Behavioral Biases and Cognitive Pitfalls: Navigating Resource Orchestration in Supplier-Partnered Innovation Projects

Abstract

Innovation projects play a crucial role in maintaining competitive advantage but often experience high failure rates. This study examines how behavioral biases influence supplier resource management in failed innovation projects. Using Resource Orchestration Theory as a lens, we analyze six failed projects, each involving two suppliers, to explore how cognitive biases disrupt critical resource management activities, including structuring, bundling, and leveraging. Key biases, such as overconfidence, optimism, and strategic misrepresentation, were found to skew decision-making, prioritizing technical competencies over relational history during supplier selection. This misalignment impaired supplier interactions and knowledge-sharing practices, ultimately contributing to project failure. The findings offer a novel perspective on how cognitive biases undermine resource orchestration and highlight the importance of incorporating collaborative history into supplier selection frameworks. Addressing these biases can significantly improve decision-making processes and enhance the success of innovation projects.

Keywords: *Collaborative Innovation; Project Management; Resource Orchestration Theory; Behavioral Bias; Buyer-Supplier Collaboration*

Managerial relevance statement

This study offers actionable insights for supply chain managers, project managers, and corporate policymakers to address the disruptive effects of cognitive biases, such as overconfidence and optimism, on supplier-partnered innovation projects. The findings highlight the importance of incorporating collaborative history into supplier selection processes alongside technical competencies, reducing the risks of resource mismanagement, delays, and quality failures. Managers can leverage this approach by designing evaluation frameworks that explicitly weigh both factors, ensuring a balanced and informed decision-making process. Additionally, fostering direct communication channels, such as colocated engineering teams and tri-party meetings, has proven effective in mitigating biases and enhancing collaboration. These informal mechanisms facilitate real-time problem-solving, improve coordination, and align project expectations with execution realities. Corporate policymakers can support these practices by developing training programs and project management guidelines that raise awareness of cognitive biases and promote collaboration strategies. For example, scenario-based workshops and standardized relational audits can help teams better anticipate and manage the complexities of supplier partnerships. By implementing these strategies, organizations can improve supplier relationships, optimize resource orchestration, and increase the overall success rates of innovation projects.

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I. Introduction

Organizations are increasingly turning to collaborative innovation projects as a strategic response to the complexity and dynamism of modern markets. These projects, which depend on the integration of diverse resources and expertise—especially from suppliers—have become critical drivers of breakthrough products, services, and processes [36], [49]. Effective orchestration of supplier resources is a key determinant of success, enabling firms to fully capitalize on these collaborative efforts [6], [37]. Yet, the high failure rate of such projects suggests that managing these collaborations remains a significant challenge, warranting closer examination of the factors contributing to these outcomes [9], [40], [54].

One significant but underexplored factor is the influence of behavioral biases on buyer-supplier collaborations. Behavioral biases, defined as systematic deviations from rational decision-making, can lead to suboptimal choices that negatively affect project outcomes [13]. These biases may distort the judgment of project managers, thereby compromising resource management practices and ultimately undermining project performance [38], [19], [18], [42]. Despite their potential impact, the role of behavioral biases in resource orchestration within supplier-partnered innovation projects has received limited empirical attention, making it a critical gap in the literature. This is especially relevant in light of the increasing recognition of the role cognitive factors play in decision-making processes within project management (PM).

This study addresses this gap by employing resource orchestration theory [44], [29], [12] to investigate how behavioral biases influence resource management in failed supplier-partnered innovation projects. Specifically, it examines how resource orchestration—encompassing the structuring, bundling, and leveraging of resources—is disrupted by these biases, leading to project performance deficiencies. We focus on prevalent behavioral biases, such as strategic misrepresentation, optimism bias, uniqueness bias, planning fallacy, overconfidence bias, hindsight bias, availability bias, base rate fallacy, anchoring, and escalation of commitment [19], and explore how these cognitive distortions interact with resource orchestration practices to derail collaborative innovation efforts [10].

The research question guiding this study is: *How do behavioral biases intertwine with supplier resource orchestration failures and impact project performance in collaborative innovation initiatives?*

To answer this question, we conduct an in-depth analysis of seven innovation projects, each involving collaboration with two suppliers, with the goal of unraveling the complex relationships between behavioral biases and resource orchestration failures. This focus not only advances our theoretical understanding of how cognitive biases influence resource management but also provides practical insights for improving project outcomes.

The findings of this study make two significant contributions. First, they address a critical gap in the literature on resource management in buyer-supplier collaborations (e.g., [22], [51], [28], [37]) by examining the underexplored role of behavioral biases in failed innovation projects. The analysis identifies how biases such as overconfidence and optimism disrupt resource orchestration, providing new insights into the mechanisms that link cognitive distortions to project performance failures. This perspective contributes to both project management (PM) and supply chain management (SCM) research, offering a more detailed understanding of how biases impact decision-making in collaborative settings.

Second, the study delivers practical strategies for managers to mitigate the effects of these biases and improve the outcomes of supplier-partnered innovation projects. An important and novel insight is the effectiveness of prioritizing collaborative history alongside technical competencies during supplier selection, which challenges the conventional focus on technical expertise. Additionally, the findings show that informal mechanisms, such as colocated engineering teams, can reduce bias-driven inefficiencies and improve coordination. These recommendations not only enhance decision-making processes but also provide a practical framework for strengthening supplier partnerships and increasing the likelihood of project success.

The paper is organized as follows. Section 2 provides the theoretical background and research framework. Section 3 outlines the case study methodology, while section 4 describes the characteristics of the projects examined. Section 5 presents the cross-case findings and propositions. Finally, section 6 summarizes the key theoretical and practical contributions of the research.

II. Theoretical Motivations, Existing Gaps and Research Framework

A. The Strategic Role of Collaborative Innovation Projects

Collaborative innovation projects have transformed how organizations develop new products, services, and processes [50]. Defined by Barbic et al. [4] (p.175) as "*temporary entities comprising a set of purposively planned and managed knowledge flows between organizational representatives to solve a particular innovation problem*," these projects involve external stakeholders working jointly to co-create innovative solutions [7]. Unlike traditional closed innovation models that depend solely on internal resources [2], collaborative innovation harnesses external knowledge, ideas, and resources, creating a dynamic open innovation ecosystem [11].

In markets driven by rapid technological advancements and uncertainties, collaborative innovation offers significant advantages [50]. By integrating external expertise, organizations access a broader knowledge base and diverse perspectives critical for breakthrough innovations [47]. At the project level, this approach fosters creativity, agility, and access to complementary resources, including specialized knowledge, advanced technologies, and deeper market insights [20]. These factors strengthen an organization's innovation potential and competitive edge [7].

A well-developed innovation ecosystem, built around partnerships, is essential for the success of collaborative innovation [39]. Suppliers play a particularly crucial role, offering not only materials or components but also unique resources, specialized knowledge, and valuable industry insights that are often key to innovation [52]. As co-creators in these projects, suppliers transcend traditional roles, enriching the innovation process and contributing to more integrated and effective collaboration [25].

B. Managing Supplier Collaborations and Resources at the Project Level

Supplier collaboration has evolved from traditional transactional relationships to strategic partnerships that are crucial for innovation success [51]. Suppliers contribute critical resources and expertise, actively participating in various stages of the innovation lifecycle, including idea generation, design, prototyping, testing, and implementation [23]. For example, in the automotive industry, supplier involvement in design and prototyping is key to achieving cost-effective and innovative solutions [24].

Strategically integrating suppliers into the innovation process offers several advantages. It accelerates innovation, shortens time-to-market by streamlining supply chain processes, and leverages complementary resources [52], [45]. These collaborations foster a culture of learning and knowledge exchange, boosting creativity and expanding an organization's intellectual capital [37]. Beyond the immediate project benefits, these partnerships contribute to long-term organizational learning and sustainable competitive advantage [22].

However, managing supplier collaborations is not without challenges, particularly regarding strategic resource orchestration [33]. Coordinating resources across diverse stakeholders, each with unique priorities and capabilities, requires effective communication and negotiation to ensure proper resource alignment and integration [37].

A further challenge is balancing openness in knowledge sharing with the protection of intellectual property and proprietary information [34]. While collaborative innovation depends on the exchange of ideas, firms must safeguard competitive advantages through trust-building, clear agreements, and robust governance mechanisms [27].

Cultural and organizational differences also complicate these partnerships. Aligning goals, coordinating activities, and managing cultural disparities and power dynamics are essential for successful resource orchestration [8]. Failure to address these aspects effectively can result in collaboration breakdowns, highlighting the need for mindful and strategic management of supplier resources at the project level [48].

C. Behavioral Biases in Project Management

Behavioral biases are cognitive and psychological tendencies that can significantly affect decision-making in PM [43]. Initially conceptualized as mental shortcuts or heuristics [46], these biases can simplify decision processes but often lead to deviations from rational, optimal outcomes [1]. Since Tversky and Kahneman's foundational work, the study of biases has expanded across fields such as economics, management, and the social sciences. While initially considered cognitive phenomena, more recent views incorporate political, sociological, and organizational dimensions, broadening their recognized impact [19].

In PM, where multiple stakeholders, strict performance metrics, and complex negotiations are common, behavioral biases are particularly influential. Flyvbjerg [19] deepened the understanding of these biases by combining cognitive and political perspectives, identifying ten key biases relevant to PM and planning. Appendix A (Table A1) in the supplementary material provides definitions and outlines the effects of these biases, which often distort perceptions and lead to suboptimal project outcomes [19].

For example, strategic misrepresentation can cause cost and timeline underestimations, resulting in delays and budget overruns [17]. Anchoring bias may lead decision-makers to overly rely on initial information, overlooking emerging risks [46]. Similarly, the planning fallacy often results in unrealistic timelines, while overconfidence bias can cause project managers to dismiss contradictory evidence and overemphasize confirming data [35].

These biases affect various aspects of PM, including decision-making, resource allocation, and collaboration dynamics [32]. Supplier selection, contract negotiation, and risk assessment are particularly vulnerable to distorted judgments caused by biases, leading to inefficient resource allocation and suboptimal decisions [38]. The consequences include project delays, cost overruns, compromised quality, and missed opportunities for innovation [43].

In supplier-partnered collaborative innovation projects, biases can further distort perceptions of supplier capabilities and contributions, hindering effective integration and synergy with internal teams and other stakeholders [21]. Appendix A (Table A1) also illustrates specific examples of how these biases can manifest in practice, negatively affecting supplier collaboration at the project level. Recognizing and managing these biases is essential for improving decision-making and achieving successful project outcomes.

