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Strategies and habits for adapting the plan in agile teams: a grounded theory  
and improvisation perspective

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Estratégias e hábitos para adaptar o plano em times ágeis: uma perspectiva  
da improvisação e *grounded theory*

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**Strategies and habits for adapting the plan in agile teams: a grounded  
theory and improvisation perspective**

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## ABSTRACT

Reigado, C. R. (2018). *Strategies and habits for adapting the plan in agile teams: a grounded theory and improvisation perspective*. (Master's dissertation). Production Engineering department, University of São Paulo, São Carlos.

The ability of agile teams to adapt the project plan to unexpected problems is still a less-researched area. They must change the project plans as facing unexpected challenges and, even though existing studies relate some aspects to this ability, such as participatory decision-making, openness to discuss problems in an immediate sense and focus on actions to be taken in near future, these studies do not yet offer a complete theory, or set of practices, about how adaptation takes place. What actions and decisions of the team allow for adaptation? Improvisation is an approach that could potentially fill this gap and consists of someone executing an action without previously planning it, or doing it differently from the original plan, when facing a problem. This study presents an investigation of how agile teams adapt when facing unexpected changes or problems during the projects. The concept of improvisation is used and the study involved two agile software development teams and using Grounded Theory (GT). The results indicate that the teams apply different improvisation strategies, such as breaking standard work rules, as well as maintain habits that contribute positively to improvisation. Clients also play an important role in helping teams solve unexpected problems and should be invited to collaborate. These results can be used to assist professionals in search of more effectiveness in agile teams in terms of adapting the plan during the project.

Keywords: Agile teams. Agility. Adaptation. Project Management. Software Development

## RESUMO

Reigado, C. R. (2018). *Estratégias e hábitos para adaptar o plano em times ágeis: uma perspectiva da improvisação e grounded theory*. (Dissertação de mestrado). Departamento de Engenharia de Produção, Universidade de São Paulo, São Carlos.

A habilidade de os times ágeis adaptarem o plano do projeto de acordo com problemas inesperados ainda é uma área de pesquisa pouco explorada. Essas equipes precisam ser capazes de adaptar o plano do projeto quando se deparam com desafios inesperados e, ainda que os estudos relacionem alguns aspectos a essa habilidade, como tomada de decisão participativa, abertura para discutir problemas de imediato e foco em ações de curto prazo, os estudos ainda não oferecem uma teoria completa ou conjunto de práticas que descrevam como, de fato, a adaptação acontece. Quais ações e decisões do time lhe garantem a capacidade de adaptação? A improvisação é uma abordagem interessante para compreender esse *gap*, e consiste em executar uma ação sem previamente planejá-la, ou de uma maneira diferente do que a planejada, quando da ocorrência de um problema ou mudança inesperada. Esse estudo apresenta uma investigação da adaptação em projetos ágeis quando as equipes se deparam com mudanças ou problemas inesperados. O conceito da improvisação é usado e o estudo envolveu dois times ágeis que desenvolvem software, e utilizando o método *Grounded theory* (GT). Os resultados indicam que os times utilizam diferentes estratégias de improvisação, como quebrar regras de trabalho, assim como mantêm hábitos que contribuem positivamente para a improvisação. O cliente também desempenha um papel importante ao ajudar os times a resolverem problemas inesperados, e portanto devem ser convidados a colaborar. Esses resultados podem ser usados para auxiliar profissionais no sentido de obter-se times ágeis mais efetivos na adaptação do plano durante o projeto.

Palavras-chave: Equipes ágeis. Agilidade. Adaptação. Gestão de Projetos. Desenvolvimento de software.

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## LIST OF ABBREVIATIONS AND SYMBOLS

APM	Agile Project Management
B2B	Business-to-business
GT	Grounded Theory
IT	Information Technology
NPD	New Product Development
PMO	Project Management Office
STSD	Socio-Technical System Design
WIP	Work In Process
XP	eXtreme Programming

## SUMMARY

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## **1 Introduction**

This section presents the contextualization and justification of the research. Next, the objectives of the work are presented, as well as the structure of the work.

### **1.1 Contextualization and justification**

The Agile Project Management (APM) is a managerial approach indicated for turbulent environments and companies are expected to be able to respond quickly to changes that happen throughout the project (Highsmith, 2009). The author points out that the plan in agile projects consist of hypotheses, and feedback from reality will lead to adaptation, through adaptation actions.

APM is based on a set of principles, such as continuing delivery of value, welcoming changing requirements, self-organizing teams, and face-to-face conversation (Fowler & Highsmith, 2001). As APM literature evolved, more and more practices and techniques have emerged to make these principles possible on projects' routine. For example, the continuous delivery of value occurs through iterations, called sprints, which are based on small deliveries being made in short periods of time. Sprints are combined with sprint planning meetings and daily meetings. That is, practices that involve moments of review of project achievements, learning and preparation of the next iteration.

Regarding other agile principles such as are welcoming changing requirements and developing self-organizing teams, it means that during sprints and revisions, teams need to identify changes in requirements and adapt plans, backlogs and tasks, to accept the changes. There is an already consolidated literature on characteristics of self-organized agile teams (Hoda, Noble and Marshal, 2012, 2013), describing cases of agile self-organized teams (Sharp and Robinson, 2004; Robinson and Sharp, 2004; Whitworth and Biddle, 2007; Whitworth, 2008). A consensus among the authors concerns the responsibility of project teams to

successfully deal with any changes that affect execution (Nerur, Mahapatra, & Mangalaraj, 2005; Conforto, Amaral, et al., 2016, Hoda & Murugesan, 2016). But how does a self-managed team carry out the adaptation of the plan, either in terms of practices or skills required?

Although there is not a vast literature on this specific issue, evidences can be identified in the course of the works cited, on self-management. Some authors have pointed out important aspects to achieve adaptation, such as participatory decision-making process (Nerur et al., 2005), openness to discuss problems in an immediate sense, the focus on actions to be taken in near future (Whitworth & Biddle, 2007) and the redundancy of functions (Morgan, 1986).

Additionally, the daily meetings have been related to faster solving of design issues, especially due to their impact on software development teams' communication (Pikkarainen, Haikara, Salo, Abrahamsson, & Still, 2008). Highsmith (2009) argue that at the end of every iteration the teams need to reflect on the necessity of adapting in relation to four themes: product value, product quality, team performance and project status. In order to adapt, the team needs to stay focused on the value being delivered and on the project's vision. He suggests some actions, such as customer focus group and project status report, to achieve adaptation.

However, there is still a gap on the literature relating to set of actions and decisions that guide practitioners more practically and consistently to adapt plans during the project, at the moment a problem is perceived. For example, there are no specific and synthetic recommendations that bring these observations together in a theory that can support the actors.

As a consequence, important questions have not yet been solved. What are the possible actions that can be used to ensure greater success in the adaptation? How do participatory decision-making and openness to discuss problems influence the practice of teams so that they are able to react to the most complex and unexpected problems at the time they occur in projects? Are there practices or habits that can help? When, and how, does the adaptation begin during the projects?

Improvisation is a concept that may elucidate these questions. Klein, Biesenthal, and Dehlin (2015) discussed the concept of improvisation on project management, defining it as "a form of practical excellence in which the project

manager masters daily challenges through educated and context-dependent actions” (Klein et al., 2015, p. 270). Additionally, in the APM literature improvisation has been defined as “the ability to create and implement a new or an unplanned solution in the face of an unexpected problem or change” (Conforto, Rebentisch, & Amaral, 2016, p. 8).

Moorman and Miner (1998b) argue that adaptation is a potential outcome of improvisation, and, even though there is a wide range of studies on improvisation, there has been no attempt to use the concepts of improvisation as an instrument to elucidate the mechanisms of adaptation of the plans in agile projects and to answer the questions asked above.

This study was designed to describe in details the improvisation process in two agile teams experimented with the agile techniques. The research method of Grounded Theory was used in order to synthesize the adaptation process and to identify the elements that could support the members during this adaptation.

This is the first study to investigate in details the adaptation in agile teams, using the improvisation. The results point to the existence of habits and strategies that teams use to adapt the plan, improvising in situations of incongruity with the original project plan. Thus, it enlightens the phenomenon of adaptation, opening space for future research on the theme and to guide agile software development teams to respond effectively to unforeseen changes in the projects. A deeper understanding of the mechanisms that enable agile teams to achieve adaptation is essential for being able to stimulate teams to adapt in the future. Guiding team members, as well as leaders and PMOs, is a contribution for making agile teams more effective and productive in their performance.

## **1.2 Objectives of the research**

This research aims to investigate how agile teams adapt when facing unexpected changes or problems during the projects. The improvisation theory was chosen as a theoretical reference to base the analysis and as a starting point for the

search of a set of concepts, categories and connections that contribute to the comprehension of the phenomenon of adaptation in agile teams. In practice, it means to elicit and categorize elements such as actions, decisions, artefacts, organizational aspects or other aspects that describes how agile teams adapt the project plan through improvisation. It is expected that these elements will contribute to the development of a theory capable of enhancing comprehension on how a company may improve its teams' capacity of improvising and adapting.

In order to achieve the main goal, a field study was conducted based on Grounded Theory, involving two agile teams in an APM experienced company. The researcher observes the teams' routine and improvisation episodes, which are registered and analysed.

This study's specific objectives are:

- I. Describe actions and decisions made by members of the teams, regarding identification of problems, planning of the solution, execution and control of the defined solution.
- II. Identify patterns of behaviour or contributing aspects during improvisation episodes and translate them as concepts, categories and connections to enable the comprehension of the phenomenon.

### **1.3 Document Structure**

This document is organized in eight chapters. Chapter one introduces the research through the presentation of the context and research questions and objectives.

Chapter two comprises the literature review, organized in two fronts: agile teams and improvisation, each one organized accordingly. Then, chapter three focuses on the methodology of this study, the justification, steps and the methods that were utilized – Systematic Literature Review and Grounded Theory (theoretical sampling, coding, constant comparison).

The fourth chapter encompasses the field study, including the presentation of the company, the teams and the episodes of improvisation observed. Chapter five comprises the results, describing the strategies and the habits for adapting the plan through improvisation in agile teams. Chapter six presents a comparison between the results of the analysis and the literature. Finally, chapter seven brings the conclusions, limitations and future research.



## **2 Literature Review**

This section presents the results of the two literature reviews performed in this research: one focused on agile teams (section 2.2) and another on improvisation (section 2.3).

### **2.1 Agile teams**

The content studied in the agile teams' literature review was organized into two sections. The first is dedicated to the understanding of the origin of the work and organization of agile teams (section 2.1.1), and the second intends to present the definitions and characteristics proposed by the literature on these teams (section 2.1.2).

#### **2.1.1 The origin of agile teams**

Agile teams literature is deeply related to the self-management literature, and agile teams are commonly referred to as self-organizing teams (Fowler & Highsmith, 2001; Cockburn & Highsmith, 2001; Hoda et al., 2013), self-disciplined teams (Highsmith, 2009), self-managing teams, autonomous teams (Moe & Aurum, 2008a) and empowered teams (Moe & Aurum, 2008a; Hoda et al., 2013).

One of the origins of these concepts is in the Socio-Technical System Design (STSD) paradigm. STSD is based on the belief that the work system must consider better working conditions and productivity in a balanced manner. This philosophy takes into account the condition of rapidly changing world and continuous change (Eijnatten, 1993) and introduced the idea of semi-autonomous teams. Thereby,

Whitworth and Biddle (2007, p. 1) defines agile software development teams as "complex adaptive socio-technical systems."

The work of Takeuchi and Nonaka (1986) was one of the first studies to discuss the context and the practices of APM, being, therefore, a great reference in the APM literature. The authors highlight the emergence of a competitive environment that demands speed and flexibility in the development of new products. To thrive in this environment, self-organizing project teams are an essential part.

Self-organising teams are marked by team members being able to execute multiple functions, as Morgan (1986), calls redundancy of functions, Takeuchi and Nonaka (1986) calls cross-fertilization and Trist (1981), calls multi-skilling; by having their activities being minimally predetermined by managers, as Morgan (1986) calls minimum critical specification, Takeuchi and Nonaka (1986) calls autonomy and Trist (1981) calls 'managing its own activities'.

The learning capacity of the teams is also highlighted in literature. Morgan (1986) describes the importance of teams maintaining the ability to question how they are executing their activities and learn from it. Trist (1981) states that teams will increase their skills over time and, consequentially, their decision space will also rise. Takeuchi and Nonaka (1986) discuss different levels of learning, their transference, and constant improvement of the team (self-transcendence).

Therefore, regarding the characteristics of agile teams, they embrace the characteristics already identified in the self-organizing teams literature was used as a source for those agile's academic. There is few distinctions and the next section describes the definitions and characteristics of agile teams from the point of view of APM researchers.

### **2.1.2 Agile teams' definition**

The collective factor is one of the most remarkable characteristic of agile teams. Collective thinking is characterized by a holistic view instead of the individual view, with regard to tasks and roles (Whitworth and Biddle, 2007; Whithworth, 2008).

This collective vision is strongly represented in the teams' way of working. The team members collectively decide on the planning, including what work needs to be done and how to execute the work (Sharp & Robinson, 2004), which includes team members assigning tasks for themselves, without the leader's approval (Hoda et al., 2013), and the evaluation of the work done, making sure the results were satisfactory (Sharp & Robinson, 2004).

According to Nerur and Balijepally (2007), the agile culture encourages the formation of teams with interchangeability of functions, in the same meaning as redundancy of functions mentioned by (Morgan, 1986). The interchangeability also allows members to assist each other in the designated activities. Whitworth and Biddle (2007) mention that members would even offer to help others when their own activities were done.

The collaborative decision-making process is another strong trait of agile teams (Cockburn & Highsmith, 2001). Members are considered at the same level, which reveals the democratic aspect of these teams (Hoda et al., 2013). Nerur et al. (2005) add that, when members have discretionary power and take part in decision-making, they gain cross-functional abilities. On the other hand, the authors point out collaborative decision making as a challenge, since it requires time and patience for being executed.

According to Whitworth and Biddle (2007), the communication and team awareness are other fundamental characteristics of agile teams. This aspects is build through fairly regular communication, allowing for members being aware of everyone's activities and performance. Giving and receiving feedback regarding performance in tasks, and sharing knowledge are also important practices. As a consequence, agile teams reinforce the collective endeavor and accountability (Whitworth & Biddle, 2007).

Whithworth (2008) adds that the most supportive practices to team awareness and feedback are the daily meetings and the information radiators. Information radiators are artifacts that indicate progress of the team's work, such as burnout charts, story cards or even toys. According to the author, the use of the radiators is connected with members' motivation and feeling of team cohesion.

Another example of how team members take part in decisions in agile teams is the hiring process. In some teams, members can express their opinion regarding

the candidates and influence the hiring process. This gains importance when considering the necessity of agile teams' members trusting each other since they work much more closely than they would in a traditionally managed project (Hoda et al., 2013). The importance of trust and respect, had already been mentioned by other authors, such as Cockburn and Highsmith (2001), Robinson and Sharp (2004), and Whitworth and Biddle (2007).

The hiring process also has a remarkable importance in agile teams, because the personality of teams' members is even more important than their technical skills. Abilities such as learning and changing, openness and communication are essential and, if not present, can compromise the work of the whole team (Hoda et al., 2013).

In order to sustain the collaborative working model, the team needs to be oriented according to a strong guideline. Therein lies the importance of factors such as shared purpose and understanding (Sharp & Robinson, 2004), and a common focus (Cockburn & Highsmith, 2001). Sharp and Robinson (2004) also highlight the importance of team members taking responsibility and believing in their own abilities for achieving the goals set by themselves.

Sharp and Robinson (2004) noted in their study with XP teams that the rhythm of working is beneficial both for the productivity and for member's quality of life, being comfortable and relaxing for people. Whitworth and Biddle (2007), nevertheless, present an opposite view. According to these authors, the negative effects of the agile teams way of working may include stress, due to people being "on" or socially active during the whole day, having contact with the same people, and the high involvement with the activities from the same project, every day.

Despite the opposite views, agile teams face many challenges. While they have great autonomy, they also carry a great responsibility for the deliveries they intend to make. Similarly, the challenge of balancing the benefits of cross-fertilization without losing the efficiency and effectiveness of the specialization work and, in addition, coping with the iteration pressure without leaving aside constant learning, are also present (Hoda, Noble, & Marshall, 2012).

In this regard, Hoda et al. (2012) highlight the importance of agile teams balancing different aspects: freedom and responsibility, cross-fertilization and specialization, and continuous learning and iteration pressure. The authors argue that the equilibrium of the teams lies just in the self-organisation, through what they

call the balancing acts. For instance, they suggest that varying the members' tasks in terms of functional roles and technical area is a manner of dealing with cross-fertilization and, at the same time, keeping members' interest in their work.

These characteristics and qualities of agile teams found in the literature are interesting and serve as a guide for professionals. These studies, however, do not discuss how these concepts can be articulated or related to the adaptation of the project management plans and connected to agile practices. Could the concept of improvisation elucidate this phenomena?

