Caveat Emptor: Explosion des Couts dans les Programmes de Défense – Une Question d'Alignement des Ecosystèmes Comme Processus ?

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Résumé :

Les théories écosystémiques sont désormais essentielles à la compréhension des collaboration inter-organisationnelle et de la performance, en particulier dans les secteurs marqués par une complexité technologique élevée et une interdépendance stratégique forte. Cet article analyse les processus et les mécanismes d'alignement au sein des écosystèmes, en se concentrant sur les industries de défense, contextes caractérisés par de fortes contraintes. Nous examinons l'influence des processus d'alignement sur la performance des écosystèmes et sur la réduction des risques d'inefficience et de fragmentation, comblant ainsi un déficit majeur de la littérature concernant les environnements hautement contraints et stratégiques. À partir d'une étude de cas processuelle et comparative, nous identifions les mécanismes critiques à l'alignement des écosystèmes. Nos résultats montrent que les modèles de gouvernance, et les canaux de communication qui les sous-tendent, déterminent fortement l'efficacité des processus d'alignement. En particulier, ils soulignent le rôle indispensable des « espaces conversationnels » pour gérer la confiance, les dépendances et les ajustements dynamiques. En reliant nos résultats empiriques aux théories écosystémiques et à la littérature sur les capacités dynamiques, nous mettons en lumière l'importance de mécanismes d'alignement sur mesure pour renforcer la résilience des écosystèmes et fournissons des recommandations opérationnelles pour la gestion de structures inter-organisationnelles complexes dans des industries à enjeux élevés.

Mots-clés : Ecosystème, Alignement, Innovation, Capability, Conversation

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1. INTRODUCTION

The growing importance of ecosystem governance as a dominant mode for coordinating collaborative networks of autonomous yet interdependent partners engaged in complex projects underscores the critical role of alignment in driving both innovative and economic performance. (Adner, 2012; Iansiti & Levien, 2004, Jacobides & al., 2018; Moore, 1993). Innovation-driven activities often require coordinating specialized and co-specialized actors, whose contributions are uniquely tailored to deliver a shared value proposition (Adner, 2017). Then, misalignment of even a single partner or opportunistic behavior restricting access to complements can create bottlenecks and innovation imbalance, leading to a risk of ecosystem failure (Adner & Kapoor, 2010). Unlike hierarchies, ecosystem-based governance modes rely on mutual adjustments and shared understanding of roles, activities and objectives rather than contracts or authority to align motives and efforts to co-create a value proposition (Jacobides & al., 2018; Kramer & Pfitzer, 2016). By fostering mutual agreements, alignment mitigates risks, reduces information asymmetries, and maximizes complementarities among partners (Adner, 2006, 2012).

Yet, alignment rarely emerges from bottom-up agreement among actors negotiating and self-adjusting to achieve a well-defined value proposition. It usually results from the leadership of a legitimate orchestrator, which defines roles, rules and governance structures (Iansiti & Levien, 2004; Lingens, & al., 2020; Thomas & Ritala, 2021). Beyond formal arrangements and technical decisions to ensure compatibility and coordination across innovation cycles (Adner

& Kapoor, 2010; Gawer & Cusumano, 2002), orchestrators must foster trust through iterative dialogue and ongoing feedback loops, enabling repeated interactions (Kramer & Pfitzer, 2016).

While strategic management literature offers relevant outlooks on alignment, it provides very limited understanding of processes leading to successful alignment. Typically, ecosystems adopt different governance modes, and orchestrators exhibit heterogeneous ability to foster communication and trust. This article intends to analyze how alignment processes vary across different ecosystem structures and provide a better understanding of the relationship between governance modes, alignment processes and performance outcomes of the ecosystem.

We focus on the highly constrained environment of defense ecosystems, in which an intergenerational cost escalation phenomenon (Augustine, 1982; Lefeez, 2013) is predominant. As defense literature describes cost surge as the ransom of incorporating technological progress (Danet, 1997), we were surprised to observe striking cost disparities between technologically similar systems, like nuclear submarines. Given these gaps, we studied French and American military programs focusing on the comparison of governance models and alignment strategies, in similar strategic and technological environments. Drawing from ecosystemic theories, semi-structured interviews and a set of qualitative derived from field observations and a multi-sourced corpus, we extend existing frameworks by integrating perspectives on governance, and the dynamics of constrained environments. We tailored Eisenhardt's (1989) case study method with a processual approach to assess program management and alignment mechanisms in both ecosystems. As we characterized, articulated and illustrated the firms' opportunistic behaviors in the defense sector, it led us to classify alignment variables and evaluate the impact of management mechanisms on coordination and performance, at governance and activity levels.

Our results show that contract-based governance modes tend to generate greater cost surge than monopolistic structures. We find that the French ecosystem higher performance is essentially related to the combination of a quasi-monopolistic competition environment and the orchestrator's ability to manage ongoing relationships between partners through symbolic and physical spaces dedicated to foster dialogues -what we call conversational spaces. They allow constructive confrontations and adjustments between all individual strategies and constraints enhancing alignment among partners and easing a constant pursuit of realignment. Also, we highlight that reducing competitive pressure in constrained environments increases players' alignment, as it stabilizes roles, fosters collaborative innovation and limits opportunistic risks.

This study makes valuable academic contributions to strategic management and defense economics. Firstly, it enriches the strategic management literature by clarifying the dimensions of interorganizational alignment and analyzing the mechanisms that ease or impede it, along with their strategic implications for ecosystem performance. By showing how conversational spaces are strategic lever, we outline their ability to foster efficiency, coherence and innovation in highly interdependent environments. Secondly, this article advances defense economics by providing an ecosystemic analytical framework to assess behaviors, performance and relational mechanisms, while illustrating the opportunistic behaviors that intensify defense cost overruns.

2. THEORETICAL BACKGROUND

Alignment is crucial in minimizing goal conflicts and opportunistic behaviors while leveraging complementarities between parties involved in transactions (Williamson, 1991). The alignment concept is applied to emphasize different coordination constraints across strategic and managerial contexts (Adner, 2012; Gawer & Cusumano, 2002; Henderson & Venkatraman, 1993; Porter, 1996; Venkatraman, 1989). Despite its diverse applications, alignment steadily refers to mutual agreement on positions, roles and activities of organizational stakeholders, contracting parties or partners in a venture. Thus, alignment typically results from negotiations or authoritarian decisions and is generally depicted as an explicit, and often formal, agreement.

Unlike transactional exchanges or hierarchical orders, ecosystem value creation depends on collaborative relationships between multiple autonomous, yet potentially interdependent, firms or entities. Ecosystem as a governance mode is "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017: 40). They are often tied to knowledge-intensive, innovation-driven activities, that involve non-generic complementarities and co-specialized relations, creating tight dependencies, where every contribution is tailored to deliver a shared value proposition (Jacobides & al., 2018).

Standardization and modularity help balance the autonomy of decentralized actors with the need for coordinating interdependent activities, highlighting alignment as a key process (Brusoni & al., 2001; Lingens & al., 2022; Tiwana, 2014). Though, changes in the nature and intensity of interdependencies across modules demand seamless integration and timely contributions, amplifying uncertainties (Agarwal & Kapoor, 2022; Jacobides & al., 2018; Masucci & al., 2020). Furthermore, limited access to complements can create bottlenecks and imbalances, increasing the risks of free riding (Gulati & al., 2012; Masucci & al., 2020).

Then, hierarchical control or enforceable contracts absence means that alignment results from mutual adjustments, ongoing interactions and informal governance mechanisms rather than authority (Kramer & Pfitzer, 2016). Alignment is a multilateral coordination process that involves synchronizing dependencies and partnerships to achieve a "consistent construal of the configuration of activities" (Adner, 2017: 42). As Adner explains, multilateral relationships are not mere aggregations of bilateral interactions as overall performance depends on every actor's effort directed towards an agreed upon common value proposition. The misalignment of even a single partner can jeopardize the entire ecosystem (Adner & Kapoor, 2010). Thus, for a focal value proposition to materialize, "participating actors in the system have a joint value creation effort as a general goal […and] reach a threshold level of coordination" (Adner, 2017: 43).

However, alignment rarely emerges as a self-organizing process and typically requires coordination and adjustments tailored to activities, positions, and members' characteristics. To ensure that partners align their actions toward shared goals, members must engage in frequent communication to build trust, relational norms and shared understanding (Jacobides & al., 2018; Moore, 2006). Literature stresses the role of orchestrators or keystone members as central players in aligning partners (Iansiti & Levien, 2004; Thomas & Ritala, 2021): "Orchestrator designs the alignment structure of an ecosystem to facilitate appropriate distribution and allocation of attention and, thus, joint decision-making and the creation of a joint value proposition" (Lingens & al., 2020). Beyond formal arrangements to ensure compatibility and coordination across innovation cycles (Adner & Kapoor, 2010; Gawer & Cusumano, 2002), they must foster trust through iterative dialogue and ongoing feedback loops among members, enabling repeated interactions (Kramer & Pfitzer, 2016). Also, they play a critical role in mediating conflicts to maintain ecosystem alignment and cohesion (Ring & Van de Ven, 1994).

While the literature offers valuable perspectives on alignment management and robust analytical frameworks, alignment processes understanding remains quite limited. For instance, Thomas and Ritala (2021) propose a collective process involving value proposition framing, shared narratives and identity construction to establish ecosystem legitimation. Yet, the interplay between governance modes, orchestrators' ability to foster communication and trust, and the resulting effects on ecosystem performance are insufficiently explored. Moreover, governance modes must enable a temporal and adaptable realignment dynamic to accommodate changes (Gulati & al., 2012). Effective alignment management thus suggests the ongoing redefinition of identity: who is in, who is out, and essentially, who gets what (Gulati & al., 2012; Klein & al., 2019). Furthermore, the literature falls short in addressing how alignment mechanisms vary across different ecosystem structures and industry types.

Our case study aims to address this gap. Based on a comparative and processual analysis of French and US defense industries, we show how differences in governance modes –contract based vs. ecosystem-based management processes– produce varying coordination mechanisms and abilities leading to performance disparities. Building on a processual approach (Pettigrew, 1987), we intend to clarify interorganizational alignment processes and analyze mechanisms that explain how orchestrators manage dynamic relations between autonomous actors operating in constrained environment, subject to high innovation uncertainty and significant cost surge.

3. DATA & METHODS

Our study focuses on alignment processes in ecosystems. We chose to apply the case study methods to illustrate and substantiate our arguments, as it aligns perfectly with our research question. To reconstruct complex phenomenon dynamics, we shaped a protocol for designing and analyzing a processual case study, using strategic management literature on case method and processual analysis. Following Eisenhardt (1989), we adopted the eight-step protocol, which we adapted for a process-oriented approach and longitudinal tracking. (Pettigrew, 1987, 1990). Eisenhardt (1989) suggests the following steps: (I) Define research focus; (II) Select theoretically useful cases; (III) Combine multiple data methods; (IV) Collect and analyze flexibly; (V) Conduct within and cross-case analysis; (VI) Shape hypotheses; (VII) Compare conflicting and similar work; and (VIII) Stop at theoretical saturation.

Grasping ecosystem functioning requires the identification of critical variables and occurring processes of change and development. A processual approach allows to examine the unfolding of phenomena over time, to understand the dynamics of change and the evolution of inter-organizational configurations (Dawson, 1994; Van de Ven, 1992). Longitudinal analysis provides valuable insights into key phases, transition periods, and critical moments (Van de Ven & Huber, 1990). These frameworks emphasize the importance of temporality, event sequencing, new roles emergence, and relationships and practices transformation (Pettigrew, 1990; Langley, 1999). Hence, we used Pettigrew's (1987) processual framework and dimensions of analysis: internal (structure, culture) and external (environment, technology) context, content (i.e., the object of study), and processes (i.e., the impact of actions and interactions on change).