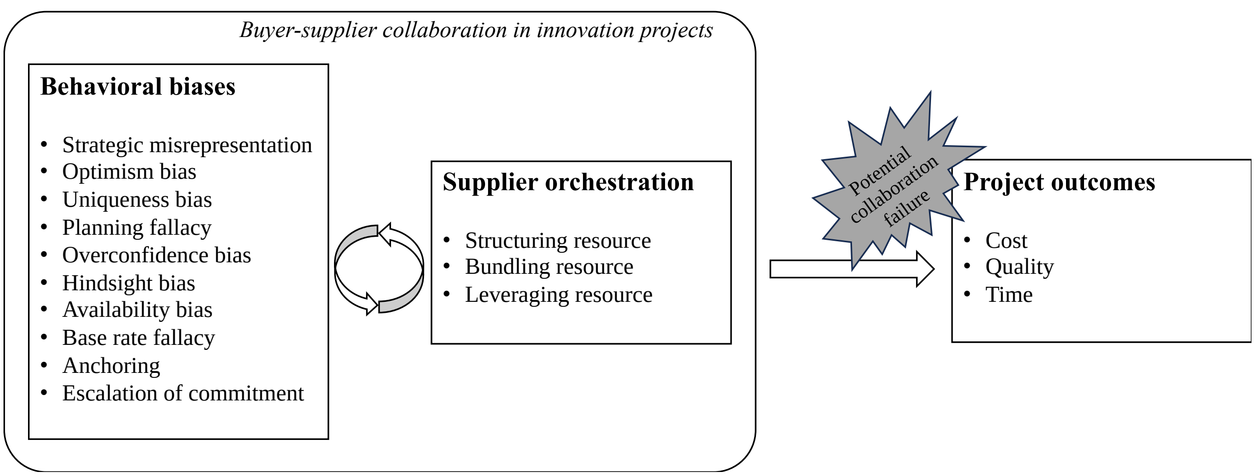
D. Research Gaps and Framework: Linking Supplier Resource Orchestration, Behavioral Biases, and Project Outcomes

Resource Orchestration Theory (ROT) offers a robust framework for understanding the strategic management and deployment of resources in innovation projects [44], [29]. ROT posits that the mere possession of resources is insufficient for achieving innovative outcomes; success is driven by the strategic allocation, bundling, and leveraging of these resources [12]. In collaborative innovation projects, ROT is particularly relevant, as it emphasizes the integration of diverse resources, knowledge, and capabilities from multiple stakeholders, including suppliers, to maximize innovation potential and achieve project objectives [9].

Despite the recognized importance of resource orchestration, the literature has largely neglected the influence of behavioral biases on supplier resource orchestration and their subsequent effects on project outcomes. While the SCM literature has explored mechanisms of supplier collaboration and identified factors that contribute to collaboration failures (e.g., [22], [8], [33]), it has not sufficiently examined *how* PM behavioral biases affect collaboration outcomes at the project level. Similarly, although the PM literature has addressed the impact of behavioral biases on project performance (e.g., [38], [19], [42]), there is limited research on their role in innovation projects involving external partners. This gap is critical for understanding how these biases might influence the success of supplier collaborations in innovation projects, an area that remains underexplored.

This study addresses this gap by investigating how behavioral biases influence supplier resource orchestration and, in turn, affect project outcomes in collaborative innovation projects. The conceptual framework presented in *Figure 1* illustrates the bidirectional relationship between behavioral biases and supplier resource orchestration. Behavioral biases shape how project managers perceive and allocate resources, influencing key decisions related to supplier selection, integration, and coordination. At the same time, the resource orchestration process—including structuring, bundling, and leveraging resources—can either amplify or mitigate these biases depending on how well resources align with project goals. This creates the potential for a vicious cycle, where biases lead to poor resource orchestration, further reinforcing the biases and ultimately undermining project outcomes.

Figure 1. Research framework.



Examining the interplay between PM behavioral biases and supplier resource orchestration is crucial for several reasons. First, collaborative innovation projects often require integrating specialized expertise, technologies, and unique resources from multiple stakeholders [9]. Effective orchestration of these resources allows organizations to access a broader knowledge base and enhances the potential for generating novel and impactful innovations.

Investigating the role of behavioral biases in this process can reveal how these biases distort resource allocation practices, potentially weakening the effectiveness of supplier resource orchestration and hindering project performance.

Second, resource orchestration enables organizations to overcome internal resource constraints by leveraging external resources provided by suppliers—an essential capability for improving innovation outcomes [12]. Understanding how behavioral biases interact with supplier resource orchestration offers insights into the mechanisms through which biases may either obstruct or facilitate effective resource integration. This understanding is key for developing strategies to mitigate the negative effects of biases on project performance and to enhance the success of collaborative innovation projects.

III. Research methodology

To explore the interplay between supplier resource orchestration and behavioral biases in failed collaborative projects, this study employs a qualitative research methodology [41]. Case studies were chosen to provide an in-depth analysis of multiple collaborative projects, offering a holistic understanding of the factors contributing to project performance failures [3].

A. Selection of case studies

To align with the research objectives, a purposeful sampling approach was adopted to ensure the selected cases were relevant to the study's focus on failed supplier resource orchestration in innovation projects. The emphasis was placed on manufacturing firms, which often engage in collaborative innovation to enhance and expand product lines—critical for business development and survival. Multinational and global supply chains were prioritized, as these contexts frequently involve structured collaborative initiatives with suppliers that require robust mechanisms for effective resource orchestration [37].

A multi-step approach was used to identify suitable participants:

(1) *Initial Identification*: A pool of 20 firms was identified through personal contacts, previous research collaborations, and industry-relevant news sources, including supply chain blogs and websites. This ensured access to organizations likely to provide insights into failed innovation projects.

(2) *Screening Process:* The identified firms were contacted via email and phone to assess their recent involvement in collaborative innovation projects and their willingness to share details. The screening targeted firms that had participated in such projects within the last two years, particularly those involving one or more suppliers. Selection criteria were designed to capture experiences related to failed supplier resource orchestration and its impact on project performance.

(3) *Final Selection:* After this rigorous screening, six companies were selected, contributing detailed information on seven collaborative innovation projects that had encountered significant challenges or failures. Projects were classified as failures based on unmet performance indicators such as cost, time, and quality targets, stakeholder dissatisfaction, and unachieved innovation objectives. During screening, respondents were asked to provide specific examples of how behavioral biases influenced decision-making and contributed to these failures. This ensured that the selected cases were not only relevant but also rich in data concerning the role of biases in project outcomes. Each company

contributed one project example, except for *Baby*, which provided two distinct projects managed by different business units and involving different informants and suppliers.

Table 1 summarizes the characteristics of the companies and projects included in the study.

Table 1. Case sample and interviewees.

Case company (buyer)	Company HQ	Industry	Turnover (2018)	Employees (2018)	Buyer interviewees	Supplier interviewees	Project name and characteristics	Project budget
Chem	Germany	Chemical and consumer goods	€ 17 B	4,700	Supply Chain Manager (BC1) Procurement Team Leader (BC2) Category manager (BC3)	Product Manager (SC1)	*Packaging* - Printing machine to design packaging with few combinations of colours	€ 1.8 M
Med	Italy	Medical devices and components	€ 24 B	1,500	Sourcing Director (BM1) Product manager (BM1)	R&D Engineer (SM1) Project Manager (SM2)	*Cabinet* - Integrated modular avionics cabinet for aircraft	€ 0.75 M
Quas	Switzerland	Medical equipment	€ 280 B	500	Procurement Manager (BQ1) Regulatory Affairs Manager (BQ2)	Quality Manager (SQ2)	*Laser Skin* - Laser machine for skin treatment	€ 0.4 M
Ener	Italy	Electrical equipment	€1.5 B	3,900	R&D Manager (BE1) Project Manager (BE2)	Head of Quality (SE1)	*House* - Domestic energy control system	€ 1.1 M
Baby	Switzerland	Healthcare and babycare	€ 700 B	2,900	Purchasing manager (BB1) Project Manager (BB2)	Head of Quality and Safety (SB1)	*Stroller* - Stroller with automatic folding and braking system	€ 0.3 M
					Head of Industrial Manufacturing (BB3)	Product manager (SB2)	*Toy* - Child learning development toy	€ 0.2 M
Hely	Italy	Aerospace and defence	€ 4.5 B	6,900	Project Manager (BH1) Vendor Manager (BH1)	Customer Relationship Manager (SH2)	*Recorder* - Mission video/data recorder for aircraft	€ 1.75 M

B. Interview Structure and Data Collection

Data collection spanned two years, from 2015 to 2016, with follow-up phases in 2017 and 2018 to ensure comprehensive coverage. The process was structured into four key stages, designed to capture detailed insights into the dynamics of collaborative innovation projects and the factors contributing to their failure.

Stage 1: Orientation Interviews – The initial stage involved orientation interviews with senior managers from the buying companies. These interviews had two main objectives: first, to establish rapport and secure access to key project team members, and second, to gather preliminary information on the suppliers involved. This step provided an overview of the project context and helped identify critical stakeholders and decision-makers.

Stage 2: Preliminary Pre-interview Data Collection – Prior to the main interviews, a pre-interview form was distributed to both the buying companies and their suppliers. This form collected foundational data on various aspects of the collaboration, such as the nature of the innovation project, supplier engagement methods, project management approaches, collaboration experiences, and key challenges. This preliminary step ensured the main interviews were focused and well-informed, while also laying the groundwork for triangulating information during later stages.

Stage 3: In-depth Interviews – In-depth interviews were conducted with multiple informants from both the buying organizations and their suppliers. As shown in Table 1, each case involved interviews with at least two members of the buying organization's project team and one representative from each supplier, chosen based on their direct involvement in the project. These interviews lasted between 1.5 to 3 hours and were conducted either face-to-face or via Skype, depending on logistical constraints. Whenever possible, interviews were transcribed to ensure accuracy, and in cases where transcription was not feasible, detailed notes were taken by at least two members of the research team to ensure reliability. The interviews followed a structured set of open-ended questions but allowed flexibility to explore emergent themes and delve deeper into participants' perspectives. This approach facilitated a nuanced understanding of the factors driving project failure, especially in relation to the interplay between resource orchestration and behavioral biases.

Stage 4: Additional Project Documentation – In addition to interviews, supplementary project documentation was collected from the buying organizations. These documents included Gantt charts, anonymized resource lists, project timelines, organizational charts, risk management plans, contracts with suppliers, and post-project review reports. These materials provided critical context and validated the interview data. For instance, Gantt charts and project timelines clarified task sequencing and resource allocation, while organizational charts illustrated team hierarchies and decision-making processes. Contracts confirmed agreed deliverables, roles, and responsibilities, corroborating interview accounts regarding collaboration dynamics. This documentation offered a more comprehensive view of the project management processes, revealing gaps and inconsistencies that might not have surfaced during interviews alone.

Stage 5: Case Profile Feedback and Validation – Following data collection, detailed case profiles were constructed using the interview transcripts and supplementary data from follow-up interviews. These profiles were further enriched through triangulation with external sources, such as news media, company websites, and additional documents from interviewees. Draft versions of the case profiles were shared with both the buying companies and suppliers for feedback. Follow-up calls and emails ensured accuracy and completeness, and the final profiles incorporated any additional insights gathered during this validation process.

C. Case Coding

The coding approach in this study was designed to ensure reliability and methodological rigor. It focused on three main themes: supplier resource orchestration, behavioral biases, and project performance. Coding was independently conducted by two researchers, with discrepancies systematically resolved through cross-checking and consensus-building. Both within-case and cross-case analysis methods were applied [15], enabling a comprehensive examination of patterns across the data. To further enhance reliability, the coding process involved double coding by the researchers, with inter-coder reliability measured using Cohen's Kappa, which achieved a satisfactory agreement level above 0.75. This measure reflects a high degree of consistency in the coding process. Thematic analysis was employed to identify first-order themes, which were then aggregated into higher-order dimensions aligned with the study's theoretical framework. These themes were directly derived from the interviews to ensure validity and grounding in the empirical data. *Figure 2* presents the resulting coding tree.

