

Managing tensions related to information in coepetition

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Abstract:

This study seeks to provide insights into the management of tensions related to information in coepetition. The literature on coepetition management recommends a separation principle, an integration principle or a combination of both. Focusing on tensions related to information in coepetition at the project level, we consider which principle is most appropriate. We theoretically discuss the control mechanisms used to address information criticality and information appropriability. In addition, we conduct an in-depth case study of a space project involving two competitors, Astrium and Thales Alenia Space. First, we describe the tensions related to information that arose in the context of this coepetitive project. In particular, financial and technical information presented dilemmas. Second, we explain how the coepetitors used formal control mechanisms to separate critical information from non-critical information. Specifically, information that was critical to the project's success was shared through a common information system specially designed for the project, whereas non-critical information was withheld from the partner. Third, because formal control mechanisms were insufficient to address critical information that was also appropriable, we show how project managers implemented informal control mechanisms. For example, project managers transformed appropriable information into non-appropriable information by aggregating data and withholding details such as calculation methods and cost structures. Our findings suggest that the management of tensions related to information in coepetitive projects requires a combination of formal control mechanisms (to manage information criticality) and informal control mechanisms (to manage information appropriability).

Keywords: coepetition, coepetitive project, tensions, information, control mechanism, information criticality, information appropriability

Introduction

Firms adopt coopetition strategies – simultaneous collaboration and competition - to address current technological challenges (Bengtsson and Kock, 2000; Czakon et al., 2014a; Gnyawali and Park, 2009; Ritala, 2012; Santamaria and Surroca, 2011). However, coopetition strategies are replete with tensions as a result of combining these two contradictory forces (Bengtsson et al., 2003; Fernandez et al., 2014; Gnyawali and Park, 2011; Raza-Ullah et al., 2014; Tidström, 2014).

The management of cooperative tensions has become a critical factor in cooperative success and a pervasive research issue. Previous studies have identified various solutions to manage cooperative tensions. Based on the notion that individuals are unable to internalize the paradox, certain scholars recommend a separation principle, i.e., the spatial, functional or geographical separation of competition and collaboration management (Bengtsson and Kock, 2000; Dowling et al., 1996; Herzog, 2010). However, because the separation principle creates new internal tensions, other scholars recommend an integration principle, which is based on individuals' capacity to integrate collaboration and competition (Chen, 2008; Das and Teng, 2000; Oshri and Weeber, 2006). In addition, despite the theoretical contradiction between these two principles, recent studies show that the efficiency of coopetition management depends on a combination of separation and integration (Fernandez et al., 2014; Pellegrin-Boucher et al., 2013).

Previous studies have focused on cooperative tensions as a whole and show that cooperative tensions are multidimensional and can arise at different levels (Chiambaretto and Dumez, 2016; Fernandez et al., 2014; Tidström, 2014). The project level is one of the most relevant levels of analysis. Indeed, the implementation of coopetition strategies requires employees from competing parent firms to work together on specific projects on a daily basis (Fernandez et al., 2014; Gnyawali and Park, 2011). Among the numerous cooperative tensions

at the project level, the tension between sharing and protecting information is critical (Baruch and Lin, 2012; Fernandez et al., 2014; Levy et al., 2003). Although partners must share information and knowledge to achieve the common goal of the collaboration (Dyer and Singh, 1998; Gnyawali and Park, 2011), they remain competitors and therefore must protect certain information from each other (Baruch and Lin, 2012; Khanna et al., 1998; Lane and Lubatkin, 1998). This dilemma is even greater in innovative cooperative projects because the risk of opportunism and appropriation is particularly high in such projects (Baruch and Lin, 2012; Bouncken and Kraus, 2013; Hurmelinna-Laukkanen and Olander, 2014; Ritala and Hurmelinna-Laukkanen, 2009, 2013). Thus, we define the tensions related to information in a cooperative project as the difference between a firm's need to share information to ensure the success of the common project and the firm's need to limit information sharing to avoid informational spillovers into other markets.

There is a gap in the cooperation management literature regarding the management of tensions related to information. To explore this issue, we build on control mechanisms designed to foster the success of a common project while limiting the risk of opportunism (Das and Teng, 2001). We distinguish between formal and informal control mechanisms to manage tensions related to information (Das and Teng, 1998a, 1998b; Hurmelinna-Laukkanen and Olander, 2014; Ritala et al., 2009). To determine whether information should be shared and/or protected, managers must consider two dimensions of the information: criticality (Baumard, 2010; Pfeffer and Salancik, 1978) and appropriability (Das and Teng, 1998; Miller and Shamsie, 1996; Oxley, 1997).

Regarding information criticality, both formal and informal control mechanisms may be used to share critical information and to protect non-critical information. However, critical information can be non-appropriable or appropriable. Although non-appropriable critical

information may be shared with low risk, the sharing of appropriable critical information is highly risky (Padula and Dagnino, 2007; Un et al., 2010).

Thus, our research questions are as follows: (a) What control mechanisms do companies use to manage tensions related to information in cooperative projects? (b) Are these mechanisms consistent with the separation principle, the integration principle or a combination of both?

To provide relevant insights, we conducted an in-depth case study of Yahsat, a space project jointly implemented by Astrium and Thales Alenia Space (TAS), two major competitors in the European market for the manufacture of telecommunications satellites.

Our findings contribute to the knowledge on the management of tensions related to information in cooperative projects. First, we describe the existence of different forms of tensions related to information. Second, we show that the management of information in a cooperative project depends on the nature of the information, i.e., its criticality and appropriability. The studied competitors constructed formal control mechanisms to address information criticality. However, we show that these formal control mechanisms were insufficient to address information appropriability because they were incapable of managing information that was simultaneously critical and appropriable. Consequently, the management of information appropriability necessitated informal control mechanisms implemented by project managers. Thus, both formal and informal control mechanisms were necessary to manage tensions related to information. Formal control mechanisms were used primarily to address information criticality, whereas informal control mechanisms were used to manage information appropriability.

