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# Managing Knowledge Sharing-Protecting Tensions in Coupled Innovation Projects among Several Competitors

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## SUMMARY

While collaborating with several competitors on coupled innovation projects requires smooth knowledge sharing to ensure the project's success, protecting knowledge is also essential due to the prevailing risks of coalition formation, opportunism, and knowledge leakage. Intense tensions between knowledge sharing and protection may arise and must be managed to avoid project failure. This article explores the formal and informal mechanisms used to manage these tensions. The case studied (Galileo) reveals the limited role of informal mechanisms to manage such tensions and shows how a centralized project structure encouraged the formal sharing of knowledge by protecting firms from unwanted knowledge transfers between competitors.

**KEYWORDS:** open innovation, coopetition, management, project management, third-party intervention

Companies rely on open innovation strategies to obtain access to the knowledge that is necessary to develop their innovations.[1] The combination of internal and external knowledge should lead to positive outcomes, especially in coupled innovations in which companies simultaneously share complementary knowledge flows and collaborate to develop joint innovations. As competitors hold complementary knowledge, they

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can sometimes appear to be relevant partners for innovation and joint participation in coupled innovation projects. Sharing knowledge with competitors in open innovation projects can be risky because the shared knowledge can be used by competitors against each other. Thus, competitors are exposed to high behavioral risks, such as knowledge leakage, unwanted spillovers, and opportunism. To avoid such risks, the partners-competitors are tempted to protect their internal resources and limit the knowledge they share with others. In open innovation projects, the engaged parties face tensions stemming from simultaneously sharing knowledge to create value and protecting internal knowledge to preserve their competitiveness. This dual situation creates tensions in knowledge sharing and protecting.

Moreover, firms increasingly rely on more than one competitor to handle the challenges of innovation.[2] Multipartner relationships involve the possibility of building coalitions, cheating, and free-riding behaviors[3] that are difficult to identify.[4] Thus, competitors do not know whom to trust and with whom they can share their knowledge. Knowledge shared could be used, acquired, and integrated by any firms involved in the coopetitive project and that are attempting to maintain their own competitive advantage. Firms could also try to cheat by manipulating and distorting information against their partners. Firms will then be faced with a higher risk of knowledge leakage, unwanted spillovers, and knowledge plunders. To avoid these risks, competitors might be tempted to reduce the amount of sharing and increase the protection of their knowledge. However, this extreme protection may lead to a lack of knowledge sharing and to the potential project failure.

Therefore, with the increase in the number of competitors involved, knowledge sharing-protecting tensions may also increase. According to previous studies,[5] such tensions should be managed to facilitate the sharing of the knowledge that is necessary to achieve joint innovation while protecting companies from the risk of unintended knowledge transfers. This protective approach is even more critical at the project level where the knowledge is actually shared. Our research aims to understand how knowledge sharing-protecting tensions are managed in coupled innovation projects involving several competitors.

We draw on two complementary literatures. First, previous studies on open innovation projects have highlighted the role of formal and informal mechanisms to manage open innovation projects.[6] However, the combination of these mechanisms is not discussed in these studies with regard to the type of open innovation project or the type of partner involved. Second, the literature on coopetition (i.e., cooperation between competitors) reveals the importance, in dyadic coopetitive projects, of designing the relevant project structure according to the nature of the innovation, i.e. a common project team (CPT) for a radical innovation and a separate project team (SPT) for incremental one.[7]

To explore this subject, we conducted a case study of Galileo, the European project to build a satellite positioning system, which was launched in 2001 with a budget of €13 billion. To develop Galileo, three competitors—OHB (a European multinational technology and aerospace corporation), Thales Alenia Space (TAS), and Airbus Defence and Space (ADS)—were required share their core knowledge;

however, as they were simultaneously competing in other markets, they also needed to protect that knowledge.

## Managing Knowledge Sharing-Protecting Tensions

### *Coupled Innovation Projects*

Firms widely rely on open innovation strategies to share and acquire knowledge to foster innovation processes and to achieve radical innovations.[8] Open innovation consists of sharing internal knowledge and accessing external sources of knowledge that can be combined with internal knowledge to improve innovation processes.[9] Consequently, in open innovation, companies can expect higher levels of innovation performance than in traditional innovation.[10]

A key success factor of open innovation projects seems to be the knowledge sharing between partners.[11] Indeed, companies must share their own knowledge to gain access to new and unique external knowledge that can increase their innovation performance.[12] For instance, companies can share strategic information about their customers' experience or business expertise with external partners.[13] This sharing allows companies to improve their market knowledge about customer trends, new production techniques, and new technologies.[14]

While some studies have recommended that firms be fully open to enhance innovation performance, others have highlighted that extreme degrees of openness can sometimes be counterproductive as too much openness can hinder firm competitiveness. Companies should thus find an optimal level of openness.[15]

In addition, companies involved in open innovation projects are exposed to high levels of risks of knowledge leakage and opportunism,[16] which can negatively affect firm performance and can damage firm competitiveness in the long run. As a result, firms may lose their competitive advantage and their leading market position. To limit these risks, companies may be tempted to reduce their sharing to the minimum level and overprotect their knowledge. However, without knowledge sharing, there is no value creation and thus no innovation.

Companies involved in innovation projects face a dilemma between knowledge sharing and knowledge protection that is even more critical in coupled innovation projects.[17] While inbound or outbound innovation projects are essentially based on a one-way flow of knowledge (inside-out or outside-in), coupled innovations involve multiple and simultaneous knowledge flows. Firms are thus engaged in an interactive and collaborative process to develop innovations to create joint value.[18] The tensions between knowledge sharing and knowledge protection might be more intense in coupled innovations than in inbound or outbound innovations.

In addition, coupled innovations can involve a great diversity of partners, including competitors. Coupled innovations rely on the combination of knowledge flows from complementary partners.[19] As competitors can share complementary and similar resources, they can function as relevant partners for coupled innovation projects.[20] However, competitors can behave opportunistically and use the shared knowledge at the project level against their partners-competitors. To avoid these intense risks, competitors may be more willing to protect the shared knowledge in a coupled innovation project than in other projects with partners. This extreme protection will lead to a lack of knowledge sharing and potentially to project failure.

To manage this tension, an appropriate management approach seems essential.[21] A few studies have investigated the management of open innovation projects and highlighted the role of formal and informal mechanisms.

