

Modelling and Measuring Innovation Culture

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Abstract: We aim to provide a conceptual model of innovation culture in organizations and build a survey tool to measure it. Innovation management focuses often on formalized processes whereas unwritten rules related to organizational culture are also a major factor for innovation and firms' performance. We first position the role of culture with regard to innovation processes, then provide a model of innovation culture relying on five branches (External links, Teams, Organizational context, Individuals, and Leaders). Following the elaboration of this model called ETOILe, we address the issue of measuring it. In this paper, we focus on the less-known components such as External Links and design an ad hoc questionnaire. The validation study is performed through a laboratory test with 115 professional participants followed by reliability analysis of data and principal components analysis. The results of the study enabled us to refine the diagnosis tool as well as the underlying model of innovation culture. The current version includes four branches (Team, Organization, Individuals, Leaders) and ten sub-dimensions including promotion and prevention regulatory focus, managerial practices, discovery and delivery skills, etc. Because of its implicitness and intangibility, culture is often disregarded in the analysis of key ingredients of firms' performance. Our model of innovation culture gathering such unwritten rules contributes to understanding why innovation is so natural and efficient in some companies, and why it is sometimes painful, despite robust managerial structure and methodological processes. Finally, we provide a diagnosis tool intended for all hierarchical levels of the organization, and not only for managerial staff. Our model and tool could be used at several levels: at the company's level to grasp the overall cultural profile, at the department or team level to assess differences in innovation culture between subdivisions in a given company, and at a trans-company level to characterize cultural differences associated to business sectors (e.g., manufacturing sector, consulting sector, retail sector).

Keywords: Organizational culture, Innovation, Survey

1. Innovation as a driver of firms' performance

Innovation is considered as central to solve the major problems of societies (e.g., social and demographic challenges, climate change) while still supporting economic growth. In the long term, innovation is believed to fuel society's transformation towards more wellbeing and more prosperity (OECD, 2016). However, the concept of innovation is polysemous in itself (Battistelli, 2014; Beylat and Tambourin, 2013). The last version of the Oslo Manual defines innovation as a result (new or improved product or process differing significantly from the unit's previous products or processes and made available to potential users or brought into use; OECD, 2018). However, measuring innovation remains a challenge, as existing assessment tools still mix outcomes and process indicators (Edquist et al, 2018; European Commission, 2018). Furthermore, in our view, a third side, namely innovation culture, is missing to gain a complete view of firms' innovation.

We model innovation factors through an analogy with the interactionist paradigm known as the Lewin equation (Lewin, 1936), which models human behaviour (B) as the result of interactions between personal characteristics (P) and situational features (S): $B = f(P, S)$. In our case, the target is innovation performance. The situational features may correspond to all observable innovation rules that were formalized as a process, or a framework to innovate. The personal characteristics, in the case of an organization, may refer to implicit cultural features influencing innovation. We therefore model innovation as follows: *Innovation performance* = $f(\text{innovation culture, innovation process})$.

Both process and culture define how people act in firms, but they are fundamentally different: we consider that innovation process gathers rules that are explicit, and usually written, whereas innovation culture refers to the rules that are implicit and seldom officially described. Culture and process may be independent orthogonal dimensions that are not necessarily consistent within a given organization. One can imagine an organization with formalized processes regarding innovation activities, but a culture inhibiting innovative thinking at the same time. Conversely, some organizations may possess a culture prone to innovation but weak innovation processes structuring these activities. The aim of this paper is to set out the basis for a model of innovation culture and a method to assess it. The other terms of the equation (innovation performance and innovation process) are usually approached through declarative, objective or observational data.

Culture constitutes the unwritten rules of the social game (Hofstede et al, 2010). Organizational culture may mainly rely on practices: people gathered for work come with their own values that can hardly be changed, but they can adopt common symbols, heroes and rituals. In line with this approach, we consider organizational culture as a set of habits, behaviours, and representations shared by its members (Davies and Buisine, 2018). Innovation culture is a particular configuration that makes innovative thinking natural within the organization and encourages innovation activities at all levels of the organization.