We make several contributions to the cooperation literature. First, we develop literature- and case-based insights into how firms involved in a cooperative project effectively manage tensions related to information through a combination of formal and informal control

mechanisms. These revelations provide original insights into coopetition theory and have important theoretical and managerial implications. Second, we discuss our findings in the context of the existing coopetition management literature. Whereas most previous scholars opposed the separation principle to the integration principle (Bengtsson and Kock, 2000; Chen, 2008; Das and Teng, 2000; Dowling et al., 1996; Herzog, 2010; Oshri and Weeber, 2006), our research seems to be more consistent with recent research that reconciles these two principles (Fernandez et al., 2014; Pellegrin-Boucher et al., 2013). Our results suggest that the combination of separation and integration principles in a coopetitive project can be achieved by effectively managing tensions related to information through a combination of formal and informal control mechanisms. Third, our research underlines the key role of project managers in the management of tensions related to information and in the success of coopetition strategies. We show that the efficient management of tensions related to information is critical to the success of a coopetitive project. Finally, our paper is based on rich conceptual development and provides a solid basis for expanding the understanding of coopetition and its implications. The findings from the studied case provide interesting perspectives for the design of future research, such as large-scale empirical studies.

1. Theoretical background

1.1. Tensions related to information in coopetitive projects

Bengtsson and Kock (2014: 182) define coopetition as “*a paradoxical relationship between two or more actors simultaneously involved in cooperative and competitive interactions, regardless of whether their relationship is horizontal or vertical*”. Because coopetition combines the benefits of cooperative and competitive behaviors, it is meant to produce greater results than pure collaborative agreements (Bengtsson and Kock, 1999, 2000; Brandenburger and Nalebuff, 1996; Czakon et al., 2014a, 2014b; Lado et al., 1997; Peng et al., 2012; Ritala, 2009). However, the combination of collaborative and competitive behaviors contributes to

the emergence of tensions at various levels, including inter-organizational, intra-organizational and inter-individual levels (Bengtsson and Kock, 2000; Czakon, 2010; Fernandez et al., 2014; Le Roy and Fernandez, 2015; Luo et al., 2006; Padula and Dagnino, 2007). Coopetitive tensions are even more important at the project level because the implementation of coopetition strategies requires employees from competing parent firms to work together (Fernandez et al., 2014; Gnyawali and Park, 2011). The project level is thus crucial to an understanding of how intra-organizational tensions are managed. One critical intra-organizational tension arises from the dilemma between sharing and protecting information (Baruch and Lin, 2012; Fernandez et al., 2014; Levy et al., 2003).

The partners of an alliance can easily learn from one another, especially if they are competitors (Baruch and Lin, 2012; Capaldo and Petruzzelli, 2014; Khanna et al., 1998; Lane and Lubatkin, 1998). Although partners must share information and knowledge to achieve the common goal of the collaboration (Dyer and Singh, 1998; Gardet and Mothe, 2011; Gnyawali and Park, 2011; Mention, 2011), each partner must also protect the strategic core of its knowledge from its competitor (Baruch and Lin, 2012; Baumard, 2010; Hoffmann et al., 2010; Ritala et al., 2015) because partners that operate in the same industry must develop unique skills (Nelson and Winter, 1982). Information that is shared within a common collaborative project potentially could be used in a different market in which the partners compete. In brief, the competing partner could benefit by appropriating the shared information (Hurmelinna-Laukkanen and Olander, 2014). Building on Saxton and Dollinger (2004), we define the appropriability of information as the extent to which an organization could incorporate such information into its own products or markets. In inter-organizational relationships, firms must share resources while remaining wary of the risk that a partner may use these shared resources for other products or markets. This risk, or “appropriability hazard” (Oxley, 1997), is stronger when partners are competitors because the appropriated

resources might be used to develop products that could compete in the future with the focal firm's products (Ritala et al., 2009; Ritala and Tidström, 2014). Coopetition thus offers interesting learning opportunities for partners (Larsson et al., 1998). In a coopetitive project in which partners could utilize shared information for their own purposes, the risk of opportunism and appropriation is particularly high (Baruch and Lin, 2012; Bouncken and Kraus, 2013; Hurmelinna-Laukkanen and Olander, 2014; Ritala and Hurmelinna-Laukkanen, 2009, 2013).

We define tensions related to information in a coopetitive project as the difference between a firm's need to share information to ensure the success of the common project and its need to limit information sharing to avoid informational spillovers into other markets. Although previous studies have focused on describing coopetitive tensions related to information, little attention has been given to the management of these tensions (Fernandez et al., 2014; Tidström, 2014).

1.2. The management of tensions related to information in coopetitive projects

Coopetition management literature has identified two theoretical principles. The first principle, separation (Bengtsson and Kock, 2000; Herzog, 2010; Poole and Van de Ven, 1989), advocates a functional, temporal or spatial separation of the management of competition and the management of collaboration. The second principle, integration, encourages individuals to transcend paradoxes (Chen, 2008; Farjoun, 2010; Luo et al., 2006; Oliver, 2004). Managers involved in coopetition must develop a coopetitive mindset to internalize the paradoxical nature of coopetition and to efficiently manage the related tensions (Chen, 2008; Gnyawali and Park, 2011; Luo et al., 2006; Raza-Ullah et al., 2014).

A few empirical contributions have gone beyond theoretical principles and identified the real stakes of managing coopetitive tensions at the project level (Fernandez et al., 2014;

Herzog, 2010; Le Roy and Fernandez, 2015). These studies confirm the importance of both principles (Herzog, 2010) and of the combination of the two principles (Fernandez et al., 2014) in managing coepetitive tensions. However, these studies suffer from a major limitation: they investigate coepetitive tensions as a whole and ignore the specific managerial tools required to resolve each type of tension. To manage tensions related to information, a firm can implement a separation principle, an integration principle or both principles simultaneously.

