Time-constrained interactions in public-private collaboration projects. The case of ENABLE

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Abstract

Purpose – This paper aims to focus on time-constrained interactions involving industry and public actors, mainly universities, conducting research. This kind of interaction has become increasingly important to develop new pharmaceuticals, especially antibiotics. The proposed theoretical frame relies on industrial marketing and purchasing's interactive perspective on inter-organizational relationships and especially the activities, resource, actors model, combined with key concepts on temporary organizing and project management. This study identifies the temporality and time constraints imposed by this project on public–private interactions, specific coordination tools used to create such temporality and time constraints and their consequences, including positive and negative effects for the interacting parties.

Design/methodology/approach – The study builds on a single in-depth qualitative case study of a major antibiotics R&D collaboration project called ENABLE.

Findings – For negative consequences, this model includes the need for constantly rebuilding trust due to fast turnover of actors, difficulties in combining resources as efficiently as possible, resource constraints, bottlenecks and neglect of some activities, such as publishing, which are normally pivotal for universities. Despite these problematic consequences of temporality, resources are rapidly made available and new competencies learned quickly. Another positive effect is the possibility to achieve complex adaptations of resources and activities even in short time frames. Importantly, projects can act as a springboard for the parties to continue collaboration and in the long term develop a continuous business relationship.

Originality/value – Based on the findings the authors develop a model of time-constrained inter-organizational interaction between public and private organizations.

Keywords Interaction, Projects, Collaboration, Temporality, Inter-organizational, Public–private

Paper type Research paper

1. Introduction

Economic action is increasingly taking place in temporary systems (Bakker, 2010), for example, in inter-organizational projects (Jones and Lichtenstein, 2008). From an industrial marketing and purchasing (IMP) perspective (Håkansson, 1982; Ford *et al.*, 2003), which for a long time has focused on the importance of long-term interaction between firms, time-constrained inter-organizational interaction poses interesting theoretical and methodological challenges. Time is a central concept in the IMP perspective (Håkansson *et al.*, 2009), although with a focus on the long-term nature of business relationships emerging from continuous interaction (Håkansson and Snehota, 1995). Business relationships develop in due course because it takes time to achieve mutual orientation, trust and commitment, which are necessary for business relationships (Håkansson and Snehota, 1995). Peters and Pressey (2016, p. 308) argue that there is a need to rethink some of the concepts in IMP research because:

> [...] relationships between actors such as those in TOs [temporary organizations] are not long-term in nature [...] but they still need to establish states of trust and commitment, cooperation and lines of communication.

Several marketing researchers focus on time, namely, Lee *et al.* (2015) use relationship duration to explain relational bonding strategies, Olaru and Purchase (2015) focus on time and history to explain patterns of change in innovation networks and Peters and Pressey (2016) look at coordination practices in temporary organizations. In particular, Peters and Pressey (2016) focus on the constraints of time (temporality) and suggest that future research should focus on understanding these constraints.

Therefore, this paper expands the knowledge on time-constrained interactions, i.e. interactions subjected to artificial time limits and time-based management tools. This aim is achieved by developing inductively a model based on an in-depth case study of an inter-organizational project that focuses on antibiotic development, ENABLE. This large international project addresses the societal challenge of antibiotic resistance (Årdal *et al.*, 2018) by attempting to speed up the development

of new antibiotics – a very complex task. The last truly novel antibiotic was discovered in the 1980s, and most large pharmaceutical firms have left the antibiotics field (Boucher *et al.*, 2009; Kinch *et al.*, 2014). The project is specifically suited to study time-constrained inter-organizational interaction because it has two drivers of temporality, namely, the project stretches for six years, between 2014 and 2020, and the project members can enter and exit the project (or become inactive) depending on the success of their drug programs (the project uses a fail fast and cheap strategy, which is described in detail below). This strategy influences interaction between parties and the formation of relationships as new actors join and old ones leave during the same project in the pursuit of joint knowledge development in antibiotics R&D.

Moreover, by focusing on this project, this paper also contributes to increased understanding of time-constrained public–private interactions. In fact, ENABLE includes universities, public research institutions, small and medium-sized enterprises (SMEs) and multinational pharmaceutical firms. Following a general trend of the increased importance of university–industry interactions (UICs) (Ankrah and AL-Tabbaa, 2015), public–private interactions have become increasingly important in the antibiotics field as the pharmaceutical industry is increasingly withdrawing from the business of developing new antibiotics (Högberg *et al.*, 2010). Thus, this paper also contributes to the ongoing debate in the *Journal of Business & Industrial Marketing* on public–private inter-organizational interaction (de Zubielqui *et al.*, 2015; Redondo and Camarero, 2017; Mattsson and Andersson, 2019; Wagrell and Baraldi, 2019; Waluszewski *et al.*, 2019).

Against this background, this paper investigates time constraints and temporality (the knowledge that the project will end) in ENABLE affects public and private partners and their interactions. Two levels of analysis are applied, namely, the entire project with its overarching structure and the daily interactions occurring within specific teams. In particular, we address the following research questions:

RQ1. How do a project's temporality and time constraints manifest in the interactions between public and private parties?

RQ2. What tools are used to coordinate interactions between public and private partners within these temporary settings?

RQ3. What are the consequences of temporality and time constraints for public and private partners?

These research questions are closely connected and will help us build the foundation of a model that describes how public–private inter-organizational interactions occur within the time constraints of a project. The paper is organized as follows: Section 2 presents our theoretical frame. In Section 3, methodology is described, followed by a description of ENABLE in Section 4. Section 5 discusses the case by addressing our research questions and developing our model of time-constrained inter-organizational interactions between public and private parties. Finally, Section 6 presents the conclusions.

2. Theoretical framing

Focusing on the interaction between private and public actors, namely, companies and universities, we start by describing the commonalities and differences of these actors. Next, we discuss inter-organizational interaction in more general terms. Then, we consider temporary organizing and temporality, as our focus is on how such issues affect public–private interactions. Finally, we reunite all these elements into our theoretical framework.

2.1 Interactions between industry and university

Several differences can hinder UICs (Ankrah and AL-Tabbaa, 2015). For example, the logic in industry and universities are different (Redondo and Camarero, 2017). Universities follow the norms of communalism, universalism, disinterestedness, originality, and skepticism (Merton, 1973; Ziman, 2002), whereas industry and the private sector aim to leverage the economic value of new knowledge before their rivals (Teece, 1986). These differences also entail cultural distance and language barriers (Wright *et al.*, 2008) as well as divergent motives and time orientation (Plewa *et al.*, 2005; Plewa and Quester, 2007). This different time orientation can result in academic partners neglecting deadlines important to industrial partners or in uneven personnel turnover, which is typically higher in the private sector (Plewa *et al.*, 2005), so the same personnel from the universities and the private sector are less likely to interact throughout a collaboration.