On one hand, companies can rely on formal mechanisms such as intellectual property rights (IPRs), licensing, patenting, incentive practices, or systems to share and protect knowledge in open innovation projects.[22] Formal protection such as licensing can be helpful to cope with the dilemma of knowledge sharing and protection.[23] Counterintuitively, formal protection can lead to more openness and to more knowledge sharing.[24] With such an approach, the shared knowledge is formally protected, companies are more willing to share it, and more innovation capabilities can be developed.[25] IPRs are modular and can be simultaneously used to create value with partners and to capture the value from this type of collaboration.[26]

On the other hand, companies can use informal mechanisms such as trust, relational capabilities, or individual capabilities to solve the tensions between knowledge sharing and knowledge protection in open innovation projects.[27] Formal and informal mechanisms can then be simultaneously used to manage knowledge sharing in the context of open innovation.[28] Thus, the management of open innovation can be seen as a dynamic process combining structural or transactional (i.e., formal) and relational (i.e., informal) interactions (see Table 1).[29]

However, the literature on the management of open innovation does not discuss the balance between formal and informal mechanisms depending on the type of open innovation or on the type of partner involved. As knowledge sharing-protecting tensions can be intense in coupled innovation projects involving competitors, a specific mode of management can be expected.

In addition, the literature on the management of open innovation does not deeply investigate how such mechanisms are implemented at the project level although knowledge sharing-protecting tensions seem to be more critical at this level and may require a specific management approach.

Indeed, the project level is more important as firms must rely on expertise, know-how, and knowledge from other companies to handle the challenges of complex products. To do so, firms tend to create projects with other companies,[30] and sometimes with multiple competitors. As dyadic alliances bring together various and diversified resources,[31] high benefits can also be expected in projects between multiple competitors. However, multiple partners can also lead to higher tensions. Also, as knowledge transfer takes place at the project level and thus can have consequences for the project performance,[32] it is important to understand these tensions at this level of analysis. In complex projects, extensive knowledge sharing is needed, and managers must find the right governance mode[33] and the right organizational design to manage these tensions.

**TABLE 1.** Specificities of Coupled Innovations between Competitors.

| | Coupled Innovations with Noncompetitive Partners | Coupled Innovations with Competitors |
|---|---|---|
| Innovation type | Radical or incremental | Radical or incremental |
| Drivers | Access to broad complementary knowledge | Access to unique complementary and similar knowledge |
| Characteristics | No current competition between partners | Strong competition between partners |
| Objectives | Creation of joint value | Creation of joint value and capture of the highest share of the value created |
| Knowledge sharing/ protecting tension | Low risks of opportunism, free-riding, leakage knowledge, and unwanted spillover<br>Protection not necessary<br>Opportunity to increase income | High risks of opportunism, free-riding, leakage knowledge, and unwanted spillover<br>Protection necessary to avoid the capture by the competitor leading to too little sharing |
| Potential negative outcomes | No gain (or little gains) from the collaboration<br>Arming a potential future competitor | No gain (or little gains) from the collaboration but significant competitor gains<br>Decrease of the firm's competitiveness |
| Management of knowledge sharing/ protecting tensions | Formal mechanisms: IPRs, licensing, patenting, incentive practices or systems<br>Informal mechanisms: trust, relational capabilities, or individual capabilities | Formal mechanisms: project structure, third-party implications<br>Informal mechanisms: trust, individual capabilities |

*Note*: IPRs = intellectual property rights.

### *Innovation Projects among Competitors*

Several studies on coopetition for innovation have shown the positive effects of such strategies on innovation performance.[34] However, a major source of tension in coopetition for innovation is the dilemma between value creation and value appropriation.[35] To create value, competitors must share their knowledge; however, in doing so, they are exposed to high risks of knowledge leakage, opportunism, and unwanted spillovers.[36] The knowledge shared within a common project can be used by one competitor against another and can damage firm competitiveness. To avoid such risks of opportunism, competitors are tempted to limit the sharing of their knowledge while they seek to learn from their competitors. However, without knowledge sharing, there is no potential innovation. Competitors might thus face the dilemma between the sharing of knowledge to create value and the need to protect their knowledge to preserve their competitiveness.[37]

Recent studies have argued that coopetition strategies can positively influence innovation performance only if coopetitive tensions are efficiently managed.[38]

Some studies have highlighted the critical role of project designs[39] based on the nature of the innovation.[40]

As the development of radical innovations is challenging and requires the best knowledge of the competitors, a common project team is recommended.[41] Competitors pool human, financial, and technological resources in a common project team to facilitate the knowledge sharing between them and thus create joint value. Within a joint project team, competitors have direct and close interactions daily, which encourages the informal sharing of the knowledge needed at the team level to achieve radical innovations. To preserve the equity between coopetitors at the project level, the common project team should be governed equally and jointly, without any hierarchical relationships between the coopetitors. Consequently, the common project team is a costly structure as all the managerial positions are duplicated and held by one manager from each company.[42]

Conversely, incremental innovations are less challenging and require less knowledge sharing from competitors. Consequently, implementing a costly structure such as a common project team is not necessary. With incremental innovations, coopetitors rely on separate project teams based on a clear division of tasks and frequent coordination at points of interface. Knowledge sharing is limited to the minimum level and formally controlled by information systems.[43]

### *Coupled Innovation Projects among Several Competitors*

However, innovation projects sometimes require the pooling of knowledge from more than two competitors.[44] Managing knowledge sharing-protecting tensions might thus differ when several competitors are involved in an innovation project (see Table 2).[45]

Coupled innovation projects involving more than two competitors[46] are highly complex due to the increased likelihood of the formation of coalitions and the possibility of cheating[47] triggered by the dynamics among the actors in a multipartner relationship. Prior research on collusion[48] has shown that collusive phenomena are a concern of any organization with more than two parties. In multipartner relationships, firms are tempted to us their power to create subcoalition groups[49] or to manipulate a partner against another for their own benefit.