Figure 2. Coding Tree.

First-order concepts
Second-order themes
Aggregate dimensions
• Supplier Selection Rationale
• Roles and Responsibilities Definition
Structuring Supplier Resources
• Inter-Supplier Relationship Management
• Supplier Integration in Project Design
Bundling Supplier Resources
• Resource Allocation for Supplier Interface
• Coordination and Knowledge Exchange Facilitation
Leveraging Supplier Resources
Supplier Resource Orchestration
• Suppliers' intentional misrepresentation of their capabilities
• Buyer's skewed perception of suppliers' capabilities
Strategic Misrepresentation
• Optimistic outlook of the project timeline.
• Underestimation of challenges and risks
Optimism Bias
• Overlook of prior knowledge or best practices
• Special contract conditions to suppliers
Uniqueness Bias
• Underestimation of the internal and/or suppliers' time, effort, and resources
Planning Fallacy
• Excessive confidence in the abilities, decisions, or estimates of the buyer and/or the suppliers.
Overconfidence Bias
• Inability to formalize previous lessons learned
Hindsight Bias
• Overestimation of the likelihood of certain events to occur and overallocation of resources
Availability Bias
• Low or no use of previous data and experience from previous collaborative innovation projects
Base Rate Fallacy
• Excessive reliance on knowledge or best practices from other collaborative innovation projects
Anchoring
• Continuous investments in additional resources and effort to justify their prior decisions
Escalation of Commitment
Project Behavioral Biases
• Projects characterized by advanced technological endeavors
• Projects characterized by established technologies
Technological complexity
Project Characteristics
• Cost savings
• Cost overruns
• Cost efficiency
Cost Performance
• Quality issues
• Alignment with original requirements
• Customer satisfaction
Quality Performance
• Timely delivery
• Delays and missed deadlines
• Impact on time-to-market
Time Performance
Project Performance

Supplier resource orchestration was coded using the three constructs from ROT: structuring, bundling, and leveraging supplier resources [44]. Each subtheme focused on specific aspects of resource management, such as supplier selection, resource integration, and the effectiveness of resource utilization.

Behavioral biases were coded based on the ten biases identified by [16]. Each bias was identified and coded for its presence and specific manifestation within the project cases.

Project performance was coded across three dimensions: cost, quality, and time. Each dimension was analyzed not just as a binary success or failure, but in a nuanced way to reflect the degree and nature of deviation from the project's initial goals.

Additionally, technological complexity emerged as a significant theme influencing both resource orchestration and project outcomes. This was coded based on the sophistication of the project's technological components, categorized as either "High" or "Medium/Low."

Appendix B in the supplementary materials provides extended descriptions of the themes and coding processes. Tables B1 and B2 in Appendix B offer a structured representation of these themes, along with exemplary quotes from the cases.

IV. Project characteristics

Table 2 summarizes the characteristics of each project. A more detailed description of each case is available in Appendix C of the supplementary materials, along with an expanded version of Table 2 in Tables C1 and C2.

Table 2. Within-case characteristics ("-" = absent).

		Packaging	Cabinet	Skin	House	Stroller	Toy	Recorder
Project Characteristics	*Technological complexity*	Medium – Known technology, integration uncertainty	High – New technology, different software	Medium – Evolution of existing technology	High – New eco-efficient, automated, low consumption technology	Medium - Adaptation of the existing technology	Medium - Adaptation of the existing technology	High – New technology, different hardware and software
Supplier Resource Orchestration	*Structuring mechanisms*	Suppliers with complementary technical capabilities, no previous collaboration experience	Suppliers with integrated technical capabilities, collaboration experience not considered	Suppliers with complementary technical capabilities, collaboration experience not considered	Suppliers with integrated technical capabilities, limited collaboration experience	Suppliers with integrated technical capabilities and collaboration experience	Suppliers with integrated technical capabilities and collaboration experience	Suppliers with complementary technical capabilities and collaboration experience
	Bundling mechanisms	Two-way relationship – Buyer acted as a mediator to prevent spillover	Two-way relationship – 1st-tier supplier managed supplier-supplier interaction	Two-way relationship – Buyer acted as a mediator to maximize knowledge gain	Two-way relationship – 1st-tier supplier managed supplier-supplier interaction	Three-way relationship – Buyer facilitated the interaction	Three-way relationship – Buyer facilitated the interaction	Three-way relationship – Buyer facilitated and supervised the interaction
	Leveraging mechanisms	Colocation of buyer's engineers at suppliers' facilities	Colocation of buyer's engineers at 1st-tier supplier's facilities, shared design platform	Colocation of buyer's engineers, prototyping	Ad-hoc platform for joint development activities, formal progress meetings, real-time information sharing	Colocation of buyer's engineers combined with several others knowledge-sharing mechanisms	Colocation of buyer's engineers combined with several others knowledge-sharing mechanisms	Sharing of design and development documents combined with several others knowledge-sharing mechanisms
Behavioral Biases	*Strategic Misrepresentation*	-	Overestimated suppliers' managerial capabilities (buyer)	-	Overestimated suppliers' managerial capabilities (buyer)	-	-	Trusted suppliers' ability to work with low visibility (buyer)
	Optimism Bias	-	Overly optimistic project timeline (buyer)	-	Overoptimistic beliefs about integrating 2nd-tier	Underestimated project complexity	Underestimated project complexity	Underestimated integration complexity

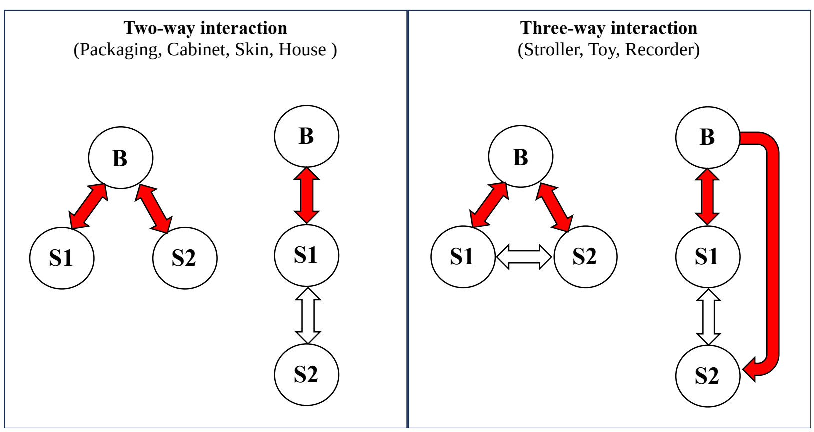
				supplier (buyer and supplier)	(buyer and suppliers)	(buyer and supplier)	
Uniqueness Bias	Treated project with ad-hoc approaches (buyer)	-	-	-	-	-	Treated project with ad-hoc approaches (buyer)
Planning Fallacy	Underestimated resources for coordination (buyer)	Underestimated resources for relationship management (1st -tier supplier)	Underestimated resources for relationship management (buyer)	Underestimated resources for supplier integration (buyer and 1st -tier supplier)	Underestimated time and efforts for supplier integration (buyer)	-	-
Overconfidence Bias	Overconfident about integration capabilities (buyer and suppliers)	Overconfident about 2nd-tier supplier capabilities (buyer and supplier)	Overconfident in supervising supplier relationships (buyer)	Overconfident in 2nd-tier supplier's abilities (buyer and supplier)	-	-	-
Hindsight Bias	-	-	Project was not considered as an "exception" (buyer)	-	-	-	-
Availability Bias	Overemphasized spillover risk (buyer)	-	-	-	-	Overemphasized the risk of ineffective supplier integration (buyer)	-
Base Rate Fallacy	-	-	-	-	-	-	Did not consider integration issues in other projects (buyer)
Anchoring	-	Adopted approach from previous successful projects (buyer)	-	Approach influenced by successful past collaboration with 1st-tier supplier (buyer)	-	Planning based on other failure experiences (buyer)	-

	Escalation of Commitment	-	-	-	-	No delegation to the 1st-tier supplier (buyer)	-	-
Project performance	*Cost*	Costs 15% higher due to increased coordination	Overall, in line with budget	Costs 20% higher than planned	Costs 10% higher than planned	Overall, in line with budget	15% higher costs than planned	17% higher costs than planned
	Quality	Components delivered as requested, but quality issues in machine	Software in line with requests, cabinet issues	Components developed as per buyer's request; laser machine functionalities met requirements	System developed in line with design, but quality issues arose	Control system and stroller functionalities met requirements	System and toy functionalities met requirements	Developed as requested, but integration issues caused delays
	Time	Components delivered with 1 month delay, project on schedule	Software delivered on time; cabinet release delayed 2 months	4-month delay in component and machine development	Electronic circuit delivered on time; system development delayed 3 months	Control system delayed by 1 month, stroller delayed by 2.5 months	System delayed by 3 weeks; toy delayed by 2 months	Developed on time, integration took longer due to additional quality control and testing

V. Cross-case findings

The cross-case analysis reveals a clear dichotomy in supplier orchestration approaches that significantly influenced project performance. This dichotomy is defined by two critical dimensions: the criteria for supplier selection—prioritizing technical capabilities versus leveraging previous collaborative experience—and the modes of interaction among project stakeholders—two-way versus three-way interaction (illustrated in Figure 3). These dimensions enabled us to categorize the projects into two groups based on similar choices: Group 1 includes the Packaging, Cabinet, Skin, and House projects, while Group 2 includes the Stroller, Toy, and Recorder projects.

Figure 3. Types of buyer-supplier-supplier interactions observed in the cases (note: in red, interactions were managed by the buyer; in white, interactions were managed by the supplier).



The differences between these two groups offer critical insights into how supplier orchestration impacts cost, quality, and time management in collaborative innovation projects. Additionally, the analysis uncovers the complex interplay between behavioral biases and supplier orchestration decisions, as well as how technological complexity shapes these dynamics. The findings are summarized in *Table 3* and explained in detail in the following subsections.

Table 3. Patterns identified in the two groups of projects.

Pattern identified	**Empirical evidence from the cases**	
	Group 1 (Packaging, Cabinet, Skin, House)	*Group 2 (Stroller, Toy, Recorder)*
Supplier Orchestration Approaches and Project Performance	Prioritized technical capabilities, often neglecting previous collaborative experience. Interaction primarily two-way, mediated or delegated. Result: High coordination complexity, cost overruns, and quality issues (e.g., Cabinet, House).	Valued previous collaborative experience, with three-way direct interaction among stakeholders. Result: Smoother integration, more efficient coordination, and better project performance (e.g., Recorder).
Behavioral Biases and Structuring Mechanisms	Overconfidence Bias and Optimism Bias prevalent, leading to underestimation of complexities in managing new supplier relationships. Result: Coordination issues, cost overruns, and delays.	Focused on past collaborative experiences, mitigating biases. Result: Balanced decisions, better management of supplier integration.
Behavioral Biases and Bundling Mechanisms	Overconfidence, Optimism Bias, and Strategic Misrepresentation led to reliance on mediating or delegating bundling mechanisms. Result: Suboptimal resource allocation, delays, and quality issues.	Direct three-way interaction mitigated biases, allowing for more adaptive and responsive project management. Result: Improved coordination and project outcomes.
Behavioral Biases and Leveraging Mechanisms	Planning Fallacy and Overconfidence Bias led to rigid, structured leveraging mechanisms. Result: Underestimated resources for coordination, cost overruns, and delays.	Integrated leveraging mechanisms (e.g., colocated engineers, joint platforms) mitigated biases. Result: More accurate resource allocation and improved project performance.
Role of Technological Complexity	High complexity projects (e.g., Cabinet, House, Recorder) associated with Optimism Bias and Strategic Misrepresentation, leading to misalignment between expectations and realities. Medium complexity projects (e.g., Packaging, Skin) more prone to Planning Fallacy and Uniqueness Bias, leading to bespoke but often inefficient strategies.	Projects managed technological complexity better due to prior collaborative experience and integrated mechanisms, resulting in fewer delays and better alignment of expectations (e.g., Recorder, Toy).

