Managing coopetition:
rethink the resolution of the paradox of knowledge sharing

Bez, Sea

MOMA, Univ Montpellier, France et UC Berkeley, USA

Sea.bez@umontpellier.fr

Le Roy, Frédéric

MOMA, Univ Montpellier, France et Montpellier Business School, France

frederic.le-roy@umontpellier.fr

Abstract:

There is considerable interest in studying the risk of sharing knowledge in coopetition for innovation and the managerial solutions to reduce this risk (i.e. misappropriation and opportunism). However, in practice, there are no managerial solutions which completely prevent misappropriation and opportunism. In other words, safeguards mechanisms, as the use control mechanisms, do not erase the risk of the coopetitor misappropriating the shared knowledge. Thus, past research overlooked the fact that in coopetition for innovation, firms need to share knowledge even if this knowledge can be misappropriated. Our case study in the pharmaceutical industry digs deeper into the implementation of a risky knowledge sharing in coopetition.

Keywords: coopetition, innovation, knowledge sharing, opportunism, misappropriation, interdependence.

«This research received financial support from the French National Research Agency through the program "Investments for the Future" under reference number ANR-10-LabX-11-01 (LabEx Entrepreneurship) ».

Managing coopetition: rethink the resolution of the paradox of knowledge sharing

INTRODUCTION

In coopetition literature, the main adage is the inability to prevent knowledge sharing from opportunism and misappropriation explains the ambiguity of the coopetition success (i.e., a coopetition strategy could as easily end as a win-win or a win-lose relationship) (Faems, Janssens and Van Looy, 2010; Fernandez and Chiambaretto, 2016). More precisely, the past research predicted that fear of opportunism and misappropriation would lead to withholding, delaying or lowering the quality of the critical knowledge for the mutual value creation (Nieto and Santamaría, 2007; Bouncken *et al.*, 2017). These actions considered as competitive actions would hurt the potential mutual value creation and thus the promising theoretical strategy of coopetition would be a myth in practice (Le Roy and Czakon, 2016). In response, past research considered the ability to implement a control system that prevents opportunism and misappropriation due to knowledge sharing as almost a mandatory condition to ensure the positive link between coopetition and innovation (Ritala *et al.*, 2015; Fernandez and Chiambaretto, 2016).

In contradiction to this main adage, our result highlights that despite the inability to prevent the knowledge sharing from opportunism and misappropriation, coopetitors can implement broad-based knowledge exchange and learning. Thus, this research reopens the topic of knowledge sharing in coopetition by bringing an empirical proof that it is not mandatory be able to completely prevent opportunism and misappropriation to share knowledge between coopetitor. If to ensure knowledge sharing between coopetitors, a control mechanism that prevents misappropriation and opportunism is one possibility, there are other enabling conditions. Our case study of the pharmaceutical company Sanofi in the co-development and co-commercialization of the drug highlights that broad-based knowledge exchange and learning can be ensured by a deliberate hostage arrangement that makes the coopetitors interdependent in wins and failures.

One of the key insight from this result is that adding an interdependence in the failure to the usual interdependence in the wins creates pressure to enabling the coopetitor. This pressure makes sharing a priority that overcomes the fear of misappropriation and opportunism. It is why, we argue that to innovate with a competitor (implement coopetition strategy), firms need to overcome their own reluctance to enable their coopetitor with their knowledge even if they know that it can be risky. One managerial solution is to combine a high interdependence in the wins and in the failure (i.e. create a deliberate hostage arrangement).

This insight is counter-intuitive because it changes one of the key assumptions in coopetition literature: coopetitor are not implementing bungling actions to the coopetitor learning but the management of coopetition aims to implement effective actions toward the coopetitor learning (i.e. improve, and not worsen, the coopetitor's chances of capturing value as learning knowledge from the collaboration).

1. THEORETICAL BACKGROUND

1.1. THE PARADOX OF INTER-ORGANIZATIONAL KNOWLEDGE SHARING BETWEEN COMPETITORS

Sharing knowledge between coopetitors is a promising strategy for innovation because competitors have resource complementarities, partner similarity and critical thinking (Bouncken & Fredrich, 2012; Cozzolino & Rothaermel, 2018; Gnyawali & Park, 2011). The use of this external knowledge leverages their internal innovation process by creating new layers of knowledge, allowing learning process and decreasing the risk of decision traps (Bouncken & Fredrich, 2012; Gnyawali & Park, 2011). Past research in coopetition literature used qualitative and quantitative studies to prove it (Gnyawali & Park, 2011; Le Roy & Fernandez, 2015; Quintana-García & Benavides-Velasco, 2004).

However, the coopetition strategy for innovation is also a risky strategy. As its success relies on the use of this external knowledge to the internal innovation process, broad and deep knowledge sharing and learning are needed (Fernandez, Le Roy, & Chiambaretto, 2017). This knowledge sharing and learning are considered as the negative "other side of the coin" of coopetition (e.g. Baumard, 2010; Fernandez & Chiambaretto, 2016; Ritala, Huizingh, Almpanopoulou, & Wijbenga, 2017; Ritala et al., 2015)[1]. Indeed, by sharing knowledge, focal

1 This erosion is called "outbound spillover rent" (Lavie, 2006) or "negative reverse-impact" (Ghobadi & D'Ambra, 2011; Loebecke, van Fenema, & Powell, 1999).

firms take the risk of an erosion of the current or future competitive advantage in case the coopetitor misappropriate the knowledge or use it in an opportunistic way (e.g. Bouncken, Fredrich, Ritala, & Kraus, 2017; Hamel, 1991; Mention, 2011; Park & Russo, 1996).

1.2. THE MANAGEMENT OF PARADOX

The literature on the management of paradox highlights the need to shift from the defensive managerial approach of paradox to the acceptance of the paradox. Acceptance consists of embracing paradoxical tensions via a strategy of 'working through' (Dameron & Torset, 2014; Jarvenpaa & Majchrzak, 2016; Smith & Lewis, 2011; Smith & Tushman, 2005). A stream of research focused on the management and the acceptance of the inter-organizational knowledge sharing paradox (Bouty, 2000; Faems et al., 2010; Jarvenpaa & Majchrzak, 2016). This stream of research highlights that it is possible to accept inter-organizational knowledge sharing paradox. The cornerstone is to be aware that the sharing of some knowledge is strategic for the project success, but it can be hurtful and implement safeguards. The capacity to share knowledge and simultaneously protect its knowledge from the internalization by rivals is one of the most critical ways to solve the tension.