In addition, when several companies are involved in the same project, they have to face high behavioral risks[50] such as opportunistic behaviors,[51] cheating, and free-riding.[52] In this context, firms might try to protect their knowledge while using their partners' knowledge to maximize their own competitive advantage. Firms could cheat on their partners by pretending to share knowledge but without actually sharing it or by sharing false knowledge. Firms could also manipulate the knowledge shared by some partners to damage other partners. The knowledge shared could be acquired, institutionalized, and then used by other partners to gain market share, to win calls for tenders, and/or to maintain their own competitive advantage. Because of the presence of multiple partners, it can be difficult to know who to trust and with whom to share knowledge safely. Consequently, companies involved in coupled innovation projects

**TABLE 2.** Specificities of Coopetition among Multiple Competitors.

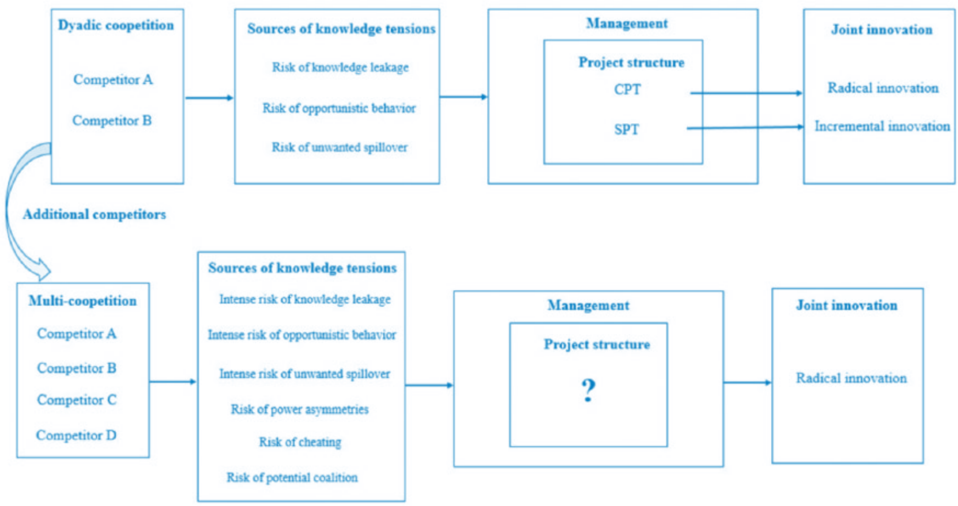
| Characteristics | Dyadic Coopetition for Radical Innovation | Coopetition among Multiple Competitors for Radical Innovation |
|---|---|---|
| Number of actors | Two | More than two |
| Specificities | Collaboration with one market competitor | Complex collaboration with several competitors<br>Multiple interactions |
| Sources of the knowledge sharing-protecting tensions | Knowledge leakage<br>Opportunism of the coopetitor | Knowledge leakage among multiple coopetitors<br>Opportunism of multiple coopetitors<br>Risk of coalition and risk of cheating<br>Complex coordination |
| Intensity of the tensions on knowledge sharing | High | Increase with the number of coopetitors involved |
| Formal mechanisms | Common project team<br>Formal protection and formal sharing between the team and the parent firms | Specific project team<br>Strong formal protection and formal sharing |
| Informal mechanisms | Trust<br>Informal sharing and informal protection of the knowledge shared at the project team level | Informal sharing and protection of knowledge share within dyads: Informal meetings; informal interactions; informal capabilities |

with several competitors might face high risks of knowledge leakage, unwanted spillovers, and knowledge plunders and might have to deal with high levels of knowledge tensions.

To manage these tensions, recent studies[53] recommend a separate project team to achieve incremental innovations and a common project team to achieve radical innovations. In separate project teams, each partner designs its own project team that remains located in the parent firm so that the knowledge sharing is formally limited and formally controlled. Coopetitors rely on informal mechanisms such as trust and individual capabilities to manage the risks of knowledge transfers at the points of interface. However, when more than two competitors are involved in the same project, trust might be hard to build, so managing the risks of knowledge transfers informally might be very difficult.

Conversely, in common project teams, the knowledge sharing is more intense but informally controlled. The common project team could be challenging to implement when more than two competitors are involved. If the duplication of all managerial positions is possible between two competitors, duplicating the managing positions among three or more competitors could be very complex. How could several competitors make all the decisions equally and together? In addition, the redundancy of individuals in managerial positions can be a waste of

**FIGURE 1.** Theoretical framework.




*Note*: CPT = common project team; SPT = separate project team.

resources. In common project teams, the knowledge sharing is mostly informal. However, if several competitors are involved in a common project team, the knowledge sharing might not be enough because of the lack of trust between the competitors and the lack of formal protection. Trust mechanisms can be difficult to implement among several competitors.

While the common project team is recommended to achieve radical innovation projects between two competitors, it does not seem appropriate when several competitors are involved. On the contrary, the separate project team could be relevant when several competitors are involved but not to achieve radical innovations. Consequently, neither the separate project team nor the common project team seems appropriate to manage radical innovation projects among several competitors. So, we assume that another specific project team might be designed to achieve radical innovation projects among several competitors (see Figure 1).

## Method and Research Settings

### *Empirical Settings*

Since open innovation projects among several competitors often occur in high-tech industries, we investigated the European space industry. As the space industry is organized by projects,[54] we focused our attention on the project level to understand the management of knowledge sharing-protecting tensions. Because innovation cycles in the space industry are very short, the protection of knowledge by IPRs, especially through patents, is difficult. Firms must thus rely on other mechanisms to manage the knowledge sharing-protecting tensions in innovation projects.

The space industry is segmented into three main activities: telecommunications satellites, earth observation satellites, and navigation satellites. As the navigation satellite segment is very innovative, we decided to conduct an in-depth study of this segment. For example, in this sector, the European Space Agency (ESA) spent approximately €28 million in Research and Development (R&D) programs in 2016.[55] Overall, around €90 million are invested annually in high-technology programs.[56]

In Europe, the navigation satellite industry is led by three actors: OHB, TAS, and ADS. Moreover, the space strategy is defined by the ESA at the European level and by the National Centre for Space Studies (CNES) at the French level. ESA is the second largest space agency and oversees implementing European space policy by carrying out programs and selecting appropriate projects to support the space industry.

All these companies are capable of manufacturing navigation and telecommunications satellites alone. They compete daily to answer tenders from space agencies (institutional markets) and from operators (commercial markets).[57] OHB, TAS, and ADS are strong competitors as they market similar products to the same clients (institutional or private). Price is an important leverage factor in the competition among these organizations.

However, the oligopolistic nature of the navigation satellite industry widely encourages these competitors to develop innovation projects together. OHB, TAS, and ADS collaborate horizontally in one of the most important projects of the European space industry: Galileo, a complex and innovative project to develop a European satellite positioning system.

OHB, TAS, and ADS led the project; however, they were also involved in the realization of the project. Only OHB, TAS, and ADS together had the knowledge and resources to develop such a radical innovation as Galileo. The three competitors had to share knowledge at the project level while protecting themselves from knowledge leakage, as they remain strong markets competitors. Galileo is thus an interesting case to study the management of knowledge sharing-protecting tensions in a coupled innovation project among several competitors.