A. Supplier Orchestration Approaches and Project Performance

Projects like Packaging, Cabinet, Skin, and House adopted an orchestration strategy that prioritized selecting suppliers based primarily on their technical capabilities, with little emphasis on their prior collaborative experience with the buyer or other suppliers. This approach, combined with a two-way interaction model—where the buyer mediates separately with each supplier or delegates the interaction with the 2nd-tier supplier to the 1st-tier supplier—introduced several challenges.

First, the reliance on formal mechanisms for knowledge transfer, without direct supplier-to-supplier communication, increased coordination complexity. This complexity often led to cost overruns, as seen in the Packaging and House projects, where budgets were exceeded due to the added effort required to synchronize supplier contributions. For instance, in the Packaging project, the buyer’s mediation role resulted in a 15% cost overrun, illustrating how rigid orchestration structures can create hidden costs.

Second, selecting suppliers solely based on technical expertise can create integration challenges, particularly when suppliers lack a history of collaboration. The Cabinet project demonstrates this risk, where integrating software components from different suppliers caused quality issues, ultimately misaligning the final product with initial design specifications. These findings suggest that overlooking collaborative history compromises project quality and efficiency, as suppliers may struggle to integrate their contributions effectively.

Finally, the structured yet restrictive interaction model employed in these projects often delayed the resolution of emerging issues, posing risks to project timelines. For instance, the Skin project experienced a significant 4-month delay due to the buyer's overconfidence in managing informal supplier interactions without formal communication channels. This highlights the timeline disruptions that can arise from relying heavily on buyer mediation and rigid interaction structures.

In contrast, projects such as Stroller, Toy, and Recorder employed a supplier selection strategy that valued prior collaborative experience, supported by a three-way interaction model that encouraged direct communication among suppliers. This approach fostered a more cohesive project environment and yielded several benefits.

Prioritizing collaborative history in supplier selection led to smoother integration, as established trust and mutual understanding among suppliers improved coordination. For instance, the Recorder project illustrates how direct interaction between experienced suppliers facilitated seamless integration of complex components, even under high technological complexity. Informal knowledge exchange mechanisms in these projects also streamlined issue resolution, promoting more dynamic and adaptive PM.

Direct supplier-to-supplier communication enabled a more proactive approach to addressing compatibility and integration challenges, improving the quality of the final product. In the Toy project, despite the presence of optimism and availability biases, the direct communication facilitated by the three-way interaction model helped mitigate potential quality issues, ensuring the toy’s functionalities met the initial design requirements.

Additionally, while explicit cost savings were not quantified, the three-way interaction model reduced coordination costs by enabling suppliers to negotiate integration details directly. This was evident in the Stroller project, where collaborative history and direct interaction helped keep the project within budget, even with delays in control system development. These findings highlight the potential for more cost-effective project execution when collaborative history is emphasized and interaction models promote direct communication.

B. Behavioral biases and structuring mechanisms

The analysis shows that the choice of supplier orchestration approach is heavily influenced by the presence (or absence) of specific behavioral biases. Contrasting approaches to structuring supplier resources across the case studies highlight how cognitive predispositions shape strategic decision-making, leading to varying outcomes in supplier selection and integration.

In the first group of projects (i.e., Packaging, Cabinet, Skin, House), the focus on selecting suppliers based primarily on technical capabilities, while neglecting prior collaborative experience, appears to have been influenced by certain behavioral biases:

- *Overconfidence Bias*: In the Packaging and House projects, buyers and suppliers displayed excessive confidence in their technical expertise, underestimating the complexities involved in coordinating new supplier relationships. This overconfidence led to increased coordination efforts, cost overruns, and quality issues, as the absence of collaborative history made integration more challenging.
- *Optimism Bias*: The Cabinet project highlights how optimism bias can lead to unrealistic project timelines and an overestimation of suppliers’ managerial capabilities. In this case, the buyer’s overly optimistic view of the 1st-tier supplier’s ability to manage the 2nd-tier supplier led to misaligned expectations, project delays, and integration difficulties.

In contrast, the second group of projects (i.e., Recorder, Toy, Stroller, Packaging) employed a supplier selection strategy that balanced technical and relational competencies, showing greater sensitivity to the importance of prior collaborative experience. This approach was shaped by different biases or their absence:

- *Uniqueness Bias*: In the Recorder project, the buyer's perception of the project as unique resulted in the development of tailored collaboration mechanisms that leveraged the specific strengths of the chosen suppliers. While this approach could have increased risk, it proved advantageous by fostering more effective integration and smoother collaboration.
- *Availability Bias*: The Toy project illustrates how concerns arising from past failures can lead to cautious decision-making. The buyer allocated additional resources to avoid integration issues, resulting in more thorough planning and risk mitigation. While this bias-driven approach might appear resource-intensive, it helped maintain quality standards and control project costs.
- *Anchoring Bias*: Although anchoring bias was not explicitly present, its absence in these projects suggests that decisions were more balanced. Buyers were able to integrate both technical capabilities and prior collaborative experience into their evaluations, leading to improved project outcomes.

In summary, projects influenced by overconfidence and optimism biases often underestimated the complexities of managing new supplier relationships, resulting in cost overruns, quality issues, and delays. Conversely, the second group benefited from a more balanced approach, potentially moderated by biases such as uniqueness or availability, which helped mitigate risks and enhance integration outcomes. These findings underscore the importance of recognizing and managing behavioral biases to improve supplier selection and resource structuring.

Based on this evidence, we propose the following:

P1: *Projects that prioritize supplier selection based solely on technical capabilities, influenced by overconfidence and optimism biases, are more likely to encounter coordination complexities, leading to cost overruns and integration challenges. Projects that incorporate past collaborative experiences into supplier selection are better positioned to mitigate the risks associated with supplier coordination and integration, resulting in improved project performance across cost, quality, and timeline metrics.*

C. Behavioral biases and bundling mechanisms

The analysis of behavioral biases in relation to bundling mechanisms illustrates how cognitive tendencies shape PM strategies and coordination approaches, ultimately influencing project outcomes.

In the first group of projects, two distinct approaches to managing supplier interactions were observed: direct mediation by the buyer and delegation to a 1st-tier supplier. Both approaches were shaped by specific behavioral biases:

- *Overconfidence Bias*: This bias was prevalent across all projects in the first group, leading buyers to underestimate the complexities of supplier integration and coordination. For instance, in the Cabinet and House projects, buyers displayed excessive confidence in their own or their 1st-tier suppliers' abilities to manage relationships effectively. This overconfidence resulted in inefficiencies, increased costs, and delays as the challenges of coordinating multiple suppliers were underestimated.

- *Optimism Bias and Strategic Misrepresentation*: These biases were evident in projects where the buyer delegated the management of supplier interactions to a 1st-tier supplier. In the Cabinet and House projects, buyers' overly optimistic timelines and inflated expectations of the 1st-tier supplier's managerial capabilities caused a misalignment between expectations and actual performance. This delegation strategy, influenced by these biases, failed to account for the complexities of multi-supplier coordination, resulting in delays and quality issues.

In contrast, the second group of projects adopted a more strategic approach to managing interactions, mitigating the effects of the biases observed in the first group. The use of a three-way interaction model, promoting direct communication among all stakeholders, enabled a more realistic assessment of coordination needs. This approach leveraged collective expertise to inform decision-making, enhancing adaptability and responsiveness to project complexities.

Moreover, active engagement in three-way interactions accounted for the inherent uncertainties of innovative projects. This approach effectively countered optimism bias by facilitating direct problem-solving and open communication among stakeholders. As a result, project timelines and resource allocations were more closely aligned with the realities of execution, reducing delays and ensuring smoother integration.

Based on this evidence, we propose the following:

P2: *The presence of Overconfidence Bias, Optimism Bias, and Strategic Misrepresentation in collaborative innovation projects is associated with the buyer's use of mediating bundling mechanisms or delegating the management of supplier interactions to a 1st-tier supplier.*

Although these strategies aim to manage project complexities, they often result in suboptimal resource allocation and project delays due to an underestimation of coordination challenges.

P2.1: *The mitigation of Overconfidence, Optimism, and Strategic Misrepresentation biases through direct three-way interactions among project stakeholders leads to more efficient project management and coordination. This approach enhances project adaptability and responsiveness, potentially improving outcomes in terms of cost efficiency, quality, and adherence to timelines.*

D. Behavioral biases and leveraging mechanisms

The analysis of leveraging mechanisms in the context of behavioral biases highlights distinct approaches across the two groups of projects. These approaches reflect how cognitive tendencies influenced strategies for extracting and utilizing knowledge from suppliers.

In the first group of projects, a reliance on structured, formal knowledge exchange mechanisms—such as meetings, shared performance metrics, and training sessions—was evident. However, these mechanisms often lacked deeper integration strategies, such as informal exchanges or joint problem-solving, which are critical for effective knowledge leveraging:

- *Planning Fallacy and Overconfidence Bias*: These biases were particularly evident in the underestimation of the complexities associated with managing supplier relationships and in the overestimation of the buyers' coordination capabilities. For instance, in the Skin and House projects, planning fallacy led to an underestimation of the resources required for effective supplier coordination, resulting in delays and cost overruns, even though formal mechanisms were in place.
- *Optimism Bias*: In the Cabinet and House projects, optimism bias caused buyers to set

unrealistic timelines, driven by overly optimistic expectations of the effectiveness of leveraging mechanisms. Combined with strategic misrepresentation, this resulted in delays when the anticipated benefits of knowledge sharing did not materialize.

In contrast, the second group of projects adopted more integrated leveraging mechanisms, including colocated engineers, joint development platforms, and cross-functional teams. These mechanisms facilitated informal knowledge exchange and collaborative problem-solving, addressing the challenges associated with the biases observed in the first group. These projects promoted direct communication and collaboration among stakeholders to address the common underestimation of the complexities involved in coordinating suppliers.

Furthermore, by actively participating and directly engaging in knowledge-sharing activities, these projects set more realistic expectations. The alignment between project timelines, resource allocation, and actual capabilities reduced the risk of delays and cost overruns commonly associated with overly optimistic planning. For example, the use of colocated engineering teams in the Recorder project allowed for real-time problem-solving and immediate adjustments, enhancing both efficiency and project outcomes.