1.3. SECURING THE KNOWLEDGE SHARING WITH CONTROL MECHANISM: A WOBBLY SOLUTION

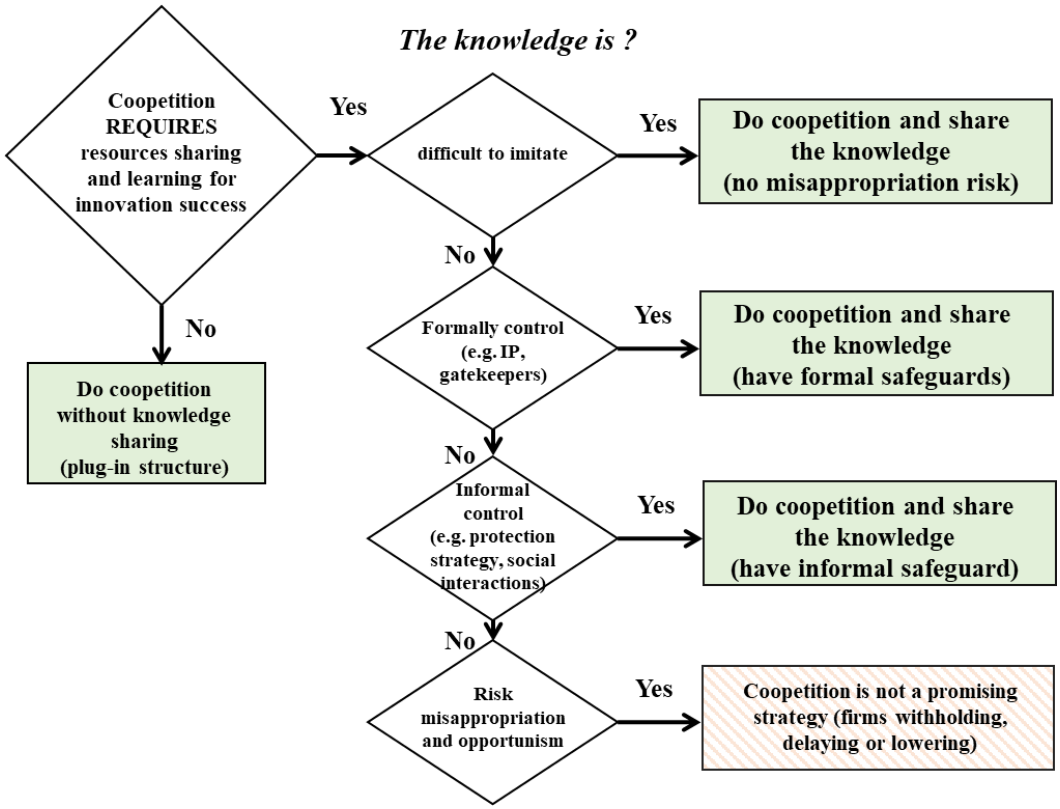
The management of the paradox of openness by protecting the knowledge against misappropriation or opportunism can also be associated with a stream of research on the inter-firm control mechanisms (Das & Teng, 1998; Fernandez & Chiambaretto, 2016). The control mechanisms refer to organizational arrangements designed to determine and influence the focal firm beliefs that proper behavior of the other party is ensured (Das & Teng, 1998). Merchant (1984, p.10)[2] argues that "good control means that an informed person can be reasonably confident that no major, unpleasant surprises will occur." Thus, applied to our research objective, the good control means no unpleasant surprises concerning the knowledge sharing and learning in coopetition. More concretely, it means to overcome this either/or approach of sharing and protecting knowledge. **Firms release the knowledge in such a way**

2 Merchant, K. A. 1984. Control in business organizations. Marshfield. MA: Pitman Publishing, Mjoen Even if we did not manage to access to the book, we still use the quote found in Das and Teng (1998) because we think it is powerful illustration of what is control.

that the other individual's home organization is unable to act on it in a harmful way (Faems et al., 2010; Jarvenpaa & Majchrzak, 2016).

Control mechanisms allow overcoming this either/or approach and integrating the duality of simultaneously sharing and protecting represents a managerial challenge (e.g. Fernandez & Chiambaretto, 2016; Heiman & Nickerson, 2004). The key assumption behind this previous research is that sharing strategic knowledge is safe because multiple control mechanisms are used. In other words, if the knowledge cannot be protected/controlled, firms are delaying or withholding knowledge sharing which negatively impacts the success of coopetition (cf. Figure 1).

Figure 1. What the literature says about coopetition and knowledge sharing



But what happens when the control mechanisms are not a sufficient condition to protect the knowledge. If sharing the strategic knowledge for the project success is still risky, how do firms manage the knowledge sharing?

2. RESEARCH CONTEXT AND METHODS

The research method adopted in this work is based on a single case study. Despite the widely acknowledged limitations of this approach, especially in terms of reliability and validity (Yin, 2009), a case study is a very powerful method for building a rich understanding of complex phenomena (Rynes and Gephart, 2004).

2.1. CASE SELECTION

We choose the pharmaceutical company Sanofi and the disruptive innovation Plavix co-developed and co-commercialized with Bristol Myers-Squibb for a number of reasons.

First, we followed Reynes and Gephart (2004) and looked-for industry and firm in which coopetition and knowledge sharing among competitors naturally occur, and which has social meanings for the actors. The pharmaceutical industry is an industry characterized by the long and extending partnerships. The development and commercialization of a drug between competitors are common, and more precisely the projects are 20 years long with high cost and high uncertain. The uncertain concerns the outcome of the drug: a failure, an improvement of existing drug or a "first in class" which disrupt the medical treatment practice class drug[3].

Second, the cardiovascular drug Plavix appeared to be an interesting case from the start of our early exploratory contacts, since it disrupted the way of treating patients who have the high-risk cardiovascular disease. The Plavix is the first agent shown in a variety of patients to reduce the risk of MI and mortality. Moreover, it allows the discovery that myocardial infarction was not a thrombotic disease and that the past treatment based on anticoagulant made people bleed but didn't improve the severity of their infarct[4].

Third, it is interesting to delve deeper into this case study because its highly performant innovation outcomes are in contradiction with past authors arguing that opening the innovation to a competitor leads to a reduction in the knowledge sharing and thus to a low innovation performance (Nieto and Santamaría, 2007; Santamaria and Surroca, 2011). Here the fear of making the competitor stronger was overcome. For example, Sanofi taught BMS all about the Plavix and its market. Similarly, BMS taught Sanofi how to succeed in an FDA

[3] A disruptive innovation is an innovation that shape social practices. Its specificity is that is that the potential capabilities of the technological breakthrough innovation can be predicted but it is impossible to predict if and how it can shape social practices (Chesbrough, 2003).

[4] *O'Riordan, 2012 (medical article in Medcape)*

process (i.e. how to succeed in the authorization process to put the drug on the American market).

2.2. SOURCES OF DATA

Our data collection goal was to get insight into Sanofi's knowledge sharing paradox and its resolution. We conducted 27 semi-structured interviews, and when it was possible, we asked them to do a schematic representation of the flows of knowledge. Our interviews were conducted with Sanofi's alliance managers, Project Chiefs of Plavix development, researchers who discovered the molecules and then developed it, experts participating in the development of the molecules at the beginning of the alliance before commercialization, and various experts in charge of marketing at global and local level (cf. Table 1). For the record, we used interviews with BMS and secondary data (e.g., press articles) to triangulate our results.

Table 1. List of the interviews at the different level of the firm

	THE PROJET PROCESS		
	BEGINNING OF THE ALLIANCE	**DEVELOPMENT AND PRODUCTION**	**LAUNCH OF THE PRODUCTS**
TOP MANAGERS IN THE FIRM	X		N° 14 – Sanofi's R&D director N° 19 – Director of Montpellier area of R&D N° 26 – BMS's Director, Product and Portfolio Strategy
GLOBAL ALLIANCE MANAGERS	N° 9 –Sanofi's first Alliance manager and first Alliance manager on the project Sanofi-BMS		N° 4 – Sanofi's global alliance manager and also directly in charge of Sanofi-BMS alliance N° 2 - Sanofi's Alliance manager for commercial alliances
SANOFI/BMS PROJECT TEAM MANAGERS	N° 16 – One of Sanofi's project chief of the Plavix N° 10 – One of Sanofi's Project chief of the Aprovel		N° 15 - Sanofi's project chief of the Plavix
SANOFI/BMS PROJECT TEAM	N° 8 –Sanofi's Research expert in the project team which was part of the Plavix's discovery team	N° 7 - clinical & Exploratory Pharmacology Department. N° 3 - New Product Marketing (publication) N° 11 – Toxicologist Expert N° 23 - BMS's Development expert	N° 17 – Marketing expert N° 24 – BMS's Marketing expert global N° 26 – BMS's Marketing expert global N° 27 – BMS's Marketing expert
OPERATIONAL WHO WERE INVOLVED IN THE SANOFI/BMS PROJECT	N° 18 – The finder of the Plavix N° 22 - Sanofi's Research who was involved in the team which discovered the Plavix	N° 5 - Sanofi's Master Plan Project Coordinator (in charge of the construction of the production building) N° 20 - Sanofi's operational who oversaw the informatic issue of the alliance move from paper to computer data; now the collaborative innovation director in Montpellier N° 22 - Sanofi's operational in charge of the clinical trial	N° 4 - Sanofi's Marketing Director for the Plavix in Spain and France
OTHER	N° 11 – Director of Toxicology (hierarchical director of all the toxicologist expert involved in the project) N° 1 – a senior expert who helped with specific toxicology issue N° 12 – a senior expert who helped with specific toxicology issue		

