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**The influence of organizational culture  
on problem creation process:  
exploring the relationship using CAS perspective**

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## **Abstract**

**Title:** The influence of organizational culture on problem creation process: exploring the relationship using CAS perspective

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**Examiner:** Ass. Professor Sotaro Shibayama

**Keywords:** Front end of innovation, problem creation process, problem finding and framing, problem formulation, organizational culture, complex adaptive systems.

**Research question:** How does organizational culture, using complex adaptive systems perspective, influence problem creation process in the front end of innovation?

**Methodology:** A qualitative research based on a single case study of a Swedish high-technology company, following an inductive approach. Interviewees were treated as multiple cases, selected using purposive snowball sampling to gather empirical data through semi-structured interviews, which were analysed adopting a within- and cross case method.

**Theoretical perspectives:** Front end of innovation literature is the core subject of this thesis, focusing on problem creation process. Academic literature on organizational culture and complex adaptive systems is presented to show the relationships between theoretical concepts and highlight gaps and contribution to existing literature.

**Conclusions:** The findings supported that organizational culture shapes problem creation process and the level of the innovativeness of its outcome by influencing how individuals interact within an organization, how diverse the interactions and related information sharing is and how productive and effective such interactions are, as well as, by shaping the individual beliefs and norms related to which actions are being collectively encouraged when engaging in problem finding, framing and formulation activities within an organization. In particular, it was identified that characteristics such open and informal, collective, product-oriented and problem-solving culture were influencing and shaping how problem creation process was conducted and thus what was the resulting level of problem newness as its outcome

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Ercole and Jaroslava

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## **List of Abbreviations**

PCP: Problem Creation Process

CAS: Complex Adaptive Systems

OC: Organizational Culture

EI: Employee Interaction

# 1. INTRODUCTION

## 1.1 Background

Activities in the front end of innovation are proven to play a critical role in the overall success of new product development and commercialization (Koen et al. 2014). The implications are especially potent for technology-oriented companies, where those activities shape and highly influence the later product development phases conducted generally via structured and narrow-focused project execution. Studies have previously shown their positive impact on reducing the technical uncertainty at the start of those new projects leading to the increased success of their results (Verworn, 2009). Moreover, they have supported the importance of the front end on quality of later defined product and market characteristics, influencing the overall new product success (Bacon et al. 1994). The relevance of such activities has been proved to be especially high when creating and developing new products or services which are new to the firm or new to the market and not mere product alterations (Verworn et al. 2008, Florén & Frishammar, 2012, Koen et al. 2014, Frishammar et al. 2016). It is within this context that companies are faced with the challenges to “create new ideas, give them direction and set them in motion“(Florén & Frishammar, 2012). In general, this research adopts the description of the nature of these activities as related to idea and concept development, refinement, screening and alignment, as proposed by Florén and Frishammar (2012).

Focusing specifically on the early phases regarding idea and concept development, it is proposed by existing research that the actual emergence or generation of ideas is often preceded and critically influenced by connected set of activities such as opportunity identification and opportunity analysis (Koen et al. 2001) or problem mapping and problem creation (Frishammar et al. 2016). Here the interest is especially in the latter problem approach as it is relevant when addressing the challenges of coming up with new and innovative products, which essential role is to solve new problems or solve problems in a new way. In addition, as opportunity discovery, and by extension opportunity identification, could be seen as a problem-solving process that produces answers about unsolved problems (Hsieh et al. 2007), there is a logical causality between how a solution, reflected in an idea or a concept, looks like and the nature of a problem it was supposed to answer. Therefore, it matters which problems are to be solved and how they are formulated in relation to how they will be solved and what ideas will be further developed

(Frishammar et al. 2016). A recent innovation study involving diverse group of companies across 17 countries confirms a relevance of this issue by finding that more than 80% of surveyed companies saw the problem formulation rather than problem solving as their key organizational innovation challenge (Wedell-Wedellsborg, 2017). Assuming the importance of solving the 'right problems' for companies to sustain their long-term growth, this research is interested in studying this very early phase of front end of innovation further. The focus is narrowed towards further understanding of problem creation process and its influences, as defined in literature by Frishammar et al. (2016), consisting of problem finding and framing and problem formulation.

## 1.2 Problem Discussion

The dominant approach of a current research on how the problems are being formulated and solved in relation to organizational innovation considers management behavior and its decisions as key elements. (Baer et al. 2013; Lyles, 2014 ; Hurmelinna-Laukkanen & Heiman, 2012; Bessant et al. 2014). While acknowledging the influence of management actions, it can be argued that this view is sufficient enough within a structured and formally imposed innovation management framework reflected more in later stages of innovation process, such as idea and concept selection stages and following project-based new product development stages. However, within the context of early stages of the front end of innovation which are defined by their fuzzy (Verworn, 2009), unstructured (Ho & Tsai 2011) and chaotic (Cheng & Van De Ven, 1996) nature, the models relying only on describing the nature of top-down management influence or formulating descriptive process step-by-step flow (Frishammar et al. 2016) are limited in their understanding, for example, how informal social context shapes the process not only from top-down as supported but from bottom-up as well, through influence of such collective behaviors of ordinary employees. This research is focusing on early stages of innovation in general and problem creation process (PCP) in particular within organizations which do not have formally structured PCP and thus are representative of an organization where previous research, focused as stated, falls short with its key assumptions of managed order and process linear flow. Problem creation process is defined and understood in this research as any formal or informal set of observable activities within an organization or its selected departments which reflect the original PCP proposed by Frishammar et al. (2016) as stated related to activities of problem finding, framing and formulation.

When looking at which factors influence early stages of innovation in a company, the existing research points at organizational attributes such as culture, vision and strategy as being the most important success factors in the front end of innovation (Koen et al. 2014). This is further supporting the extended argument of successful innovation requiring an integrated or holistic approach, linking product development practices and strategies with the overall business vision, culture and leadership (Lafley and Charan, 2008; Khurana and Rosenthal, 1998). In addition, as argued by Khurana and Rosenthal (1998), such holistic front end can be achieved by either implementing a formal process, or adopting a culture-driven approach. This study focuses specifically on the relationship between organizational culture and PCP within the organizational context of such minimally formalized PCP where culture is argued to be the of the dominant influence.

The existing research on front end of innovation views culture as an organizational attribute which serves as an instrument for reaching desirable innovation performance, acting as a performance driver or stifler depending on its characteristics of openness, trust and communication, as best represented in the well-established New Concept Development model proposed by Koen, Ajamian, Boyce et al. (2002). Its influence has been proven to a significant extent and it has been even suggested that in order to create more innovation, companies should start with the focus on mentioned organizational attributes rather than ideation or opportunity identification when introducing innovation initiatives (Koen et al. 2014). However, the applied culture perspective is rather static and linear, assuming the nature of the organizational culture as something organization possess and management can shape it and use it (Schneider et al. 2017) to drive increased innovation performance.

Adopting such perspective, existing research is currently able to show and support a linear, one-directional impact of culture characteristics on innovation performance. However, it lacks insights into how culture influences selected front end of innovation processes in a more complex way, not considering the potential non-linear relationships between an organizational culture, social conditions and processes' characteristics which would be more representative of real-life dynamics inside organizations. The current research disregard the existence and influence of social interactions between company's employees and how culture facilitates and partially guides such interactions, lacking the understanding of how culture, through such interactions can shape and guide informally emerged processes within organizations. To address these limitations and to contribute to existing research with such additional insights, this research proposes to adopt a new perspective on organization culture which promotes the

connection between collectively shared beliefs and exhibited actions and stresses the importance of social interactions as shaping the behaviors of organization members (Smircich, 1983). As such it is considered as a pattern of shared norms and beliefs among organization members, guiding and constraining their behaviors (Schein, 2010), collectively formed and developed by them through interactions with and within their environment.

Because organizations are complex social systems in their nature, the importance of studying them this way has implications on how internal processes are described and influenced and the understanding of the dynamics of collective actions (behaviors) within organizations, related to culture as well. Therefore, to complement the cultural perspective adopted and support the further study on PCP by overcoming the mentioned existing static and linear descriptions of their nature and dynamics within existing research, the framework of complex adaptive systems (CAS) will be adopted.

The CAS model originated within biological and social systems modelling where it captured the key characteristics of complex systems, such as non-linearity, self-organization and emergence (Anderson, 1999). The key elements of the model are agents, defined as organizational members or groups across various hierarchical levels, whose behavior is governed by a set of recognizable assumptions and beliefs regarding which actions to take when and how to respond to various choices regarding their possible courses of actions, formally called agents' schemata (Complexity Academy, 2016). Acknowledging the importance of culture in absence of formal rules and procedures, this research proposes the relationship between the organizational culture and PCP to be viewed though and studied with the help of basic characteristics and assumptions of this CAS framework (model) where the influence of organizational culture on PCP will be studied and analyzed within a context of non-linear social interactions and collectively guided actions, as assumed using CAS perspective, providing an opportunity to further our understanding in current literature.

### 1.3 Research Purpose and Research Question

In line with the previous discussion, the purpose of this research is to contribute to the front end of innovation literature by further extending the current research on early phases of the front end, specifically related to problem creation process (PCP) in the front end of innovation as proposed by Frishammar et al. (2014) and its relation with organizational culture. In general,

the aim is to extend this research by focusing on studying the interrelations between organizational culture and the PCP, using the perspective of complex adaptive systems (CAS) theory and its basic assumptions to reflect the often informal, social-context dependent and dynamic nature of both early stages of innovation and influential organizational culture, representative in the case company as well.

In particular, this research is interested in understanding how organizational culture shapes the problem creation process (PCP), using the basic assumptions within complex adaptive systems (CAS) framework, to contribute to the existing research on further studying and describing the relationship between organizational culture and PCP as present within the predominantly collaborative and informal social context of the case company chosen.

Based on the previous reasoning, this study is proposing the following research question:

**How does organizational culture, using complex adaptive systems perspective, influence problem creation process in the front end of innovation?**

## 1.4 Case Company

This research has been conducted in a Swedish technology company, which is currently the global market leader in its industry thanks to the success of disruptive hardware products innovation during the 90s. During the last decade, the company started to grow internally and expand worldwide in a fast pace, facing different organizational readjustments while trying to maintain its organic, open and informal structure and culture.

The majority of employees have an engineering educational background, either mechanical, electronics, software, firmware or IT, determining the overall high technology focus of the business. The manufacturing and sales channels of its products are outsourced and indirectly controlled through an extensive partnership program, including suppliers, hardware and software vendors, distributors, system integrators, hosting providers and consultants. In this way, the company can fully exploit its engineering nature and spend the majority of resources on R&D activity. R&D activities are performed across different product departments, each of them dealing with a specific product category, and the working rhythm is based on projects defined by a roadmap that is periodically introduced by the relative product manager. As in many other technology companies, R&D departments are the main source of innovation, where

employees have the opportunity to identify problems, generate new ideas and implement them in order to solve the problems.

While the new product development is well structured and efficient, the front end of innovation is completely the opposite. There are no guidelines, strategies and expectations regarding innovation matters, leaving employees with freedom and broad search space when looking for opportunities and problems, using preferred methods and approaches. On the other hand, projects represent an indirect practical obstacle for both individual and project-based innovations, through strict deadlines, scheduling, limited resources and technological requirements. As a result, radical innovations are discouraged and turned down due to the previously restrictions, and the company has recently focused on incremental innovation, expanding and protecting the current product portfolio. This dual effect is caused by the organizational readjustments that the company is trying to implement in order to face the recent growth, bringing more structure and bureaucracy in the everyday-way of working without changing its culture. The organic organizational culture is always regarded as a strength by employees and a major influencing force in their daily work, encouraging frequent interactions, teamwork and collaborations within and across departments, fostering creativity, innovation and allowing information and knowledge sharing. It can be argued that this factor is the main force influencing informal problem creation behavior. It is therefore interesting to study this cultural context in more details, understanding the guiding principles that are shared between employees, determining their interactions and patterns of behavior that are necessarily going to impact problem creation activities.

## 2. LITERATURE REVIEW

A systematic review of research related existing literature is adopted in order to present and elaborate in depth on the relevant concepts and theories on which this research is built. Concepts and related models are going to be introduced separately in each section and then related between each other so that the identified existing research limitations can be further highlighted and justified. The first section describes problem creation process within the front end of innovation context, its characteristics and general nature of activities involved within such process. The second section introduces the origins and basic assumptions of complexity theory and elaborates further specifically on the complex adaptive systems (CAS) framework, its characteristics and its value regarding its use as a chosen perspective in this research. The third section describes the various perspectives adopted within studies of organizational culture, defining organizational culture and its underlying assumptions for the purposes of this research.

### 2.1 Problem Creation Process and Front End of Innovation

#### 2.1.1 Early Stages of Front End of Innovation

Processes or activities which precede the generation of new idea within an organization are generally viewed as related to early stages of the front end of innovation. They are described as being related to either opportunity identification and analysis specifically (Koen et al. 2001) or preceding the idea and concept development in general (Florén and Frishammar, 2012). Regardless of various degrees of formal and methodical description of such activities within the existing literature, the authors share some common assumptions about their nature.

Firstly, early stage activities are often chaotic (Cheng and Van De Ven, 1996; Koen et al. 2001; Gomes, 2003; Ho and Tsai, 2011) and connected to environmental uncertainty (Verworn, 2009; Florén and Frishammar, 2012; Gurtner and Reinhardt, 2016). The more new to a company or a market the idea for a product or a service is, the process of coming up with such ideas requires more experimentation (Koen et al. 2001) as a company is facing a need to respond to a changing external market or technology shifts (Ho and Tsai, 2011; Gurtner and Reinhardt, 2016) and

align those changing demands with its existing internal conditions (Florén and Frishammar, 2012). Such uncertainties reduce the usefulness of formal processes (Verworn, 2009) which were set up to favor the past conditions, leading to often informal and unstructured, thus fuzzy or chaotic nature of how companies go about generating new ideas as they are trying to adopt to its changed environment. As a result, there is a need for alignment within organization as to how those activities are being approached across the departments (Khurana and Rosenthal, 1998) and ensuring their capability for flexibility and adaptability.