Based on these observations, we propose the following:

P3.1: *The presence of Planning Fallacy and Overconfidence Bias in collaborative innovation projects is associated with a reliance on structured, yet potentially rigid, leveraging mechanisms. This reliance can lead to an underestimation of the resources required for effective supplier coordination, resulting in increased project costs and delays, particularly when the buyer mediates or delegates supplier interactions without fostering direct knowledge-sharing.*

P3.1: *The mitigation of these biases through integrated leveraging mechanisms—characterized by direct three-way interactions and informal knowledge-sharing—leads to more accurate resource allocation and timeline planning. This approach enhances the adaptability and responsiveness of the project team, potentially improving project outcomes in terms of cost, quality, and timeliness.*

E. The Role of Technological Complexity

Our analysis highlights how varying degrees of technological complexity influence the prevalence of behavioral biases, shaping supplier relationship management strategies and overall project execution.

In projects with high technological complexity (e.g., Cabinet, House, and Recorder), biases such as optimism bias and strategic misrepresentation were prevalent. These biases were closely tied to the challenges of working with significantly altered or groundbreaking technologies. Optimism bias often led buyers to set overly ambitious timelines, underestimating the difficulties posed by new technologies. For instance, in the Cabinet and House projects, managers failed to fully account for the time and resources needed for successful implementation, as the allure of cutting-edge technologies clouded judgment. Similarly, strategic misrepresentation emerged as buyers overestimated suppliers' managerial capabilities, particularly in coordinating multi-tier relationships. In the Recorder project, this was evident when the buyer's overconfidence in suppliers' abilities to handle integration complexities, despite limited visibility into critical details, resulted in significant challenges. These biases frequently caused a misalignment between project expectations and practical realities, leading to delays and difficulties in achieving desired quality outcomes.

In contrast, projects with medium technological complexity (e.g., Packaging, Skin, Stroller, and Toy) exhibited biases such as planning fallacy and uniqueness bias, stemming from the challenges of adapting existing technologies to new contexts. Planning fallacy was evident in the underestimation of resources required for supplier management. For example, in the Packaging and Skin projects, managers underestimated the time and effort needed to coordinate suppliers, leading to cost overruns and delays. This bias often stemmed from an oversimplified assumption that existing technologies would integrate seamlessly into new applications. Uniqueness bias emerged when managers perceived risks, such as spillover or integration issues, and responded by adopting bespoke strategies. In the Packaging project, for instance, concerns over spillover risk led to ad-hoc relationship management strategies that, while tailored to the project's perceived uniqueness, did not deliver greater efficiency or success.

These observations reveal a tendency in medium-complexity projects to overlook the complexities of adapting familiar technologies to new environments, resulting in inefficiencies and missed opportunities to leverage standardized, proven management approaches. In contrast, high-complexity projects often suffer from biases that amplify the challenges of integrating unfamiliar technologies, misaligning expectations with execution realities.

Based on these observations, we propose the following:

P4*: The level of technological complexity in collaborative innovation projects influences the prevalence and type of behavioral biases. High technological complexity is associated with optimism bias and strategic misrepresentation, driven by the challenges of integrating new and unfamiliar technologies and overestimating the capabilities of the project team and suppliers. Medium technological complexity is associated with planning fallacy and uniqueness bias,* *stemming from underestimating the complexities of adapting existing technologies to new applications and the adoption of bespoke management approaches based on perceived risks.*

VI. Discussion, Contributions, and Future Developments

The findings of this study highlight the bidirectional relationship between behavioral biases and supplier resource orchestration—specifically, the structuring, bundling, and leveraging mechanisms—and how these elements critically influence the performance of collaborative innovation projects. This discussion clarifies these interconnections and addresses the core research question: "*How do behavioral biases intertwine with supplier resource orchestration failures and impact project performance in collaborative innovation initiatives?*"

Structuring mechanisms reveal a pivotal divergence in PM approaches based on supplier selection criteria: technical expertise versus prior collaborative experience. Projects prioritizing technical capabilities, driven by optimism and overconfidence biases, consistently underestimated the risks and complexities of integrating new suppliers. This oversight led to coordination challenges, delays, and cost overruns, reaffirming the significant role of cognitive distortions in project mismanagement [35], [16]. In contrast, projects that incorporated prior collaborative experiences into supplier selection mitigated these biases and created environments better suited for project success. This highlights a novel insight: leveraging relational history not only reduces integration risks but also acts as a countermeasure against cognitive biases, suggesting that such history should be an explicit consideration in resource orchestration frameworks.

Bundling mechanisms further illustrate the influence of biases on interaction strategies.

Delegated and mediated interaction models, shaped by optimism bias and strategic misrepresentation, often amplified integration challenges, leading to misaligned expectations and inefficiencies. A key innovation emerging from the findings is the effectiveness of three-way interaction models in addressing these issues. These projects demonstrated improved adaptability and alignment by enabling direct communication among stakeholders and leveraging collaborative history. This approach represents a paradigm shift from traditional reliance on hierarchical coordination [26], [16], emphasizing instead a networked, participatory model of supplier integration that enhances responsiveness to project dynamics.

Leveraging mechanisms—focusing on knowledge transfer and integration strategies—provide additional evidence of the impact of behavioral biases. Planning fallacy and overconfidence bias led to resource underestimation and an overreliance on formal knowledge-sharing mechanisms [18], [35]. In contrast, projects employing integrated leveraging mechanisms—featuring informal knowledge sharing, colocated teams, and cross-functional collaboration—achieved better outcomes. These findings highlight an innovative perspective: informal mechanisms not only enhance knowledge transfer efficiency but also act as an adaptive tool to counter biases, enabling more realistic planning and execution.

Overall, the study demonstrates that behavioral biases, particularly optimism and overconfidence, significantly affect supplier resource orchestration and project performance. If unchecked, these biases cause projects to overlook the complexities of supplier coordination, leading to performance deterioration. Moreover, the interaction between biases, such as overconfidence feeding optimism and strategic misrepresentation [16], adds layers of complexity to PM. While this cascading dynamic warrants deeper exploration, the findings presented here offer actionable insights for both practice and theory. They underscore the need to incorporate bias-awareness strategies into resource orchestration processes, creating frameworks that explicitly account for the behavioral dimensions of supplier collaboration.

A. Theoretical contributions

This study makes several important theoretical contributions. By intertwining behavioral biases with ROT within the context of collaborative innovation projects, it bridges two critical yet previously disjointed areas of PM and supply chain management SCM. Specifically, the findings extend ROT [44] by revealing how behavioral biases—an underexplored area in SCM and PM—significantly influence the orchestration of supplier resources in innovation projects.

Our study builds on prior works that emphasize the importance of strategic resource management and deployment in achieving desired outcomes (e.g., [29], [12]). We demonstrate that behavioral biases can disrupt strategic resource allocation and integration, highlighting the need for a more nuanced approach to resource orchestration that accounts for cognitive limitations among decision-makers.

Additionally, this study addresses calls for deeper insights into the impact of behavioral biases on collaboration outcomes at the project level [38], [16], [42]. By providing a comprehensive analysis of how these biases intersect with supplier resource orchestration practices, we offer a new perspective on mitigating project pitfalls—not only through better documentation and resource management but also by addressing the behavior of key actors. From a PM standpoint, this research contributes to the growing literature on behavioral biases, detailing how these biases manifest, their potential effects, and how they can be mitigated to improve project outcomes.

Furthermore, the study observes how all the projects analyzed were based on a traditional PM approach, and the issues that emerged—such as difficulties in knowledge transfer, integration challenges, and delays—might benefit from an agile approach [5], [30]. Many biases, particularly in areas of collaboration and integration, tend to have a reduced effect in agile environments [14]. The mitigation seen in the three-way communication approach, which aligns more closely with an agile culture, is a preliminary sign. Future studies could further explore the impact of agile or hybrid practices [31], [53] in innovation projects that involve buyer-supplier collaboration.

Finally, we enrich the SCM literature by situating these biases within the specific context of collaborative innovation projects involving external suppliers. This study addresses the previously unexplored area of the role of behavioral biases in supplier collaboration (e.g., [22], [8], [37]).

B. Managerial contributions

The findings of this study offer actionable strategies for managers seeking to address the influence of behavioral biases on supplier resource orchestration in collaborative innovation projects. A key recommendation is the adoption of a balanced supplier evaluation framework that explicitly integrates both technical capabilities and collaborative history. Managers should establish criteria that assign equal importance to these factors, supported by historical performance reviews and relational audits. This approach ensures that decisions are grounded in empirical data rather than overly optimistic or biased judgments. For instance, pre-engagement assessments of prior collaboration outcomes can help identify potential integration challenges early in the process, reducing the risks associated with overconfidence and optimism biases.

Effective communication between all stakeholders is critical for countering biases and improving project coordination. Managers should prioritize the establishment of regular, structured tri-party meetings involving buyers, suppliers, and subcontractors to discuss progress, alignment, and emerging issues. Workshops designed to facilitate open dialogue and problem-solving can externalize diverse perspectives, providing a clearer understanding of potential challenges. Additionally, communication protocols, such as shared dashboards or the appointment of dedicated liaison roles, ensure transparency and help maintain alignment throughout the project lifecycle.

While formal communication mechanisms are necessary, the study highlights the importance of informal knowledge exchange as a complementary strategy. Managers should create environments that encourage spontaneous interactions, which can uncover hidden challenges and foster collaborative problem-solving. Practical measures include colocating key project teams to facilitate real-time knowledge sharing or organizing informal gatherings such as team lunches or collaborative brainstorming sessions. Furthermore, leveraging digital collaboration tools with integrated chat functions can enable dynamic exchanges, even in distributed project environments. These informal mechanisms are particularly effective in addressing the complexities associated with high technological uncertainty and innovation.

Reflective practices also play a crucial role in enhancing decision-making and reducing the recurrence of bias-driven inefficiencies. Managers should institutionalize processes for reviewing past project successes and failures to identify how biases influenced decision-making and outcomes. Creating a centralized repository of lessons learned allows organizations to systematically integrate this knowledge into future supplier selection and orchestration strategies. For example, detailed post-mortem analyses can reveal patterns of optimism or overconfidence, enabling teams to refine project planning and execution processes.

Finally, organizations should invest in bias-awareness training programs to build long-term resilience against cognitive distortions in supplier management. Scenario-based workshops, where managers and teams simulate decision-making under varying conditions, can help participants recognize and counter biases. These programs should also provide tools for identifying bias-related risks during critical phases such as supplier evaluation, project planning, and coordination.

C. Limitations and future research

This study is not without limitations. The focus on a selected set of projects within specific sectors may limit the generalizability of the findings across different industries and cultural contexts. Additionally, the reliance on retrospective case analyses introduces the potential for recall bias, possibly affecting the accuracy of the insights derived regarding the influence of behavioral biases on project outcomes. Furthermore, while our focus was on behavioral biases, we did not explicitly collect information on other relevant aspects of buyer-supplier collaboration, such as trust and power dynamics, which could also impact project performance.

Future research could address these limitations by broadening the empirical base to include a more diverse array of industries and cultural settings, thereby enhancing the generalizability of the findings. Longitudinal studies could offer a more nuanced understanding of how behavioral biases evolve over the lifecycle of a project and their impact on supplier resource orchestration. Moreover, experimental designs could provide more controlled conditions to rigorously test causal relationships between specific biases and orchestration strategies. Given that we focused on the ten behavioral biases suggested by Flyvbjerg [16], future research should explore additional biases and investigate how these biases are interrelated and mutually reinforcing. Finally, future studies could validate these findings through broader quantitative research, exploring interconnections between variables and assessing how different biases relate to specific resource orchestration mechanisms and innovation project performance. Exploring successful projects using the same lenses could also offer a comparative perspective, examining how behavioral biases are managed to achieve project success.