Shifting to a processual case study approach demands to tailor Eisenhardt's (1989) generic protocol by incorporating key concepts of context, temporality, and process. We paid specific attention to the case's temporal delineation and phases (Pettigrew, 1990) during the observation period and data collection preparation. For data analysis, we completed traditional case study techniques with processual techniques (Langley, 1999), like event sequence analysis, temporal bracketing, as well as narrative and visualization strategies to ease the presentation of findings. During the theorization phase, we linked empirical observations to existing theories, seeking to highlight trajectories, recurring patterns, and causal mechanisms (Pettigrew, 1987).

To enhance the reliability and trustworthiness of a study as it unfolds, we used Lincoln & Guba's (1985)[1] four guiding principles and affiliated techniques. Especially, as we study defense sectors, numerous biases are to be considered, as publicly released data is influenced by strategic and confidential aspects, which tend to alter data's veracity to avoid the disclosure of sensitive information to challengers. Hartley (2007b) studies the variability of governmental data quality and coverage, showing that cost, performance or technologies are subject to biases. To avoid such pitfalls, we triangulated all our data with a multi-source dataset. Our dataset combines qualitative primary data derived from field observations, interviews and meetings, and secondary data drawn from a multi-sourced current and historical documentary corpus.

Semi-Structured Interviews. We conducted over thirty semi-structured individual and group interviews with actors holding one or more roles within the French defense ecosystem. Others focused on international organization and foreign countries (European Union, U.K.). For details of interviewed structures and roles, see Table 1. Carried out between 2020 and 2024, each interview lasted between 60 and 90 minutes and followed a standardized protocol. Special attention was given to the multiplicity of roles assumed by some interviewee. Each insight was

[1] Credibility: Prolonged Engagement, Triangulation, Persistent Observation; Transferability: Thick description; Dependability: External Audit; and Confirmability: External audit, Triangulation, Audit trail, Reflexivity.

consistently affiliated with the specific role and organization they concern. Including collective interviews and the multiplicity of functions held, we examined nearly 50 entities and roles. We then cross-referenced the data from these interviews with informal interviews. With various operating modes and lengths, this second series of interviews targeted operational field agents from France and the U.S. In a dialogue format, this confirmatory series aimed to validate, or challenge, formal interviews identified biases by comparing the findings to operational realities. Importantly, no prior data was modified, nor new data were introduced, based on these informal interviews. Lastly, given the sensitivity of the topic, especially with foreign countries, we ensured the anonymity of all participants and data confidentiality.

SEMI-STRUCTURED INTERVIEWS			
ORGANIZATION	***Quantity***	**ROLES**	***Quantity***
Prime Defense Contractors	11	Executive management	12
Other Large Companies	1	Military Staff / High-ranking officer	5
Specialized SMEs	2	Operations Directorate	2
Start-ups	5	Strategy Directorate	1
Business Incubators & Accelerators	2	R&D / Innovation / Technical Directorate	9
Professional Associations	3	International Relations Directorate	1
Department of Defense, Armies & other branches	7	Other Directorates	2
Academic Structures	8	Manager	2
Funding Structures	2	Consultant / Adviser / Researcher / Expert	9
International Organizations	3	Member of Parliament	2
Foreign Organizations	1	Investors	2
Political and Institutional Organizations	2		
TOTAL	***47***	***TOTAL***	***47***

Table 1. Details on conducted formal semi-structured interviews.

Participant and Non-Participant Field Observations. Field observations were conducted, between 2019 and 2023, within the French Ministry of Defense and extended to affiliated research institutes and contracting firms. They focused on examining organizational actions, processes, tools, culture, routines and social interactions. We took detailed notes on the environments and relevant contextual elements (biases, structures, etc.). These were conducted in the context of consulting missions and supported by data provided by the organizations and deliverables produced during these engagements. Also, indirect observations, derived from feedback and insights, were collected from various professionals within the French, and to a lesser extent, the U.S., defense ecosystems.

Multi-Sourced Documentation. Our third data source is an eclectic and comprehensive set of documentation, organized into four distinct categories, each with its own specificities and biases: (I) official archives from France and other nations (China, Germany, Italy, Israel, Japan, Russia, South Korea, Spain, Sweden, Turkey, U.K., U.S.), (II) specialized reports (think tanks, expert analyses, research institutes), (III) general and specialized national and foreign media literature, and (IV) multidisciplinary academic literature. All archival documents originate from institutional bodies of the studied countries. To address the variability in quality and coverage of governmental data (Hartley, 2007b), we consistently cross-referenced and supplemented data with general and specialized media, independent think tank studies, expert reports and academic literature. Collectively, this corpus represents a robust secondary data set (Jick, 1979).

4. CONTEXT

Rigorous comparison is generally difficult because of the differences in structures, contexts and value proposition goals across ecosystems. Defense industry offers a suitable context as defense ecosystems tend to have similar industrial landscapes, technologies and characteristics, while aiming to develop comparable products that often are competing on the international market. Focusing on similar projects in the US and French ecosystems allows us to highlight the differences in relational management, governance structures and performance. Also, a Franco-American comparison seems relevant as both share broadly similar environmental constraints and doctrines, albeit with differing technologist intensities (Desportes, 2009). As costs of new generation of armaments have skyrocketed in the last decades, we found major differences in the cost surge levels between French and American defense programs. While economic evaluation remains largely cost-centric, we contend that the differences in the mode of governance as well as the alignment process explain those disparities. We first show that defense production systems are best viewed as ecosystems, emphasizing the importance of ecosystem alignment. Then, our comparative study underscore differences in the governance mode and the subsequent management style of US versus French orchestrators.

4.1. Defense Sector as Ecosystems

Defense economics literature generally defines defense sector as a Defense Technology and Industrial Base (DTIB). According to Dunne (1995) and Gansler (2011), a DTIB has the following characteristics: (I) Besides the U.S., firms are national oligopolies or monopolies; (II) Technological performance is prioritized over cost considerations; (III) States absorb part of project risks, notably in R&D and infrastructure; (IV) Regulatory frameworks address the absence of competitive market; and (V) Ambiguous players' relationships result in a "revolving door" phenomenon. Qualified as ecosystems by institutional discursive logics, DTIBs align perfectly with Adner's (2017: 40) definition and key characteristics of an ecosystem, markedly a "*set of partners*", an "*alignment structure*", multilateralism, and "*a focal value proposition*".

Set of partners. A DTIB represents a set of interdependent actors, including prime contractors, suppliers, complementors, technology providers, research centers, universities, public and military institutions. Ecosystem identity is marked by peer recognition and a sense of belonging, defining members inclusion or exclusion (Serfati, 1995; Walker, 1988). Joint value creation binds these actors, each with specific asset and resource co-specialization. Reliance on research institutions for R&D is a foundational element. At the production level, defense programs are temporally flexible, porous, and grounded in a specific value proposition.

Alignment structure. Defense production's complexity imposes defined positions and activity flows among DTIB players. Ecosystem members generally agree on roles and flows, despite differing objectives: Firms manage program execution, production, and supply chain relationships; Public institutions oversee budgets, and technological paths; Military bodies handle specifications, contracts and procurement; Research centers focus on disruptive innovation. All operate in a dynamic flow of interactions and resources, which needs to be constantly readapted to evolving economic and technological changes. The ecosystem is shaped by its environment, which is equally influenced by ecosystem members. Finally, a set of norms governs actors' positions, roles, and relations to meet value proposition requirements.

Multilateralism. Defense ecosystems exhibit indecomposable and strong interdependencies between military, institutional, industrial, and academic spheres (Krause, 1992), which intensified with the globalization of supply chains (Gansler, 2011). They stem from State's dependance on industrial expertise to ensure its autonomy and the market's monopsonic nature, where firms rely on the State. Multilateral interdependencies are managed through crossholdings and mutual relationships, to ensure alignment with strategic priorities, limit risks or industrial failure and foster the emergence of national champions. In France, the DGA is the coordinating body managing interdependencies to ensure program continuity and alignment (Lazaric & al., 2011). Defense contract nexuses illustrate this multilateralism.

Focal value proposition in defense ecosystems. Armament programs fall within Adner's (2017) concept of innovation ecosystems. Through coherent activity distribution, they aim to materialize a common value proposition that meets both armed forces needs and governments strategic constraints. The value proposition generates the endogenous ecosystem's boundary, which differs whether analysis focuses on governance or activities. Aligned with Hobday's (1998: 690) definition of complex products and systems (CoPS), defense production creates highly complex, customized and successive generations (Kurth, 1972) of technically advanced products. Firms operate in a highly uncertain, technologically interoperable and politically regulated environment. These long production runs entail specific and evolving coordination to foster and reorientate scientific and technological knowledge intensity and flows (Dittrich & al., 2006) to avoid "locked" trajectories and path dependencies (David, 1986).

DTIBs as Ecosystems. Due to complex organizational structures and challenges in identifying subcontractors (Walker & al., 1988), "Some suppliers might not be aware that they are involved in defense production" (Hartley, 2007a: 1143). To address this, defense economics literature (Dunne, 1995; Walker, 1988) highlight sense of belonging, peer recognition and customization of military components principles to establish defense sectors boundaries. Thus, DTIBs present all the constituting elements of ecosystems and differ from hierarchical networks and production chains by their interdependencies, members' diversity as well as coordination and alignment imperatives to materialize highly complex value propositions.

4.2. Defense Programs and Cost Disparities

Intergenerational cost escalation was identified in the U.S. by Augustine (1982) in the 1980s, and similar observations were made in France (De Vestel, 1993; Lefeez, 2013). Yet, the origins, mechanisms and implications of growing costs were variously attributed to governance, scale effects, technical integration, information asymmetry, or innovation uncertainty (Krause, 1992; Lefeez, 2013; Luttwak, 2007). While human resources attrition led to equipment volumes reductions and encouraged over-technologism, it partly explains these cost increases. As cost escalation undeniably reflects the technological complexity and the limited production runs, literature has primarily addressed intergenerational cost disparities but gave limited attention to intra-generational and intercountry cost comparisons, as systems are deemed incomparable.

Since the "post-historical paradise" (Kagan, 2003) and the prevalence of technologist doctrines, U.S. defense programs never ceased to astonish, not so much for their ambitions but for their gargantuan costs. Costly but successful, one might argue? Reality suggests otherwise, given the number of abandoned programs after consuming tens of billions of dollars (e.g., RAH-66, FARA, LCS, Zumwalt, FCS, OMFV). Such failures are unthinkable for other DTIBs as they don't have the budgetary means and industrial capabilities to entertain simultaneous programs for a same system. On that matter, defense literature focuses on identifying cost overruns at the acquisition stage between generations of weaponry within the same country (Lefeez, 2013; Luttwak, 2007). As evidenced by our comparison between French and American defense systems (Table 2), despite different national operational needs. If intergenerational costs surge in all countries, intragenerational price variations are substantial and striking.

