or not.
- Benefitting from increasing experience of talents: This variable is based on the question if the involvement of talents from previous SolLabs can be considered

beneficial for the dynamics of the working groups. This assumes that "experienced talents" who are aware of the SolLab approach can share their experience with "new" talents. Being well aware of the highly specific character of each challenge, an experienced person in each group could contribute with methodological advice, time management aspects etc. Consequently, the analysis includes the variable TEXP that explains whether individual persons have been taking part in a previous SolLab or not.

- Similar arguments have been put forward concerning client companies. Companies that already brought in an innovation challenge in a SolLab gained insight about the results they can expect. This leads to the question if client companies are inclined to use this experience for another time or not (variable CEXP).
- The design and preparation of the SolLabs in Tunisia, the question was raised whether on-site visits in companies could enhance the understanding of the challenge treated by the working groups. Though being aware that this also depends on distance and organizational aspects, it can be argued that on-site visits enhance the understanding of the challenge and bring about more tailored results. This information is therefore included through variable VIS.
- The SolLabs approach foresees the coaching of working groups especially concerning methodological questions, support in organizing the working process, etc. The SolLabs started with a collaboration between coaches with different backgrounds, both in terms of disciplines, organizational and national background, cultural and language experience, etc. In the course of the whole process, the approach was increasingly handed over to a Tunisian team, which leads to the question whether the adoption of the process by local actors could be adopted effectively (variable TUN).
- In order to assess the results obtained during the SolLabs and embedded in the philosophy of successive and continuous further development of the SolLab approach in Tunisia, the client companies have been contacted after the SolLab events. Main discussion points concern client companies' evaluations of the final results developed by the working group and their ideas for further development of the SolLab approach. Companies' assessments are covered by variable COM.
- Similarly to the assessments of the companies, the talents have also been contacted and asked for their assessment of the SolLab. Contrary to the companies that have been addressed by phone or e-mail (following their preference), the talents were asked to participate in a short online survey. This survey covers a set of easily to respond questions with predefined answer categories, complemented by text-based questions, which allow to give more in-depth assessments. Further, the survey remained nearly unchanged for all SolLabs so that comparisons are possible. The general evaluation of talents is represented by variable TAL.
- Finally, continuous exchanges between coaches both during the SolLabs as also

after the events took place in order to share experience and ideas, to collaboratively achieve learning effects and reflect about bringing in experience and learning in the SolLab approach for the Tunisian context. These results are covered by variable COA.

- The variable entitled CNU indicates the challenge to which the results are referring.

The list of the resulting selected variables is displayed in Table 2.

Table 2. List of the variables used for the analysis.

CNU	Challenge Numbering of the different challenges from 1 to 18
DUR	Duration: reinforcing time constraints (introduced only during SolLab #3) 0 = duration of 5 days; 1 = duration of 4 days
EMP	Embedment of companies' employees in the group: reinforcement of tacit knowledge (introduced for the first time during SolLab #4) 0 = no; 1 = yes
TEXP	Integration of experienced talents (i.e. who already participated in a previous SolLab): reinforcement of phronesis (introduced for the first time during SolLab #2) 0 = no; 1 = yes
CEXP	Integration of experienced companies: reinforcement of explicit knowledge (introduced for the first time during SolLab #3) 0 = no; 1 = yes
VIS	On site visits: reinforcement of explicit knowledge (introduced for the first time during SolLab #1) 0 = no; 1 = yes
TUN	Tunisian coaches only: effectiveness of the adoption of the process by local actors (introduced only during SolLab #6) 0 = no; 1 = yes
COM	Evaluation of the results by the concerned companies (introduced for the first time during SolLab #1) 0 = results of low or average quality; 1 = results of high quality
TAL	Evaluation of the results by the concerned talents (introduced for the first time during SolLab #1) 0 = results of low or average quality; 1 = results of high quality
COA	Evaluation of the results by the concerned coaches (introduced for the first time during SolLab #1) 0 = results of low or average quality; 1 = results of high quality

4. Assessing Learning Effects and Improvements

This section attempts to identify the learning effects that emerged having conducted all six experiments. This is expected to indicate which factors led to improvement. At first, the data collected are displayed, then a multiple correspondence

analysis is performed. Finally, the results are interpreted in order to stress potential factors of improvement.