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SUPPLEMENTARY MATERIALS FOR THE PAPER:

“Behavioral Biases and Cognitive Pitfalls: Navigating Resource Orchestration in Supplier-Partnered Innovation Projects”

- ***APPENDIX A: Definition of behavioral biases and potential impact on buyer-supplier collaborations at the project level***
- ***APPENDIX B: Case Coding Approach***
- ***APPENDIX C: Case characteristics***

APPENDIX A: Definition of behavioral biases and potential impact on buyer-supplier collaborations at the project level

Table A1. Behavioral bias: definition, examples of manifestation, their effect, and impact on buyer-supplier collaboration (authors' elaboration based on the definitions by Flyvbjerg, 2021 and previous literature).

Type of behavioral bias	Definition	Potential Impact(s) on Supplier Collaboration at the Project Level	Potential Impact(s) on Project Management and Performance	Main references
Strategic misrepresentation	The tendency to deliberately and systematically distort or misstate information for strategic purposes	This bias can undermine trust and transparency in supplier collaborations. Deliberately distorting or misstating information for strategic purposes can lead to misalignment of goals, miscommunication, and conflicts between project managers and suppliers.	Cost underestimation and benefit overestimation.	[17], [57], [64]
Optimism bias	The tendency to be overly optimistic about the outcome of planned actions	Overly optimistic expectations can lead to unrealistic project planning and resource allocation in supplier collaborations. Project managers may underestimate the potential risks and challenges involved, resulting in inadequate risk mitigation strategies and resource allocation.	Systemic deviation from rationality.	[58], [62], [16]
Uniqueness bias	The tendency to see one's project as more singular than it actually is	This bias may result in missed opportunities for leveraging shared knowledge and experiences, limiting the effectiveness of supplier collaborations in driving innovation and project performance.	Risk underestimation and compromised learning.	[17], [58]
Planning fallacy	The tendency to underestimate costs, schedule, and risk and overestimate benefits and opportunities	Inadequate planning and unrealistic expectations can lead to resource constraints, time pressure, and increased likelihood of conflicts between project managers and suppliers.	Unrealistic timeline	[26], [19]
Overconfidence Bias	The tendency to have excessive confidence in one's own answers to questions	Project managers may dismiss or downplay valuable insights and expertise from suppliers, limiting the potential for collaborative problem-solving and innovation.	Underestimation of variance in events and risk	[35], [60], [61]

Hindsight bias	The tendency to see past events as being predictable at the time those events happened	Project managers may judge supplier performance based on hindsight, overlooking the uncertainties and contextual factors that were present at the time. This bias can hinder objective evaluation and learning from past experiences, inhibiting the improvement of future collaborations.	Compromised learning, reduced project's innovation	[59]
Availability Bias	The tendency to overestimate the likelihood of events with greater ease of retrieval (availability) in memory	Project managers may rely heavily on information readily available to them, potentially overlooking relevant but less accessible data or alternative perspectives from suppliers.	Misjudged risk, distorted perception and decision making	[58]
Base rate fallacy	The tendency to ignore generic base rate information and focus on specific information pertaining to a certain case or small sample	Project managers may prioritize individual supplier experiences or anecdotal evidence over broader industry or market trends. This bias can lead to biased supplier selection, inadequate risk assessment, and ineffective resource allocation.	Strong Convexity	[66] [67]
Anchoring	The tendency to rely too heavily, or "anchor," on one trait or piece of information when making decisions, typically the first piece of information acquired on the relevant subject	Project managers may anchor their judgments or negotiations based on initial information, potentially overlooking alternative perspectives or updated data from suppliers. This bias can limit flexibility and creativity in collaborating with suppliers.	Underestimation of risks	[66]
Escalation of commitment	The tendency to justify increased investment in a decision, based on the cumulative prior investment, despite new evidence suggesting the decision may be wrong	Project managers may persist with underperforming suppliers or ineffective resource allocation due to the desire to avoid perceived sunk costs.	Financial losses and resource drain	[65], [63], [55], [56]

APPENDIX B: Case Coding Approach

The coding approach in this study was designed to capture the complex dynamics of collaborative innovation projects through three main themes: supplier resource orchestration, behavioral biases, and project performance. This section provides a detailed account of the coding process and theme derivation.

The first-order themes for the aggregate dimension *of Supplier Resource Orchestration* followed the three constructs of the ROT [44].

The theme “structuring supplier resources” focuses on how organizations orchestrate the structural composition of supplier resources within projects. Key considerations under this theme encompass the rationale behind supplier selection, allocation of roles, and delineation of responsibilities among suppliers, thus laying the groundwork for subsequent collaborative efforts.

The theme “bundling supplier resources” captures the strategies employed by buying organizations to manage interactions with and between suppliers. The focus here is on the synthesis of resources from multiple suppliers, examining how these resources were integrated to create cohesive capabilities within the context of the innovation endeavor.

The theme “leveraging supplier resources” scrutinizes the buying organization's efficacy in capitalizing on supplier contributions. Areas of interest include resource allocation strategies for each supplier, coordination mechanisms to harmonize diverse competencies, and knowledge transfer practices.

The first-order themes for the aggregate dimension *Behavioral Bias* followed the ten behavioral biases suggested by Flyvbjerg [19]. As a consequence, the themes refer to “strategic misrepresentation," "optimism bias," "uniqueness bias," "planning fallacy," "overconfidence bias," "hindsight bias," "availability bias," "the base rate fallacy," "anchoring," and "escalation of commitment." For each source of bias, we coded whether it was present in the case and under which form.

The first-order themes for the aggregate dimension *of Project Performance* followed the three typical performance dimensions: cost, quality, and time. Cost performance was coded as the degree to which the collaborative innovation project stayed within budgetary confines and managed its financial resources with efficacy. This involved analyzing variances between budgeted and actual expenditures, assessing cost overrun instances, and examining the responsiveness of financial planning to project evolution. The quality performance focus was on the project's output adherence to predefined standards and specifications. This code tracked the alignment between the final deliverables and the project's initial quality requirements, including functionality, user satisfaction, and technical performance. It also considers the adaptability of the process in maintaining quality amidst project alterations. Time performance examined schedule adherence and captured the extent to which a project met its timeline objectives. The coding for this performance entailed an assessment of any delays, the reasons behind these schedule shifts, and the effectiveness of time management throughout the project lifecycle. Each of these performance dimensions was coded not merely as a binary achievement or failure but was nuanced to reflect the degree and nature of divergence from the project's initial goals and plans.

Finally, we encountered a recurrent theme that had a significant influence on the orchestration and outcomes of collaborative innovation projects: Technological complexity. Recognized as the intricacy inherent in the project's technological components, this facet was meticulously coded based on the sophistication of the technology involved in the final output. We distinguished between “High” (for projects characterized by advanced technological endeavors, often at the frontier of current capabilities, involving intricate design and development processes) and “Medium/Low” (for projects that dealt with established technologies) technological complexity. By differentiating projects along this spectrum, we could explore how technological complexity influences resource orchestration strategies, potentially exacerbating or mitigating the impact of behavioral biases on project performance.

Table B1 provides a more structured view of the coding structure. In table B2, we include exemplary quotes for each theme.

Table B1. Dimensions, themes, and concept coding.

Aggregate dimensions	Second order themes (based on theory)	First order concepts (emerged from the interviews)
Supplier Resource Orchestration	*Structuring Supplier Resources*	This dimension probes into the strategic organization and involvement of supplier-provided resources by the buying organization. It encapsulates: • *Supplier Selection Rationale*: criteria and considerations that led to the selection of suppliers, exploring factors such as quality, reliability, innovation capacity, and prior collaboration history. • *Roles and Responsibilities Definition*: strategic distribution of roles and responsibilities among suppliers, detailing how such assignments align with project objectives and supplier competencies.
	Bundling Supplier Resources	This dimension examines the integration and synergistic combination of resources across the supplier base by the buying organization, encompassing: • *Inter-Supplier Relationship Management*: methods employed by the buying organization to facilitate and govern interactions between suppliers, fostering a collaborative atmosphere conducive to innovation. • *Supplier Integration in Project Design*: tactics for integrating multiple suppliers into a coherent project framework, ensuring that each supplier's contributions are harmonized and oriented towards the collective project goals.
	Leveraging Supplier Resources	This dimension focuses on the buying organization's strategic utilization and optimization of supplier resources to enhance project value, including: • *Resource Allocation for Supplier Interface Management:* specific resources (such as tools, platforms, or personnel) allocated by the buyer to manage the interfaces between various suppliers, ensuring seamless interaction and collaboration. • *Coordination and Knowledge Exchange Facilitation:* mechanisms implemented for effective coordination among suppliers, as well as the strategies for knowledge transfer, to integrate supplier expertise into the project, thus maximizing the potential for innovation and performance enhancement.
Behavioral Biases	*Strategic Misrepresentation*	Instances where project information may have been deliberately skewed to align with certain interests or expectations. For example: • Suppliers' intentional misrepresentation of their capabilities or performance to secure the contract. • Buyer's skewed perception of suppliers' capabilities.
	Optimism Bias	Tendencies to underestimate challenges or overestimate positive outcomes during the project's planning and execution phases. For example: • Optimistic outlook of the project timeline. • Underestimation of challenges and risks involved in supplier collaborations.
	Uniqueness Bias	The assumption of project singularity that might lead to the dismissal of relevant historical data or lessons learned from similar projects. For example: • Overlook of prior knowledge or best practices from other collaborative innovation projects. • Special contract conditions reserved to suppliers.

	Planning Fallacy	Underestimations of time, costs, and risks involved, coupled with an overestimation of the project benefits. For example: • Underestimation of the internal and/or suppliers' time, effort, and resources required to complete the collaborative innovation project.
	Overconfidence Bias	Over-reliance on the project team's own abilities or the project's prospects of success. For example: • Excessive confidence in the abilities, decisions, or estimates of the buyer and/or the suppliers.
	Hindsight Bias	Any retrospective reinterpretations of project planning and decision-making processes to appear more favorable or predictable. For example: • Inability to formalize lesson learned from the collaborative innovation project.
	Availability Bias	The influence of recently encountered or easily recalled information on decision-making and project planning. For example: • Overestimation of the likelihood of certain events to occur, with overallocation of buyer and/or suppliers' resources.
	Base Rate Fallacy	When typical outcome rates are ignored in favor of anecdotal or idiosyncratic evidence. For example: • Low or no use of previous data and experience from previous collaborative innovation projects by the buyer and/or the suppliers.
	Anchoring	The reliance on initial pieces of information as 'anchors' in decision-making, even if irrelevant to the decision at hand. For example: • Excessive reliance on knowledge or best practices from other collaborative innovation projects from the buyer and/or the suppliers.
	Escalation of Commitment	The propensity to continue a project despite evidence of its impending failure. For example: • Buyer's continuous investments in additional resources and effort to justify their prior decisions, despite negative feedback or evidence suggesting that the collaborative innovation project is not proceeding as planned.
Project Characteristics	*Technological Complexity*	The degree of complexity associated with the technological aspects of the collaborative innovation project: • "High" for projects characterized by advanced technological endeavors, often at the frontier of current capabilities, involving intricate design and development processes. Such projects usually required pioneering new tools, software, or systems integration and were susceptible to higher degrees of uncertainty and unpredictability in performance outcomes. • "Medium-low" for projects dealing with established technologies. Although the technology was well-understood, the complexity arose from customizing and adapting these solutions to fit specific project contexts and requirements, presenting a distinct set of challenges and orchestration needs.
Project Performance	*Cost Performance*	If the project achieved cost objectives considering aspects such as • Cost savings • Cost overruns • Cost efficiency
	Quality Performance	If the project achieved quality objectives considering aspects such as • Quality issues

		• Alignment with original requirements • Customer satisfaction
	Time Performance	If the project achieved quality objectives considering aspects such as • Timely delivery • Delays and missed deadlines • Impact on time-to-market

Table B2. Exemplary quotes for each theme.