Two dimensions of national culture may particularly influence innovation process, namely power distance and uncertainty tolerance (Hofstede, 2016; Hofstede et al, 2010; Chai and Xiao, 2018; He and Lee, 2020). Innovation is encouraged by a low power distance and a high level of tolerance for uncertainty (Hofstede et al, 2010). An organization's culture may also depend on its stage of evolution (Laloux, 2015). According to this evolutionary model, Amber (i.e., conformist and stable structures with well-defined functions and processes, like many public administrations) and Orange organizations (which promote innovation, responsibility, and meritocracy, like many multinationals) are predominant in today's society. More recent and marginal forms of organizations are named Green (fostering empowerment, inclusiveness, and meaningfulness) and Teal (based on self-management, wholeness, and evolutionary purpose, or reason for being). The Orange stage flourished with the development of industry and resulted in an innovation strategy mainly driven by economic performance. Green organisations will stress environmental and social innovation, and Teal ones will emphasize the societal impact and sense of purpose in innovation activities.

2. Building a model of innovation culture

Innovation culture has specific characteristics that can be observed from five viewpoints. The first one is the presence of *innovative leaders and managers*. The most innovative organizations are led by innovators who are equipped with high discovery skills (e.g., who have created new products, and believe they can change the world; Christensen et al, 2013). Leaders have a central role to play in supplying all company departments with innovative individuals (Christensen et al, 2013) and in encouraging staff creativity (Amabile et al, 1996; Mathafena and Grobler, 2021). Leaders and managers are therefore key to approaching an organization's innovation culture.

Innovation culture is also implemented at *teams' level* (Barnhill, Smith and Oja, 2021). Promotion-oriented teams (seeking benefits aimed at an ideal, as opposed to prevention-oriented teams focused on avoidance of losses) perform better on idea generation and diffusion (Rietzschel, 2011). In addition, innovative teams gather individuals with complementary skills, some excelling in discovery skills (Christensen et al, 2013), others with good communication, openness to new ideas, ability to challenge, trust, and help each other (Amabile et al, 1996). To enhance team's capacity to innovate, it is recommended to increase its diversity (Jones et al, 2020; Park et al., 2021).

The third level of innovation culture is supported by *innovative individuals* (Volery and Tarabashkina, 2021) exhibiting higher discovery skills (Christensen et al, 2013). Among factors contributing to innovation culture, Dobni (2008) identified several individual characteristics such as empowerment, freedom, creativity and commitment to the innovation process. In addition, the results of work engagement surveys also suggest that there is a direct link between individual engagement and firm-level innovation (Gallup, 2013). Engaged individuals are those who work with passion, in accordance with their company's vision. They stimulate innovation and are strong driving forces.

Innovation culture can also be inferred from how *external links* are managed (Fu, 2022). Networking is one of the discovery skills (Dyer et al, 2008). In innovative companies (Christensen et al, 2013), one will find this skill at all levels (individuals, teams, management), to develop both internal relationships inside the company and external relationships outside. Innovation culture is characterised by numerous and easy relationships with the outside (Cameron and Quinn, 2011; Hwang and Horowitz, 2012). In Laloux' model (2015), organizations develop a specific type of external relationship at each stage of evolution. At the Amber stage, the organization seeks to have no connection with the outside world, wants to be self-sufficient and aims for monopoly. Others are suspicious. In the Orange stage, competition reigns. Others are rivals, and you have to be better than them. With the Green stage, justice, equality, and harmony are sought with stakeholders, shareholders, management, employees, civil society and nature. Others are valuable partners. With the Teal stage, the organization integrates humans as a whole; each relationship is possibly fruitful, whether internal or external. Borders of the

company tend to disappear. Thus, depending on the type of organization, external relationships can be denied, suspected, or trusted. In highly innovative start-up companies (Hwang and Horowitt, 2012), relationships with the external environment favouring innovation have three characteristics: first, a benevolent view of the external environment, then a multiplicity and variety of internal/external contact points, and finally the ease and speed of setting-up collaborations.