4.1. Data Collected

The data used for the analysis were collected during each SolLab and are related individually to each of the 18 groups, which participated in the six consecutive SolLabs performed between 2022 and 2024 (Table 3).

Table 3. Overview of the data collected related to the 18 groups of the six SolLabs.

	CNU	DUR	EMP	TEXP	CEXP	VIS	TUN	COM	TAL	COA
	1	0	0	0	0	0	0	0	1	0
SolLab 1	2	0	0	0	0	1	0	0	0	0
	3	0	0	0	0	0	0	0	1	1
	4	0	0	0	0	1	0	0	1	0
SolLab 2	5	0	0	1	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	1	0	1	1	0	0	0	1	0
SolLab 3	8	1	0	1	1	1	0	0	0	0
	9	1	0	1	0	0	0	1	1	1
	10	0	0	1	0	0	0	0	0	0
SolLab 4	11	0	1	0	1	1	0	0	1	1
	12	0	0	1	0	0	0	1	1	1
	13	0	1	0	0	0	0	1	0	0
SolLab 5	14	0	1	1	0	0	0	1	0	1
	15	0	1	1	0	0	0	0	1	1
	16	0	1	1	0	0	1	1	1	1
SolLab 6	17	0	0	0	1	0	1	1	0	1
	18	0	1	0	1	0	1	0	1	1

4.2. Multiple Correspondence Analysis

A multiple correspondence analysis (MCA) was performed on the basis of the data presented in the table above. The development of correspondence analyses derives mainly from the pioneer work performed in the 60's (see for instance Benzécri (1992) for a detailed presentation and overview of the possibilities in this field). Originally, such procedures were limited to the analysis of contingency tables (crosstabs of two nominal characters). In the meantime, correspondence analysis has been extended to (at least theoretically) an unlimited number of characters.

Thanks to their mathematical properties and due to their richness in terms of interpretation potentialities, MCAs constitute a powerful tool for exploiting qualitative data. All variables in a MCA are inspected for their categorial information

only. That is, the only consideration is the fact that some objects are in the same category while others are not. One important advantage (due to the presence of qualitative or categorized variables only) is the possibility of considering non-linear relations between variables.

The choice of using a multiple correspondence analysis as a suitable instrument is motivated by different arguments. First, a MCA can be performed using a small amount of statistical individuals (here 18 groups). Second, a MCA can be performed with binomial variables. Third, a MCA is a suitable tool for an explorative analysis since it may (often) detect unexpected associations between variables. The analysis was performed using R tools (Figure 3).