Aggregate dimensions	Second order themes (based on theory)	Quotes from the interviews
Supplier Resource Orchestration	*Structuring Supplier Resources*	"Choosing suppliers for the optical systems and control units based solely on their technical capabilities, without considering our past project collaborations, might not have been the best approach. We underestimated the value of a history of working together." (Skin) "We opted for suppliers with whom we had a solid history of collaboration. This wasn't just about their technical capabilities but also about knowing we could rely on their integration skills and mutual understanding from past successes." (Recorder) "Choosing a supplier for their cutting-edge software expertise without considering our collaborative history was a gamble. We learned the hard way that past collaboration could have mitigated many coordination issues." (Cabinet)
	Bundling Supplier Resources	"We saw our role as the central node in a web, mediating every interaction between our suppliers to make sure nothing slipped through the cracks that could jeopardize the project (…) Reflecting on the project, it's clear that our avoidance of direct supplier interaction, driven by fear of spillover, was a misstep. It complicated coordination and ultimately affected our project's quality and cost." (Packaging) "By delegating the management of interactions to our lead software developer, we thought we'd streamline communication. In hindsight, this may have siloed crucial information, slowing down integration efforts." (Cabinet) "Facilitating a three-way dialogue wasn't easy, but it ensured that all parties were on the same page, fostering a sense of unity towards the common goal. This direct communication minimized misunderstandings and streamlined the integration process." (Stroller)
	Leveraging Supplier Resources	"By colocating our engineers with the suppliers, we aimed to foster an environment of open knowledge exchange. This direct interaction was crucial for navigating the uncertainties of integrating the new system with the stroller." (Stroller) "Ensuring an open line of communication and knowledge sharing between our engineers and the suppliers was key. It wasn't just about transferring information but about creating a shared vision for the project." (Stroller)
Behavioral Biases	*Strategic Misrepresentation*	"We pitched our ability to manage the software development with more confidence than was warranted, believing it would smooth over any concerns about integrating with the aircraft's systems." (Cabinet)
	Optimism Bias	"Looking back, our timeline was incredibly ambitious. We were certain we could overcome the technical hurdles faster than ever before, underestimating the integration challenges." (Recorder) "Our enthusiasm for the new eco-efficient system perhaps blinded us to the integration realities. Looking back, our optimism had us believe integration would be simpler than it was, ignoring the lessons from past projects." (House)
	Uniqueness Bias	"We treated this project as a one-off, believing its unique challenges justified entirely new approaches, ignoring lessons that could have been applied from past projects." (Packaging)
	Planning Fallacy	"We thought two months was enough to integrate the new system. As work progressed, it became evident we had grossly underestimated the time required." (Toy) "We clearly underestimated the resources needed for supplier coordination. Our planning was not good,

		as we thought we could manage without fostering direct supplier-to-supplier interaction." (Packaging)
	Overconfidence Bias	"Our confidence in seamlessly integrating the components without formal supplier interaction was high. This overconfidence overlooked the intricate details of their technologies." (Skin) "The project taught us a hard lesson in humility. Our beliefs in managing new technology and supplier coordination autonomously led to delays and integration problems that were a wake-up call." (Cabinet)
	Hindsight Bias	"Despite the project delays, we still think we made the right decisions. Looking back, it's easy to justify our choices, even if they didn't lead to the best outcomes." (Skin)
	Availability Bias	"Our focus was so fixed on avoiding spillover risks that we overemphasized its probability, diverting resources from other crucial aspects of the project." (Packaging) "Focusing too much on previous failures led us to overallocate resources to avoid past mistakes. We let our fear of repeating history dictate our project management strategy." (Toy)
	Base Rate Fallacy	"We didn't consider the common integration issues that similar projects encountered. Our assumption was that our project would be different and face no such hurdles." (Recorder)
	Anchoring	"Previous successes led us to link our strategies too closely to what worked before. This didn't leave room for adjustments tailored to this project's unique technological demands." (House)
	Escalation of Commitment	"Even when it became clear that our approach wasn't working, we kept investing time and resources, convinced it would eventually pay off instead of reevaluating our strategy." (Stroller)
Project Characteristics	*Technological Complexity*	"We knew the technology wasn't new, but integrating it into our packaging machinery presented unique challenges we hadn't anticipated. It was like fitting a square peg into a round hole, and we were overly optimistic about how smoothly it would go." (Packaging) "The cabinet's software was revolutionary for us. The leap in technology was exciting but brought unforeseen challenges. We overestimated our ability to manage these complexities, especially when coordinating with suppliers not previously worked with." (Cabinet)

APPENDIX C: Case characteristics

In this section, we provide 1) a description of the projects included in the sample and 2) their characteristics of these project in line with the coding approach presented in Appendix B (Tables C1 and C2).

Packaging

The Packaging Case involved a collaborative innovation project with medium technological complexity, aiming to integrate established technology into a packaging printing machine. The project faced uncertainties regarding the successful integration of these technologies. The project triad included two 1st-tier suppliers responsible for strategic components (axes and projector), selected based on their complementary technical capabilities. However, these suppliers had no prior collaboration with the buying company, leading the buyer to act as a mediator between them. The buyer implemented shared performance measures, ad hoc NDA documents, and supplier training on quality aspects to manage the relationship. Colocation of the buyer's engineers at both suppliers' facilities facilitated the exchange of technical knowledge.

Among the behavioral biases, the case showed the presence of Uniqueness Bias, where the buyer treated the project with ad-hoc relationship approaches due to perceived spillover risk. The Planning Fallacy was evident as the buyer underestimated the resources required for supplier coordination. Overconfidence bias was also an issue for both the buyer and the suppliers.

Regarding project performance, a cost overrun of 15% occurred because of the higher resources required for supplier coordination. The components were delivered with a one-month delay, and quality issues emerged when included in the machine, resulting in a prototype launch instead of full-scale production. Nonetheless, the overall printing machine functionalities were aligned with those of the original design.

Cabinet

The Cabinet Case involved a high-complexity innovation project requiring the development of new software technology with a radically different architecture from previous projects. The project included a 1st-tier supplier responsible for software development and a 2nd-tier supplier for strategic code aspects. The 1st-tier supplier played a significant role in selecting and integrating the 2nd-tier supplier, although prior experience was not considered in selection. The buyer delegated management of supplier interactions to the 1st-tier supplier and provided training on project management and technical aspects. Knowledge exchange was facilitated by colocating buyer engineers at the 1st-tier supplier's facilities.

Regarding behavioral biases, the case demonstrated the presence of strategic misrepresentation, where the buyer overestimated the suppliers' managerial capabilities in coordinating the relationship with the 2nd-tier supplier. The buyer also displayed optimism bias, being overly optimistic about setting the project timeline. Additionally, the anchoring bias influenced the buyer's decision-making, as they adopted a previous successful approach from other projects.

Regarding project performance, overall cost performance was in line with the budget. The software was developed as requested, but the cabinet functionalities did not align with the initial design owing to integration issues with the aircraft, leading to a 2-month delay in cabinet release despite on-time software delivery.

Skin

The Skin Case involved a collaborative innovation project with medium technological complexity, using the evolution of existing technology with uncertainty related to its integration within a new machine. The triad was structured with two 1st-tier suppliers responsible for optical system and computer control system development, both of which are involved in the early stages. Only the supplier of the optical system had collaborated with the buyer on previous occasions, but this was not considered in the selection.

The buyer acted as a mediator between the suppliers, avoiding formal interaction and instead focused on maximizing knowledge gain regarding component development and integration. Coordination mechanisms included cross-functional teams and integration of information systems for real-time sharing. The colocation of buyer's engineers at both suppliers' facilities and prototyping facilitated the understanding of component technology and technical aspects.

Regarding behavioral biases, planning fallacy influenced the buyer, leading to an underestimation of the resources required to manage supplier relationships. Additionally, the buyer displayed overconfidence bias, being overly confident in their capabilities to informally supervise supplier-supplier relationships. The buyer also showed hindsight bias, not considering the project an "exception" and being convinced of the relationship choices made.

Regarding project performance, cost performance experienced a 20% increase owing to higher resources for supplier coordination and material costs. However, the components were developed according to the buyer's request and the laser machine functionalities met the initial requirements. Despite this, both the components and laser machine development faced a 4-month delay compared with the original timeline.

House

The House case involved a collaborative innovation project with high technological complexity. It used a new technology based on eco-efficiency, automation, and low consumption. The project aimed to develop a prototype system to be launched on the market.

The triad was structured with a 1st-tier supplier responsible for developing an integrated electronic circuit and a 2nd-tier supplier for the printed circuit board. The 1st-tier supplier was involved in the early stages and suggested a 2nd-tier supplier, facilitating its integration into the project.

Bundling mechanisms involved the buyer delegating most of the supplier-supplier interaction management to the 1st-tier supplier.

To leverage supplier resources, the buyer needed to understand the technology and technical aspects of the developed circuit and the managerial aspects of supplier-supplier interactions. Formal exchanges in project meetings and ad hoc platforms for joint development activities are used for knowledge sharing. Cross-functional teams and integration of information systems enabled real-time sharing of project information.

Regarding behavioral biases, optimism bias influenced the buyer and 1st-tier supplier, leading to over-optimistic beliefs about integrating the 2nd-tier supplier. The planning fallacy affected both parties, resulting in an underestimation of the resources needed for effective integration. Additionally, the overconfidence bias led the buyer and 1st-tier supplier to be overconfident in the 2nd-tier supplier's ability to handle the relationship. Strategic misrepresentation also played a role, as the buyer trusted the 1st-tier supplier's ability to coordinate with the 2nd-tier supplier without the buyer's supervision.

Regarding project performance, cost performance experienced a 10% increase due to higher resources for supplier coordination and material costs. The system was ultimately developed in line with the original design; however, quality issues (overheating) arose, delaying a full-scale launch. The electronic circuit was delivered on time, but the system development faced a 3-month delay due to the additional testing needs.

Stroller

The Stroller case involved the development of a new stroller using an adaptation of the existing technology, resulting in a medium level of technological complexity. The triad was structured with two suppliers selected independently - a 1st-tier supplier for the new system and a 2nd-tier supplier for the software interface. Both suppliers were involved in the early stages of the project and had already had a relationship with the buying company.

To facilitate supplier integration, the buyer took on the role of establishing and managing the supplier-supplier relationship through three-way interaction. Coordination mechanisms included shared performance measures, periodic progress meetings, and cross-functional teams. Additionally, the colocation of buyer engineers at both suppliers' facilities allowed for the exchange of technical knowledge in advance, preventing constraints during development.