Secondly, the characteristics of such early stage activities are dependent on the organizational context (Florén and Frishammar, 2012; Perry-Smith & Mannucci, 2017) and collaborations (Reid et al. 2014). The authors argue how an idea needs to be perceived as relevant within an organization first and thus made legitimate to be even considered for further development (Florén and Frishammar, 2012). It is therefore assumed that later success of new idea is not only related to how well it reflects the external environment but its relevance is viewed and filtered through particular internal social environment within an organization in which it is collectively understood, at least on an informal level, what is ‘a good idea’ and what is not. This means that the influence of social norms or shared beliefs within an organization about which actions to take and how, is even more significant and visible when there is a lack of formal rules to guide such actions, as is often reflective of early stage activities as described. Furthermore, the relevance of social interactions is further supported by a predominantly collaborative nature of early stage activities where authors argue that collaboration between individuals or groups within an organization is necessary and thus naturally occurring as they are seeking to gather relevant information needed which would enable them to generate and develop potentially successful ideas.

Thirdly, to be successful in such early stage activities, as engaged in by various individuals or groups within an organization, its required for those engaging in them to have capacity for cognitive flexibility (Perry-Smith & Mannucci, 2017) and divergent thinking (Reid et al. 2014). As individuals should be able to generate ideas which are new and original compared to the existing company or market solutions, they have to be able to generate and consider many alternative and creative ideas (facilitated by divergent thinking) to be able to diverge from the known solutions and expand their thinking into new ideas with higher degrees of innovation. Similarly, as new ideas are to respond to the changing external environment (change in markets, technologies, etc.) creators or developers of such ideas need to be able to be flexible in their professionally operating beliefs and assumptions and be ready to change their ways of

thinking and working to support the changed environmental conditions. Such capability is described as cognitive flexibility (Perry-Smith and Mannucci, 2017) and as such heavily influences how individuals are able to mentally adapt and shape their ideas to reflect the experimental and chaotic nature of the front end of innovation, as described.

### 2.1.2 Problems and Idea Generation

Using problem-solving theory approach, certain authors argue that innovative solutions in general (Baer et al. 2013; Lyles, 2014) and idea generation and development (Florén and Frishammar, 2012) in particular, are actually preceded by finding and formulating what problems are to be solved (Frishammar et al. 2016). Authors view idea generation and development as a problem-solving activity, which is dependent on and constrained by what problem is to be solved. Formulating right and thus valuable problems to be solved instead of invaluable ones is seen within the existing research as a key challenge that needs to be overcome (Nickerson et al. 2012, Baer et al. 2013) to arrive at successful and innovative solutions which will be valued by the market and would lead to a company's sustainable growth. As key obstacles to formulating such problems, the research counts narrow sampling of information, jumping to solutions and differences in understandings of a problem within among the members of a team (Baer et al. 2013). Authors argue that such challenges lead to formulating problems with fewer alternatives and reduced relevance, negatively affecting the potential future success of ideas based on such problems. It is further proposed that to mitigate such obstacles would result in improved effectiveness of problem formulation process and less limiting solution search, increasing the possibilities for potential future value creation for a company (Baer et al. 2013).

In addition, as one of the key concepts of highly influential Behavioral Theory of the Firm – problemistic search – concurs, the problem solutions are often sought in the vicinity of the problem or the problem symptoms. It supports the importance of adequate problem finding as well as previously described problem formulation, especially as a more explorative and distant search is required (Gavetti et al. 2012), as it often is a general case when coming up with new products or services which are new to the companies or markets. Existing research sees problem finding as a starting point when companies want to create and capture value by solving valuable problems formulated and determines two main biases or challenges related to it, problem-finding context and individual/group biases (Hurmelinna-Laukkanen & Heiman,

2012). The authors further argue that in order for organizations to overcome such biases and thus realize their innovative potential, they need to be aware of the biases and implement appropriate processes to overcome them.

Appropriate problem-finding and problem-formulation drive companies to identify the fundamental challenges in their environment and generate alternative innovative solutions (Baer et al. 2013). The overall importance of relevant problem finding and formulation as being a part of early stage innovation activities is related to three main aspects. Firstly, it provides guidance towards what ideas are to be generated as they are supposed to solve the defined problem(s). It provides a relevant set of constraints within which the exploration of new ideas should take place, facilitating the needed alignment within the organization. As often being a case, there could be many specific solutions to one general problem. The orientation on the problems to be solved as a starting point in early stages of innovation provides management with a relevant yet flexible strategy for making the idea generation process faster and more relevant to the overall business strategy (Lyles, 2014), thus more efficient in its nature. Secondly, it represents a needed orientation on problems the company's existing or potential customers have or will have as well as focusing primary on the solutions. This is particularly relevant within the technology-oriented companies, which struggle less with the technological uncertainty but more with customer-oriented market uncertainty, as they are constantly facing the changing external technological and market conditions (Verworn et al., 2008). Thirdly, the problem finding and formulation focus within early stages of innovation helps to stimulate flexibility in ways or approaches how new ideas are being generated (Lyles, 2014). As author further suggests organizations have tendencies to rely on their best practices and past successful solutions but this approach is not sufficient for coming up with new and innovative solutions. Therefore, an active engagement in problem finding and formulating activities before jumping to solutions helps to decrease the possibility of solving wrong or overly simplified problems and stimulates solutions which are driven by problems and what they need in order to be solved, encouraging flexibility and adaptability in a process (Lyles, 2014).

The dominant perspective of a current research on how the problems are being found, formulated and solved, as impacting the level of organizational innovativeness, focuses on a role of management, its behavior and decision-making practices (Baer et al. 2013; Lyles, 2014 ; Hurmelinna-Laukkanen & Heiman, 2012; Bessant et al. 2014). Such perspective adopted imply that managers are the only key actors facing challenges connected to addressing such innovation-inducing problem formulations and solutions, and that only their faulty or biased

actions result in defining the wrong problems to work on (Lyles, 2014). While acknowledging a significant role of management, especially related to formally structured organizational processes and their success criteria, and decision-making capabilities, it can be argued that this view is well suited and sufficient enough within a structured and formally imposed innovation and new product development management processes, reflected more in later stages of innovation, such as idea and concept selection process and formal project-oriented new product development process.

However, relating to the previously stated key characteristics of early stage innovation activities as being chaotic and unstructured, dependent on organizational social context and collaboration, and influenced by level of flexibility and adaptability of their participants (managers as well as non-management employees), currently adopted top-down approach of the sole management influence and involvement is limited in its application in such context. Firstly, it does not consider the scenarios in which problem finding and formulation are being also executed on lower levels of organization by relevant groups of employees (e.i. R&D teams) due to the lower levels of formal control within the organization or overall informal culture-induced organizational process structures. Secondly, it underplays the importance of organizational social context (e.i. organizational culture, nature of work, employees' profiles, etc.) and related characteristics of social interactions as also influencing the way how problems are being found, formulated and even solved and which problems are being collectively considered relevant and the right ones to pursue. Thirdly, it promotes a linear causality between management decisions and problem finding and formulation processes and outcomes, and logically by extension idea generation as solution outcomes, omitting the collective and bottom-up driven influence of developed organizational routines and shared beliefs, represented in the particular organizational culture, in influencing which and how different actions and tasks within the organization are being encouraged and pursued. As the case company reflects these real life circumstances, as companies with similar characteristics often do as well, this research recognized these limitations and will address them by adopting the perspective that would facilitate describing and understanding of the nature and dynamics of such early stage activities in their more real-life context as described previously.

### 2.1.3 Original Problem Creation Process Framework

The original framework of problem creation process reflects the empirically based findings that problems are often not merely discovered but newly generated thus created, especially when pursuing more higher-degree innovation where new products are new to the company or new to the market (Frishammar et al. 2016). Within the proposed early stages of the front end of innovation practices as defined by Frishammar et al. (2016), problem creation process within an organization consists of three activities: *problem finding*, *problem framing* and *problem formulation*. The problem creation process as stated represents Step 2 out of the overall Process of Idea and Concept development model, based on the empirical data from a successful innovation consulting company. Theoretically, the model is based on the previous work by the authors in front end of innovation and previously discussed problem-solving perspective.

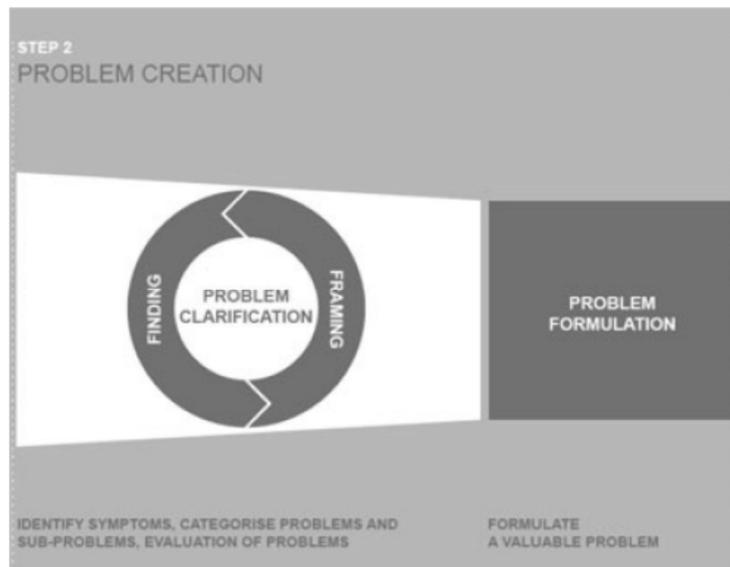


Figure 1: Problem creation process by Frishammar et al. (2016)

According to the authors, the first two activities of problem finding and problem framing capture the activities related to identifying and categorizing problems. The problems identified within the original framework are based on insights regarding the clients' problem situations or challenges. The main outcome of this phase is a curated list of identified problems with their connected sub-problems and symptoms. Adopting these activities to this research and the context of the case company, the problems identified are considered as being related to the

company's customers and end-customers, end-customers being the actual product or service users. The third activity, problem formulation, aims to select and formulate valuable problems that are clearly defined, well understood and agreed upon by all involved activity participants, usually on a group or departmental level. The criteria used for selection are described as being informal and subjective in nature, related to prior experience or information from clients. As the context of the framework and the empirical study was focused on a consulting company working within client project-based structures and more formalized nature of the processes mentioned, it is assumed that it would be used as an overall reference framework for studying the problem creation process within the case company and it is expected that the specific characteristics and dynamics of such process within the case company would reflect its own organizational conditions. As the case company represents the technology-oriented company with no formalized processes or structures regarding early stages or innovation, the problem finding, framing and formulation activities are considered to be highly informal, dependent on organizational social context and dynamics, and diverse competencies and assumptions of individual participants involved.

As the overall framework is based on the previously stated problem-solving literature and selected empirical data, this research considers the previously mentioned theoretical and contextual limitations and is proposing to address these limitations and further expand the current understanding related to problem creation process within front end of innovation by adopting the perspective of complex adaptive systems.

## 2.2 Complex Adaptive Systems

### 2.2.1 Complexity and Complex Systems

Complexity is more and more acknowledged to be a key characteristic of the world we live in. With the rise of technology and forming of large-scale systems within different kinds of environments, the interest in studying and understanding such complex systems gained momentum after the World War II, relating to General Systems theory, Information theory and Cybernetics (Simon, 1996). Complexity is a result of interactions of simple elements within systems and can be recognized as behaviors which can be observed on a systemic level and can not be observed and studied on individual levels only (Cilliers, 1999). This perspective reflects real-life conditions within systems where precisely because of rich interactions

between elements new patterns of behaviors come to being and thus stresses the importance of interactions between elements as much as the characteristics of those elements as shaping the system itself and processes occurred within it. They are usually open systems (e.i. natural ecosystems, societies, organizations, internet and social networks), meaning they are not closed off to the external environment, they interact with their environment and therefore are shaped by it as well (Cilliers, 1999). This means that external as well as internal interactions between elements within and across system's boundaries are both contributing to behaviors observed within a system. Such perspective applied to studying organizations gained momentum in 1960s where complexity became a central concept for organization scientists who treated it as one of the fundamental characteristics of organizations and their environments (Anderson, 1999).

Viewing organizations as complex systems have meaningful implications on how internal organizational processes are being described and how dynamics of such processes are understood. As opposed to adopting complex systemic view of an organization, the main limitations of adopting linear perspective and related deterministic models when studying organizational processes and behaviors are that they focus on only explaining how process's static structures and management criteria relate mainly to its performance (McCarthy et al. 2006) and are valid and sufficient for studying and explaining stable, unchanging and balanced patterns (Cheng and Van De Ven, 1996). It thus can be argued that as such they lack sufficient explanatory mechanisms or parameters when faced with unstructured, evolving, dynamic and socially collaborative processes, such as early stage activities of front end of innovation usually look like. Simply stated, when using linear models to describe organizational processes they assume that cause and effect relations exist only in one direction and their final output is determined by set of unchanging rules. It is obvious that as organizations are not machines but systems involving human beings and other various elements, they do change and contain many unpredictable interactions and changes in in their conditions, justifying limitations of linear models once applied.

In order to reflect more real-life nature of organizational processes and to enhance and complement existing understanding of such early stage innovation activities in general and the problem creation process in particular, this research is adopting the well-known complex adaptive systems (CAS) model as its perspective framework to guide this research aim.

### 2.2.2 Complex Adaptive Systems Model

Complex adaptive systems (CAS) model originated from the need to understand and model evolution and behavior of biological, physical and social complex systems (Simon, 1996), especially applied in the past for organization studies in general and studies of selective organizational processes, innovation processes among them as well, in particular (Anderson, 1999; Eisenhardt and Bhatia, 2002; Gomes, 2003; MacCarthy et al. 2006). Applied to organizational context and processes, CAS is predominantly focused on studying and explaining how social interactions form and shape organizational and process dynamics and characteristics and how organizations and their processes adapt to their changing environment, internal and external (Kaisler and Madey, 2009). In general, operating on the same assumptions as previously described with the overall complexity perspective, CAS stresses the importance and influence of interactions between organizational elements, resulting emerged patterns of behaviors observed on an higher organizational levels and inherent overall capacity for change within an organization.

This perspective is thus relevant and suitable when studying the informal and social-interaction-based processes within an organization, which are not bound by formally imposed rules and performance criteria, are not formally managed and thus their characteristics and dynamics are significantly shaped by a particular organizational context. As previously argued, early stage innovation activities in general, including in particular the problem creation process as described and studied within the case company, are reflective of such conditions and characteristics and thus it is argued would benefit from adopting CAS perspective to describe and understand their characteristics and dynamics.