Despite these differences, university and industry do interact, especially in science-based sectors such as pharmaceuticals, if compatible organizational structure and personnel experiences (Plewa and Quester, 2007), complementary goals (Baraldi *et al.*, 2016) and interaction-stimulating tools (Jonsson *et al.*, 2015) can help overcome the aforementioned barriers. These interactions include licensing of universities' technologies, joint R&D projects, access to university equipment and participation in research consortia (Nilsson *et al.*, 2010; Baraldi *et al.*, 2016). The interactions between specific industrial and academic actors can vary in terms of the depth of the connections between the two parties, ranging from superficial participation in meetings to closer collaboration, with combinations of resources and shared goals, all the way to relationships entailing adaptations and interdependencies (Baraldi *et al.*, 2013). Whereas a collaboration is contained within a specific time frame, such as a project with a clear start and end (section 2.3), a relationship implies not only a deeper form of interaction but also continued interaction between the two parties, e.g. after a collaborative project ends.

2.2 The industrial marketing and purchasing perspective on inter-organizational interactions

Inter-organizational relationships build on "mutually oriented interaction between two reciprocally committed parties" (Håkansson and Snehota, 1995, p. 25). The commitment and mutuality aspects become visible when interaction occurs continuously, creating a substance that makes relationships "quasi-organizations" (Blois, 1972). IMP researchers have stressed that "interaction is the essential analytical concept at the heart of the relationship and network perspective of business markets" (Medlin, 2004, p. 185) and that this

interaction consists of dynamics of exchange and adaptations (Johanson and Mattsson, 1987).

Considering the dynamics of exchange, relationships are formed and maintained through episodes of interaction. Time is a central concept for business interaction (Håkansson *et al.*, 2009), which stresses that long-term business relationships emerge from continuous interactions (Håkansson and Snehota, 1995). Building relationships, mutual orientation, trust and commitment takes time and are necessary to develop and reinforce a business relationship (Håkansson and Snehota, 1995), including adaptations. Adaptations (Hallen *et al.*, 1991; Brennan and Turnbull, 1999) are an important condition and consequence of business relationships. Moreover, trust between the involved actors (Andersen and Kumar, 2006) is necessary for motivating the parties to adapt and support the development of a relationship over time.

Adaptations, mutual orientations, as well as interdependencies are in turn visible across the three layers of activities, resources and actors that constitute the ARA model, which was developed to analyze inter-organizational interactions by focusing on activity links, resource ties and actor bonds (Håkansson and Snehota, 1995). Activity links emerge when two organizations change their activities, such as manufacturing or testing, to make them fit better with each other, typically in search of improved efficiency (Dubois, 1994; Håkansson and Snehota, 1995). Resource ties emerge when two organizations combine their resources (e.g. products, machinery and competences) in unique ways so they better address the specific needs of one or both parties (Dubois, 1994; Håkansson and Snehota, 1995; Baraldi and Strömsten, 2008; Baraldi *et al.*, 2012). Finally, actor bonds concern the mutual orientation and understanding, including shared perceptions and goals, that connect either single individuals or subunits in the two organizations (Håkansson and Snehota, 1995; Munksgaard, 2010). We apply the ARA model to the ENABLE case to penetrate both the manifestations of temporality and its consequences for the interacting public and private actors.

2.3 Temporary interaction

Time is important not only for tracing the history of a relationship but also for understanding other aspects that influence interactions. The perceived future, especially the perceived importance in the future of counterparts, plays a significant role in forming interactions (Håkansson *et al.*, 2009). Moreover, time acts like a container for business relationships (Medlin, 2004). Interaction can only occur in the present, but both the past and the future influence how parties interact (Medlin, 2004). Medlin (2004) explicitly states that "without a future there is no need for continuing interaction between firms", known as "the shadow of the future" effect (Axelrod, 1984, p. 188).

The length of the shadow of the future depends on the duration a group of interacting actors is expected to remain together (Bouas and Arrow, 1995). Moreover, temporary teams, expecting to finish interacting in the near future, display clear differences from permanent teams, who expect to continue interacting permanently (Saunders and Ahuja, 2006). Whereas members of permanent teams anticipate future interactions and are concerned with the long-term efficiency of interactions, members of temporary teams are not concerned

with this long-term efficiency as they do not expect future interactions with the same actors. Thus, members of temporary teams focus more on finishing the task at hand than on maintaining relationships with other actors, which is witnessed also by managers in a typical project-based industry such as construction, who have a stronger task emphasis than other industry leaders (Bryman *et al.*, 1987).

As business relationships are formed and maintained over time in episodes of interaction, which in themselves are temporary, the line between what is temporary and what is permanent (i.e. there is no *a priori* decided point in time when the relationships will end) might become fuzzy (Bakker *et al.*, 2016). From the IMP perspective, it is fruitful to think about temporary organizing rather than temporary organizations. This perspective requires adopting a process view: studying what is going on in a temporary organization rather than the organization itself (Karrbom Gustavsson and Hallin, 2015; Bakker *et al.*, 2016).

2.3.1 Coordination tools and pacing over time

Collaborative efforts in teams show several forms of temporal patterning (McGrath, 1991), including the need for scheduling and synchronizing workflow, matching activities with specific time frames, and coordinating across several teams and external events (McGrath, 1991, p. 161). Timing norms are pivotal in coordinating (synchronizing) activities because they are "the rhythm of interaction" (Ancona *et al.*, 2001, p. 648) and "enable people to coordinate their behavior with that of others". Timing norms are organizing elements that create cycles of rhythms and provide explicit schedules and deadlines that the involved actors have to respond to Dille and Söderlund (2011). However, in inter-organizational projects, these timing norms can lead to temporal misfit, i.e. different actors might have diverging timing norms (Dille and Söderlund, 2011). As pointed out by McGrath (1991), this misfit leads to scheduling, coordination and time allocation problems. These problems can be mitigated by different kinds of pacing tools.

Jones and Lichtenstein (2008) suggest that coordination in inter-organizational projects can be achieved through such tools as milestones and flowcharts, which create pacing through particular events and timelines to be followed, and meetings wherein key decisions are made, such as go-no-go decisions or major resource allocations. Moreover, a third coordination tool is the particular roles assigned to certain actors, which help create order in a temporary organization that lacks a permanent structure (Bechky, 2006). The actual people will change from project to project, so roles are the primary structuring and stabilizing force (Bechky, 2006). The effects of roles on coordination depend on the level of interdependence between activities, making role coordination more effective with higher levels of interdependence (Bechky, 2006). Using the metaphor of scaffolding, Peters and Pressey (2016) found three scaffolding practices in temporary organizations that enable coordination, namely, consistency, consensus and co-constitutiveness. Consistency includes boundary spanners, such as artifacts or individuals. Consensus refers to achieving agreement among members and is influenced by the trust. Co-constitutiveness refers to commitments between actors to undertake certain tasks and is connected to the "buy-in"

(Peters and Pressey, 2016, p. 307) to the temporary organization's goals and objectives.

2.4 Theoretical and analytical framework

The previous section identified a series of relevant features of temporary interactions, such as those occurring within projects. In particular, they entail an increased focus on the specific tasks to be achieved (Bakker, 2010) and a reduced concern with the long-term efficiency of social and business interaction processes (Saunders and Ahuja, 2006). Moreover, temporality (the awareness that project-bound interactions will end) might obstruct the development of long-term inter-organizational relationships. Finally, the three main project coordination tools are:

1 meetings and discussions;
2 milestones and flowcharts; and
3 roles assigned to particular actors.