The fifth level of innovation culture is the *organizational context* in itself (Nani and Safitri, 2021). For Christensen et al (2013), innovative companies are characterised by a general philosophy that includes four principles: Innovation is everyone's business, disruptive innovation is central, small and structured project teams are preferred, intelligent risks are taken. Most of the key factors proposed by Dobni (2008) to evaluate innovation culture are related to organizational context and philosophy of action: social representation of innovation, organizational learning capacity, market orientation (product, customer, competitor), value orientation, and agile and flexible context. Another school of thought focuses on the work environment, and how it enables and promotes innovation (Amabile et al, 1996; Amabile and Kramer, 2011; Amabile and Pratt, 2016). A work environment which will enable innovation is characterized by the absence of organizational obstacles, meaningful work, a good level of challenge for everyone, and motivation to innovate. Hwang and Horowit (2012) compare the Silicon Valley with the Amazonian forest (hence the title of their book, *The Rainforest*). This model implies that innovation would occur preferentially in luxuriant contexts, rich in exchanges, and would often emerge from "weeds" that develop spontaneously without having been expected or encouraged. This image contrasts with that of the field (planted with "seeds"), with a well-defined process, everything all lined up, in which weeds are regularly eliminated. A parallel could be drawn with Laloux's (2015) model: When innovation is natural, it does not need a formalized process, it develops no matter what happens, like a weed.

3. The ETOIle model

We gather these insights from the literature in a model called ETOIle, which stands for External links, Team, Organization, Individuals and Leaders. The word "étoile" also means "star" in French, which seems appropriate to refer to innovation. Table 1 summarizes the aforementioned references used to ground this model.

Table 1: Innovation culture model ETOIle sources

Branches		References
E	<i>External links</i>	(Amabile et al, 1996; Amabile and Pratt, 2016; Cameron and Quinn, 2011; Christensen et al, 2013; Fu, 2022 ; Hofstede et al, 2010; Laloux, 2015)
T	<i>Innovative Team</i>	(Amabile et al, 1996; Barnhill, Smith and Oja, 2021 ; Christensen et al, 2013; Rietzschel, 2011)
O	<i>Organization context</i>	(Amabile et al, 1996; Amabile and Pratt, 2016; Cameron and Quinn, 2011; Dobni, 2008; Hofstede et al, 2010; Hwang and Horowitt, 2012; Laloux, 2015; Nani and Safitri, 2021)
I	<i>Innovative Individuals</i>	(Amabile et al, 1996; Amabile and Kramer, 2011; Amabile and Pratt, 2016; Christensen et al, 2013; Dobni, 2008; Gallup, 2013; Hwang and Horowitt, 2012; Volery and Tarabashkina, 2021)
Le	<i>Innovative Leaders and managers</i>	(Amabile et al, 1996; Amabile and Pratt, 2016; Cameron and Quinn, 2011; Christensen et al, 2013; Hofstede et al, 2010; Laloux, 2015 ; Mathafena and Grobler, 2021)

On the basis of this model we designed a tool to diagnose innovation culture, as elaborated in the following section.

4. Diagnosing innovation culture

4.1 Design of the questionnaire

The questionnaire we built actually addressed only four branches of the ETOIle model, namely External links, Team, Organization and Individuals. The Leader's branch was disregarded for several reasons. First, our preliminary investigations on the issue of evaluating leadership in organizations suggested that it was a sensitive matter. Therefore, leadership evaluation may be highly prone to a social desirability bias. Secondly, the literature regarding leadership style evaluation is already abundant and we felt it was not necessary to build a new tool on this topic. For example, the MLQ (Multifactor Leadership Questionnaire; Bass et al, 2003) is a validated and widely used tool to do so.