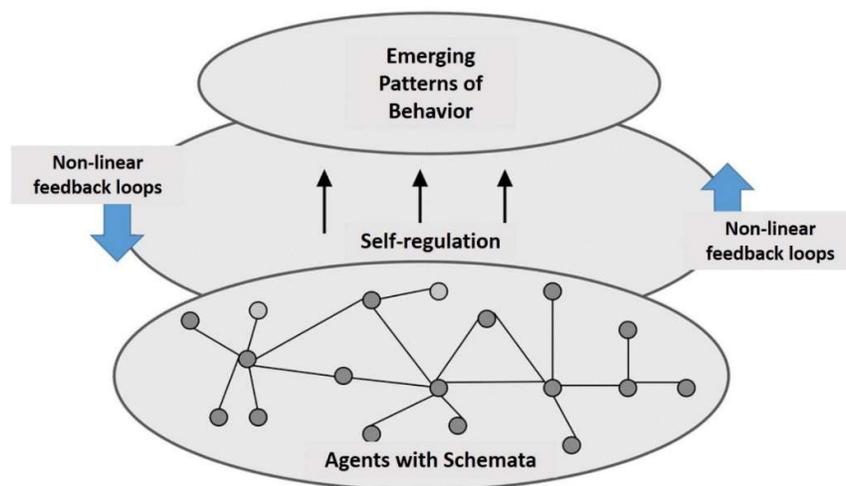


Figure 2: Simplified CAS model

The fundamental features of CAS model, similar to complex systems as such, are non-linearity, self-organization and emergence (Simon, 1996). All of them are related to existence and nature of interactions between elements within any particular system, how such interactions can shape how those elements behave collectively, how they are able to adapt to changed conditions and how even small changes within interaction patterns or their characteristics could lead to unproportional changes on a systemic level (Anderson, 1999).

Non-linearity describes the type of relations within a system where such relations add or subtract some value to the overall system (Complexity Academy, 2016). It means that when looking at organizations or selected parts of organizations as such systems, the nature of relations, interactions between their elements, usually individuals or groups, positively or negatively influence the value created from related organizational processes as well as the nature of process inputs. This non-linear feature when applied as a perspective thus assumes that it is not sufficient to view systems or processes through a particular set of linear and unchanged rules which govern the behaviors of and inside a system, it suggests to look how systems' elements and their behaviors relate to each other as both influencing and being influenced by others, exploring if such related behaviors are collectively reinforcing each other or reducing each other on a higher systemic level (Carver & Scheier, 2002).

Self-organization and emergence are only possible precisely due to the non-linear nature of CAS (Poutanen et al. 2016). Together, they describe how behaviors of a system and within a system studied are able to form and change. Self-organization describes a feature of CAS where particular patterns of behaviors within a system emerge naturally because of interactions within a system, without the intervention of a central controller (Anderson, 1999). Such perspective is thus appropriate to apply when studying selected behaviors or processes in organizations which are not formally structured or managed from top-down, they are informal and flexible in nature, yet particular collective patterns of behaviors can be observed as present which guide or influence such behaviors, actions. Overall, this feature promotes bottom-up logic of how collectively shared behaviors by individuals or groups within organizations emerge, evolve and are being shaped where interactions and relations between them play an important part in their characteristics.

In addition, emergence as closely related to self-organization describes how higher-level order can emerge as a result of lower-level interactions between systems' elements (Carver and Scheier, 2002). This feature stresses that emergence of such orders or properties is not driven

by a single force or element but arises precisely because of interactions between its elements. The CAS model is thus inherently multilevel, because order is considered an emergent property that depends on how lower-level behaviors are aggregated (Anderson, 1999). Applying this to organizations, it argues that when particular orders, meaning particular set of existing patterns, are present and observed as collectively followed by individuals or groups of individuals across departments or even on an organizational level, such orders are considered as being higher-level orders reflecting and being able to be explained by characteristics and dynamics of interactions present and observed on lower-levels (individual level being seen as the lowest level in organizations).

Considering CAS main features and assumptions, such perspective adopted assumes one additional key characteristic, which is important for a subject of innovation: adaptability. Within CAS model, interacting elements (individuals or groups of individuals) of a system are able to and are presumed to change their behaviors according to changing environmental conditions (external or internal) as they are trying to adopt to such new conditions and maintain or increase the value (otherwise payoff) from their actions (Anderson, 1999). They are able to do so through receiving and responding to the nature of feedbacks resulting from their actions (Kaisler & Madey, 2009) that show which behaviors have been rewarded and which have been not. Such ability is especially important for innovative efforts and behaviors where with changing technological, market and social environment conditions, organizations need to constantly respond to such changes and in accordance adopt new assumptions, behaviors and structures in order to innovate successfully (MacCarthy et al. 2006). As linear frameworks represent organizational processes as stable, sequential and predictable system of activities (Bonner, Ruekert & Walker, 2002) they struggle when faced with a need to account for unpredictable or changing conditions and related changing behaviors within processes which were not caused by a change in input variables but adopted and emerged collectively, through interactions between system, its elements and its environment as enabled by functioning feedback mechanisms.

In CAS model, its elements are called agents, who are partially connected to and interact with other agents within multiple hierarchical levels of the system (Simon, 1996). When applied to organizations, as previously indicated, agents represent individuals or groups of individuals within organizations (McCarthy et al. 2006), where depending on size and nature of the particular research interest agents could thus represent individual employees or teams of employees. Cooperation between such individual agents within organizations lead to their

interactions where, as assumed by CAS, based on those interactions shared patterns of behaviors emerge (Schneider & Somers, 2006). For the purpose of this research, agents are viewed as individual employees in the case company as chosen for studying the nature and dynamics of their interactions as relevant for and related to the research interest, problem creation process (PCP) of the front end of innovation.

Agents act, thus their behavior is also shaped by their schemata, meaning by their cognitive frameworks or conceptual representation of the world which help them organize and interpret received information, compare it to information they already have and decide on appropriate response to a given stimuli (Complexity Academy, 2016). Agents thus determine which actions they will take derived from information they receive from other agents they are connected to and the nature of feedback they got on the value and appropriateness of their past actions (Anderson, 1999). As author further argues, schemata, which could be alternatively viewed as environment-induced blueprints for their decision-rules of sorts for agents' appropriate behavior responses, represent more than just a set of fixed action-reaction rules, they represent in essence the internal logic governing the agent's behaviors. Based on their schemata, agents are able to apply if-then logic and discern between given set of inputs/stimuli from the environment to select an appropriate course of their action (Complexity Academy, 2016).

This principle of how agents act implies that characteristics and information content of agents' interactions plays a crucial role in determining which course of action would be deemed as appropriate and beneficial to the agent. As a result, it is argued that when agents act within such informal and unstructured organizational processes as front end innovation processes and specifically process creation process tend to be, they respond based on their schemata which are shaped by their cumulated experience and information regarding which behaviors are expected, encouraged and rewarded by their environment related to such processes. When applying the CAS perspective to the present research area and interest, it is therefore important to determine which organizational dimension or structures mostly influence and have an impact on how such schemata are shaped within the case company and what their dominant logic or essential components look like, as related to the nature of problem creation process.

Based on the existing front end of innovation research, the organizational context of the case company and the mentioned characteristics, it is argued that organizational culture is the dominant organizational dimension that shapes agents' schemata regarding how to act within informal organizational processes and thus their behavior, leading to emergence of collective

patterns of behaviors which could be understood in relation to the particular characteristics of the organizational culture in question.

## 2.3 Organizational Culture

### 2.3.1 Cultural Perspective and Traditional View

The concept of culture had been borrowed from the field of anthropology and is nowadays among others tightly linked with the study of organizations (Smircich, 1983). As author further describes, the varying approaches to organization-culture relationship in the literature stem from different assumptions that researchers make about organization and culture. Across wide spectrum of cultural perspectives, culture could be for example viewed as an instrument, an adaptive mechanism, an expression of human mind or a set of shared symbols and meanings (Smircich, 1983). There is no single definition of culture, the views and assumptions are being constantly adopted based on the context and objective of particular cultural studies. However, definitions generally stress its fundamental nature of representing the shared values, meanings and beliefs of a group (Alvesson, 1989). As author further argues, such broadly stated concept of culture only provides superficial description of its characteristics and roles and that is why such wide ranges of cultural perspectives have been developed across literatures and disciplines.

As one of the most dominant views on culture in organizational and managerial studies is the one where 'the right kind' of culture could be developed and used by managers to influence how effective organizations are (Schein, 2010). It is reflective of functionalist and instrumental view of culture as being characterized as an independent linear variable within an organization (Smircich, 1983) and as such this perspective on organizational culture promotes understanding of culture as representing beliefs and values that are beneficial for companies to achieve their corporate goals, effectiveness or performance, resulting in evaluating, separating and labelling of cultures as 'good' or 'bad' depending on how well they support or drive the intended outcomes (Alvesson, 1989). In similar nature, existing research on relations between organizational culture and front end of innovation views culture as an organizational attribute, independent variable, influencing performance in the Front End and thus innovation performance in general (Koen et al. 2001; Koen et al. 2014; Reid, Brentani & Kleinschmidt, 2014; Gurtner, S & Reinhardt, R 2016; Mohan,Voss & Jiménez, 2017). To drive such

performance, authors suggest in various ways what characteristics the culture needs to have or which actions it needs to encourage, maintaining the functionalist view across studies. Among the most common ones, authors suggest that such cultures need to be open, transparent, encouraging of idea freedom and diversity, enabling time for considering and testing of new ideas and stimulating information and knowledge sharing.

The tendency to view organizational culture in such a way means that focus is exclusively concentrated on its directly manageable dimensions and performance-stimulating norms, leading to its oversimplification and related assumption that it is easy to manipulate from top-down organizational structures such as management (Alvesson, 1989). As author further argues, when approaching culture from the outside of this dominant management and functionalist perspective, it would be needed to acknowledge the importance of cultural context of organizations when studying the relation between culture and organization. Therefore considering the assumptions behind the previously characterized traditional view on organizational culture, it is argued that such understanding proves limiting in three main aspects. Firstly, it focuses on its usefulness for achieving organizational goals and performance and promotes it as a tool, a variable which is in a linear relationship with organizational process outcomes, performance and effectiveness, not allowing for an unproportional, non-linear nature of influence. Secondly, it assumes the top-down approach where culture is successfully managed by direct managerial interventions only, not allowing for the influence of organizational social context and interactions, and thus omitting the bottom-up influence within organizations. And thirdly, it does not account for instances where culture and its related cultural norms and beliefs function as basis for individual decision-making and behaviors in an absence of formal rules and process structures.

### 2.3.2 New Perspective on Organizational Culture

As opposed to traditional and functionalist view of culture, considering a more recent cognitive perspective on organizational culture, it sees the limitations of previous approaches, goes beyond the instrumental view and sees culture as representing organizations and their dynamics more in their complexity and not just as something organizations possess and can deploy towards performance accomplishment (Smircich, 1983). As author further describes, cognitive perspective on culture emphasizes the beliefs and related behaviors of individuals within organizations whose behaviors are guided by collectively shared perception and understanding

of the world around them, reflected in the culture. In line with this view, it is further argued that culture represents collectively shared beliefs and values held by the organization's members with help of which those members interpret and understand what and who matters in the organization, how and why things are being done as they do in the organization and what to do when facing problems in the organization (Louis, 1981). As this perspective emphasizes a direct connection between a belief and an action (Smircich, 1983) it views individual behaviors as connected to culture within an organization. It can be thus argued that adoption of such perspective in general is appropriate when studying collectively and informally shaped processes which are assumed to be strongly influenced by individual and collective beliefs, attitudes and behaviors, as is the case in this research. It is thus argued that in the absence of formal process structures and management, culture is the one which indirectly guides behaviors within such processes.

Building on the characteristics and role of organizational culture as defined and understood so far, it is further built on its fundamental social and collective nature by discussing and defining how it is formed and shaped. As literature concurs, any organizational research from cultural perspective “would be concerned with intersubjective, context-embedded and emergent phenomena in organizational settings” (Louis, 1981, p.251). Such view is consistent with the previously stated collaborative and organizational context-dependent cultural characteristics but in addition to that, it stresses the nature of organizational culture as something that emerges within an organization as opposed to something that was created by a single individual. In line with cognitive perspective on culture which assumes that culture develops out of continuing interpersonal interaction (Smircich, 1983) it has been proposed that culture is being generated and evolves from the bottom up through nature of social interactions and communication (Latané, 1996). As organization members interact over time and space and keep processing shared social information they develop similar perceptions and interpretations which if shared by the members constitute the organizational culture (Harris, 1994). As author further argues, this is how the organizational culture becomes embedded cognitively in individuals, guiding them towards behaviors which are socially acceptable within a given organizational social context. Based on this it is obvious that social interactions are necessary for culture to emerge, stressing beliefs and behaviors which become shared among its members and acted upon.

Complementary to the bottom-up nature of how culture emerges in an organization as described, it as explained influences at the same time the nature of organizational processes through behaviors of its members who shape it. On one hand, individuals interact with each

other and with their environment within an organization, they are perceiving and evaluating the dynamics of the world around them, making sense of how to respond to it and make decisions on how to act (Giorgi, Lockwood & Glynn, 2015). In this process, the beliefs and patterns of behaviors which are collectively shared form the fundamentals of their culture which describes in a sense their social world, consisting of a set of social norms which are consciously or unconsciously abided by them (Schein, 2010). On the other hand, at the same time while a culture is being formed and shaped, its characteristics and embedded core beliefs influence how organizational processes look like in companies. As a part of those processes, individuals do not behave randomly because if they did, it would have been difficult to observe any patterns of such behaviors that constitutes process in a first place (Carver & Scheier, 2002). When organizational processes are formally structured and controlled, there exist a clear set of guiding rules individuals need to obey to behave accordingly. The influence of culture, even though present throughout different types of behaviors within an organization, becomes significant in relation to the processes which are without such imposed formal rules or control but are still observable and present within an organization, where behaviors within those processes are thus strongly influenced by informal, social cues instead (Schein, 2010). As a result, culture within an organization is to be viewed as representing and being reflective of interactions between different inter-dependent elements and dimensions of the organization. To view it only from a single and deterministic perspective of an organizational attribute similar for example to its corporate strategy, as traditional perspectives do, constraints the level of understanding of its relation with and impact on different processes and thus their outcomes within organizations.