To investigate how temporality- and artificially-imposed time constraints affect inter-organizational interactions between public and private actors, our framework departs from the IMP perspective that such interactions between two counterparts can lead to changes and transform aspects of the resources and activities of the involved organizations (Håkansson *et al.*, 2009). If repeated over time and entail mutual adaptations, these interactions become a relationship that can span over many years (Håkansson *et al.*, 2009). However, these interactions happen also as discrete episodes that can occur irregularly and can be far apart from each other (i.e. they can give rise to so-called "interimistic" relations) (Lambe *et al.*, 2000).

No matter how continuous or intermittent interactions in an inter-organizational relationship are, the rhythm of interaction is accelerated within a project. This additional time constraint might create consequences for the interactions between two kinds of actors such as university and industry, which have different time orientations (Cyert and Goodman, 1997; Plewa *et al.*, 2005). The industry seems to be more attuned with the short-term timing of projects compared to universities, which are more long-term in their operations (Cyert and Goodman, 1997; Plewa *et al.*, 2005). Moreover, being exposed to time pressures, members in large inter-organizational projects are likely to make the most out of the situation during the limited time available. As seen in the previous section, a short, as opposed to a long, duration of a project orient its members to focus more on task completion than relational processes.

Our analytical scheme will first extract from the ENABLE case-specific manifestations of temporality and time constraints visible both at the level of the whole project and within specific daily interactions among the involved actors, such as those occurring at the level of specific sub-projects dealing with particular drugs. We will also identify the particular effects of the three main coordination tools, namely, meetings/decisions, milestones/flowcharts and assigned roles (Bechky, 2006; Jones and Lichtenstein, 2008). Finally, we will analyze at these levels the consequences of temporality and project coordination tools for the actors, resources and activities in the studied public–private interactions (Håkansson and Snehota, 1995).

3. Method

Empirical investigations of temporary organizing face some unique research challenges (Bakker *et al.*, 2016). In particular, the availability of respondents is limited due to time constraints and the high tempo of projects, and the dynamic emergent nature of temporary organizing requires more longitudinal and flexible research methods (Bakker *et al.*, 2016). Case study research is a useful method for studying interaction processes and gives enough flexibility to follow up on emergent themes during the research process. This paper applies a systematic combining approach (Dubois and Gadde, 2002) as it is flexible with respect to identifying and formulating emergent themes found in the continuous confrontation of theory and empirics.

Data were collected between 2015 and 2019 through unstructured and semi-structured interviews (Kvale and Brinkmann, 2015). The interviews were conducted in four rounds, with each round initiated after a confrontation between theory and the empirics. Starting with unstructured interviews trying to answer the question "What is ENABLE?", we conducted six interviews with key individuals in the project (Consortium Management Office and Portfolio Management Committee members). The second round of interviews, now semi-structured, focused on value creation in collaboration and totaled 22 interviews. Here, one respondent commenting on the project's fail fast and cheap strategy noted that "you don't fall in love with the molecules." This led to a refocus of this study on time-limits and temporality in the third round of interviews, totaling 16 interviews. It became evident that several ENABLE partners had initiated new collaborations outside ENABLE, which became the focus of the fourth round of interviews, totaling three interviews focusing on one particular new collaboration. In total, 47 semi-structured interviews were conducted.

Twenty-eight of these interviews involved representatives of public organizations, mostly academic laboratories or innovation-supporting units, and 19 interviews involved private partners representing either drug development companies or contract research organizations (CROs). Most the interviews were transcribed and then analyzed by first writing comprehensive narratives (Boje, 2001), followed by a more systematic search for particular evidence of how interactions between selected project members unfolded and how particular manifestations of temporality and time pressures influenced the emergence and development of inter-organizational interactions inside ENABLE.

The interviews were complemented by documents produced in and for ENABLE by its members and initiators (e.g. the description of work and the collaborative agreement). This data contributed to understanding the context, goals and rules affecting how specific interactions and processes unfolded within the project. In particular, some project management and pacing tools were represented in flowcharts and schemes that we could consult and subsequently ask interviewees about. The use of different sources of data for this research was based on the argument of multiple sources of data being able to contribute to the revelation of unknown and surprising aspects of a phenomenon (Dubois and Gadde, 2002) rather than checking the accuracy of the data (Yin, 2014). The systematic combining approach (Dubois and Gadde, 2002) that we

applied is an iterative process where the empirical world and the framework of the research, theory and the case are developed together where each part directs and redirects the other parts (Dubois and Gadde, 2002). Following this abductive or retroductive logic (Alvesson and Sköldberg, 2009), the theoretical frame proposed above is more a result of this study rather than an analytical frame created *a priori* and then simply applied to our case.

When analyzing data, we applied two levels of analysis:

1   the whole ENABLE project (with its central organizational structure composed of several committees); and
2   the molecule-specific drug development activities, which include frequent interactions at the so-called drug program level.

More specifically, we searched within these two levels for time-related issues and constraints in the interactions as viewed from the public and the private counterparts as well as for project coordination tools (later framed as meetings/discussions, milestones/flowcharts and roles) (Jones and Lichtenstein, 2008; Bechky, 2006). Moreover, we searched for consequences of temporality and coordination tools for the two kinds of counterparts by looking at the level of activities, resources and actors according to the ARA model (Håkansson and Snehota, 1995).

4. The case of ENABLE

ENABLE is a six-year project with a total budget of €82m, funded by the European Union and the European Federation of Pharmaceutical Industries and Associations. The goal is to create a collaborative drug development platform that will optimize a variety of antibacterial programs. The key objectives are to identify three antibacterial leads[1], two antibacterial candidates and progress at least one development program into preclinical and Phase 1 clinical studies. Optimization of hits and leads is a highly collaborative and iterative process, but historically academics, SMEs and industry partners have competed with each other instead of collaborating. ENABLE was initiated to "break down these barriers" (Innovative Medicines Initiative, 2012, p. 29) by establishing a vibrant drug discovery hub across Europe with the resources, skills and expertise to progress a pipeline of drug development programs originating from private or public partners.

ENABLE was launched on February 1, 2014, and consisted (at the time) of 32 organizational partners, including large pharmaceutical companies, universities, SMEs, non-profit research centers and private CROs. Since its start, the ENABLE consortium has grown as so-called hit-owners (i.e. private or public developers with a molecule to be tested) as well as new members of the Drug Discovery Platform have joined ENABLE. At the start of 2019, ENABLE included 24 public partners, 14 SMEs and four large pharmaceutical companies. Not all of these partners are currently active; for example, hit-owners remain partners in ENABLE even after their funding has been terminated. These partners are, however, inactive as they do not perform any activities in the project.