## **2.2 Improvisation**

The content studied in the improvisation literature review was organized into four sections. The first one introduces the context in which improvisation occurs, which central idea is the impossibility of planning every aspect in advance when it comes to innovative projects and dynamic environments (section 2.2.1). The second section (2.2.2) presents and summarizes the different conceptions of the phenomenon in the literature. The third section (2.2.3) presents and summarizes factors pointed by the literature as influencing the occurrence and effectiveness of the phenomenon. Finally, section 2.2.4 presents the correlation of improvisation and project management found in literature.

### **2.2.1 Introduction to the improvisation**

Aggeri and Segrestin (2007) state that, in innovative contexts, there are situations in which the team does not have the knowledge required for solving a specific problem at the time the problem is identified. Or even, a problem may not be anticipated due to a lack of knowledge. In these cases, the team will develop the knowledge as the issue is faced and solved.

This idea does not imply that teams are being poorly prepared or are not competent. It is a consequence of the impossibility of anticipating every minimal aspects or problems in scenarios characterized by uncertainty, ambiguity, or complex interactions (Leybourne & Sainter, 2012).

During the 1960's, organizations had a negative view of improvisation, which was considered as a dysfunction. However, according to Leybourne (2006), the study of Weick, in 1979, changed the way organizations saw the phenomenon. The interest in improvisation grew significantly during the 1990's, due to the focus on reducing the cycle times (Crossan, 1997, apud Leybourne, 2006), or improving the product development and project management processes. Moorman and Miner (1998b) also mention the change in pace and the technological advances as factors that contributed for the crescent importance of improvisation in organizations.

Many topics have been addressed by the improvisation literature, such as levels and types of improvisation (Moorman & Miner, 1998a; Miner, Bassoff, & Moorman, 2001) reasons and triggers that mark the occurrence of improvisation (Leybourne, 2006; Gallo & Gardiner, 2007) and how companies manage and control improvisation (Leybourne, 2006). When it comes to improvisation definition, the literature offer varied concepts and considerations.

Aggeri & Segrestin (2007) studied a project case of great innovation with ambitious targets in the automobile industry, and reported several failures that led to problems of lead time, cost and innovation. The authors concluded that in innovation projects, knowledge often needs to be built and that traditional design methods may not contribute to this situation. According to them, the solution depends on the team's expertise in detecting emerging issues and on their ability to dynamically reassess the degree of innovation.

These findings reinforce that, in innovative contexts, the process of planning is not capable of considering every important aspect of the project and fully preparing the team. Therefore, it is important that project teams to be able to act independently of the plan, solving problems arising from uncertainties not foreseen during planning.

In fact, uncertainty is an inescapable element of new product development (Stockstrom & Herstatt, 2008; Munthe, Uppvall, Engwall, & Dahlén, 2014). Uncertainty can be defined as "the difference between the amount of information

required to perform a particular task and the amount of information already possessed by the organization” (Galbraith, 1973, apud Stockstrom & Herstatt, 2008, p. 481).

The concept of improvisation could enlighten this conflict. According to Moorman and Miner (1998b, p. 1) “improvisation can be an effective choice when a firm faces environmental turbulence that requires action in a time frame that is shorter than a regular planning cycle”. Eisenhardt and Tabrizi (1995) corroborate this idea, arguing that iterative experience, intuition and improvisation suit well on environments characterized by uncertainty.

When improvising, the team takes non-planned actions aiming to solve the issues faced at the moment. Leybourne (2006) describes improvisation as a combination of known and unknown routines, and Miner et al., (2001) state that improvisation results in learning, which will add the created knowledge to the organizational memory.

The adaptation of agile teams' plans, discussed in the previous section, consists of an improvisational phenomenon in which the team needs to adapt the project plan to the context it is facing. Could the already theorized concept of improvisation contribute to the understanding of the adaptation phenomenon? The next section lays on these definitions.

### **2.2.2 Improvisation definition**

Moorman & Miner (1998a, p. 698) define improvisation as “the degree to which the composition and execution of an action converge in time”. This definition highlights the importance of the temporal variable that the authors concede to the phenomenon. According to them, the shorter the time gap between planning and executing an action, the more improvisational is the action. In addition, they mention that, for being considered as an improvisation, an action is required some level of innovation.

By considering the temporal distance between planning and execution, the authors present different levels of improvisation that compose a continuum of improvisational actions. Other authors, such as Cunha, Cunha, and Kamoche (1999), agree with a continuum approach for understanding degrees of improvisation.

However, a few years later, the study of Miner et al. (2001) brings a critique to the authors' own definition of 1998. The study of 2001 affirms that it is risky to use the temporal distance between planning and execution to characterize improvisation, since it is possible, through technology, to reduce it (using Computer Aided Design, for example) without the occurrence of improvisation. For this reason, they present a new definition: "improvisation is the deliberate and substantive fusion of the design and execution of a novel production" (Miner et al., 2001, p. 314).

Moorman and Miner (1998b) take into consideration, in their studies, organizational improvisation, that embraces improvisations in the group, department and organization levels. Collective improvisation involves situations when more than one person improvise together, interacting as to execute an action while composing it.

The work of Munthe et al. (2014) is focused on automotive product development and discusses deviations and strategies for dealing with them. The author defines deviation as "something that is not going as planned" (p. 2014) and that are originated from problems that are not solved within the expected time frame. The concept is similar to improvisation and time is also an important element, as the author mentions the presence of time pressure for solving the emerging problems.

In despite of this critique by the authors themselves, the studies of Moorman and Miner (1998a, 1998b) are very respected and influenced the following improvisation studies of the time. In the 1998's and 2001's studies, the authors mention correlate concepts and explain the differences between each of them and the improvisation phenomenon. These concepts are: bricolage, creativity, intuition, adaptation, learning and innovation.

Regarding bricolage, creativity and intuition, the authors mention that they can be part of some improvisation, but improvisation does not require any of these to occur. The authors consider the following definition of bricolage: "making do with the materials at hand" (Levi-Strauss, 1967: 17, apud Moorman & Miner, 1998a). The fact

that bricolage is limited by the non-use of extra resources differentiates it from improvisation. However, the authors state that, the more improvisational an action, the more likely is to have bricolage occurring, and that being skillfull at bricolage contributes positively for improvisation.

In this regard, Cunha et al. (1999) present an opposite view, describing improvisation very similarly to bricolage: “conception of an action as it unfolds, by an organization and/or its members, drawing on available material, cognitive, affective and social resources” (Cunha et al., 1999, p. 302). The authors highlight the importance of members being aware of the resources available, as they may not be the optimal resources for executing the actions. More than that, Cunha et al. (1999) mentions that this definition aims to provoke the development of the theory in a way that these resources will be further investigated and comprehended.

When it comes to intuition, it had been considered by Crossan and Sorrenti (1997, p. 156, apud Klein et al., 2015) as a key component of improvisation: “intuition guiding action in a spontaneous way”. However, Moorman and Miner (1998a) seem to disagree, as they mention that intuition may compose some improvisation, but it is not an essential component of improvisation. Nevertheless, further studies have continued to consider intuition when defining and characterizing improvisation. Some examples are: Leybourne (2006), Leybourne and Sadler-Smith (2006) and Gallo and Gardiner ( 2007).

Leybourne and Sadler-Smith (2006) investigated the relationship between intuition and improvisation, by conducting a survey with project managers. According to the authors, intuition is a cognitive process in which decisions are based on previous experiences, and that composes improvisation. The results indicate a positive relation between the two constructs. Differently from Moorman and Miner (1998a, 1998b, 2001), Leybourne and Sadler-Smith (2006) argue that intuition is a key element of improvisation, as managers trust their ‘gut feelings’ and initial impressions. Similarly, Klein et al. (2014) also has a different view from Moorman and Miner’s when it comes to creativity. They believe in creative sensemaking as the basis of improvisation.

When it comes to adaptation and learning, Moorman and Miner (1998a) argue these are potential outcomes of improvisation. However, the study of Miner et al.

(2001) reviews the learning aspect and concludes that improvisation is a type of learning, a short-term, real-time learning.

They consider learning as “occurring when experience generates a systematic change in behaviour or knowledge (Levitt and March, 1988; Argote, 1999, apud Miner et al, 2001), and they argue that during the improvisation episodes, change happens as experience unfolds. Finally, regarding innovation, Moorman and Miner (1998a) state that every improvisation involves some level of innovation, even though innovations are not restricted to improvised actions.

Many authors consider improvisation as a skill or ability (Vera & Crossan, 2005; Leybourne, 2006; Bjørkeng et al., 2009, apud Klein et al., 2015). Similarly, the definition of Conforto, Rebentisch et al. (2016, p.2) consider improvisation as: “the ability to create and implement a new or an unplanned solution in the face of an unexpected problem or change”. Additionally, Holmberg and Tyrstrup (2010) mention the ability to act in the "here and now", taking impromptu action, as an important ability of a leader.

Although the literature of improvisation is extensive, this literature is still in development. Regarding the definition of the phenomenon, the existing definitions focus on different aspects of the phenomenon. It is concluded that there are four styles of definitions for improvisation, as the Figure 1 shows.

Considering that learning in a short time can happen when an unplanned problem appears, and that the solution depends on team's and individual's skills, we conclude that the definitions seem to be more complementary than controversial. In fact, they highlight different aspects of the same phenomenon.

Figure 1 - Definitions of improvisation found in the literature.

Main focus of the definition	Example	References
The temporal proximity between planning and execution	“the degree to which the composition and execution of an action converge in time” (MOORMAN and MINER, 1998b, p. 698)	Moorman and Miner (1998b); Cunha et al. (1999)
The fusion of design and execution	“improvisation is the deliberate and substantive fusion of the design and execution of a novel production” (MINER et al., 2001, p. 314).	Miner et al. (2001)
Improvisation considered as a type of learning	“improvisation can fruitfully be seen as a special type of short-term, real-time learning” (MINER et al., 2001, p. 4)	Levitt and March, 1988; Argote, 1999, apud Miner et al, 2001)
Improvisation considered as a skill or ability	“the ability to create and implement a new or an unplanned solution in the face of an unexpected problem or change” (CONFORTO, REBENTISCH and AMARAL, 2016, p.2)	Vera and Crossan, 2005; Leybourne, 2006b; Bjørkeng et al., 2009, apud Klein, 2014); Conforto, Rebentisch and Amaral, 2016.

Source: the authors.

The divergence in theory lies in the identification of the components of improvisation, especially in relation to the six elements cited by Moorman and Miner (1998a, 1998b): bricolage, creativity, intuition, adaptation, learning and innovation. While there are authors who associate the phenomenon with some of these elements, others consider them as distinct concepts. Therefore, the contours and components of the improvisation phenomenon are still unclear.

The present work considers improvisation as an ability, as suggested by some authors. This view allows for considering skills for improvisation and the possibility of preparing people and teams for effective improvising. This concept will be used for investigating how agile teams adapt the plan to emerging problems in the project. The aim is to identify practices related to successful improvisations, present and discuss these practices with the teams, stimulating them to develop the capacity to improvise.

### 2.2.3 Factors and practices influencing improvisation

Moorman and Miner (1998b) highlight that improvisation does not always lead to effective outcomes. Therefore, companies should understand the conditions that influence the effectiveness of the improvisation actions and its outcomes. There are, in literature, many studies that investigate the influence of organizational, team and individual factors on the occurrence and effectiveness of improvisation.

Moorman and Miner (1998b) conducted a statistical study and concluded that the more turbulent the environment, the higher the incidence of improvisation. Additionally, highly turbulent environments were linked to positive impacts of improvisation in design and market effectiveness. More than that, the study indicates that real-time information flow improves the chances of generating more effective products through improvisation.

The work of Vera, Nemanich, Vélez-Castrillón, and Werner (2016) tested the influence of some factors in the improvisation capability, defined by the authors as “the team’s capacity to act spontaneously in trying to respond to problems or opportunities in a novel way” (p. 1877). The survey was applied to R&D teams and received 100 useful responses. The influence of the team’s ability to create shared understanding of new knowledge and the team’s external knowledge-gathering ability in improvisation capability were confirmed. The team’s experience working together could not be connected to the improvisation capability, however, when minimal structures are present, the team’s experience working together had a positively effect on the improvisation capability. In the same way, minimal structures increase the effect of team’s ability to create shared understanding of new knowledge.

Magni, Proserpio, Hoegl, and Provera (2009) conducted a survey with 38 information systems development (ISD) project teams regarding team’s cohesion, team’s behavioral integration and individual improvisation. Cohesion is defined as when teams interaction are mostly social, based on affective links (Hambrick’s, 1994, apud Magni et al., 2009). The results indicate that both the cohesion and the behavioral integration positively influence the occurrence of individual improvisation.

Empowering leadership and overload have also being related to the effectiveness of improvisation. Magni and Maruping (2013) conducted a survey with 48 teams from two different sector companies and investigated how these two factors moderate the relationship between improvisation and team performance. The results

show that when empowering leadership is high, the relationship is positive. On the contrary, when the overload is high, the relationship is low. There is also a three-way interaction, so that a high overload jeopardizes the positive effect of the empowering leadership. The relationship between improvisation and team performance is strongest if empowering leadership is high and overload is low.

Another study, involving 128 NPD project managers in service-based industries, showed that improvisation occurrence in the NPD process is higher in companies in crisis (Samra & Hartman, 2009). Magni and Maruping (2013) investigate the effect of improvisation and dispersion in the performance of 71 software development teams. The results indicate that improvisation has a positive effect in team performance. Additionally, geographic dispersion moderates this effect, so that the relationship between improvisation and team performance will be strongest when team dispersion is low.

Conforto, Rebentisch et al. (2016) also developed a study investigating the occurrence of improvisation. However, this study focused in companies applying APM practices. The investigation have identified, through a survey, the importance of three organizational factors. The first one is an organizational culture that encourages positive attitude when facing ambiguity and necessity of changing. This aspect had already been partially identified in the minimal structure presented by Kamoche and Cunha (2001), as the “Trust in a climate of trial and error experimentation” and “Attitudes conducive to experimentation with new product ideas; continuous learning”, but the term “organizational culture” indicates the importance of the organization as a whole, and not only the attitude of members inside the NPD teams.

A second aspect observed by Conforto, Rebentisch et al. (2016) is team structure, specially internal communication and communication with stakeholders and higher level of selfmanagement. Kamoche and Cunha (2001) have also mentioned “Cross functional and cross project communication” but did not focus on other stakeholders, such as the client, which as a strong characteristic of APM. In regards to selfmanagement, Kamoche and Cunha (2001) listed semi autonomous workteams.

Finally, the third factor identified by Conforto, Rebentisch et al. (2016) relates to agile practices and tools, such as iterative planning, recurrent delivery of value for the customer, visual management and active involvement with the client. This aspect had not been directly mentioned by the work of Kamoche and Cunha (2001) and it is relevant for this research. Nevertheless, agile tools are manners of achieving some of the aspects listed by Kamoche and Cunha (2001): visual management, for instance, is related to communication and information sharing.

Vera and Crossan (2005) based their study in knowledge from theatrical improvisation and proposes that organizational improvisation is a skill that can be trained, and consists of the following dimensions: expertise, teamwork, experimental culture, real-time information and communication, and memory. This study investigated the effect of training a group of people on these dimensions and found improvements in participants' ability to deal with such dimensions.

Another interesting finding of the study is that more memory did not result in more improvisation. The study was taken in a public organization, responsible for different services in a city, such as firefighting. These kind of services are guided by many rules and norms. The authors realized that, in this context, employees relied on informal knowledge, such as stories and observation of supervisor behavior, to improvise, much more than in the guidelines.

Organizational memory, which is defined by Moorman and Miner (1998b, p. 7) as “learned ways of thinking and behaving”, is a paradoxical concept. According to Vera and Crossan (2005) it can reduce the incidence of improvisation or be a useful resource for teams to improvise.

In this regard, the study of Moorman and Miner (1998b) argue that more memory would result in less improvisation in PD actions, an hypothesis that is supported by their study. The authors mention previous studies that have investigated how memory can constrain the action of individuals in different situations, such as in jazz improvisation (Weick, 1993, apud Moorman and Miner, 1998b) and in producing innovations in general. More than that, Moorman and Miner (1998b) affirm that the time pressure present in improvisation moments may influence people to act according to previous knowledge and experiences that were successful. When it comes to experience, the study of Leybourne and Sadler-Smith

2006) included a survey with project managers that concluded on the relevance of experience. According to the results, more experienced managers improvise more.

Mascitelli (2000, p. 190) defends that, to be able to improvise, the team needs to “experience each other’s actions and thoughts personally and in real time”. The author argues that physical prototypes are a great opportunity for providing these conditions, as stimulate ideas and insights. Other practice mentioned by the author is the stand-up meetings, that embraces interaction, socialization and stimulate collaboration between team members.

This literature review indicated that there is a significant number of papers seeking to understand the influence of certain factors on the occurrence and efficacy of improvisation. Figure 2 summarizes the factors studied, their effect on the improvisation capacity and the reference of the works.

Although these studies bring interesting content, contributing to the understanding of the improvisation in organizations, they do not clarify the phenomenon in terms of practices or behaviors of the teams. In part, because they used the survey method, without deepening in specific cases and without considering the context of teams’ working processes and rules. Likewise, the results point to conditioning factors or elements of the organizational structure, in a broad perspective. Details such as habits, other internal factors of the teams, and the process of how decisions are made when the teams face unexpected problems, are not captured.