### *Data Collection and Analysis*

We conducted a case study of Galileo.[58] We focused our attention on the project level as that is the most critical for the management of knowledge sharing-protecting tensions. Data from multiple sources were gathered. To limit biases, we crosschecked and triangulated the facts by collecting primary and secondary data.[59]

The primary data were gathered through 36 semi-structured interviews conducted with experts, directors, top managers, and project managers involved in coupled innovation projects with competitors. The interviews were conducted over two periods: from November 2017 to July 2018 and from September 2018 to July 2019. The interviews were mainly conducted with top managers and project managers from the prime contractors (OHB, TAS, and ADS), managers from space agencies (European and French agencies), managers from a cluster in the aerospace industry (Aerospace Valley), managers from a professional federation in this industry (Grouping of French Aeronautical and Space Industries [GIFAS]), and managers from a university center (Centre Spatial Universitaire [CSU]).

As our study is an exploratory and qualitative research, we first interviewed people at the macro level such as individuals working at CNES, CSU, GIFAS, and Aerospace Valley. These interviews were done in the first step of the data collection. This phase helped us to understand the space industry, its activities, and the relationships between the different actors and the organization of Galileo. These interviews were also helpful in gaining us recognition and enabling us to be recommended to other companies. The second phase aimed to understand more deeply the relationship between the three competitors in the space industry: OHB, TAS, and ADS.

The interview guide used to conduct the interviews was structured as follows: presentation of the interviewee (background and previous experience); presentation of the context of the space industry (structure, actors, evolution) and open innovation projects (drivers, characteristics, project types, partners, evolution); presentation of Galileo (characteristics, partner selection, role of institutions); difficulties due to the involvement of competing firms (risks and tensions); the management of these difficulties (organization, role of manager, and tasks division); the knowledge sharing process (type of knowledge, difficulties, management, tools used); the knowledge protection process (type of knowledge, difficulties, management, mechanisms used); and conclusion (request for other contacts, internal documents, and thanking).

The interviews allowed us to understand why the firms decided to develop coupled innovation with several competitors; the tensions due to the involvement of competitors in these projects; and how these tensions were managed. The interviews also allowed us to emphasize the importance of knowledge sharing-protecting tensions and to shed new light on the management of these tensions.

For triangulation purposes, we collected secondary data from internal sources (presentations and reports) and external sources (reports and press releases). We also had access to some internal documents such as financial reports and presentations. Additionally, for external sources we used industry reports, press releases, articles, and academic publications.

Most of these data came from the companies' websites, ESA and CNES websites, or association websites (such as GIFAS or Aerospace and Defence Industries Association of Europe). These external sources helped us to understand the formal aspects of open innovation projects among competitors in terms of knowledge sharing-protecting.

All the empirical material was coded in two rounds.[60] An initial round of coding followed the literature review to identify coupled innovation projects among several competitors, as well as their drivers and outcomes, to confirm the existence of tensions due to knowledge sharing-protecting and the use of tools and mechanisms to manage them. Then, a more inductive round of coding was undertaken to reveal the role of the project structures and the formal and informal mechanisms in managing knowledge sharing-protecting tensions.

We began by identifying first-order categories, which allowed us to label the interviews. Then, we arranged 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 combined the second-order themes into aggregate dimensions to study the relationships among them.

### *Case Presentation*

Galileo is an exemplar case of a coupled innovation project involving multiple competitors. The objective of Galileo was to develop a European satellite positioning system to compete with the U.S. Global Positioning System (GPS). Without their own satellite positioning system, Europeans were highly dependent on American technology. Americans were leading the market, leaving Europeans in a challenger position. Thus, in 2001, for strategic, economic, and military reasons, the European Union encouraged the development of a European satellite positioning system. Satellite manufacturers decided to launch Galileo to compete with GPS and to improve their positions in the market.

The decision to build a common project with the three European leaders—OHB, TAS, and ADS—was motivated by the opportunity to have access to new knowledge, to have more visibility on the market, and to improve the companies' own innovation processes. Moreover, from the ESA's point of view, the creation of a common project team was an intuitive solution to ensure the necessary knowledge sharing to realize Galileo. Even if the three companies could manufacture satellites alone, none of them had the knowledge to achieve Galileo by themselves. As the three had similar and complementary knowledge, the sharing of knowledge among them would allow for the development of Galileo. These competing partners had to be open with one another in sharing their knowledge.

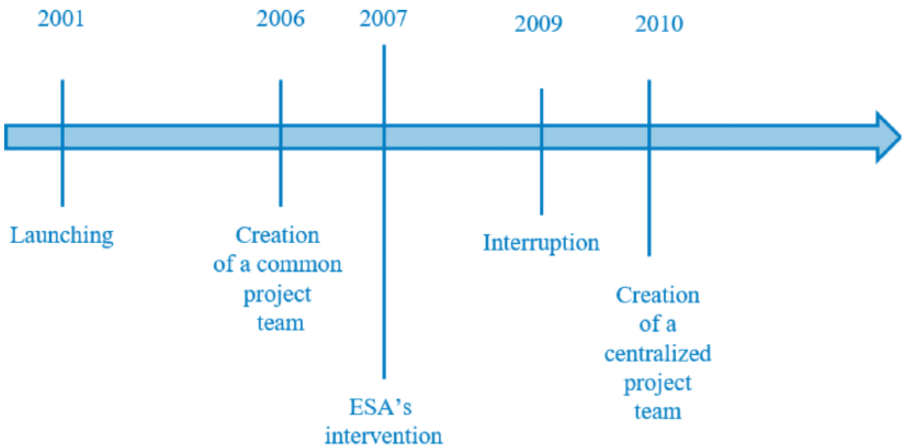
However, despite their collaboration on Galileo, they remained fierce competitors. Simultaneous with conducting Galileo, they were competing to win the call for tenders of Copernicus, the International Space Station, and the Meteorological Third Generation Satellite.[61] Thus, they faced the risks that one firm might learn more than the others or that the knowledge shared for the project would be used by one competitor at the expense of the others. OHB, TAS, and ADS faced a dilemma: share their knowledge to create value or protect their knowledge to preserve competitiveness. The resulting tensions had to be managed to realize the project. Therefore, the structure of the project was changed to ensure the project's success (see Figure 2).