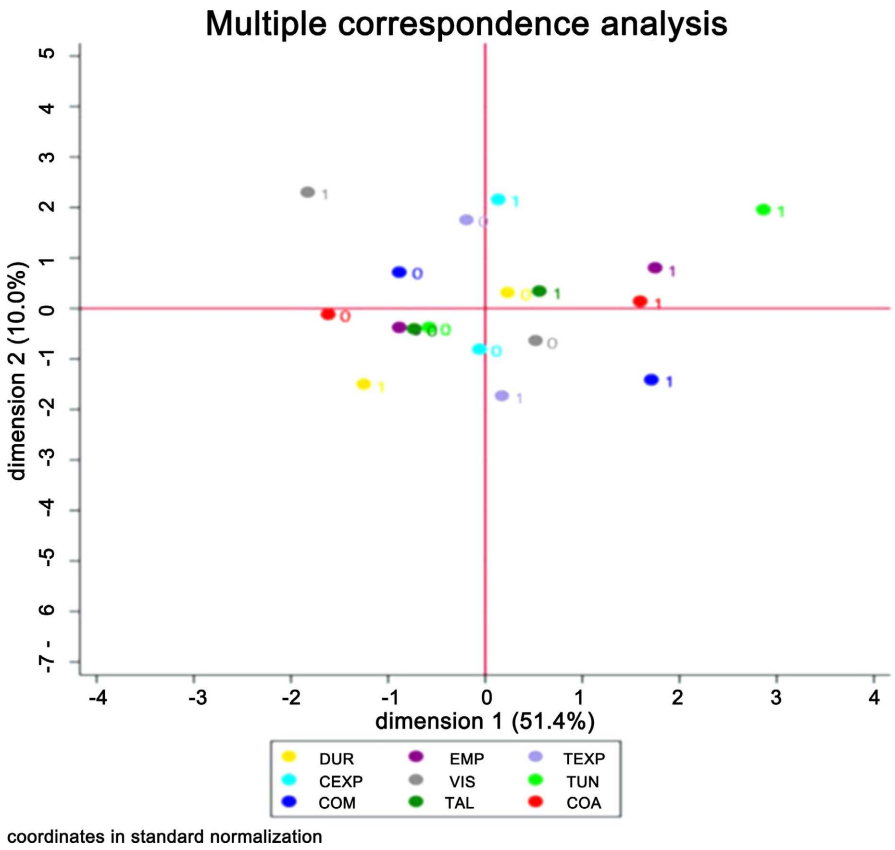

Figure 3. Graphical display of the results from the multiple correspondence analysis.

The graphical display of a MCA provides a two-dimensional visual representation of a complex n-dimensional space, where n corresponds to the number of variables included in the analysis. In this particular case, n equals 9, as the variable CNU (numbering of the SolLabs) is not considered relevant for the analysis. The primary objective of a MCA is to determine the optimal two-dimensional projection onto the two principal dimensions. Each dimension (or axis) represents a distinct pattern of relationships within the data. The first dimension accounts for the largest proportion of variance, with subsequent dimensions explaining progressively smaller portions. In this analysis, Dimension 1 captures over 50% of the

total variance, while Dimension 2 accounts for more than 10%. This significant cumulative explained variance (>60%) suggests that the two-dimensional representation effectively captures the main patterns in the data.

In a nutshell, it can be stated that categories plotted close together are more closely associated, categories far apart are less associated or negatively associated and that the distance from the origin (center) indicates how distinctive or unusual a category is. This graphical representation allows for a nuanced understanding of the relationships between multiple categorical variables, facilitating the identification of patterns and structures that might not be immediately apparent in the raw data. Nevertheless, it must be kept in mind that a MCA cannot provide evidences in terms of causality.

4.3. Interpretation of the Results

When interpreting the results of a MCA, it is extremely important to keep in mind that no statistical proof is provided in terms of causalities, but only associations between variables can be determined. Depending on the variables, the observations may result from random effects. Nevertheless, it can be expected that stressing some associations between variables may be useful in the frame of an explorative analysis even if they do not constitute a formal proof in a narrow statistical meaning.

The first dimension (i.e. the horizontal axis) resulting from the analysis alone accounts for over 50% of the dispersion. The second (vertical axis) accounts for just over 10%. This makes it easier to interpret the results. Most of the information provided by the MCA can therefore be extracted along the horizontal axis by contrasting the plots on the left and right, and identifying the most telling associations (and oppositions).

What stands out first and foremost is the closeness of the respective evaluations of companies (COM) and coaches (COA) when it comes to positive (on the right of the graph) or negative (on the left of the graph) assessments of the results produced by the different groups. Note that coaches and companies have provided their assessments independently, eliminating any potential bias that can emerge when coached are influenced by the company's evaluations. In addition, coaches and companies may evaluate success of a solution from different perspectives. Whereas companies may evaluate the final solution provided to them based on its suitability and appropriateness to be integrated in the organization, coaches may rather draw on other criteria such as the atmosphere in the working team and creative abilities of the team. Furthermore, a similar observation can be made, but to a much lesser extent, with regard to talent evaluations (TAL). In other words, the three perspectives (COM, COA, TAL) of what constitutes "good" and "less good" (or even disappointing) results from a convergent SolLab. These initial elements provide a framework for further interpretation of the MCA results.