4.1 ENABLE's organization

ENABLE's organization can be divided into three parts (Figure 1):

Figure 1 Overview of ENABLE's components and their connections
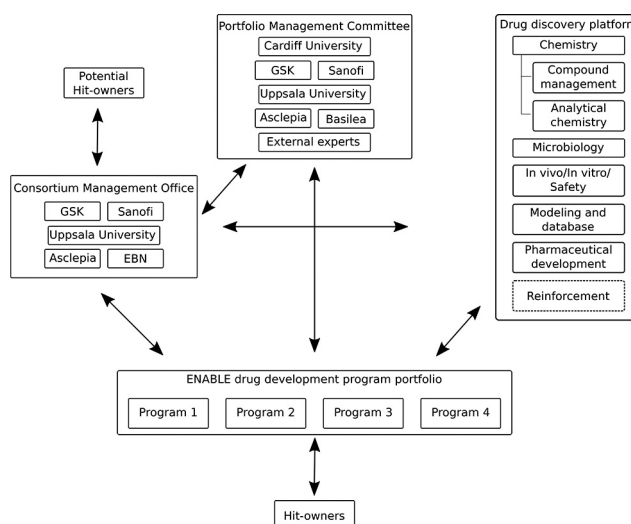
Note: GSK – GlaxoSmithKline; EBN –European Biotechnology Network

1   the management organization that includes a Consortium Management Office (CMO) and a Portfolio Management Committee (PMC);
2   a Drug Discovery Platform; and
3   the owners of the molecules being developed.

The CMO is responsible for the day-to-day running of ENABLE, including resource allocation. It is a central group that steers the overall project with support from all the leaders and teams in the project. The PMC is responsible for the overall prioritization of the ENABLE portfolio, both for new (potential) and existing programs. The PMC includes equal representation from public, private and external partners. The overall prioritization of the portfolio involves three main activities:

1   evaluation of new expressions of interest (applications to join ENABLE);
2   deciding on the continuation or termination of funding of active programs; and
3   key transitions (i.e. changes of status) for each program such as lead nomination or candidate selection, signaling that a major milestone has been reached by a drug development program.

The Drug Discovery Platform consists of scientists from a wide array of mostly public organizations throughout Europe and incorporates all key disciplines and activities needed to successfully develop antibiotic programs. This platform was designed so that it can simultaneously advance multiple development programs. In ENABLE, each scientific discipline is called a platform and has one or two platform leaders who coordinate and plan activities between platforms when needed. The platform also has so-called platform lead meetings. In addition, each discipline coordinates activities internally. The Drug Discovery Platform consists of both public and private partners but with a larger share of public partners, mainly universities. This means that most of the public–private interactions within drug development programs in ENABLE

occur between private partners who are hit-owners and public partners who operate within the Drug Discovery Platform.

ENABLE members who take part in this platform are not as exposed as hit-owners to ENABLE's fail fast and cheap strategy, where unsatisfactory molecules are terminated as soon as possible. However, platform members with very specific expertise connected to a specific drug development program depend on that specific molecule and development program. Some public organizations in the Drug Discovery Platform have gone from intense activities to becoming inactive due to a lack of hit-owners who require their specific expertise.

4.1.1 Development programs

ENABLE's portfolio consists of drug development programs created around compounds brought to the consortium by the so-called hit-owners. Hit-owners include both private and public organizations. Each program is led by two program leaders (PLs) who interact with several teams attached to the program, such as the specialized groups belonging to the six elements in the Drug Discovery Platform (Figure 1). One of the PLs comes from the hit-owner organization and one from an organization belonging to the drug discovery hub (typically a public specialized laboratory).

Each program has different teams. A core team consists of between 5 and 15 people, both from the hit-owner organization and the drug discovery hub. A program team, which is a fluid group expanding the core team, includes also a wide range of experts from the whole consortium. This team is often the largest, but as the level of engagement of any specific group or member is fluid, it is hard to say how many members are in this group for a program at any one time. This number depends on the agenda for the program team meetings each time. In addition to these two teams, teams are formed around different competencies from the Drug Discovery Platform, such as chemistry or microbiology teams, depending on the program stage. The core teams generally meet in webinars one to two times each month, the program teams meet in a webinar generally once a month, and the additional teams (chemistry and microbiology) often meet following the core and program team meetings.

The platform leaders decide the composition of these teams, so hit-owners cannot choose their collaboration partners. Because the composition of the core teams depends on the different disciplines needed for the specific program, each representative in the core team has a role that corresponds to the discipline they represent. When specific competencies are missing inside ENABLE, hit-owners can request that new partners should be found that can join ENABLE's Drug Discovery Platform.

4.2 Coordination tools within ENABLE

ENABLE's development and evaluation activities revolve around a three-month cycle. Every third month, the PMC evaluates each program in ENABLE's portfolio. Based on these evaluations, the program will either continue to be supported within ENABLE or be terminated within ENABLE. If terminated, the program will no longer receive ENABLE's funding, but the corresponding hit-owner organization remains a member of ENABLE. The decisions made by the PMC have by far the highest impact on ENABLE, namely, new programs

might enter ENABLE, active programs might be terminated and criteria to meet overall objectives might be endorsed.

Flowcharts are commonly used management tools for coordinating activities in antibiotic development. A flowchart is a visual representation of all the fundamental assays[2] needed to progress a development program. Specific assays are used as a basis for decisions on whether to advance the molecule to the next round of development. This process is iterative as many compounds are tested and re-modified. Flowcharts make the coordination of activities very straightforward. In the Drug Discovery Platform of ENABLE (Figure 1), each discipline performs the assays that correspond to its specific field. The coordination of these activities is handled in the core team meetings. During these meetings is where the most intensive interactions between the different organizations in ENABLE occur.

The fail fast and cheap strategy creates clear time constraints because it states that both financial resources and the engagement of other resources such as the Drug Discovery Platform's competencies are taken away from an actor if the expected results are not achieved. Hence, next to time pressure, also comes a range of resource constraints. That is, the most visible aspect of temporality in ENABLE is when new programs and their actors join ENABLE and therefore are provided with funding and other resources, especially when existing programs are terminated, which takes away resources from the involved actors.

These constraints will impact the effectiveness of overall activities as all of these actors need time to develop relationships and learn how to coordinate their activities. In general, all activities within ENABLE are designed to achieve a high speed of execution and there is especially an expectation on the Drug Discovery Platform to perform their development and analytical activities at the highest speed. Financial resources are also allocated to the universities and institutes in this platform based on the planned volume of activities for each upcoming period. However, all disciplines have constraints that limit the number of activities that can be performed at any given time, which can cause delays when facing high requirements all at the same time. Given this, minimal time and resources are allocated for such activities that do not directly lead to the goal of ENABLE, such as writing and publishing academic papers.

4.3 Public–private interaction and temporality in ENABLE

The CMO, Drug Discovery Platform and ENABLE portfolio are continuously interacting. To be efficient and achieve economies of repetition, these parts of ENABLE benefit from the development of interaction routines. ENABLE has several routines in place, such as recurring meetings and the use of flowcharts. However, the new hit-owners bring their expectations and experiences to the project, which will influence the interactions within ENABLE.