Another difficulty is the absence of an organized synthesis of these factors. They are very different in nature, varying from team characteristics (such as experience working together), environmental characteristics (such as turbulent environment), flow of information and resources. Systematizations and syntheses, applied to specific contexts such as project management, are necessary to advance a theory useful to professionals and researchers.

Another interesting aspect is how organizations evaluate the effectiveness of improvisation and the how they manage the phenomenon. According to some authors, the companies themselves still seem to have difficulties in evaluating the effectiveness of the improvised actions, registering and sharing the lessons learned with these actions (Leybourne, 2006, Miner et al., 2001; Conboy & Lang, 2011).

Figure 2 - Factors influencing improvisation.

ID	Factor	Effect on improvisation	Study
1	Highly turbulent environment	Higher the incidence of improvisation Positive impacts of improvisation in design and market effectiveness	Moorman and Miner (1998b)
2	Real-time information flow	Improves the chances of generating more effective products through improvisation	Moorman and Miner (1998b)
3	Team's ability to create shared understanding of new knowledge	Positive effect in the improvisation capability	Vera et al. (2016)
4	Team's external knowledge-gathering ability	Positive effect in the improvisation capability	Vera et al. (2016)
5	The team's experience working together, in the presence of minimal structures	Positive effect in the improvisation capability	Vera et al. (2016)
6	Minimal structures	Increases the positive effect of (3) and (4) in the improvisation capability	Vera et al. (2016)
7	The experience of project managers	Increases the occurrence of improvisation	Leybourne and Sadler-Smith (2006), Leybourne (2006)
8	Cohesion and the behavioral integration	Increases the occurrence of individual improvisation	Magni et al. (2009)
9	High empowering leadership	Positively moderates the relationship between improvisation and team performance	Magni and Maruping (2013)
10	High work overload	Negatively moderates the relationship between improvisation and team performance. Also jeopardizes the positive effect of the empowering leadership.	Magni and Maruping (2013)
11	Companies affected by crisis	Higher improvisation occurrence	Samra and Hartman (2009)
12	Team's geographic dispersion	Negatively moderates the relationship between improvisation and team performance	Magni et al. (2013)
13	Organizational culture that encourages positive attitude when facing ambiguity and necessity of changing	Positively contributes to improvisation competence	Conforto, Rebertisch et al. (2016)
14	Team structure: internal communication, communication with stakeholders and higher level of selfmanagement.	Positively contributes to improvisation	Conforto, Rebertisch et al. (2016)
15	The use of agile practices and tools	Positively contributes to improvisation	Conforto, Rebertisch et al. (2016)

Source: the authors

Another set of studies advocate the importance of giving people a base on which to improvise. Eisenhardt and Tabrizi (1995) proposed an enough structure, Brown and Eisenhardt (1997) mentioned a limited structure, Weick (1998) mentions guidelines and structure, Naveh (2007) defends the combination of formality and discretion, and Kamoche and Cunha (2001) proposed the minimal structure.

The minimal structure of Kamoche and Cunha (2001) is the most cited from the list above and also the most detailed concept. The authors started from an analogy with improvisation in jazz and, from a bibliographic review in new product development (NPD), they present the idea of a minimal structure that works as a template based on which people can create in the NPD context. The structure consists of social structures and technical structures. Social structure includes communication and trust between the musician, while technical structure involves competence, knowledge and the use of template of a song. Figure 3 exhibits the components of both the social structure and the technical structure.

Figure 3 - Minimal structure for improvisation in NPD.

<b>Social structure</b>	<b>Technical structure</b>
Team's objectives specified priorities; members' responsibilities; regular meetings	Identification of critical quality standards and performance criteria
Cross functional and cross project communication; networking	Template of a product concept, process, prototype, vision, milestone, etc upon which to improve
Intense interaction in (semi) autonomous workteams; information sharing	Board range of cross-functional skills; frequent training and rotation
Trust in a climate of trial and error experimentation; mutual faith in performance integrity	Extensive knowledge of available technology and how it leads to collective action
Revolving leadership in product design and development; mentoring and empowerment	Application of unusual tools, methods and technologies; creating experimental products; Bricolage; multiple iterations and testing
Attitudes conducive to experimentation with new product ideas; continuous learning; supporting an rewarding risk-taking	Constant systematically remodeling; use of real-time information flows; involvement of customers in testing prototypes

Source: adapted from Kamoche and Cunha (2001)

Differently from the studies summarized in Figure 2, this study provides guidelines at the team level. Nonetheless, and there were not found studies analysing the structure in real cases, with real improvisation cases.

Regarding practices for improvisation, the study of Akgün, Keskin, Byrne, and Ilhan (2013) was the only one found in the literature, even though the term improvisation is not utilized. The study considered real teams and investigated adaptive management practices in NPD, through surveys. Two practices, storytelling and counterfactual thinking, are mentioned. The former refers to mention events from the past and connecting them with present and future. The latter consists of reflecting

on how events would have taken place if some past decision had been made differently. According to the study, these practices help people to see new possibilities in their actions, improving the adaptability of the organization. Thus, there is a potential relationship between these practices and the capacity for improvisation.

#### **2.2.4 Improvisation and Project Management**

The APM context is usually a dynamic environment with strong presence of uncertainties (Conforto, Rebentisch et al., 2016). Thus, the need to adapt to unexpected changes and problems is present, and the study of improvisation becomes relevant.

Leybourne's study (2009) is one of the few studies found to explicitly address improvisation and APM. In this study, the author uses the seven constructs presented by Moorman and Miner (1998a): bricolage, creativity, innovation, adaptation, learning and compression - as criteria for comparing the improvisation approach and the agile approach. The study concludes on the similarity between the two, especially in relation to the constructs adaptation and intuition, and states that, as the theory of APM develops, this similarity will be strengthened. The study was made at a time when the APM theory was fairly recent, which may be the reason why the analysis was a little superficial. However, the work leaves its contribution in stimulating future research in the theme, as is the case of the present work.

Additionally, Zheng, Venters, and Cornford (2011) commented on the similarity of the concept of improvisation as defined by (Moorman and Miner, 1998b): the convergence in time of conception and execution; and the Highsmith's (2002, apud Zheng et al., 2011) concept of agility: quickness in acting. The paper of Conforto, Rebentisch et al. (2016) is another example of study connecting improvisation and APM. However, the method was also a survey and the topic was addressed in a broad perspective, without deepening the analysis into the agile teams.

Thus, the literature is still very scarce with regard to establishing the relation between improvisation and APM. The literature review of agile teams (Section 2.1) corroborates this affirmative, since the ability of teams adapt the plan, or to improvise, is little investigated. There is still a significant gap regarding to understand what actions and elements are important to support improvisation in agile teams.



### **3 Method**

This section will introduce the Grounded Theory method and the justification for this choice (section 3.1). The sections 3.2, 3.3 and 3.4 present the activities and analytic tools applied at each step.

#### **3.1 Justification**

Grounded Theory is a method recognized for providing techniques for analyzing qualitative data, such as coding and constant comparison, and does not require a well-established theoretical framework prior to the start of the research. In fact, this is exactly its differential and the aspect that most justifies the choice of GT. As presented in the literature review on section 2 there is no theory that synthesizes the recommendations on how to adapt the plans in agile projects. Thus, because GT does not use previously developed theories as an initial assumption of the research, the method is useful for less than theoretical topics, aiming at the generation of theoretical hypotheses that can be tested and considered by future studies.

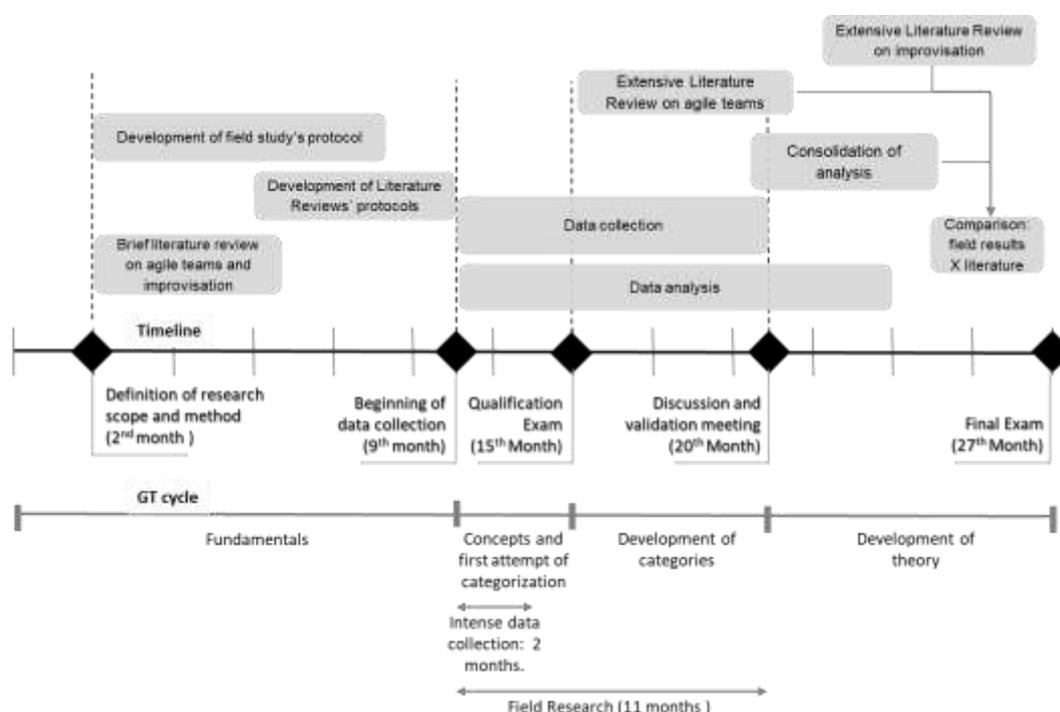
The initial scope of research in GT is open, leaving room for the main subject of the research to emerge during its development, according to the data collected and with the concerns expressed by the observed participants (Glaser & Strauss, 1967). This is why GT is much used in introductory researches.

Finally, it is worth noting that GT has been used in recent research involving the study of agile teams, such as in Whitworth and Biddle (2007), Whithworth (2008), Hoda et al. (2012, 2013), Hoda and Murugesan (2016) and Stray, Sjøberg, and Dybå (2016).

### 3.2 Steps of the research

Tarozzi (2011) describes the process of GT as the following phases: identify an investigation area, define the research question, define methods and tools, initial coding, theoretical sampling, focused coding, writing memos, theoretical coding, writing the report and evaluate the research. This study is based largely on this description. Figure 4 illustrates the steps followed during this research.

Figure 4 - Steps of the research.



Source: the authors.

The figure contains the main activities (in gray) and the milestones (the diamonds) representing the events or decisions that marked the beginning or end of important phases of the research, such as the discussion and validation meeting marked the end of the data collection. The line at the bottom refers to the results produced, according GT recommendations, such as the development of concepts, categories and the theory.

Before the beginning of data collection, researchers defined the scope and the method of the research. Then, both the field study and the literature reviews'

protocols were developed. At the same time, the researcher started the brief literature review on agile teams and improvisation.

At the 9<sup>th</sup> month of the research, the field study was initiated. The first two months were the most intense ones in terms of data collection, however, it was only finalized at the 20<sup>th</sup> month. Data analysis started together with the data collection, as GT recommends the iterativity between these two processes, and were only finalized a few months later. Then, the major literature reviews were executed and the results of the reviews were compared to the field study's.

### **3.2.1 Brief literature review and field study preparation**

At the beginning of the research a brief bibliographical review was executed in order to confirm the absence of a theory or proposition to prepare agile teams to adapt in face of unforeseen situations. In addition, it was also aimed at familiarizing with the concepts of improvisation and agile teams.

The literature review focused on key papers and priority was given to works identified as the main references in the subject. For example, Moorman and Miner (1998a, 1998b) in improvisation and Takeuchi and Nonaka (1986) for agile teams, and works found in the early research, such as the work of Kamoche and Cunha (2001) in the context of improvisation, and Hoda et al. (2012) for agile teams.

This initial phase also contemplated the study of the GT method. Some reference books, such as Glaser and Strauss (1967) and Charmaz (2006) were consulted, as well as the book by Tarozzi (2011) after the recommendation of an experienced researcher at this methodology. Research protocols with the GT method were also studied, and the specific protocol of this research was elaborated.

The readings were complemented by conversations with two researchers with experience in using the method. It is worth noting that the protocol is not available in this document because it was not updated throughout the research, so that many practices performed during the field study were not recorded in it, but are described in the following sections.

### 3.2.2 Theoretical sampling

Theoretical sampling is the process of collecting and analysing data iteratively, where the researcher decides what data to collect next based on the analysis of previously collected data. The initial sampling is based on the general problem area of the research (Glaser & Strauss, 1967).

In this research, the initial sampling was defined according to some criteria. The teams involved in the research needed to apply APM practices in the management of their projects, independently on which methodology (SCRUM, XP or others). Additionally, because the research aims to investigate improvisation episodes, and we assumed that improvisation contributes for the teams' performance, we were looking for teams with a great performance and experienced at APM practices. Besides, we believed that more experienced teams would be more capable to adapt the plans, using the improvisation, in an effective way.

The teams were selected alongside with the company's management board. Two members discussed this issue with the researchers, and they have indicated two teams. According to them, these teams were among the best teams of the company in terms of performance and application of APM practices. Additionally, these two teams share a leader and are located in the same room, which would facilitate the observations of the researcher.

The number of teams to be involved in the beginning of the study had not been defined by the researchers previously. The only concern was to avoid too many teams at once in order to guarantee the quality of the observations. The company's management members indicate two experienced teams that were closely located, at same room, and could be observed by one unique researcher. The conditions were verified and the researchers decided to include two teams in the study, at first. Both teams were receptive and the research was initiated.

After the beginning of data collection, theoretical sampling still took place. Whenever an episode of improvisation occurred, the members involved, those who demonstrated participation through dialogues, were interviewed. As they mentioned the participation of other members, or as the observer perceived the involvement of

other members, they were also involved. This strategy remained throughout the research.

### **3.2.3 Data collection**

The data collection was performed between November 2016 and October 2017. From November 2016 to February 2017 data collection was more intense. It has been done through observation and semi-structured interviews with the teams. Observations have been the major source of data. On an average, the researcher went to the company three times a week and stayed for half the work shift. In addition, the researcher had a workstation close to the teams, and took part in meetings, such as daily meetings, business and technical refinement meetings, and pair programming sessions, apart from observing the routine of the teams. The aim was to be able to identify improvisation episodes while they happened and to register the dialogues and actions involved in it. Later, from February 2017 to October 2017 some visits occurred with the purpose of collecting specific information and validating the partial results.

Additionally, during the research three validation meetings were held with the teams. At these meetings the researcher presented the partial results to the teams, which would comment on them, adding new information and confirming the perception of the researcher.

Theoretical sampling is another important guideline of GT. The idea is that data collection and data analysis occur iteratively and that the next sample is defined according to the analysis (Glaser & Strauss, 1967). In this research this occurred quite directly. Observations generated the need for interviews, so that when observing an improvisation episode or a dialogue that attracted the attention of the observer, she would then talk with the most direct stakeholders. If they mentioned another person involved, this one would also be approached.

### **3.2.4 Definition of the phenomenon**

One of the assumptions of the GT is the importance of the context of the facts that will be analyzed. The authors suggested to use interviews and observation and to remain faithful to the speeches and terms originally mentioned by the participants (Glaser & Strauss, 1967).

At the beginning of the field study, when the first observations began, a difficulty related to the records was soon perceived. In short periods of time many records were generated describing incidents and facts from different nature. The observed teams worked in complex projects and the professionals performed a multitude of tasks throughout the day. Some of them were not linked to the project itself or to any episode of improvisation, for example, regular activities developed in accordance with the plans. This difficulty in understanding which dialogues and observations were directly related to the phenomenon of improvisation or project management caused confusion during data collection. The researchers' concern was to generate a large amount of non-relevant data, which could be more confusing than positive to the analysis.

This issue was reported in the paper by Reigado, Castro, Dias, and Amaral, (2017), which also describes the methodological solution. The solution came about through the development of the concept of "improvisation episodes", developing the idea of triggers.

The idea of triggers is related to the Zarifian's concept of event. The event consists of any alteration, partially unexpected, that emerges both in individual and organizational levels. It includes any occurrence differing from planning, which could not be predicted, so that it escapes any previous planning or detailing of the activity to be performed (Zarifian, 2001). More than that, what makes the event relevant is the importance given to it by the subject who perceived it. His (her) judgment about the relevance of the occurrence and the consequences of the facts is what makes the event notorious (Zarifian, 1995, apud Salerno, 2008).

Similarly, we used the idea of triggers as being the perception of the plan's insufficiency and consequentially marking the beginning of an episode of improvisation. This new added step became fundamental for the success of this research. It allows researchers delimiting the moment in which this adaptation begins and, consequently, when the data were intensively gathered. These new practices of

phenomenon definition and trigger concept contribute for better focus, greater depth in the analysis in terms of investigating the facts that unfold from this moment.