The questionnaire we designed draws on existing scales measuring sub-dimensions of the ETOIle model. Table 2 details the sub-dimensions included, the relevant references, the total number of items selected for each sub-

dimension, and an example of these items. Some items were directly extracted from existing validated scales; others were translated, rephrased, or written by us, which further justifies that a laboratory validation was required. The final questionnaire was written in French.

Table 2: Innovation culture questionnaire sources

Branches of the ETOILE model		Sub-dimensions	References	Item's examples	Number of questions
E	External links	Outward-links: multiplicity and diversity of relations with the external environment	(Bertelli et al, 2016; Hwang and Horowitz, 2012; Mercan and Goktas, 2011)	"In my company, I can easily and quickly launch a project with external partners."	8
T	Team	Encouragement to use discovery skills	(Christensen et al, 2013)	"We are encouraged to ask questions even if it means changing habits."	5
		Promotion regulatory focus	(Rietzschel, 2011)	To which extend this proverb is representative of your work team: "Nothing ventured, nothing gained."	9
		Prevention regulatory focus	(Rietzschel, 2011)	To which extend this proverb is representative of your work team: "Prevention is better than cure."	9
O	Organization	Significance of innovation	(Dobni, 2008)	"In my company, we invent and propose new products and services."	5
		Focus on products and customers	(Dobni, 2008)	"In my company, every employee knows the customers and their needs."	4
		Managerial practices: position with regard to Laloux' model (Amber, Orange, Green and Teal stages)	(Laloux, 2015)	"In my company, leaders are mainly focused on short-term objectives."	12
I	Individuals	Engagement	(Gallup, 2013)	"There is someone at work encouraging my development"	12
		Discovery skills	(Christensen et al, 2013)	"I often experiment new methods."	10
		Delivery skills	(Christensen et al, 2013)	"I am extremely careful to avoid mistakes in my job"	10
Demographics		Age, gender, tenure			6

4.2 Laboratory test

4.2.1 Hypotheses

In order to validate our questionnaire, we hypothesized that:

H1: Each branch is consistent and the chosen items are coherent with one another.

H2: The four branches (External links, Team, Organization and Individuals) are independent from one another.

4.2.2 Participants and procedure

115 French-speaking participants volunteered to take the survey; the sample was composed of 60 women, 52 men and 3 persons who did not identify their gender. They were on average 29.1 years old (SD = 7.75). All of them were working for different companies; 34% had less than 2-year work experience, 42 % between 2 and 5 years, and 24% for more than 5 years. Respondents were all engaged in a one-year executive training program that they followed as initial or as continuing training in our institute and were recruited in this context. The

participants filled out paper forms of the questionnaire during their training time, during a 30-min dedicated session.

4.2.3 Results

To test H1, we performed a reliability test on each branch of the ETOI model, as detailed in Table 3. In the Managerial-practices sub-dimension of the Organization branch, only the items related to Green and Teal stages proved reliable, hence we decided to remove the items related to Amber and Orange stages. With this new set of items, the three sub-dimensions (Significance, Focus and Managerial-practices) are consistent as a branch ($\alpha = 0.708$). We then kept 10 sub-dimensions allocated to four branches of our model: External links, Team, Organization and Individuals.