These routines, and especially the PMC cycle, have different effects on different actors within the project. For example, the *in vitro/in vivo* discipline in the Drug Discovery Platform is spread over three public member organizations. Compared with the chemistry competencies gathered in ENABLE, which are rather general and interchangeable, the *in vitro/in vivo* competencies are specific for each of these member organizations and cannot be switched between each other. This

specificity has led to bottlenecks as several hit-owners might request that experiments be done at the same time. Generally, there are surges in their workload closer to PMC meetings because then the PLs need to gather, elaborate and present the results from all the activities. Several respondents have mentioned that because of these administrative activities, the time they can actually focus on generating essential new data for the next PMC meeting is closer to two months instead of three (which is the interval between the PMC meetings). Furthermore, some hit-owners push for some specific experiments because they believe that they are crucial for getting further funding to their program, requests that have resulted in rushed experiments and short-sightedness. Some hit-owners, feeling pressure from the PMC, have asked for experiments to be done that will answer only specific questions instead of taking a step back and thinking about what is best for the development of their program as a whole.

In the drug discovery hub, terminated programs and new programs also influence the learning curve for academic researchers. Some university laboratories do not have experience working with a specific molecule (or area of chemistry) that a new ENABLE program requires. For example, one research group had to change how it usually performs experiments because the molecule required fresh human blood rather than frozen blood, which they usually worked with. In addition, another public partner, a governmental research institution, had to develop a new assay to test an unfamiliar molecule. Although this experiment took six months to set up, the program was terminated soon after the experiments were prepared. Interestingly, in this particular example, the hit-owner started a new research project outside ENABLE and invited the same public research institution and two other ENABLE partners to be part of the new project.

ENABLE's fail fast and cheap strategy is especially challenging for academic partners. ENABLE partners only receive reimbursement for activities performed for a program, whereas traditional research projects receive funding from the inception of a project. The most challenging situation is for university laboratories that enter ENABLE as hit-owners as these partners need to adapt to non-academic settings. Typical academic research projects are often funded for a specified period and the results are presented at the end of the project. In ENABLE, however, the fail fast and cheap strategy means funding can be terminated every third month. This new way of conducting research can be challenging for the academic partners: "The possibility of termination of programs every three months […] you don't fall in love with the molecules so much" (an academic partner).

Several university partners have mentioned that this time pressure influences staffing. When funding cannot be guaranteed for a longer period, it is difficult to hire post-docs and researchers solely based on ENABLE funding. This uncertainty and time constraints affect public organizations who are hit-owners to a higher degree than those who are part of the Drug Discovery Platform as the latter organizations can often expect ENABLE funds to be allocated regularly as new programs often require the expertise they have. One academic hit-owner had employees leave their organization due to the stress associated with the uncertainty of funding.

Another time constraint afflicting university partners is that there is basically no time allocated to write papers based on the results obtained in ENABLE. ENABLE provides no room for curiosity-driven research, which is a cultural norm for many academic researchers. Interestingly, some private hit-owners mentioned that academic partners tried to understand *why* some test results look like they do rather than focusing on solving the immediate problem at hand as is the norm in drug development companies. This conflict of approach occasionally delayed the delivery of experimental data for some programs.

For SMEs, time is money because they have limited financial reserves, often just enough to complete the next R&D step. Several of the SME partners mentioned that obtaining funding for their R&D is one of the main reasons for joining ENABLE as this gives them more time to develop their programs. However, some academic partners are not used to delivering results as fast as SMEs would want. One SME noted that it is easier to work with their usual CROs because the complex learning process has already been completed. That is, often academic researchers might perform experiments for the first time within ENABLE. Another SME partner who explicitly said that the only reason they joined ENABLE was for the funding decided to leave ENABLE. This partner also saw an issue in that members of the Drug Discovery Platform, which are almost exclusively public partners, are not affected by the PMC decisions in the same way as hit-owners. This issue was related to public partners not delivering results as fast as expected by the hit-owner, which could have had consequences at the next PMC meeting.

Gaining trust and commitment is difficult when drug development programs are terminated rapidly and new partners are continually joining ENABLE. Several partners, both public and private, mentioned that trust and commitment are the most important facilitators for collaborating within ENABLE. Face-to-face meetings are seen as beneficial for building trust, especially when new partners join ENABLE. However, the project has a very limited travel budget, which has led some hit-owners having face-to-face meetings at their own expense. Such efforts and investments in trust-building might lose value rapidly if a program is terminated quickly and its owners leave ENABLE.

We have seen that the time constraints imposed by ENABLE have been more challenging for the public than for private partners. A good example is the only program in ENABLE with Big Pharma as hit-owners. This drug development program is a joint program between GlaxoSmithKline (GSK) and Sanofi/Evotec[3]. Compared with other programs in ENABLE, this program differs in one very distinct way that the time pressure from ENABLE does not affect this program to the same extent as most other programs because the internal timelines imposed by GSK and Sanofi/Evotec are as rigid as ENABLE's, if not more. Moreover, these two companies have also greater internal resources at their disposal than other programs. However, on an individual level, the time pressure affects the PLs in the GSK and Sanofi/Evotec program differently, with one of them feeling more pressure than the other. This time pressure comes from the administrative responsibilities and the surge in workload connected to the preparation for the PMC meetings.

Some partners deal with ENABLE's time constraints by initiating formal and informal collaborations outside ENABLE. Some public partners, both from the CMO and the Drug Discovery Platform, have written joint research applications.

Some private partners have asked public partners to conduct experiments outside ENABLE. Four public partners have initiated a new six-year research project based on their work within ENABLE. Several of these partners who started to collaborate outside ENABLE knew each other and had developed relationships. However, others had never met before joining ENABLE and are now collaborating because of the connections made within ENABLE.

5. Analysis and discussion

The analysis of the ENABLE case is done by considering the two levels of analysis proposed in our methodology, namely, the whole ENABLE project, with its central structure with committees and groups and the specific drug development program. This analysis addresses our three research questions presented in Section 1:

- singling out temporality issues and time constraints;
- penetrating to the coordination tools applied to handle the public–private interactions; and
- searching for the consequences for public and for private actors of those temporality/time constraints and coordination tools.

These aspects are summarized in Table I below according to the activity-resource-actor dimensions (Håkansson and Snehota, 1995) visible in the ENABLE case for both private