In addition, several scholars have examined project management for the development of new products. Lewis et al. (2002) study the different tensions and challenges confronted by project members when they are required to meet contradictory demands. The researchers identify and compare the relevance of different project management approaches. Following a similar approach, Bonner et al. (2002) examine the necessity for project managers to combine formal and informal control mechanisms to increase project performance.

Combining these approaches on coepetition management and project management is thus essential to understanding the specificities and the management of tensions related to information in a coepetitive project.

1.3. Theoretical framework

This research aims to determine how information is managed in a coepetitive project. To provide insights on this issue, we discuss the role of control mechanisms in managing tensions related to information depending on the nature of the information, i.e., whether the information is critical and/or appropriable.

1.3.1. Control mechanisms to manage tensions related to information

To manage tensions related to information, most firms rely on control mechanisms to foster the success of a common project while limiting the risk of opportunism (Das and Teng, 2001). Following Das and Teng (2001), we define a control mechanism as a set of formal and informal rules that is designed to control the behavior of the partners and of the alliance *per se*. Control mechanisms are implemented to facilitate interactions between partners while limiting the risk of opportunism. Fostering cooperation between partners improves the partnership's "performance benefits" (i.e., the prospect of achieving the strategic goals of the alliance given the full compliance of all partners (Das and Teng, 1996, 1998)). However, control mechanisms should also minimize "relational risks" related to the level of each partner's commitment to the joint venture.

Control mechanisms may assume several forms. Formal control mechanisms may comprise contracts that define rules and penalties related to the information shared between coopetitors. Formal control mechanisms can also refer to formal procedures or structures to support the strategies of firms (Das and Teng, 1998, Lee and Cavusgil, 2006; Poppo and Zenger, 2002). By contrast, informal control mechanisms can be used to make decisions on a daily basis and to complement formal control mechanisms (Hurmelinna-Laukkanen and Olander, 2014; Ritala et al., 2009). For instance, to help determine whether a particular type of information should be shared to enhance a common project's short-term success or withheld to protect the parent firm's long-term success, managers must develop daily procedures and routines for categorizing information (Bouncken, 2011; Bouty, 2000). These informal control mechanisms, such as trust or reputation (Filatotchev et al., 2008; Gulati, 1995; Lui and Ngo, 2004; Reuer and Ariño, 2007), also play a central role in the relational view of alliance governance and are not specific to the cooperation context.

However, several contributions have highlighted that formal and informal control mechanisms do not work separately and must be combined to manage tensions between

partners and increase alliance performance (De Man and Roijackers, 2009; Faems et al., 2008; Lee and Cavusgil, 2006, Poppo and Zenger, 2002; Reuer and Ariño, 2007). In the specific case of coepetitive projects, we can assume that firms also combine formal and informal control mechanisms to manage tensions related to information.

1.3.2. Information management in a coepetitive setting

Managers need to consider two dimensions of information: criticality and appropriability.

First, building on Pfeffer and Salancik (1978), information is critical if it is important or essential to a project's success. In a coepetitive project, some information should be shared to avoid the failure of the common project (Baumard, 2010). Information that is critical to the success of the project should be shared, whereas non-critical information should be protected.

Second, managers must consider the appropriability of the information. Not all information presents the same appropriability hazard (Oxley, 1997); rather, some information is less appropriable than other information (Bengtsson et al., 2003; Das and Teng, 1998; Dubois, 2006; Kumar, 2010; Miller and Shamsie, 1996). The risk of appropriation is lower in collaborations involving non-competitors than in collaborations between direct competitors (Hurmelinna-Laukkanen and Olander, 2014; Padula and Dagnino, 2007; Un et al., 2010).

To address information criticality, formal and informal control mechanisms can be used to separate critical from non-critical information, thereby ensuring that critical information is shared within the coepetitive project and that non-critical information is protected.

Critical information can be appropriable or non-appropriable. Formal and informal control mechanisms can be used to evaluate the degree of information appropriability. Non-appropriable critical information can be shared between coepetitors with low risk because the partner is unable to use the information for other projects (Padula and Dagnino, 2007; Un et

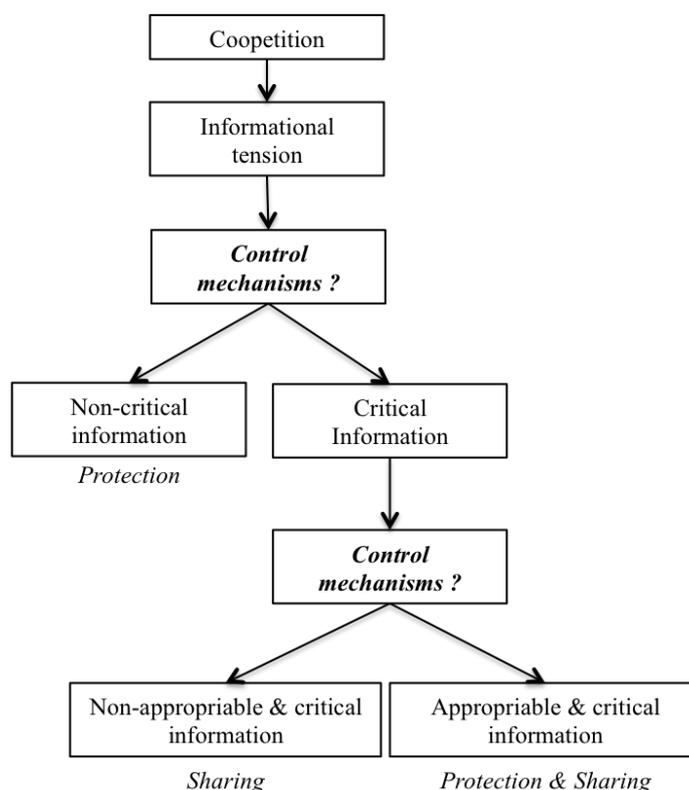
al., 2010). However, appropriable critical information should, paradoxically, be both shared (for the project’s success) and protected (to limit the long-term risk that a coopetitor will use this information for competing projects) (see Table 1).