## Managing Knowledge Sharing-Protecting Tensions in Galileo

### *The Creation of a Common Project Team*

In Galileo, the competitors involved had to share their core knowledge to develop this radical innovation together. To achieve this objective, the

**FIGURE 2.** Galileo's time line.




*Note*: ESA = European Space Agency.

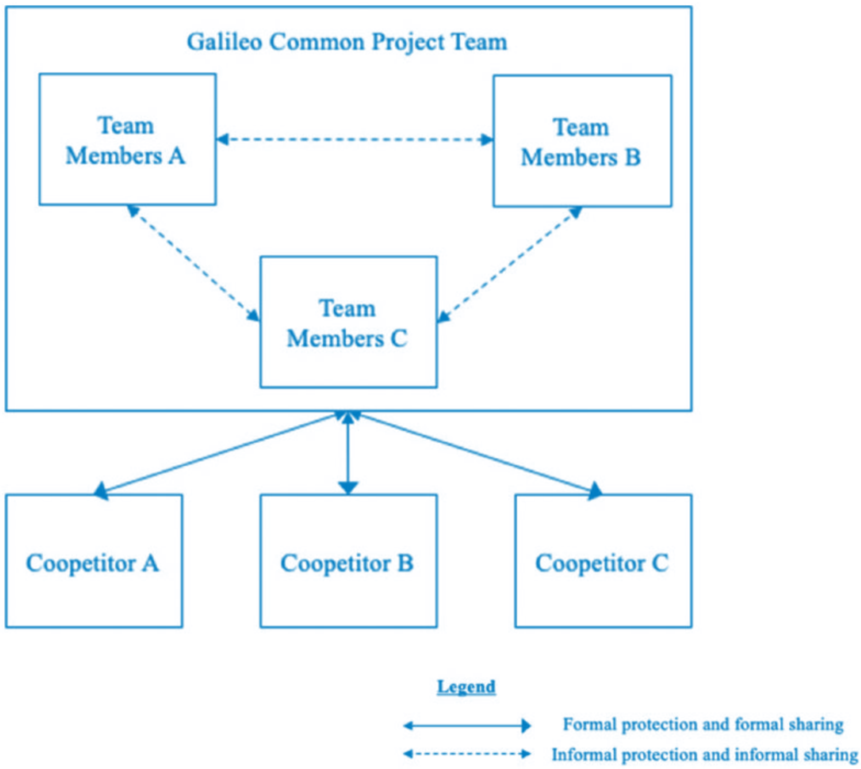
competitors pooled their best resources (best competencies and best technologies) in a common project team governed by project managers and top managers from each competing firm.

At that time, Galileo was a non-equity-based partnership in which the companies did not invest directly. The partnership was signed to formalize the agreement of the companies to jointly develop a new technology. The European Commission asked ESA to financially support this initiative because it was a strategic priority of European policy. The companies pooled their human and technological resources to achieve the project. To preserve some equity in their relationships, their contributions had to be equal. However, the contribution of each partner was very difficult to assess. How could the human resources involved be assessed? How could the technologies and the knowledge be valued? Thus, the objective was for each manufacturer to contribute approximately the same amount (see Figure 3).

The project team's objective was to launch the industrialization of Galileo—specifically, to build satellites and launch them. To do that, the project team's objective was to organize the work for their construction, and activities and work packages had to be equally divided among the competitors. As all the competitors had similar expertise and similar know-how, they all wanted to oversee the same work packages. Long negotiations among them lead to tacit agreements defining the task division process. From the competitors' perspective, the common project team was an opportunity to access strategic knowledge and to benefit from the shared knowledge.

The project team was conceived as a formal structure to encourage knowledge sharing. Informal interactions were encouraged among the team members. Frequent meetings or events were also organized to enhance informal exchanges of knowledge flows among the coopetitors. Since decisions were taken according to a show-of-hands vote, personal interactions and interpersonal relationships

**FIGURE 3.** Galileo common project team.




were influencing the decision-making process. There were no formal mechanisms for protecting and sharing knowledge, and there were no real rules. Decisions and task organization were negotiated informally and according to the core business of the companies. Also, when tensions appeared, the companies used mechanisms such as informal discussion and negotiation. The relationship between the partners and their interpersonal links was also used to decrease tensions and find a solution.

The common project team was separated from the rest of the parent firms so that the team members had limited interactions with their product lines and with their engineers. This formal structural separation acted as a physical boundary to limit the knowledge transfers between the project team and the strategic business units of the parent firms. The knowledge shared for Galileo needed to remain in the project team. At the same time, the companies were controlling the sharing by choosing the resources they wanted to allocate to the common project team.

Within the project team, the knowledge sharing process was informal. The team members had to be open and share their knowledge daily. When they were not sure about whether the information should be shared or protected, they could refer to the project managers who were informally monitoring the knowledge sharing. Based on their assessment of the criticality of the knowledge, they could decide whether to share it. There were no formal mechanisms to protect the shared knowledge or to limit the sharing. The decision was binary—protect or share—and only depended on the assessment of the risks made by team members and project managers. Consequently, trust among and between team members and project managers was critical.

However, in the early stages of Galileo, the team members and project managers perceived the risks of knowledge leakage and knowledge transfers as very high because of the presence of multiple competitors. They could not assess the real risks of the sharing of a piece of knowledge, and they were afraid of the worst consequences for their companies. Sometimes they wanted to share a piece of knowledge with only one coopetitor; however, they did not have a guarantee that the knowledge shared with that coopetitor would not be transferred to the others. Therefore, they were required to share their knowledge relying only on trust; however, apparently, trust mechanisms were not sufficiently developed within the team. Consequently, the development of Galileo was paralyzed because of the lack of knowledge sharing between the coopetitors.

### *Tensions on Knowledge Sharing-Protecting and the End of the Common Project Team*

The coopetitors agreed to share their knowledge to achieve Galileo in return for access to external sources of knowledge that could be used to maintain their innovation capacity. They collaborated to develop the new technology; however, they simultaneously competed in other markets to win calls for tenders of private and institutional clients. The knowledge shared within the Galileo project team could be used by the coopetitors to win such tenders against one another. As a result, the team members struggled with the question of the information they could share, including why, with whom, when, and how they could share it. The perception of the high risks of cheating and opportunism led to an erosion of goodwill and distrust. The lack of formal knowledge protection led to a lack of knowledge sharing among the coopetitors and created tensions at the common project team level.