Table I Our analytical framework applied to the ENABLE case

	ENABLE		Specific drug programs	
1. Temporality issues/time constraints	Private part: *Actor*: new programs (and their owners) joining, termination of programs, personnel turnover, exposure to new contacts *Resource*: lack of development programs, Drug Discovery Platform underused *Activity*: creation of routines by CMO/PMC for milestone declaration, go/no-go decisions, new hit-owners routines and fast time expectations on activities	Public part: *Actor*: new programs joining, termination of programs (Lower personnel turnover), exposure to new contacts *Resource*: changing resource constellation, bottlenecks, required timely and effective use of resources *Activity*: creation of routines by CMO/PMC for milestone declaration and go/no-go decisions, expectations of highest speed for drug discovery hub activities, allocation and re-allocation of resources depending on periodic volumes	Private part: *Actor*: development of trust, alignment of goals, stress for some *Resource*: pivotal effective use of resources, other funding running out fast (SMEs) *Activity*: take longer time than expected, pushing to get times respected by public partners, preparation for PMC meetings, need high coordination and follow ENABLE pacing	Public part: *Actor*: development of trust and commitment harder to achieve, alignment of goals, stress for most *Resource*: highly specialized resources, capacity constraints when time pressure, bottleneck for delivery of data *Activity*: new experiment procedures, short timelines, no time for writing publications and general learning
2. Coordination tools for the time issues	Private part: *Actor*: meetings and specified roles *Resource*: PMC timeline request, budgets and periodic resource allocation to various partners *Activity*: milestones, indicative timelines for development stages and termination of entire project	Public part: *Actor*: meetings and specified roles *Resource*: PMC timeline request, budgets and periodic resource allocation to various partners *Activity*: milestones, indicative timelines for development stages and termination of the entire project	Private part: *Actor*: meetings and specified roles *Resource*: suggested timelines and strict criteria on molecule qualities for program progress *Activity*: flowcharts, timelines and termination decision of a program, role-based coordination	Public part: *Actor*: meetings and specified roles *Resource*: suggested timelines and strict criteria on molecule qualities for program progress *Activity*: flowcharts, timelines and termination decision of a program, roles-based coordination
3. Consequences for the parties	Private part: *Actor*: turnover of personnel and of organizations require to rebuild trust constantly. New contacts *Resource*: fair possibility of reaching overall project goals in terms of molecules. New resource constellations *Activity*: highly coordinated routines, but possible delays when new partner enter and need to learn ENABLE process. New activity patterns	Public part: *Actor*: need to rebuilt trust with new private counterparts. New contacts *Resource*: bottlenecks during the project for all programs, funding will be stopped when ENABLE ends, and very limited academic publication output. New resource constellations *Activity*: learn how to perform new fast routines for efficient project management, no performance of academic research activities. New activity patterns	Private part: *Actor*: high turnover of personnel, relationships started outside ENABLE. New actor bonds *Resource*: longer (delayed) development time for key molecules, loss of competence for specific molecules. New resources ties *Activity*: coordination with public partners sometimes difficult due to different time-orientations. New activity links	Public part: *Actor*: some turnover of personnel and need to rebuild trust and commitment, relationships started outside ENABLE. New actor bonds *Resource*: loss of some competence, difficult recruitment, new technologies need new adaptions, adapted resources not transferrable to other programs. New resources ties *Activity*: some adaptions occurred, learnt new routines and how to work under time-pressure. New activity links

and public parties. We start by commenting on Table I and then exploit these findings to develop a model that describes the time-constrained interactions between private and public parties occurring in an inter-organizational project.

5.1 Temporality and time constraints

In the studied project, the turnover of actors is the most visible aspect of temporality. The actors include the organizations that own drug programs and who join and leave the project as programs are accepted and terminated. These shifts at the actor level take away resources from the other actors (e.g. those performing activities for the parties leaving), who accordingly have to reduce their commitment to the project as a whole. These temporality issues are visible at the level of the whole project as well as within specific interactions in the programs. This uncertainty affects the trust between the actors and organizational units across the entire project. Single actors perceive difficulties in creating trust with other actors within the project's time frame and personnel turnover due to potential exits of some partners in the short term. Actors who expect to remain within this project until its end act on the basis of this perceived future (Bryman *et al.*, 1987; Saunders and Ahuja, 2006) and occasionally arrange additional meetings that can create trust with selected parties. Temporality is visible at the actor level in terms of fluid participation (Van De Ven *et al.*, 1999), high uncertainty, and limits to create trust and commitment among parties.

As for resources, the project's resource constellation (Håkansson and Snehota, 1995) is constantly evolving due to the admission and termination of programs and hence the expansion and contraction of the other resources connected to them (molecules, information and previous test data and competence). The most obvious resources that are changing are the molecules that hit-owners bring to ENABLE, but resources in the Drug Discovery Platform are also changing. When hit-owners need specific competence not included in this platform, new partners are recruited, even outside the ENABLE project. The resource combinations (Håkansson and Snehota, 1995) are ever changing as new core and program teams are assembled for new programs. Therefore, there is a high degree of flexibility in the resources available to the various parties in the project as these expand and contract (or can even be withdrawn) at different times. However, another time-related issue on the resource level is the fact that some special competencies in the Drug Discovery Platform (e.g. *in vitro/in vivo* competencies) are specialized and therefore not interchangeable. As the workload surges right before key meetings, several drug development programs have experienced bottlenecks. Hence, the available resources also present elements of rigidity when exposed to specific demands within a short time frame.

As for activities, speed is essential both at the level of the entire project, where key resource allocation decisions are made and within activities of single programs, where particular routines are developed to keep up a very high pace. However, the entry of new parties can reduce such speed as they have to learn these routines. The activities of public parties are strictly based on the financial resources allocated to them on the basis of the needs of hit-owners, often a private partner. However, as mentioned for the resource dimension, some competencies have constraints that limit the activities that can be run in parallel at any given time. Resources are also allocated in such a way that creates a strict prioritization of activities that are functional for the project as a whole at the expense of those that are advantageous just for some public parties, such as publications. Temporality is visible at the activity level in terms of speed, limit to parallelism and strict prioritization.

Moreover, we can distinguish between two forms of temporality and time constraints. First, temporality expressed as the awareness that the project will come to an end and has to deliver results by a specific time (2020 in our case) is more visible at the entire project level and the structural interactions, where activities are organized to achieve such results and resources are allocated to optimally create the resource constellation to support them. Second, temporality expressed as time-constraints and specific time-bound achievements becomes more visible at the level of the single drug development program and daily interactions. The two aspects of temporality are clearly connected, namely, the daily time constraints are imposed by the overall goals and structure of the entire project and become visible, in our specific case, especially in the three-month cycle, where single programs are evaluated and possibly terminated.

5.2 Project coordination tools

In coordinating this project, three main tools are used:
1 discussion occurring during meetings;
2 flowcharts and milestones (Jones and Lichtenstein, 2008); and
3 a set of clear roles attributed to various actors (Bechky, 2006).

These tools are used as scaffolding practices, with consistency being achieved by milestones and flowcharts, consensus with discussions and meetings and co-constitutiveness achieved by roles (Peters and Pressey, 2016). The use of these three coordination tools is visible both at the structural level of the entire project, within the central functions of ENABLE and specific daily interactions inside the single drug development programs.

Meetings and discussions are key tools for coordinating and synchronizing the whole project as well as the activities within single programs. These meetings cover both daily current and operational issues and strategic decisions. Some pivotal meetings entail key decisions about resource allocations (program continuation or termination), even if they often build on many smaller decisions made weekly during other meetings that coordinate the various activities on a smaller timescale. During meetings, the actors also define the resource combinations (Baraldi *et al.*, 2012) that will be used to make the project progress, such as which molecule will need to be combined with which competence center. Finally, meetings entail direct interactions between individuals that contribute to building trust between actors (Jones and Lichtenstein, 2008).

Milestones and partly flowcharts are coordinating tools that apply the decisions made during meetings, especially concerning the goals to be achieved at a particular time. Moreover, flowcharts are used to steer single programs and indicate the key activities to be performed, leading to particular events. Because these activities are associated with decision

points about the specific results obtained, they contribute to coordinating the various activities. Additionally, the various actors involved in the project follow the scripts of the flowcharts as they inform them how they should relate with each other so that these tools guarantee daily interactions.