Table 1. Management of different types of information

Criticality	<i>Critical</i>	<i>Non-critical</i>
Appropriability		
<i>Appropriable</i>	Protection and Sharing	Protection
<i>Non-appropriable</i>	Sharing	

The question of how formal and informal control mechanisms can allow the simultaneous sharing and protecting of appropriable critical information remains unanswered. We have little information about the management of information in cooperative projects. Thus, we formulate the following research questions: (a) What control mechanisms do companies use to manage tensions related to information in cooperative projects? (b) Are these mechanisms consistent with the separation principle, the integration principle or a combination of both? Our research aims to answer these questions.

Figure 1: Theoretical framework



As Figure 1 illustrates, to manage tensions related to information in cooptation, firms need to decide what type of control mechanisms should be used. The choice will be driven by two features of the information – its criticality and its appropriability. Combining both features, firms will decide to protect (non-critical information), to share (non-appropriable and critical) or to protect and share (appropriable and critical information).

2. Methods and empirical setting

2.1. Research design: an in-depth case study

This research aims to understand how firms implement different control mechanisms to address tensions related to information in a cooptative setting. More precisely, we investigate the extent to which these control mechanisms allow managers to share or protect information depending on the nature of the information. Because we aim to describe and understand a new

phenomenon (rather than to test propositions), an exploratory research design is appropriate (Miles and Huberman, 1994). Accordingly, we conduct an in-depth case study to analyze the management of tensions related to information between cooptitors (Yin, 2009, 2012). Two reasons justify the choice of a single case study. First, a single case study allows us to investigate a new phenomenon at various levels without being constrained by preliminary decisions regarding tools or types of data (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). Because we do not know the precise boundaries of our research object, conducting a single case study allows us to analyze the phenomenon more deeply while focusing on a specific level of analysis: the cooptitive project. The second reason for our choice is that recent contributions to the field have highlighted the necessity of using case studies to investigate the challenges generated by cooptition (Bengtsson et al., 2010). In-depth case studies allow researchers to understand how cooptitive management principles (integration and/or separation) are actually applied within firms.

2.2. Data collection

Both primary and secondary data were collected to enable the use of triangulation techniques (Eisenhardt, 1989; Gibbert *et al.*, 2008; Lincoln and Guba, 1985). We collected primary data through 51 semi-structured interviews with CEOs, department heads, project managers and team members. The duration of interviews ranged from 43 to 154 minutes, and the average duration was 77 minutes. With the exception of five conference calls, all interviews were conducted face to face. The interviews were recorded and then transcribed as soon as possible to preserve the quality of the data (Gibbert et al., 2008). Following Gioia et al. (2013), we assured the interviewees that the names of individuals and firms would not be used. Throughout the remainder of this article, the interviewees are identified according to their functions within the innovation project, and the firms are called firm A and firm B to

distinguish between them. Secondary data were obtained from various sources, including internal documents (e.g., contracts, presentations, meetings and reports) and external documents (e.g., news articles and industry reports). The combination of primary and secondary sources allowed us to triangulate the collected information by crosschecking facts and dates to avoid potential interpretation biases.

2.3. Data analysis

The primary and secondary data were coded according to the recommendations of Miles and Huberman (1994). The selected method is abductive; accordingly, the phases of the empirical investigation were alternated with theoretical reviews. Two stages can be differentiated within the analytical process.

An initial round of coding followed the literature to identify inter-organizational relationships within the industry; the drivers of these relationships; tensions and their management; and the outcomes of common projects. This round was essentially deductive and allowed us to ensure that our chosen case and industry were relevant to the study of tensions related to information.

Then, an inductive round of coding was undertaken to reveal the sources, dimensions and features of cooperative tensions and their management. This second round was inspired by the method proposed by Corley and Gioia (2004) and Gioia et al. (2013) and entailed coding our material in different steps. We began by identifying first-order categories, which allowed us to label the interviews. Then, we attempted to arrange the first-order categories within second-order themes to link the first-order categories with the existing literature and to identify potential nascent concepts or mismatches. Finally, we attempted to combine the second-order themes into aggregate dimensions to study the relationships between them. To

implement the different steps in the inductive round, we used NVivo 8 software to conduct the content analysis and to design arborescence.

2.4. Empirical setting

Coopetition is frequently observed in high-tech industries (Gnyawali et al., 2006). In addition, tensions related to information are likely to occur in high-tech industries (Bonel and Rocco, 2007; Gnyawali and Park, 2009) because information is a primary asset of firms in these industries (Powell and Dent-Micallef, 1997; Wade and Hulland, 2004). In light of these observations, our in-depth case study was conducted within the European market for the manufacture of telecommunications satellites. Three American manufacturers (Boeing Space Systems, Lockheed Martin, and Space Systems Loral) and two European manufacturers (TAS and Astrium) operate in the international market. These firms compete fiercely with each other as they respond to invitations to tender from space agencies in institutional markets and from private telecom operators in both local and international markets.

The European space industry is structured around two leaders: Astrium and TAS. Although these two firms are essentially competitors, collaborative relationships have developed between them.

In August 2007, Al Yah Satellite Communications Company (Yahsat) contracted with Astrium and TAS for the manufacture of a dual system of telecommunications satellites. With a global value of 1.8 billion dollars, Yahsat became the most important space project in the world. This project was successfully completed in 2012. The alliance between the two European manufacturers was driven by the presence of a common American competitor and by the high level of risk associated with Yahsat. To achieve the project goal, TAS and Astrium pooled technological, financial and human resources into a common project team.