The governance of Galileo increased knowledge sharing-protecting tensions. The common project team was governed by a single and unique project management office (PMO); however, the members of the PMO were geographically distant. They came from different countries and different cities; it was impossible to co-locate the PMO of Galileo. Thus, the coopetitors decided to divide the team location into two sites. Therefore, the geographical distance between the members of the PMO reduced the group dynamics, limited the knowledge sharing, and created new tensions.

The knowledge sharing-protecting tensions were exacerbated by divergent interests and the lack of consensus on the strategic vision of Galileo. The coopetitors had different visions of Galileo and disagreed on the resource allocation for the process. The coopetitors also had different opinions about task division and budget allocation. To optimize this allocation process, knowledge from each coopetitor was needed. It was important to know what each coopetitor could do, in how much time, and for how much money; however, this knowledge was too critical to be shared at the project level. The information about technologies and cost structures was confidential. This lack of knowledge sharing partly explained the delays in the early stages of the project as well as some delays in decision making for the project.

When technical and organizational difficulties appeared in the project, the coopetitors discussed potential solutions. However, when a coopetitor proposed a solution, the other coopetitors claimed that it favored the competitor but not the project. Ultimately, no solution was found, and the development of the project was stopped.

As coopetitors were not willing to share their strategic vision or their interests, it led to misunderstandings and speculations from the coopetitors and thus to mistrust among them. Each company thought that the others were not contributing anything to the project, that they were only involved to capture the shared knowledge, and that they did not have the capacity to contribute to the project. The coopetitors distrusted one another's competencies.

In addition, the coopetitors doubted the priority given to Galileo in the planning of each parent firm. As they were managing a portfolio of simultaneous projects, the coopetitors distrusted that Galileo occupied the same place for each participant. This reasoning was then used to justify a lack of sharing. "Why should I make Galileo a priority when my coopetitors are not willing to do the same?" "Why should I share knowledge to achieve Galileo when my coopetitors are not willing to do the same?"

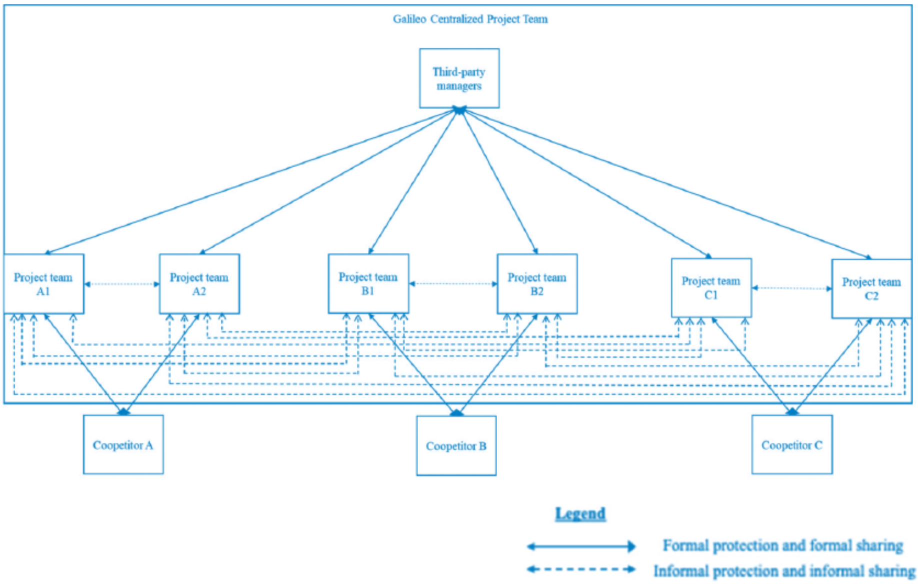
Because they distrusted each other, the coopetitors feared that the knowledge shared on the Galileo project was simply an opportunity for the coopetitors to win new tenders or more quickly complete other projects. Feeling that they were the only ones working and sharing knowledge for the project, each coopetitor perceived other coopetitors as free riders or cheaters.

The tensions were exacerbated during the project interface meetings in which the coopetitors had to closely collaborate to integrate their work and to solve technical issues. This coordination was complicated because coopetitors did not want to reveal their industrial secrets or their secret weaknesses. The problems of integration were due to technological incompatibilities and required more coordination and more knowledge sharing among the team members to adapt the technologies.

After a few years of nonprogress, the coopetitors had concluded that the common project team was not the relevant structure to realize Galileo. Far from reducing the tensions about knowledge sharing-protecting among the coopetitors, the common project team seemed to increase them.

At the team level, the knowledge sharing was exclusively informal and mostly relied on the capacity of the coopetitors to trust one another. Trust was difficult to build as the team was exclusively composed of geographically distant

**FIGURE 4.** Galileo centralized project team.




competitors. No formal mechanisms had been established to protect the shared knowledge. The lack of trust and the absence of formal team-level mechanisms to protect shared knowledge led to insufficient knowledge sharing. After a few years of nondevelopment, to avoid further delays and a loss of money, the coopetitors decided to design a new project structure.

### *A Centralized Project Team to Manage Knowledge Sharing-Protecting Tensions*

To avoid further delays and a loss of money, and to save Galileo, the coopetitors decided to create a new project structure and entrusted ESA to help them to find the best design. ESA thus became involved in the management of the project (see Figure 4).

To solve the major issue of the lack of knowledge sharing, ESA followed a clear task division to split the whole project into six work packages called industrial segments. One coopetitor was responsible for each package so that they could not pretend that they were not in charge of this task. As the division of tasks was clearly formalized, each coopetitor could work independently and each of the industrial teams could remain located and integrated in its parent firm.

At first, the formal division of activities seemed to reduce the knowledge sharing among the coopetitors. However, the six segments were formally governed by ESA so that the coopetitors had to formally share their knowledge with ESA. In the new configuration, ESA coordinated the collective activities and integrated the developments of each partner. As ESA has technical knowledge and expertise, they can integrate technologies coming from several companies. More specifically, ESA hires engineers experts who will ensure that the different modules produced by each company are compatible and work as one. Then, they coordinate the industrial interfaces.