The concept of organizational culture as understood within this research encompasses more than just such simplified understanding and captures more comprehensibly a real-life, dynamic, non-linear, self-perpetuating and socially inter-dependent nature of culture and its relations within an organization, with its members and processes. Simply said, just as inner personality and character guide and constrain individual behavior, so does organization culture can be defined as guiding and constraining behaviors of its members through the shared norms and beliefs (Schein, 2010), formed and developed by them through interactions with and within their environment, connected to the particular context of such behaviors within which they occur.

### 2.3.3 Organizational Culture and CAS

Organizational culture include both individual and group-level observable phenomena (Harris, 1994) as CAS model is reflective of as well. The assumptions characterizing the concept of organization culture as defined within this research, as related to its nature, role and dynamics resonate with the underlying assumptions behind the selected CAS model. As this model has been selected to further the understanding of how organizational culture influences problem creation process and to overcome the existing limitations of related current research, it is important to understand how the concept of organizational culture as developed and described is positioned within the model to facilitate a desired enhancement of understanding. In terms of shared assumptions between concepts, it is argued that both deal with multi-level, dynamic, socially driven and non-linear phenomena which capture the underlying dynamics of collectively exhibited patterns of behaviors within an organization which are observed in relation to and change in a response to particular environmental conditions.

When organizational culture is viewed through the lenses of CAS perspective as related to its features, elements and related to the object of this research study, problem creation process (PCP), it is argued that the guiding and sense-making role of the culture can be approximated towards the guiding role of schemata within CAS model. In CAS, schemata account for behaviors of agents and as previously stated, represent the internal logic of how they respond to a given range of stimuli (Complexity Academy, 2016). The nature and role of organizational culture in guiding and shaping behaviors of its members through the shared norms and beliefs (Schein, 2010) is very similar in nature, especially applicable when related to behaviors in informal processes exhibited on a collective level and thus influencing those processes significantly in the absence of other formal structures or procedures. Both cultural beliefs and norms, and agents' schemata are being shaped by given organizational context, social interactions and cumulated experiential knowledge (Harris, 1994) based on which individuals (agents) decide how to interpret and understand their environment and which course of socially acceptable and for them beneficial action to take within it.

In addition, as both concepts have importance of social interactions, interactions between organization members/agents, at a core of their principles and assumptions, it is argued that characteristics of interactions between agents are influenced by the characteristics of organizational culture present within the case company as well as influenced by the content of their schemata as now understood as being approximated to and thus represented in collectively

shared beliefs and values embedded in organizational culture. When CAS is applied to organizational studies, the pattern of connections among agents needs to be specified as related to existence, absence and nature of connections among agents, as this influences the nature, effectiveness and speed of interactions (Morris et al. 2011), and ultimately, as CAS model explains, their behaviors (Anderson, 1999). Therefore, the characteristics of organizational culture influencing which patterns of connections among agents are being established and favored would shape the nature of agents' interactions, reflected for example in how agents communicate, how they share information and how openly (Morris et al. 2011) or how close agents are physically close to each other and how diverse agents' interactions are (Gomes, 2003). As a result, it is argued that organizational culture influences behaviors observed within process creation process (PCP) by influencing the nature of agents' interactions.

## 3. RESEARCH METHODOLOGY

### 3.1 Research Design

For the purposes of this research, the case company is a primary source of empirical data available and studied. This study is considered to be revelatory, as it is proposed to view and understand the relationship between organizational culture and problem creation process with a help of newly proposed perspective of complex adaptive systems (CAS) where a prior empirical research of this nature has been scarce. Using the proposed perspective, it assumes to provide additional new insights and disclose new research opportunities regarding the subject of this research interest. The key subjects of this research are agents with their culture-based schemata, treated as multiple case studies within the case company, whose collectively shared behaviors would be studied and analyzed in order to describe the informal problem creation process as present in the case company. In this context and based on the previously described dimensions of CAS, data will be collected within the case company observations and documents and from selected individuals – agents, on agent characteristics, their schemata in a form of particular organizational culture, agent social interactions and feedback characteristics, and problem creation process characteristics.

As the aim of this research is to study the subjective constructs and interpretations of social beliefs and norms and thus resulting behaviors, the research adopts interpretivism as its epistemological position within this study (Bryman & Bell, 2011). This choice is further justified as it is argued that the “truth status of emergent properties of complex adaptive systems models should be based on an epistemology of proof by constructive verification and therefore on the ontological axioms of a non-realist logical system such as constructivism” (Shipworth, 2007). Constructivist view assumes that “realities are apprehendable in the form of multiple, intangible mental constructions, socially and experientially based and dependent for their form and content on the individual persons or groups holding the constructions” (Guba and Lincoln, 1994, p.110-111). This view is in line with the purpose of this research and is thus adopted as this study’s ontological approach. Using the CAS perspective and applying it towards studying the relation between organizational culture and problem creation process, it puts the study of collectively formed and shared agents beliefs and behaviors at its core of this research. Therefore, in line with the ontological approach, agents and their constructs are the primary

source of data in this research as researchers strive for discovering and interpreting the shared patterns between them. The resulting research design of agent-based multiple case studies and interpretive construct formation paradigm (Bryman & Bell, 2011) has enabled to uncover and reconstruct the particular elements of those schemata held by agents which are shared and related specifically to the organizational culture, the social context of the case company and problem creation process behaviors.

Even though existing models and theoretical background were used to identify the nature of relationship between organizational culture and problem creation process to be explored, the authors later drew conclusions from the empirical data gathered to describe specific elements and dynamics of such problem creation process behaviors and their relations with organizational culture within the case company. Therefore this research was primary inductive in nature, following the overall qualitative research strategy, collecting research material in order to generate new theory related to the subject of this research (Bryman & Bell, 2011).

## 3.2 Data Collection

This section on data collection elaborates on the data collection process, the sampling criteria and their justification for the purposes of this research and describes the process of preparation for semi-structured interviews, including the description and purpose of the key topics covered in the related interview guide have been used.

### 3.2.1 Data Collection Process

In line with the inductive and interpretative nature of research design, qualitative data were collected in order to answer the research question (Bryman & Bell, 2011). Data were collected from multiple sources in order to capture more information and identify possible contradictions. As the study has been conducted in situ during approximately five months, the initial sources of information were observation, informal meetings and internal documents, which helped authors to determine the focus of this research. Observations within the case company were conducted in general as authors conducted the research on the premises of the case company headquarters and engaged with employees in a form of short small talk

conversations related to their roles, the case company's culture and their opinions about how the case company works with innovation.

At the beginning of the research, the set of informal, unstructured interviews and longer open conversations were conducted to determine key challenges related to innovation processes within the case company and using the additional examination of existing literature and business articles, the area of research interest was determined as to reflect research interest which findings could be applicable to more than just the case company in question, related to the various company studies and academic articles and their shared interest in the chosen phenomenon and its challenges and implications. Unstructured interviews were conducted with employees across functions, including not only employees within R&D department but also employees from Products department, Sales department, Marketing department, HR department and New Business department.

This triangulation method allowed to cross-check the initial sources of information by proper formal interviews (Bryman & Bell, 2011). Indeed, the main source of data collected were semi-structured interviews, which enabled to gain in-depth insights into interviewees' beliefs, values and attitudes (ibid.) and their behaviors related to the research question.

### 3.2.2 Sampling

A theoretical purposive snowball sampling was used, which means that the first interviewee was used as a reference point in order to exploit his network to identify other potential participants matching the selected criteria (Bryman and Bell, 2011). It was purposive in nature (ibid.), trying to make sure that the criteria reflected the research data needs related to the research interest and the research question. In addition, data collection respected those criteria as this research strived to have a rich, detailed, minimally biased and representative qualitative data for further analysis (ibid.). Criteria considered were comprised of three fundamental characteristics and relevant interviewees were strictly selected according to their match to these characteristics.

Firstly, all interviewees selected were individuals employed within the same R&D department, the focal system of this study. Overall, R&D activities are divided into several product-oriented departments, representing a silos structure where procedures, activities and processes are very similar in nature and the only difference is their focus on a certain product category. Therefore,

it is possible to treat a single R&D department as a subsystem which dynamics are representative of all R&D-related activities. The reasoning for this selection is a result of R&D departments being a dominant formal and informal source of new ideas for new products and services being generated and developed within the company as they have a structural mandate within the case company for all activities related to developing new products, from early stages of defining a problem to solve, develop ideas up to the later stages of new product development. Even though the case company does not have a formally structured problem creation process as part of their R&D activities, it has been verified by initial exploratory interviews and observations that activities related to problem finding, framing and formulating are present within the mandate of activities of R&D departments and are in their nature informally a part of their approach to coming up with new ideas.

Secondly, the interviewees selected had already had experience with generating new ideas or concepts and with proposing of such ideas or concepts to another agent or collaborating on such ideas with other agents. The reasoning for this criterion follows the assumptions made within this research as related to the dependency of idea and concept generation on problem creation and the fundamental principle of CAS model – interactions of agents as a determinant of emergent patterns of behavior. This criterion ensured that the interviewees (agents) were able to recollect and describe their set of beliefs and actions about what was their approach to and experience with problem creation process. This led to their new idea being generated and it satisfied the assumed existence of social interaction and communication among agents related to this subject, thus making the assessment of such interactions possible and valid.

Thirdly, as interviewees selected needed to be indicative of lower-level agent behaviors within R&D department(s), they could not hold a higher position than project manager. The aim was to study the emergent collective and higher-level patterns of behavior related to the particular subject-oriented beliefs and actions of lower-level agents and their interactions. The role and influence of higher-level management as bound to formal processes and structures has been argued as limited within the research of such informal and unstructured behaviors as problem creation process. In addition, based on the initial observations and internal company documents, the roles of R&D department managers (related to specific product types) and higher has been regarded to be more formally decisive in nature, as they did not represent the agents who enacted original idea or concept generation behaviors. In case of project manager role, the agents within this role are generally involved in early stages of innovation practices

within the case company, displaying sufficient level of shared characteristics with other relevant agents related to problem-solving (and by extension problem creation) behaviors.

In addition, within the criteria proposed it was strived for a balanced and diverse profile of the interviewees related to their gender, race, age, seniority, experience or expertise, in order to avoid high degrees of bias and capture the full extent of shared elements of their schemata.

<b>R&amp;D department employees (agents)</b>	<b>Job role</b>	<b>Date</b>
Interviewee 1	Project technical lead	24/04/2017
Interviewee 2	Mechanical engineer	24/04/2017
Interviewee 3	Project manager	25/04/2017
Interviewee 4	Mechanical designer	25/04/2017
Interviewee 5	Electronics engineer	25/04/2017
Interviewee 6	Mechanical engineer	26/04/2017
Interviewee 7	Mechanical engineer	26/04/2017
Interviewee 8	Electronics engineer	26/04/2017

*Table 1: Selected interviewees*

### 3.2.3 Interview Guide Preparation

The interviews had two aims. The first was to overcome the limitations of prior exploratory information gathered. The second aim was to achieve a deeper understanding of the dynamic and complex relationship between organizational culture and informal problem creation process within the company.

Based on the theoretical background and models being referenced, the interview guide was constructed to ensure that relevant knowledge was gained from the interviewees related to the theoretical framework and research design. Following the CAS model and the definition of organizational culture within the model, interview guide was structured into the four key topics.

The first topic starts with the introduction of the agents and basic characteristics, demographic information, educational background and then focusing on their professional expertise, covering both past and current job roles and tasks, including perceived responsibilities and objectives. The second topic builds around organizational culture as reflected in agents' schemata, trying to get interviewee's own perspective on how those guiding principles, values and beliefs shape its ordinary working activities related to innovation, idea generation and problem creation. The third topic is centered on individual approaches and behaviors related to problem creation process, explicitly reflecting on a recent idea or project in order to gain relevant and detailed insights into problem finding, framing and formulation behaviors. The fourth topic deals with agents' interactions and related nature of feedbacks involved, providing researchers with data on their individual connections and interactions and how they changed in time. The nature of feedbacks were covered and understood by asking agents to reflect on which behaviors, related to problem creation process, were perceived by them as encouraged or discouraged based on the nature of feedback received. Moreover, it was enquired if such feedback were present or not, and if so, how beneficial it was perceived to agents.

<b>Key Topic</b>	<b>Key Sub-topic</b>	<b>Data objectives</b>
1_Interviewees <i>(~ Agents)</i>	1.1 Basic personal information	Demographic indicators and categorization
1_Interviewees <i>(~ Agents)</i>	1.2 Basic role information	Role and expertise constraints and subjective perceptions of role objectives
2_Organizational culture <i>(~ Schemata)</i>	2.1 General core beliefs and norms	Individual interpretation and content of core cultural beliefs and norms
2_Organizational culture <i>(~ Schemata)</i>	2.2 Innovation-related beliefs and norms	Individual interpretation and content of cultural beliefs and norms influencing innovation-related behaviors
2_Organizational culture <i>(~ Schemata)</i>	2.3 Idea generation-related beliefs and norms	Individual interpretation and content of cultural beliefs and norms influencing early stages of innovation behaviors (e.g. idea generation)

3_Problem creation process  <i>(~ Emergent patterns of behavior)</i>	3.1 Problem finding	Problem finding / identification behaviors and related reasoning
3_Problem creation process  <i>(~ Emergent patterns of behavior)</i>	3.2 Problem framing	Problem framing /categorization behaviors and related reasoning
3_Problem creation process  <i>(~ Emergent patterns of behavior)</i>	3.3 Problem formulation	Problem formulation /selection behaviors and related reasoning
4_Social interactions  <i>(~ Self-regulation)</i>	4.1 Current characteristics	Nature of interactions with other agents – current characteristics
4_Social interactions  <i>(~ Self-regulation)</i>	4.2 Previous characteristics	Nature of interactions with other agents – change in characteristics
4_Social interactions  <i>(~ Self-regulation - dynamics)</i>	4.3 Feedback	Nature of feedbacks received  Positive and negative feedbacks related to problem creation process behaviors (encouraging - discouraging)

Table 2: Interview guide preparation

The interview guide was prepared using a simple and straightforward language and phrasing, since this study deals with engineers with no business background. The semi-structured nature allowed probing and asking for further elaborations and explanations when needed, without affecting concepts and terminologies of interviewees' answers (Bryman and Bell, 2011). Open questions ensured the required degree of flexibility to be sure of collecting data that were relevant to the research question, altering the ordering of questions if needed and making sure they were understandable and not too leading.