Perception is a key word in this definition, since it represents the judgment of importance given by the team member who, noting something unforeseen and escaping from what was expected, attributed to this fact such relevance that considered necessary to treat this deviation. In this research, the researcher considered the trigger as those in which the deviation were perceived equally by all team members. The episodes in which one or more members felt the need to share with the team and whose story stimulated a mobilization for their solution. This represents a limitation: the adaptations handled and effected individually, by a member or manager, for example, may not have been identified. This limitation, however, is consistent with the perspective of collective improvisation, conceptually adopted as a premise of the work.

By using this concept, the researcher started to register facts that marked the beginning and the end of what has been called improvisation episodes. An episode of improvisation was defined as situations in which the current project plan was insufficient, according to the perception of a team member or the entire team and required immediate action and/or change in the next steps. An episode of improvisation has a trigger that marks its beginning, a phase of searching for solutions, a phase of definition of the solution, a phase of execution of the solution and a phase of verification of the effectiveness of the solution, which marks the end of the phenomenon.

These procedural options are also aligned with the collective aspect of actions that are taken after an event in the quest to solve contingencies, as observed by Zarifian (1996, apud Salerno, 2008). The author highlights the importance of communication and of involving in the discussion of the solution other individuals who can contribute to solving the problem. To this end, an important assumption is that individuals recognize each other's abilities, and, based on that, know who to involve when a difficulty arises.

The communication about the perception to solve incongruences in the plan is then part of the trigger's definition, but it is not enough to notice them. It is necessary that team members engage and put themselves to assist the problem, all of them

committed with the conflict solving. This would, then, be the first step towards achieving the solution.

The final definition of trigger used in this work is: the perception of the plan's insufficiency, followed by the communication of that perception to the relevant people, is the trigger of an episode of improvisation.

Thereby, episodes have a beginning, middle and end. Although the observer was not present at all times of all episodes, it was possible to perceive that, in general, after the perception of a problem or incongruity in the project plan, one has to search for a solution, then define the path to be followed, execute the solution and verify if the resolution of the problem was achieved.

The episodes of improvisation observed have varied actors. In every episode there is participation of team members, however, in each observed episode some members are more active and others are more supportive, including the leader of the teams. Actors of the client company are invited to participate according to the nature of the problem and the expertise required for its resolution.

Organizing of the database according to the episodes of improvisation facilitated the analysis of the data and also the narrative of the analysis, which became more organized and logical. This was done through the use of codes for marking the different moments of the episodes. Besides, by using the episodes it was possible to relate the context of the problem with the strategy of improvisation and habits observed. The definition of episode of improvisation is illustrated by Figure 5.

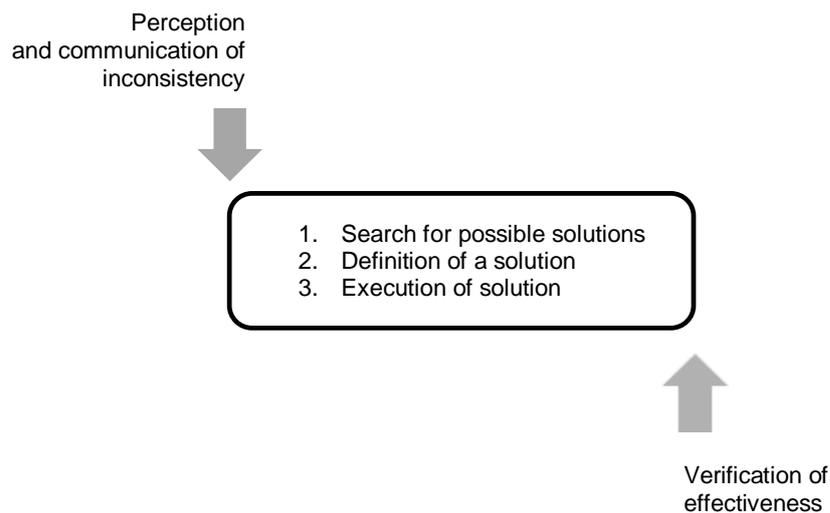
The plan may either have taken into account some aspect that is in fact different from what was considered; or have failed to consider some aspect that is fundamental. In both cases, the plan would not be sufficient or coherent with the reality observed. This concept of episode was detailed and published in Reigado et al. (2017).

The observer-researcher monitored all the actions that unfolded after identifying the trigger and recorded the perceptions of the agents (i.e., members of the team). The phenomenon comes to an end when the team, after executing the solution, considers that the problem related to the trigger was solved. At this point, the researcher would go back to the mode of waiting for another episode, while interviewing the various actors at appropriate times.

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Figure 5 - Episodes of improvisation



Source: the authors.

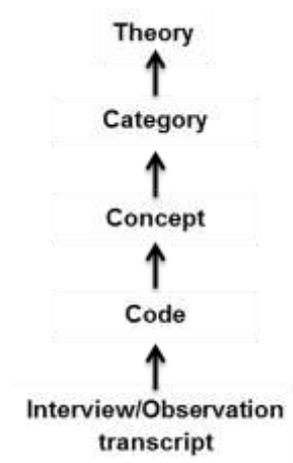
Regarding data collection, the observer continued to record all the activities she observed, so the use of the episode concept was not a filter of the observed data. This allowed, for example, to observe that some attitudes of the teams during the episodes also happened in routine moments, what led to the identification and denomination of the category habits.

### 3.3 Data analysis

As the fundamental premise of Grounded Theory is the iteration between collecting and analyzing data (Glaser & Strauss, 1967). The data analysis was conducted right after the first transcript was generated. Observations and interviews were first written down on the researcher's diary and later transcribed into a digital format. The transcripts were added to a software, Max QDA®, which supported the coding process.

Coding is a key method from Grounded Theory that comprises different phases of analysis and makes it possible to understand and create concepts from raw data (Tarozzi, 2011). According to Charmaz (2006), by naming a segment of text with a code, the researcher is comprehending and defining what is happening. Tarozzi (2011) also mentions that coding is the process responsible for the progress from one abstraction level to the other (Figure 6).

Figure 6 - Abstraction levels in coding.



Source: Adapted From Hoda, Noble and Marshal, 2012).

As the collect-analyze-collect cycles takes place, abstraction rises. Transcriptions constitute the first level, the raw data. Codes arise when the researcher uses tags to analyze the raw data. Then, concepts start to emerge as a set of codes. Categories are the next level, consisting of sets of concepts (Hoda et al., 2012). The core category, its properties and the relation with the other categories, constitute the theory (Tarozzi, 2011). Figure 7 illustrates the result of one specific coding process for the category "Strategies for adapting the plan with improvisation".

The software utilized, Max QDA®, allows for selecting segments of the transcripts and tagging them with codes. Codes may be organized as subcodes of other codes. It is also possible to visualize every segment of text tagged with the same code, which makes it possible to constantly compare data during the analysis. In addition, the software offers some other tools, the visual maps, which also contributes for data analysis.

Figure 7 – Example of the coding process

Category	Concept	Codes	Raw data
Strategies for adapting the plan through improvisation	Break rules	Increase WIP	<i>“Our WIP, I don’t know if you have noticed, but it has the limit of two stories (...) and now it has 3. (...) It may even come to 4.”</i>
		Overtake stories	<i>“A story related to this functionality was already in the kanban board, but the new procedure needs to be implemented before the ongoing story, which means the team will have to accelerate the new story so it will overtake the one that is already being developed”</i>
		Agglutinate stories	<i>“Usually, we would create a new story, but the component had to be implemented together with the validation. So what they did was to agglutinate the component’s story and the validation’s story”</i>

Source: Created by the authors

The software utilized, Max QDA®, allows for selecting segments of the transcripts and tagging them with codes. Codes may be organized as subcodes of other codes. It is also possible to visualize every segment of text tagged with the same code, which makes it possible to constantly compare data during the analysis. In addition, the software offers some other tools, the visual maps, which also contributes for data analysis.

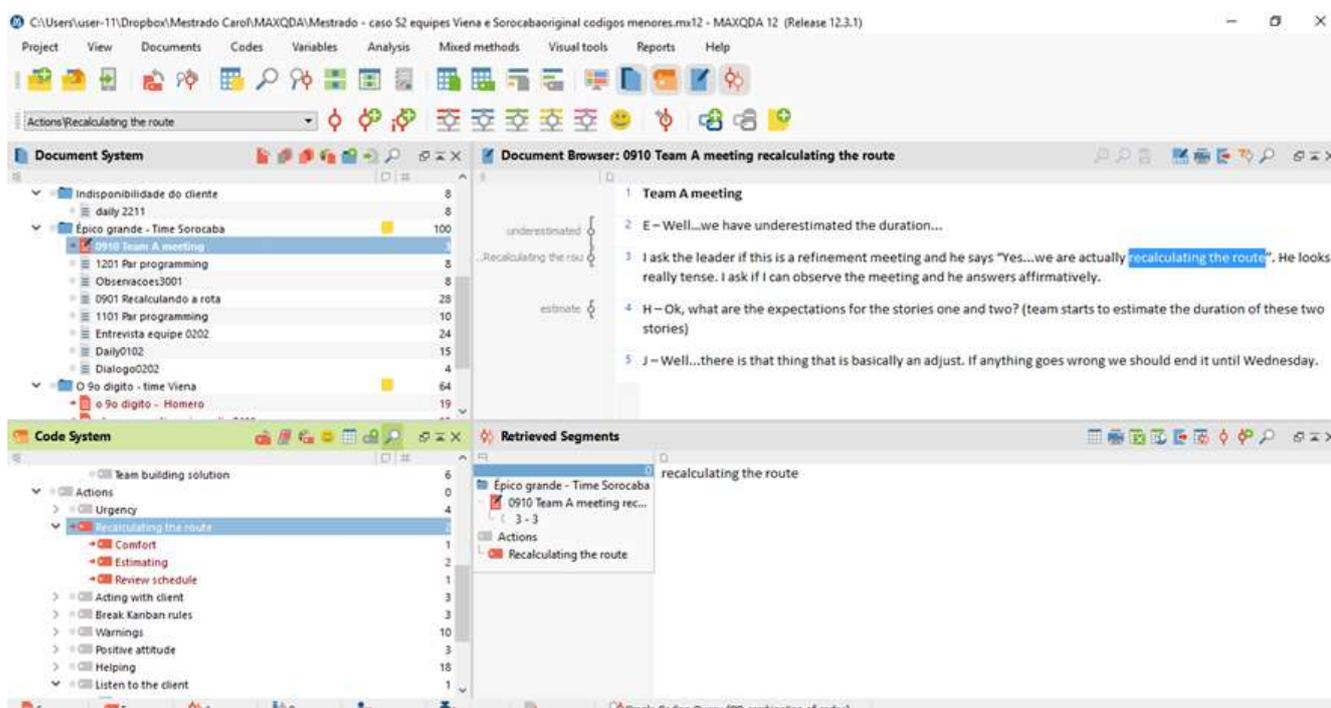
The Figure 8 shows the documents uploaded for analysis in the upper left quadrant and the codes generated during the analysis in the lower left quadrant. The

upper right quadrant shows the current document being analyzed, while the lower right quadrant shows every fragment of the selected document (in this case, "0910 Team A meeting") that has been labelled by the selected code (in this case, "recalculating the route "). Appendix A shows a consolidated table of the codes used during the analysis, which was obtained from the software.

Another method, also fundamental in GT, is constant comparison. It consists of comparing data all the time, from the beginning of the analysis process until its end. Data should be compared not only in the same transcript, but also between different transcripts and even different episodes.

The main objective of this comparison is to identify possible similarities and differences between data, which may contribute to either confirming or changing concepts and categories being theorized (Glaser & Strauss, 1967).

Figure 8 - Max QDA® screen



Source: the authors.

This research considers the following phases: initial coding, focused coding and theoretical coding. The steps taken in each phase are presented in the next section.

### 3.3.1 Initial coding

According to Tarozzi (2011), in this phase the first concepts begin to emerge. In the following phases they will be more developed and will form the categories, as explained in the previous section.

The authors suggest several strategies for coding in this phase. One of them is the use of *in vivo* codes, which consists of preserving the participants' language when naming the codes (Tarozzi, 2011, Charmaz, 2006). In addition, the word-by-word strategy was applied. It consists in searching for meaning in each word of the transcripts (Charmaz, 2006), and was used as a way for the researcher to ensure that every relevant information would be considered.

Scripts for more general interviews and observations were written for this phase (Appendices B and C). The data came mostly from observations. Some conversations, informal interviews, were also made with team members. Many of these conversations aimed at understanding the main concepts and working methods of the teams. In addition, in this stage the first validation meeting was held to present the partial results for the teams, with discussion and validation of the analysis.

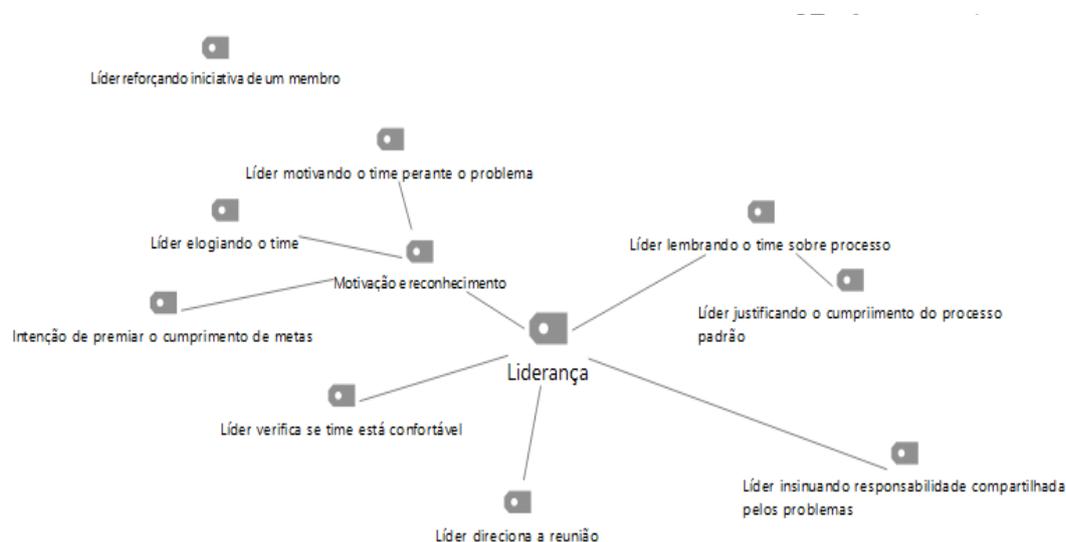
Thus, in this stage the transcripts of interviews and observation of dialogues and the routine of the team began to be codified. The researcher was not limited to tagging segments of text directly linked to improvisation episodes at that time, to avoid that something important went unnoticed, but even then it was possible to realize that some codes seemed more relevant to the phenomenon than others.

The first cycle of data collection and data analysis in this research resulted in more than 20 transcriptions and approximately 100 codes. The researcher tried to organize the codes into groups by using a tool from the Max QDA® software, as shown in Figure 9, however, due to the high number of codes and still little depth and familiarization with the data, it was not very effective.

Some difficulties were introduced at this stage. First, the difficulty in using objective and short codes. Often the researcher used large codes, with 3 words or more, which were then revised and reduced, for the most part. In addition, the

difficulty in identifying and delimiting the phenomenon of improvisation was perceived, for which the definition of the improvisation episodes was developed.

Figure 9 - Code map



Source: the authors

### 3.3.2 Focused coding

Tarozzi (2011) explains that focused coding has the purpose to develop more concepts, organize them into categories and start to describe connections between categories. Charmaz (2006, p. 42) states that this phase "requires decisions about which initial codes make the most analytic sense to categorize their data incisively and completely". Furthermore, Glaser and Strauss (1967) highlight the importance of using emerging categories, instead of categories previously defined in literature.

In order to enrich the understanding of concepts and categories, it is necessary to focus the data collection, such as asking questions related to the concepts and categories of interest (Tarozzi, 2011). Therefore, the second questionnaire was reviewed and is shown in Appendix D. At this stage a second meeting was held with the teams, where the partial results were presented, discussed and validated again.

A category consists of a group of concepts (Hoda et al., 2012). The criteria applied for grouping codes were similarity and interface. Because some codes were

not correlated to others, or not directly related to the improvisation episodes, they were not grouped in categories. Next, a template was used to analyze the categories (Appendix E), in order to summarize the information already available about each category, and to understand the hypotheses about each one. After using this template, several questions were generated and guided the collection of data in the following moments.

One difficulty encountered at this stage was the confusion between concept and categories. A first stage of the data analysis resulted in 11 categories. Of these 11, 7 were prioritized, taking into account that the others had no link with the phenomenon studied (such as a category named "improvement initiatives"). These 7 are: warnings, help, urgency, recalculating the route, flexibility, positive attitude towards problems, and customer relationship. However, from further reading and study, the researchers noticed the confusion and, based on the study by Hoda et al. (2012), which shows the formation of categories as groups of concepts, the previous 7 categories were considered as concepts, and were regrouped in two new categories: strategies and habits. In addition to the study of the method, other important criticisms were also taken into account, such as the questioning about the concept of flexibility, which appeared in the analysis that had been received during the presentation of the results to two specialists, in the qualification examination, besides the analysis of more data collected in the meantime.