2.3. DATA ANALYSIS

The data analysis of the interviews went through two stages. An initial round of coding followed the literature to ensure that our chosen case and industry was relevant to the study. It needs to fit three characteristics: (1) a coupled innovation process *(permits to internalize knowledge of the partners and to externalize its knowledge to them)*, (2) occurred between competitors (*high resource and market overlapping*)[5]; (3) implied flow of highly sensitive knowledge (*strategic knowledge which could be internalized and reused opportunistically by the partner)*. A second inductive round of coding was undertaken to reveal: (1) the drivers of knowledge sharing *(the opportunities expected, and the outcome realized*); (2) the control mechanisms to make the knowledge sharing safe, (3) the challenges/tensions of sharing knowledge (*the fear and the concreate cases of misappropriation or opportunism)*; (3) the drivers of knowledge sharing despite the high risk of sharing.

3. RESULTS: NAVIGUATE AN UNSAFE KNOWLEDGE SHARING

The origins of Sanofi's knowledge sharing paradox in the development of the cardiovascular drug Plavix can be traced in 1992[6] when Sanofi began the phase 3 clinical trial on Plavix. A phase 3 clinical trial aims to demonstrate drug efficacy and long terms adverse reactions compared to the current best in class drug. These trials are usually risky (i.e., only one every four drugs succeed phase 3 trials). In the Plavix case, the risk was higher because it was not enough to be powerful and well tolerated, it needed to be better than the very common,

[5] Sanofi and BMS were competitors. Indeed, in 1993, at the beginning of the collaboration, Sanofi and BMS were two pharmaceutical companies which aimed to develop blockbusters at the global world scale. Their market and resources overlapped more and more. For instance, in some European countries, they were already selling competing paracetamol, and BMS intended to expand its influence on Sanofi's European market. Conversely, Sanofi was also stepping into BMS market. Sanofi had recently acquired a Sterling Drug, a pharmaceutical subsidiary of Kodak, which gave Sanofi an access to the American market. And above all, Sanofi had discovered the Aprovel, a drug to cure hypertension, which was a new and more efficient mechanism. If successful, the Aprovel could have hurt the BMS sales rate as the current leader of the hypertension market. In their rivalry, the power was asymmetric. BMS was a top 5 strongest pharmaceutical company in regard to the stock market, and Sanofi was ranked twentieth.

[6] Its goal was to replace Sanofi's current blockbuster Ticlid. Ticlid was an antiplatelet drug used for preventing strokes and coronary stent occlusions but in 1978, after its launched, it appeared that was not particularly well tolerated by patients. It could generate severe bleeding. Thus, only some months after its launched Sanofi engaged a research program to find a new generation of drug with a better benefit-risk profile than Ticlid. After, 10 years of research (i.e. thousands of analogues molecules to Ticlid synthesized and tested in animals for their antiplatelet and antithrombotic effects, eight of them developed up to trials in healthy volunteers, and several failures to used separation method on the only molecule that had a clearly more active and better tolerated than Ticlid), the Plavix was patented and began its preclinical trial.

efficient, cheap and as well tolerated drug, Aspirin. Thus, the trial planned to involve the worldwide biggest number of patients in phase 3 trial, 15000 patients[7].

Despite the risk, Sanofi was confident, they knew that they had found a new mode of action which was powerful, different from other platelet inhibitors such as aspirin, sulfinpyrazone and dipyridamole and that had a relatively long duration effect. But in 1993 they faced other several challenges: lack financial capabilities, lack of development capabilities, high level of risk and ineffective channels to market products in the American market (cf. vignette 1). To overcome these challenges Sanofi had to collaborate with a stronger pharmaceutical industry in terms of developing blockbuster capabilities and accessing American market capabilities.

Vignette 1. Sanofi motivation to involve in coopetition

The financial challenge

A phase 3 trial in cardiovascular costs in average $25 billion. However, in 1992, Sanofi was only a subsidiary of the French oil and gas company Elf Aquitaine and had other drugs in its pipeline: 5 in pre-clinical stage, 25 in clinical stage and 3 as advance as the Plavix[8]. By opening its drug Plavix to a coopetitor, Sanofi could share 50/50 of the phase 3 development cost but also share the production and marketing cost. Thus, Sanofi had not to sacrifice the other drugs in its pipeline. For example, Sanofi had unexpectedly find Aprovel, a hypertension drug that was in the race with other company as Novartis to disrupt the leadership of Bristol Myers Squibb in the hypertension market. If Sanofi had managed to bring the drug into the early phase 3 development, it was a new entrant in this specific market, thus this drug might be put on the innovation shelf.

The high level of failure risk

Develop several drugs simultaneously is a way to manage the risk of failure which is very high in the pharmaceutical industry. They are only 25-30% of drugs move to succeed phase 3.

The lack of knowledge and capabilities to access the American market

Concerning the development knowledge, Sanofi knew very well the development process to obtain a drug launch authorization in Europe but in the past, they had failed several times to obtain FDA approval. Failing in obtain an FDA approval in the US is a big opportunity cost because the US represents more than one third of the worldwide drug consumption. Thus, Sanofi needs to open its development process to overcome its current decision traps or lack of knowledge about the US process. An external partner could leverage its current processes and increase the rate of success. Lastly, Sanofi had not a strong sale force in the US. It had just acquired Sterling Drug but this channel to the American market was to weak compare to the

[7] The phase 3 trial was named CAPRIE: "Clopidogrel versus Aspirin in Patients at Risk of Ischemic Events" study).

[8] Usine nouvelle, 1993 <https://www.usinenouvelle.com/article/medicamentsanofi-parie-sur-l-efficacite-de-sa-recherchele-rachat-de-sterling-ouvre-a-la-societe-francaise-le-marche-americain-un-atout-si-la-societe-francaise-reussit-a-lancer-des-molecules-originales.N72747>

promising blockbuster that Plavix could become. Thus, Sanofi needs a partner to path the drug to the American market.

Sanofi chooses to collaborate with one of the top four company in the pharmaceutical industry, Bristol Myers-Squibb (BMS). As top four company, BMS had a high financial resource, strong stratus in the pharmaceutical industry (and in cardiovascular indication) and more important it had proved by the past its capabilities in co-developing successful blockbusters with competitors. However, BMS was not interested in the Plavix. It was much more interested in another of Sanofi's drug in phase 3, Aprovel. Aprovel had the potential to become the second-in class of new mechanism of action to treat hypertension (i.e. the market was shifting from angiotensin-converting enzyme ACE inhibitor to angiotensin II receptor). This new mechanism of action was predicted to take over BMS's leadership in hypertension market which had found the first ACE inhibitor. BMS's internal research on this new mechanism of action was too far behind. Thus, BMS wanted to co-develop Sanofi's Aprovel to maintain its leader position in the hypertension market. Sanofi agreed to the co-development and the co-commercialization of the Aprovel on the condition that BMS co-developed and co-commercialized the Plavix. July 29, 1993, they signed the co-development agreement and the first draft of a co-commercialization agreement in case they managed to launch the drugs.