### 3.3 Data Analysis

The data analysis was performed according to the within- and cross-case methodology proposed by Eisenhardt (1989), as this research studies agent-based multiple cases to be analysed separately and then compared in order to discern dissimilar and shared patterns between them. It started with the transcription of interviews, following the instruction recommended by Bryman and Bell (2011): each interview was transcribed entirely in order to avoid the possibility of omitting potential findings in advance and to keep the original language and terminology, which will be extensively used for the coding phase.

During the within-case analysis, interviewees' experiences and perspectives were studied in isolation, generating codes and looking for patterns in the findings (Eisenhardt, 1989). Particular effort was spent on making sure to cover extensively and in detail all agents' experiences, assumptions, perspectives and beliefs, without overlooking something and assess patterns in the data to facilitate the following cross-case step. Similarities and differences were identified during the cross-case analysis and resulted in a number of dimensions and categories, which were further compared in order to form and develop higher order themes (Eisenhardt, 1989). Finally, the findings emerging from data analysis were used along with relevant literature to answer the research question.

In addition, authors considered the guidelines and recommendation related to data analysis as proposed by Gioia et al. (2013), aiming to further improve the overall strength and transparency of this qualitative analysis. Moreover, this research shares the three main assumptions presented by Gioia et al. (2013) that have been kept in mind for the whole analysis process. Firstly, organizations are social constructs that are generated and shaped by the continuous interactions of the agents within the context. Secondly, agents know and understand their behavior and actions, which should be considered pure insights that are going to be combined in higher order themes, building a new layer of the social reality. Thirdly, researchers have enough knowledge, expertise and information gathered in order to identify patterns in data that are not visible to interviewees.

It is important to stress that as this study is part of an internship, held in parallel with a business development project, researchers have been in a close relationship with the research context and agents, involving many risks regarding neutrality, objectivity and going native (Gioia et

al., 2013) while interpreting our findings. On the other hand, this close connection and physical proximity have guaranteed the gathering of rich data and insights, while providing a deep understanding of the case company characteristics at the same time. Moreover, the risk of adapting and adopting interviewees' perspectives and going native was minimized using the "devil's advocate" method suggested by Gioia et al. (2013): one researcher was responsible for the interviews, from preparation to transcription, while the other could have an outsider perspective on the transcriptions, able to question all the findings more objectively.

Regarding the overall analysis process, it did not proceed perfectly linearly, due to several iterations between data gathered, generated concepts and reference theory, readjusting the research question accordingly, since the aim was to assess both if findings had precedents and if we discovered new concepts (Eisenhardt, 1989). Iteration was essential since the analysis should provide findings that are relevant to fully answer the research question, building a framework that is able to explain the relationship between concepts and at the same time refer back to the existing theories.

### 3.4 Validity and Reliability

The qualitative nature of this overall single case study design (composed of multiple cases within the one case company) requires to address validity and reliability measures carefully, being aware of the known limitations in order to avoid stating unrealistic claims. According to Bryman and Bell (2011), some methodologies can be adopted to contribute in strengthening validity and reliability criteria. In this research, high degree of internal reliability and internal validity as well, are reached thanks by having two researchers involved in a deep, intensive and direct contact with the organizational context. Two different perspectives over the research process bring inter-observer consistency, while the use of different sources of data, such as observations, informal interviews, experiments, workshops and organizational document, allow to employ the triangulation method to cross-check information gathered with the formal semi-structured interviews (Bryman and Bell, 2011). On the other hand, it is not possible to have strong claims about external validity and reliability, due to the particular organizational and social context of this study and the chosen research design and method, limiting the full replication of this research in other contexts.

## 4. PRESENTATION OF FINDINGS

The relevant findings from the data collected are presented, directly reflecting the results obtained the within and cross case analysis of the Eisenhardt's (1989) method. Each topic is overall introduced and then further explored by its constructs, reporting shared patterns among interviewees with supporting quotes from the transcriptions. The order presented introduces and follows the logical flow of the elaborated concepts and their relations that will be fully explained within the model in the next chapter.

### 4.1 Characteristics of Organizational Culture

Organizational culture within the case company is recognized by its founders and employees as one of its key internal organizational forces. As communicated internally, its fundamental characteristics are summarized in the developed case company's core values related to openness, collaboration and innovation which were formally defined based on employees' descriptions of the culture present in the company. Its importance for day-to-day operations as well as strategic decisions is not only shown when recruiting new employees but considering long-term commitments as well.

*“Culture is strong here. I believe we are working a lot with core values, which we focus on when hiring people. We do many workshops with employees to discuss our core values, how we use them daily and how we use them for long term and short term goals.” (Interviewee 3)*

Such recognition of the culture's nature and influence on daily work by employees themselves enables to clearly define its key characteristics and further validate its influence specifically focused on creating and developing ideas and new products, analyzing the additionally shared and observed patterns of attitudes, beliefs and behaviors among the interviewees.

#### 4.1.1 Open and Informal Culture

As even reflected in one of the case company's core values stressing openness, employees are accustomed to interacting in an open and informal way. They are encouraged to seek information or help by informally approaching their colleagues and they themselves are

expected to be always open towards inquires by others and to share their knowledge and expertise when relevant or asked for. Employees perceive minimal boundaries or breaches of implicit cultural protocols when approaching any type of employee, across hierarchical levels or functions.

*“There is still this feeling of a small company, where you can go to anyone seeking help and there are no boundaries in what you do in your role and responsibilities. We don’t have rigid role descriptions with specific tasks, we have processes but nothing is printed on a paper regarding individuals” (Interviewee 3)*

In relation to early phases of innovation, the openness is exercised in stimulation to openly discuss the employees’ current work and ideas among colleagues from various projects or teams. Such informal meetings, often conducted during lunch or coffee breaks, enable exchange of different individual approaches to defining problems and their solving within various areas of technical expertise or sharing of current discoveries or challenges within new project-related or technology-related work. Such interactions are not only driven by seeking help and advice with the current work responsibilities but often accidentally result in providing inspiration for coming up with new ideas and discussing the potential problems to solve from various functional perspectives or related to experience-based insights.

*“...very open and friendly, it surprised me a lot when joining. Before joining, I worked in the sales department in a family business where I was alone and I wasn’t accepted very quickly. Here it is the opposite, in my work I have a lot of suggestions and everybody is willing to listen.” (Interviewee 8)*

Nevertheless, the encouragement and heavy reliance on informal, often face-to-face, communication and interaction as well as on open role definitions and responsibilities inherently possess constraints that have become visible with the growing size of the case company, its global presence and increased complexity of its portfolio product and solution offerings. With resulting increasing employee count, geographical distance and projects workload demands employees need to prioritize their efforts when seeking or providing information or support and their informal, face-to-face reach within the case company is constrained by their location or limited awareness of different information hubs or information sources within the case company. As a result, the culture of openness, even though still strongly encouraged, has practical limitations and stifling implications related to the mentioned changing organizational conditions of the case company.

*“...very open and I think is trying to find a new identity because the culture that was here when I started was more the one of a 100 people company that has grown. The culture didn’t shift at all. So everyone just think that you can go and talk to anyone, knowing what’s going on everywhere. However, I think people start to realize that it doesn’t work anymore.”*  
(Interviewee 1)

#### 4.1.2 Collaborative Culture

Collaborations are not only encouraged within the case company as facilitating its openness and informality but are a necessity for sourcing knowledge and expertise needed when facing problems which solutions are unknown to an individual employee or for exploring alternative options and methods related to new products and solutions, especially in the early project stage or when developing new ideas outside of projects.

*“You can get ideas just from hearing something from others, what problems they have and what solution they are thinking about. You get a good tool box for innovation just by being around and meet people with challenges close to yours”* (Interviewee 4)

As almost all R&D employees have an engineering background with selected areas of expertise (mechanics, electronics, software, design, optics etc.) their knowledge and experience is limited when compared to all knowledge demands related to features and functions of a product or products-based solution. Extending even outside of projects and related R&D teams, collaborations across departments are a natural part of exploring and discussing which areas are to be prioritized for developing new products and solutions. The combination of various inputs, expertise and insights is necessary to be able not only to successfully deliver new product development projects but also develop any new ideas within the case company.

*“In general everyone is very friendly and you know that you can count on other colleagues. In the worst case they will recommend you someone else that has the knowledge you are looking for, if they don’t have it or they have no time.”* (Interviewee 1)

*“If there were walls between departments they would never realize their ideas and test something quickly. But here they can go and ask for help from other people...”* (Interviewee 3)

The collaborative nature of interactions within the case company is viewed as relatively easy, without significant barriers and well supported, however, when looking at the primary purpose

of such interactions being to seek advice and help, enhance or broaden one's knowledge or just exchange relevant information, it is of significance who are the right people to interact with. It becomes crucial to be aware of or to know whom to contact or seek out in relation to a particular issue one faces. In addition, even though employees are open towards helping others, the particular expertise, knowledge and experience of employees involved in such collaborations shape the outcome of those collaborations, putting much weight on who is a part of interactions, how they are conducted and how productive they are.

*"...it's easy to ask questions to the right people or at least being suggested to go to someone else who has more experience in that topic" (Interviewee 4)*

*"I'm not alone, I feel I can always ask someone when I need something....However, sometimes it's hard to know where to find some kind of knowledge..." (Interviewee 5)*

#### 4.1.3 Product-oriented Culture

As the case company is technology-driven company offering wide range of mostly hardware-based products, a product is at the center of its innovative efforts. When coming up with new ideas, employees generally think in terms of future products, how they would look like, what functions and features they would have and how easily they would be able to be installed. This underlying and commonly shared attitude among employees guides them even within the earliest stages of their innovative behaviors as their efforts are mostly focused on technical feasibility of new ideas and the improvements made related to the existing similar products on the market.

*"Lots of ideas come when we look at the product and its features and think about what is working and what is not" (Interviewee 6)*

*"I try to understand the product and what it needs to have" (Interviewee 7)*

In addition, such product orientation leads to commonly expected and demanded necessity to develop (often alternative) product prototypes to experiment with in order to present, justify and being able to further develop initial product ideas or concepts. There exists a shared understanding with the case company that when coming up with new ideas one needs to present a functioning prototype to increase a probability for further development within a project and thus future successful launch. As a result, when facing a lack of time, knowledge or resources

to do it harms the future chances of development and employees take this understanding into consideration, explicitly or implicitly, even when initiating or pursuing new ideas in their most earlier stages.

*“I’m figuring out many ideas but we don’t have resources. Or sometimes we have a prototype that works but we don’t have time to implement it. Sometimes you have a good idea and you want to file a patent for it, but we don’t have time to actually test it.” (Interviewee 1)*

#### 4.1.4 Problem-solving Culture

A general and natural approach for coming up with new ideas and developing new products within the case company is to start with a problem. Problems identified can be small, big, simple, complex, broad or specific in nature but are expected to be connected to customers’ and end-customers’ existing problems and pains or stem from product complaints and deficiencies.

*“We see a problem somewhere, either from customer descriptions or looking at our current state of innovation and products, usually something that is missing or needs to be fixed.” (Interviewee 1)*

A key focus on solving problems, especially from technical perspective, among R&D employees within the case company shows that what problems are chosen to be solved naturally impacts solutions, ideas proposed and developed. Even though employees are free to pursue different approaches or methods for solving given problems, they recognize that solution to a problem and which problem is to be chosen to be solved are related and interdependent. As observed from the data gathered, the culture present within the case company does not facilitate nor stimulate the recognition of new product and business opportunities as sources for new ideas but encourages to start with the problem and solve problems, whether previously known or newly identified.

*“I see a problem and I want to solve it, this reflect what engineers do in general about ideas....I think it’s difficult to just grab something and have an idea with that.” (Interviewee 8)*

*“The first step is that there is a problem.” (Interviewee 3)*

## 4.2 Employee interaction

### 4.2.1 Interaction scope

Interaction scope simply represents the scope or size of interactions employees take part in with other employees within the case company, reflecting how employees are connected and what is the scope of their social communications. As observed from data, various employees interact within variously scoped employee networks within the case company, related to the number of employees they interact with and thus the overall scope of potential information being exchanged.

*“The network has grown bigger, but I have a bit more firsthand contact. Now I know what people know.” (Interviewee 4)*

*“I know more people and I get new contacts. One day I will need them for my work, so I try to give as much as possible.” (Interviewee 8)*

As interactions preferred within the case company as described are more on informal and face-to-face basis, there are obvious limits perceived to how many people could interact this way and how fast one is able to build the well-sized network of personal contacts within the company, especially across departments and geographical locations. As observed from the data, employees are growing the scope of their interactions in time as they are working in different projects resulting in interaction with new and additional people or as they become more experienced within their areas of expertise and are sought after by other employees, often placed further from their closest colleagues known from the projects or shared physical locations.

*“In one project I will work with someone and the next with others. My network here is big, I know where and to whom to go for any problem to get help. Since I know who is good at what and how does they work with something.” (Interviewee 6)*

### 4.2.2 Interaction diversity

Interaction diversity describes a construct which reflects how diverse the employees involved in particular interactions are. It is natural, as observed in the case company as well, that employees with similar backgrounds or roles within the company or members of the same team, project or department are more likely to interact as they share common meetings, deal with similar issues and discuss similar problems. As cross-functional collaborations, at least from a

technical perspective, are highly stimulated within the case company, supporting diverse expertise areas related to the company's products and their development, diversity in interactions is viewed especially relevant when pursuing innovative ideas.

*“There are some experts in different departments, so if you have an idea it should be confirmed by this person, the master in that area, so check with that person and see if it's feasible.”*  
(Interviewee 3)

Interacting with different people from different roles, teams and functions provides employees not only with diverse scopes of technical knowledge and information related to products but enables them to access and utilize insights from different departments such as operations, sales, production or marketing.