Intergenerational Franco-American Comparison of Major Armament Platforms Procurement Costs (Excluding development and maintenance costs)						
Previous Generation of Equipment	Procurement Cost	Entry-into-service	New Generation of Equipment	Procurement Cost	Entry-into-service	Technological and Performance Composite Index**
France *(unit costs in constant euros 2023)*						
AMX-30 B2 Battle Tank	2,7 M€	1966	Leclerc Battle Tank	11,1 M€	1993	4,09
VTT AMX-10P	2,4 M€	1972	Véhicule Blindé de Combat d'Infanterie (VBCI)	4,2 M€	2008	4,25
Charles-de-Gaulle Aircraft Carrier	3 Mrds€	2001	New Generation Aircraft Carrier (*forecast*)	4-5 Mrds€	2036	N/A
Gazelle HAP Helicopter	7,1 M€	1973	Tigre HAD Helicopter	32,2 M€	2005	4,05
SA330 Puma Helicopter	6,7 M€	1968	NH90 TTH Caïman Helicopter	33,8 M€	2011	4,22
Mirage 2000C single-seater	27,9 M€	1984	Rafale C single-seater	81,3 M€	2002	4,74
Rubis Class Attack Submarines	366,4 M€	1983	Barracuda / Suffren Class Attack Submarines	1,55 Mrds€	2020	4,72
La Fayette Class Frigate	303,1 M€	1996	Aquitaine Class Multimission Frigate (Fremm)	787,4 M€	2012	4,66
United States *(unit costs in constant dollars 2023)*						
M60 Patton Battle Tank	5 M$	1960	Abrams M1A2 Battle Tank	20,8 M$	1994	4,02
M2A1 Bradley	2,4 M$	1981	M2A4 Bradley	4,5 M$	2022	4,24
Nimitz Class Aircraft Carrier	11,3 Mrds$	1975	Gerald R. Ford Class Aircraft Carrier	15,8 Mrds $	2017	N/A
AH-1 Cobra Helicopter	22,6 M$	1967	AH-64E Apache Helicopter	52 M$	1984	3,94
UH-1 Iroquois Helicopter	7,3 M$	1959	UH-60M Black Hawk Helicopter	25 M$	1979	3,68
F-16 Fighting Falcon	35,2 M$	1978	F-35 Lightning II	147,2 M$	2015	3,96
Los Angeles Class Attack Submarines	2,1 Mrds $	1976	Virginia Class Attack Submarines	4,3 Mrds$	2004	4,27
Oliver Hazard Perry Class Frigate*	570,15 M$	1977	Independance Class Frigate*	784,12 M$	2010	3,33
			Constellation Class Frigate*	1,4 Mrd$	2029	N/A

**We chose several examples of American frigates to take account of the shortened timescales between programmes. Also, the failure of the LCS programme (Independence and Freedom class) led to a premature withdrawal from service (5-10 years of service) and these frigates still have many defects preventing them from carrying out their operational missions. The constellation programme is based on the Italian FREMMs.*

*** We developed a composite index to provide a statistical measure for evaluating the technological and operational performance gaps between French and American equipment. The categories of indicators examined include technological performance (breakthrough technology, evolutions compared to previous generations, longevity), operational performance (capacity to respond to operational needs, acquisition cost, operating cost), system scalability (modularity, frequency of updates, modernization cost), maintenance and availability rate (availability rate, maintenance timeframes and costs), and system interoperability (national and international interoperability, technological trajectories). Scores from 1 to 5 are attributed, where 1 is the weakest and 5 the strongest, and categories are differently weighted. The closer the score between the two types of equipment, the more similar their technological and operational performances, rendering them comparable.*

***Sources** : Institutional archives, industrial documentation, public interviews, general and specialized press (Le Monde, Meta-Défense, La Tribune, JDAL, National Defense Magazine, Reuters, ASPJ, Space & Defense Power Journal), French Senate and National Assembly hearings and reports, French Court of Audit reports, French Defense Ministry documentation, commissions and reports, American Congress hearings and reports, Government Accountability Office (GOA), Congressional Budget Office (CBO) and Congressional Research Service (CBS) reports, DoD and Armies documentations reports, Selected Acquisition Report (SAR), academic articles (Esquerre, 2015, 2016; Lefeez, 2013; Wallaert 2017)*

Table 2. Intergenerational Franco-American Comparison in the Procurement of Major Armament Platforms

Economy of Scale and Series Effect. Our comparison was constructed with a composite index (technological and operational performance, system scalability, maintenance, system interoperability), which evaluates the comparability of defense equipment. This index does not indicate that one piece of equipment is superior to another, but rather that they can be compared. Besides, this index highlights several noteworthy points. First, although most U.S. production runs are tenfold than their French counterparts, we have not observed any economy of scale that generated significant unit cost reductions. Second, the significantly higher costs of U.S. systems aren't justified by notable technological advantages. In this aspect, the Constellation-class and FREMM frigates example is particularly revealing, as both rely on similar, if not identical, technologies. Even considering the FREMM's substantial cost overruns, they remain half as expensive as their U.S. counterparts. It underlines the extent of manufacturing defects, and considerably higher modernization and maintenance costs of U.S. defense platforms.

Focus. Nuclear Attack Submarines (SSNs). Table 3 compares the French Suffren class, the American Virginia class, the English Astute class, and the Russian Yasen class. These four SSNs offer broadly equivalent technological and operational capabilities, while operational and strategic doctrine are very similar. The disparities depicted in Table 3 reflect operational needs and do not indicate major technological gaps[2]. Despite being more compact, the Suffren offers unmatched automation, maneuverability, stealth, and requires fewer human resources. They represent minor alterations without noticeable cost repercussions. As all four SSNs belong to the same generation, cost disparities cannot be solely explained by technical differentiation.

Intercountry Comparison of the Main Characteristics of SSNs (Ship Submersible Nuclear)				
SSN	Suffen Class	Virginia Class	Astute Class	Yasen Class
Country	France	United States	United Kingdom	Russia
In Commission	2022	2004	2007	2013
Summerged Tonnage (tons)	5 300	7 900	7 800	13 400
Dimensions (meters)	99,5	115	97	130
Payload Capacity	24	40	38	72
Crew members	65	135	98	90
Submerged Speed (knots)	> 27	> 25	> 29	> 28
Maximum Depth (meters)	> 350	> 240	> 300	> 450
Propulsion	Nuclear Fission Reactor	Nuclear Fission Reactor	Nuclear Fission Reactor	Nuclear Fission Reactor
Fuel Enrichment	6,5%	97%	97%	97%
Range of action	Illimited	Illimited	Illimited	Illimited
Unit Price (2023 currencies)	€1.5 billion	$4.3 billion	€2.62 billion	€1.62 billion

Table 3. Intercountry comparison of the national SSNs main characteristics.

Total costs. The total costs[3] of the U.S. F-22 and F-35 programs epitomize the cost surge phenomenon. Keeping in mind biases of such data, F-35 program total cost is estimated at over $2 trillion for 2,456 aircraft (GAO, 2024), equaling Italy's annual GDP for an aircraft that hasn't met its initial operational standard. Even when distributed, costs exceed $800 million per unit. Moreover, according to U.S. oversight bodies and foreign clients (e.g., Belgium, Finland), costs are largely underestimated, especially concerning maintenance. To compare, the program total cost for 225 Rafale (standard 4.2) is estimated at €50 billion over a 50-year lifecycle, or around $200-250 million per unit. Breaking down costs by production phases, the figures are even

[2] The main technological variation lies in propulsion, where the French K15 reactor uses low-enrichment fuel (6.5%), against 97% for the other three. While refueling is needed every ten years, against thirty years, it enhances the Suffren's export potential, as fuel enrichment is well below the 20% threshold defined as weapons-grade under international law

[3] Total costs including R&D, production, lifetime maintenance and modernization over the system's lifecycle

more striking. In constant 2023 currency, the Rafale R&D expenses are €10 billion, €25 billion for the European Eurofighter Typhoon, $55 billion for the F-22, and $100 billion for the F-35[4].

According to the literature, it corresponds to "the ransom of incorporating technological progress" (Danet, 1997: 130). Given those amounts, one might assume American aircraft to be technologically superior in every aspect to their European counterparts. But is there a technological gap so significant as to justify fourfold to tenfold cost differences? Or are other factors contributing to these major cost disparities? In the absence of technological differences, it is legitimate to question if technological complexity is the primary driver of cost overruns. Thus, how can we explain cost disparities between French and American programs?

5. CASE STUDY

For our comparative case study, we employed Pettigrew (1990) and Langley's (1999) processual approach, to emphasizes the sequential and temporal analysis of inter-organizational dynamics and highlight critical phases and respective alignment processes. We first examine the structure, technological contexts and the organizational frameworks for defense programs management in the U.S. and French markets. We then analyze two fighter jet programs, the French Rafale and the F-35. Finally, we discuss the temporal phases and alignment processes.

5.1. Contexts and Organizational Structures

The strategic significance of defense production compels States to exercise tight control over their DTIB through dedicated institutional coordinating bodies. However, national cultures, strategic doctrines, and technological orientations result in significant differences in market and ownership structures as well as program and relationship management.

France: Monopolistic Structure and Centralized Governance. In France, limited budgets and state ownership of major industrial players lead to monopolistic structures across

[4] These data are derived from a multi-source documentary corpus, primarily composed of archival documents produced by institutional bodies (oversight and audit offices, committees, ministerial and military commission reports). These were supplemented with general and specialized press data, both archival and contemporary (e.g., Le Monde, Meta-Défense, La Tribune, Journal of Defense Analytics and Logistics, National Defense Magazine, Reuters, ASPJ). On specific points, data were contextualized and contrasted with expert opinions from the field.

the defense production chain. The State allocates roles and technological specializations to players and establishes norms and tacit rules to regulate relationships. While permeability is low at the governance level, it increases at the production level to include new technologies meeting value proposition imperatives (Droff & Malizard, 2024). The General Directorate of Armaments (DGA) coordinates and controls armament programs, leveraging its sharp technical expertise to replicate private-sector competencies if needed. Since major reforms in 1996, the DGA has expanded its prerogatives to ensure lasting strategic and technological autonomy. It operates as an innovator (Defense Innovation Agency), a quality controller (Directorate of Engineering and Expertise) and a production and technological capabilities orchestrator (Directorate for Future Planning and Programming). The DGA's central coordinating body is the Defense Industry Directorate (DID), which oversees defense industrial policies, participates in governance, and ensures that expressed needs are met. As client, investor, and regulator, the State structures the DTIB with regulatory tools, economic barriers, and shareholding influence.

***U.S.: Competitive Framework and Delegated Program Management*.** In the U.S., the defense market contains a dozen of major prime contractors, fostering outward competition but obscuring monopolistic behaviors at the subcontracting level. Driven by financial imperatives, the U.S. defense sector struggles with the loss of fundamental production competencies due to short-term profit pressures. For instance, TransDigm exploits its monopoly position to increase prices for aircraft parts, achieving gross margins as high as 55%, compared to 13.6% for Boeing and 10.9% for Lockheed Martin. Additionally, supply chain vulnerabilities and outsourcing to countries like China have led to production delays for critical systems such as Virginia-class submarines. The absence of domestic producers for key military components underscores the long-standing erosion of research and engineering capabilities. Unlike France, U.S. program management is entirely delegated to private prime contractors. Public and military institutions issue specifications, allocate R&D funds, and oversee program management through various entities. The OUSD(A&S) directs long-term R&D, while the OUSD(R&E) oversees development, support, and procurement processes in collaboration with industrial firms. Each armed forces branch maintains its own specification committees, project management bodies, and acquisition agencies. The DOT&E independently evaluates and reports on system performance, while oversight bodies like Congress and the GAO assess program outcomes. Despite strict regulatory frameworks, fragmented program management allows private firms to dominate, as the State refrains from direct intervention in private ownership or management.

Both France and the U.S. standardize roles across their DTIB, yet their governance approaches diverge significantly. France's centralized model enables cohesive coordination and long-term planning, ensuring strategic alignment and technological autonomy. Conversely, the U.S. fragmented governance, emphasize contractor competition but leads to monopolistic inefficiencies, supply chain vulnerabilities, and diminished innovation capabilities. By contrasting these models, the impact of governance structures on ecosystem alignment becomes evident, highlighting the trade-offs between centralization and market-driven approaches.

5.2. Program Comparison: Rafale versus F-35 Lightning II

This section presents a detailed processual case study of two emblematic programs: the French Rafale and the American F-35 Lightning II. It highlights the key phases of these programs to engage a discussion on each country's alignment processes and mechanisms.

