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Managing time pacing in organizations transitioning to a project-based mode – 3 case studies of two multinational companies

Hala Alioua, Fanny Simon

Abstract:

This paper aims to better understand how teams create new knowledge to adapt their work processes as they move from managing on-going and well-defined operations to a project mode. We particularly focus on major events affecting projects and demonstrate that temporality influences actors' willingness and ability to generate new knowledge within the team and to diffuse that knowledge at different levels in the organization. Results show that time is mostly not considered as linear but rather in its subjective dimension. Thus, subjective perceptions of time such as temporal compression or flow enhance the generation of tacit or explicit knowledge.

In this study, we study three projects by two multinationals to show the different reactions and perceptions of timing of team members. Our research brings new insights on organizations that moved from a mode based on on-going operations to a project-led mode as well as knowledge generation.

Keywords: Knowledge creation, time, projects, exploration, temporality.

1. Introduction

Organizations increasingly adopt project-based working practices to manage organizational changes (Leybourne, 2006). Processes associated with those practices can be contrasted to routine operation as project management processes need to be flexible, goal oriented and staged in contrast to routine operation management, where the processes need to be stable and continuous (Turner and Müller, 2003). The transition from ‘routine’ activities, which are based on the exploitation of the current knowledge base, planning, and a clear definition of future goals, to an ‘innovative’ project-based mode require the development of new knowledge at the team level (Davies and Brady, 2016). More particularly, teams need to develop specific knowledge to be able to plan their activities in real time and deal with unforeseeable conditions (Chédotel and Journé, 2016). Teams involved in the transition from routine operations to project-based management need to acquire three main competencies:

- An ability to coordinate specialized skills and resources within the project-group to complete the project task within time (Cattani et al., 2011);
- The capability to synchronize communication with actors and entities external to the group.
- Competency in defining the work organization vis-à-vis the permanent surrounding organization (Packendorff, 1995).

This research focuses on the contextual factors, which enhance the development and deployment of the three types of knowledge previously described and more particularly on the impact of time on knowledge creation. Knowledge creation is a topic that has received a surge of interest since the pioneering works of Nonaka (1994). However, few works specifically focus on new knowledge development and time (Purser and Petranker, 2005), even though recent studies demonstrated that various dimensions of time bring different outcomes in terms of knowledge creation (Hautala and Jauhiainen, 2014). For example, Hautala and Jauhiainen (2014) showed that actors embedded in creative projects face different temporalities such as slow time, disruption or linear time and this leads to different processes of knowledge creation. Most researchers consider time as linear, having a past, present and future, but few studies “capture issues of temporality such as tempo, acceleration and deceleration, rhythm, or entertainment” (Bakker et al., 2016, p. 5).

Thus, the objective of this paper is to study the development of new knowledge as the perception of time changes throughout the projects. The authors carried out 3 case studies on different project teams in two multinationals, which had to transition from a 'routine' to a 'project-based' mode. Changes in time perception are triggered by external events that the team cannot control. Consequently, the authors analyses how major events affecting projects can alter actors' perceptions of time within projects and entice them to change (or not) their knowledge.

Our article brings new insights into the literature on time and knowledge creation. In fact, changes can be conceived as coming from on-going local adjustments performed by individuals (Orlikowski, 1996); however, we still lack an understanding of the temporal dynamic that is responsible for these constant variations (Purser and Petranker, 2005). We bring new perspectives by identifying the impact of different types of events on the perception of time, which would affect actors' ability and desire to change processes.

We conducted three case studies in the subsidiaries of two different multinationals. We focused on teams that were newly involved 'in innovative project-based projects'.

The aim of this article is twofold:

- To understand how temporality can impact knowledge creation.
- To determine how individuals adapt knowledge processes as a reaction to events.

The following section examines the relationships among time, changes in knowledge processes and creation and events. Then, the methods and cases are described. In the result section, we compare the impact of 9 main events on the three projects, and we draw conclusions in the final section.

2. Literature review: Temporality, events and changes in processes.

2.1. The transition toward exploratory-oriented projects and knowledge creation

Several studies address the transformation of the organizational structure to conduct their activities in project mode (Midler, 1995; Maylor et al., 2006). Projects are perceived as particularly adequate to conduct new activities, which require experimentation and new combinations of expertise (Danneels, 2002; Brady and Davies, 2004). They are characterized

by a temporary allocation of resources and personnel and a definite time frame that make it possible to perform innovative activities (Cattani et al., 2011). A shift from on-going exploitative activities to an exploratory project mode requires the development of new knowledge at the team level and in the interface between the team and the whole organization as processes to carry out tasks are different (Brady and Davies, 2004).

On-going activities are associated with a focus on planning and rewarding team members for enforcing deadlines (Lenfle and Loch, 2010). Schedule and achievement of objectives are predictable, and the focus is on the refinement of existing practices. On the contrary, exploratory project-based activity involves experimentation, the recombination of knowledge from team members having different backgrounds and a focus on long-term benefits. It is characterized by an emphasis on learning events, which paces activities with an unpredictable timing. Thus, the first type of knowledge that the project teams, which are transitioning toward more exploration-oriented projects, must develop is their ability to coordinate specialized skills and resources within the project-group to complete the project task within a given time (Cattani et al., 2011). Then, team members also need to adapt processes to balance interactions with actors external to the team such as stakeholders. An organization is formed from different small worlds or groups of actors having specialized knowledge (Dougherty, 1992). Thus, project team members need to access specific information and knowledge from others team members (Ancona and Caldwell, 1992). They also need to connect knowledge generators to knowledge users (Sundquist, 1978) to ensure the usability of the solutions proposed. Finally, proposals from the team need to be embedded into the company's strategy to get funding. Consequently, information on the management's vision needs to be acquired by the team (Burgelman and Sayles, 1988). Thus, the second type of knowledge that needs to be developed concerns the capacity to synchronize communication with external actors. Finally, working space, relationships with support functions and the influence of the project group need to be negotiated in the new organization (Packendorff, 1995). We labelled this third type of knowledge, which is required, a competency to define the work organization vis-à-vis the permanent surrounding organization.

Works on knowledge have already highlighted the central role of time on its development. Thus, a major study by Nonaka and Konno (1998) specify that for knowledge creation to occur, actors need to interact at a specific time. However, few works specifically focus on the influence of temporality on knowledge creation (Hautala and Jauhiainen, 2014). Whereas

temporality has been demonstrated to have an impact on the processes of knowledge creation (Hautala and Jauhiainen, 2014), we lack an understanding of the relationships between time and the type of knowledge generated. Actually, Polanyi (1966) differentiates between tacit knowledge, which is abstract and communicated through repeated interactions and explicit knowledge, which is codified and easily transmittable. The work of Nonaka (Nonaka, 1994; Nonaka et al., 2014) implies different temporalities for the generation of those two types of knowledge; the development of tacit knowledge relates to a long and suspended moment of time, whereas explicit knowledge would be enhanced as rhythms characterized team interactions. However, the exact mechanisms underlying the generation of the two types of knowledge are still unknown.

2.2 How does time shape processes?

Scholars who have studied knowledge creation have mostly considered time to be stable and linear (Hautala and Jauhiainen, 2014). Time is conceived as an objective form that can be measured and that is invariant. These studies mostly focus on how to establish milestones and deadlines and schedule time to enhance the efficiency of the team or the generation of new knowledge. A first stream of works describes how to accelerate development time and implement repeatable processes to improve organizational efficiency (Snell and Dean, 1996; Eisenhardt and Tabrizi, 1995). Another stream of studies explains how timing activities can affect (or not) changes in processes. For example, Lenfle and Loch (2010) demonstrate that stage-gate processes, which are often used in multinationals to monitor the development of projects, and the setting of strict objectives lead to an early withdrawal of exploratory projects and do not allow disruptive knowledge generation. Similarly, Söderlund (2002) describes cases where strict deadlines allow new methods of organizing and new practices to be deployed. Thus, objective time and tools used to measure, pace or cycle activities can lead to very different outcomes with regard to processes. Well-defined and strongly enforced mechanisms to control the development of projects can lead to rigidities and hamper knowledge creation (Lenfle and Loch, 2010). However, time pressure and general mechanisms to pace activities can lead to improvement in existing processes, coordination and more efficiency in knowledge generation. This perspective considers time as linear and having a past, present and future. However, as members of a team work together, they can have different conceptions of time, which also influences knowledge creation.