The two final categories, strategies and habits, as well as the concepts that compose them, are shown in Figure 13 and Figure 14 in the section 5.

### **3.3.3 Theoretical Coding**

This phase embraces four steps: punctuate the categories, interconnect the categories, identify the core category and integrate and delimitate the theory. The core category is a central category, which unifies all categories, organizes the category and is responsible for the variation in data. The core category, together with its properties and relationships with the other categories is the theory that GT aims to develop (Tarozzi, 2011). What marked the transition between focused coding and

theoretical coding in this research was the categorization of data into habits and strategies. From then on, the categories were described, the relationship between them was analyzed and the core category was chosen.

According to Glaser (1978, apud Hoda et al., 2012), one of the characteristics of the core category is the longer it takes to achieve saturation in relation to the other categories. The author also mentions that the core category is central, meaningfully and easily related to several other categories and their properties, and occurs frequently.

The category identified as core was "strategies". The main reason for this choice is the fact that this category is very strongly linked to the event, in a very central way. Strategies contain the decisions that teams take during the perception of the problem and that will directly influence the resolution of the problem, in terms of time consumption, resources involved and, consequently, the effectiveness of improvisation.

Habits emerged as an important category. Even though they contribute to the ability of adapt the plan and also be present in the routine of the team, this aspect is not exclusive to improvisation and was not considered at the same level of strategies.

In addition, it was noticed that the strategies present a larger universe and with more analysis potential. Team members, when asked about strategies, provided greater wealth of information than when asked about habits, indicating that the habit category reached saturation. Saturation is the point when new data does not add new information to the understanding about the categories. The process of characterizing a category should be executed until saturation of theory is achieved (Tarozzi, 2011).

At this stage, in addition to individual observations and interviews, an informal group interview was also used. The meeting was planned with the purpose of deepening the understanding of the strategies and validating the list of habits and practices that emerged as theory.

The meeting was directed by the researchers, focusing on the strategies and gaps that were perceived in previous analysis. About 10 developers attended the meeting. About half of these were members of teams A and B who participated in the previous stages of the research. At that point the teams had undergone staff

changes, so members who did not participate in the previous stages were present at the meeting, and their involvement in the meeting was rather low, with few comments coming from them. Among the members who were already participating in the research, all were active during the discussions, with prevalence of participation of two members.

The meeting lasted about an hour and a half, and all the strategies were discussed in details in order to get more details on each of them, especially in relation to the following aspects: which criteria are used to choose each strategy? What are the characteristics of each strategy, how does the decision process for using a strategy happen, disadvantages of the strategy, and other cases where they used the strategy beyond those observed during the research. The objective of the meeting was considered as reached and, as a result of the data collected at the meeting and its subsequent analysis, the Figure 15.

**Figure 15** and the descriptive text were obtained, both in section 5.2.

The strategy initially named “urgency” receive a new tag: “putting out the fire” at this stage of the research. This decision was intentionally planned to differentiate this concept from a previous one, identified in literature. The technical term urgency has been mentioned in the previously literature (Hoda & Murugesan, 2016; Dönmez et al., 2016; Cunha et al, 1999; Crossan et al., 2005; Holmberg 2010) with a different meaning than situations described in the field. Considering that the meaning of “urgency” as identified at the field did not scope all aspect present in theoretical definitions was necessary this new tag, and the details are explained in section 6.

### **3.4 Major literature review**

For the literature review, it was considered that it is possible to find case reports and theorizations about the adaptation of plans in APM projects in two literatures: the agile teams’ and the improvisation’s. The brief literature review already presented considers the ability to adapt to the unexpected situations as a characteristic of agile teams, thus, the aim at this review was looking for papers that

characterized the teams. In the literature of improvisation, the focus was on organizational improvisation, and seeking to relate the phenomenon to the project management.

The steps taken to carry out the literature reviews were: definition of the objective of the review, definition of primary sources for identification of key terms, definition of the search string through tests with key terms in the search platforms, definition of criteria for selection of the articles found in the search, definition of the platform, and definition of a schedule accomplishing the review. These steps are further described in next sections.

### **3.4.1 Literature review on agile teams**

The purpose of this review is to look for characteristics and definitions of teams working with practices of Agile Project Management. The researchers search for articles that characterize agile teams, whether through the definition of these teams, presentation of factors that compose teams that go beyond self-management, barriers or inhibitors for their application and success, among others.

#### **3.4.1.1 String definition**

Many similar terms are found in literature for describing agile teams, such as self-organising project teams (Takeuchi & Nonaka, 1986), self-disciplined teams (Highsmith, 2009) and empowered teams (Moe & Aurum, 2008). The same applies to self-organization, in relation to other terms, as self-management and self-discipline. The result was four groups of keywords that represent a specific part of the search interest, listed in **Figure 10**. These terms were then included in the search string.

Figure 10 - Similar terms used in agile teams review.

Topic	Similar terms
<b>Teams' characteristics</b>	Character/capability (Takeuchi & Nonaka, 1986), Requirements (Whitworth & Biddle, 2007).
<b>Self-management</b>	Self-organising (Takeuchi & Nonaka, 1986), self-organization (Hoda et al, 2013), Autonomy e Self-regulation (Eijnatten, 1993; (Trist, 1981), Self-management (Moe & Aurum, 2008; Tata & Prasad, 2004), Self-discipline (Highsmith, 2009).
<b>Self-managing teams applying APM</b>	Self-organising Project teams (Takeuchi e Nonaka, 1986), Agile team (Whitworth & Biddle, 2007; Cockburn & Highsmith, 2001), agile project team Cockburn & Highsmith, 2001), self-organising teams Cockburn & Highsmith, 2001; Morgan, 1986), Semi-autonomous work groups (Eijnatten, 1993), self-managing groups (Eijnatten, 1993), Self-disciplined teams (Highsmith, 2009), Self-organising agile teams (Hoda et al, 2013), Agile software development teams (Hoda et al, 2013),, Autonomous teams(Moe & Aurum, 2008), empowered teams(Moe & Aurum, 2008, Self-managed teams (Tata & Prasad, 2004).
<b>Agile methods</b>	SCRUM, XP, Extreme Programming, Kanban, Dynamic Software Development Method (DSDM, Feature Driven Development (FDD), Crystal, Adaptive Software Development (ASD)

Source: the authors

### 3.4.1.2 Papers' selection

The research (phase 2.1) of this review was conducted using the Web of Science and returned 344 studies platform. The process of selecting these studies involved two filters. The first filter included only articles consisting of qualitative study, in depth, regarding agile teams; or studies presenting problems and challenges of agile teams; or theoretical propositions such as maturity models, frameworks, success factors. Moreover, studies focusing on tools or methods for agile teams were only accepted if there was also a focus on the teams and the dynamic of the teams' work with such tool or method.

Additionally, articles focusing on students of computer science were also discarded. Ultimately, a total of 190 articles were selected after the first filter. The second filter consisted of two criteria. The first one is related to method and scientific rigor, and only studies that presented to clear and consistent methodology were approved. Thus, approaches such as pure experience report, or studies that did not mention the applied methodology were not accepted. The second criterion includes selecting papers that present definitions, characteristics, practices or challenges in managing agile teams.

After applying the second filter, 91 studies remained. Because it is still a high number, they were organized in categories according to their main focus. As a result, thirteen categories were identified, as Figure 11 presents. Because the main objective of this review is to characterize teams working with APM, the group “Definitions, characteristics and contextualized practices” is of major interest to this work. For this reason, the 21 studies included in this class are being analyzed first.

Figure 11 - Distribution of studies in agile teams review.

Category	Fr equence
Architecture planning	2
Definitions, characteristics and contextualized practices	21
Multi-teams and inter-teams	6
Maturity models	1
Decision making	5
Motivation	8
Performance and Productivity	4
Knowledge and learning	17
Relationship with stakeholders	5
Teamwork	6
Distributed teams	13
Leadership	2
Challenges	1
<b>Total</b>	<b>91</b>

Source: the authors

### 3.4.2 Literature review on improvisation

The main goal of SLR 2 was to find characteristics of improvisation in teams or organizations. Moreover, by executing SLR 2, it is expected to confirm the gap of the literature concerning improvisation in the context of the projects managed by APM. More than that, it aims to prove the existence of the gap in terms of elements for understanding how agile teams adapt to unexpected challenges, and demonstrate the contribution of theory to filling this gap.

#### **3.4.2.1 String definition**

Two searches were performed for this review. The first search string was the term: ("organizational improvisation" AND (team\* OR development OR project)) and resulted in 58 studies. Even though other possibilities of string were tested, this one was chosen to be presented in the results of all the most important studies of improvisation already known by the researchers. However, throughout the work, researchers have come into contact with articles dealing with improvisation and project management more specifically, and noticed that they were not included in this string's results. New string tests were performed and it was realized that the best result would be obtained with the use of two strings. Then, the second search was executed with the string (Improvisation AND Project AND Management).

#### **3.4.2.2 Papers' selection**

Using the string "organizational improvisation", 58 papers were found, 18 of which went through the first filter, and 11 through the second. Many of the papers related to very varied areas of this research, such as government, while others had very specific and different focuses of research interests, such as metaphors for jazz. In the second research, with the string "Improvisation AND Project AND Management", 58 papers were found, of which 28 passed through the first filter, and 15 through the second. Thus, 26 articles were fully considered in the review. In both

cases, the first filter verified whether the article was contextualized in project management or product development, and whether the article actually addressed improvisation as its main theme. The second filter considered the quality of the articles and the relevance of the discussion for this research.

## **4 Synthesis of Field Study observations**

This section presents the company in which the field study was held, as well as the teams that participated in the research. Then, the episodes of improvisation observed will be described.

### **4.1 The company**

The company is a B2B IT organization that carries out different types of services, such as the creation and maintenance of ERP applications, the complete development of corporate solutions, improvements and maintenance of web solutions, e-commerce platforms and outsourcing of servers and databases. The main site of the company, where this research was carried out, is located in the country area of São Paulo, Brazil, where 160 employees are stationed.

Due to the variety of services offered, the company uses different project management practices, with all teams having metrics controlled by a PMO. Most teams, however, develop full and innovative solutions, using agile practices based primarily on SCRUM, such as daily meetings, and Kanban, such as the kanban board. They also use XP techniques, such as pair programming. In these teams, there prevails a strong culture of using agile techniques that were introduced in the company in 2008.

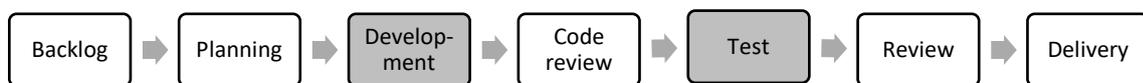
### **4.2 The teams**

For this research, two specific teams among the agile teams were selected for close observation. The criterion used for selection was the teams' experience. The

PMO of the company assisted the researchers to identify two teams with a high degree of maturity in using agile techniques. These two teams are identified in the study as A and B.

Teams A and B have four members each, and share the same leader. Teams A and B follows the same process, the workflow of which is controlled through a virtual kanban board. This board comprises the following phases: backlog, planning, development, code review, test, review, and delivery (Figure 12).

Figure 12 - Teams' working process



Source: the authors

The white blocks represent processes that require client participation. Additionally, Education of the teams' members vary from technical to graduated, in IT related areas, such as software engineering, computer science and information systems.

The first phase, backlog, includes the explanation of the demand by the client product owner (PO). Additionally, in this phase, team members list all the activities needed to fulfil the client demand and organize the work in stories. Then, the team discusses the priority and interdependency of the stories and organizes them in a sequence to establish a delivery date to be communicated to the PO.

Next, in the planning phase, the objective of the meeting is to verify if there is any impediment (i.e., if the client team is currently working on the system in a way that could influence the work of the project). Development consists of creating the codes and is executed by the project team members, usually organized in pairs and applying pair programming. The next phase is code review and consists of a new review of the codes by the client teams. Following this step is the test phase, in which project teams (A and B) perform several tests. Finally, in the review phase, the PO reviews the code. The last phase is the delivery, which consists of installation of the software.

In addition to the virtual kanban board, the teams follow a series of rules, such as the criteria for moving a story in the board from one phase to another. There is

also a maximum number of stories that can be at the same phase of the board at the same time, according to the allocation to the teams. As both teams have four members and usually work in pair programming, they usually work with no more than two stories in phases that require involvement of pairs, such as development and test.

Another important aspect is the daily meeting. Because the PO is not located in the same company, these meetings are usually done through conference calls. The meetings usually do not take more than fifteen minutes and include checking the status of each story present in the kanban board, next steps, and any potential problems.

### **4.3 Improvisation episodes**

In order to facilitate the understanding of the analysis, five episodes of improvisation observed during the field study are briefly described.

#### **4.3.1 Episode 1 - The ninth digit**

The demand received by the team involved the adaptation of an online e-commerce form meant for the users of the client company at the time of their registration. The demand required a change in the customer registration system. This episode happened during a period in which the standard of cellular telephone numbers was being altered in Brazil, from eight to nine digits.

The demand involved changing a mission-critical system containing a base of millions of users performing e-commerce transactions with complex business formats. The inclusion of the ninth digit in the Brazilian cellular telephone system was carried out by National Telecommunication Agency Telecom Regulator in Brazil

(ANATEL) regionally. The introduction was gradual, one state followed by another, until the numbers were updated in all the Brazilian states.

The first episode started when team B identified an initial plan failure. Initially, the plan included changing a number of components of the client company's system related to validation. The team planned the project according to this premise and identified and executed the stories by changing the components identified as necessary, together with the PO. However, during the tests performed in the development phase, the team realized that it was not possible to implement the action to identify users with 8-digit mobile phones and instruct them on the differentiated procedure in these cases. They identified the need for a warning screen but, due to the complexity, this would require a new component. According to one member, *"In refinement, specifically, they did not remember that the component needed to get along with validation."* That way, the team needed to reorganize the plan to include the component and make the delivery successfully.

#### **4.3.2 Episode 2 - The ninth digit implementation**

After the delivery, another unforeseen problem appeared. The PO contacted the team, reporting a high occurrence of an instability that was preventing customers with 8-digit cell phone numbers to complete the registration, something of great impact in the commercial area of the company. As mentioned by the leader: *"They noticed something was not right and then we immediately think of what we delivered lately, right? Because if everything was OK, then we make a delivery and a problem starts to appear, then the problem is possibly related to our delivery."* The team had to organize itself and was able to generate a new solution quickly that was adequate and solved the problem. This solution was written together with the client and it composed the second episode of improvisation.

#### **4.3.3 Episode 3 - The big epic planning**

Team A performed episodes 3 and 4 and the demand was called by the team as "The Big Epic." This demand was related to a change in the system of entry and persistence of a mission-critical web application for an e-commerce platform. The demand was considered complex by the team because it required changes in four different systems of the client to act in an integrated way, to provide the services of the site.

The team had no prior knowledge of one of these systems and lacked the experience with the systems' technology. A second challenge was not knowing the client's team responsible for the system and the way that team works. They would have to work together to carry out the code review and would have to overcome these challenges. Initial demand planning generated a large number of stories for a single epic and the expectation of a certain deadline for completion, which was communicated to the PO.

The third episode of improvisation began when the team encountered several challenges to meet the deadlines, as one member mentioned: *"We plan things, but in the middle of the road there are always unforeseen things, and something always happens."* The team realized that the expectation of deadlines was unreal and therefore, it would be necessary to carry out a re-planning.

#### **4.3.4 Episode 4 - Idleness in the big epic**

The fourth episode of improvisation, which was also part of this demand, began with the occurrence of idleness among team members due to the delay in the code review activity by the client's team. One of the members was waiting for this review and was idle. To avoid idleness, the team decided that this member could start working on a new story of the epic.

However, according to the team culture, the team was expected to work with a maximum number of stories at a time on the kanban board. At that moment, the team was already working on that limit. Thus, a working rule was broken due to the perception of idleness and the judgment of the team was a good decision. The delay

in reviewing the code was an unexpected problem, not contemplated in the initial plan, requiring changes to be made.

#### **4.3.5 Episodes 5 and 6 - Client team's unavailability**

Episode 5 of improvisation began with Team B's perception of a possible delay in the ongoing story. During a daily meeting, the leader reported that the client's team, responsible for code review of a story, would be unavailable throughout the week. Team B was already awaiting revision of codes for this story, and there was a concern about the story's deadline.

It was noticed that Team B had an initial plan, in which the revision of the code by the client's team was anticipated to occur routinely. However, the unavailability of this team caused an unforeseen issue. After internal discussions about the impact of the problem during a meeting, the leader contacted the hierarchical superior of the PO, communicated the concern of the team, and they came up with a solution.

Episode 6 happened when an activity of the "Big Epic" was also depending on the participation of the client team. The person responsible for the activity was not answering the team A's call even after many tries. Then, team A's member suggested that it was necessary to contact the hierarchical superior of the person responsible.

## 5 A theory for adapting the project plan through improvisation

After defining episodes of improvisation, we began to observe some practices and behaviors of the teams during these episodes and also in their routine activities. As mentioned in the method section, this analysis evolved, practices were grouped, and the understanding about them was expanded as new interviews and observations were made with teams. At some point we understood that these practices and attitudes had similarities and differences, and that it was coherent to group them into two large groups: (1) strategies to adapt the plan with improvisation and (2) habits to adapt the plan with improvisation.