Yahsat thus represents an interesting case for studying the management of tensions related to information in cooperative projects.

3. Findings

3.1. Tensions related to information in cooperative projects

Tensions related to information represent a key strategic issue in cooperative projects such as Yahsat. Each partner must simultaneously share information that will ensure the project's success and protect strategic information from the other partner.

The first illustration of informational tension relates to financial information. The client demanded a single agent, and Astrium was appointed. Astrium and TAS needed to agree on a common price before meeting with the client. To establish a suitable common price, the partners needed to share information about their respective margins and internal cost structures. Sharing this financial information was essential for the project's commercialization. However, this type of information is highly appropriable. The sharing of information related to margins or internal costs could expose either firm to a high risk in terms of future projects. Indeed, each firm would know its partner's competitive advantage, and this knowledge would distort future competition (Quote 1, Appendix 1).

The second illustration of information tension relates to technical information. Technical information refers to information about an electronic component (shape, technical features and duration), technology (e.g., electric power, chemical power, propulsion and engines) or math formula (e.g., calculation of power and calculation of resistors). Yahsat was a technically challenging project, and neither TAS nor Astrium had the competencies and resources to undertake the project alone. Rather, technical resources from both partners were essential to the success of Yahsat. Accordingly, the sharing of technical information between the companies was imperative (Quote 2, Appendix 1).

Sharing technical information also presented an opportunity for each firm to learn the strengths and weaknesses of its competitor, which would enable each firm to evaluate its strategic advantage over its competitor on future bids. Furthermore, the technical information shared within the project could be appropriated and used to improve either partner's own products. The partners would learn from each other; TAS would be able to imitate the best aspects of Astrium, and *vice versa*. Consequently, team members needed to share critical technical information to ensure the progress of the project while protecting appropriable technical information (Quote 3, Appendix 1). Team members were thus required to manage the tensions related to information between the need to share technical information to fulfill collaborative objectives (short-term perspective) and the need to protect technical data to preserve the firm's competitiveness (long-term perspective).

Tensions related to information appeared to be important in this cooperative project, especially for appropriable critical information. The questions are thus how such tensions were managed and what control mechanisms were used to manage them.

3.2. Management of tensions related to information in cooperation

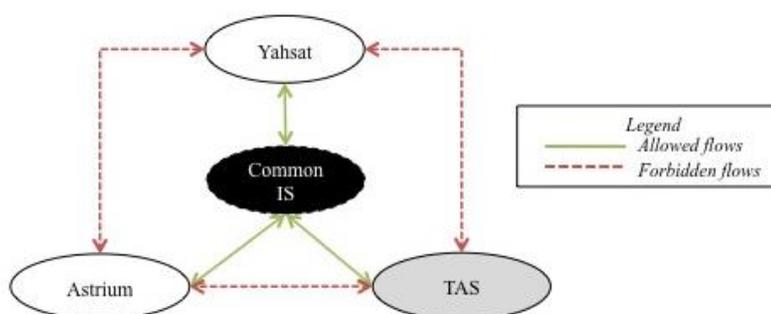
3.2.1. Formal control mechanisms to manage tensions related to information

To manage tensions arising from the sharing and protecting of financial information, TAS and Astrium created specific formal control mechanisms through the development of a dedicated information system (IS).

This system allowed the partners to share financial information that was necessary for the formulation of a joint tender, thereby enabling the partners to establish a common price, but protected financial details, such as margin rates and internal cost structures. Each partner could share confidential and strategic financial information through the IS, but financial details remained in the system and could not be accessed by the competitor. As a result of the

dedicated IS, neither TAS nor Astrium had access to information regarding the financial competitiveness of its partner. The IS combined information from both partners to generate common global aggregate information that could be communicated to the client. The aggregate offer received by the client omitted information regarding the financial structures of TAS and Astrium to prevent the transfer of financial information through the client (Quote 1, Appendix 2). Figure 2 presents the architecture of the IS developed by the companies to handle financial information.

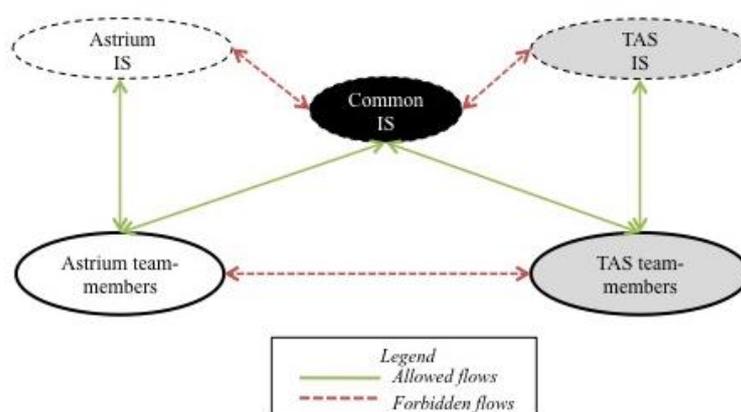
Figure 2. IS to manage financial information



To manage tensions related to technical information at the project team level, TAS and Astrium implemented an additional dedicated IS that met several objectives. First, this IS allowed the sharing of technical information that was necessary for the project. Technical information that was essential for the collaboration was shared only *via* the IS; direct sharing between team members was prohibited. The IS maintained the data in a cloud, and team members had restricted access to these data. The position of a team member (manager, technician, or engineer) would determine whether that member had access to particular information. The IS did not communicate all details of the technical information; rather, it provided information as a package or as a ready-to-implement solution. The integrated IS facilitated the exchange of information between team members to ensure that the project progressed in a satisfactory manner (Quote 2, Appendix 2).