Actually, teams can react to an event and disruption in the process. The pioneering work of Gersick (1989) focuses on time pacing by teams having to find new solutions. It is based on the fact that time pacing has outcomes both in terms of interactions among individuals and the team's productivity. Gersick's study (1989) demonstrates that group members do not adapt their activities in a sequential and linear manner but go through phases of inertia and radical change. Even though a team experiences different forms of temporal patterning, the group's attention to time is the main factor that explains those transitions, which are opportunities for developing new knowledge. Environmental events also have consequences on the ability of members to pace their activities. Whereas those events may have a beneficial effect at the beginning and midpoint of the project, they may lead to resistance at other moments of time (Gersick, 1989).

A third perspective focuses on the subjective dimension of time as experienced by individuals and in their relationships with each other (Orlikowski and Yates, 2002). Individuals may perceive their project as having long-or short-term anticipated termination, and their perception of time influences processes inside the team (Bakker et al., 2013). Thus, teams that have conceived of their project as a long-term engagement utilize a more heuristic mode of processing information (*Ibid*). This heuristic mode often leads to more creative ideas and tacit knowledge generation (Amabile, 1982). The perception of time also affects actors' emotions (Larson, 2004), which can then affect the willingness of actors to change processes. For example, Cartensen and co-authors (1999) describe how actors who perceive that they are running out of time focus their attention on emotion and are more likely to implement changes. Thus, the subjective dimension of time also affects individuals' ability or willingness to change processes. Larson (2004) particularly identifies variations of temporality, which have consequences on actors' behavior and can impact knowledge generation : Flow, which is a sense of timelessness, could be conducive to tacit knowledge generation as people are committed to their task (Csikzentmihalyi, 1996); whereas compression or a shortened sense of time could have both positive and negative effects on knowledge generation; Interstitial, which in in-between time leads to interruption of action and discomfort, may impede knowledge generation, whereas temporal rupture may have a paraxial effect.

We still need deeper exploration on the influence of each perception of time on knowledge creation. Furthermore, as teams are transitioning toward a project-mode, those changes in perceived temporalities will be triggered by events.

2.3 The influence of events on time pacers and the perception of time

Events are discrete and bounded in space and time and can trigger changes (Morgeson et al., 2015). Focusing on events makes it possible to understand how change may arise in an organization within and across different hierarchical levels and over a long period of time (Ibid). Events can impact temporality in organizations in different ways. First, events can be directly related to time pacers. For example, an event can be related to the fact that a team did not meet a deadline or to the establishment of a new schedule within the team. Thus, events can shape the manner in which actors perceive time. Therefore, events can introduce temporal ruptures (Larson, 2004). In these instances, a major event restructures the daily routine, and habitual patterns cannot be performed. Individuals must find and implement new routines, but they may feel that this situation is particularly complex (Ibid). Novel events also lead people to perceive time as longer than clock time (Ibid).

Thus, the succession of events can also impact the perception of time. A fast speed of change, characterized by a succession of events in a short time frame, can be perceived as overwhelming for individuals who have the impression that time is shrinking (Smollan et al., 2010). They may then be unable to change and adapt. By contrast, Eisenhardt and Brown (1998) demonstrate that actors anchored in a continuous flow of events are more likely to be able to adapt processes.

The sense of temporality is related to personal experience, occupations and emotions (McGrath and Kelly, 1986; Larson, 2004). Recent studies have shown that the perception of timing depends on the process of commitment and the involvement of the individual, the activity and the perception of the event (Flaherty, 1993, 1999; Larson 2004). The triggers of positive and negative emotions are related to the capacity of the person to manage novelty or complex events. The individual will have positive emotions and show more interest and engagement in the activity when he has information that allows him to understand the situation. Moreover, the temporality of the task or project will be perceived as shorter and challenging because he will use his own experience and skills. Nevertheless, the unfamiliarity of the event and the lack of experience of the individual will generate negative emotions because the individual will not have the internal and external information that allows him to understand the situation and be able to adapt and perform his work. The individual will be in an ambiguous situation, and he will take more time to understand what is occurring around him, and he will perceive time as very long.

Thus, in this study, we assess how different types of events affect actors' temporality, such as project pacers, which may (or not) lead to explicit and tacit knowledge generation. We particularly rely on a framework developed by Morgeson et al. (2015), who propose that the impacts of events vary according to the following three dimensions related to the events:

- The event strength, which relates to the fact that the event can lead to organizational changes;
- The event space, which reflects the origin of the event and its dispersion in the organization; and
- The event time, which reflects the fact that events can be transitory or long-lasting.

Figure 1 summarizes the relationships between events, the pace of events, objective and subjective time and knowledge creation.

PLEASE INSERT FIGURE 1 HERE

Figure 1: Relationships among events, time and knowledge creation

In this research, we focus on teams that face new temporality as they move from on-going operations to project mode. We attempt to gain a better understanding of how team members create new knowledge in that specific situation. The following section describes the particular context of our case studies and the methods.

3. Methods:

The authors signed two research contracts with two multinationals. The first is a semiconductor company that we call Alpha; the second, called Delta, is a supplier of automotive and industrial technologies. Alpha had subsidiaries in 25 countries and 28 000 employees. Regarding Alpha, we focused our study on a French R&D center. In 2006, as new markets, such as healthcare and lighting applications, emerged in the semi-conductor industry, the parent company enticed each subsidiary to develop exploratory projects. Thus, those projects had to fit with the company's strategy. A financial allocation was attributed to the French R&D center and led to the establishment of an "emerging market" business unit for exploratory projects. The project that we analyze is related to R&D centers located in both France and the Netherlands.

Delta is a leading technology and services company in automotive and industrial technologies as well as consumer goods. In 2014, it had more than 290 000 employees and a turnover of

48, 9 billion euros. The headquarters is in Germany, and the group has subsidiaries in 60 countries. We focus on a French subsidiary of the group because this entity needed to become more competitive, and the following two main events shaped its relationships with the parent company:

- The establishment of a “lead plant” activity in 2011. The site’s role was to define and stabilize processes of production for new products and then transfer them to countries with lower manufacturing costs.
- The deployment of a "bottom-up" approach in 2014: A project team of the subsidiary needed to find new products for customers to ensure the site’s sustainability and workload. These new products may or may not fit in the core activities of the company and must not be in direct competition with the product of the group. A "new business" project team, whose main objective was to seek new medium- and long-term projects in France, was established.

Both companies have subsidiaries worldwide and have recently changed their processes to allow their local units to explore new activities and propose new products for emerging markets.

The authors conducted an ethnographic study and spent extensive time with the teams involved in exploratory activities. Each author spent more than 3.5 years in one of the companies. Consequently, they were able to assess changes in practices at the team level. They have also conducted 57 interviews with the management team and with engineers. Three projects have been studied in the two multinationals because they particularly highlight an evolution towards exploratory-oriented activities.

Case A: This case concerns the development of new LED-based lighting solutions. Three different versions of new products were developed for camera flashes. The project involved members from different subsidiaries.

Case B: This case addresses the development of batteries for electric bicycles. It was the first time that the team worked on products that were not aimed at the automotive market. The team had to deploy new production methods to develop these new types of products.

Case C: This product is based on LiFi technology, which makes it possible to diffuse information using light from light-emitting diodes (LED). This project was generated at the subsidiary level through contacts with local partners.

We compare cases to draw new theoretical insights (Eisenhardt, 1989; Miles and Huberman, 1994). We could compare cases as they all emerge in the same geographical zone and were impacted by strategic change, so there is no variation in terms of cultural differences among cases or in terms of economic events. Then, cases B. and C. occurred in the same company, at about the same period of time. Case C. and A. both deal with similar knowledge based on LED. The three projects are innovative projects requiring the mobilization of new processes and knowledge. Furthermore, we chose three projects that were considered by headquarters to be successes (rewards, new releases). Furthermore, several events that occurred in headquarters, in the relationships between headquarters and the subsidiary or in the broader environment impacted the three cases.

Because these cases are in two different companies that have different types of activities, it is possible for us to replicate the results of our research.

We interviewed 22 engineers and managers involved in project A. These engineers worked in France, the Netherlands and the USA. We also interviewed 7 top managers of the French R&D center. The interviews lasted one hour on average. We participated in 11 meetings concerning the deployment of innovations and monthly meetings where project progress was presented.