ESA implemented routines and processes to encourage the sharing of knowledge only between each coopetitor and the agency. The routines and processes were adapted to each coopetitor and each segment. The routines took multiple forms, such as monthly technical and strategic meetings, and weekly project managers update meetings. These meetings took place only between the ESA and a competitor, at specific times and on different days. For the agency, the objective was to understand each company's challenges and difficulties. During these meetings, in particular when some technical difficulties or discoveries at the project level, the competitor could share core and confidential knowledge with ESA to help the development of Galileo. Therefore, a specific process was used to avoid the transfer of knowledge to other competitors for purposes other than Galileo. For example, during a meeting, a company could share technical and progress documents with ESA. The firm's project manager was directly communicating with the ESA's project manager. Depending on the level of confidentiality and on the level of protection required, project managers were using different communication technologies and different information systems to share the documents. Once the documents were shared, ESA and the company discussed the documents. Each competitor had to explain to ESA each technical issue, the technical decision made, and the management of the issue. In addition, double-loop verification processes were used by the agency to verify the sharing of each coopetitor and to guarantee the progress of the project.

As a result, the knowledge was formally shared and centralized by ESA. The routines and processes were also used to protect the shared knowledge from leakage or knowledge transfers between the coopetitors. All knowledge flows converged toward ESA, which prevented knowledge exchanges among the coopetitors.

In addition, tools were created within the companies to formalize the knowledge sharing and to explicitly detail what knowledge should be shared or not, how, and with whom. Each coopetitor developed its own tools and trained its employees to use them. They mostly relied on information technology (IT) tools such as computer servers, machines, and mailboxes to protect the knowledge shared with ESA from imitation by the other coopetitors.

The new project structure was designed as a centralized structure. ESA was positioned at the center to coordinate knowledge flows among the coopetitors. The agency played an essential role as it enabled, through formal processes, the coopetitors to share the knowledge necessary for the development of Galileo while protecting their know-how and preventing them from unintended sharing or outright theft.

A project manager from ESA coordinated and centralized the knowledge flows so that no knowledge was formally shared among the separate project teams. The ESA project manager was the privileged interlocutor of all the coopetitors and responsible for the coordination of the six segments. Most of the meetings and negotiations were bilateral only between ESA and one coopetitor. Thus, the direct interfaces among the coopetitors were limited, which tended to reduce the tensions on information sharing-protecting.

In addition, the ESA project manager coordinated the schedule, the budget, and the resource allocation. When tensions emerged among the coopetitors, he acted as referee and supervised all the decisions made by the coopetitors to ensure that they served the project's best interests. Thus, he was in permanent interaction with the three coopetitors to help them to find the best solutions for Galileo at the lowest cost and to manage the consequences of these changes at the project level.

In this centralized configuration, knowledge leakage and transfers from one coopetitor to another could have happened through ESA. However, this situation never happened, because coopetitors trusted ESA to protect the shared knowledge. This trust in ESA from companies can be explained by several reasons.

First, ESA is an institutional actor and was mandated by the European Commission. If ESA had acted as a double agent, it would have had harmful political repercussions within the European Commission. Therefore, they had no choice other than to be as neutral as possible. ESA is a sort of orchestrator of the industry and cannot benefit one actor at the expense of others. Otherwise, its legitimacy and voice would easily be in danger in the market.

Second, ESA's business model is to promote the industry. Transferring information away from one competitor to another would be contrary to their business model. Thus, the agency did not increase the competition among OHB, TAS, and ADS. On the contrary, ESA balanced the power among the coopetitors and encouraged them to collaborate on Galileo.

Third, OHB, TAS, and ADS can trust ESA because of their previous experiences. Through past and successful experiences, they are familiar with the functioning of ESA. These past experiences have not only enabled them to know how ESA works, they have also enabled ESA to create very strong interpersonal relationships.

Finally, to not jeopardize other ongoing projects with them, ESA also must be neutral and respect their commitments.

The new centralized structure allowed the protection and sharing of the knowledge necessary to serve the development of Galileo. Beyond the formal sharing-protecting, some knowledge flows were informally shared among the coopetitors but only dyadically. Because of their frequent personal interactions on the project, some project managers have developed social ties and interpersonal relationships. So, the line between professional and personal life became blurred. Managers could call or see each other when necessary to share information, some tips, or to help each other when technical issues happened. This informal information sharing depended on the interpersonal relationships developed between managers within the project. However, no written documents were shared, no processes were implemented, and the information was only shared through oral conversation. As no evidence of the sharing could be found, managers felt that the knowledge was more protected and that they were sharing even more knowledge.

The coopetitors had informal meetings, two by two, in which they shared knowledge about Galileo's progress and organization. These informal knowledge flows were essential, as the coopetitors shared knowledge about the difficulties encountered in their project teams and about the development of the project. During these informal meetings, for the difficulties encountered, the companies could even provide some solutions, but to avoid the reproduction of the solution in another context, the solutions could only be provided in an aggregated format and without details. A learning process occurred informally between pairs of coopetitors. While in the common project team, the coopetitors did not share enough knowledge because they did not trust each other enough, in this centralized configuration, the coopetitors deliberately shared, albeit dyadically, informally aggregated knowledge.

## Conceptual and Practical Implications

### *Theoretical Implications*

In the case studied, the competitors had to share their core knowledge to develop radical technologies. To encourage pooling, the competitors decided to create a common project team. This decision was in line with the recent studies on coopetition management that recommended the design of joint project teams to develop a radical innovation between two competitors and separate project teams for incremental ones.[62]

The three competitors designed this common project team to encourage direct and close interactions among the competitors daily. The competitors thought that no formal procedures were necessary and relied on informal sharing among the team members. However, while the previous studies have shown that common project teams should be designed to achieve radical innovations, we show that this design is not relevant when several competitors are involved.

The common project team was not adapted to achieve a project such as Galileo. As the shared knowledge was informally protected, the competitors perceived very high risks of transfers and knowledge leakage; thus, the knowledge sharing at the project team level was very limited. Designing a common project team that relied only on informal mechanisms to share and protect knowledge was not the appropriate project structure for Galileo. Just as knowledge protection encourages competitors to share knowledge,[63] designing a project structure that allows the protection of the knowledge shared among several competitors seems essential.

The progress of the Galileo project was paralyzed by the lack of knowledge sharing among the competitors. To resolve this issue, the project structure evolved in line with the dialectics perspective.[64] The common project team was replaced by a centralized structure formally coordinated by a third party and composed of separated subproject teams. This result is consistent with the coopetition management literature and confirms the critical role of project structure in managing tensions in innovation projects.[65]

However, this study goes beyond the previous studies by highlighting a new project structure adapted for coupled innovation among multiple competitors: the centralized project team. In this new configuration, each competitor was responsible for one work package and interacted directly with the third party and not with its competitors. The knowledge flows were thus formally centralized by the third party, which guaranteed the protection of the shared knowledge and mitigated knowledge transfers from one competitor to another.