Table 3: Reliability of the branches and sub-dimensions of the ETOI model

Branches		Sub-dimensions	Cronbach's alpha	Reliability
E	External links	Outward-links: multiplicity and diversity of relations with external environment	0.809	$\alpha=0.809$
T	Team	Encouragement to use discovery skills	0.841	$\alpha=0.686$
		Promotion regulatory focus	0.690	
		Prevention regulatory focus	0.825	
O	Organization	Significance of innovation	0.841	$\alpha = 0.708$
		Focus on products and customers	0.690	
		Managerial practices: position in Laloux' model	Amber	0.178 (items removed)
			Orange	0.378 (items removed)
			Green and Teal	0.842
I	Individuals	Engagement	0.914	$\alpha=0.673$
		Discovery skills	0.787	
		Delivery skills	0.787	

To test H2, we performed a principal component analysis (rotation method: Varimax with Kaiser normalization) with the 10 aforementioned sub-dimensions. Analysis converged after five iterations. Three components appeared, that are presented in Table 4 together with factors loadings of each sub-dimension.

Table 4: Components matrix after rotation

		1	2	3
External links	Outward-links	0.687	0.38	0.009
Team	Encouragement	0.607	0.315	0.479
	Promotion	0.269	0.789	0.218
	Prevention	0.095	0.839	0.171
Organization	Significance	0.768	0.296	0.224
	Focus	0.714	-0.231	0.169
	Managerial-practices	0.703	0.29	0.164
Individuals	Engagement	0.447	0.371	0.469
	Discovery	0.024	0.151	0.863
	Delivery	0.305	0.128	0.743

The first component gathers the branch External links, the three sub-dimensions of Organization (Significance, Focus, Managerial-practices), and the sub-dimension Encouragement, which we had initially positioned in the Team branch. This component best matches the Organization branch of our model. The second component gathers two Team sub-dimensions (Promotion and Prevention) and therefore matches the Team branch of our model. The third component gathers 2 of the 3 sub-dimensions related to Individuals (Discovery and Delivery skills) and matches our Individuals branch. The sub-dimension Engagement is equally distributed on the three components. The principal component analysis shows that all ETOI branches are not independent, as External links and Organization fall within a unique component. H2 is therefore partly validated.

4.3 Discussion

As our results show, the External links branch appears to be part of the Organization branch. This result is not so surprising. Our initial model was in line with Cameron and Quinn's (2011) vision which classifies organizations along two orthogonal axes (flexibility vs. control and internal vs. external focus) but the results of our study are consistent with Laloux' (2015) model, in which all the characteristics of an organization evolve concurrently at the same time: individuals and hierarchy roles, perception of the outside of the organisation, interest in and

naturalness of change and innovation... Besides, the innovative ecosystem described in Rainforest (Hwang and Horowitz, 2012) highlights the absence of border between the inside and the outside of an organization. The same rules apply with collaborators, external stakeholders and society as a whole. This analysis supports the view that Organization and External links can be seen as a single branch and operate alongside in innovation culture.

Concerning the Team branch, we hypothesized that it has three sub-dimensions. One of them (Encouragement) appears to be part of the Organization branch. Encouragement is related to how far the use of discovery skills is supported and rewarded within a team. Our results suggest that the level of encouragement in teams, in this sense, is actually representative of the level of encouragement in the organization. Although one may observe some teams with practices non-aligned to their parent organizations (Amabile and Pratt, 2016), our data appear to be consistent with Christensen et al's (2013) view that, in innovative firms, the organization core processes drive the possibility to implement extensively and reward the discovery skills at all levels.

The Team branch of our model is now restricted to Promotion and Prevention regulatory focus. These two sub-dimensions appear to correlate positively whereas we expected them to correlate negatively at the team level, with teams particularly used to risk taking (Promotion), or to uncertainty avoidance (Prevention), but not to both. It seems possible that, at the individual level, promotion and prevention regulatory focus are independent, but can be positively correlated at the team level, each team being composed of individuals with different profiles and building on everyone's dispositions. In this respect, it could be interesting to replicate Rietzschel's (2011) protocol to study individual regulatory focus of each team member, and confront it to the team-level regulator focus. This would enable us to understand if the team is structured as the intersection or as the union of its members. Furthermore, group's mechanisms might be different depending on the team mission (e.g., control laboratory, innovation project).