Second, this integrated system ensured that confidential and strategic technical information was protected. Critical information could be shared only through the IS, and team members were the only individuals allowed to access the IS. Employees working on non-collaborative projects did not have access to the information pooled in the IS. Moreover, the information in the IS was communicated in aggregate form. Specifically, general solutions to technical problems were disclosed without any explanation of why the problem occurred or how the solution was found. The objective of this IS was to maintain the collaborative spirit of the project while preserving the competitiveness of each partner. In sum, the IS was built to encourage the sharing of technical information necessary for the collaboration while preserving the confidentiality of this information to respect the competitive dimension of the relationship between TAS and Astrium. Finally, the integrated IS had no connection to the private IS of either TAS or Astrium. The strict separation between the integrated IS and the private systems of TAS and Astrium provided additional protection from undesired transfers of information from the project team to the parent firms. However, team members needed access to the internal databases of their respective employers to solve problems and find technical information. To allow this access, TAS and Astrium each created a specific and restricted network, and each team member received a username and password to access the database of his or her employer. Figure 3 presents the architecture of the IS implemented by the companies to manage technical information.

Figure 3. IS to manage technical information



3.2.2. *Informal control mechanisms to manage tensions related to information*

Project managers from both TAS and Astrium were essential to the development of informal procedures to manage information sharing within the cooperative project. Project managers were the decision makers regarding the sharing/processing dilemma; these managers explained to team members what types of information should be shared (e.g., format, data and details) as well as how and when such information could be shared.

When a project manager considered certain information to be critical to the project, he could encourage team members to share the information *via* the IS. If the critical information was neither strategic nor confidential, the project manager could encourage full disclosure of the information, including all details and data. On the contrary, if the project manager considered the critical information to be highly strategic and confidential, he would encourage partial sharing (i.e., only aggregate technical information without any details or related data) *via* the IS. Project managers were thus responsible for determining whether critical technical information was strategic and/or confidential. The competitive dimension of the project encouraged team members to limit the disclosure of strategic information (Quote 3, Appendix 2).

Decisions regarding the sharing of information were not made *a priori* but rather were based on project needs (the criticality of the information) and the risk of information transfers (the appropriability of the information). Moreover, technical information was considered to be strategic for a limited period of time. Accordingly, project managers could prohibit the sharing of information for a certain period and allow sharing thereafter.

Team members from TAS and Astrium interacted during coffee breaks and lunch periods on a daily basis. Because these informal meetings were difficult for project managers to control, unwanted transfers of strategic information could occur. Project managers were responsible for addressing such leaks. Various situations involving unwanted transfers of

information can be distinguished. For example, a team member might mistakenly share confidential technical information. In this case, the project manager would attempt to limit the effects of the information transfer by meeting with the responsible team member to discuss the mistake and to avoid replication of the transfer in the future. The project manager would then meet with the other firm's project manager to explain the criticality of the situation. He would request that the other manager not use the information that was transferred. Because this situation could arise for either TAS or Astrium, the project managers trusted one another and agreed to maintain the confidentiality of transferred information. The shared information thus remained at the project team level and was not transferred to the competitive parent firm. A different situation arose if a team member voluntarily shared confidential technical information. In this case, the project manager would blame the team member and, in extreme cases, exclude him from the team. In this situation, the other team's members were permitted to use the information for the benefit of their parent firm, even if it was confidential. In sum, the practice adopted by TAS and Astrium was to be respectful in cases of mistakes but to take advantage of opportunistic behavior. The issue could thus be whether the transfer was accidental or intentional. No formal procedures were established to answer this question; rather, it remained the responsibility of the project manager. Thus, the project manager was the actor responsible for defending or blaming the individual who shared the information. The informal management of tensions related to information therefore relied on the project manager.

In summary, the firms combined formal and informal control mechanisms to manage tensions related to information in the cooperative project. The IS was designed to provide a formal control mechanism for the team, whereas project managers developed informal control mechanisms to manage informational tension on a daily basis.

4. Discussion

Because information is considered a key resource for any organization (Powell and Dent-Micallef, 1997; Wade and Hulland, 2004), our research aims to understand how information is managed (shared and/or protected) in cooperative projects. To provide insights on this question, we propose a framework built on both cooperation management and control mechanisms. We explore (a) what control mechanisms companies use to manage tensions related to information in cooperative projects and (b) whether these mechanisms are consistent with the separation principle, the integration principle or a combination of both.

In the previous cooperation management literature, scholars oppose both the separation principle (Bengtsson and Kock, 2000; Herzog, 2010; Poole and Van de Ven, 1989) and the integration principle (Chen, 2008; Luo et al., 2006). However, more recent empirical studies highlight a possible combination of both principles for better management of cooperation (Fernandez et al., 2014). Our findings are in line with the latter approach. Specifically, we find that both separation and integration are necessary to manage tensions related to information in cooperative projects.

Additionally, our findings extend beyond those of previous studies (Fernandez et al., 2014; Le Roy and Fernandez, 2015) by providing insights into the formal and informal mechanisms established according to both principles. To manage tensions related to information, the use of these mechanisms is closely linked to the nature of the information, i.e., whether the information should be shared or protected. We focus our attention on two key dimensions of information that have been highlighted by previous scholars (Baumard, 2010; Hurmelinna-Laukkanen and Olander, 2014; Kumar, 2010), namely, appropriability and criticality.

4.1. Formal control mechanisms to manage information criticality

To decide what information should be shared and/or protected in the context of a cooperative project, managers must consider the criticality of specific information. As noted by Baumard (2010), the development of a common project requires the sharing of certain information to avoid project failure.

Our findings highlight the use of information systems to manage information criticality. We analyzed the co-existence of several ISs. For financial information, a common IS was created to meet the customer's demand for a single representative. Similarly, for technical information, a second common IS was created. In both cases, absolutely critical information for Yabsat was shared through the common IS. In contrast, non-critical information was protected and remained in the private IS of each parent firm.