*“I know both people within the project but also people that are not related to it and come from different parts. We meet in different circumstances. Since we change project teams quite often we get to know many other people with different roles and jobs.”* (Interviewee 6)

*“It changed, at the beginning I related only with mechanical engineers, then I got to know people.”* (Interviewee 7)

#### 4.2.3 Employee seniority

Employee seniority within the context of its construct is viewed and defined as not only the time being employed by the case company but as well as level of expertise achieved within employee's area of experience and knowledge or formally recognized level of their role within the organizational structure of the case company, specifically connected to R&D department. As networks of interactions need to be built within the case company and are related to the particular role and its demands on interaction scope or diversity in addition to informally connecting and interacting with other employees based on various other reasons or circumstances, it was observed from analyzed data that employee seniority is relevant for employee interaction.

*“Now I do more talking than coding since my tech lead position, so the network has expanded”*  
(Interviewee 1)

*“Sometimes it’s hard to know where to find some kind of knowledge and since I’m new I don’t know everyone and who knows what.” (Interviewee 5)*

#### 4.2.4 Information blind spots

Information blind spots as a construct was developed and described as being reflective of observed challenges of looking for information when one does not know where to look or not even looking for information because one does not realize there is a need to look for it. Both dimensions of such limitations were labeled as information blind spots and are related to employees’ lack of knowledge regarding needed information sources, simply put whom to ask in the organizational context of the case company, or related to unawareness of a need for additional information that would benefit their course of action or currently pursued goals.

*“We don’t have the big picture. My main role is to take the problems. I know what the customer wants; if not I do research, then I have to find a solution. But it’s not an easy process even if it’s easy to contact people.” (Interviewee 7)*

When observed within the scope of developing new products, the very early phases of what problems to solve as a source for new ideas and new product concepts specifically, it was identified that employees working on such issues within the case company often struggle with gathering all the relevant information needed. They are not aware of all relevant sources within and outside of the case company, or they have access to but they do not understand the relevance or application of information provided. So they use and rely on previous and verified product-related information and replicate it within new product ideas as well, not exploring different and more innovative approaches or new problems to solve. This type of issue of unawareness or lack of information was observed as a shared pattern among the interviewees.

*“We tend to focus a lot on problems here and solve what we already know instead of searching for things that we don’t know.” (Interviewee 2)*

#### 4.2.5 Interaction effectiveness

Interaction effectiveness reflects a relative degree to which employee interactions resulted in a desired, productive or otherwise successful outcome. Interactions among employees within the case company can be described as mostly having a purposeful nature. Whether they are about seeking help with particular issue, looking for needed information, searching for advice or

alternative opinion, or just exploring relevant topics, it has been found that varying degrees to which such interactions are being collectively effective is connected to how well and how fast the objective or purpose of such interactions was satisfied or how much value they brought to the employees participating in such interactions.

*“It can be difficult to find things on intranet and it’s much better to go around and ask people, if they faced similar issues.” (Interviewee 3)*

*“They can be anyone from any department, it’s very easy to meet people but we often don’t have time for that...” (Interviewee 8)*

As seen from the data, interaction effectiveness further embodies the selection with whom to interact in the first place as it often determines the nature and perceived success of interactions as well.

*“You have an idea of what people know and what they are good at, the more you know them the more you understand who to talk to for more specific problems. I know what questions I can ask to someone...” (Interviewee 3)*

*“Well I got to know people better so I know a lot more now about their personalities to interact with them. I know more what people know.” (Interviewee 5)*

## 4.3 Problem creation process

### 4.3.1 Problem scope for Problem finding and framing

The process of finding and framing problems to solve as a basis for idea development within the case company is not structured, formalized nor commonly shared across teams or projects in the form of set of steps to follow. As there are no imposed best practices when looking at problems, employees are encouraged and given freedom to try different methods. However, employees share the approach of starting with a problem or problems to be solved, collectively sharing and discussing them with other colleagues.

*“In our group we do reasoning about what’s going on, what are the problems. We discuss about those, take a step back and think about what it’s an issue or not.” (Interviewee 4)*

Therefore, problem scope was identified as being the influential measure that helped to explain the nature of problem finding and framing processes within the case company. Scope defines and provides employees with a space to create within, constrained by product and customer requirements on one side and the case company's internal technical and business criteria on the other side functioning as insights and facts they are building on when engaging in the process of problem finding and framing.

*“When deciding about what problems are more relevant and should be solved, it is important to meet the requirements specified...It is important to understand what is critical for the product and the features to the customer.” (Interviewee 3)*

*“We discuss in the project how to solve the requirements, understand who is going to use this product, do we really need to take this into consideration, why?” (Interviewee 7)*

When finding and framing problems to be solved, defined problem scopes also reflect on additional pools of data they can build upon, including customer descriptions and complaints, existing product portfolio gaps, product testing failures and competitor products. In addition, it was observed that such scope is also shaped by collective knowledge and experience being shared and discussed within or across project teams and with the case company's partners and customers. Even though the process of problem finding and framing is not formally structured and demanded by management, the activities which are to be expected to be involved in it and related employees behaviors are observed as being tightly related to exploring and defining the problem scope which would be operated within.

*We get a firsthand experience. We have also external people we talk to and they have direct contact with costumers in order to get their needs and problems.” (Interviewee 6)*

*“Now you can see someone that says that there is a problem, but maybe is small for some and can be blown into unrealistic proportions to others.” (Interviewee 3)*

Identified problems are studied in an isolated way and then categorized looking at cause-effect relationships, keeping in mind the product and its design as the system where problems are related and integrated. Again, there is no common approach in this phase and problems are framed in a subjective way, relying on previous product testing to identify the main cause of several problems which are later assumed as a problem scope for developing new products ideas and concepts.

*“I look at them isolated, not as a part. I try to get ideas from the isolated problem and then proceeding backwards in order to see if it makes sense in the product.” (Interviewee 1)*

*“The design is what makes every part in a functional way and also the supportive systems to interface correctly. The problem will be caught in the verification.” (Interviewee 5)*

Problem finding and framing process is conducted either within the project domain or in an individual autonomous way. Even if employees are assigned to projects, they engage in problem finding and framing process when the project scope is yet very broad and problem scope is yet to be specifically determined. At the same time, employees are by the nature of their work in R&D always searching for and identifying various problems to work on and to be solved and turned into successful product ideas. It is true that in case of narrowly specified problem scopes to be explored and solved, the problems are usually being handed down from product and project managers to work on by project members, however, some degree of engagement in problem finding and framing behaviors is still conducted even if in this case, only on a more detailed product level and within a narrow technical scope. In addition, in such cases of perceived minimal changes required for new products to be developed, employees often search for combining various problem symptoms or less valuable problems and come up with ideas which would solve a combination of smaller problems, reframed in a more interconnected and systematic way.

*“The problems that get thrown at me, I’ll try to solve them and some of them have a simple solution, that is fast but also elegant.” (Interviewee 1)*

*“The first approach is to look at problems isolated, but then you see that they can have impact to each other and you make them more complex.” (Interviewee 3)*

#### 4.3.2 Available time for Problem formulation

Available time for problem formulation process was identified as a construct which embodies how much time employees have available to dedicate themselves, their knowledge, expertise and energy towards evaluating and selecting problems to be solved as a basis for new ideas and product concepts. Available time could be seen as time spent by employees to work on their own identified problems and new ideas outside of R&D projects scopes or time available and spent to be able to engage in problem formulation behaviors at the beginning of projects they

are a part of. Such behaviors could be expressed in employees' alternatives exploration and initial assessment of various problems identified, trying to decide which problems would be the most beneficial to suggest for development and pursue or trying to evaluate which ones have more potential to become new successful products or product solutions and thus higher chance to be later approved by management in later stages of new product development activities.

*"Most engineers want to be creative, but we have 1 year and half of project where we can be very creative in the first months and the rest is about solving problems." (Interviewee 7)*

*"We have 1 day a month to ourselves to develop our own things. It needs to come from the top, because right now they just want us to produce fast." (Interviewee 8)*

As it was identified from data, time is a significant variable when developing new products, especially within those early phases of problem formulation where additional knowledge needs to be gathered and interpreted in order to formulate the problems in a clear and well-defined way, ensuring that such formulated problem will be of value to solve for the case company. In addition, informal, collaborative and more experimental nature of behaviors within this phase, as expressed by employees, does impact how much time there is and on the other hand, how much time it is needed, as related to the problems formulated to be solved. It was commonly acknowledged that when facing such tensions and time pressures, a criterion of shorter time (future predicted time to develop and launch as resulting from the formulated and selected problems to pursue) is often preferred and expected to be prioritized.

*"Anything that takes so much time is not prioritized. We have a project that makes a lot of money with quite a little effort, because we just need to improve quality of some features, add a little value on each piece. A big problem as I see is that we don't have time to spend on research... (Interviewee 6)*

Even though not formally recognized as a process, it was observed that to save time and respect other constraints and requirements (e.i. return on investment, cost of production, technical specifications, etc.) the problems selected to be solved were often the same as existing ones. They reflected minimal changes or they were selected based on previously stated solution-oriented criteria desired, thus keeping the additional effort of alternative problem evaluation and selection to a minimum. In these cases, it has been observed that behaviors related to problem formulation were exhibited only sporadically or were skipped all together, further justifying the relevance and influence of time in relation to problem formulation specifically.

*“The majority of times we are into optimization, and this is not regarded as important. We have a strict time schedule, the goal is to make things work, not working optimally.” (Interviewee 4)*

*“When it comes to innovation, it’s “make it work”. Our time schedule is very strict. Also if it’s not a problem, don’t fix it. If it works, don’t touch it.” (Interviewee 8)*

As further observed within the case company, the focus in general is more significantly put on developing solutions that work than to invest time in problem formulation activities. However, when employees engage in such behaviors they are not supported by formally structured process nor by expectations of thoroughly evaluating all the problems identified in a productive manner. As a result, interviewees admitted that they are often discouraged to pursue and evaluate alternative and possibly more valuable problems to solve when facing time-to-market constraints. Within such constraints, it is observed that potentially new and valuable problems are not formulating because functioning solutions to existing problems were deemed satisfactory enough to pursue and prioritized in development.

*“Time to market is very important... If we don’t have a real problem, like the product is working but there could be a better solution, we usually don’t use it and discard that solution.” (Interviewee 8)*

#### 4.3.3 Level of Problem newness

As most of the case company’s innovation efforts start with a problem to solve, it was observed that more innovative solutions, compared to its existing portfolio of products, were developed and successfully launched as solutions to newly identified or modified problems which contributed to continuous growth of the case company. Innovation is regarded highly within the case company but many new products launched are very similar to existing products and share the same overall underlying problems they are solving.

*“Often when you go to people with an idea or a solution, many people are happy and think it’s cool. But when it’s time for budgeting and time, the thing get cut off are always the innovative features... the product which was supposed to come out as innovative, instead is very basic.” (Interviewee 1)*

Level of problem newness construct was chosen and labeled as such to reflect the level of innovation, which occurs at those early phases of innovative efforts and new product development, related to the outcome of problem finding, framing and formulation, a formulated problem(s) to be solved. It represents one of the key characteristics of such problem creation process outcome where it embodies a measure of how innovative and thus potentially how valuable its outcome is. As described by interviewees, the level of newness reflects either how new and innovative the problem is for the case company or how different and innovative the approach is for looking at the problem, even if previously generally known, compared to how it had been viewed and thus defined in the past.

*“The way of working today is the result of previous work, so this is why thing did not change so much recently...” (Interviewee 6)*

## 5. ANALYSIS AND DISCUSSION

This chapter presents the outcome of the analysis of findings previously introduced. The aim is to relate the three higher order themes, which are the result of a further aggregation of findings, in order to reflect and answer the research question of this study on how organizational culture, using complex adaptive system perspective, influences problem creation process in the front end of innovation. With the support of the literature review in chapter 2 and the perspectives related to key concepts in the research adopted, a model is developed and proposed to visualize the relationships between constructs and concepts as found and defined, which is the reference point to guide the discussion of each key relationship. Three sections are elaborated in order to introduce the main logic between the three high order themes and then explore in detail the interdependencies and causal relationships between the constructs presented in chapter 4, as related to the findings.

### 5.1 Model Presentation

The purpose of the model is to present the relationships between the concepts and constructs presented in chapter 4 and in a clear, visual and explicit way, to answer the research question, staying close to the terminology used, the flow of the argumentation and the relevant existing literature presented.

In line with adopted perspective of CAS, the model strives to capture the underlying dynamics within and between the studied phenomena and shows related interdependencies between their elements, supporting the assumed overall non-linear nature of the relationship between organization culture and problem creation process. In addition, the model references the description of problem creation process activities as being related to problem finding, problem framing and problem formulation by Frishammar et al. (2016).

The overall structure of the model reflects nature and directions of relations between its elements, following the causal influences of those elements to other elements influenced. In addition, relating to CAS assumptions, higher theme of *Employee interaction*, consisting of interaction-influencing elements and their relations, functions as the key enabling dimension which facilitates relation between *Organizational culture* and *Problem creation process*, the

same way as interactions among agents with their schemata shape the patterns of behaviors observed and shared among them.

The components of the model (concepts and constructs presented in chapter 4) are placed within the model as connected to high order themes mentioned and positioned accordingly to reflect their found direct relation to the closest component being influenced. Together, the model captures a relationship map of such influences expressed in both direct and indirect net of such causal dynamics found as related to the phenomenon studied and analyzed. The Organizational culture theme is composed by its four key characteristics presented in chapter 4.1: *Open and Informal, Collaborative, Problem-solving and Product-oriented*. The five constructs presented in chapter 4.2 compose the *Employee Interaction* theme: *Interaction scope, Interaction diversity, Employee seniority, Information blind spots and Interaction effectiveness*. The *Problem creation process* theme is composed by the constructs elaborated in chapter 4.3: *Problem scope for Problem finding & framing, Available time for Problem formulation and Level of problem newness*.