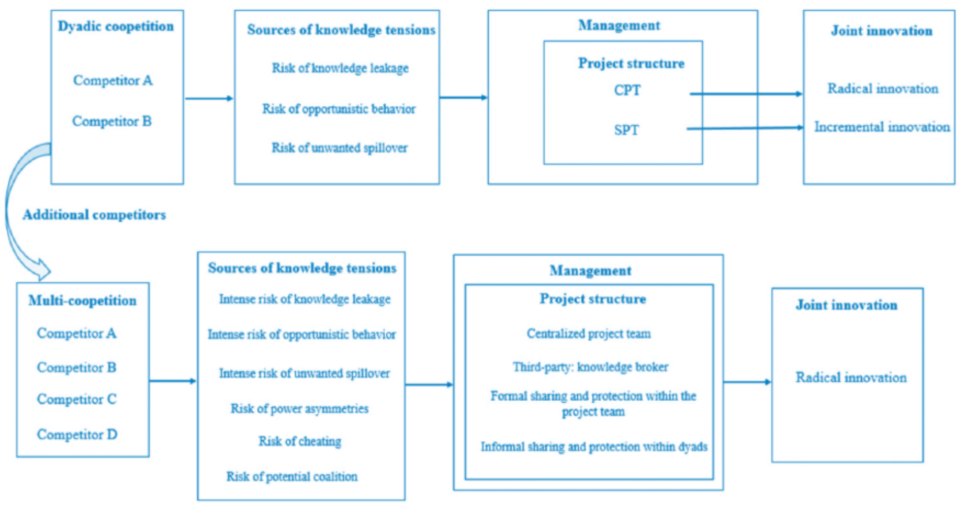
This finding might seem counterintuitive. The development of radical coupled innovation projects might require close interactions and direct knowledge sharing between competitors. However, the centralized structure limits formal and direct interactions among competitors. This project structure allowed the sharing of necessary knowledge through a third party. The knowledge sharing was indirect, and the shared knowledge was centralized and protected by this intermediary. Thus, the role of a third party as a knowledge broker seems essential.[66] The project structure was also essential to balance knowledge sharing and knowledge protection. As the knowledge was protected from competitors' opportunism, it could be shared indirectly, through a third party.

Through formal knowledge protection provided by a project structure, firms will be more willing to share knowledge to develop a project. Indeed, if competitors know that the shared knowledge is protected from leakage, they will be less cautious about sharing knowledge. Formal protection will encourage coopetitors to formally share their knowledge. In Galileo, the use of a third party as a formal mechanism to centralize knowledge flows and manage the tensions among the coopetitors was essential.

When several coopetitors are involved, it can be difficult and complex to control the sharing process and to maintain a balance between what knowledge should be shared or protected. To reduce this complexity and ensure smooth knowledge sharing, coopetitors create dyads within the project structure. This sharing in dyads was very helpful to ensure a certain reciprocity of the exchange, which reduced the risks of collusion and opportunism. As the risks of collusion, cheating, and free-riding behavior can be limited by the creation of dyads of coopetitors within the project structure, firms might be encouraged to share knowledge. In these dyads within the project structure, informal mechanisms—such as trust, individual capability, informal meetings, and interpersonal interactions—can then be used to share knowledge.

In the centralized project team, the knowledge shared informally by the coopetitors was mainly about Galileo, its organization, and its future. Some

**FIGURE 5.** Final theoretical contributions.




*Note*: CPT = common project team; SPT = separate project team.

technical knowledge was shared. However, it was specific to the project and thus not reusable on other projects. The risks of damaging the coopetitor's competitiveness were very low. This informal knowledge sharing was not possible in the common project team because there was no formal knowledge protection to protect competitors from the risks of opportunism, and knowledge leakage. Technical knowledge and other types of knowledge could be used by competitors for another project, and then could damage the competitor's competitiveness. In the new project team, even if there was no guarantee, thanks to trust, informal control processes were put in place to encourage knowledge sharing.

Finally, the shared knowledge was aggregated knowledge, and the coopetitors did not share any financial or technical details. The objective was to help the coopetitors find a solution for Galileo but not to help them reproduce or adapt it for their own product ranges. The sharing of the solution without the details on the shared knowledge is less appropriable and reduces the risk of transfers (see Figure 5).

### *Managerial Implications*

Managers with some experience of innovation projects with one competitor may have developed specific relational capabilities with and trust in that competitor. However, as projects involving several competitors are very complex, managers cannot rely on the trust and individual capabilities developed in dyadic projects. Indeed, to manage dyadic coopetitive projects, managers need to develop specific individual and organizational capabilities. As these projects involve several competitors, to manage multiple interactions, managers might need to rely other skills, such as coordination skills.

In the space industry, patenting is quite difficult as the innovation life cycles are very short. Companies do not have time to patent their knowledge. The project structure is an important lever for managing knowledge flows. More specifically, managers should avoid designing common project teams when more than two competitors are involved and they should instead design separate project teams based on clear task division. Knowledge flows should be centralized and coordinated so that the knowledge cannot be transferred from one competitor to another.

Managers should rely on third parties to facilitate the centralization and the coordination of the knowledge flows among several competitors. The third party can be an institution, a federation, a union, or even a client. The third party must be neutral and should not increase or decrease the competition among the project members. This key actor will behave as a knowledge broker in the project.

Informal knowledge sharing can occur but only under certain conditions. Managers should share knowledge informally only with one competitor in dyads of competitors within the collective project. In dyads, trust mechanisms can be easier to develop. Thus, the knowledge that is shared informally can also be protected informally. Instead of sharing critical and appropriable knowledge, managers should only share aggregated knowledge. Technical solutions can be shared without details about the engineering process. Financial statements can be communicated; however, the details about cost structures should remain confidential. Managers should learn how to transform critical and appropriable knowledge into nonappropriable knowledge.

## Conclusion

This research showed that a common project team that allows informal knowledge sharing and informal protection is not effective when several competitors collaborate in the project. On the contrary, that structure leads to an intensification of the knowledge sharing-protecting tensions. To manage such tensions, a specific centralized project team was designed. This new structure was composed of separate project teams coordinated vertically by a third party. The third party was formally in charge of the protection of the knowledge shared by the coopetitors. This formal centralized structure allowed the competitors to trust one another more and to accept some informal sharing of aggregated knowledge by dyads of coopetitors.

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