The co-development agreement gave the lead to Sanofi on the development of Plavix. Thus, it was planned that Sanofi would oversee the implementation of the development trial and gain regulatory approvals in Europe and US. However, BMS had to validate each of Sanofi decision and implementation process. The goal was to leverage Sanofi's innovation process by BMS's critical thinking and past experiences. Similar, BMS had the lead on Aprovel, and Sanofi would bring the critical thinking and past experiences to improve BMS decisions.

These leveraging effects did also concern the co-commercialization. In 1996, when they obtain the approval to launch Plavix and Aprovel, they signed a partnership agreement under the French status of "a societe en nom collectif." The world was approximatively divided into two territories: mainly the US and the rest of the world. This division followed their competitive advantage (BMS mainly the US and Sanofi mainly Europe). BMS would oversee the selling of Plavix and Aprovel in the US, and Sanofi in the rest of the world. In these splitting of the world, the same validation system was implemented. Sanofi needed the approval of BMS for each of its commercial decisions and reciprocally BMS needed the

approval of each of Sanofi decision. The value capture system decided was based on royalties. For each sale, the company had to pay royalties to the other. More concretely, Sanofi paid co-development royalties for each of its sales, and received discoveries and co-development royalties for each of BMS sales.

Our analysis of Sanofi knowledge sharing paradox reveals three themes. First, for Sanofi it was promising to share openly its knowledge about Plavix to BMS. Second, even if it was a promising strategy, the sharing was risky, and the control mechanism implemented to have a safe sharing did not protect Sanofi against misappropriation and opportunism. Third, even if Sanofi feared misappropriation and opportunism and was not able to implement strong enough protecting strategy, they did not withhold, delay or lower the quality of the sharing.

THEME 1: THE PROMISING OPPORTUNITIES OF SHARING KNOWLEDGE BETWEEN COMPETITORS

Our first theme underlines the promising opportunities of sharing knowledge in coopetition for innovation. An analysis of the data revealed three opportunities that can be unlocked only by sharing the knowledge: identifying the most valuable uses of an invention (reduce the technological and market uncertainty), reduce the time to market and optimize the revenue.

Identifying the most valuable uses of an invention

In the development of Plavix, Sanofi needed to manage Plavix technological and market uncertainty. From the beginning Sanofi knew that it had found a promising drug. Plavix mechanism of action was powerful and differed from that of other platelet inhibitors such as aspirin, sulfinpyrazone and dipyridamole[9]. But, they had a major issue they had not the knowledge to explain the mechanism of action and thus why the Plavix was so powerful. Moreover, currently they did not know yet the most valuable uses of the Plavix which is for the clinical events stent thrombosis and MI. Indeed, currently these clinical trials were rare.

> *"The clinical events stent thrombosis and MI, for example, are relatively infrequent, so physicians really had no idea how large a role Clopidogrel was going to play. One of the major benefits of treating patients with aspirin and Clopidogrel was apparent in how quickly stented patients could*

[9] "At variance with these drugs, it appeared as a powerful inhibitor of ADP-induced platelet aggregation" (Maffrand, 2012)

> *move out of the hospital, however" (Dr Robert Harrington, Duke Clinical Research Institute, Durham, NC)*[10]

> *"The first stents were quite large and required large bore groin sheaths, so the bleeding complications were just enormous," […] "Understanding the importance of dual antiplatelet therapy with Clopidogrel was a great advance forward over Coumadin and even over ticlopidine. It was a great advantage to get a once-a-day drug and to get away from the bleeding that Coumadin caused. The bleeding with full heparinization and Coumadin for the first coronary stents makes the bleeding with Clopidogrel seem like a walk in the park." (Dr Jeffrey Marshall, Northeast Georgia Medical Center, Gainesville)* [11]

In other words, it took more than 10 years after the synthesis of Clopidogrel to elucidate the mechanism of action of the Plavix. Facing this uncertainty, being challenged by BMS allow them to have the financial support and external knowledge to not fall into the decision trap of following only the current market. More than 11 different trials were undertaken to test the different use of the drug.

Reduce the time to market

The competition between pharmaceutical firms is about patenting new pharmaceutical products either in an existing therapeutic indication or in a new therapeutic indication. To have the possibility of marketing a new pharmaceutical product, the product needs to be effective, safe, convenient, reliable and available. Moreover, factors such as the price, the third-party reimbursement and the patent exclusivity impact its competitiveness.

However, these product characteristics are not enough to explain the competitive advantage of a firm. The competitive advantage also relies on time market introduction of the drug. Competitive advantage can be gained by reducing the time for complete clinical trials and obtaining the regulatory approval, receiving pricing and reimbursement in certain markets and supplying commercial quantities of products to the market. Knowledge is crucial to enter the market at the best time. This knowledge is an understanding of the actual and past market which allows the firm to see the market's opportunities and risks. The knowledge also includes the ability to fit the internal development to the external demands, such as the legal constraints and patient expectations. Because without shaping the products to respond to the external demand or shaping the external context, the invention will never be a commercial drug.

10 Quote extracted from O'Riordan (2012)

11 Quote extracted from O'Riordan (2012)

For example, the time to market for Plavix was reduced by six months due to BMS tips. After Sanofi exposed the development tactic for Plavix, BMS leverage it by highlighting that they might have a contact in the FDA which could help them obtain an authorization to begin the analysis of the results on the first data collected from the trials and not wait for the end of the trials. It was possible to do some test on the first development results meanwhile the development team was finishing the tests. Sanofi chief of product argues that thank BMS the time innovation process was reduced:

> *"BMS was in contact with the FDA, which is the U.S. Health Agency. Thus, we could make tactics, let's say - analyzing data even if it was not finished yet. It makes us win six months."*

Being implemented in the country is crucial for the time to market. The network and tacit knowledge cannot be bought. The same chef of product highlights the existence of gateway that could slow down or stop the access that Sanofi did not know about:

> *"There are gateways that you won't ever just with your knowledge or with time. To penetrate the world, you need time and the time you spend is very important. However, [when you are from this country or with high notoriety in this country], there will always be someone you know that it will open the door quickly and cooperation or a co-[UH]. [coopetition is needed] […] We do it because by joining forces together we'll get more quickly to the target"*

Optimize the revenue

Global marketing was necessary to redeem the R&D expenses. Indeed, a drug's success on a global level might compensate the high failure rates of other drugs. Moreover, by reaching out to global markets, Sanofi could increase its revenues. Sanofi was well established in the European market, which is its domestic market. But despite the acquisition of Sterling Drug in the United States, Sanofi was almost unknown on the American market. This was a big issue because the American market is the world's largest market for pharmaceuticals. The optimization of revenue required efficient and experienced sales all over the world, especially in the US. One top manager of Plavix relates how the alliance was perceived when she began to work in the alliance as an operational doctor in charge of the clinical test:

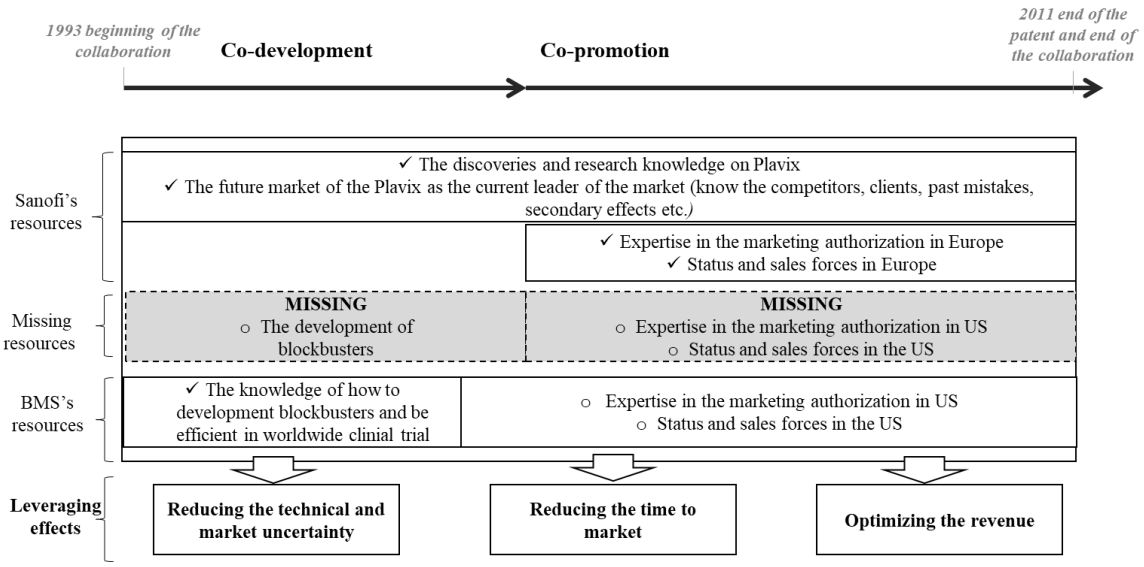
> *"We heard the following about BMS alliance, it's a caricature, but it's that I've learned. BMS at the time it was the big American pharma. […] we did a deal on the following basis: for Clopidogrel so future Plavix, we needed a "footprint" in the United States... of someone very strong, very well established to launch [it]."*

Moreover, as each company needed to obtain the other approval for any marketing decision, they did not just split the market but implement interaction between Sanofi and BMS marketing directions. These interactions were not easy. They even had to implement team building session to foster the knowledge sharing. But in the end, it revealed to be value creating. For example, one interviewee spoke about the comparison of the list of doctors they needed to convince. Having a competitor is a way to challenge the diffusion process. One project team spoke about benchmarking they process:

> *"[due to our interaction with BMS, we learn that we were not aggressive enough, and we learn how] to be more aggressive in the communication"*

We summarized the leveraging effect that Sanofi benefits from implementing a coopetitive relationship in which the coopetitor do not plug-in the task done internally but create a structure which encourages knowledge sharing and interaction (cf. Figure 2).

Figure 2. The leveraging effect of sharing knowledge between Sanofi and BMS for Plavix



THEME 2: THE RISKS OF MISAPPROPRIATION AND OPPORTUNISM SUBSIST DESPITE THE CONTROL MECHANISMS

If knowledge sharing with BMS was promising, the risk of misappropriation and opportunism became a reality (cf. *Figure 3*). By sharing its knowledge with a competitor, Sanofi enabled BMS and took the risk of cannibalizing its own profit: BMS was almost able to create its own internal "Plavix" and, at least twice, BMS captured value for him at the expense of Sanofi.

The reality of misappropriation and opportunism in coopetition

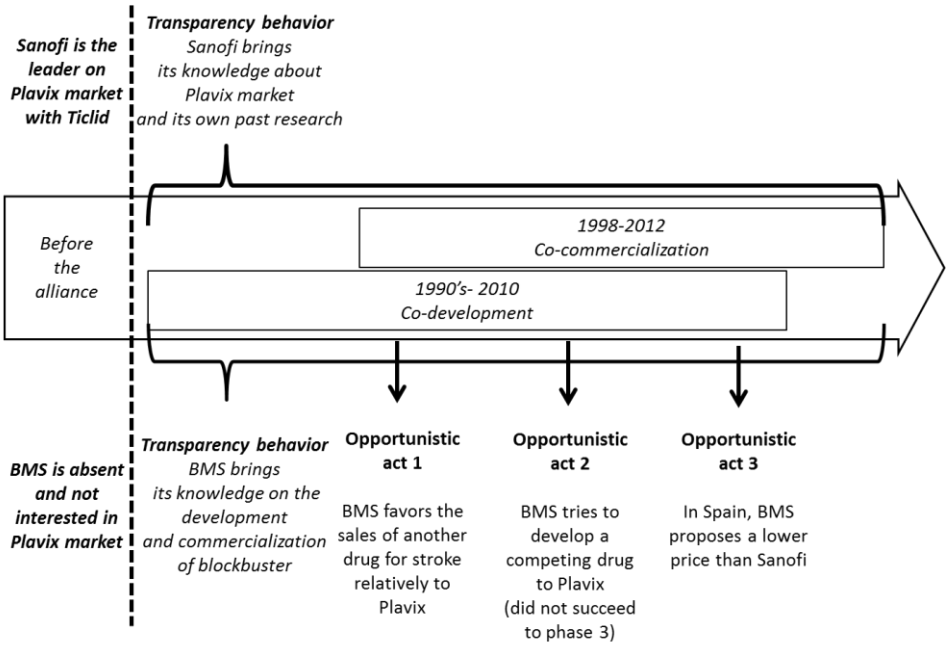
As discussed earlier, BMS was absent and not interested in the Plavix market. During the interviews with Sanofi's and BMS's employee, Plavix was the "icing on the cake". BMS was interesting in Aprovel and not in Plavix. As the success of the innovation process involved sharing Sanofi's knowledge on this market and drug, BMS was able to internalize Sanofi's arguments why Plavix was a growing market and to absorb Sanofi's databases and past knowledge on the development process (success and failure). BMS reused this knowledge to create a competing drug on Plavix market without Sanofi. One of the top managers interviewed who worked 15 years for the alliance relate their fear when they discover that BMS was developing a competing drug to Plavix:

> *« ... on the fact that BMS had access to a lot of research on this subject and used what we managed to create on Plavix via the shared databases, knowledge about the development, on a project that was beyond the scope of the alliance, I know there were issues, because it could serve them to develop other products."*

Nevertheless, this competing drug was never commercialized because some tests on the human were not good enough. If BMS had succeeded to develop its own drug, Sanofi would have harmed its competitor which its own weapons.

The knowledge sharing did not only allow misappropriation of the knowledge shared but also it also leads to opportunism. At least twice, BMS increased its private value capture at the expense of Sanofi. As, Plavix was considered by BMS as "icing on the cake." When it came to the selling of Plavix. BMS gave priority to the sales of its own cardiovascular drug relative to the co-developed drug "Plavix." It preferred to sell its internal drug even if they were less efficient than the co-develop one (i.e. capture 100% of the revenue instead of 50%). The second example occurred due to the uncertainty of the legislation. In some countries like Spain, due to legislation constraints, Sanofi and BMS were not allowed to do co-commercialization (i.e. to sell one drug under the same brand), they had to do co-promotion (i.e.to sell the same product under two different brands). Thus, they were in direct competition in Spain. For example, in one of the largest hospitals in Madrid, each company had a full-time sales representative in charge of selling the drug. Because the product was the same, for the sales representative, it was not possible to differentiate them based on product characteristics. Thus, to boost the competitiveness of their product, BMS decided to lower its price compared to Sanofi's product. This action allowed BMS to capture Sanofi's market share in Spain.

Figure 3. BMS's opportunistic behavior



The use of controlled mechanisms

One specificity of coopetition for innovation based on broad and intense knowledge sharing is that it invites opportunism. Although we just highlighted Sanofi was not protected from the misappropriation and opportunism, Sanofi tried to minimize the misappropriations and opportunistic behaviors by the used of multiple control mechanisms (cf. Table 1). Those control mechanisms failed in allowing a safe against any unpleasant actions from BMS.