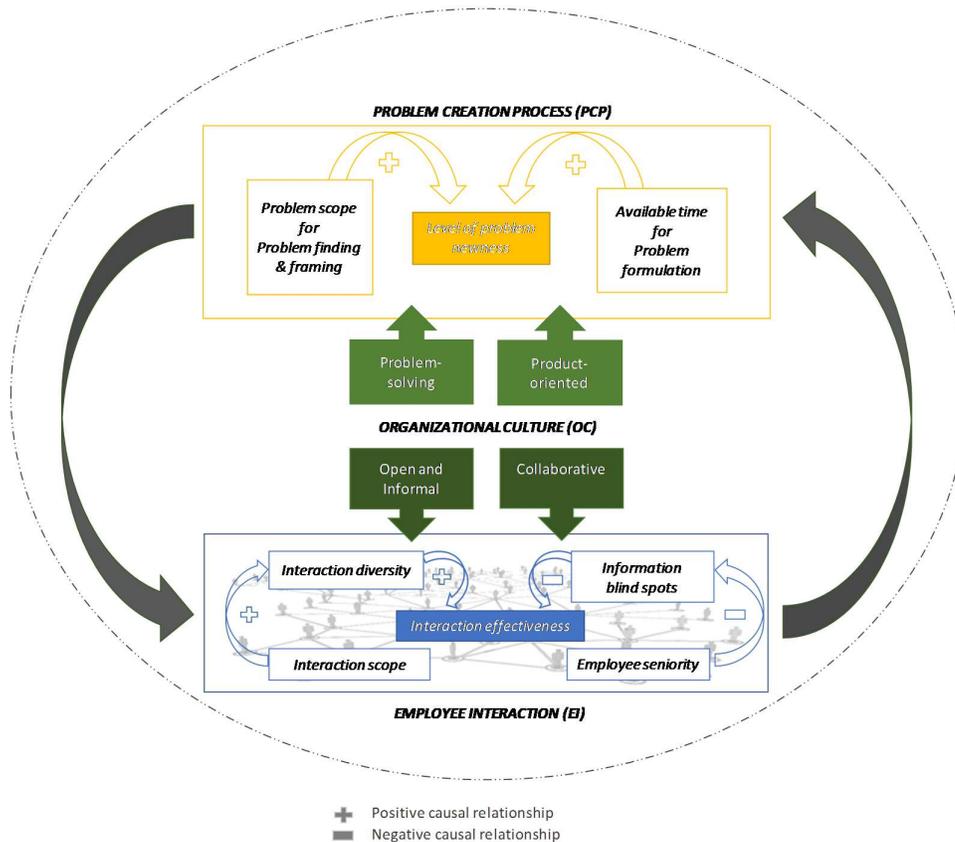


Figure 3: Model of relations between findings

## 5.2 Organizational culture and Employee interaction

As literature suggests, organizational culture represents collectively shared beliefs and values based on which organization members, employees in this case, interpret and understand what and who matters in the organization and how and why things are being done there (Louis, 1981). Both cultural beliefs and norms shape and are being shaped by particular organizational context, social interactions and cumulated experiential knowledge of employees (Harris, 1994). Based on those employees decide how to interpret and understand their environment and which course of socially acceptable and for them beneficial action to take within it. Related specifically to interaction, it has been argued that the pattern of connections among employees influences its nature, effectiveness and speed (Morris et al. 2014). Therefore, as it has been proposed, the characteristics of organizational culture influencing patterns of connections among employees would not only shape interactions but via them shape the outcome of such interactions, contributing to related processes and activities the employees interact within or for the purpose of.

It has been found and supported that organizational culture is the major force that directly influences employees interactions and, as admitted by employees within the case company, their actions as well. The core values, norms and beliefs are the same ones since the foundation of the case company; despite the continuing organizational growth, both horizontally and vertically, in terms of structure, globalization, increasing partnership network, acquisitions and so on; the case company has strived to maintain the original essence of its organizational culture. Shared core values are relevant criteria during the hiring process, they are subject of discussions in frequent meetings, and workshops. The data further support that culture-based values and norms are acknowledged and communicated influencing impact on employees daily work, both at the individual and collective (group) levels.

*“Culture is strong here. I believe we are working a lot with core values... This is a big thing to create a culture like this. We have been growing a lot the last 10 years, there is still this feeling of a small company, where you can go to anyone seeking help and there are no boundaries in what you do in your role and responsibilities.” (Interviewee 3)*

The model components of *Open and Informal* culture and *Collaborative* culture characteristics thus directly enable and stimulate *Employee interaction (EI)*. The open door policy of the case company allows employees to reach colleagues physically and informally, having possibility to interact with other employees across departments and hierarchical levels with minimal

formal barriers. Employees know that they can count on each other for any reason, being able to seek out knowledge and information and at the same time being always available to provide help and contribution to others when approached. The project-based and teamwork nature of the case company workplace environment means that problems are worked on and solved mostly collectively, even across different project team members, in order to facilitate knowledge and information sharing (Harris, 1994). However, such cultural context entails that employees' interactions are driven by employees themselves, by their needs and perception of job responsibilities and tasks, and information sought.

As it has been found, *Employee interaction (EI)* and its nature is influenced and shaped internally via its relation to its components such as *Interaction scope*, *Interaction diversity*, *Employee seniority*, *Information blind spots* and *Interaction effectiveness*. Reflecting key principles within CAS adopted, it has been supported that interactions among employees (interactions between agents in CAS) are shaped by employee characteristics (agents characteristics), their social environment (the system and its conditions agents interact within) and their held beliefs and cumulated interpreted information which guide their behavior across such interactions (agents' schemata as represented by organizational culture). The components such as *Employee seniority*, *Information blind spots* and *Interaction effectiveness* relate to elements of agents and schemata and highlight the observed constraining factors within the case company on their, more individual level. The components such as *Interaction scope* and *Interaction diversity* reflect environmental conditions within the system as well as are highlighting the observed constraining measures on a more collective level, describing more general characteristics of employee (agent) connections and interactions within the system.

In particular, one part of the model related to EI reflects on the findings that *Interaction scope* positively influences *Interaction diversity* which then positively influences *Interaction effectiveness*, meaning that bigger the scope of employee interactions leads to higher level of diversity of those interactions improving their overall effectiveness. The open, informal and collaborative organizational culture of the case company has demonstrated to broaden the scope and diversity of employees' connections and interactions, encouraging them to step outside of the conventional job-title-related boundaries, having the possibility to freely move within the organization and interact even with employees they did not know before. Without minimal formal barriers to interaction scope, employees have a higher chance to interact with a vast multitude of diverse employees, as represented in their differences in professional seniority, expertise, knowledge, competencies or functional roles. This way, employees can

expand their networks of connections in the organization and receive information from a bigger and more diverse pool of employee sources. As a result it has been supported that increased scope and diversity of interactions positively influence their effectiveness, as employees know to whom to turn to for information needed, do not waste time locating different sources of knowledge and experience and benefit from such gained knowledge to successfully pursue their tasks and related goals within their day-to-day working environment.

*“My work is highly influenced by culture and I would say that my progress as engineer is all dependent on the culture. I have been helped from the beginning and it is a continuous support from colleagues, so I developed and learned a lot. I had the chance to help more experienced engineers with my knowledge too.” (Interviewee 8)*

Nevertheless, it has been also found that due to the high degree of informality and technology-orientation of employees, interactions can be actually limited due to widening of geographical and physical proximity between employees, maintenance efforts within developed personal relationships, lack of time or due to high focus and demands on technological expertise of employees. Such constraints identified support similar assumptions and sentiments expressed in literature as they are closely connected to how individuals communicate and interact within organizations and what conditions for interactions are beneficial or less beneficial for their outcomes (Morris, 2014).

At the same time, the other part of the model related to EI reflects on the findings that *Employee seniority* negatively influences *Information blind spots* which then negatively influences *Interaction effectiveness*, meaning that more senior employee is the less information blind spots they have which then leads to improved effectiveness of their interactions. The organizational culture of the case company facilitates relatively comfortable and non-competitive workplace environment where employees tend to be helpful, friendly and open towards each other when interacting, experiencing high degree of autonomy and engagement through meetings, events and workshops. It is therefore understandable why the majority of agents expressed the willingness to stay and work in the case company for an indefinite time. Complementing the relations stated in the previous paragraph, the more time is spent within the organization, the higher the level of employee seniority is gained, in terms of both increase in developed set of skills, capabilities and expertise. This leads to an increased awareness and knowledge of where to find specific relevant information within the personal network or organization in general, improving the interaction effectiveness as employees know better to whom or where to turn to

for information needed, do not waste time locating different sources of knowledge and experience and benefit from such gained knowledge to successfully pursue their tasks and related goals within their day-to-day working environment. In the same line of argumentation, higher employee seniority, related not only to their time spend in the case company but as well related to their level of organizational role or expertise, mitigates or even minimizes their information blind spots as they interact with big and diverse group of employees by default stemming from their higher role function, or they do not face significant amount of technology-related information blind spots as they are experts in that area and are not expected to pursue other non-technology-related areas in their roles. This, as well, leads to improved interaction effectiveness. In addition, less of information blind spots directly translates into improved interaction effectiveness as it makes interaction faster, easier and more focused in nature.

However, presence and influence of certain constraining factors could be again argued here as well. Increase of employee's level of seniority could lead to increased path dependency within their working methods and beliefs. As partially supported by the data, some employees within the case company exhibited tendency to work predominantly with their established set of methods and colleagues, as they were not encouraged to do so via new kinds of interactions with other employees and are maintain a certain level of information blind spots, not related to technical knowledge but to set beliefs about how to approach their roles, tasks and even problems to be solved.

*“I have different way of coming up with new ideas, developed during my previous experiences, but when I started here I found things very different from what I used to do.... here it is more focused, solving things in one way. It a little bit different from my preferred way of working, ..., but it's a bit tricky because it's very easy to go with the flow and do what everyone else is doing.” (Interviewee 2)*

### 5.3 Employee interaction and Problem creation process

As reflected in literature, it has been argued that early phases of innovation processes in organizations are usually not formally structured or managed processes, they are informal and not clearly defined in nature, yet particular collective patterns of behaviors can be observed in organizations which represent to some extent or other the activities or actions which are associated with such early phases. It was identified that behaviors related to problem creation

process activities were indeed very blurry, informal and unstructured in nature in the case company. However, as argued such behaviors were present and as such it was argued and even now supported by the findings that they were strongly influenced by the case company's organizational structure.

Before data collection, it was argued, as related to the existing literature, that studying influences on such kind of process required more dynamic approach which was based on the importance of interdependences, interactions between elements and resulting patterns of behaviors (Anderson, 1999), and as such appropriate for the nature of process to be studied, thus using the perspective of complex adaptive systems (CAS). The underlying assumptions behind CAS suggested not to only look at elements within the system and their characteristics but to search for relations between them and uncover what kind of patterns of behaviors as a result were collectively reinforced and thus exhibited within the studied (organizational) system (Carver & Scheier, 2002) In line with the proposed assumptions, the findings brought to light a discernable set of patterns which were observed, analyzed and supported by data within actions related to problem creation process within the case company.

The model components of *Problem scope for Problem finding & framing*, *Available time for Problem formulation* and *Level of problem newness*, as related to the higher theme of *Problem creation process*, were identified as being the most representative of the key characteristics and dynamics of problem creation process behaviors and their outcomes exhibited within the case company. When looking overall at the relationship between *Employee interaction (EI)* and *Problem creation process (PCP)*, it has been found that its non-linear dynamic is indeed in line with this principle within CAS where it is not only that interactions between employees and its characteristics influence problem creation process but such problem creation process characteristics and outcomes influence back the nature of interactions and so on, as depicted in the model via a loop of curved arrows. As *Interaction effectiveness* has been identified and depicted as the key characteristic and as such a key resulting concept representing *EI* in the model, it is now used as a starting point for a further analysis of relations between *EI* and *PCP*.

In particular, one part of the model related to *PCP* reflects on the findings that *Problem scope for Problem finding & framing*, as being shaped by *Interaction Effectiveness*, positively influences *Level of problem newness*. It has been found that the interactions between employees are a consistent source of inspiration for new ideas, since they are able to share and discuss problems they think about solving and how they identified or found them. Therefore, a

high level of *Interaction effectiveness* provides an increased pool of useful knowledge and inspiration being exchanged regarding possible problems to solve or possible alternative approaches to how to identify them. This, as it has been found, translates into an expanded *Problem scope for Problem finding & framing*. Such expanded scope then leads to increased *Level of problem newness* as employees now have expanded knowledge and understanding about alternative, various and different potential sources of problems, in which ways they can be identified and framed. As a result, as employees-engineers are naturally curious and inventive in nature as observed within the case company as well, they are exploring and considering new problems which could be solved, pursuing new sources for insight to identify innovative and valuable problems to solve.

When employees are able to source identified problems from a broad and diverse scope of sources such as technology insights, product requirements and testing, customer needs, competitor analysis or market trend workshops, it has been found that the outcome of such problem finding & framing behaviors is a problem with higher level of newness, compared to the problems resulting from a narrow and purely technical scopes.

*“Usually when we have this customer visit, have a workshop, then we discuss openly our findings. With a group discussion ideas pop up. Sometimes problems are not so big, or they are not problem at all and you can discuss about what to solve...” (Interviewee 6)*

However, as found in the case company, the absence of formally structured problem finding and framing processes and the presence of predominantly technology-oriented solutions, is partially hindering the scope searched and defined for new problems to be identified and solved for new and highly innovative products. As have been observed, employees tend to consider mainly internal sources of problems, such as product standards, requirements and testing, often jumping into solutions without thinking in terms of customer needs. Even though there is access to information from sales and marketing related to customer, competitor and market intelligence departments for example, employees often preferred to look at existing and known problems within the product portfolio, innovating only incrementally, related mainly to improving product features or components.

Other part of the model related to *PCP* reflects on the findings that *Available time for Problem formulation*, as being also shaped by *Interaction Effectiveness*, positively influences *Level of problem newness*. This link is definitely immediate and logical in its nature, since a highly effective interaction enables employees to save time and effort to spend more to consider the

value of different problems being identified, or to select alternative problems and further discuss which ones could be more valuable to solve (Frishammar et al. 2016). The finding of time constraints in general was well supported by employees in the case company as related to innovative behaviors. In particular, it has been observed that this kind of constrain had a very influential impact on choosing problems with low levels of newness when facing strict project deadlines and time scheduling. At the same time, when employees are able to interact more effectively, they subsequently have more time for more exploring and evaluating discussions about what is the value of solving various identified problems, how to prioritize them and therefore which problems to select for coming up with new ideas or product concepts. Within these stimulating conditions, employees tend to decide to work on problems that are more innovative in nature, contributing to the overall innovation efforts within the company.