In Delta, we conducted 28 interviews, which lasted one hour and thirty minutes on average. We obtained information from both French and German managers who all worked in the French subsidiary. Over the course of three years, the second author participated in bi-monthly meetings that addressed the company's activity and roadmaps. Twice a year, the author participated in a workshop on the deployment of the new strategy, during which managers expressed their problems concerning new initiative deployment. Figure 2 represents a timeline of observations and interviews.

PLEASE INSERT FIGURE 2 HERE

Figure 2: Timeline of observation and interviews

For each case, we write case narratives and draw a diagram that represents the different events that impacted project development. Then, we identify 9 main categories of events that occurred in all three projects. To identify those categories, we identify on our diagram similar events that impacted the 3 projects, and we grouped these events and coded them into a broader category, which reflected the meaning of these events. As highlighted by the events

described above, our results highlight events that are traditionally described in studies of project management, such as establishing a team/work place or designing the first prototype and tests as well as becoming aware of planning (Gersick, 1989), but we also identify events that can be attributed to a more turbulent environment, for example, involvement in other projects or a change in requirements at the request of a customer in addition to external events. Consequently, the impact of those categories of events has been studied less frequently.

These categories are as follows: the first triggering event, establishing a team/work place, becoming involved in other complementary projects, designing the first prototype and tests, launching the product, having resources allocated (or not), becoming aware of delays in planning, customers adapting their requirements, and other external events.

For each category, we use event system theory to more precisely describe what makes an event impactful and how events affect temporality (Morgeson et al., 2015). Thus, we follow the recommendations of Mohammed et al. (2009) and try to understand how actors adjust their temporalities to events, which are external to the team. Actually, as actors are transitioning to a project-based mode, they are particularly receptive to external pacers, and those pacers can affect time perception (actors can have the impression that time is shrinking or they can become more engaged in their work because of external events). However, in multinationals, those pacers can occur at different levels (at the subsidiary or headquarter level or in the external environment) and with different strengths. Consequently, our goal is to identify specific pacers, which lead to changes in temporalities as those changes could result in knowledge creation. For that, we combined time characterizations defined in Larson's (2004) as well as Hautala and Jauhiainen's (2014) works. Thus, some concepts are mentioned in both articles such as temporal rupture (labeled as temporal disruption in Hautala and Jauhiainen's (2014) works) and flow. In our study, we coded verbatim, which relates to flow and temporal rupture. Others approaches of temporalities such as slow time (Hautala and Jauhiainen, 2014) and interstitial (Larson, 2004) are very similar and relate to the fact that actors perceive that time passes slowly. We kept Larson's definition of interstitial time to code that perception. Finally, we added Hautala and Jauhiainen's (2014) notion of linear time, which relates to objective time and Larson's (2004) definition of temporal compression, which is a shortened sense of time. To synthesize, we include the different temporalities as defined in Hautala and Jauhiainen's (2014) work and we took into account an additional perception of relational time (temporal compression) from Larson's (2004) article. We

excluded two sequences proposed by Larson (2004) which are protracted duration and synchronicity. Indeed, protracted duration relates to extreme events such as violence or threats. Even though actors in our studies experienced major changes in their practices, they did not go through such life-threatening happenings. On the contrary, synchronicity relates to unproblematic and comfortable situations. As the actors we are interviewing are leading major changes in the company, they felt uneasy with their situation and did not experience synchronicity. As proposed by Hautala and Jauhiainen (2014), certain temporalities such as linear time and flow or temporal compression are not always separable. Thus, for some verbatim, we coded them with two modes of temporalities. However, others modes are mutually exclusive such as flow and temporal compression or interstitial. Table 1 summarizes the different temporalities and their definitions.

PLEASE INSERT TABLE 1 HERE

Table 1: Characterizing events and time (Morgeson et al., 2015 and Larson, 2004).

As proposed by Morgeson et al. (2015), for each of the 9 categories of events, we assess their novelty, disruption and criticality as well as the event space (where the event occurs) and duration as defined in table 1.

Then, we compare the consequences of each category of events on tacit and explicit knowledge adaptation and more particularly on internal coordination within the team, synchronization with clients, support functions or other teams and work organizations. As highlighted by Krogh et al. (2000) tacit knowledge creation is difficult to observe. However, as the authors carry out longitudinal studies and observations, they were able to assess changes in actors' insights about customer needs, technological knowledge, and skills to perform a task.

We draw conclusions in terms of how different events change the team's temporality and knowledge creation.

In the next section, we describe the three cases and highlight the main events that occurred. We also propose a diagram that represents the sequence of events during project development and the level at which they were generated.

4. Case descriptions

Case A:

In 2006, the management of the French R&D center detected a major change in lighting. To drastically reduce power consumption, systems based on Light-Emitting Diodes (LEDs) are going to replace traditional lighting components. These LEDs are driven by semi-conductors. Consequently, a small team was formed to identify applications that could be designed to use LEDs. That team worked in an “emerging business unit”. A client, one of the leading phone manufacturers, contacted a sales person in the Netherlands, requesting LEDs to be introduced in mobile phones for use as a flash. Indeed, at that time, flashes for mobile phones were not well-functioning. Headquarters did not have the required human resources to design the component. Consequently, a marketing manager in the French R&D center proposed establishing a team in France. The product was completely new for the site. However, the team had expertise in power management. The chip had to be developed with team members from France and the Netherlands and in relation to the client’s team. Three different versions of the product were developed. The first version was designed without any customer feedback and was not launched on the market. The second and third products corresponded to different versions of the products, which became more sophisticated as new functionalities were added. As different projects unfolded simultaneously, new members were affected. They were mainly young graduates or employees who had previously worked in Alpha’s other sites. The second version of the product was a design win for the customer, and Alpha became the first supplier of this solution. A reward of excellence was bestowed upon the team because the product explored new activity segments. The development and sales of the third version of the product were then transferred to a team located in the USA because that team was used to working with the phone manufacturer. Figure 3 summarizes the main events affecting case A:

PLEASE INSERT FIGURE 3 HERE

Figure 3: Main events affecting case A.

Case B: In 2011, the parent company asked the subsidiary to deploy a project in e-mobility. This project was an exploratory project because for the first time the product was aimed at the

consumer market. It addressed the development of a lithium battery for electric bicycles. The design of the new battery was defined in Germany, and the French site was in charge of implementing a pilot line. New processes to manufacture the battery had to be outlined to produce the batteries. Fourteen persons in the site were trained and allocated to the project. Consequently, this project involved adapting rules and norms to answer the clients' needs while simultaneously ensuring an efficient manufacturing process. Furthermore, new security measures were implemented. The team also had to work on another version of the product that was more sophisticated. As the team conducted the first tests before beginning the production process, software bugs were detected. Consequently, experts from Germany had to come to the French site. Then, the manufacturing of the first version of the product was delayed because the team did not receive parts from headquarters at the planned date. Headquarters decided to assign new people to the project to meet the final deadlines. This project was ultimately transferred to other subsidiaries to reduce costs, but it was considered a success, with a local press release highlighting the hard work of the team being published. That press release made it possible to put an end to rumors from competitors concerning the delays in production. Figure 4 summarizes the main events affecting case B.

PLEASE INSERT FIGURE 4 HERE

Figure 4: Main events affecting case B.

Case C: This product is based on LiFi technology, which uses light from light-emitting diodes (LEDs) as a medium to deliver high-speed communication in a manner similar to Wi-Fi. This project emerged because the headquarters of the company did not propose a new project to the subsidiary and required the management team to explore new activities to ensure the survival of the site. Delta participated in an exhibition that was organized by a competitive cluster. The subsidiary's manager aimed at presenting his company as a potential partner to develop electronics and mechatronics systems for small and medium-sized companies. An area manager met with representatives of a start-up company that were working on LED and agreed to a collaboration. It was the first project to come from the subsidiary's initiative. A team was established to work on the project. It had to completely rethink its processes because the client required shorter delays to define the product than what the team was used to. As the team managed to propose a first product prototyping to the client, the client changed its requirements. The team had to adapt the manufacturing and purchase order but still managed to sign a contract with the client within short deadlines. As

the team began to produce the first version of the product, it faced significant challenges because the current processes of the company did not allow the client's requirements to be met. Negotiations with headquarters led to small improvements, and the product was delivered. Figure 5 summarizes the main events affecting case C.

PLEASE INSERT FIGURE 5 HERE

Figure 5: Main events affecting case C.

5. Results:

Our results are based on a comparison among the case studies. We first highlight the similarities and then explain the differences among the cases based on the nine main categories of events defined above.