Table 1. The weakness of the control mechanism implemented by Sanofi

Control mechanisms	Descriptions	BMS's overcomes the control mechanism	Weaknesses of this control mechanism
Appropriability	Plavix was patented	BMS engaged in the development of a competing internal drug	The patent protected Sanofi against an external imitation but not an internal one
Hostage arrangement	The collaboration concerned two drugs: Plavix and Aprovel. And each firm had the lead on one of the drugs.	BMS behaved opportunistically on Plavix (misappropriation of the knowledge learned)	It would be irrational to threaten the success of the other drug, Aprovel, because BMS was opportunistic on Plavix
Cross royalties	Created a value capture system in which the value capture increases with the increase of the other sales (interdependence in the wins)	BMS preferred 100% of the revenue of an internal drug that 50% of Plavix	Secure the knowledge sharing and the enabling process but not the opportunistic behavior
Commitments in a risky project	Sanofi and BMS invested money, a full-time project team, and the times of the top management. This commitment created a pressure not to fail	Increase the willingness to capture private value and thus took the opportunity to reap the market share from Sanofi in Spain.	Secure the knowledge sharing and the enabling process but not the opportunistic behavior in the value capture
The choice of the partner	BMS was not interested in the Plavix and its market	It is through time and its interaction with Sanofi that BMS change its perception of the market	The partner's behavior is unpredictable
Social interaction	Each expert had a full-time counterpart in the other company and they had to work "hand in hand" on a daily basis	BMS behaved opportunistically despite these social interactions	The social interaction at the operational level does not hinder the opportunistic decision at the strategic level

THEME 3: SHARE KNOWLEDGE EVEN IF THIS SHARING IS LIKELY TO GENERATE MISAPPROPRIATION AND OPPORTUNISM

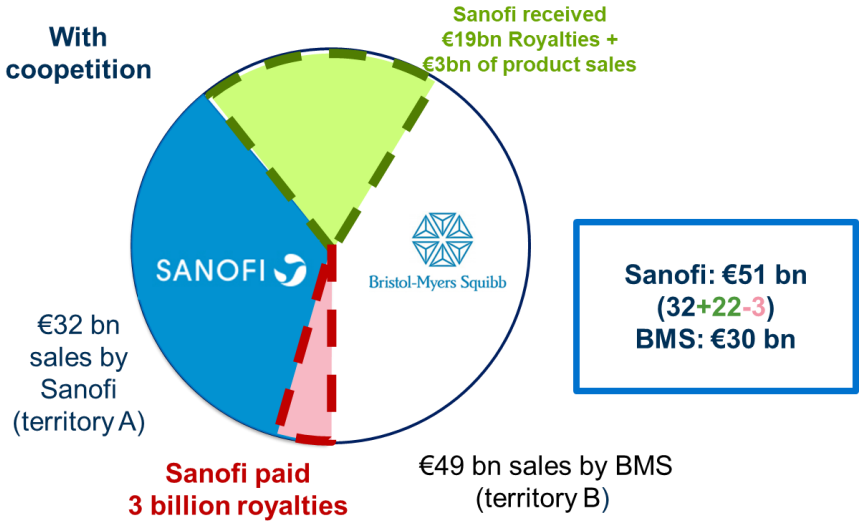
Sharing knowledge when this knowledge can generate misappropriation and opportunism is counter-intuitive. The proof is that the marketing experts involved in the Plavix did not want to share the marketing strategies and best practices with each other. Thus, to implement the knowledge sharing, Sanofi and BMS used team building sessions.

These empirical facts do not explain the decision of sharing knowledge when the partner is likely to misappropriate or be opportunistic with the knowledge shared. The answer is that Sanofi had no choice. If Sanofi did not share the knowledge, BMS would not have leveraged Sanofi decisions, and the risk of failure would have increased. Sanofi and BMS had committed so many resources in terms of monetary investment, human resource investment (one team in each company), top managers times in Plavix committee that they could not fail. Any knowledge which could enable the project, needed to be shared. Ideally it would be protected by the control mechanism but if not, it should be shared anyway.

Moreover, paradoxically the more BMS understood Plavix and was able to be opportunistic, the more interested BMS was is Plavix success and sales. The more BMS was interested, the more it committed resources in the project. BMS send twice a team to teach Sanofi how to obtain an FDA approval. An Approval that Sanofi had never succeeded to obtain before and that they obtain several times by themselves after the collaboration.

Finally, Plavix reveals to be a disruptive drug which disrupted the way of treating and operating patients who have the high-risk cardiovascular disease. As discussed earlier, this level of success was not possible to predict, and it generated for Sanofi. Together, the Plavix and the Aprovel generated €51 billion. These €51 billion are the results of €32 billion to which we addition the royalties of discovery and the royalties of co-development, less the own Sanofi had to pay to BMS.

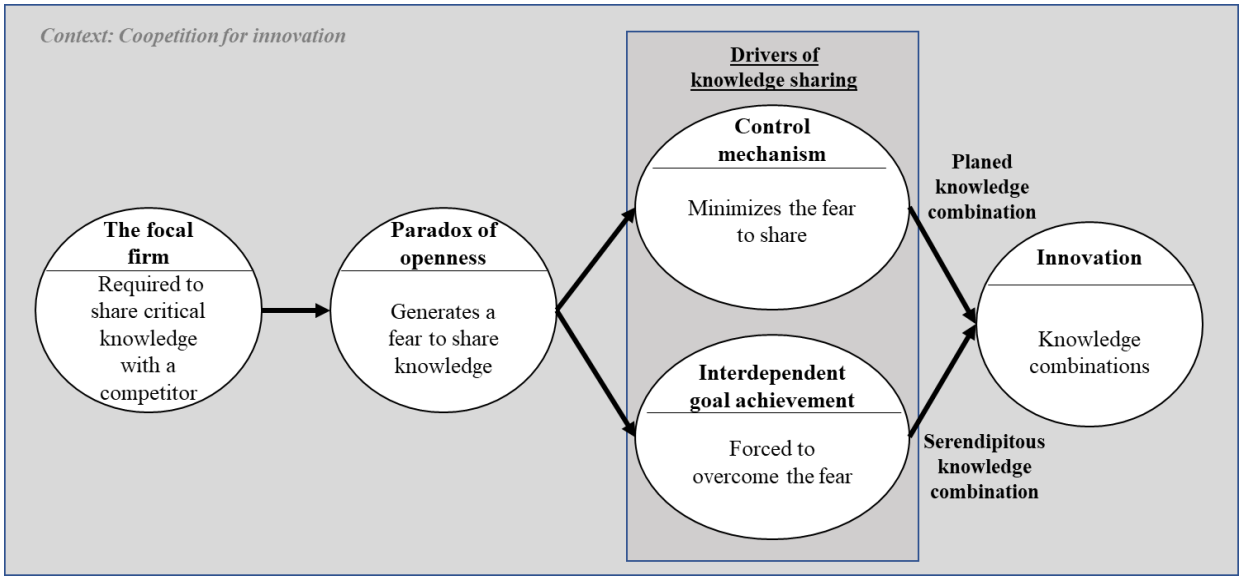
Figure 4. Sanofi gains due to its collaboration with BMS



4. DISCUSSION AND CONTRIBUTIONS

We began the paper by asking how a firm can overcome the fear of sharing knowledge that is not protected against misappropriation and opportunism. Our findings on Sanofi in the co-development and co-commercialization of Plavix generated several insights, which we articulated as themes in the previous section. In this section, we use these insights to propose a model of the management of knowledge sharing in coopetition for innovation (cf. figure 5). We also highlight the contributions of our study to different literature streams. More precisely, this model deepens our understanding of the paradox of sharing knowledge in coopetition and its resolutions. We highlight a new insight into the resolution of the paradox: shifting from transcending the paradox to accepting it. Then, our results highlight one concreate form to accept the paradox of sharing knowledge. This concreate form can be linked to the existing literature of the "*hostage arrangement.*" Finally, this hostage arrangement goes deeper into the understanding of the ambiguous results concerning the use of coopetition for innovation.