The last coordinating tool surfacing in the ENABLE project is the establishment of clear roles assigned to various actors, both individuals and organizations, within the various management bodies and committees. By virtue of these roles (e.g. hit-owner or leader of discipline in the Drug Discovery Platform), each actor is also responsible for undertaking a set of stable activities. Moreover, several of these roles are grounded in particular competencies and capacities (e.g. ample experience of drug development or disciplinary knowledge) so that the individuals holding a certain role also become trusted actors for the counterparts interacting with them.

5.3 Consequences for the parties

A first general finding about the consequences of temporality and the use of the aforementioned coordination tools is that such effects are more visible and stronger in the daily interactions that characterize single drug development programs than the structural level of the entire project. That is, whereas the awareness of the project's time limit certainly influences the formation of and interactions within the central committees, the constraints visible in Table I frame more strongly and in more detail the activities and resources involved in daily interactions. In particular, whereas the entire project as a time frame of six years and its basic structure and central interactions have been created to reflect and support this level of temporality, single drug development programs can be terminated every third month and have to follow rigid templates, flowcharts and multiple short deadlines, which create more time pressures.

Starting from the consequences on the actor level, a positive effect is that especially public parties encounter and start interacting with new partners, which are often really new contacts when it comes to companies, especially SMEs. Therefore, there is an important effect of broadening the contact network for all parties involved in this project. However, we have already mentioned that this kind of project entails that new parties can enter and others can leave. Therefore, a more problematic effect is a certain degree of instability in terms of and for the peripheral actors, which is balanced by more stability in and for the central actors who populate the core administrative bodies of the project. Furthermore, the actors, especially public ones, who have made more adaptations to the unique needs of counterparts are those affected the most by time constraints and the risk of losing such partners.

Another problematic consequence of time constraints and temporality is personnel turnover, which occurs more often at private than public partners (Plewa *et al.*, 2005) and does so for different reasons, whereas private employees more actively seek new roles and work opportunities, public employees have left their positions due to high perceived stress or uncertainty. Personnel turnover, stress and instability in terms of participating actors (especially at the project periphery) have the further effect of making it hard to create trust, especially between actors involved in the daily interactions necessary to

progress single drug development programs. It takes time to build trust (Håkansson and Snehota, 1995; Andersen and Kumar, 2006), and this lack of time and increased uncertainty (Saunders and Ahuja, 2006; Håkansson *et al.*, 2009) seems to make it difficult for both private and public partners to develop mutual relationships. However, some actors perceive that they have found new attractive partners across the public–private boundary with whom they would like to continue interacting after the termination of or outside the project. Hence, a final positive consequence of temporality is that some actors build relationships beyond the project.

If we move to the consequences of temporality on resources, the first positive effect is that resources have been made available to all involved actors. This is a broad pool of financial means and competencies that become available more rapidly within the structure and procedures of this project than the normal timing to access them outside the frame of such a project. Especially public partners have learned a lot of new competencies because they have to consider the specific and more sophisticated needs of private actors, namely, SMEs. For example, hit-owners and public actors have to learn to deal with unfamiliar chemical properties. That is, these actors need to learn new ways to combine their techno-scientific competencies with physical resources (Baraldi *et al.*, 2012). However, at the same time, the aforementioned personnel turnover and the exit of some parties means rapid losses of resources and competencies for the whole project and, more seriously, for the specific drug development programs most dependent on those particular competencies.

Moreover, there seems to be a misfit between short-term employments and the needs of researchers on the public side, whereas the project funding follows quite short time frames, researchers at public institutes look for long-term employment. This misfit makes it problematic for public actors to recruit and engage competent human resources. These limits in human resource, as well as the fast time frames and irregular patterns in which competencies and other resource need to be deployed and combined, imply that resources appear rigid and create bottlenecks, which occasionally blocks the performance of some key activities and hence the progress of some drug programs.

These resource bottlenecks reflect clear consequences for activities in terms of delays experienced by private actors in their programs. Such delays are also caused by the misfit in the time orientation between public and private actors, with the former being accustomed to longer times in performing their activities as well as more tolerance for delays, compared with the shorter times and strict deadlines applied by private partners such as companies. On the other hand, also reflecting the aforementioned resource and competence adaptations, most public partners have been rather rapid in adapting their own activities (laboratory procedures and various assays) to the specific needs of private partners such as SMEs. Although these quick adaptations of public actors to the needs of private actors are a positive effect, one also needs to consider the other side of the coin, i.e. all these adapted activities loose value if that private party exits the project.

Looking at the activity pattern (Håkansson and Snehota, 1995) across the whole project, we see that both private and public actors have achieved high coordination among several

parties. This is especially an important accomplishment for public actors who learned how to use project management tools to control activities, which also has shorter and tighter deadlines. However, activity coordination is problematic and might result in delays associated with the entry of new parties that must learn the project's routines. Finally, another problematic consequence of temporality and time constraints is the lack of time to conduct "slack" activities such as reflection on a project's results, including publications, a particularly problematic consequence for such public parties as universities.

The model presented in Figure 2 summarizes our results concerning the manifestations of temporality and time constrains (visible in the central part of the figure), the coordination tools used (depicted in the lower part of the figure) and the consequences for the actors, resources and activities involved in this kind of temporary or time-constrained interactions (on the right side of the figure). As for temporality, the model indicates that we can distinguish between structural interactions, occurring at a higher and central level of the project organization, where more stability exists and over longer time frames and daily interactions, occurring at any level of the project organization, although especially at the periphery, almost instantaneously and with greater uncertainty about whether they will continue. This seems to indicate that there are two different sorts of temporality, a long and a short temporality, which frames differently the interactions between public and private parties. In our specific case, one can set a very rough boundary of the long temporality stretching to six years (the entire duration of the whole ENABLE project) and the short temporality being three months (the cycle of approval/termination imposed to single drug development programs). Because it is likely that daily interactions are more intense and rigidly governed by templates such as deadlines and flowcharts, the consequences of temporality and time constraints are more visible in daily interactions. Structural interactions, however, seem to be governed in a more flexible way by the moderate stability implied by the longer form of temporality.

Even if temporality is manifested mostly in terms of time-based constraints (i.e. limitations) for actors, resources and activities (Figure 2), several positive consequences can arise for these actors (e.g. new contacts), resources (e.g. new competencies) and activities (e.g. high coordination) (Figure 2)

Figure 2 A model over time-constrained inter-organizational interaction between public and private organizations
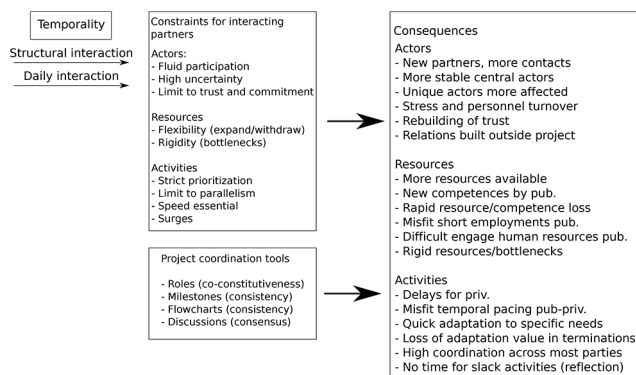
when temporality is combined with the various coordination tools (meetings, flowcharts and roles).