5.1. Events and their influence on temporalities

Even though the events that we identified generally have a high level of strength, there are differences in terms of direction of events (bottom-up or top-down approach), the duration of events (long or short duration) and the event proximity. Table 2 summarizes the characteristics of the nine events.

PLEASE INSERT TABLE 2 HERE

Table 2: Characterization of events for the three cases

We then identify whether those events change temporalities for each case. We find out that 4 different temporalities follow the occurrence of the other for the three cases and that the same bundles of events are associated with changes in temporalities. The first triggering event dramatically transforms time perception for the three cases, although differently. Indeed, in case A and B, a temporal rupture is perceived and flow characterizes temporalities. The following verbatim illustrates time perception in team A:

“It was really strange as the management was setting deadlines and we knew that we could not make it. There was always a time lag; a date was given and the team was figuring out what can be done. However, we were delivering outputs that were not working without any calling into question from the management.” (Case A)

This can be contrasted to case C. for which the team was experiencing temporal compression. The differences among the three cases can be explained by the fact that the triggering event emerges from a bottom-up approach in case C. versus a top-down approach in case A. and B. Consequently, in case C., team members were liable for the success of the project and synchronized their temporality with the clients' as demonstrated by the following verbatim:

“We cannot respond to the needs of customers with the current processes and rules of the group. The customer asks to have an answer in a week. However, to have the approval of the group if we follow the nomenclatures and the procedures, it is necessary that we wait months.” (Case C)

On the contrary, in case A and B, as the project came from headquarters, the team pretended to follow the scheduling process, which was set by headquarters even though members knew that they would not meet deadlines. This leads to a mismatch between the headquarters' and the subsidiary's representations of time and thus a temporal disruption. Team members were also excited to be involved in an innovative project and were engaged in their activity, which explains temporal flow.

The second bundle of events, which influences temporality, concerns the setting up of the team and subsequent resource allocations. The two events are characterized by a high level of strength, a long duration and an increase in their impact. Consequently, they dramatically changed temporality within the three cases. In all projects, members from different backgrounds were assigned to the team. Consequently, new routines were introduced, and this led to miscommunication among team members. Consequently, the team had the impression of making little progress and not keeping track of time; this corresponds to interstitial temporalities, which is characterized by the fact that the pace of time is perceived as slow. The following verbatim illustrates this feeling, which predominates for the three cases:

“There was not many backward movement, not many advances.” (Case A).

The event, which corresponds to the design of the prototype and first tests, did not have an impact on temporality. Indeed, this event is either not novel or critical, and its impact either decreases with time or has a short duration. Interstitial temporality was still predominant with different perceptions of time from the members of the team.

The third bundle of events corresponds to the fact that the client adapts its requirement, the team became involved in other complementary projects and there were delays in planning. Whereas adaptation has a high level of strength, the involvement in other projects as well as delays have a relatively low level of disruption or criticality. However, their effects are cumulative, and they turned temporality into linear time and temporal compression. For example, for case A, a new project leader was appointed, and although during the first phase of the project the team did not actually have to meet deadlines, during this new phase, schedules and milestones were perceived as key criteria of success. Time was experienced as passing quickly, and individuals focused more on automatic processing (Larson, 2004). The following verbatim illustrates the fact that the team was focusing on deadlines and always had the impression to rush:

“The timing of the project was very short, the team did not finish the validation when the product left in series. In addition, we had to start the second type of battery for the e-bike. This second battery had to be developed in record time and was thus an additional burden on the team. There was a large degree of innovation in this product; thus, we were too ambitious at the beginning of the project, but when we look in the rear-view mirror, we met the deadlines despite all of the difficulties that we had.” (Case B)

The main difference among projects corresponds to the fact that at the end of the period, the team involved in case C was experiencing flow, as people were deeply involved.

The last bundle of events corresponds to the product launch and other external events. They correspond to a high level of strength, an increase in their impact and mostly a top-down approach. They introduce a temporal disruption.

We represent in figure 6 changes in temporalities as well as differences in modes of knowledge creation on a timeline.

PLEASE INSERT FIGURE 6 HERE

Figure 6: Results.

Thus, the 6 modes of knowledge creation were identified although at different periods of time for the three cases. Table 3 gives examples of those different modes.

PLEASE INSERT TABLE 3 HERE

Table 3: Different modes of knowledge creation for the three cases.

The next part of the paper aims at explaining the process of knowledge creation in the three cases in relation to the different temporalities as well as the output in terms of knowledge created.

5.2. Temporality and its influence on knowledge creation

-The first temporalities that we identified correspond to flow and temporal rupture for case A and B and temporal compression for case C as highlighted in figure 6. This led to very different outcomes in terms of knowledge creation outputs and modes. For the three cases, a specific working place was set up with open spaces; thus, we consider that there is some explicit knowledge created in the work organization. However, this knowledge was limited for cases A and B as planning, as well as relationships with support function, was based on existing processes. Thus, the two teams applied unappropriated processes, which were aimed at on-going activities, to highly innovative projects. They relied mostly on headquarters to formalize new processes and solve problems as highlighted in the following verbatim. Thus, there is little appropriation of the new knowledge in work organization that is generated:

“We exchange permanently with [the headquarters]. There are a lot of things for which we need to ask support to develop the product. We have limited capabilities to understand default patterns, which are occurring. Consequently, when an analysis is needed to be carried out or we do not know what is wrong, we exchange with [the headquarters]” (Case B.)

Tacit knowledge is generated in synchronizing with the headquarters or other sites for case A and B, as demonstrated by the verbatim. However, that knowledge concerns only a few individuals working at the interface between the team and other groups, and no diffusion and conversion in explicit knowledge takes place. This leads to dysfunctions as parts were not delivered in case B and inappropriate testing methods were used in case A. Those dysfunctions are caused by the lack of changes in specifications.

Similarly, tacit knowledge in coordination within the team is generated but is not converted into explicit knowledge. That knowledge emerges from the combination of experiences of individuals with different backgrounds as illustrated by the following verbatim:

“The other members of the team are used to work in a graphical environment and they are not accustomed to use scripts and files, whereas I am working with scripts. Consequently, we are interested in communicating and this makes things evolve. (...) I observe how they do things and I show them how to do it better” (case A)

The lack of diffusion of explicit knowledge within the team and with the client led to misunderstanding as described below:

“The client expressed its needs to the person in charge of application who explains to us what the client had said. We understood what we wanted to and at the end, the client asked for cabbage and we did carrots.” (Case A)

This could be explained by the fact that the perception of time as flow led the team to being caught in their everyday task and to disregard future consequences of current development. Consequently, team members minimize the importance of explicit knowledge creation. This leads us to state the first proposal (P1), for which appendix 1 provides additional supporting justifications:

P1: Flow constraints the generation of explicit knowledge in terms of coordination

By contrast, for team C, time perception relates to temporal compression. Consequently, the team mainly focused on adapting its way of addressing clients and internal processes to design a new product in a period of time that is perceived as short. To adapt processes, teams use a bricolage approach (Halme et al., 2012):

“To go ahead with the project, we needed to improvise and propose several costs to gain customers. We did not know how to do it.” (Case C)

Explicit knowledge is generated in terms of internal coordination as highlighted below:

“Currently, we are trying to write the process to define the list of our suppliers.” (Case C)

However, the headquarters’ management team did not understand these necessary changes, which led to frustration among team members and a lack of explicit knowledge in terms of synchronization:

“We cannot be competitive and reactive in the market since we are using the old processes, which are inappropriate for our project.” (An engineer, case C)

This leads us to state the second proposal (P2), for which appendix 1 provides additional supporting justifications:

P2: Temporal compression leads the team to reconsider existing practices and to generate explicit knowledge in terms of internal coordination

-Regarding the second period, temporality was experienced as interstitial. Actually, actors were not always aware of the differences in practices and only realized them when the first prototype was designed and showed problems due to miscommunication among team members. The following quotation shows that members did not have the required knowledge but they are becoming aware that they need to develop explicit knowledge:

“Indeed, the members of the team were confronted with new situations that were totally unknown to them and that they did not know how to answer with the structure that they had at that time. They did not have adequate knowledge, they were obliged to make more development to be able to increase structures. Furthermore, we had no structure dedicated to the new activity.” (An engineer, case B)

Furthermore, other collaborators joined the team. They brought new expertise and knowledge from other fields as well as new methods of planning. This corresponds to an awareness of the project complexity and the necessity of adopting new approaches. This event represents a major change in the unfolding of projects because the teams also focused more on organizing knowledge sharing, defining responsibilities and building team cohesion. Thus, new tacit knowledge is created in coordination, as highlighted by the following verbatim:

“We had a new team with people with diverse and varied experiments and the necessity also to establish a working method, to make it acceptable.” (Case A)

Other new processes have been generated such as a “team building” day outside the company or workshops on specific topics. This leads us to state the third proposal (P3), for which appendix 1 provides additional supporting justifications:

P3: Interstitial time enhances tacit knowledge generation in internal coordination

During the third period, although temporality is experienced as linear time and temporal compression for the three cases, as described in figure 6, knowledge creation is different in teams A and B compared to case C. The three teams generate explicit knowledge in work organization and transform their planning methods as well as communication processes with support functions. However, in cases A and B, knowledge was generated through periods of inertia and disruption (Gersick, 1989), whereas on-going progress characterized case C. Concerning cases A and B, the involvement in other projects did not lead to any change in the practices of teams A and B. Consequently, the teams were overburdened. For example, in case A, the team continued producing prototypes using existing planning processes. However, the prototypes were not completed, and products could not be launched. The following

quotations illustrate the fact that the team only changes its processes and generates explicit work organization processes as previous developments failed:

“The first version that we launched did not worked at all. Consequently, we fixed it and then we decided to have more formal working method, particularly concerning testing and checking.” (Case A)

“We have a more clear definition of what the responsibility of everyone is. The organization was structured as we go through that is also why I was appointed to be the manager of the test part. And especially we define the way we could cooperate between the two sites, Caen versus Eindhoven. That was something that in the beginning we did not know each other, the communication was different so we spend a lot of times on that.” (Case A)

Furthermore, the delays triggered external events such as rumors from competitors or the client’s dissatisfaction, which introduce a disruption in the two projects. Consequently, in case A, several complementary projects were halted, and team members were asked to establish their own planning. This leads to explicit (for case B) as well as tacit knowledge creation in synchronization. First, in case B, explicit knowledge is generated on testing and validation methods with the client. The first verbatim shows that the team was first not successful:

“At the beginning, there were problems at the level of the parts of the e-bike. The tests that were performed did not fit the requirements; thus the team had to revise the concept. In addition, the validation of certain stages, which was performed under certain criteria, was not adequate.” (Case B)

With the help of the headquarters, the team finally manages to adapt its process to exchange with the client as described by the following verbatim:

“It implies the institution, the organization and the adaptation of many directives and regulations to make it possible to satisfy the customers while ensuring good progress between development and manufacturing.” (Case B)

The same situation characterized case A. Tacit knowledge is developed to liaise with the client as described by the verbatim:

“We send the report to [the client], and [the client] says, oh, it looks nice, but I want to have this change, so we had to make another redesign and another redesign, and at the beginning, we planned 2, maybe 3, I do not know, and to finish, we needed 6 or 7 redesigns before it was ok. (...)It means that every customer had his specificity. There are a number of things that clients do not tell us; on the other hand, if we ask them rather precise questions, they are going to answer our questions. [...] It is necessary to know how to ask good questions and try again regularly. Thus, that is the practice that we had begun to set.” (Case A)

By contrast, in case C, the team understood from the beginning that it had to work iteratively with the client. The following quotation shows that the client was aware of the challenges:

“With regard to the requirements of the customers, we were completely late, but the customer himself realized that what asked for was completely impossible because the product was accomplished not at all crossing in the industrialization phase.” (Case C)

The team began to perceive the project as a challenge and was embedded in a flow of rich experience. It focused less on objective time, which demonstrates that the team managed to develop new processes that led to the emergence of new activities in the subsidiary as highlighted by the following verbatim:

“I am trying to acquire new knowledge by making a study market and benchmark in order to exploit this knowledge in this new project.” (Case C)

In case C, from the beginning, the team attempted to move from a traditional approach of planning based on assessing the work amount for each task to an approach focused on customer orientation. The team assessed the client’s needs, defined the components of the product with the client and validated the progress and phases of development. However, because the team was experimenting with changes to its practices, it accepted the fact that it could not fully meet the customers’ requirement and that delays were part of the unfolding of the project, as demonstrated in the following quotation:

“It is very difficult to hold a 16-week delay to deliver to our customers. We are late even more often now that we move forward. Regarding the customers, at the moment, we do not completely tell them the truth.” (Case C)

These delays allowed the subsidiary’s manager to negotiate with headquarters for changes in purchasing and referencing processes. Consequently, all contributors of the project were then able to work with a common time frame characterized by a phase in which uncertainty concerning the project was reduced and another phase in which the team attempted to accelerate the process, which is characteristic of a focus-down convergence logic (Midler, 1995). At the end, the team was successful in generating both tacit and explicit knowledge in work organization and synchronization. This leads us to state the fourth proposal (P4), for which appendix 1 provides additional supporting justifications:

P4: Linear time associated with temporal compression facilitate the creation of explicit knowledge in work organization and tacit knowledge in synchronization.

Concerning the last temporality, the beginning of the period is embodied by external events, which consist of different types of events such as rumors or moves by competitors (case B) or the impact of the economic crisis on the semiconductor or automotive industry (case A and C). These events were disruptive for the project, and they always led to further involvement by headquarters, as demonstrated by the following quotation:

“An e-bike competitor spread a rumor on social networks. It announced that the partners of the group (bike) were going to lose a season because of the delay in production of the site. The management in Germany decided to allocate more resources to the site to guarantee the delivery of the product to the market in time.” (Case B)

These events triggered temporal disruption because individuals with different temporalities were assigned to the project or the pace of development in the entire industry accelerated or slowed down. Disruption enhances the generation of momentum to change practices and generates new knowledge, both within the team and the external environment. This leads us to state the last proposal (P5), for which appendix 1 provides additional supporting justifications:

P5: Time disruption enhances the absorption of external knowledge.

6. Summary and Discussion:

Our study brings new insights to the literature on knowledge creation in project-based organizations. Actually, most studies deal with understanding knowledge sharing among projects in project-based organizations (Koskinen et al., 2003; Maurer, 2010; Sydow et al., 2004). Thus, we still lack an understanding of the processes that lead to the generation of knowledge and its transformation for diffusion within the organization (Prencipe and Tell, 2001). In this research, we focus on a project at a particular moment in two companies and their transition toward project-based organizing. This specific situation requires a project team to generate new knowledge, both to coordinate members of the team, organize work at the interface with support functions and synchronize activities with clients and others teams. We demonstrated that knowledge is generated in reaction to changes in temporalities and that different temporalities lead to two main processes in terms of changes; one characterized by inertia and changes and the other one by continuous progress. Differences can also be highlighted in the type of explicit or tacit knowledge generated. Thus, we complement Hautala and Jauhiainen’s (2014) work, which demonstrates that temporalities lead to different processes in terms of knowledge creation. Indeed, those authors carried out their research on academics. Teams, working in private organizations face different challenges as academics, as they have to promote knowledge generation and diffusion to several stakeholders (Huang and

Newell, 2003). The process of knowledge creation and diffusion can then be impacted by several events, some of them prompted by the stakeholders, that the team cannot control. Our results show that those events transform temporality or the perception of time by the team. Patterns can then be identified such as the fact that interstitial temporality results in the team focusing on internal mechanisms to share knowledge and thus to a focus on internal coordination. Flow, which is characterized by a timeliness feeling, enhances tacit knowledge generation, whereas linear time and temporal compression boost explicit knowledge generation to fasten development. Temporal disruption also leads the team to reassess its routines and processes and try to find a solution. Consequently, our research shows that emotion, time and change (Smollan, 2010) should be considered to understand knowledge generation. Furthermore, enabling both tacit and explicit knowledge generation requires changes in temporalities during the project. Actually, flow facilitates tacit knowledge generation but may inhibit its transformation into explicit knowledge. Temporal compression particularly enhances the generation of knowledge in synchronization whereas interstitial temporality leads to a focus on internal coordination. Consequently, enabling knowledge production and diffusion both within the team and with its external environment requires periods of time flexibility and challenging situations as well as moments of well-defined and strongly reinforced deadlines.