France: The Rafale Program. Launched in the late 1980s and operational by the 2000s, the Rafale is a multirole combat aircraft developed by Dassault Aviation for the French Air Force and Navy. It was designed to replace and perform the missions of seven different types of aircraft, including nuclear deterrence, air superiority, reconnaissance, anti-ship warfare. From a processual perspective, the program followed three key phases:

Phase 1: Conceptualization and Framing (Late 1980s – Early 1990s): Facing the need to replace aging aircraft, France initially pursued collaboration with Germany, Italy, the U.K., and

Spain to develop a multirole fighter. However, disagreements over specifications, industrial division, costs, and engine concessions led to France's withdrawal in 1985 from what would become the Eurofighter program. French industrial leaders emphasized the need to preserve national technological and industrial autonomy. They also ensured their industrial and technological ability to lead an independent national program. The DGA initiated close consultations with Dassault Aviation, Safran, and Thales to define specifications. The goal was to develop a polyvalent aircraft to replace seven aircraft types and fulfill all related missions.

Phase 2: Development and Integration (1990s – Early 2000s): The Rafale's specifications were highly ambitious, particularly regarding modularity to foster incremental innovation and facilitate maintenance. Dassault Aviation relied on a network of national subcontractors to integrate technologies, such as the M88 engines, RBE2 radar, and electronic warfare systems. Benefitting from a compact ecosystem and privileged relationships among all stakeholders, Dassault developed the CATIA computer-aided design software, which enabled efficient management of integration complexity and ensured consistency across the ecosystem. The DGA supervised scheduling, subsystem compatibility, and alignment with national operational orientations. The shared value proposition, role acceptance, ongoing dialogue, and incremental validations (e.g., tests, technical reviews) synchronized progress across stakeholders.

Phase 3: Industrialization, Lifecycle Management, and Export (2000s – Present): The Rafale entered production in 1994, supported by CATIA's digital mock-up, which enhanced collaboration among subcontractors. Deliveries were delayed until the early 2000s due to State budgetary constraints. Upgrades and retrofits, such as evolving from F1 to F4 standards, incorporated operational feedback and technological advancements (e.g., data links, sensors, stealth), involving heightened dialogue among the DGA, armed forces, research centers, and industrial firms. Ongoing maintenance requirements fostered long-term collaboration among all parties, sometimes including export clients. The DGA oversaw export contracts, facilitating interactions with international customers, such as Egypt, Greece, Qatar, and India.

United States: The Joint Strike Fighter Program. The F-35 Lightning II is a multirole combat aircraft developed by Lockheed Martin for the U.S. Air Force, Navy, and Marine Corps. This international collaborative program officially started in 1996 with ambitious cross-service standardization goals. From a processual perspective, the program followed three key phases:

Phase 1: Launch and Initial Design (Late 1990s – Early 2000s): With the end of the Cold War reducing defense capacity needs, the U.S. DoD sought to replace several aging aircraft types (F-16, F/A-18, Harrier) with the development of three variants a unique platform (conventional, STOVL, carrier-based). From inception, this export-oriented program involved U.S. allies as partners to share development costs in exchange for influence over the F-35's specifications. Based on financial contributions and technical involvement, these partnerships were stratified into three tiers. Lockheed Martin won the prime contractor role over Boeing after a competitive selection process. However, the program's scope and the involvement of multiple contracting authorities (DoD, Air Force, Navy, and Marines), led to conflicting requirements, complicating the design and initial coordination of the value proposition.

Phase 2: Development and Concurrency (2000s – Early 2010s): In 2001, Lockheed Martin secured the System Development and Demonstration phase contract, while Pratt&Whitney was tasked with developing the F135 engine. Major partners included Northrop Grumman, BAE Systems, and RTX Corporation, all of which are first-tier competitors in other projects, leading to collaboration and co-specialization challenges. As a concurrent engineering strategy was adopted, where production began before testing and development were complete, significant technical and managerial challenges emerged: the variants led to technological divergences in subsystems (e.g., avionics, propulsion, software), while the lack of fully validated systems caused frequent reengineering and adjustments, resulting in delays and budget overruns. Also, the involvement of multiple authorities within the DoD fragmented decision-making. Despite establishing steering committees and involving oversight bodies (e.g., GAO), coordination issues persisted. The DoD's coopetition model, which subjected major component development to competitive bidding, increased both integration complexity and the number of intermediaries.

Phase 3: Production and Evolution (2010s – Present): F-35 production adopted a Continuous Capability Development and Delivery approach, which emphasized incremental technological upgrades. Despite numerous deficiencies and scaled back validation testing to recover schedule delays, aircraft were delivered starting in 2015. Initial deliveries were plagued by unresolved deficiencies, as Pentagon noted over 1,150 flaws in Block 2B alone, like software malfunctions and engine inefficiencies. Block 3 and 4 upgrades were deferred to address unresolved defaults, delaying Full Operational Capability from 2022 to 2029. The TR-3 configuration exposed other challenges, leading the Pentagon to reject deliveries until flight certification was completed. As deficiencies created double hardware components standards across aircraft variants and blocks, retrofit capabilities became more limited for oldest versions. Also, post-delivery adjustments, such as maintenance complexities caused by reliance on private firms, grounded many aircrafts awaiting repairs due to spare part shortages and incompatible software. At export, promised operational costs were two to three times lower than actual figures and cost differences have been noted by foreign client (Finland: €8.4B for 64 units; Switzerland: €5.5B for 36 units; Norway: €8B for 52 units). Retrofit costs for older blocks could exceed $50 million per unit, requiring extended downtime. Subscription-based systems (e.g., ALIS) further inflated costs.

5.3. Key Learnings

The French case demonstrates an alignment process characterized by institutional centralization around the DGA. Stability of roles and prerogatives ensured coordination through both DGA's centralized governance and system integrators decentralized program management, fostering clarity in roles and tasks (Lazaric & al., 2011). This well-supervised architecture reduced fragmentation risks and eased overall coherence with a continuous dialogue among all actors. It enabled objectives' congruence and adaptation to address value proposition priorities. Thus, key alignment processes include (I) DGA planning via multi-year defense laws, offering long-term strategic and financial outlooks; (II) Institutional and cultural proximity between all stakeholders, ensuring synchronized efforts; and (III) a compact ecosystem of peer-recognized actors, promoting mutual trust, seamless information flows, co-evolution and co-specialization.

In contrast, the F-35 case reflects multipartite management and contracting authorities' fragmentation, leading to unclear objectives and higher misalignment risks. Multiple variants, expectations and stakeholders created a dynamic of successive iterations and costly adjustments to accommodate ambitious goals. Despite the mobilization significant resources, alignment was only partly, belatedly, and reactively achieved. Adaptability was hindered by opportunistic behaviors and insufficient incentive and coercion mechanisms. Alignment was impeded by (I) multi-agency programs, causing technical incompatibilities due to retroactive interoperability construction; (II) internal competition, reducing information sharing and dispersing R&D efforts; and (III) economic culture dominance, weakening alignment with short-term priorities.

Using temporal bracketing (Langley, 1999), we identified several recurring phases in both ecosystems. Theoretically, these findings support the idea that an ecosystem's trajectory is closely tied to its institutional configuration and to the members' ability to co-construct robust alignment mechanisms. The processual approach stresses the constant evolution of alignment equilibrium, altered by institution orientations, technologies, and competitive interactions. Our cases provide key insights into alignment processes in constrained environments.

Opportunistic behaviors. Across all ecosystem configurations, opportunistic behaviors are a prevalent risk, driven by information asymmetry between stakeholders. To mitigate them, orchestrators need to possess the necessary technical expertise and governance tools (Steffek, 2007). In defense constrained environment, program management models influence the degree of information asymmetry and alignment efforts required. Otherwise, firms can adopt various opportunistic behaviors to maximize their captured value, often at the State's expense. Building on our case studies and defense literature, Table 4 outlines and exemplifies those behaviors. To prevent this, the ecosystem orchestrator can employ several governance mechanisms to promote mutual understanding, risk-sharing, and, ultimately, alignment among members.

Behavior of private contractors	**Behavior #1: Intermediate gamification of systems**	**Behavior #2: Over-technologism**	**Behavior #3: Alteration of perceived system complexity**	**Behavior #4: Intentional underperformance**	**Behavior #5: Waiting strategy *(Goldberg, 1985; Oudot, 2007)***	**Behavior #6: Visibilisation & Technological and operational anticipation**
Objectives	Constraining the modularity of systems, to create a *de facto* programmed obsolescence, to prioritize the regular development of new systems whose features cannot be integrated into the modernization of previous standards.	Innovating beyond issued specifications, at the expense of costs, to develop a competitive technological advantage that can be duplicated in civilian markets or mitigate the risks of future competitive procedures.	Taking advantage of information asymmetries concerning technical characteristics to intentionally alter the perceived complexity of the system to increase costs, or margins, in certain phases of the system's lifecycle.	Taking advantage of a monopolistic position to meet the strict requirements of the contract and/or detach oneself from certain contractual constraints to reduce costs for the company.	Maximizing the captured value in contract renegotiation by capitalizing on the interdependence of contracts and the costs of "waiting".	Developing and aggressively pushing a competing solution, often intermediate between the existing and the expected systems, or in a new technological segment, to maintain or develop technological skills, renegotiate the allotment of a contract or the task allocation.
Requirement	• Lack of modularity specifications • State funding capacity for procurement	• Incomplete contracts • High information asymmetry • Contractualization based on costs	• Lack of technical competence from state contractors • High level of information asymmetry • Existence of less supervised phases in terms of budget	• Little or no contestability • High information asymmetry	• Nexus of contracts • Contract renegotiation • Technical specificity • Strict technical or scheduling objectives	• Loss of a contract or initial contract negotiation • Competition • Technical specificity
Lifecycle phase	• R&D • Manufacturing	• R&D	• R&D • Maintenance	• R&D • Manufacturing • Maintenance	• R&D • Manufacturing • Maintenance	• R&D • Manufacturing • Maintenance
Competition structure	• Free competition • Monopolies	• Free competition • Monopolies	• Free competition • Monopolies	• Monopolies	• Monopolies	• Free competition
Advantages	• Recurring technology financing • High profitability over the life of the contract • Technological advantage over competitors	• State financing of technological capabilities • Technological advantage • Increased profitability on civil markets OR limited competition on state markets	• High short-term profitability • Annuity over the entire system life cycle	• Monopolistic rent in short and medium term • State funding of R&D and infrastructure	• Improved financial or technical endowments • Increase in captured value or profitability • Supplanting a competitor • Contract repositioning	• Maintaining or developing skills • Reallocation of contracts or tasks • Reduced risk of being squeezed out of future competition procedures • Image enhancement
Risks	• Lack of government funding for procurement • Early project drop-out • Technological lethargy	• Lack of state funding • Early project drop-out • Poor image	• Challenging technical complexity • Competitive bidding on downstream phases (e.g. maintenance) • Poor image	• Monopoly contestability (*national and international*) • Loss of technological expertise • Poor image	• Competency contestability • Poor image among partners	• Technological and financial risks • A solution outside of technological guidelines or operational needs • Impact on the subcontracting chain and complementors
Example	• U.S.' F-16 fighter aircraft program (*Lockheed Martin*)	• U.S.' F-35 fighter aircraft program (*Lockheed Martin*) • U.S.' Littoral Combat Ship frigate program (*Lockheed Martin & Marinette Marine / General Dynamics & Austal*) • U.S.' Zumwalt destroyer program (*Bath Iron Works & Ingalls Shipbuilding*)	• U.S.' F-22 fighter aircraft program (*Lockheed Martin*) • U.S.' F-35 fighter aircraft program (*Lockheed Martin*)	• France's MRO contracts (DMAÉ)	• France's Eurofighter & SCAF programs (*Dassault Aviation*) • France's Eurofighter & A400M programs (*Safran*)	• France's LOGIDUC program (*Dassault Aviation*) • France's SCORPENE program (*Naval Group*) • France's CAESAR program (*Nexter*) • Germany's KF-51 Panther program (*Rheinmetall*)

Table 4. Detailed characteristics of identified industrial opportunistic behaviors in defense ecosystems.