Strategies are usually defined by the team as early as the beginning of the episode since they consist of how the team will approach each problem, taking into account several factors, such as its complexity and criticality of the problem and the difficulty to solve it, and the strategy impact the whole episode. An example is the strategy of Putting out the fire: it is used to treat very critical problems that require immediate action. It impacts on how the team deals with the problem, since solutions are usually focused on containing the problem, and the root cause solution is made in a later moment.

Habits, on the other hand, are behaviors, and are observed at different moments of the episodes, and are also present in the daily activities of the teams. An example is the positive attitude when the team identifies a problem, which was perceived at the beginning of the episodes.

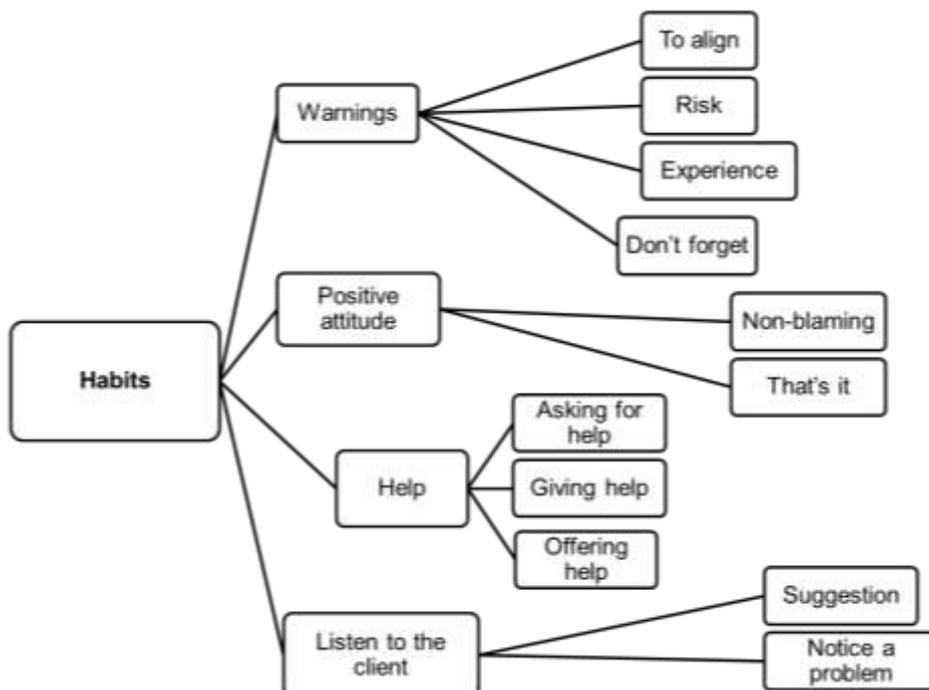
**Figure 13** and **Figure 14** illustrate the strategies and habits identified. At left, the first level are the categories are identified. Then, the second level represents each strategy and habit, the concepts that compose the category. Finally, at right, there are codes that originated the concepts.

Figure 13 - Strategies for adapting the plan through improvisation.



Source: the authors.

Figure 14 - Habits for adapting the plan through improvisation.



Source: the authors.

## 5.1 Habits for adapting the plan through improvisation

The analysis also explicated some behaviors of team members that happened frequently in their routine, as part of these team culture, and not exclusively during improvisation episodes. However, they have been observed to be present in moments of identification and analysis of a problem and definition and execution of the solutions. Therefore, researchers believe these habits support improvisation at all these moments.

### 5.1.1 Warnings

Warnings were observed many different times, majorly during daily meetings. Warnings were made by different members of the team, including the leader, and different types of warnings were observed: some pointing the necessity of aligning aspects with the client, some alerting the team about a risk for the success of the current story, some sharing experience about something, and some raising issues that cannot be forgotten.

A pattern was observed, warnings prepare the team for dealing with potential problems and contribute for an early identification of problems. These are the reasons the researchers consider them as positively related to the capacity of the two teams that were improvising. For example, in episode 5, "Client team's unavailability," a member of Team B expressed a potential risk for the project regarding the timeframe: *"We need to press the [client] team. The time frame is not tight, but there is a risk"*. This warning was the beginning of a discussion that led to the leader contacting the PO, as described in the "acting with the client" strategy.

### 5.1.2 Positive attitudes

Another habit consists of some positive attitudes regarding treating unexpected problems. One of these is the non-blaming attitude, which is the attitude of the team members not trying to find one person responsible for the problems. For instance, regarding improvisation in episode 1, one of the members stated: *“I think anyone is culpable of this problem, it was a communication issue.”*

Another example was the attitude of the leader in the *“recalculating the route”* meeting, when he transmitted a positive climate about changing the plan: *“But in the end that’s what we have to do, identify the problems in advance, communicate with the PO, and then, what we do next, we do with dedication.”*

### 5.1.3 Helping

Helping is one of the most noticeable habits in the teams’ routines. It was really common among members to ask for others’ help, even when the colleagues are not involved in the activity. Even pairs, during pair programming, ask for a third person’s help. During code development, moments when help was offered were frequently present. Additionally, there was not even a single occurrence of a help request not being responded to by the teams, or fulfilled in an explicitly unwilling way. There was also an occurrence of a member voluntarily offering help to a colleague during the execution of tests for a story after the plan of episode 3 had been recalculated (*“J, are you gonna need help with the tests?”*).

### 5.1.4 Listening to the client

The fourth habit is listening to the client and includes two situations. The first one refers to team members accepting suggestions of the client team, as observed in

episode 3. After Team A realized that the plan was unreal, a client team made a suggestion. One of Team A's members stated: *"What we are trying to do now is to set milestones"* and another member stated: *"What we should have done was to set small objectives, as the [client] team from SP suggested."* Another situation is when the client is the one who identifies a problem and communicates it to the team, such as in episode 2.

## 5.2 Strategies for adapting the plan through improvisation

After being selected as the core category, strategies were more deeply investigated, through a group discussion with both teams. The analysis of the data collected in the meeting, added to the previous analysis, is summarized in Figure 15.

Figure 15 and described below.

### 5.2.1 "Put out the fire"

The first strategy consists of approaching the problem immediately after its identification, by gathering the team and focusing on searching and immediately testing possible solutions, without any kind of planning or root cause investigation process.

This strategy was verified in episode 2, "The ninth digit implementation," in which the problem was identified by the client and communicated to Team B that the system was blocking the creation of user accounts with 8-digit mobile numbers. Then, Team B began to search for a solution in a scheme they have described as: *"We [the team] met to start thinking of solutions, in urgency mode, is to think and to apply."* Together and right after noticing the problem, the team considered possible solutions, tested them, and delivered them, as understood from the statement of a team member in a later conversation: *"We already know the system, right, so we*

*started to think ... if we do this, it will stop blocking the accounts. Then we tested in QA [quality assurance] and uploaded it."*

The team had to find a temporary solution so that the system would stop the creation of these accounts. The team then solved the problem, leaving the search for root causes for a later moment. That is another feature of the put out the fire strategy: it does not focus on the best possible solution, but on putting out fire, leaving the root cause analysis for a later moment.

The criterion used by the team to choose this "put out the fire" strategy includes two aspects: the complexity and the nature of the problem. To be approached in this mode, the problem needs to be simple. According to a member, in Episode 2, the problem, although relevant, had a simple solution: *"It could have been treated as fastlane [a parallel line of the Kanban board used in emergencies], but it was solved at the moment, simpler, it was not an incident."*

Additionally, the team needs to analyze the nature of the problem. If the problem affects the normal operation of the client's system, or if compromise any financial operation or put the system's safety in risk, then the "put out the fire" strategy should be applied.

### **5.2.2 Recalculating the route**

This strategy is characterized by the revision of the plan. There are a few situations in which the team should recalculate the route, as when there are changes in the premises that originated the plan, or when the team notices that one or more time estimates for the stories are, actually, wrong.

This happened, for example, when the team was planned according to information provided by a third party. According to one of the members, the team has already been through situations in which, due to lack of time, they took into account information passed by the client team and that, during development, the team discovered that it was not true. This information directly influenced the complexity of development and, therefore, required an alteration in the plan, extending the time

frame. Regarding the wrong estimates, members pointed out that, as teams accumulate experience, they tend to make better estimates.

Another situation is when the client requests interruption of the story in development so that another one, more important, is executed. The strategy of recalculating the route is also used in this case.

During episode 3, "The big epic planning," the team met and decided to tell the leader they would not be able to deliver according to plan. After everyone was aware of the situation, the team started planning the epic again and established a new time frame, in a meeting described by the leader as "recalculating the route."

A feature of this strategy is that the delayed, as well as the uninitiated stories were redesigned, since they had all been planned on the same premises. Thus, the team can re-estimate the duration of the stories, now with more accurate information. In the case of episode 4, "Idleness in the big epic," the team was able to take into account the actual scheme of work of the client's team responsible for code review in the system they were working on. This was information they did not have when they made the initial plan.

Another feature of this strategy is to verify if the team is comfortable and in accordance with the new plan before presenting it to the PO. In episode 3, "The big epic planning," this was done by the leader as the team came up with a new plan: *"Is everyone comfortable with these dates, guys? Can we do it?"* Next, the plan was presented to the PO, together with the justification for the delay and all the difficulties that were faced.

### **5.2.3 Acting with the client**

The third strategy identified was "acting with the client" to solve problems. This strategy is to always trigger the customer and keep her/him informed about the problem. The open communication with the client and PO is part of the APM theory (Highsmith, 2009). However, the report of these teams indicates that the open communication channel is especially important in these episodes of improvisation.

We have identified two subcategories: involving the client in the development of the solution and escalate the problem.

### **5.2.3.1 Involvement in the development**

According to team members, the clients should always be involved in the development of solutions, but in different levels, according to the situation. They mentioned that the client may point priorities, help establishing deadlines, approve the deliveries or contribute with knowledge. In this regard, they mentioned "*It is something really natural. There are no restrictions.*" When questioned about cases when the client contributed for the development itself, the team mentioned a few cases and highlighted the share of knowledge in these cases.

Episode 2, "The ninth digit implementation" is one example of the application of this strategy. A client company developer was responsible for creating a script that, along with the validation produced by Team A, solved the problem. This script automatically added the ninth digit to cell numbers that were only eight digits long. In this way, Team B and the client developer working together resulted in solving the problem.

### **5.2.3.2 Escalate the problem**

Escalate a problem consists of contacting the hierarchical superior in order for a decision to be made. Teams use this strategy when, according to them: "*When it is not in our influence, when we cannot solve it directly*". In such cases, the team contacts the responsible person, who has the necessary authority to make the decision.

An example of the application of the strategy is Episode 5, "Client team's unavailability," when the team faced a situation in which the client's team, in charge of reviewing the code, did not turn in the task due to unavailability. After critical

analysis, the team identified the need to involve higher management levels to solve the situation. The hierarchical superior of the PO was informed and it was decided that the priority should be the revision of the codes, favoring the fulfillment of the term by Team B.

At first, this strategy can be seen as a trivial response to contingency. However, we have noted, from the cases studied, the importance of team members asking themselves, once the problem has been identified, if it can be solved within the current responsibility of those involved in the project. This attitude should be stimulated in order to avoid frustrated attempts at solution being maintained for a long time, slowing down the solution and consequently impacting the adaptation.

#### **5.2.4 Break standard work rules**

This strategy is triggered at times when the team, faced with a problem, believes it is worth it to break a standard work process rule, and this attitude is essential for the elaboration of the solution of a problem. The team “puts cards on the table”, analyzes the risks and the benefits of breaking the rule and make the decision of breaking (or not) the rule.

In episode 1, "The ninth digit," regarding the late execution of the component, the following annotation of the observer reveals: *"Normally they would create a new story, but the component needed to be deployed along with the validations."* To do this, the team accelerated the planning and development stages for the component, because, according to them, it was *"very simple,"* and developed the rest as a single story. Thus, what would be a new story of the component was agglutinated to the already existing story of the validations.

In addition, while the planning and development stages for the component were done in an accelerated way, another story that was already in the kanban board was eventually overtaken by this component story. This kind of overtaking was not expected by the team even through the routine use of the kanban board. Thus, two

rules were not followed in this episode: the agglutination and the overcoming of stories.

In episode 4, "Idleness in the big epic," the "breaking rules" strategy was also observed. While Team A waited for the code review by the client team, some members of Team A became idle. The team chose to advance the work on another story, as stated: *"Observer - So she started this other story because she was idle?; Team member - Yes, while those other stories are not moving she is doing progress with this one."* While this attitude reflects a good use of developer time, it also represents a rule of the team's Kanban board not being followed, as one of the team members explained: *"I don't know if you have noticed, our WIP is limited to two stories (...) and now it has 3. (...) It may come to 4."* The team was accustomed to work with at most two stories in the WIP of the Kanban board. However, being surprised by a code revision period bigger than expected, the team decided to act to get around this unforeseen problem.

Therefore, four strategies were identified: put out the fire, recalculating the route, acting with the client, and breaking kanban rules. They, as well as their characteristics, are presented in Figure 15.

**Figure 15 - Description of the strategies.**

Strategy	When to apply	How does it work	Examples
Put out the fire	When the problem is simple When the problem affects the functioning of the system When the problem involves financial or safety impact for the client	The problem is solved right after the identification "To think and to apply" - The team tries different solutions immediately "Put out fires" - root cause is investigated in a later moment	Episode 2
Recalculating the route	When there is some change in the premises When there are interruptions in the sequence of stories to be developed, according to the priorities of the PO When the team finds out that the estimates are wrong	The team reviews the whole schedule The team estimate again The leader checks if the team is comfortable with the new plan The problem and the new plan are presented to the PO	Episode 3
Acting with the client - Involvement in the development	Client should be involved in different levels according to the situation When the team can benefit from client team's knowledge	Sometimes the client only points out the priority Help establishing deadlines Approve the deliveries Contribute with knowledge	Episode 2
Acting with the client - Escalate the problem	When the team is not able to solve the problem by itself When the team is not able to directly influence the situation	Contacting the person responsible for the decision	Episodes 5 and 6

Break standard work rules	When the team believes that the benefits of breaking the rules overcome the risks	The team “puts cards on the table” The team makes a risk and an impact analyses In the end, it is a team’s decision	Episodes 1 and 4
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Source: the authors

### 5.3 Summary of the theory

Using these concepts, we can conclude that improvisation within agile teams is a recurring phenomenon and is useful for understanding the teams adapt the plan. During the development of the project, dysfunctions are identified and serve as triggers for a set of actions. The way the team solves the dysfunctions, including actions and behaviors, is directly linked to the success of solving the issue.

According to the observations, the episodes present a set of moments. First, the perception and communication of a problem or incongruity in the project plan, then the search for a solution, followed by its definition, execution and verification of effectiveness. Thus, one can see the adaptation as the result of improvisation episodes in which the team rearrange the plan during the execution. In the episodes, the team can use some strategies, which define what actions will be taken. The teams’ habits will also be present and may favor the success of improvisation.

Figure 16 exhibits a summary of how the strategies and habits were observed, according to the episodes of improvisation. It is noticed that commonly more than one habit is perceived in the same episode. For example, in episode 2, the team used the Put out the fire strategy, in which the habits of listening to the client and positive attitude toward the problem were perceived. In sequence, in order to solve the root cause of the problem, the strategy taken was acting with the client.

The use of strategies and habits were complementary during the episodes, and together they built the ability of the teams to react to unexpected adversities through improvisation.

The figure also shows those involved in each episode, and it is evident the strong presence of teamwork in both teams, which is consistent with the review of the

literature that strongly emphasizes the collective aspect present in agile teams. The triggers are also displayed in the table due to their importance in the definition of the phenomenon used in this study. In this regard, there are different ways of perceiving problems: some by the team itself, either individually or concluding on an incongruity, and others by the client, who comes in contact communicating about unexpected deviations.

Figure 16 - Summary of the episodes.

Episode	People involved	Trigger	Strategy	Habits
Episode 1 - The ninth digit	Team B, leader	Perception during test in the development phase, followed by communication to the team	Break standard work rules	Positive attitude
Episode 2 - The ninth digit implementation	Team B, leader PO, other members from the client company	Perception by the client company, communication with team B	Urgency Acting with the client	Listening to the client Positive attitude
Episode 3 - The big epic planning	Team A, leader, PO	Perception by team A and communication with leader	Recalculating the route	Positive attitude Listening to the client Help
Episode 4 - Idleness in the big epic	Team A, leader	Perception of team A's members and communication within the team	Break standard work rules	Help
Episode 5 - Client team's unavailability	Team B, leader, PO, PO's coordinator	Perception of one team A's member and communication between the team and leader	Acting with the client	Warning
Episode 6 - Client team's unavailability	Team B, leader PO	Perception of one team B's member and communication with the leader	Acting with the client	

Source: the authors.

Although these ideas have been observed only in these cases of these two teams, it is known that many of these aspects are not new and had already been mentioned in the literature in some way. The following section will highlight these points.

## 6 Discussion

After data analysis, each reference of habit or strategy identified in the literature was compared to the present study. **Figure 17** summarizes this comparison.