Both common ISs were autonomous and formally separated from those of the parent firms to avoid leaks to the parent companies. The common ISs represented formal control mechanisms used to separate critical information (for the client at the corporate level and for the project at the project level) from non-critical information. Critical information was shared with the client or within the project, whereas non-critical information was protected from the competitor. The common ISs allowed the competitors to simultaneously share the necessary information (to ensure the project's success) and protect non-critical information (to preserve each parent firm's competitiveness). According to the separation principle, the competitors' implementation of formal control mechanisms highlights the need to separate cooperative and competitive activities (Bengtsson and Kock, 2000; Poole and Van de Ven, 1989). This premise enables us to formulate proposition 1:

Proposition 1: *In a cooperative project, firms use formal control mechanisms to share critical information and to protect non-critical information.*

Once the critical information is in the IS, it can be accessed by all team members of the cooperative project and thus can be transferred by team members to their respective parent

firms. Therefore, critical information shared through the common IS could become highly appropriable, and both parent firms face a high risk of opportunism. Because the common IS was insufficient to address this risk, additional control mechanisms were necessary.

4.2. Informal control mechanisms to manage information appropriability

Managers involved in the coopetitive project were required to address information appropriability. Specifically, managers were responsible for evaluating whether the competing partner could appropriate the shared information for its own benefit at the expense of the manager's employer. This responsibility seems to be consistent with previous studies (Hurmelinna-Laukkanen and Olander, 2014).

Our results confirm the essential role of appropriation in the shared value generated by coopetition (Kumar, 2010). As the term is defined by Saxton and Dollinger (2004), appropriability appears to be a key driver of managers' decisions. The managers in this study aimed to evaluate the level of appropriability hazard on a daily basis (Oxley, 1997). Project members had an incentive to share "non-appropriable information" (i.e., information whose value was limited when used in isolation). Non-appropriable information could not be used outside of the project for other technologies, markets or products (Bengtsson et al., 2003; Dubois, 2006). Consequently, sharing non-appropriable information presents a low risk of opportunism because the cooperator cannot use this information to increase its competitiveness. On the contrary, sharing appropriable information presents a high risk of opportunism because the information can be transferred to the parent firm to strengthen its competitive advantage.

As previously explained, formal control mechanisms such as the IS could not adequately evaluate the appropriability of information or separate appropriable from non-appropriable information. Therefore, the management of information appropriability

depended on informal control mechanisms. The question is thus how project managers could handle information that was simultaneously critical and appropriable. Appropriable critical information should by definition be both shared and protected. This dilemma arose frequently in the studied coepetitive project. To resolve this dilemma, project managers transformed appropriable information into non-appropriable information, which allowed the sharing of critical information while limiting the appropriability hazard (Oxley, 1997). Transforming information was the only available option that ensured both collaboration and fair competition. Two methods of transforming information were available to project managers.

The first method entails changing the nature of the project. When information is critical for the common project but cannot be shared, the common project can be modified to avoid sharing this information. The information is thereby transformed into a non-critical piece of information and no longer needs to be shared. However, this method reduces the scope and potential of the project. The second approach involves transforming appropriable information into non-appropriable information. In the case studied, project managers mainly used the second approach. Specifically, managers shared data in aggregate form to successfully cooperate at the project level while remaining careful about potential leaks. For instance, project managers shared technical solutions but did not explain the steps that led to these solutions. To reduce the probability of reverse engineering, no details or calculation methods were provided. The same strategy was used for financial information. The only financial data shared between Astrium and TAS were factory sale prices, which have little value without details regarding the firms' internal cost structures. In sum, for both financial and technical information, managers transformed appropriable critical information into critical information that could not be exploited for other projects or purposes. This finding enables us to formulate proposition 2:

Proposition 2: *In a coepetitive project, managers use informal control mechanisms to assess the degree of appropriability of information and to transform appropriable critical information into non-appropriable critical information.*

Project managers are thus able to differentiate appropriable from non-appropriable information and to act accordingly. Their ability to simultaneously share and protect information shows that they have integrated the coepetition paradox. Consequently, this finding is consistent with the principle of integration that is highlighted in coepetition management literature. Project managers have developed a coepetitive mindset and the capacity to behave appropriately in a coepetitive context (Chen, 2008; Farjoun, 2010; Luo et al., 2006; Oliver, 2004).

5. Contributions and conclusion

The paradoxical nature of coepetition strategies generates multiple tensions at different levels (Fernandez et al., 2014; Tidström, 2014). Among these tensions, the dilemma between sharing and protecting information is critical. Coepetitors must simultaneously share information to enhance collaboration and protect information from the competition (Baruch and Lin, 2012; Baumard, 2010; Levy et al., 2003). This dilemma creates coepetitive tensions that have been highlighted in the previous literature (Fernandez et al., 2014) but have yet to be thoroughly investigated.

5.1. Contributions

Our findings shed light on the management of tensions related to information in the context of a coepetitive project. First, in line with previous studies (Fernandez et al., 2014; Le Roy and Fernandez, 2015; Pellegrin-Boucher et al., 2013), we show that the management of tensions related to information relies on a combination of separation and integration principles.

Consistent with previous studies, separation was organizational (Bengtsson and Kock, 2000; Herzog, 2010), whereas the integration of the coepetition paradox was supported by individuals (Chen, 2008; Farjoun, 2010; Luo et al., 2006; Oliver, 2004). Moreover, our findings extend beyond the previous literature by providing details on the mechanisms used to separate information that should be shared from information that should be protected. We also confirm the importance of project managers' integration of the coepetition paradox. According to the literature, the development of a coepetitive mindset (Chen, 2008; Gnyawali and Park, 2011; Luo et al., 2006; Raza-Ullah et al., 2014) allows project managers to create processes to transform the nature of information and thereby to manage tensions related to information. Second, we show that the management of tensions related to information depends on the nature of the information, i.e., whether it is both critical and appropriable. In sum, both formal and informal control mechanisms are necessary to manage tensions related to information in a coepetitive project. Formal control mechanisms, such as ISs, enable coepetitors to address information criticality. Informal control mechanisms implemented by project managers, such as the transformation of information and the use of aggregate data, allow coepetitors to manage information appropriability. Finally, we show that the implementation of formal control mechanisms is primarily consistent with the separation principle (Bengtsson and Kock, 2000; Herzog, 2010), whereas informal control mechanisms are based on project managers' assimilation of the coepetition paradox according to the integration principle (Chen, 2008; Farjoun, 2010; Luo et al., 2006; Oliver, 2004). The combination of separation and integration principles, which has been recommended by recent studies (Fernandez et al., 2014; Pellegrin-Boucher et al., 2013), is operationalized by the implementation of both formal and informal control mechanisms.