To conclude, alignment processes are contingent on institutional and industrial configurations, particularly the orchestrator's ability co-construct durable and shared alignment mechanisms and discussion interfaces that both bring conflicting interests to the fore and continuously realign members. The French program demonstrates the virtues of centralized coordination, whereas the U.S. program reveals the challenges of a competition-driven multipartite and governance, which generate tensions and costly iterations. Conceptually, these findings resonate with Pettigrew's (1990) emphasis on recontextualizing organizational change dynamics and Adner's (2017) insights on orchestration strategies and oversight in technologically complex systems. Governance structures, technological interdependencies, and temporality of political decisions strongly influence an ecosystem's ability to align efficiently.

6. RESULTS & DISCUSSION

As defense economics literature state that contextual and relational variables have only derisory repercussions on cost overruns (Lefeez, 2013), we stress the impact of governance and underlying relationship structure on strategic alignment. In defense constrained environment, program management models affect the degree of information asymmetry and define the required efforts to develop the ecosystem's alignment. Opportunistic behaviors and risks can be reduced if ecosystem orchestrators possess the appropriate skills and tools.

6.1. DISCUSSION INTERFACES AND STRATEGIC ALIGNMENT IN DEFENSE ECOSYSTEMS

Discussion interfaces are dynamic spaces essential for managing interdependencies, fostering trust, and ensuring strategic alignment in ecosystems. Based on our observations, their emergence and functioning appear to rely on three complementary yet successive processes:

Design and Structure of the Space refers to the process of intentional creation and configuration of a physical, virtual or symbolic environment that facilitates effective dialogue, collaboration and alignment among ecosystem stakeholders. This process involves multiple sub-processes, such as defining governance mechanisms, meaning rules, norms and procedures that regulate participation, decision-making and accountability within the space. It should ease inclusivity for adequate representation of all players, promote transparency, so roles, duties and outcomes are clearly defined, and enable fluid communication to foster mutual understanding and reduce information asymmetry. Crucial resources to support meaningful participation and effective collaboration should be provided. The space needs to be both structured and flexible, allowing dynamic adaptability to change while sustaining a coherent interaction framework. A collective identity constitutes the cultural backbone enhancing the initial setup of such spaces.

Defense production creates highly complex, customized and technologically advanced CoPS. Long production and contractual cycles generate a unique State-firm dynamic, central to shape technological trajectories and industrial capabilities as environmental changes directly affect individual and collective strategies. Thus, it requires unique management practices and evolving technological knowledge intensity (Brusoni & al., 2001). Dialogues are therefore vital to coordinate the ecosystem's adaptability, establish initial contracts, encourage performance beyond agreements, or limit adverse procurement effects (Joana, 2008). To handle complexity over time, an enduring "*constitution*" is often instituted (Goldberg, 1976: 428), which structures extra-contractual relationships to ensure interfirm coordination and stakeholder flexibility.

To preserve technological capabilities, mitigate risks of industrial failures and align with national strategic priorities, the DGA uses the legal framework to govern access, synergies and complementarities (Oudot & Bellais, 2008). Governance level discussion interfaces were thus established, though the DID and other recognized intermediaries, and historically centered on military budget negotiations, technological and industrial capacity planning (Laguerre, 2009; Serfati, 1995). After the 1990s privatizations, they cascaded to the program level, fostering shared representations (Joana & Smith, 2006) and enhancing coordination (Joana, 2008).

In France, the DGA shapes the unified vision and centralizes interactions (Danet, 1997) to entertain dialogue and coherence so that every member can voice its concerns and contribute to the value proposition (Joana, 2008). As interdependencies have intensified with the shift to "*chain-linked*" innovation models (Serfati, 1995), DGA's "*high-tech Colbertism*" logic (Cohen, 1992), which leverages financial crossholdings to create an interconnected ecosystem, fostered repeated interactions and trust among actors. Thus, peer recognition and sense of belonging are deeply ingrained in defense ecosystems (Hartley, 2007a; Walker & al., 1988). Civilian producers are often excluded, while firms like Safran and Airbus, despite deriving small military activities in revenue terms, are part of the global ecosystem.

Institutionalized discussion interface creation is eased by "revolving doors" (Duncan & Coyne, 2015), the shared language of armament engineers (Kolodziej, 1987) and the proximity of expert bodies (Bauer & Bertin-Mourot, 1995), which foster the dissemination of a collective identity in the ecosystem. Moreover, it enhances clarity of roles, orchestrator's legitimacy and mutual understanding of interests, objectives and strategies within it. Other tools, like access to capital and entry barriers, fortifies the creation and perpetuation of this common identity. However, identity in armament programs often diverges from that of the broader global ecosystem (Droff & Malizard, 2024) as system integrators shape the ecosystem to meet value proposition objectives. Hence, discussion interfaces' focus mainly lies on achieving mutual understanding of strategies and constraints (Joana & Smith, 2006; Lazaric & al., 2011).

Therefore, Design and Structure of the Space must be tailored to ecosystems' specific goals and consider factors such as power dynamics, complexity, cultural and strategic diversity. A well-designed space is ethical, to negotiate shared norms, values, and roles, should reinforce sense of belonging and collective identity, and enhance respect, mutual listening, and structured exchanges to align divergent perspectives. All those factors will promote trust, creativity, and thus strategic alignment, enabling ecosystems' capacity for innovation and resilience.

Conversation Development processes depict the continuous cycle of iterative dialogue, interactions and engagement among stakeholders, to foster collective co-evolution, adaptation and alignment in response to dynamic conditions. It relies on repeated information exchanges, feedback and collaborative decision-making to refine strategies, address emerging challenges and sustain mutual trust. Sub-processes include intersubjective exchanges, to develop shared representations through sequential and context-aware dialogue, reciprocal feedback loops, by creating mechanisms to provide and respond to feedback ensuring that adjustments are made, and organizational learning, leveraging iterative exchanges and problem-solving to enhance collaboration and collective knowledge and competencies. Continuous dialogue and feedback loops will entail repeated transparent interactions, hence generating cumulative trust-building, which will consolidate relationships and reduce opportunistic behaviors. Also, the creation process of shared narratives will condense the ecosystem's goals and values through collective myths and representations, reinforcing unity and common identity. Thus, relational quality of dialogue is at the core of any alignment process, but temporal continuity needs to be accounted for to maintain ecosystem coherence, stability, predictability and resilience over long cycles.

Conversations and qualitative dialogue are essential to ensure ecosystems' coordination and strategic alignment as multi-decade defense production cycles are partly decoupled from short-term profitability expectations. Historically, the DGA cultivated privileged ecosystemic relationships, acting as a representative for stakeholder grievances and a driver for realignment via equilibrium adjustments. Through complementarity and interdependency management, it shapes stakeholders' repeated interactions and dynamic adaptation to foster trust and deter opportunism (Argyres & Mayer, 2007), as it reminds the benefits of remaining in the ecosystem (Benkler, 2006). Over time, the DGA gathered, confronted and aligned all stakeholders' perspectives in a unified vision meeting State objective, thus creating shared representations and narratives. In the absence of a shared vision, perceived risks are increased (Adner, 2006) and formalized alignment mechanisms are impeded, causing repeated costs and misalignments.

Effective alignment demands proactive orchestrator management and the appropriate toolset (Nambisan & Sawhney, 2011). Else, detached management extends perceived risks and information asymmetry, spurring opportunistic behaviors. Tools can formal, informal, incentive or coercive. Incentive tools (*e.g., granting advantages: profitability index, market positioning, competition*) structure ecosystem activities, strategies and development, while coercive tools (*e.g., market contestability – Baumol & al., 1982*) prompt firms to rigorous cost management and superior technical performance (Kapstein & Oudot, 2009). Strategic alignment and trust can also be further reinforced via reciprocal risk-sharing strategies (Danet, 1997), R&D funding to limit financial risks, and long-term visibility (*e.g., forecasted order volumes*). In return, firms must meet resource and performance requirements while ensuring ecosystem stability.

The DGA leverages tailored tools to develop dialogues and handle ecosystem dynamics effectively, among which contractualization. While flexible contracting can foster mutual trust, stimulate innovation and limit cost deviations, systematic competition and cost-based contracts intensify moral hazard risks, as firms focus on profitability instead of alignment. Fixed contracts place greater risk on suppliers who must adapt to unforeseen changes, but partly capped revision clauses and unforeseeability doctrines can mitigate it (Oudot & Bellais, 2008). The DGA uses hybrid formal and informal contracts to address underperformance risks (Oudot, 2013).

Conversation Development processes are critical in complex and uncertain ecosystemic environments, as static contracts or isolated interactions are insufficient to ensure coordination. By fostering iterative and ongoing interactions, collective learning, reciprocal feedback loops, trust-building and shared narratives, ecosystems can build dialogue's relational quality and continuity, enhancing stakeholder commitment, reducing information asymmetry, and enabling collective adaptation to changes, thereby improving overall performance and sustainability.

Alignment of Frames embodies the process of ongoing and deliberate negotiation and harmonization of perspectives, values and objectives among stakeholders to create a shared understanding of goals, priorities and the broader context within an ecosystem. It is the process reframing the shared structure to overcome divergent interpretations or competing interests, and realigning members to reach consensus and coherence on common objectives, decision-making and action. Sub-processes encompass the management of power dynamics, by balancing power asymmetries with equitable participation and transparency, and conflict resolution, reshaping the communicative framing to align divergent goals or interpretations and mitigate confusion or deadlock, that may lead to inefficiencies, delays or disputes. Those processes will enhance and maintain mutual respect and collaboration. Also, dynamic adaptation allows stakeholders to continuously adjust their frames as new insights or environmental changes emerge, fostering the dynamic alignment of roles, responsibilities and resource allocations to maintain coherence and effectiveness over time. Thus, orchestrator's role and credibility are vital to facilitate dialogue, mediate conflicts and ensure adherence to agreed-upon norms and values. Shared interpretative context, that is conceptual framework for members to interpret opportunities or challenges similarly, and strategic decision-making guidance are necessary to reduce risks of fragmented or conflicting actions. To ensure dialogue continuity, orchestrators should preserve their legitimacy through neutrality, transparency, expertise and norms and values alignment.

Overtime, ecosystems capacity for coherence, adaptation and alignment can erode. Thus, lasting dedicated discussion interfaces are essential to reach realignment, as it enables to reconcile individual objectives and constraints with collective needs. Realignment capability derives from stability of members, roles and specializations, as well as relationships robustness (Moura & Oudot, 2017). Given specifications fluctuation and system complexity of defense production, orchestrators must continually adjust value distribution, specializations and task allocation, through regular bilateral or multilateral meetings. Also, continuous dialogue allows to match complementarities with the evolving intensity of scientific knowledge (Fauconnet, 2020), determine ecosystem access to new actors and allocate emerging technologies.

As defense production introduces unique risks, such as contract nexuses (Oudot, 2008), firms are tempted to adopt opportunistic behaviors, like delay strategies (Oudot, 2013). These risks can be deterred with specific prerogatives and the legal framework (e.g., nationalization). The DGA's technical expertise offers unique oversight over system complexity, reduces rework cycles and technological uncertainty (Christensen, 1997), effectively lowering information asymmetries, by staying a key player in system architecture designs. Hence, effective strategic realignment demands proactive orchestrators attention to day-to-day activities, which fortifies its roles as ecosystem mediator and protector. For the members, it reduces the perceived risks and information asymmetry. Safran's compromises on the A400M engine illustrates the role of discussion interfaces in ecosystem mediation and realignment (Joana & Smith, 2006).