Then, the work of Larson (2004) was developed to understand individual behavior in reaction to temporalities in their occupation. We apply temporal categories proposed by Larson (2004) to the context of project-based organization and demonstrate that those types of temporalities can also explain processes at the group level. Thus, whereas most researchers studying project management consider time as linear, we demonstrate that temporality is mostly experienced as subjective. In certain periods, individuals, working on the same project, can have different perceptions of time, which constrains knowledge generation. Thus, as highlighted by Krogh et al. (2000), individuals react differently as they go through novelty. Some people are excited by novelty and experience flow whereas others just feel unsecured and unconfident. Thus, within the same group, some actors, who are immersed in flow, generate tacit knowledge whereas others are trying to reuse unappropriated and existing data. Consequently, we shed new light on Nonaka and Konno's (1998) claim that individuals need to interact at a specific time to create knowledge. Time here should not be only assumed as a particular moment of linear time but also as a convergence of temporality with individuals sharing the same

perception of time. In multinationals which implement project-based organization model, temporality can be either driven by external stakeholders such as the client or by internal processes. In this context creating conducive environment would reduce feeling of insecurity as new events occur and transform temporality so that team members working on the same project experience the same reality and are able to improve their knowledge base at a similar pace. This would then facilitate the creation and dissemination of explicit knowledge.

Then, we relate the characteristics of events occurring during project development to temporalities and knowledge creation. As events that occur are perceived as slightly novel, involving a top down approach and a high special distance (such as in cases A and B), the team may disregard external pacers. Consequently, knowledge generation is characterized as a period of inertia and change as described by Gersick (1989)'s work. Changes mostly occur as the team realized that they cannot comply with the deadlines. On the contrary, teams that face disruptive, novel events with spatial proximity and a bottom-up approach are aware that they need to change their processes. Those teams progress iteratively and experiment to create new knowledge. Finally, as described by Brady and Davies (2004), members developed new practices at the project level and diffused them in the subsidiary and then at the organizational level. Pettigrew (1990) has already called for further studies that would give a better sense of the underlying logics that give events meaning and significance. We demonstrate that emotions as well as the speed of change and the specific location where the event originated have a significant impact on the consequences of the events for the innovative process. Thus, we complement Gersick (1989)'s work in explaining transition among different cycles of activities in a team. In a counterintuitive manner, events that occur in the broader environment have significance for both the team and headquarters, leading to changes. Events that emerged at the team level may trigger changes when they are perceived as novel and critical, but individuals have difficulty making sense of these events at all of the hierarchical levels in the subsidiary and in the relationships with headquarters.

7. Conclusion:

This paper has highlighted the impact of temporality actors' willingness and capacities to create new knowledge and to spread it within the team at different levels in the organization.

It has also attempted to highlight how team members react and interact and perceive time (Packendorff, 1995; Orlikowski and Yates, 2002) while moving from a mode based on on-going operations to a project-led mode (Packendorff and Lindgren, 2014).

The conclusion is that the perception of temporality and the speed of change can limit the creation and the spread of knowledge. There also needs to be an improved distinction between the several events that impact the perception of temporality of the project and project management interests (shareholders). Therefore, the process of knowledge creation and diffusion depends on one hand on the individual's behavior in reaction to perceptions of change and time and, on the other hand, the internal mechanism to share knowledge and to focus on internal coordination.

This article has certain limits; it focuses on three main projects of two different subsidiaries; two of them are in the same subsidiary, while the other project was in another subsidiary. Consequently, it does not enable us to have a satisfactory element related to inter-organizational creation of knowledge and also neglects the practical aspects of project management that are the source of creation and knowledge sharing, such as the power games of actors that can exist in corporate headquarters as well as in subsidiaries.

We can draw managerial implications from our study. In order to ensure the change of a project mode for a project team and to be successful, the organization must, first, put in place an appropriate management mode by taking into consideration the pace and the manner of transition for the different events and temporality of a wider project and the specification of the knowledge process.

Second, the organization must allow team members to contribute actively in the creation and diffusion of knowledge by creating an internal coordination team that will be a hub of knowledge and best practices. This would be properly accompanied by the different team members in the project from technical evaluation, not just in the implementation processes but also in the evaluation of temporality differences, especially for external events that are ruptures between the client and the team, in order to examine if there can be convergence and coordination processes within the team to develop. In order to adapt to this situation, the team members can set their own schedule in a bottom-up manner; and when additional resources are allocated, it is necessary to ensure that the timing is the same for all members of the team. Therefore, the team members can set a regular rhythm of meeting and process that will be driven by the top management. This should allow for the expression of explicit knowledge,

and if not, it will impose deadlines for the team that will facilitate their assimilation and adaptation. For example, in periods of prototyping and testing that are iterative, it is possible to work on iterative short cycles centered on learning and training (one-week cycle with bug-solving objectives and emphasizing that these resolutions are the object of creation of knowledge and then disseminating them in the organization). It is very important to help the team to anticipate these different events that represent an important change for them. Thus, the organization should put in place a change management working place that strengthens the link between the team members by following up their actions regarding the different events through (retro planning, training, workshops) that allow them to have less break in temporality.

Finally, this study contributes to the field of project management in terms of research and practice by identifying the transition toward exploratory-oriented projects and relating this approach to knowledge creation and temporality in an international context.

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Appendix 1: Propositions and justifications

Propositions	Justifications
<p>P1: Flow constraints the generation of explicit knowledge in terms of coordination</p>	<p>Flow occurs as individuals go through a dense and challenging experience. Consequently, all efforts and attention are devoted to carry out the task at hand. Actors may then generate tacit knowledge and ignore their collaborators. Thus, they are so deeply engaged in their tasks that they are not conscious of the need to formalize their new knowledge. Cases A and C illustrate the lack of formalization as individuals develop their own expertise but nobody tries to coordinate works and exchange the new knowledge generated. Consequently, inadequate testing methods were used for a new technology: “There were specialists and none was able to have an umbrella view of the whole project. (...) Consequently, we use the wrong assembly technology for the new process.”(Case A) “I have the impression to be alone, others work alone and never ask me what I am doing. They forget that we are a team.” (Case C)</p>
<p>P2: Temporal compression leads the team to reconsider existing practices and to generate explicit knowledge in terms of internal coordination</p>	<p>Temporal compression leads the team in case A to feel a sense of urgency and to embrace changes. The team changes both its way of dealing with the client and testing methods. An external manager with a different leadership style was also appointed to bring in new coordination methods. New working processes were also defined to meet top management’s and client’s deadlines. Similarly, design and test methods were reconfigured in (Cases B and C). “There were rumors circulating in the market saying that we will not be able to produce the e-bike on time. To respond to those rumors, some engineers from the research and development in Germany came in to help us solving the problem of the battery by changing our methods and process. The headquarters imposed us a deadline and we were obliged to change the pace of work in order to face the rumors and to produce in very short time” (Case A)</p>
<p>P3: Interstitial time enhances tacit knowledge generation in internal coordination</p>	<p>In case A and C, the team experiences interstitial time as the first version of the product was being tested by the client and the team was waiting for the management’s approval to carry on others projects. During that period, the middle manager transforms decision making processes from a top-down to a bottom-up approach. “When we produced the Lifi, we found many problems to work with the process and method of the group. Consequently, we asked the headquarters if we can develop our methods and process in order to be competitive and to satisfy the clients. When we did not receive answer from them we tried to bend the rules in order to win other projects.” (Case C)</p>
<p>P4: Linear time associated with temporal compression facilitate the creation of explicit knowledge</p>	<p>Actors need to react quickly and are aware of deadlines. Consequently, they develop new ways to work with others departments and external partners to improve their efficiency. Thus, they generate tacit knowledge in synchronization. For example, in case C, they learn how to use a 3D printer to be able to produce</p>

<p>in work organization and tacit knowledge in synchronization</p>	<p>prototype within a short time: “ We bought the first 3D printer and we learn how to use it from the internet in order to produce parts for the production department, to reduce cost in very short time” (Case C) “When we produced parts for the production by using the 3D printer, we have decided to develop this idea also for others close clients. Many clients from other sectors where interested by our approach. They decided to produce their parts and prototypes in our 3D printer. This strategy was supported by the top management which invested to buy other 3D printers”. (Case C)</p>
<p>P5: Time disruption enhances the absorption of external knowledge</p>	<p>Time disruption leads team A and C to contact an external partner to understand how the client will test the product and to transform its information exchange processes. “The development of the prototype of the Lifi was in Braga, Portugal because we do not have experience in electronic manufacturing services product and we cannot make the development here” (Case C) The knowledge generated was then reintegrated into the team.</p>

TABLES AND FIGURES

Table 1: Characterizing events and time (Morgeson et al., 2015 and Larson, 2004).