5.2. Managerial implications

Our findings have several managerial implications. First, we recommend that parent firms and project managers build a separate IS that is dedicated to the sharing of information deemed essential for the collaboration. Formal control mechanisms allow coepetitors to manage information criticality. Our findings also provide guidelines for the design of the common IS, its architecture and its role in the management of tensions related to information. Nonetheless, because a common IS is insufficient to address information appropriability, we also recommend that the managers involved in coepetitive projects transform appropriable information into non-appropriable information. Our findings provide guidelines for project managers regarding the transformation of information through aggregation. In sum, the successful management of tensions related to information in coepetitive projects requires a combination of formal control mechanisms (to separate critical from non-critical information) and informal control mechanisms (to address information appropriability). Second, our findings highlight the key role of project managers in the management of tensions related to information in coepetitive projects. Thus, our research has implications for the recruitment of project managers. We suggest that coepetitors recruit project managers who feel comfortable in paradoxical situations such that they are able to integrate the coepetitive paradox and behave accordingly. Project managers are responsible for creating and implementing informal control mechanisms to address coepetitive tensions. Because they develop and implement such informal control mechanisms on a daily basis, project managers are critical to the success of coepetitive projects. More attention should therefore be paid to the recruitment of project managers in a coepetitive setting.

5.3. Limitations and directions for future research

Our research has several limitations that provide opportunities for future research. First, in our discussion of the formal and informal control mechanisms that are implemented to manage

tensions related to information, we mentioned—but did not fully investigate—the existence of trust between project managers. The case suggests that trust could be a key determinant of the existence and efficiency of informal control mechanisms. Investigating the link between informal project management mechanisms and the degree of trust among the project members in detail appears to be a promising area for future research (Ariño et al., 2005; Castaldo and Dagnino, 2009). Second, our approach focused on tensions related to information, but it is difficult to study these tensions without considering learning issues (Baumard, 2010; Khanna et al., 1998). The appropriability of information is clearly related to learning because information is a key element of the learning process (Hamel, 1991; Hurmelinna-Laukkanen and Olander, 2014; Inkpen, 2000). Therefore, it is important to conduct additional research on the links between informational and learning tensions in coopetition, and future studies on tensions related to information should aim to incorporate the absorptive capacity of the cooperative partners into the observations (Ritala and Hurmelinna-Laukkanen, 2013; Vasudeva and Anand, 2011). Third, the future of formal control mechanisms (such as a common IS) must be addressed. At the time of this writing, the studied project was ongoing. However, like most projects, cooperative undertakings operate for a limited period of time (Bakker et al., 2013; Das, 2006). It is thus important to consider what will happen to the shared information and to the cooperative IS once the project is completed. Finally, it would be interesting to further investigate the tools and devices that are specifically designed by organizations and managers to manage cooperative tensions related to information.

We are confident that our study provides useful insights and a greater understanding of several issues regarding the tensions related to information confronted by firms in coopetition.

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Appendix 1. Tensions related to information in cooperative projects

Quote	Verbatim	Interviewee	Dimension
1	<i>"I influence the totality of the share made by A, as I must calculate the factory price of A. I do not know if you noticed when you arrived, but there is a written notice that states "A staff only." In this part of the corridor, my team and I, we must be completely separated from the rest of the team because we manage all internal costs. Because we are in the same markets, they cannot... they should not know our costs because otherwise they could offer the same price."</i>	Project Control Manager – Firm B	Appropriable critical financial information
2	<i>"There is little information that we can keep in-house because we do not know how to build the program alone."</i>	Project Manager - Firm A	Appropriable critical technical information
3	<i>"It's engineering people who say 'we don't want to give this because it is our core business and we do not want to give this type of information.' So, we start a discussion to determine how we can extract useful information or how to reach the established information-communication objective without disclosing too much know-how."</i>	Project Manager – Firm B	Critical informational tension

Appendix 2. Management of tensions related to information in cooperative projects

Quote	Verbatim	Interviewee	Dimension
1	<p><i>"The prices of companies are set at a given time in relation to internal costs. Each company defines a procedure to exchange prices without necessarily sharing the details of their cost structures to ensure that there is no relationship between the price and the internal cost. We want to be sure to agree on what we call a factory sale price, an FSP. And once we have exchanged this FSP, we can submit it to the client."</i></p>	<p>Project manager - firm B - Responsible for the new IS</p>	<p>Importance of the IS in defining the factory sale price</p>
2	<p><i>"When developing a satellite, we have what we call a database in which we store all of the vital data and technical information about the platform. Regarding technical data, there are data coming from Astrium and from Thales. So, they have to create a common database with common software... to manage the specifications of the program. So, they used the DORSE tool (an IS tool). It provides something common that they both have access to, essentially regarding the technical aspects of the program."</i></p>	<p>Head of the Telecommunications Business Unit - Firm A</p>	<p>Creation process of a common database for Yahsat</p>
3	<p><i>"It is clear. We try to avoid giving total visibility or giving information that does not relate to the project to the other manufacturer."</i></p>	<p>Project Manager – Firm A</p>	<p>Limits on the visibility of strategic information</p>