Conversely, perduring discussion interfaces appear largely absent in the U.S. defense ecosystem. Even if such spaces shaped stakeholders' dialogue to maintain competition during the 1990s defense industry consolidation (Gansler, 2011), this assertion is evident in challenges faced by recent programs (*e.g., F-35, Zumwalt*). U.S. dispersed governance model exacerbates information asymmetries and undermines ecosystemic coherence, while the multiplicity of contracting authorities weakens the orchestrator's authority and legitimacy, thus impeaching activity synchronization. Also, the lack of sharp technical expertise begets overspecification and inefficiencies, of which firms can benefit by adopting opportunistic overtechnologization or gammification strategies. The absence of effective discussion spaces prevents the seamless confrontation and reconciliation of individual strategies, as members lack incentives to share strategies or exploit complementarities, ultimately undermining performance. The ecosystem therefore proves deficient as values and roles are not clearly understood (Jacobides & al., 2018).

Alignment of Frames processes are essential where multiple stakeholders bring varied priorities, perspectives and expertise. By dynamically aligning frames, through power dynamics and conflict resolution management, members can move beyond entrenched positions to focus on shared goals, enhance coordination and drive collective performance. If the orchestrator's role is recognized and legitimized by all, the process not only facilitates collaboration but also strengthens the ecosystem's capacity to adapt to change while maintaining strategic coherence.

6.2. Conceptualizing Conversational Spaces

Alignment mechanisms require an ongoing dialogue to ensures mutual understanding regarding resources, performance, and profits, identify synergies, adapt to dynamic conditions, and reshape alignment equilibria. Based on our observations, we conceptualize these interfaces as "*conversational spaces*". Etymologically, conversation comes from the Latin *conversatio*, which originally covers a broader sense of living together and interacting, focusing on ongoing association, shared values and mutual engagement, rather than strictly verbal exchanges (Randall, 2018). Thus, a conversation is about interaction, relationship-building and mutual presence. It highlights (I) the relational quality of dialogue –engaging in conversation is a way of "being with" others, fostering shared understanding and trust–; and (II) the ethical dimension –conversation often involves mutual trust to negotiate values, meanings and norms.

Schutz (1970) views conversation as a process, a bridge between subjective realities, in which individuals create and maintain shared meaning within their social world. Through face-to-face interactions, parties engage in a mutual exchange that allows to interpret gestures, tone and context, all of which contribute to the synthesis of shared understanding. Conversation eases identification, as actors identify with each other's meanings, perspectives and intentions. Conversation, for Schutz, operates within a temporal framework. Each utterance is embedded in a sequence of meaning depending on prior dialogues and the anticipation of future responses.

Hence, conversation is a mutual recognition aimed at inventing an art of being together, but it can be contentious, prone to tensions, and does not always require agreement. Mutual confrontations reveal differences and awake to other ways of meaning. Conversation is a dialogical space that enables "a back-and-forth exchange of speech according to principles that the participants must uphold to understand one another: respect for speaking turns, mutual listening" (Le Breton, 2024: 22). In line with Habermas' (1981) communicative action theory, conversation is a mutual effort to align perspectives and require a space to ensure the conditions for a rational-critical dialogue to clarify meanings, foster constructive interactions and reach consensus through reason, rather than manipulation or force (Habermas, 1981). Conversational spaces shape the intersubjective exchange of validity claims leading to mutual understanding: sincerity, truth and normative rightness. Sincerity relates to the speaker's own beliefs, feelings, or intentions truthfulness. The claim to truth refers to the factual correctness of a statement, which can be challenged by questioning its accuracy or evidence. Normative rightness implies the appropriateness of an action, rule, or behavior within a shared social or cultural context.

Drake & Donohue (1996) underline communicative framing as a condition to conflict resolution through conversation, that is the process by which interlocutors use interaction and language to shape and present their understanding of an issue (Goffman, 1974). Successful conflict resolution often depends on alignment of frames, which may diverge when disputants identify competing values, goals or interpretations, leading to misunderstanding or deadlock. Designing a conversational space helps participants to move beyond entrenched positions by focusing on shared interests or redefining the problem. Therefore, they are essential to develop a common group identity and define leadership and governance mechanism in the established structure. Through participation, actors align with social groups, adopting shared values, norms and narratives that define a group identity (Karreman & Alvesson, 2001). Alignment processes to agree on roles and beliefs, also shape a sense of collective belonging. By fostering dialogue and interaction, such spaces contribute to the continuity of personal and collective identities.

Moreover, conversational spaces allow to manage power dynamics, reframe issues and ensure equitable participation. Well-designed, they foster collaboration and trust. Yet, success depends on the capacity of a central actor to design and develop such spaces but also on its credibility, impartiality and ability to navigate complex stakeholder dynamics effectively. In this regard, legitimacy matters, as it ensures that all view the process and its outcomes. Without legitimacy, even well-designed conversational spaces risk resistance, lack of trust or failure. Notably, the sources of legitimacy are neutrality, transparency, expertise and competence, inclusivity, and alignment with norms and values (Albin, 2008; Clark, 2006; Steffek, 2007).

Finally, based on our observations, notably of the French defense ecosystem, we identified two types of conversational space. The first, tied to initial and ongoing contractualization, is present at the productive-level and involve a select group of stakeholders aligned with the value proposition. They focus on technical and operational coordination. The second, at the overall governance-level, encompass the entire ecosystem, addressing broader, strategic issues such as budget allocation, industrial capacities, and technological trajectories.

6.3. Framing Alignment Process Variables into Categories

This section proposes a detailed framework for the alignment process variables, organized into five hierarchical categories: Rules of the Game, Ecosystem Identity, System Architecture, Ecosystem Coordination, and Ecosystem Management. Building on our data and observations, we define each category, using variables derived from the ecosystemic literature. We then explore their impact on alignment processes within the two levels of conversational spaces identified: (I) Governance level and (II) Activity level. This approach illustrates how alignment unfolds across varying dimensions of ecosystemic interactions.

Rules of the Game encapsulate the foundational principles that define and structure the ecosystem, guiding players' behaviors and shaping collaboration and competition (Dhanaraj & Parkhe, 2006). These rules comprise formal elements such as laws, norms, public policies and contractual regulations, alongside informal aspects like values, habits, sectoral practices and tacit conventions. They delineate the ecosystem's boundaries, roles, operational modalities and collaboration mechanisms: "*Institutions are the rules of the game, organizations are the players*" (North, 2005: 59). Key variables include (I) legal frameworks (Jacobides & al., 2018), (II) conventions, norms and certifications (Baldwin & Clark, 2000), and (III) formal, informal, and cultural rules (Iansiti & Levien, 2004; Storbacka & Nenonen, 2015).

At the governance level, multipartite institutional interfaces, such as professional associations, parliamentary commissions and committees, play a crucial role in establishing the initial principles. These spaces formalize ecosystem boundaries and operational modalities through charters, working groups and discussion platforms. The legitimacy and transparency of these mechanisms enable stakeholders to align practices within a cohesive framework. Explicitly defined roles and responsibilities limit ambiguity and opportunistic behavior (Williamson, 1991), enhancing mutual trust and reducing transaction costs (Dyer & Singh, 1998). At the activity level, operational rules are defined through formal contracts, assigning roles, allocating tasks and delineating power dynamics. Clear standards support technological integration and standardization (Gawer & Cusumano, 2002, 2014), while rigid frameworks may stifle innovation. Alignment also depends on intellectual property rules to secure knowledge flows, fostering collaboration and technology transfer (Nambisan & Sawhney, 2011).

At both levels, dedicated platforms, forums and working groups reinforce legitimacy and transparency while enabling stakeholders to adjust practices within a shared framework. Yet, contract typologies and relationship management can influence dialogue outcomes. For instance, strict budget limits can lead firms to perceive profitability metrics as disconnected from actual financial requirements. As well, incomplete contracts can exacerbate opportunistic behaviors, highlighting the need for robust consultation mechanisms (Goldberg, 1976).

Ecosystem Identity concerns the collective mission, shared values and overarching value proposition that unite stakeholders (Adner, 2012). Cohesion arises through symbols, labels, sectoral narratives and a dedicated language, fostering a sense of belonging and external legitimacy (Suchman, 1995). Key variables include (I) shared visions, objectives and mission (Dattée & al., 2018), (II) collective beliefs, reputation and values (Dhanaraj & Parkhe, 2006), and (III) sectoral narratives, like founding myths (Glynn, 2000; Storbacka & Nenonen, 2011).

At the governance level, alignment processes rely on strategic mobilization and shared narratives to enhance stability and resilience. They legitimize role allocation, foster peer recognition and facilitate decision-making, while mitigating fragmentation risks (Jacobides & al., 2018). At the activity level, alignment depends on clear strategic objectives and an integrated value proposition. Strong identities attract talent and resources, promoting innovation and complementarities (Dhanaraj & Parkhe, 2006). However, value proposition imperatives can restrict traditional or new member inclusion based on ecosystem needs.

Collaborative tools, like steering committees, internal communication platforms and surveys, reinforce cultural cohesion and operational alignment. Official speeches and storytelling tools allow the emergence of founding myths, while shared language and peer recognition remain pivotal in maintaining shared narratives (Thompson & al., 2018). All of these tools drive trust and mitigate fragmentation risks (Argyres et al., 2019).

System Architecture pertains to the technical and structural organization of ecosystem offerings, encompassing system design, role distribution and technological interfaces (Gawer & Cusumano, 2014) to ensure a coherent value proposition. Key variables include (I) standards and technical protocols (Tiwana, 2014), (II) functional decomposition and technical distribution (Baldwin & Clark, 2000), (III) management of component interdependencies (Adner & Kapoor, 2010), and (IV) resource and capability complementarities (Jacobides & al., 2018).

At the governance level, processes focus on interdependency management and value chain coherence. Management of static synergy centers on role allocation, standard selection and coordination capacity (Iansiti & Levien, 2004). Dynamic management instead addresses long-term strategic and technical choices, such as market organization, co-specializations and technological trajectories (Liebowitz & Margolis, 1995). At the activity level, architecture assigns co-specializations and distributes value among stakeholders, to ensure smooth integration and reduce friction (Tiwana, 2014). Modular architectures enable incremental innovation, while excessive integration may hinder adaptation (Henderson & Clark, 1990).

As technologies mature, specific assets and co-specializations increase simultaneously, developing the likelihood of opportunistic behaviors (Adner & Kapoor, 2010). Ecosystem alignment relies on collaborative technical platforms (e.g., CAD tools, databases), architecture committees, internal discussion interfaces and processes, or innovative techniques, such as digital twins. This network of conversational tools streamlines coordination and allows for iterative architectural adjustments and consensus during development cycles, as the multiplication of critical components naturally increases the number of actors, necessitating knowledge and technology flows reorientation (Mowery & Langlois, 1996).

Ecosystem Coordination refers to the formal and informal mechanisms through which stakeholders coordinate, including strategic steering, information sharing, conflict resolution and activity regulation. Coordination covers trust, reputation, relationship networks, incentive and coercive measures (Argyres & Mayer, 2007). Key variables include (I) governance and coordination mechanisms (Ritala & al., 2013), (II) long-term trust and reputation, to stabilize relationships (Santos & Eisenhardt, 2009), (III) ecosystem leadership and orchestration (Iansiti & Levien, 2004), and (IV) dedicated information-sharing tools (Nambisan & Sawhney, 2011).

At the governance level, coordination mechanisms aim to mitigate tensions and reduce information asymmetries to encourage repeated interactions and deter opportunistic behavior (Argyres & Mayer, 2007; Dyer & Singh, 1998). In long-term relationships, mutual trust reduces perceived risks (Gulati, 1995) and stabilizes power structures, mainly the orchestrator's role, by establishing mutual acceptance of positions and responsibilities (Iansiti & Levien, 2004). By leveraging incentives and coercive tools (Parker & al., 2016), orchestrators can fulfill their mediation role in conflict resolution (Ring & Van de Ven, 1994). At the activity level, efficient exchanges supported by information-sharing tools enhance operational alignment. Over time, misalignment can stem from evolving value propositions, uneven value distribution or institutional inconsistencies (Malherbe & Tellier, 2022). Adaptive mechanisms, such as organizational learning and flexibility, enable ecosystems to evolve continuously while managing interdependencies effectively (Sanchez & Mahoney, 1996; Senge, 1990).