The second aspect—which is of critical importance—concerns the groups that participated in the last SolLAb, which was organized and coached fully by the

Tunisian University without the intervention of the German University and research institutions that were part of the project. The sixth SolLab was also an opportunity to check whether the knowledge transfer from the German to the Tunisian institutions that took place during the project was successful or not. The association of variables suggests a very high level of success compared to all previous SolLabs. Two hypotheses can be put forward to explain this observation. First, a cumulative learning effect across the various SolLabs is at work. Hence, the overall approach has not only been improved, but also perfectly adapted to the Tunisian context in terms of companies' expectations and creative potential of the participants. The inclusion of employees from the companies concerned (EMP) in the groups dedicated specifically to the challenge provided by the companies in question also seems to have had a positive effect.

Second, in view of the MCA results, neither the inclusion of experienced participants (TEXP), nor the provision of challenges by companies (CEXP) that had previously participated in a SolLab led to any remarkable associations with variables relating to the evaluation of results (COM, COA, TAL). Finally, an association between the organization of on-site company visits (VIS) and lower quality results is observable. The same is true for reducing the duration of SolLabs (DUR). In both cases, the same hypothesis can be put forward: less time devoted to group work itself influences the quality of the final results. And the hypothetical gain in information through a site visit (usually half a day) does not seem to offset the negative effect of the reduced time available for group work itself.

5. Conclusion

The paper explores organizational factors that can enhance creative solution-seeking processes by using the Tunisian SolLab project (2019-2024) as a case study. It specifically examines the learning effects that emerged across multiple SolLabs through a multiple correspondence analysis of original data.

As a result, some assumptions can be made in terms of key findings. At first and concerning cumulative learning effects, the analysis suggests a progressive learning effect occurred across successive SolLabs, indicating improvement over time. Second, in terms of contextual adaptation, it can be assumed that the approach evolved to better suit the Tunisian context, aligning with companies' expectations and participants' creative potential. This adaptation was notably facilitated by including employees from the concerned companies in the teams. Finally, and related to organizational adjustments, some changes, particularly reducing the reflection time for teams to address challenges, may have negatively impacted the quality of results.

The primary contribution and research significance of this analysis lie in its advancement of the understanding of creative problem-solving processes. The approach's uniqueness and originality stem from its exploratory nature: rather than testing against predefined "best" or "better" solutions, it examines a set of multiple changes in light of their associations with positive or negative variations.

While the study was intentionally designed as exploratory and did not aim to

establish causal relationships, the observed associations between specific variables offer valuable insights into the effects of organizational changes and potential improvements on cumulative learning and contextual adaptation.

This research makes several key contributions. First, it provides a novel perspective on how creative solution-seeking processes can be enhanced, potentially inspiring future experiments in this field. Second, the findings offer valuable insights for organizations seeking to improve their innovation processes, particularly in cross-cultural or developing market contexts. Third, by analyzing the interplay between various factors without predetermined outcomes, the study allows for a more nuanced understanding of the complex dynamics involved in creative problem-solving. As such, this research not only contributes to the theoretical understanding of creative problem-solving but also offers practical implications for organizations striving to foster innovation.

Nevertheless, some limitations of the analysis must be stressed. First, the sample size is a major limitation as the relatively small number of SolLabs analyzed limits the generalizability of results. Second, the analytical method that is used in the research. While multiple correspondence analysis can detect unexpected associations between categorical variables, it cannot establish causal relationships. Third, the influence of subjectivity is worth emphasizing as some variables are based on subjective evaluations, potentially introducing bias.

This research contributes to understanding how creative solution-seeking processes can be improved, potentially inspiring future experiments in this field. The findings could be valuable for organizations looking to enhance their innovation processes, particularly in cross-cultural or developing market contexts. The continuation of SolLabs in Tunisia beyond the project's lifetime and the German external funding suggests the methodology's relevance and sustainability.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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