Regarding the Organization branch, two of the three sub-dimensions are consistent (Significance of innovation and Focus on product and customers). However, concerning Managerial practices, neither Amber items nor Orange ones were reliable. In contrast, Green and Teal items were aggregated to create a Teal index which gathers elements dealing with the terms in which missions and responsibilities are defined, and the role of every member of the organization. It seems conceptually related to power distance (Hofstede et al, 2010). Power distance is indeed defined as the extent to which the less powerful members of organizations expect and accept that power is distributed unequally. The higher the Teal Index, the lower the power distance. However, power distance may vary within a given organization. According to Hofstede's studies, educational level, type of job and social class are highly interdependent and power distance strongly decreases with higher education, more qualified and socially recognized jobs (Hofstede et al, 2010). In our sample, the respondents were highly educated (master's degree). It would be interesting to check out the reliability of the Teal index with a sample from a single organization, with varying types of job and levels of qualification.

Concerning the Individuals branch, the three sub-dimensions are reliable. The Engagement sub-dimension appeared in the three components of the Principal Component Analysis: Organization, Team and Individuals. Therefore its contribution to the model of innovation culture is not clear. One can even wonder whether it may not be a result of innovation culture rather than a precondition. Hence we decided to remove it from the ETOILE model.

Further validation of the diagnosis tool would be necessary. We should notably include a leadership metric and study its relation with the other branches of the model. Furthermore, a predictive model including metrics of innovation performance would also enable to test the respective predictive power of each branch of our innovation model with regard to the final results of innovation. Such a study would be consistent with our analogy to Lewin's equation (1936) supporting the view that innovation performance partly results from innovation culture. In order to test a full equation of innovation performance, the study could also include metrics measuring the presence and importance of innovation process, in OECD's (2018) framework. Hence the respective predictive power of implicit cultural traits and explicit organizational processes could also be evaluated.

It would also be necessary to run complementary validations of our tool with a new type of population in the context of a case study. Our sample was generic but heterogeneous. In particular, we had only one respondent for each company, which was acceptable to check out the psychometric properties of our diagnosis tool (internal

reliability of each branch, relations between branches) but would be insufficient to characterize a given organization's culture. To be reliable, the diagnosis of an organization's culture should be performed by several members representing several departments and hierarchical levels and building a consensual view (Cameron and Quinn, 2011; O'Reilly et al., 1991).

5. Conclusion

On the basis of the results of this study, we proposed to refine our initial model and corresponding tool to measure innovation culture. Even if we did not study the Leaders' branch in the present experiment, we still believe that it is a major factor to understand innovation culture. Therefore, to date, we consider that a fruitful model of innovation culture should include four branches: Team, Organization, Individuals, Leaders. We rename it TOILe accordingly, which has several meanings in French: a "toile" may be a plain weave, a robust and sustainable material for everyday life; it is also used to designate canvas, which support artwork – canvas being also a concept frequently used in innovation to structure its spreading.

Overall, we view our contribution as threefold. First, from a theoretical viewpoint, our model intends to introduce an evolutionary approach and go beyond previous models of organizational culture which were thought in the Orange paradigm. Secondly, we also set the basis for a specific model of innovation culture to meet a contemporary need of companies to transform towards more innovation. Finally, from a methodological viewpoint, we provide a diagnosis tool for helping companies identify their strengths and weaknesses with regard to innovation.

All in all, organizational culture appears as a critical factor to master innovation strategy, implement relevant and efficient processes, and develop innovation performance and growth. Through our model of innovation culture and our diagnosis tool, we hope to contribute to supporting organizations to question themselves, gain awareness of their own position with regard to innovation requirements, existing drivers, limitations and barriers in their mindset and behavior. Such consciousness-raising process could be the first step towards a deeper transformation. In an evolutionary perspective, this transformation may meet current demands for sustainable innovation and be consistent with sociocognitive evolution of mankind.

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