Completing the overall relation loop in the model between *EI* and *PCP*, it has been found that *Level of problem newness* is related to and shapes back *Employee Interaction* as *PCP* and the activities involved in it are dependent on collaborations and thus information sharing and interacting between employees. The introduction of problems with high levels of newness involves increased demands for new and diverse information gathering where employees need to intensify collaborative efforts in order to come up with valuable as well as functioning solutions. As observed within the case company, patterns of shared behaviors related to finding, framing and formulating problems influence back the dominant patterns within interactions (who is involved, what is the scope, how diverse they are, how effectively is information sought out and shared, etc.) and thus its effectiveness, as related to various newness levels and kinds of problems which are to be solved.

## 5.4 Organizational culture and Problem creation process

It has been argued in line with existing research that organizational culture guides and constraints behaviors of its members through the shared norms and beliefs (Schein, 2010), formed and developed by them through interactions with and within their environment, connected to the particular context of such behaviors within which they occur, problem creation process (*PCP*) behaviors in this particular case. Combing perspectives on organizational culture, early phases of innovation and complex adaptive systems (*CAS*) theory, it has been argued that the relationship between organizational culture and problem creation process as described is a dynamic, non-linear and adaptive in its nature, viewing organizational culture as

guiding the individual and collective behaviors (Smircich, 1983) related to such unstructured and informal process as PCP, while at the same time those shaped patterns of behaviors related to PCP influence back how organization members are interacting. The following findings from the case company about the nature of this relationship, as represented in the research question, will be presented and as well as compared when relevant to the theoretical assumptions and arguments stated as to discuss now the level of their support in the empirical data.

As shown in the model, it has been found that the relationship between *Organizational culture* and *Problem creation process* is manifesting itself in two ways. Firstly, characteristics of organizational culture represented in concepts of *Problem-solving culture* and *Product-oriented culture* influence *Problem creation process* via directly influencing the embedded constructs of *Problem scope for Problem finding & framing* and *Available time for Problem formulation*, and thus indirectly *Level of problem newness*. This relationship reflects the argued influence of organizational culture on behaviors through the shared beliefs and socially perceived norms, guiding employees in their responses towards abiding them, related in this case to high levels of orientation towards products, technical requirements and efficient problem-solving pressures. Secondly, *Organizational culture* is influencing *Problem creation process* through *Employee interaction* and its already mentioned dynamic and interdependent relationship with *Problem creation process*. This relationship reflects the previously assumed nature of the influence of organizational culture on collectively exhibited behaviors and thus processes through the nature of employee social interactions and related to constraining or enhancing conditions for such interactions to be efficient yet productive and effective.

In particular, it has been found that both *Problem-solving culture* and *Product-oriented culture* influence *Problem scope for Problem finding & framing* and *Available time for Problem formulation*, however, each one in a different way and on a broad scale of influence intensity as it depends on particular situational context and conditions in which process creation process is conducted. Firstly, it has been found that *Problem-oriented culture* influence predominantly *Problem scope for Problem finding & framing*. As this embedded and shared approach to new ideas and new concepts is that one must start with a problem in mind, such culture stimulates problem creation process behaviors even if formally and structurally unrecognized as such, compared to the extensive step-by-step process proposed in the literature by Frishammar et al. 2016. As proposed by other authors such as Koen et al. (2001) when coming up with new ideas, focus could have been put more on opportunity recognition or the problem creation process could have been omitted completely and new ideas are being proposed without considering

their problem-related value. Orientation on starting with a problem leads to forming of problem scope to be solved and thus ensures that problems are searched for and being identified. Of course, as admitted earlier, the influence of such culture ensures the consideration of a problem to begin with but it does not ensure that the right problems are being solved. Problem scopes and by extension problem newness levels vary across ideas and projects, and as observed in the case company, have a tendency to stay within lower levels of newness, as influenced by other factors and relations mentioned.

Secondly, it has been found that *Product-oriented* culture influence *Problem scope for Problem finding & framing* as well as *Available time for Problem formulation*. As such culture focuses on products when engaging in innovative efforts, technical feasibility of new ideas and the improvements made related to the existing similar products on the market are of influence. As observed from patterns among exhibited behaviors within the case company, there exists a shared understanding among employees that new ideas and problems to be solved are expressed in product designs and features mostly and one needs to present a functioning prototype to increase a probability for further development. This influences *Available time for Problem formulation* as employees could assess how much time, or better said, how much more time they would need to have for more innovative and new ideas to develop and if strained thus turning to previously tried designs, minimizing the level of newness in the process. In addition, this kind of culture influences *Problem scope for Problem finding & framing* as well, as problems could often be seen as very specifically expressed in product-related technical problems or deficiencies, limiting the scope only to this source of problems, potentially harming the level of its innovativeness. The nature and intensity of these influences differs across product types, project scopes, employees involved and other various inputs, however, the existence and key characteristics of such relations were observed and supported in the analyzed data.

At the same time, it has been found and shown that there exists a relationship between *Organizational culture* and *Problem creation process* which encompasses a more complex set of forces and dynamics operating within it. As opposed to a more simplified view of role of organizational culture in front end of innovation processes in literature as a contributing variable, an instrument for performance stimulation or representing beneficial social conditions for more effective innovative efforts (see chapter 2), it has been proposed that such relationship was complex in nature, assuming underlying dynamics related to social interactions and their characteristics as more being influential than currently expressed in research. In line with our

expectations and argumentations, it has been supported that *Organization culture* also influences *Problem creation process* through a group of interdependent characteristics, measures and conditions of *Employee Interaction such as Interaction scope, Interaction diversity*, level of *Employee seniority*, nature and scope of *Information bind spots* of employees engaged in such interactions and the overall *Interaction effectiveness* of such interactions. As described in detail in the previous sections, these operating together influence the *Problem scope for Problem finding & framing* as well as *Available time for Problem formulation* present within *Problem creation process* and thus ultimately influence the *Level of problem newness*, the key measure of a level of innovation within the present problem creation activities within the case company.

As such, it has been thus supported that organizational organization influences the level of innovation in problem creation process and thus front end of innovation efforts and their outcomes, and is doing so not only directly via its traditionally argued innovation-supporting characteristics such as openness, trust and communication (Koen et al. 2014) but by influencing how employees interact within organizations in general and related to their early phases of innovative behaviors in particular. Using CAS perspective, we were able to identify the underlying interdependencies within such relationship and explain how specifically the dynamics within such interactions, as shaped by the organizational culture present, influence how innovative the outcome of problem creation process, a formulated problem, is. In addition, as opposed to a current linear understanding within the research, we showed the overall non-linear nature of the relationship between *Employee Interaction* (as shaped by *Organizational culture*) and *Problem creation process*. Even though previously argued for a more direct and sole influence of organizational culture (using CAS perspective, functioning as a sole source of agents' schemata within the system) as guiding behaviors in problem finding, framing and formulating, it has been supported that employees are strongly guiding by their shared beliefs and values, however, not entirely determined by the organizational culture present only but determined as well by their own professional expertise and experience, working attitudes, seniority or other personal information interpretation biases shaped independently to the organizational culture present, either outside of the case company and due to different previous experience and attitudes from other companies, partially enacting on in the case company as well.

## 6. CONCLUSIONS AND IMPLICATIONS

### 6.1 Conclusions

The purpose of this thesis was to contribute to existing literature on problem creation process in the front end of innovation and its relationship with organizational culture. In particular, the aim was to explore and overcome the limitations of the existing understanding of such relationship as being static and linear in nature, driven by the functionalist view of culture as organizational attribute to manage and stimulate innovation performance. To do so, the literature review established a strong theoretical connection between organizational culture and complex adaptive systems perspective in order to uncover the underlying dynamics of its influence on problem creation process, establishing interdependent and non-linear set of patterns which represent how organizational culture shapes problem creation process.

As a result, it was found that organizational culture shapes problem creation process and the level of the innovativeness of its outcome by influencing how individuals interact within an organization, how diverse the interactions and related information sharing is and how productive and effective such interactions are, as well as, by shaping the individual beliefs and norms related to which actions are being collectively encouraged when engaging in problem finding, framing and formulation activities within an organization. In particular, it was identified that characteristics such open and informal, collective, product-oriented and problem-solving culture were influencing and shaping how problem creation process was conducted and thus what was the resulting level of problem newness as its outcome.

The findings contributed to the existing research on how the front end of innovation processes are being shaped and influenced by organizational context and its characteristics, directly responding to the future research suggestion by Frishammar et al. (2016) as to study interaction between processes such as problem creation process and organizational culture. In addition, this research further supported the need for expanded perspective of organizational culture and its role compared to the traditional linear view when conducting organizational studies, especially related to early stages of innovation processes, such as PCP, which are significantly unstructured and informal in nature and thus shaped by the culture and organizational social context even more than the traditionally formalized processes, influencing its dynamics and interdependences in a more complex way than commonly suggested and displayed in research.

## 6.2 Practical Implications

As evident in the case company, managers need to recognize the underlying self-reinforcing and self-sabotaging aspects of relying on a culture-driven and bottom-up approach for internal processes and activities, in particular regarding front end activities that are crucial in determining the innovative outcome of the firm. Even if front end activities in general benefit from informal, unstructured and experimental conditions, such superficial focus on supporting open and collective culture is not sufficient to gain high levels of innovative problems to solve and ideas to develop. As shown in the findings, managers need to understand the interdependencies between multiple stimulating or constraining patterns of employees' behaviors related to their interactions, social conditions of such interactions, such as scope physical proximity, diversity, speed and effectiveness and their characteristics, as they influence how much time and effort they will be able to spend on finding the right, valuable problems to be solved.

Moreover, managers should be aware that a strong organizational culture has to be complemented by equally strong strategic guidance, especially regarding innovation. For example, having a clear and defined innovation strategy would encourage employees to interact on a more systematic and purposive way based on collectively understood focus what innovation means for the company, as currently with such informal and unstructured setting, individually emerging high-level innovative efforts are being stifled and minimize as a result of succumbing to a shared way of doing things the tried way and the minimal time provided to explore more innovative alternatives. Especially in case of technology-oriented companies, the diversity in information and methods shared as source for new ideas is essential, as the most valuable problems to be solved lie somewhere between the best application of new, cool technology and solving key customers problems in a effective way.

## 6.3 Limitations and Future Research

Although the case company enabled to fully answer the research question with rich, extensive and detailed findings, thanks to its particular organizational context and dynamics, the qualitative single case research design (involving multiple cases within one single company) implies consistent external replicability challenges. The proposed model can be applied to any

other business reality, which provides the logic and framework to visualize the internal dynamics in terms of cultural influence on employee interaction and the relative impact on problem creation process. However, it needs to be slightly modified and adjusted accordingly to the specific cultural characteristics and the level of structure and formalization of problem creation process activities. This research proposed a new perspective to better understand the relationship between organizational culture and problem creation process, disclosing several opportunities for further studies. Therefore, future research could engage in more robust study involving multiple companies to cover different organizational contexts, including companies with more rigid and bureaucratic cultures and higher level of formality and structure in the problem creation process, so that concepts and measures can be compared across case companies and analysed in order to build a more standardized and commonly accepted model.

Moreover, the use of quantitative methods to complement the necessary qualitative ones would be extremely beneficial for the similarly oriented studies, as with the opportunity to give numerical values to the concepts and measures described within the model it would be possible to assess the different degrees of intensity and causality as influencing the process and its outcome.

Furthermore, this research adopted complex adaptive system perspective to focus on organizational culture as the main influencer over the earliest phase of the front end of innovation, specifically problem finding, framing and formulation. This choice was made primarily due to the particular organizational context of the case company, but also due to the need to narrow the scope of this research. It was beneficial to avoid having too many theoretical concepts to be systematically reviewed and used in the analysis, with the risk of not going sufficiently into details and fully answer a broad research question. Therefore, this study excluded topics such as strategy and vision, which are regarded by existing literature to have an impact on the front end of innovation along with organizational culture. At the same time, the focus on the problem creation process excluded the other parts of the front end of innovation, without treating the process as a whole. Future research would have the possibility to adopt a complex adaptive system approach to start to concentrate efforts in studying how strategy and vision shape problem creation process, integrating the outcome of those findings with this research and then broaden the perspective over the whole front end of innovation.

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# 8. APPENDIX

## 8.1 Interview Guide

### **1.1 Basic personal information**

1.1.1 What is your age and nationality?

1.1.2 What is your educational background?

### **1.2 Basic role information**

1.2.1 What was your professional experience before joining the case company?

1.2.2 When did you join the case company?

1.2.3 What are the job roles you performed in the case company?

### **2.1 General core beliefs and norms**

2.1.1 How would you describe the organizational culture in terms of guiding principles, values and beliefs in the case company?

2.1.2 How would you say this culture affects your way of working in the case company?

### **2.2 Innovation-related beliefs and norms**

2.2.1 How do you believe that the case company culture relates to new ideas?

2.2.2 What do you believe is the role of innovation in your ordinary way of working?

### **2.3 Idea generation-related beliefs and norms**

2.3.1 What do you think is the case company way of coming up with new ideas?

2.3.2 To what extent would you say that you share or adopt this case company way of approaching to idea generation?

### **3.1 Problem finding**

3.1.1 When coming up with new ideas in your work, do you identify the problems that need to be solved first? (You can think about what you experienced in general or think about a recent project/idea recently).

3.1.2a) if yes - How do you identify them?

3.1.2b) if no - How do you arrive at your ideas? Alternatively, what is the source of your ideas?

### **3.2 Problem framing**

3.2.1 Do you relate the problems that you identify to each other? If so, how?

(You can think about what you experienced in general or think about a recent project/idea recently).

### **3.3 Problem formulation**

3.3.1 How do you decide what problems you solve with your ideas?

(You can think about what you experienced in general or think about a recent project/idea recently).

3.3.2 Why do you choose those problems to be solve with your ideas?

### **4.1 Social interactions – current characteristics**

4.1.1 How would you describe the current network of people you interact with in your role?

4.1.2 What people would you say you interact with the most in general?

4.1.3 Who do you relate to when collaborating on generating new ideas in particular?

### **4.2 Social interactions – previous characteristics**

4.2.1 Did it look like the same in the past? If not, how has it changed?

### **4.3 Feedback**

4.3.1 What do you think are the shared “unspoken rules” in the case company about which problems to choose and solve with your new ideas?

4.3.2 In your experience, what problems were you encouraged to solve and discouraged to solve?

4.3.3 What is your view on the benefits of feedbacks and how are you experiencing them in the case company?