The similarity was classified as low, medium or high. If the previous paper presented an idea that is similar to an idea presented in this study, without further details or examples, or even without identifying it as a strategy or habit for adapting the project plan through improvisation, the correlation was classified as low. If the previous study provided contextualized examples of the strategy or habit, and/or connected it to adapting the plan or improvising, the correlation was classified as medium. Moreover, if the previous study has also provided details on the strategy/habit, such as defining it, explaining its characteristics or when it is usually applied, then the correlation was classified as high. The level of similarity between the concepts was also taken into account.

### 6.1 The identified habits

When it comes to habits for adapting the plan with improvisations, the majority of them have been mentioned in the literature in some level. However, none was mentioned as an important habit for adapting the plan, but rather as characteristics of agile teams or team work in general.

#### 6.1.1 Warnings

The study of Sharp and Robinson (2008) mentions an interesting episode during a planning meeting of a mature Extreme Programming XP team. One team

member mentions that the story he is working on requires attention: “Paul picks up a card from the wall and holds it expectantly; (...) Paul comments that the story he’s holding needs attention.” This quote shows that Paul, an agile team member, noticed a potential problem and shared it with the team, spontaneously.

This story resembles to the warnings described in this work, as it shows a team member alerting the rest of team regarding a potential problem. However, because the episode has not been connected to adaptation and improvisation, the correlation was classified as medium.

### **6.1.2 Positive attitudes**

Whitworth and Biddle (2007) point out that cohesive agile teams are characterized by openness to discuss problems. Nonetheless, the study does not mention any connection of this characteristic and the adaptation of project plans, thus, the correlation is low.

Additionally, Kamoche and Cunha (2001) mention “attitudes conducive to experimentation” and “trust in a climate of trial and error experimentation”, and Conforto, Rebentisch et al. (2016), also mention the importance of a culture that encourages changes. However, these attitudes are not detailed and these study does not provide examples from real cases, thus, the correlation is medium.

### **6.1.3 Helping**

Dickinson and McIntyre (1997) describe the back-up behavior as a component of team work in general. This behavior consists of team members helping each other to execute their tasks. Sharp and Robinson (2008), on the other hand, have studied agile teams and highlight the collaborative nature of these teams. The authors mention that often, programming pairs would ask and receive help from other pairs.

Additionally, Whitworth and Biddle (2007) mention that agile team members would even offer to help others when their own activities were done.

As none of the papers related moments of members helping each other to the ability of teams to improvise, the correlation was not considered strong. However, the work of Sharp and Robinson (2008) described it in a very similar way to what was observed in this work, in the same context, so it was classified as medium. The others were considered weak.

#### **6.1.4 Listening to the client**

No case references were found where the project team receives suggestions from client representatives, other than the PO, regarding the way the team acts. The agile literature has focused on the role of the customer as an agent to prioritize the product functionalities and not as an agent to help adapt the plan in partnership with the team.

Conforto, Rebentisch et al. (2016) mention the importance for improvisation of communicating with stakeholders, however, no other details are provided. Therefore, the correlation is low.

## **6.2 The identified strategies**

Munthe et al. (2014) use the concept of deviation and classify them into four types: component, interface, concept, and scope. For each one, the authors describe how the project teams handled the problem, in terms of cause, management and solution. The study provides interesting insights such as who needs to get involved in each type of deviation, if the solution is internal or cross-functional.

Even though the classification provided fits better the manufacture context, the idea of using the complexity of the problems to classify how the team managed them is interesting and has partially been applied in this study.

Additionally, the term strategy has been mentioned by the study of Leybourne and Kennedy (2015), as being the intersection between improvisation and project management. According to them, due to the compression of timescales, managers need to deliver solutions based on intuition. No further details on these strategies are provided.

Regarding the work of Highsmith (2009), he suggests how to practice adaptive actions at the end of each iteration. These actions are related to project management, such as the use of reports and evaluation of team performance and their ability to follow the schedule as planned. In the present work, on the contrary, the improvisation actions observed are very specific and focused on specific problems. In addition, actions were observed during iterations, at the moment unforeseen events occur, rather than at the end of the iteration as suggested by Highsmith (2009).

### **6.2.1 Put out the fire**

The "put out the fire" strategy is very specific. It concerns situations where the potential impact of the problem is high and the solution is punctual. The staff stops planning and devotes entirely to immediate action. Although in this sense it approaches the concept of urgency found in theory, the denomination was changed, since the two are not considered identical.

Urgency is considered as the attitude to prioritize a problem very quickly and the actions arising from its treatment (Cunha et al., 1999). Considering this definition, we observed that all the identified strategies present characteristics of urgency. Therefore, we suggest adopting the term "put out the fire" for the strategy that was mentioned by professionals as "urgency".

The “put out the fire” strategy includes the urgency aspect, however, the team is immediately dedicated to the solution, testing possible solutions by putting them into practice right away. The problem is stagnant and usually involves partial and temporary solutions that may not eliminate the root cause and will usually require further treatment. The data collected bring the hypotheses that characteristics of the “put out the fire” strategy are very specific and should be better understood to advance in the comprehension of adaptation in agile teams.

Cunha et al (1999) provide a list of studies that have considered the sense of urgency as important for improvisation to occur. The authors consider sense of urgency as fast action when faced with an unplanned event. Crossan, Cunha, Vera, and Cunha (2005) also consider urgency as time pressure. However, this description does not comprise every aspect of the strategy of urgency identified in this study, such as the solution generated being momentary and all resources being allocated for the urgency issue. Therefore, the correlation was characterized as medium.

Hoda and Murugesan (2016) also mention the occurrence of urgent demands, causing the team to drop an iteration in order to deal with the urgent ones. However, the paper does not describe what exactly characterizes these demands as urgent. The authors also highlight that the excessive occurrence of urgent demands may be the effect of a product vision that was not well established with the customer at the beginning of the project. Therefore, the correlation was characterized as medium.

Similarly, a study conducted by Dönmez et al. (2016) shows that agile projects may suffer interruptions due to emergencies at any time. This may require changing priorities, allocating resources to critical problems or changing the iteration plan. For the same reason, the correlation was also characterized as medium.

In addition, Holmberg and Tyrstrup (2010) mention the sense of urgency as very important for the routine work of middle managers and project managers. The author defines it as the ability to take quick action when facing even the most serious problems. The solutions produced are momentary, aiming to contain the problem so that the work can continue to be carried out. These observations by Holmberg and Tyrstrup (2010) are the most similar to the strategy identified in this study, as regards being a momentary solution, which will not necessarily reach the root cause of the problem, which is why the similarity was classified as high. An interesting difference

is that, in the context of this study, this strategy was not associated to leadership, but to the team as a whole, from the perception of the problem to the development and implementation of the solution. The authors also did not describe the type of problem that is involved in the sense of urgency, as we did in this study. Despite of these differences, the similarity was classified as high.

### **6.2.2 Recalculating the route**

Hoda and Murugesan (2016) mention delayed and changing requirements as one of the challenges faced by agile teams, leading to the need to take non-planned actions, such as changing the iteration plan, waiting until the customer defines requirements, or cancelling a sprint. Moreover, these changes were not exclusive to the beginning of the iteration, but would happen at any point of the development process.

This observation is strongly connected to the strategy of recalculating the route, since this strategy includes changing the plan and redoing the estimates. Due to that, the correlation was classified as high.

### **6.2.3 Acting with the client**

No evidence of this strategy was found in the literature. Generally, the literature recognizes the client of agile projects as someone who prioritizes the backlog and participates in daily meetings, makes suggestions. This research reveals this additional role, where the client plays an active role in solving problems, as observed in the “acting with the client” strategy and also in the “listen to the client” habit.

### **6.2.4 Break standard work rules**

The study of Hoda and Murugesan (2016), when mentioning urgent demands presented by the clients, affirms that this causes the teams to act contrary to the SCRUM theory, which does not recommend the interruption of a sprint to meet a demand non- prioritized for the current Sprint.

In this sense, one sees a relation with the strategy "break standard work rules", which portrays moments just like this one, in which the team acts contrary to some rule that guides their work, due to an emerging need. Therefore, the correlation was considered to be strong.

Figure 17 - Comparisom with the literature.

Type	Findings	References in literature	Similarity
Habits for adapting the Project plan through improvisation	Warning	Sharp and Robinson (2008)	Medium
	Positive attitudes	Whitworth and Biddle (2007) Kamoche and Cunha (2001) Conforto, Rebentisch et al. (2016)	Low Medium Medium
	Helping	Sharp and Robinson (2008) Dickinson and McIntyre (1997) Whitworth and Biddle (2007)	Medium Low Low
	Listening to the client	Conforto, Rebentisch et al. (2016)	Low
Strategies for adapting the Project plan through improvisation	Put out the fire	Hoda and Murugesan (2016) Dönmez et al. (2016) Cunha et al (1999) Crossan et al. (2005) Holmberg 2010	Medium  High
	Recalculating the route	Hoda and Murugesan (2016)	High
	Acting with the client	No references found	-
	Break standard work rules	Hoda and Murugesan (2016)	High

Source: the authors.

### 6.2.5 Topics not covered by this analysis

This work focused on collective improvisation. This was not an initial determination, but rather it happened throughout the development and analysis of

data collected in the field. However, there are in literature studies on the phenomenon of improvisation in the individual sphere (Magni et al., 2009) and authors that differentiate the collective and individual spheres, such as Moorman and Miner (1998b).

Other issues identified as relevant in the literature, and which were not covered by the present analysis, are: the relationship between improvisation and organizational memory (Moorman & Miner, 1998b; Vera & Crossan, 2005; Cunha et al., 1999), minimal structures for improvisation (Kamoche & Cunha, 2001; Cunha et al., 1999; Brown & Eisenhardt, 1997), the failure of improvisations (Moorman & Miner, 1998a), and the management and evaluation of improvisation (Leybourne, 2006; Miner et al., 2001; Conboy & Lang, 2011).

These themes were not the focus of this research because they were not considered as relevant during the data analysis. The open scope of research is a feature of GT (Glaser & Strauss, 1967), which allows the specific topic of research to emerge from the data collected in the field. These themes may be the focus of future researches.

### **6.3 Evaluation of the research**

One of the final steps suggested by the GT method is the evaluation of its application. Tarozzi (2011) lists 6 parameters that guide this evaluation: theoretical sampling, process path, theory integration, depth, relevance and utility. The author suggests some questions to be considered in each criterion, as shown in Figure 18.

In relation to the theoretical sampling, the logic proposed by the GT was respected. As described in the method section, the transcripts analysis guided the decision on which people needed to be interviewed next. One negative aspect was the non-involvement of the client company members who played important roles in some of the improvisation episodes observed. The main reason for this non-involvement was the physical distance, since the contact between the client company

teams and teams A and B is majorly by phone conferences. The PO was going to visit the company and even meet with the researcher, but this visit did not happen.

Figure 18 - Criterion for evaluating the GT.

Criterion	Questions
Theoretical sampling	How was the theoretical sampling executed? Are the sufficient data for supporting the inferences?
The process path	Are the categories empirically generated? Can one go through the process of generating the categories?
Integration of theory	Are the concepts systematically interconnected? Are the categories adequately developed? How and why was the core category selected?
The depth	Does the theory embrace the phenomenon entirely? Are the results linked to the current scientific debate on the subject?
The relevance	Do the categories and process presented open new perspectives? Are they significant? Will they last in time?
Utility	Does theory make sense to the participants? Does it raise relevant issues in the professional debate?

Source: adapted from Tarozzi (2011).

It is worth highlighting the definition of the phenomenon and use of the triggers as a strategy to delimit the phenomenon analysed in the context of software development project management. This approach was not found in theory, but has proven useful for the work and is Reigado et al. (2017).

Regarding the process path, the method section is an attempt to show the reader how the data analysis was executed. Figure 7 exemplifies the coding process, which was done in the same way for the rest of the data that culminated in codes, concepts and categories. In addition, the use of *in vivo* codes contributed for keeping the analysis truly connected to the data. The categories are empirical, since they emerged during the research, without the use of theories already fulfilled.

In relation to the integration of the theory, Figure 13 and Figure 14, in section 5, illustrate the concepts grouped into categories. The concepts were linked by the similarity in terms of how they are related to phenomenon. The choice of the core was justified and is in section 3.3 of the method. We sought to develop the categories well, especially the core, through the third validation meeting held with participants, in which each category was discussed in depth. We believe, however, that the relationship between the two categories could have been further explored during the field study and data analysis.

With regards to depth, we understand that the phenomenon we studied is complex and could be analyzed from many perspectives and with different approaches. We believe that we have been able to offer an interesting perspective, which contributes for understanding how agile teams adapt to unforeseen events.

When it comes to relevance, we believe that the presented analysis opens new perspectives for the study of teams. The ability to adapt is considered fundamental by the literature, and this work points to a new path in understanding and attaining that capacity, by looking at teams more carefully. The analysis focuses on the actions the team presents and the small decision-making that compose the ability to react to unexpected problems.

The tendency of a turbulent environment, in which project success rests on this capacity of teams is not a passing trend, so these results may indeed last in time. However, it also depends on the continuity of researches of this type, which can also point out new strategies, habits and other relevant actions.

Regarding the utility, 3 validation meetings with the participants were held during the research, and in all of them the teams' reaction was positive in relation to the analysis presented. More than that, it has become evident that the aspects revealed by the analysis are linked to behaviors of the team members that are considered by them as very natural and that are not documented as rules or even good practices. Besides, during these meetings, the teams ended up debating about similar previous situations and doing a retrospective of what they have already experienced. Therefore, it is believed that this criterion was fulfilled satisfactorily.

Even though this research as the first experience of the researchers with the Grounded Theory method and therefore many difficulties were faced, we believe that the method has been respected and that the results were interesting and satisfactory.

## 7 Conclusions

This study led to the identification and systematization of a set of strategies and habits used by two agile teams that contributed to the adaptation of the plan during the project. These are elements that can help the team in the changing the plan and acting differently from the original plan drawn after receiving the demand for the PO, making these teams more efficient.

In addition, it was possible to identify a combination of these strategies and habits within the concept of improvisation episodes, enabling the structure of a theory that describes how the adaptation occurs. This can be used for preparing leaders, scrum masters, project office professionals and team members, making them more apt to identify these moments and providing them with repertoire on how to proceed.

Most of the habits and strategies presented in this study had already been cited in the literature, in varied levels of details and individually. The majority of them have been cited more superficially, without a detailed description and without being related to the phenomenon of improvisation. The present study corroborates these ideas, that have been cited before, and adds to existing literature by providing examples and more details of ideas that have been mentioned, often briefly, earlier.

Another contribution was the systematization and organization in a cohesive set of recommendations and their relationship with the concept of episode, forming a theory that makes the adaptation phenomenon more understandable. It is interesting to note that the division between strategies and habits serves as an insight for the knowledge management regarding adaptation in the companies, since, when considering this theory, it would be possible for a company to start a collection of strategies based on past and ongoing projects and making them available to managers and teams. Additionally, considering the habits as a guide for training project team members could be beneficial.

One of the limitations relates to the fact that this is the researcher's first application of Grounded Theory. Therefore, some difficulties appeared during the process. For instance, during initial coding, some codes were not kept to just one or two words, and later on were relabelled; some codes was too specific, and were

revisited later on; besides, the development of the categories also caused confusion in a first moment. In order to reduce these difficulties, applicants of the method were consulted in different occasions.

Another limitation is the number and type of teams participating in the field study. Both teams were from the same company and use the same working processes, which means the research focused the data collection in only one context.

An interesting discovery was the recognition of the "relaxation" phenomenon, when this synthesis was presented to the team members. According to the interviewees, although the company has a strong agile culture that makes the recommendations (strategies and habits) present, it is not simple to apply these guidelines. They affirmed that in periods of absence of high impact incidents, the teams decrease the readiness and prevention, diminishing also the use of the rules and recommendations of work. When a serious incident happens, teams behave more pre-emptively for a while. The researchers believe that this phenomenon is an interesting one to be studied.

Investigating improvisation in other agile teams would also be interest, in order to verify the occurrence of the phenomenon and the presence, or absence, of the categories identified in this study. Researchers can use the lists developed in this research and complement and expand them, systematizing the knowledge generated with future field studies, surveys and other studies in the literature of agile project management.

Additionally, a few topics have been addressed in section 7.4. topics that have not been the focus of this research and that could be the theme of futures researches. These topics include investigating improvisation in the individual level, the relationship between improvisation and organizational memory (Moorman & Miner, 1998b; Vera & Crossan, 2005; Cunha et al., 1999), minimal structures for improvisation (Kamoche & Cunha, 2001; Cunha et al., 1999; Brown & Eisenhardt, 1997), the failure of improvisations (Moorman & Miner, 1998a), and the management and evaluation of improvisation (Leybourne, 2006; Miner et al., 2001; Conboy & Lang, 2011). All these topics could be investigated in the context of agile teams.