Effective coordination relies on a network of conversational spaces and collaborative platforms to address challenges, resolve conflicts and define shared objectives (Ansari & al., 2016). As coordination heavily depends on non-contractual governance to define roles beyond formal agreements (Gulati & al., 2012), tools can be formal, like shared ERPs or steering committees, or informal, such as trust or communities of practice. Lastly, audits, progress tracking and shared dashboards allow to measure collaboration and identify points of rupture.

Ecosystem Management implies the operational execution and continuous oversight of ecosystem dynamics, through resource allocation, conflict resolution and dynamic regulation of interdependencies (Adner & Kapoor, 2010). Key variables include (I) resource allocation and dynamic reallocation (Teece, 2007); (II) collective inter-organizational learning processes (Nambisan & Baron, 2013); (III) monitoring mechanisms (Dhanaraj & Parkhe, 2006); and (IV) technology lifecycle management (Hobday & al., 2000).

At the governance level, ecosystem management addresses resource allocation, shared strategies adaptation and complementarities catalyzation to develop resilience and realignment capacity (Jacobides & al., 2018). Environmental changes must be continuously monitored to preempt conflicts, recalibrate and sustain consensus (Adner, 2012). Incentive and coercive tools play a pivotal role in addressing misalignment risks and maintaining ecosystem stability. For example, privileges granted to monopolies can defuse agency issues and stimulate innovation (Congleton & Lee, 2009). At the activity level, management focuses on iterative learning processes, technological co-evolution, and self-correction based on real performance (Adner & Kapoor, 2010). It prioritizes value sharing and framing processes to create collective meanings (Thomas & Ritala, 2021), as it allows orchestrators to maintain industrial coherence. Attention management at all levels is vital to align stakeholders' strategic objectives.

This continuous management involves multiple, repeated interactions rooted in trust, transparency and learning dynamics. Enduring conversational spaces (e.g., shared knowledge bases, program reviews, co-constructed strategic roadmaps) foster actors' alignment. To ensure the contribution of all parties, orchestrators rely on a set of tools, with contractualization playing a predominant role (Williamson, 1999). Incentive tools, like collaborative funding, support dynamic regulation, while coercive mechanisms deter opportunistic behavior.

	Design and Structure of the Space		Conversation Development	Alignment of Frames	
Category	**Rules of the Game**	**Ecosystem Identity**	**System Architecture**	**Ecosystem Coordination**	**Ecosystem Management**
Category Definition	The set of formal and informal principles that define the ecosystem's boundaries, roles, and operational modalities, shaping collaboration and competition.	The shared mission, values, and identity that unite stakeholders around a collective vision and purpose, fostering a sense of belonging and external legitimacy.	The technical and structural organization of the ecosystem, including modularity, integration, and role distribution, to deliver a coherent value proposition.	The mechanisms enabling stakeholders to coordinate activities, share information, resolve conflicts, and achieve strategic and operational alignment.	The continuous oversight and orchestration of the ecosystem through resource allocation, conflict resolution, and adaptation to ensure resilience and alignment.
Key Variables	• Regulatory and legal frameworks • Conventions, norms, and certifications • Formal and informal cultural rules	• Shared vision, strategic objectives, and mission • Collective beliefs, reputation, and values • Sectoral narratives	• Standards and technical protocols • Functional decomposition and technical distribution • Management of interdependencies • Resource and capability complementarities	• Governance and coordination mechanisms • Long-term trust and reputation • Ecosystem leadership and orchestration • Information-sharing tools	• Resource allocation and reallocation • Inter-organizational learning processes • Monitoring and evaluation mechanisms • Technology lifecycle management
Governance Level tools	• Multipartite institutional interfaces • Forums and working groups • Ecosystem charter.	• Steering committees • Surveys • Collaborative events • Official speeches	• Architecture committees • Collaborative technical platforms	• Steering committees, • Shared ERPs, • Audits • Strategic dashboards	• Shared strategic roadmaps • Shared Knowledge bases • Program reviews • Incentive mechanisms.
Activity Level Tools	• Formal contracts • Operational rules • Regulatory compliance mechanisms.	• Collaborative portals • Events • Storytelling tools • Shared language platforms	• Internal discussion processes • CAD software • Innovative techniques	• Operational communication platforms • Real-time dashboards • Joint decision-making tools.	• Performance tracking • Feedback loops • Iterative learning mechanisms.

Table 5. Categorization of alignment process constitutive variables in ecosystems

6.4. Limitations and Future Research

We acknowledge that our case study faces significant limitations regarding the breadth and homogenization of the object under investigation. This harmonization exercise tends to eliminate the national specificities of each DTIB, at the risk of comparing doctrinal and organizational structures with substantial differences. With this in mind, we focused on a Franco-American comparison, where differences primarily concern market structure and governance strategies rather than doctrines, operational concepts, or ambitions. In this sense, a Franco-German comparison would have been more difficult due to the major environmental differences. Moreover, our findings lever interesting issues for future research, especially regarding the replicability in less constrained ecosystems and the impact of these alignment mechanisms on ecosystem emergence. It also questions the multidimensional nature of performance and how it is perceived according to dominant design and standards.

7. REFERENCES

Adner, R., & Kapoor, R. (2010), Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal, 31*(3), 306-333. DOI: 10.1002/smj.821
Adner, R. (2006). Match Your Innovation Strategy to Your Innovation Ecosystem. *Harvard Business Review, 84*(4), 98-107.
Adner, R. (2012). *The Wide Lens: A New Strategy for Innovation*. Portfolio.
Adner, R. (2017). Ecosystem as Structure: An Actionable Construct for *Strategy. Journal of Management, 43*(1), 39-58. DOI: 10.1177/0149206316678451
Agarwal, S & Kapoor, R. (2022). Value Creation Tradeoff in Business Ecosystems: Leveraging Complementarities While Managing Interdependencies. *Organization Science, 34*(3), 1216-1242. DOI: 10.1287/orsc.2022.1615
Albin, C. (2008). Using negotiation to promote legitimacy: An assessment of proposals for reforming the WTO. *International Affairs, 84*(4), 757-775. DOI: 10.1111/j.1468-2346.2008.00734.x
Ansari, S., Garud, R. & Kumaraswamy, A. (2016), The disruptor's dilemma: TiVo and the U.S. television ecosystem. *Strategic Management Journal, 37*(9), 1829-1853. DOI: 10.1002/smj.2442
Argyres, N., Mahoney J., & Nickerson, J. (2019). Strategic responses to shocks: Comparative adjustment costs, transaction costs, and opportunity costs. *Strategic Management Journal*, *40*(3), 357–376. DOI: 10.1002/smj.2984
Argyres, N., & Mayer, K. (2007). Contract design as a firm capability: An integration of learning and transaction cost perspectives. *Academy of Management Review, 32*(4), 1060-1077. DOI: 10.5465/amr.2007.26585739
Augustine, N. (1982). *Augustine's Laws*. American Institute of Aeronautics.
Baldwin, C., & Clark, K. (2000). *Design Rules: The Power of Modularity*. The MIT Press
Bauer, M., & Bertin-Mourot, B. (1995). *L'Accès au sommet des grandes entreprises*. CNRS.
Baumol, W., Panzar, J., & Willig, R. (1982). *Contestable Markets and the Theory of Industry Structure*. Harcourt College Pub.
Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press.
Brusoni, S., Prencipe, A., & Pavitt, K. (2001). Knowledge Specialization, Organizational Coupling, and the Boundaries of the Firm: Why Do Firms Know More than They Make? *Administrative Science Quarterly, 46*(4), 597-621. DOI: 10.2307/3094825
Christensen, C. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard University Press.
Clark, I. (2006). *Legitimacy in international society*. Oxford University Press.
Cohen, E. (1992). *Le Colbertisme « high tech » : Économie des Télécom et du Grand Projet*. Hachette Education.
Congleton, R., & Lee, S. (2009). Efficient mercantilism? Revenue-maximizing monopoly policies as Ramsey taxation. *European Journal of Political Economy, 25*(1), 102-114. DOI: 10.1016/j.ejpoleco.2008.07.001
Danet, D. (1997). La production d'armement : éléments d'économie institutionnelle. *Revue française d'économie, 12*(3), 121-165. DOI: 10.3406/rfeco.1997.1029
Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in Poor Visibility: How Firms Play the Ecosystem Game when Uncertainty is High. *Academy of Management Journal, 61*(2), 466-498. DOI: 10.5465/amj.2015.0869
David, P. (1986). Understanding the economics of QWERTY: The necessity of history. In W. Parker (Eds.), *Economic History and the Modern Economist*. Basil Blackwell.
Dawson, P. (1994). *Organizational change: A processual approach*. Chapman.
De Vestel, P. (1993). *L'industrie européenne de l'armement – Recherche, développement technologique et reconversion*. Les Dossiers du GRIP.
Desportes, V. (2009). The Armies between "Technologism" and "Appropriate Technology". *Politique étrangère, 1*(2), 403-418. https://shs.cairn.info/journal-politique-etrangere-2009-2-page-403
Dhanasai, C., & Parkhe, A. (2006). Orchestrating Innovation Networks. *The Academy of Management Review, 31*(3), 659–669. DOI: 10.5465/amr.2006.21318923
Dittrich, K., Jaspers, F., Van Der Valk, W., & Wynstra, F. (2006). Dealing with Dualities. *Industrial Marketing Management, 35*(7), 792-796. DOI: 10.1016/j.indmarman.2006.07.001
Drake, L., & Donohue, W. (1996). Communicative framing theory in conflict resolution. *Communication Research*, *23*(3), 297-322. DOI: 10.1177/009365096023003004
Droff, J., & Malizard, J. (2024). Évolution des conflits et reconfigurations de l'industrie de l'armement: l'hypothèse des deux marchés. *Défense & Industrie, 18*, FRS.
Duncan, T., & Coyne, C. (2015). The Revolving Door and the Entrenchment of the Permanent War Economy. *Peace Economics, Peace Science, and Public Policy, 21*(3), 391-413. DOI: 10.1515/peps-2015-0001
Dunne, P. 1995. The defense industrial base. *Handbook of Defense Economics, 1*, 399-430. DOI: 10.1016/S1574-0013(05)80016-X
Dyer, J., & Singh, H. (1998). The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. *The Academy of Management Review, 23*(4), 660-679. DOI: 10.2307/259056
Eisenhardt, K. (1989). Building Theories from Case Study Research. *The Academy of Management Review, 14*(4), 532-550. DOI: 10.2307/258557
Fauconnet, C. (2020). L'intensité scientifique des innovations technologiques des entreprises de défense. *Revue Défense Nationale, 832*(7), 91-96. DOI: 10.3917/rdna.832.0091
Gansler, J. (2011). *Democracy's Arsenal: Creating a Twenty-First-Century Defense Industry*. The MIT Press.
Government Accountability Office. (2024). F-35 *Joint Strike Fighter: Program Continues to Encounter Production Issues and Modernization Delays*. Report n°24-106909. https://www.gao.gov/products/gao-24-106909
Gawer, A., & Cusumano, M. (2002). *Platform Leadership: How Intel, Microsoft, And Cisco Drive Industry Innovation*. HBS.
Gawer, A., & Cusumano, M. (2014). Industry Platforms and Ecosystem Innovation. *Journal of Product Innovation Management, 31*(3), 417-433. DOI: 10.1111/jpim.12105
Glynn, M. (2000). When Cymbals Become Symbols: Conflict Over Organizational Identity Within a Symphony Orchestra.