Figure 5. The management of knowledge sharing in coopetition for innovation



4.1. THE KNOWLEDGE SHARING MODEL

Figure 5 highlights that in addition to the control mechanisms that minimize the fear of knowledge sharing by controlling the risk of misappropriation and opportunism, there is a need to create a goal achievement interdependence between the coopetitors. More precisely, this goal interdependency needs to be on the gains but also on the failure. This result echoes Deutsch conflict resolution of cooperation and competition which consisted of implemented a system which, put colloquially, one swim only is the other swim and reciprocally one sink if the other sink (Deutsch, 2011)

Indeed, minimize the fear of knowledge sharing is not an incentive enough to share the knowledge. The traditional control mechanisms used to manage coopetition are not strong enough to protect against misappropriation and opportunism. There is a need to create a pressure to share knowledge even if this sharing can lead to misappropriation and opportunism. This pressure can take the form of a hostage arrangement in which the wins and failures of the firms are interdependent.

4.2. THE ACCEPTANCE OF THE KNOWLEDGE SHARING PARADOX IN COOPETITION

The literature on paradoxes and their resolution (Cameron & Quinn, 1988; Smith & Lewis, 2011) offers a holistic frame to understand how to manage the openness paradox. The coopetition literature mainly used this frame to highlight the need to transcend the paradox by lowering the risk of misappropriation or opportunism (i.e. make the knowledge non risky) (Le Roy & Fernandez, 2015). Our model explores one other possibility offered by the resolution of the paradox literature: the acceptance. The firm can constraint itself to accept the tensions. It can share the knowledge without withholding element, delaying the sharing or reducing the

quality; even if it fears the misappropriation and opportunism. More concretely, the goal achievement interdependence, which is a hostage arrangement which makes coopetitors interdependent in wins and failure, constraint to sharing of knowledge despite its fear.

4.3. THE HOSTAGE ARRANGEMENT

Williamson (1983) highlighted that credible commitments are undertaken in support of alliances and to promote exchange, and credible threats appear in the context of conflict and rivalry. Since the hostage arrangement had been considered as a managerial solution to limit misappropriation and opportunism from the partner (Dowling, Roering, Carlin, & Wisnieski, 1996; Faems et al., 2010). Forgetting that Williamson ideas were to promote exchange. The hostage arrangement is a managerial solution to not only deal with the coopetitor opportunism, but its goal is to ensure knowledge exchange. Paradoxically, our results highlight that the hostage arrangement can be a deliberate decision to overcome its own competitive behavior (e.g. knowledge withholding).

Moreover, our results highlight that in the hostage arrangement applied to knowledge sharing in coopetition there are two sides: the positive interdependence in the wins (to increase the payoff, the firm needs to increase the partner payoff), and the positive interdependence in the failures (in case of failure of the partner, the focal firm fail also, and they have committed so many resources that they cannot fail). The interdependence in the failure is shifting the incentive to share into a pressure to share. Thus, they are as important that the interdependence in the gain.

In sum navigate the knowledge sharing paradox in coopetition is not an easy task and firms might need a pressure to share to overcome their fear of knowledge sharing.

4.4. THE AMBIGUITY OF THE COOPETITION PERFORMANCE

The link between coopetition and innovation is ambiguous. Some studies even find a negative link because the firms withhold, delay or reduce the quality of the knowledge required for the mutual value creation. For those studies, coopetition is not always considered as a non-relevant strategy because the risk of misappropriation and opportunism can cannibalize the payoff of sharing the knowledge (Bouncken et al., 2017; Nieto & Santamaría, 2007; Park & Russo, 1996).

Based on our case study, we can wonder if this fear might not be based on a false premise: “reduce the risk of erosion of your competitive advantage by not sharing the knowledge”. While this premise may be true on occasion, it will be more often be false in a world of hyper-competition and innovation race. Competitors often find ways of inventing around the knowledge or replace it (Chesbrough, 2003).

The cost of not leveraging the knowledge is much greater than the one of protecting it from imitation. If the firm errs on the side of not cannibalize the payoff of sharing, it might lose some potential profit from serendipitous knowledge combination. At several occasions, Sanofi had leveraged its innovation processes in unexpected ways (i.e. the capability of reducing by 6 months a worldwide development process).

At least, our results case questions the directly link firms' inability to protect themselves from misappropriation or opportunism and the low performance of coopetition for innovation (Bouncken et al., 2017). Our case brings the empirical proof that firms can overcome their willingness of withholding, delaying or reducing the quality of the knowledge when they cannot protect from misappropriation and opportunism.

Thus, we argue that the ambiguity of the coopetition performance depends on the firm ability to overcome the fear of sharing and that they are an alternative solution that is minimizing misappropriation and opportunism.

5. CONCLUSION

The typical advice given to firms involved in coopetition for innovation is that they need to prevent any opportunism and misappropriation due to the sharing of critical knowledge with a competitor (i.e. make the knowledge sharing safe) (Bouncken et al., 2017; Fernandez & Chiambaretto, 2016). Our study shows that the ability to prevent opportunism and misappropriation is not mandatory in coopetition for innovation. If to ensure the required knowledge sharing between coopetitors, control mechanisms that prevent misappropriation and opportunism are one possibility, there are other enabling conditions. Despite the obvious risks of opportunism and misappropriation, a hostage arrangement that makes the coopetitors interdependent in their wins and failures can ensure a broad-based knowledge exchange and learning. Our study raises several questions and opens new avenues for research. For instance, how does focal firm convince the engineers to overcome their reluctance to enable their coopetitor when they know that sharing the knowledge can be risky? This empirical fact has already be highlighted in the EADS-Thales collaboration, the engineers endangered the common project by not sharing the required technologies for the project success (Fernandez, Le Roy, & Gnyawali, 2014). To overcome the engineers' fear, EASD-Thales implemented formal and informal control mechanisms that protected the knowledge sharing form the coopetitor misappropriation or opportunistic behavior. Based on this empirical fact, we can

ask ourselves if the EADS-Thales could have implemented an alternative solution as the "deliberate hostage arrangement"? Would the shift from protecting the shared knowledge to a "deliberate hostage arrangement" increase the likelihood of breakthrough innovation that shapes social practices?

Yet other research opportunities emerge when we consider the boundary conditions applicable to this study. Sanofi had no choice, it had to do coopetition. Its only freedom concerned the choice of the partner. What if the focal firm was not dependent on having a coopetitor?

Another boundary condition pertains to the nature of the industry. In the pharmaceutical industry, the coopetitive projects are twenty years long with high cost and high uncertain about its ability to shape the social practices by being a first-class drug or second-class drug (Holmes, 2016). What if the project is not so time, cost and risk consuming? To the extent that the industry is characterized by low cost, low risky and short time project, knowledge sharing is required less (Bouncken et al., 2017). But to the extent that the most valuable use of the invention and the market target are uncertain, the knowledge must be shared and learned extensively (without withholding, delaying or lowering the quality) (Bayona, García-Marco, & Huerta, 2001; Fernandez et al., 2017). Thus, the usual managerial solution of protecting the knowledge shared against misappropriation and opportunism might be possible for the former but not the latter. As an example, consider the coopetitive project in "autonomous vehicles" (self-driving cars) to develop the needed artificial intelligence the coopetitors as Renault and Nissan are openly sharing their artificial intelligence practices without being sure that the other will not misappropriate the practices they shared.