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## APPENDIX A – Consolidated table of the codes used in this analysis

Parent code	Code	Coded segments
	<b>Strategies</b>	0
Acting with client	sugestões	1
Acting with client	diferentes níveis	1
Acting with client	sempre	1
Acting with client	Alçada	1
Acting with client	Involvement in the development	1
Acting with client	Escalonar	2
Urgency	Estancamos	1
Urgency	Problemas em produção	1
Urgency	Solved at the moment	2
Break Kanban rules	análise de riscos	1
Break Kanban rules	Agglutinate stories	1
Break Kanban rules	Increase WIP	1
Break Kanban rules	Overtake story	1
Recalculating the route	Falar com o PO	1
Recalculating the route	Pensar pequeno e no global	1
Recalculating the route	Comfort	1
Recalculating the route	Mudança de premissa	1
Recalculating the route	Estimating	2
Recalculating the route	Review schedule	1
	<b>Habits</b>	0
Helping	Offering help voluntarily	1
Helping	Helping others	4
Helping	Asking for help (not pair programming)	6
Helping	Explaining	4
Helping	Checking (pair programming)	4
Listen to the client	Communication regarding problems	7
Listen to the client	Suggestion	1
Positive attitude	That's it	1
Positive attitude	No guilty	2
Warnings	Don't forget	3
Warnings	To align	2
Warnings	Experience	1
Warnings	Risk	2
	<b>Cases</b>	1
Cases	Idleness in the big epic (Episode 4)	3
Cases	Problems during programming	3
Cases	Unavailability of client team	1
Cases	The 9th digit	0
Cases	The big epic	0
Problemas caso 9o dígito	Variados códigos	8
Problemas caso épico grande	Variados códigos	12
Pensar pequeno e no global	Reaproveitamento	1
The 9th digit	Variados códigos	8
The big epic	Problemas no caso do épico grande	2
Alçada	influencia	1
Break standard work rules	análise de riscos	3

Break standard work rules	análise de riscos	3
análise de riscos	colocar as cartas na mesa	1
Analysis	Thinking about problem	4
Analysis	Team building solution	6
	<b>Improvisation phases</b>	0
Problem identification (trigger)	Changes in planning	1
Problem identification (trigger)	Noticed problem	2
Problem identification (trigger)	Problem identification after delivery	2
Problem identification (trigger)	Client team reports problem	1
Problem identification (trigger)	Problem identification during development	4
Problem identification (trigger)	Problem identification by the team without leader	1
Problem identification (trigger)	Problem identification during programming	4
Improvisation phases	Elaborate new plan	0
Improvisation phases	Keeping track, testing the new solution	3
Improvisation phases	Solution executed/proposed	10
Improvisation phases	Problem identification (trigger)	1
Improvisation phases	Problem solved (end)	1
Keeping track, testing the new	Does not work	1
	<b>Others</b>	
	115 códigos variados	156
<b>Total</b>	<b>207</b>	<b>297</b>

## **APPENDIX B – Interview script for initial coding**

### Identification and comprehension of the problem

- 1) Describe what happened in that situation, according to your point of view. What is the problem?
- 2) How does it affect (or may affect) the project?

### Searching and selecting the solution

- 3) During the (meeting, coffee time, etc...) I noted that (...). What do you think about that?
- 4) How are you dealing with this problem? How has the search for a solution been executed?
- 5) In your opinion, what are the alternatives of solution?
- 6) What do you think about the solution defined?
- 7) How did the team come to this solution?
- 8) How will this solution be applied?

### Execution or planning of the solution

- 9) Do you believe this problem could have been prevented? How?
- 10) Is there any artefact, method, resource, infrastructure or other element that could have reduced the impact or even prevented the occurrence of the problem?
- 11) Existe algum artefato, método, recurso, infraestrutura ou outro elemento que poderia diminuído o impacto ou até evitado o surgimento do problema?



## **APPENDIX C - Observation script for initial coding**

During observations, the observer should not interfere and register the following points:

- Discussions and decisions related to project's planning, control (in terms of time, cost or quality of deliveries), especially:
  - Moments when the team agrees
  - Moments when there are divergence of opinion, and how the team gets to an agreement
- Improvisation moments: moments when the team needs to act differently from the project's plan, or moments when the team or a team's member finds out that the plan is not coherent, and identify the need for a new solution. The phenomenon comes to an end when the team, after looking for and selecting a new solution, establishes a new plan or agreement that fits the situation.



## APPENDIX D – Interview script for focused coding

### Category “Warnings”

#### For everyone:

- 1) During the meetings, for many times I saw the leader given warnings, reminding you not to forget of something (such as the occupation of the client team, a problem in a system, etc). How does it work? Do these warnings help you?
- 2) What are the characteristics of a good warning?
- 3) Do you feel comfortable for given warnings for the team? Have you ever given one? Could you give me an example?
- 4) Sometimes other members also give warnings (as one time when P mentioned a programming structure that he had already used and is complex)...How does it work? Has it ever helped you?

#### For the leader:

- 5) I have notice that, during the daily meeting, you usually give some warnings for the team (such as the occupation of the client team, a problem in a system, etc). How does t work? Why do you do that? Is it a recommendation from some methodology?
- 6) What is the purpose of these warnings?
- 7) Do you notice if the team usually pays attention to the warnings you give? Could you give me an example?
- 8) I have notice that, in the majority of the occurrences, you are the person given the warnings. Do you think the members feel comfortable for given warnings, too?

### Category “Help”

#### For everyone:

- 1) For many times I sae you guys calling other colleagues to take a lookd at the code when you had a difficulty, even if you were working in pairs. How does it work? Tell me about that...What exactly makes you ask for other colleague’s help?

- 2) I also noticed that usually you respond promptly to a request of another colleague... Tell me about that...
- 3) Does this habit of asking for and giving help to one another influence your work? And how does it influence situations such as the big epic, when you faced a lot of problems? Do you have other examples?
- 4) What makes a good help?

For C, from team A:

- 5) One day I observed you asking J if he needed help with the tests (of an activity of the big epic that was late). How was that? Why did you do that? Did you know he was needing help? Is it common for you guys to voluntarily offer help to one another? Can you give other examples?

### **Category “Positive attitude”**

- 1) Which elements are important for you to feel comfortable and capable of dealing with a problem?
- 2) In your opinion, how does the team face the problems? Does the team search for a culpable one?

For PP, from team B

- 3) When you faced that problem of the ninth digit, I asked you the cause of the problem, and you guys told me that no one was culpable...How is the team's vision about that? Is it usually like that, with other problems? Why do you guys see things like that?

For, team A

- 4) Once, during a meeting when you were recalculating the route, I saw the leader telling you that you were doing the right thing, if identifying the problem, communicating the PO, and etc. How do you see that attitude? How does it make you feel?

For the leader

- 5) Once I saw you tranquilizing the team when they were facing a problem (the meeting of recalculating the route). Where does this attitude come from? Do you notice any reaction of the team to that?

### **Category “Recalculating the route”**

For,team A

- 1) Which conditions determine the necessity of recalculating the route? In this case, who made the decision that the plan was not enough was the team, without the leader. Is it always like this?
- 2) Why did the team gathered immediately? Is it always like this?
- 3) This replanning is a common practice? Tell me about other occurrences.

### **Category “Relationship with the client”**

- 1) I have notice situations in which the client suggest how you could deal with a situation, such as in the big epic case. How does it work? Has it happened before? Did it actually help you?
- 2) How does your relationship with help you to solve problems?
- 3) How do they react to problems? How does the negotiation of new time frames work?
- 4) What percentual of the problems require cliente`s involvement for its resolution?

### **Category “Flexibility”**

- 1) Even though you have a standard work process, in some occasions you do not follow this standard. For instance, in the big epic you had 3 stories in the WIP...How does it work? When and how you make the decision of working differently from the standard? What is the rule for not following the rules?
- 2) Who has the authority for making the decision of not following the standard work processes?
- 3) Have you ever been through a situation when you did not follow the processes and it was negative for the project?

**Category “Put out the fire”**For, the leader

- 1) In the ninth digit case, you mentioned that the team treated the problem in an urgency mode. What does a situation have to be like to be described as in need of putting out the fire?
- 2) Who determines if a situation is a “Put out the fire”?
- 3) Do the solutions developed in urgency mode work well?
- 4) Can you give me other examples?

## APPENDIX E – Categories' analysis

### Analysis of the category “Help”

This category includes observations related to the help among teams' members, in different occasions. It was possible to note that:

- **Members ask for help for members that are not involved in the activity.** Pair programming involves two members working together, helping each other. This type of help was also observed, however, it was also observed that the pair uses to ask for a third person's help when facing difficulties. There were also moments when a member was working alone and asked for a colleague's help. For instance: “Hey P, are you busy? Can you help me here?”
- **Members respond quickly to a help request.** When receiving a help request, members would instantly respond, usually leaving their work station and going to the colleague's work station, where they talk about the problem: “P started to explain a few things and D kept asking questions” [observer's note about the moment when P was helping D after D's request].
- **Members voluntarily offer help for each other.** It was observed one time when a member offered help for a colleague, voluntarily: “J, are you gonna need help with the tests?”

There was not even a single occurrence of a request of help not being responded by the teams, or fulfilled in an explicit unwilling way. Additionally, there was no observed situation when the leader had to interfere for members helping each other.

Hypothesis:

- **The help moments seem to be essential for the development of solutions.** The majority of the occurrences of members helping each other happened during the development of the code, when a member, or the pair, faced a difficulty. The help seems to be related to moments of identification and analysis of a problem, definition and execution of the solution. Therefore, the help among teams'

members has the potential of supporting improvisation in all these moments.

- **Helping one another seems to be a characteristic of the teams.**

These help moments occur in a voluntary and natural manner, with no direct influence of the leader, which indicates a habit of teams' members of working together.

- Aspects to be further investigated:
  - What is a good, effective help? Describe it for me.
  - Have you ever been to a situation when you asked for help and the person did not help you?
  - What characteristics of the team allow for and contribute with the habit of members helping each other?

### **Analysis of the category “Positive attitude”**

This category includes observations of positive attitudes expressed by teams' members regarding problems faced by the teams. It was possible to note that:

- **The teams do not blame members for the problems.** When facing a problem, the teams do not try to find a person responsible for the problem or blame anyone. For instance, when asked about a problem they were facing, a member said: “I think anyone is culpable of this problem, it was a communication issue.”
- **The leader transmits a positive climate.** The leader reinforces the attitude of the team recognizing a problem in advance and guides the team to solving it: “But in the end that's what we have to do, identify the problems in advance, communicate with the PO, and then, what we do next, we do with dedication”.

There was no observed case when this type of attitude have been negative for developing solutions for problems, not even cases when the opposite type of attitudes were expressed when teams faced problems.

- Hypothesis:
  - **These attitudes are favourable for solving problems.** This type of attitude keeps members comfortable, since it does not intimidate

members or blame anyone. On the contrary, these attitudes show a focus on the development of the solution. Therefore, these attitudes can contribute to a successful development of improvisation.

- Aspects to be further investigated:
  - Which elements are important for you to feel comfortable and capable of facing a problem?
  - Have you ever been through an uncomfortable situation after the identification of a problem?

### **Analysis of the category “Recalculating the route”**

This category includes observations of moments when, after identifying an inconsistency in the plan, the team decides to establish a new plan. It was possible to note that:

- **The team reviews the whole planning.** After identifying the inconsistency, the team reviews all the time frame previously established, including the stories that are not directly related to the problem: “We could take another look at these ones, too, if the time is adequate” (leader looking at the futures stories). The team estimates the new time frame: “There is the one of System I, which is basically an adjustment, if there is no bug, we end it until Wednesday”.
- **The leader verifies if the team is comfortable with the new plan.** At the end of the planning section, the leader verifies if the team considers the plan viable: “Is everybody feeling comfortable with this schedule, team? Is it viable?”
- **The participation of the team`s members is important.** The team`s members executed the planning together and it seemed to be important, since the members contributed with information and points of view that influenced the planning. Besides, in the end of the section, everyone needs to confirm the viability of the plan, which reinforces the idea of the planning being a product of a collective work.

There was no observed case when a single member have elaborated a new plan, not even situations when the leader imposed time and activities to the team.

- Hypothesis:

- **The replanning occurs right after the identification of the problem.** As soon as the team communicated the inconsistency to the leader, the whole team gather for executing the replanning. Because only one case of recalculating the route was observed, there is the need of checking if this characteristic is always present.
  - **The replanning is, by itself, an improvisation.** And the expected result is a new plan. Facing an unexpected inconsistency, the team interrupts the other activities, gather together and elaborate, as a solution, a new plan. The condition of acting without previous planning, that characterizes improvisation, is present, since the team had an initial plan and did not expect the necessity to replan.
- Aspects to be further investigated:
    - Which conditions determine the necessity of recalculating the route? In this case, who made the decision that the plan was not enough was the team, without the leader. Is it always like this?
    - Does the team always gather to replan right after the identification of the problem?
    - This replanning is a common practice? Tell me about other occurrences.

### **Analysis of the category “Relationship with the client”**

This category includes observations of moments when the communication and the relationship with the client company were essential for the identification of problems and development of solutions. It was possible to note that:

- **The client contributes for the identification of problems.** One of the ways the teams identify problems is through the communication with the client. Sometimes the problems are only identified when the functionality has already been implemented. In these cases, teams from the client company are the ones who identify the issues. For instance: “How did you find about the problem?”

(observer); P: “It was A [from the client team] who called and talked with H and S [members of the team]”.

- **The client contributes for the solving of problems.** There were cases when people from the client team suggested a way of solving a problem, and the teams accepted: “What we should have done was to add partial goals, just like the guys from São Paulo [from the client team] said, focusing on one objective at a time”. There were also cases when people from the client team took part in the execution of the solution, such as in the ninth digit case, when a person from the client team executed a script as part of the solution.

There were not any observed cases when the client company refused to work with the teams. There were cases when people from the client team were unavailable, but it was possible to note that they were always willing to work with the teams.

Hypothesis:

- **The client’s participation is relevant in every stage of improvisation,** such as during the identification of a problem and the definition and execution of the solution, as exemplified. When it comes to the verification of the solution, the client is always involved, according to the standard working process of the teams, both if it is an initial solution or an improvised one.
  - **The client is involved in external issues.** Internal problems, such as replanning and difficulties in elaborating the code, did not have the involvement of the client. Nevertheless, problems identified during or after the delivery, and involving interface with the systems from the client company, led the team to involve the client.
- Aspects to be further investigated:
    - Are there other cases, besides the ninth digit and the big epic, when the client contributed for the solution
    - Is there any case when the team noticed a problem and solved it without involving the client? What is the criteria for involving the client in the elaboration of a solution?

- How does the client react to the necessity of adapting time and activities for solving a problem?

### **Analysis of the category “Flexibility”**

This category includes situations in which, in order to solve a problem, the teams had to adapt their standard work processes. It was possible to note that:

- **The teams adapt the use of the Kanban board.** In some situations, the teams needed to be flexible in relation to the standard working process. For instance, in the case of the big epic: “Our Work In Progress (WIP), I don’t know if you have ever seen it in the board, but its limit is 2 stories (...) and it has 3 now (...) maybe we will have 4”.

There was no case when the team did not follow the standard work process in consequence of solving a problem. It was also not observed any case in which the team followed the work process even though they believed it was not the best case. More than that, there were no observed cases when the team did not follow the standard work process and it caused negative impact on the stories.

- Hypothesis:
  - **Flexibility is coherent with solving problems.** The need for improvisation appears when unexpected problems rise, that are different from the routine of the teams. Therefore, it is reasonable to work differently from the routine in order to solve these problems.
  - **Flexibility allows for quick responding to problems.** If the team would try to solve problems by following the standard work processes, it seems that the solution would take longer. As in the mentioned example, if the team would follow the rule of having only 2 stories in the WIP, they would have to wait until one of the stories that were already in the board to be finalized for, only then, starting to work on the issue. Therefore, flexibility favoured, in the cases observed, the speed of improvisation.
- Aspects to be further investigated:
  - What is the rule for not following the standard work processes?

- Who has the authority for making the decision of not following the standard work processes?
- Have you ever been through a situation when you did not follow the processes and it was negative for the project?

### **Analysis of the category “Put out the fire”**

This category includes situations in which the teams identified a problem and immediately started to develop a solution. It was possible to note that:

- **The solution is not immediate, but is accelerated.** For being an urgent situation, the team tries to develop a solution as soon as possible, but the development of the solution was not instantaneous. The solution required tentative solutions and tests: “We did not come to a solution immediately. We [the team] gathered, and started thinking of solutions, in a put out the fire mode, is to think and to apply. We already know the system, right, so we think...if we do this, we`ll get that. Then we tested in QA and uploaded”.
- **The team developed the solution together.** The developers gathered to develop the solution.
- Hypothesis
  - **This case represents an improvisation.** The team faced an unexpected issue and gathered to face it, without previous planning it.
  - **It is favourable that the team gathers to develop the solution.** The fact that the team developed the solution together seems to have been positive, influencing the speed of the elaboration of the solution.
  - **The team immediately focused on the problem.** Apparently, when facing the request of the client about the problem, the team immediately gathered and started to work on the solution. This aspect needs to be confirmed.

- Aspects to be further investigated:
  - Did the team immediately gathered to solve the problem, after facing the request of the client?
  - What characteristics does a situation need to have in order to be called urgent?
  - Who determines if the situation is one to put out the fire?
  - Have you ever been through other urgent situation? Describe them for me.
  - Do the solutions applied in a put out the fire mode work well?