Organization Science, *11*(3), 285-298. DOI: 10.1287/orsc.11.3.285.12496
Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. Harvard University Press.
Goldberg, V. (1976). Toward an Expanded Economic Theory of Contract. *Journal of Economic Issues, 10*(1), 45-61. https://www.jstor.org/stable/4224467
Gulati, R., Wohlgezogen, F., & Zhelyazkov, P. (2012). The Two Facets of Collaboration: Cooperation and Coordination in Strategic Alliances. *The Academy of Management Annals, 6*(1), 1-53. DOI: 19416520.2012.691646
Gulati, R. (1995). Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. *Academy of Management Journal, 38*(1), 85-112. DOI: 10.2307/256729
Habermas, J. (1981). *The Theory of Communicative Action*. Beacon Press.
Hartley, K. (2007a). The arms industry, procurement and industrial policies. *Handbook of Defence Economics, 2*, 1139-1176. DOI: 10.1016/S1574-0013(06)02033-3
Hartley, K. (2007b). The Economics of the UK Defence Industrial Strategy. *Security Challenges, 3*(2), 19-30. https://www.jstor.org/stable/26458856
Henderson, R., & Clark, K. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative science quarterly, 35*(1), 9-30. DOI: 10.2307/2393549
Henderson, J. & Venkatraman, N. (1993). Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal, 32*(1), 4-16. DOI: 10.1147/sj.382.0472
Hobday, M. (1998). Product complexity, innovation and industrial organization. *Research Policy, 26*(6), 689-710, DOI: 10.1016/S0048-7333(97)00044-9
Hobday, M., Rush, H., & Tidd, J. (2000). Innovation in Complex Products and Systems. *Research Policy, 29*(7-8), 793-804. DOI: 10.1016/S0048-7333(00)00105-0
Iansiti, M., & Levien, R. (2004). *The Keystone Advantage*. HBS.
Jacobides, M., Cennamo, C., & Gawer, A. (2018). Towards a Theory of Ecosystems. *Strategic Management Journal, 39*(8), 2255-2276. DOI: 10.1002/smj.2904
Jick, T. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly, 24*(4), 602-611. DOI: 10.2307/2392366
Joana J., & Smith, A. (2006). Changing French military procurement policy: The state, industry and Europe in the case of the A400M. *West European Politics, 29*(1), 70-89. DOI: 10.1080/01402380500389257
Joana, J. (2008). Armée et industrie de défense: cousinage nécessaire et liaisons incestueuses. *Pouvoirs, 125*(2), 43-54. DOI: 10.3917/pouv.125.0043
Kagan, R. (2003). *La Puissance et la Faiblesse*. Plon-Omnibus.
Kapstein, E., & Oudot, J.M. (2009). Reforming Defense Procurement: Lessons from France. *Business and Politics, 11*(2), 1-25. DOI: 10.2202/1469-3569.1264
Karreman, D., & Alvesson, M. (2001). Making newsmakers: Conversational identity at work. *Organization Studies, 22*(1), 59-89. DOI : 10.1177/017084060102200104
Klein, P., Mahoney, J., McGahan, A., & Pitelis, C. (2019). Organizational governance adaptation: Who is in, who is out, and who gets what. *Academy of Management Review, 44*(1), 6-27. DOI: 10.5465/amr.2014.0459
Kolodziej, E. (1987). *Making and Marketing Arms. The French Experience and Its Implications for the International System*. Princeton University Press.
Kramer, M., & Pfitzer, M. (2016). The ecosystem of shared value. *Harvard Business Review, 94*(5), 80-89.
Krause, K. (1992). *Arms and the State: Patterns of Military Production and Trade*. Cambridge University Press.
Kurth J. (1972). The political economy of weapons procurement: the follow-on imperative. *American Economic Review, 62*(2), 304-311. https://www.jstor.org/stable/1821556
Laguerre, C. (2009). Is The Defence Market Contestable? The Case of Military Aerospace. *Defence and Peace Economics, 20*(4), 303-326. DOI: 10.1080/10242690802365044
Langley, A. (1999). Strategies for Theorizing from Process Data. *The Academy of Management Review, 24*(4), 691-710. DOI: 10.2307/259349
Lazaric, N., Merindol, V., & Rochhia, S. (2011). Changes in the French Defence Innovation System: New Roles and Capabilities for the Government Agency for Defence. *Industry and Innovation, 18*(5), 509-530. DOI: 10.1080/13662716.2011.583464
Le Breton, D. (2024). *La fin de la conversation*. Éditions Métailié
Lefeez, S. (2013). Toujours plus chers, complexité des armements et inflation des coûts militaires. *Focus Stratégique*.
Liebowitz, S., & Margolis, S. (1995). Path Dependence, Lock-In, and History. *The Journal of Law, Economics, and Organization, 11*(1), 205-226. DOI: 10.2139/ssrn.1706450
Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. Sage.
Lingens, B., Miehé, L., & Gassmann, O. (2020). The ecosystem blueprint: How firms shape the design of an ecosystem according to the surrounding conditions. *Long Range Planning, 53*(4), DOI: 10.1016/j.lrp.2020.102043
Lingens, B., Seeholzer, V., & Gassmann, O. (2022). The architecture of innovation: How firms configure different types of complementarities in emerging ecosystems. *Industry and Innovation, 29*(9), 1108-1139. DOI: 10.1080/13662716.2022.2123307
Luttwak, E. (2007). Towards Affordable Weapons. *Politique Etrangère, 72*(4), 773-786.
Malherbe, M., & Tellier, A. (2024). Explaining the nonalignment of ecosystem partners: A structuralist approach. *Strategic Organization, 22*(4), 767-796. DOI: 10.1177/14761270221084224
Masucci a, M., Brusoni, S., & Cennamo C. (2020). Removing bottlenecks in business ecosystems: The strategic role of outbound open innovation. *Research Policy, 49*(1), 103823. DOI: 10.1016/j.respol.2019.103823
Moore, J. (1993). Predators and Prey: A New Ecology of Competition. *Harvard business review, 71*(3), 75-86.

Moore, J. (2006). Business Ecosystems and the View from the Firm. *The Antitrust Bulletin, 51*(1), 31-75. DOI: 10.1177/0003603X0605100103
Moura, S., & Oudot, J-M. (2017). Performances of the defense industrial base in France: the role of small and medium enterprises. *Defence and Peace Economics, 28*(6), 652-668. DOI: 10.1080/10242694.2016.1195574
Mowery, D. & Langlois, R. (1996). Spinning off and spinning on(?): the federal government role in development of US computer software industry. *Research Policy, 25*(6), 947-966. DOI:10.1016/0048-7333(96)00888-8
Nambisan, S., & Baron, R. (2013). Entrepreneurship in Innovation Ecosystems: Entrepreneurs' Self-Regulatory Processes and Their Implications for New Venture Success. *Entrepreneurship Theory and Practice, 37*(5), 1071-1097. DOI : 10.1111/j.1540-6520.2012.00519.x
Nambisan, S., & Sawhney, M. (2011). Orchestration processes in network-centric innovation: Evidence from the field. *Academy of Management Perspectives, 25*(3), 40-57. DOI: 10.5465/AMP.2011.63886529
North, D. (2005). *Understanding the Process of Economic Change*. Princeton University Press.
Oudot, J-M., & Bellais, R. (2008). Choix contractuels et innovation: le cas de l'approvisionnement de Défense. *Innovations, 28*(2), 85-103. DOI: 10.3917/inno.028.0085
Oudot, J-M. (2008). Risques et performance des contrats d'armement. *Revue Défense Nationale, 705*(2), 132-140.
Oudot, J-M. (2013). Renégociation des contrats de défense: le rôle des aspects informels. *Innovations, 42*(3), 59-83. DOI: 10.3917/inno.042.0059
Parker, G., Van Alstyne, M., & Choudary, S. (2016). *Platform Revolution*. WW Norton & Co.
Pettigrew, A. (1987). Theorical, Methodological and Empirical Issues in Studying Change. *Journal of Management Studies, 24*(4), 420-426.
Pettigrew, A. (1990). Longitudinal Field Research on Change: Theory and Practice. *Organization Science, 1*(3), 267-292. DOI: 10.1287/orsc.1.3.267
Porter, M. (1996). What is a strategy? *Harvard Business Review, 74*(6), 61-78.
Randall, D. (2018). *The Concept of Conversation: From Cicero's Sermo to the Grand Siècle's Conversation*. Edinburgh University Press
Ring, P., & Van de Ven, A. (1994). Developmental processes of cooperative interorganizational relationships. *The Academy of Management Review, 19*(1), 90-118. DOI: 10.2307/258836
Ritala, P., Agouridas, V., Assimakopoulos D., & Gies, O. (2013). Value Creation and Capture in Innovation Ecosystems. *International Journal of Technology Management, 63*(3/4), 244-267. DOI: 10.1504/IJTM.2013.056900
Sanchez, R., & Mahoney, J. (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal, 17*(2), 63-76. DOI: 10.1002/smj.4250171107
Santos, F., & Eisenhardt, K. (2009). Constructing Markets and Shaping Boundaries: Entrepreneurial Power in Nascent Fields. *Academy of Management Journal, 52*(4), 643-671. DOI: 10.5465/AMJ.2009.43669892
Schutz, A. (1970). *Alfred Schutz on Phenomenology and Social Relations*. Helmut R. Wagner
Senge, P. (1990). *The Fifth Discipline: The Art & Practice of The Learning Organization*. Doubleday/Currency.
Serfati, C. (1995). *Production d'armes, croissance et innovation*. Economica.
Steffek, J. (2007). Legitimacy in international relations: From state compliance to citizen consensus. *European Journal of International Relations, 13*(2), 145-172. DOI: 10.1177/1354066107076955
Storbacka, K., & Nenonen, S. (2011). Scripting markets: From value propositions to market propositions. *Industrial Marketing Management, 40*(2), 255-266. DOI: 10.1016/j.indmarman.2010.06.038
Storbacka, K., & Nenonen, S. (2015). Learning with the market: Facilitating market innovation. *Industrial Marketing Management, 44*, 73-82. DOI: 10.1016/j.indmarman.2014.10.009
Suchman, M. (1995). Managing Legitimacy: Strategic and Institutional Approaches. *The Academy of Management Review, 20*(3), 571-610. DOI; 10.2307/258788
Teece, D. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319-1350. DOI: 10.1002/smj.640
Thomas, L., & Ritala, P. (2021). Ecosystem Legitimacy Emergence: A Collective Action View. *Journal of Management, 48*(3), 515-541. DOI: 10.1177/0149206320986617
Thompson, T., Purdy, J., & Ventresca, M. (2018). How Entrepreneurial Ecosystems Take Form: Evidence from Social Impact Initiatives in Seattle. *Strategic Entrepreneurship Journal, 12*(1), 96-116. DOI: 10.1002/sej.1285
Tiwana, A. (2014). *Platform Ecosystems: Aligning Architecture, Governance, and Strategy*. Morgan Kaufmann.
Van de Ven, A., & Huber, G. (1990). Longitudinal field research methods for studying processes of organizational change. *Organization Science, 1*(3), 213-219. DOI: 10.1287/orsc.1.3.213
Van de Ven, A. (1992). Suggestions for studying strategy process: A research note. *Strategic Management Journal, 13*(S1), 169-188. DOI: 10.1002/smj.4250131013
Venkatraman, N. (1989). The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence. *The Academy of Management Review, 14*(3), 423-444. DOI: 10.2307/258177
Walker, W., Graham, M., & Harbor, B. (1988). From components to integrated systems: Technological diversity and interactions between military and civilian sectors. In Gummett, P. & Reppy, J. (eds), *The relation between military and civilian technologies*. Kluwer Academic Publishers.
Walker, W. (1988). *UK defence electronics: A review of Government statistics*. Policy Research Paper n°4. ESRC.
Williamson, O. (1991). Strategizing, economizing, and economic organization. *Strategic Management Journal, 12*(2), 75-94. DOI: 10.1002/smj.4250121007
Williamson, O. (1999). Public and Private Bureaucracies: A Transaction Cost Economics Perspective. *Journal of Law, Economics and Organization, 15*(1), 306-342. DOI: 10.1093/jleo/15.1.306