In conclusion, our study builds upon existing literature to offer new insights and raise a question for further explorations. Our study sensitizes scholars and managers to the limits of the traditional willingness of protecting the knowledge shared from misappropriation and opportunism. On the contrary, to innovate in a way that shapes social practices, firms need to overcome their own reluctance to enable their coopetitor with their knowledge even if they know that it can be hurtful. Additional research can help dig deeper into the managerial solution to enable this paradoxical unsecure sharing (i.e., confirm the "deliberate hostage arrangement" or find alternative solutions).

MANAGERIAL IMPLICATIONS

Firms need to be aware of the risk due to knowledge sharing in coopetition for innovation (e.g. misappropriation and opportunism). It is a myth that managerial formal and informal control mechanisms prevent completely against these risks. However, these risks might be a little price to pay compared to the price of not leveraging its knowledge in our context of hyper competition and innovation race. Thus, the key managerial factor in coopetition is to ensure the knowledge sharing. To overcome its fear that sharing knowledge will be hurtful. In addition to the implementation of control mechanisms to minimize the risk of sharing, firms might need to implement deliberate hostage arrangement in which they are a forced to share even if they fear the sharing.

BIBLIOGRAPHY

Baumard, P. (2010). Learning in Coopetitive Environments. In S. Yami, S. Castaldo, G. B. Dagnino, & F. Le Roy (Eds.), *Coopetition: Winning Strategies for the 21st Century* (pp. 74–94). Cheltenham: Edward Elgar Publishing.

Bayona, C., García-Marco, T., & Huerta, E. (2001). Firms' motivations for cooperative R& D: an empirical analysis of Spanish firms. *Research Policy*, *30*(8), 1289–1307.

Bouncken, R. B., & Fredrich, V. (2012). Coopetition: performance implications and management antecedents. *International Journal of Innovation Management*, *16*(5),

Bouncken, R. B., Fredrich, V., Ritala, P., & Kraus, S. (2017). Coopetition in New Product Development Alliances: Advantages and Tensions for Incremental and Radical Innovation. *British Journal of Management*, *Early View*, 1–20.

Bouty, I. (2000). Interpersonal and interaction influences on informal resource exchanges between R&D researchers across organizational boundaries. *Academy of Management Journal*, *43*(1), 50–65.

Cameron, K., & Quinn, R. (1988). Organizational paradox and transformation. In R. E. Quinn & K. S. Cameron (Eds.), *Paradox and transformation: Toward a theory of change in organization and management* (pp. 1–18). New York: Ballinger Publishing Co/Harper & Row. Retrieved from http://psycnet.apa.org/psycinfo/1988-98020-001

Chesbrough, H. (2003). *Open innovation: The new imperative for creating and profiting from technology* (Harvard Bu). Boston, MA.

Cozzolino, A., & Rothaermel, F. T. (2018). Discontinuities, competition, and cooperation: Coopetitive dynamics between incumbents and entrants. *Strategic Management Journal*, (forcoming), 1–33. http://doi.org/10.1002/smj.2776

Dameron, S., & Torset, C. (2014). The Discursive Construction of Strategists' Subjectivities: Towards a Paradox Lens on Strategy. *Journal of Management Studies*, *51*(2), 291–319.

Das, T. K., & Teng, B. (1998). Between trust and control: developing confidence in partner cooperation in alliances. *Academy of Management Review*, *23*(3), 491–512.

Deutsch, M. (2011). Cooperation and competition. In P. T. Coleman (Ed.), *Conflict, Interdependence and Justice* (Peace Psyc, pp. 23–41). New York: Springer.

Dowling, M., Roering, W., Carlin, B., & Wisnieski, J. (1996). Multifaceted relationships under coopetition: description and theory. *Journal of Management Inquiry*, *5*(2), 155–167.

Faems, D., Janssens, M., & Van Looy, B. (2010). Managing the Co-operation-Competition Dilemma in R&D Alliances: A Multiple Case Study in the Advanced Materials Industry. *Creativity and Innovation Management*, *19*(1), 3–22.

Fernandez, A.-S., & Chiambaretto, P. (2016). Managing tensions related to information in coopetition. *Industrial Marketing Management*, *53*, 66–76.

Fernandez, A.-S., Le Roy, F., & Chiambaretto, P. (2017). Implementing the right project structure to achieve coopetitive innovation projects. *Long Range Planning*, *online*, 1–22.

Fernandez, A.-S., Le Roy, F., & Gnyawali, D. R. (2014). Sources and management of tension in co-opetition case evidence from telecommunications satellites manufacturing in Europe. *Industrial Marketing Management*, *43*(2), 222–235.

Gnyawali, D. R., & Park, B.-J. (Robert). (2011). Co-opetition between giants: Collaboration with competitors for technological innovation. *Research Policy*, *40*(5), 650–66.

Hamel, G. (1991). Competition for competence and interpartner learning within international strategic alliances. *Strategic Management Journal*, *12*(Special Issue:Global Strategy), 83–103.

Heiman, B., & Nickerson, J. (2004). Empirical evidence regarding the tension between knowledge sharing and knowledge expropriation in collaborations. *Managerial and Decision Economics*, *25*(6–7), 401–420.

Holmes, D. (2016). A new chapter in innovation. *Nature*, *533*(7602), S54–S55. http://doi.org/10.1038/533S54a

Jarvenpaa, S., & Majchrzak, A. (2016). Interactive Self-Regulatory Theory for Sharing and Protecting in Inter-Organizational Collaborations. *Academy of Management Review*, *41*(1), 9–27.

Le Roy, F., & Fernandez, A.-S. (2015). Managing Coopetitive Tensions at the Working-group Level: The Rise of the Coopetitive Project Team. *British Journal of Management*, *26*(4), 671–688.

Maffrand, J. (2012). The story of clopidogrel and its predecessor, ticlopidine: Could these major antiplatelet and antithrombotic drugs be discovered and developed today? *Comptes Rendus Chimie*, *15*, 737–743.

Mention, A. (2011). Co-operation and co-opetition as open innovation practices in the service sector: which influence on innovation novelty? *Technovation*, *31*, 44–53.

Nieto, M. J., & Santamaría, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation*, *27*(6–7), 367–377.

Park, S. H., & Russo, M. V. (1996). When competition eclipses cooperation: an event history analysis of joint venture failure. *Management Science*, *42*(6), 875–890.

Quintana-García, C., & Benavides-Velasco, C. A. (2004). Cooperation, competition, and innovative capability: a panel data of European dedicated biotechnology firms. *Technovation*, *24*(12), 927–938.

Ritala, P., Huizingh, E., Almpanopoulou, A., & Wijbenga, P. (2017). Tensions in R&D networks: Implications for knowledge search and integration. *Technological Forecasting and Social Change*, *120*, 311–322.

Ritala, P., Olander, H., Michailova, S., & Husted, K. (2015). Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study. *Technovation*, *35*, 22–31.

Santamaria, L., & Surroca, J. (2011). Matching the goals and impacts of R&D collaboration. *European Management Review*, *8*(2), 95–109.

Smith, W., & Lewis, M. (2011). Toward a theory of paradox: A dynamic equilibrium model of organizing. *Academy of Management Review*, *36*(2), 381–403.

Smith, W., & Tushman, M. (2005). Managing strategic contradictions: A top management model for managing innovation streams. *Organization Science*, 16*(15), 522-536*.

Williamson, O. E. (1983). Credible commitments: Using hostages to support exchange. *The American Economic Review*, *73*(4), 519–540.