Event characteristics	Indicators
Strength	
Event novelty	The extent to which an event is different from current behaviors.
Event disruption	Reflects a discontinuity in the environment.
Event criticality	Reflects the degree “to which an event is important, essential or a priority” (Morgeson and DeRue, 2006: 273).
Space	
Event direction	How does the event travel within or across organizational units?
Event origin	The level at which the event occurs.
Event dispersion	The dispersion of the effects of the event throughout the organizational hierarchy.
Event proximity	The distance between team members affected by the event.
Time	
Event duration	How long does the event last?
Event timing	At what stage of development of the project does the event occur?
Event change	Does the event become more or less disruptive?
Temporality	Indicators
Linear	Actors refer to past, present and future as a continuous flow
Flow	A sense of timeliness
Temporal compression	Actors feel that they are overloaded and that they do not have enough time to carry out their duties
Temporal rupture	Actors have the impression that the pace of time changes suddenly
Interstitial	The pace of time is perceived as slow

Table 2: Characterization of events for the three cases

	Novelty			Disruption			Critical			Direction			Proximity			Duration			Timing			Change		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1st Event	X		X	X	X	X		X	X	T	T	B				L	S	L	N	E	E	I	D	I
Team	X	X	X	X	X	X	X	X	X	B	T	T			X	L	L	L	N	N	N	I	I	I
Allocation	X	X	X	X	X	X	X	X	X	T	T	B			X	L	L	L	N	N	N	I	I	I
Prototype		X	X	X	X	X	X			B	T	B			X	L	L	S	E	N	N	I	D	I
Adaptation	X	X	X	X	X	X	X	X	X	T	T	B			X	S	S	S	E	E	N	D	I	I
Launch	X	X	X	X	X	X	X	X	X	T	T	B	X		X	L	L	L	E	E	E	I	I	I
Others projects		X	X		X	X	X			T	T	B	X		X	L	L	L	E	E	E	I	I	I
Delays	X	X	X		X	X		X	X	T	T	B			X	L	L	L	E	E	E	I	I	I

Caption:

Sign	Meaning
X	The event is perceived as novel, disruptive, critical, is dispersed and has a low geographical distance
T	Top-down approach
B	Bottom-up approach
C	The event emerges from a client's proposal
H	The event emerges from the headquarter
O	The event emerges inside the subsidiary
L	Long duration
S	Short duration
N	The event occurs at the beginning and in a new cycle
E	The event occurs during the unfold of an existing cycle
I	Increase in event strength change
D	Decrease in event strength change

Table 3: Different modes of knowledge creation for the three cases.

Processes	Modes of knowledge adaptation	
	Tacit	Explicit
Internal coordination within the team	Workshops, frequent meetings, training sessions.	Designing new tools to share knowledge. Creating new test methods.
Synchronization with clients, support functions or others teams	Organizing “battles” to allocate human resources to project. Establishing liaison with competitive clusters and presenting expertise in exhibitions.	New documents for requirement specifications. Writing down new process for bidding.
Work organization	Acquiring and exploiting external knowledge. Changing planning methods.	Setting up a new unit to host the project and reorganization of the working space. Changing planning methods.

Figure 1: Relationships among events, time and knowledge creation

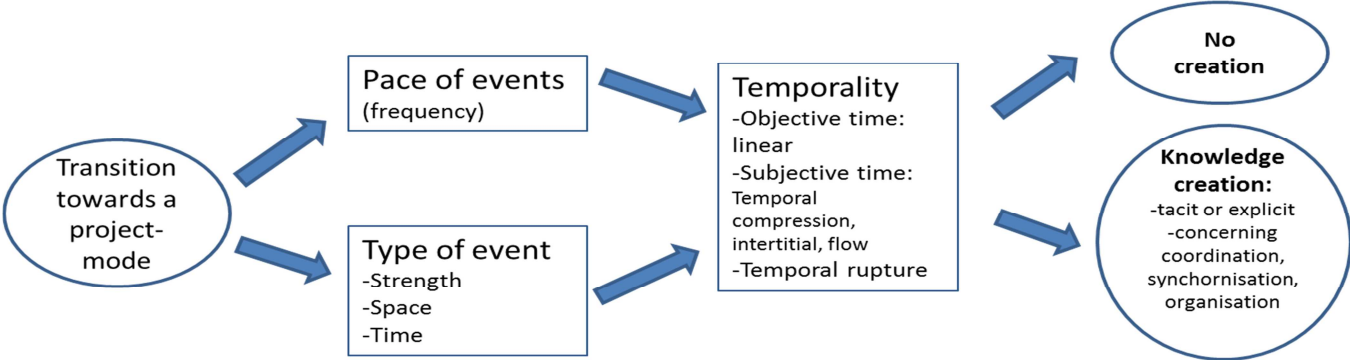


Figure 2: Timeline of observations and interviews

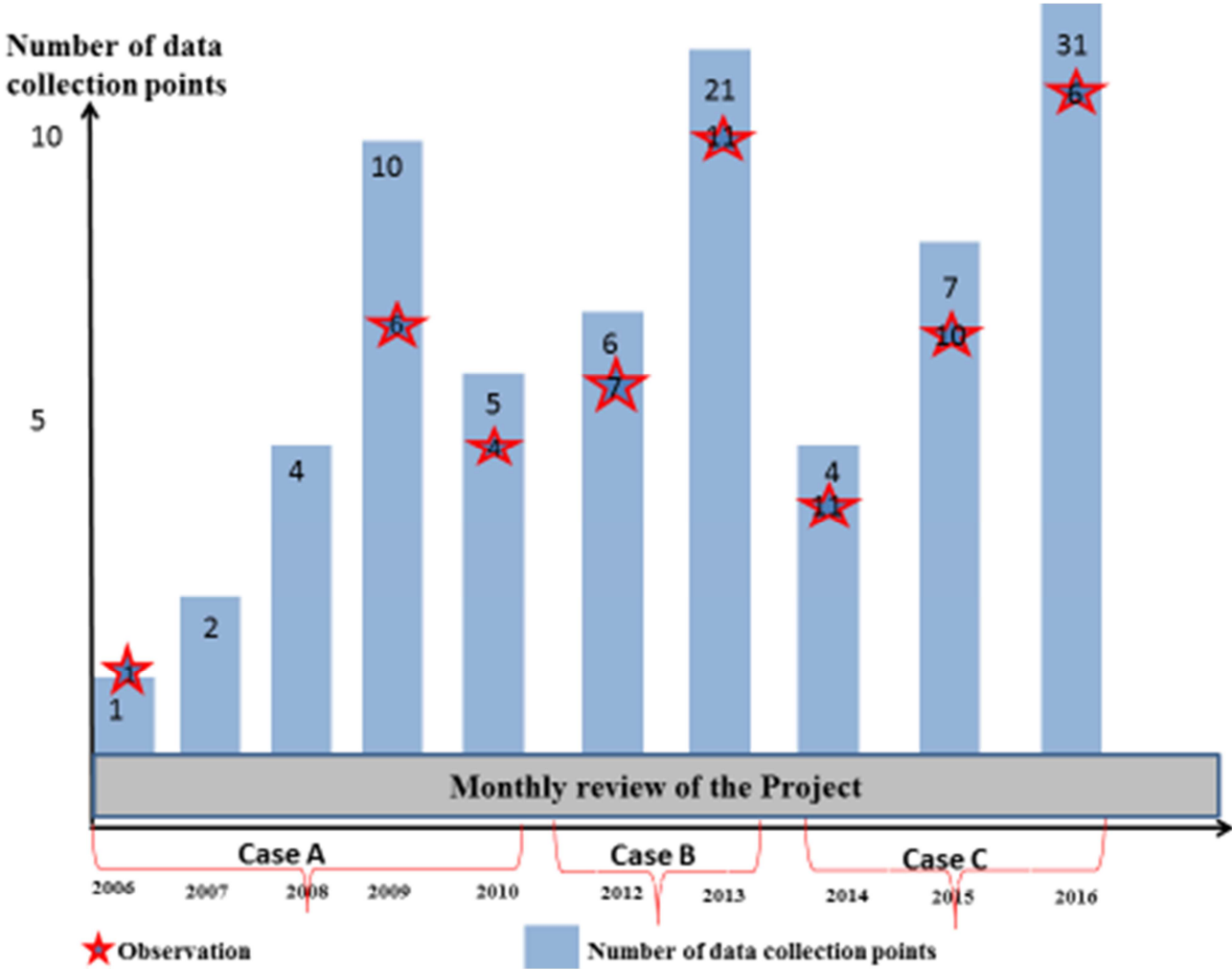
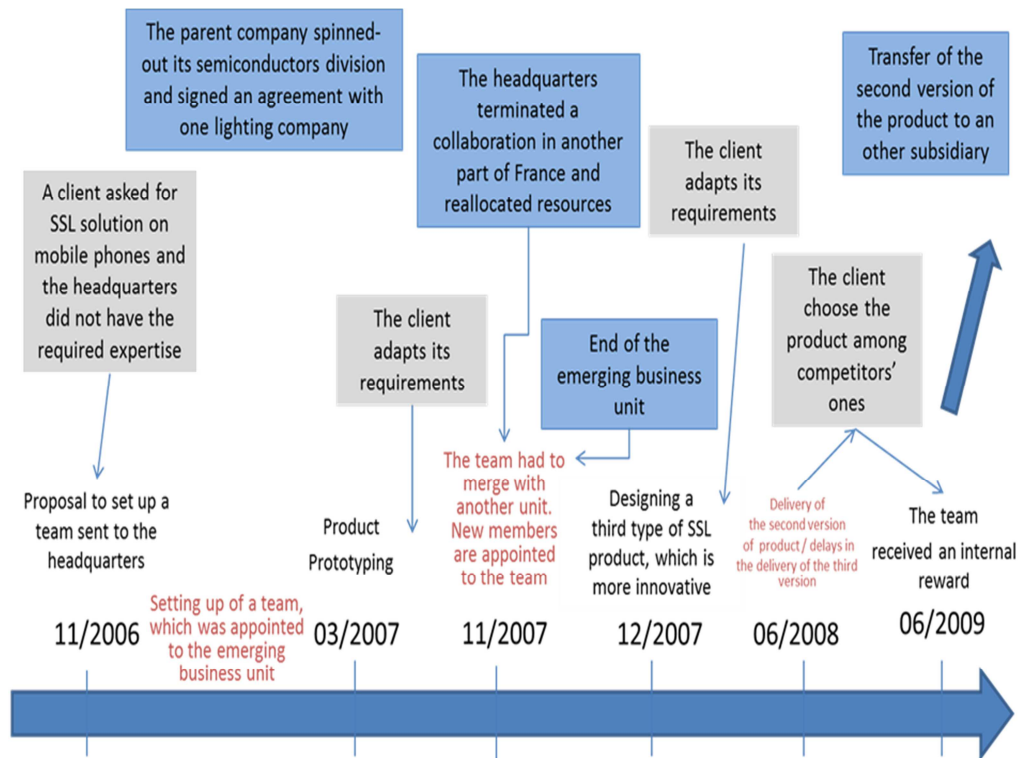