According to Figure 2, for both public and private actors, temporality implies fluid participation, uncertainty, and difficulties building trust and commitment. For resources, Figure 2 presents both elements of flexibility (rapid expansion and contraction) and rigidity (expressed as bottlenecks over short time frames). Finally, Figure 2 shows that activities must follow a strict prioritization and are less open to parallel processing and must be performed at the highest speed.

Project coordination relies on three tools:

- The first is clear definition of roles, which counterbalances the aforementioned problems in creating effective trust by establishing cognitive trust (Dowell *et al.*, 2015) in the experts and which specifies the division of labor over these roles so that activities are performed according to a stable pattern.
- Second is discussions and meetings that departs from the actors and entails making decisions on the allocation of resources and the definition of resource combinations, while simultaneously contributing to building affective trust (Dowell *et al.*, 2015) among meeting participants.
- Third is milestones and flowcharts that apply the decisions made at meetings (on resource allocations and coordination), while also creating the scripts and templates that actors follow in daily interactions as well as the coordination among the many project activities.

Finally, coming to the consequences of temporality and the use of these coordination tools, the model in Figure 2 identifies a total of 18 such effects, six each for the actor, resource and activity level. As already mentioned, although many of these consequences entail problems and limitations for interactions (instability, limited trust, rapid resource loss and bottlenecks or delays and lack of slack), there are also positive consequences such as new partners and broader contact networks, more available resources, new competencies gained, rapidly achieved adaptations and coordination, as well as the continuation of some relationships beyond the project. Some of these consequences also connect and reinforce each other. For example, the misfit with short employments makes it difficult for public partners to recruit competent human resources, which creates bottlenecks and causes delays in the activities performed for private partners. However, the connections between the various consequences can also be such that solutions are sought outside the frame of the project. For example, stress and personnel turnover make it difficult to build trust, but actors seek to build long-term relationships beyond this project if they perceive some partners as particularly attractive.

6. Conclusions

Our study investigates how temporality and time constraints in inter-organizational projects relate to the interactions between the public and private organizations. The most salient consequences of such constraints and the use of project coordination tools include a high turnover of involved actors and uncertainty about future interactions, limitations that make it more difficult to develop trust in inter-organizational interactions. This is a clear difference between these time-constrained inter-organizational relationships and the long-term interactions typically investigated within the IMP

perspective (Håkansson and Snehota, 1995; Ford *et al.*, 2003; Medlin, 2004). Another salient difference is that temporality requires that the resources combined by the actors in time-constrained interactions be used as efficiently as possible, but the short times available for deploying them as well as the actors' fluid participation and lack of continuity make it difficult to achieve such efficiency. Broader time frames and stability are needed to achieve efficiency in long-term relationships (Araujo *et al.*, 1999; Medlin, 2004).

Paradoxically, activities designed precisely to avoid any delay often create bottlenecks that eventually cause delays. In our case, it was mostly private actors that were negatively affected by delays originating from the activities of a public partner, a situation that was probably due to the longer time orientation of public parties (Cyert and Goodman, 1997; Plewa *et al.*, 2005) and their difficulty in adapting to time constraints and temporality, which companies are more familiar with. Similarly, the lack of time for slack activities, such as reflection, affected more clearly public (academic) partners. This pattern that public actors are more affected by temporality and time constraints than private actors needs to be verified by further research as our results build on a single case study.

In addition to the negative consequences for resource development and use, activities timing and trust-building, our results show several positive effects of time-constrained interactions. First, with more resources available and tighter interactions, important new competencies were quickly developed by public partners. Moreover, within a short time frame, important adaptations of activities and resources (Hallen *et al.*, 1991) can occur. Finally, actors searched opportunities to continue some interactions with selected parties outside the focal project and its strict time constraints. Therefore, there are reasons to believe that the time-constrained interactions occurring within a project can induce the parties to continue interacting outside and beyond the temporal boundaries of the project. This finding is important because it indicates that the project form of organization is not in itself a hindrance to the emergence of long-term business relationships (Håkansson and Snehota, 1995), but it can be an occasion for two parties to interact intensively and expose a future potential relationship to some sort of stress test. Thus, projects provide themselves episodes of interactions (Håkansson *et al.*, 2009) on which long-term relationships can be built. Further research should specifically address the conditions under which two parties might decide to move from a project's time-constrained interactions to the long-term interactions necessary to establish a business relationship.

Our results also indicate that the consequences of time constraints were more visible in daily interactions, which are exposed to a shorter temporality, than in the structural interactions at the entire project level, which reflects a longer temporality. This suggests that the longer the time frames, the easier it is for actors to focus on building relationships alongside the accomplishment of a project's task (Sydow *et al.*, 2004; Saunders and Ahuja, 2006). In particular, in our case, we could see clearly such effects when comparing the six-year time frame of the entire project with the three-month evaluation cycle impinging more on daily interactions. These are preliminary and case-specific results, so further research should help identifying a relevant time scale (in months or years) to set the boundary between short and long temporality for constrained inter-organizational interactions.

Finally, this paper reveals which project coordination tools are used and how. The rigid temporal steering of chronological and event-based pacing tools (Jones and Lichtenstein, 2008), such as flowcharts and milestones, which intervene directly at the level of activities, is complemented by more flexible entrainment tools (Jones and Lichtenstein, 2008), such as meetings and discussions, and role-based coordination (Bechky, 2006), which both intervene at the level of actors and resources. In particular, meetings/discussions not only generate decisions that flowcharts implement but also their own pattern and frequency allows actors and resources to move along the project's timeline. To reach our results, the ARA model (Håkansson and Snehota, 1995) proved to be a useful analytical tool, which could ideally be used for both validating our results through several cases and for penetrating even deeper into the interaction patterns.

In particular, our results and model are limited by the fact that we investigated a single project involving public and private organizations focusing on drug R&D. Further studies should apply a similar framework to cases of projects involving different configurations of players (non-governmental organizations, only public or only private parties) and dealing with more routine tasks than drug development, such as physical buildings. Another relevant avenue for further research is to penetrate the effects of temporality and time constraints on the very mechanisms and processes of joint knowledge creation, i.e. a particular dimension of the inter-organizational interactions investigated in this study. A key question could be when and how temporality and time constraints represent a barrier to interacted knowledge development.

Notes

1 Hits, Leads and Candidates are the stages of development of a drug/molecule during the optimization phase. These classifications indicate how confident evaluators are that a drug works as it should on its way to becoming a candidate to start clinical studies.

2 An assay is an experimental setting that allows the assessment or measurement of biological activities or other properties of the molecule (s).

3 In 2017, Evotec took over Sanofi's antibiotic development unit even though it was a considerably smaller company than Sanofi at the time with around only 2000 employees. Following this acquisition, Evotec also took over the role as a partner in ENABLE for this program.

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