Figure 3: Main events affecting case A.



Caption (for Figure 3, 4 and 5):

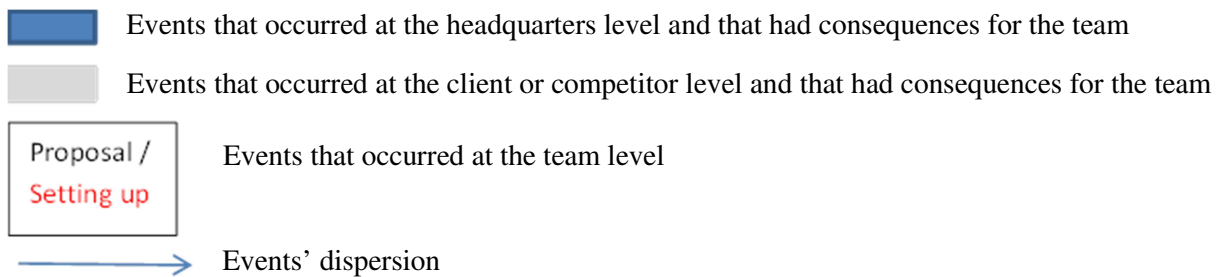


Figure 4: Main events affecting case B.

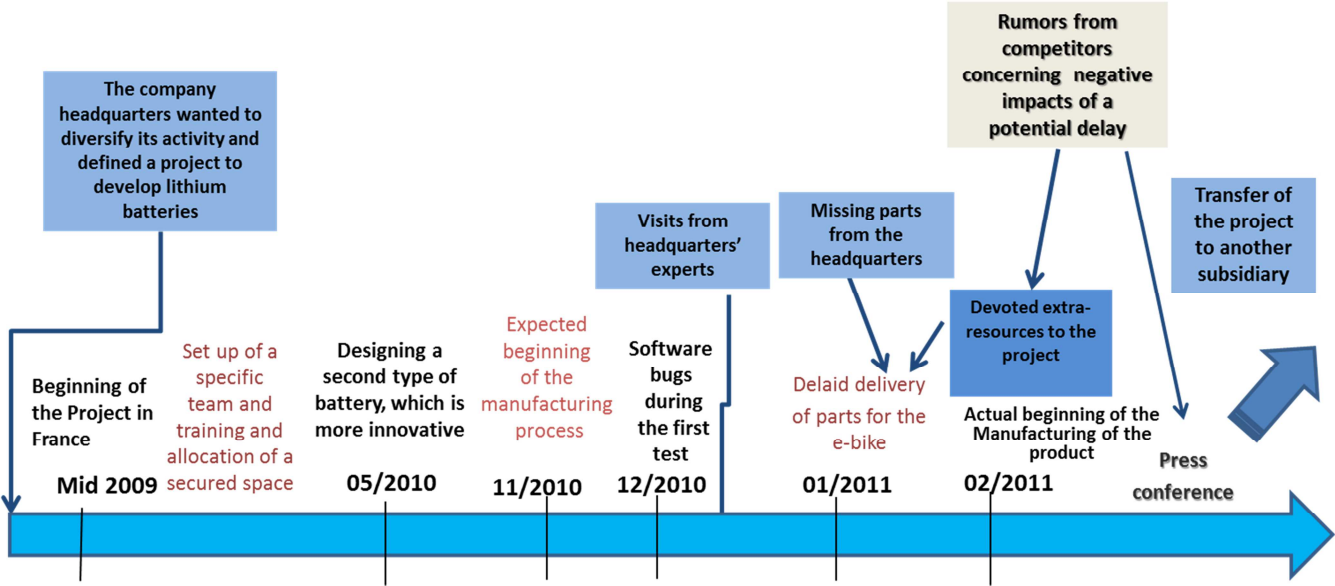


Figure 5: Main events affecting case C.

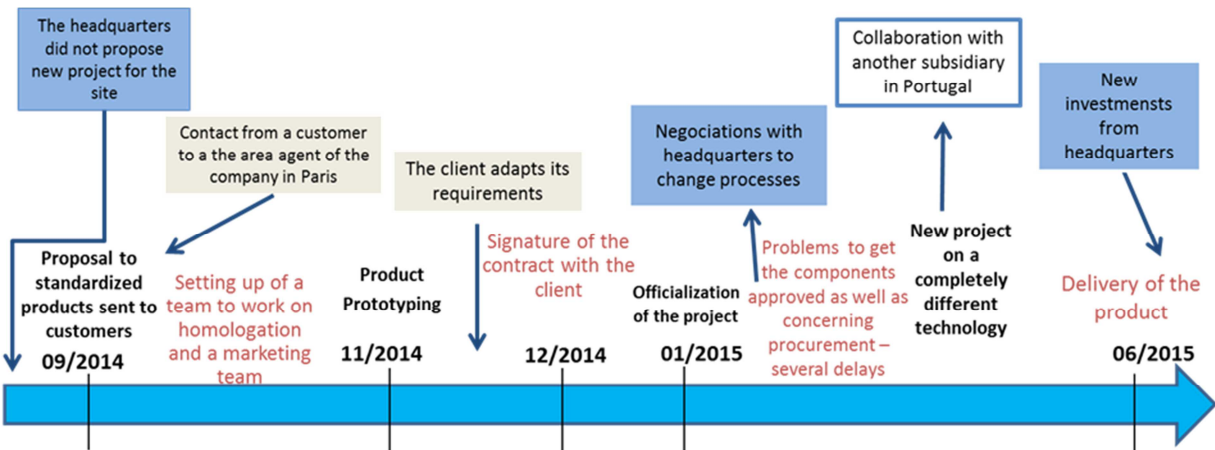


Figure 6: Results