Regarding behavioral biases, optimism bias and planning fallacy were evident, as both the buyer and suppliers underestimated the project's complexity and timeline as well as poorly planned time and resources for supplier integration.

The project's cost performance remained on budget, while the quality of the control system and stroller functionalities met the buyer's initial requirements. However, there were delays in the development process, with the control system experiencing a one-month delay and the stroller facing a 2.5-month delay due to material delivery and additional safety tests.

Toy

The Toy case involved the development of a new toy using an adaptation of existing technology, resulting in a medium level of technological complexity. The triad was structured with a 1st-tier supplier responsible for developing the new system, while a 2nd-tier supplier was selected in consultation with the 1st-tier supplier to provide electric circuits for the hardware. Both suppliers had previous experience in such collaborations, which was a key aspect of supplier selection.

To facilitate supplier integration, the buyer took on the role of favoring supplier integration and initiated the supplier-supplier relationship through a three-way interaction. To favor knowledge exchange, coordination mechanisms included cross-functional teams to support supplier integration and periodic progress meetings.

Regarding behavioral biases, the buyer and the supplier exhibited optimism bias as they initially underestimated the project complexity. The buyer also experienced an availability bias by overemphasizing the risk of ineffective supplier integration, leading to the overallocation of resources. Additionally, the buyer displayed anchoring bias when planning project activities and supplier relationship configuration based on other failure experiences rather than successful collaborations.

The project's cost performance experienced a 15% overrun due to increased resources for supplier coordination and material costs. Despite this, the system was developed in line with the buyer's request and the toy functionalities met the initial design requirements. However, there were delays in both the system and toy development, with the system experiencing a three-week delay and the toy facing a two-month delay due to additional quality control and testing needs.

Recorder

The Recorder case involved the development of a recording system based on a new technology, resulting in high technological complexity. The triad was structured with 1st-tier suppliers selected to develop different components of the recorder combined unit. Both suppliers were highly experts in collaborative product development projects, but full visibility of aircraft characteristics was not provided.

To facilitate supplier integration, the buyer established a direct connection between the two suppliers and supervised their interaction in a three-way relationship. Knowledge exchange and coordination mechanisms included cross-functional teams, cost-benefit mechanisms, ad-hoc NDA documents, and supplier training on quality aspects. The buyer leveraged technical knowledge exchange to address potential integration issues by requesting sharing of design and development documents as a contract condition.

Regarding behavioral biases, the buyer first exhibited strategic misrepresentation, trusting the suppliers' ability to work in coordination without full visibility on the aircraft model. Optimism bias was also present, as the buyer underestimated the complexity of integrating the system without full supplier visibility into the aircraft model. The buyer also displayed uniqueness bias by treating the project as unique, defining collaboration mechanisms and contractual aspects ad hoc, and base rate fallacy, as they ignore integration issues faced in other projects.

The project experienced a cost overrun of 17% due to increased resources for supplier coordination. Although the recording system was developed in line with the buyer's request, quality issues related to its integration with the aircraft caused a delay in the full-scale launch of the model.

Table C1. Within-case characteristics across the different themes and dimensions: Packaging, Cabinet, Skin, and House projects (note: empty cells = not present).

Coding dimensions		**Packaging**	**Cabinet**	**Skin**	**House**
Project Characteristics	*Technological complexity*	Medium – The technology was known but applying it in a new context (the packaging printing machine) introduced uncertainty regarding its integration.	High – The project involved new technology and software development, presenting significant integration challenges.	Medium – The project involved existing technology but faced uncertainty regarding its integration into a new machine.	High – The system used new, untested technology based on eco-efficiency, automation and low consumption, increasing the complexity of integration.
Supplier Resource Orchestration	*Structuring mechanisms*	Two 1st-tier suppliers were selected for their complementary technical capabilities in component design and development. The lack of prior collaboration with the buyer necessitated careful structuring of roles.	A 1st-tier supplier to develop the software and a 2nd-tier supplier to support strategic code development aspects were selected to provide complementary software capabilities. The 1st-tier supplier was involved at the early stages, and it participated in the 2nd–tier supplier selection, and it was responsible for favoring its integration at the project level. The 1st-tier supplier had some collaboration experience (not with the buying company), but this was not considered in the selection.	Two 1st-tier suppliers of strategic components (optical systems and computer control system) were selected to provide complementary technical capabilities in the design and development of the components. Both suppliers were involved in the early stages; the supplier of the optical system had already collaborated with the buyer in previous occasions, but this was not considered in the selection.	A 1st-tier supplier to develop an integrated electronic circuit and a 2nd-tier supplier to develop the printed circuit board were selected to provide complementary technology capabilities. The 1st-tier supplier was involved at the early stages and suggested the 2nd–tier supplier, and it was responsible for favoring its integration at the project level. Both suppliers had limited collaboration experience with the buying company.
	Bundling mechanisms	The buyer acted as a mediator to prevent direct interaction between suppliers, mitigating the risk of spillover on the final product (*two-way interaction*). Coordination included shared performance measures, ad hoc NDA	The buyer delegated supplier-supplier interaction management to the 1st-tier supplier. (*two-way interaction*). The buyer organized training on project management and other	The buyer avoided formal interaction between suppliers and acted as a mediator between them to maximize knowledge gain regarding component development	The buyer delegated most of the management of the supplier-supplier interaction to the 1st-tier supplier (*two-way interaction*). The buyer set periodic progress meetings with both

		documents, and supplier training.	technical aspects for the 1st-tier supplier.	and integration in the final product (*two-way interaction*).	suppliers to discuss project challenges and issues.
	Leveraging mechanisms	The buyer colocated engineers at both suppliers' facilities to facilitate the exchange of technical knowledge necessary for component integration.	Colocation of buyer engineers at the 1st-tier supplier's facilities, shared performance measures and the use of a virtual design platform facilitated knowledge exchange and coordination.	There is the need for the buyer to understand technology and technical aspects of the components to be integrated in the final product; to do so, there was colocation of buyer's engineers on both suppliers' facilities as well as use of prototyping. Cross-functional teams and integration of information systems for real-time information sharing were used as the main coordination mechanisms.	There is the need for the buyer to understand technology and technical aspects of the developed circuit, as well as managerial aspects related to supplier-supplier interactions. Other than formal exchanges in project meetings, ad-hoc platform for joint development activities was used for knowledge sharing. Cross-functional teams and integration of information systems for real-time information sharing were used as the main coordination mechanisms.
Behavioral Biases	*Strategic Misrepresentation*		The buyer overestimated suppliers' managerial capabilities in coordinating the relationship with the 2nd-tier supplier, also due to supplier's previous experience.		The buyer trusted the 1st-tier supplier's ability to work in coordination with the 2nd-tier supplier.
	Optimism Bias		The buyer was overly optimistic in setting the project timeline.		The buyer and the 1st-tier suppliers were overly optimistic about the easiness of integrating the 2nd-tier supplier.
	Uniqueness Bias	The buyer adopted ad-hoc relationship approaches due to			

		perceived spillover risk, treating the project as unique.			
	Planning Fallacy	The buyer underestimated the resources needed for managing supplier coordination, leading to a cost overrun.	The 1st-tier supplier did not dedicate adequate resources to manage the relationship with the 2nd-tier supplier.	The buyer underestimated the resources needed to manage the interface with suppliers.	The buyer and the 1st-tier suppliers underestimated the resources needed to effectively integrate the 2nd-tier supplier.
	Overconfidence Bias	Both the buyer and suppliers were overly confident in their ability to integrate components without direct supplier-supplier interaction.	The buyer and the 1st-tier supplier were overconfident that the supplier could handle the relationship and integration of 2nd-tier supplier autonomously.	The buyer was overly confident regarding their capabilities to supervise supplier-supplier relationships without a formal interaction between suppliers.	The buyer and the 1st-tier supplier were overconfident that the supplier could handle most of the relationship and integration of 2nd-tier supplier.
	Hindsight Bias			The buyer did not consider this project as an "exception" and was convinced of the relationship choices made based on previous experience.	
	Availability Bias	The buyer overemphasized the risk of spillover.			
	Base Rate Fallacy				
	Anchoring		The buyer relied on a previously successful project approach, without fully accounting for the differences in technological complexity.		The buyer adopted this approach because of successful collaboration experience in other projects.
	Escalation of Commitment				
Innovation project performance	*Cost*	15% overrun due to additional resources required for supplier coordination.	The project remained within budget.	20% overrun due to increased resources for coordination and materials.	10% overrun due to additional resources for coordination and materials.
	Quality	Components met original requests, but integration issues	The software met the buyer's specifications,	The components and laser machine met the	The system was developed according to

		led to a prototype launch instead of full-scale production.	but integration issues led to a cabinet that did not fully align with the initial design.	initial requirements, but delays occurred due to integration challenges.	design, but quality issues (overheating) delayed the full-scale launch.
	Time	Components were delivered with a one-month delay; however, the overall machine development adhered to the project schedule.	The software was delivered on time, but cabinet release faced a two-month delay due to integration problems.	A four-month delay was experienced in both component and machine development.	The circuit was delivered on time, but system development faced a three-month delay due to additional testing.

Table C2. Within-case characteristics across the different themes and dimensions: Stroller, Toy, and Recorder projects (note: empty cells = not present).

Coding dimensions		**Stroller**	**Toy**	**Recorder**
Project Characteristics	*Technological complexity*	Medium – The project involved adapting existing technology, with challenges related to its integration into a new product.	Medium – The project used an adaptation of existing technology, with uncertainties related to integration into the new product.	High - The recording system required new technology, with significant challenges in integrating hardware and software components.
Supplier Resource Orchestration	*Structuring mechanisms*	A 1st-tier supplier to develop the new system and a 2nd-tier supplier to develop the software interface with the stroller were selected to provide complementary and integrated technical capabilities. The suppliers were selected independently and because they both had already relationships in place with the buying company. Both suppliers were involved in the early stages.	A 1st-tier supplier to develop the new system and a 2nd-tier supplier to develop the electric circuits for the hardware were selected to provide complementary and integrated technical capabilities. The 2nd-tier supplier was selected in consultation with the 1st-tier supplier (who had experience in such collaborations). Both suppliers were involved in the early stages.	Two 1st-tier suppliers of the recorder combined unit (flight data and cockpit voice) were selected to provide complementary technical capabilities in the design and development of the two components. Both suppliers were involved in the early stages, although it was not possible to provide them full visibility on the aircraft characteristics. Both suppliers had high experience in collaborations for product development and this aspect was part of the selection criteria.
	Bundling mechanisms	The buyer was responsible for favoring supplier integration at the project level as well as for establishing the supplier-supplier relationship (*three-way interaction*). The buyer organized training on project management for both suppliers.	The buyer was responsible for favoring supplier integration at the project level and ensured effective initiation of the supplier-supplier relationship (*three-way interaction*).	The buyer established a direct connection between the two suppliers and also supervised the interaction to maximize knowledge gain regarding component development and integration in the final product (*three-way interaction*).
	Leveraging mechanisms	The need is to exchange technical knowledge in advance to avoid constraints in the development activities by the 2nd-tier supplier; to do so, there was colocation of buyer's engineers on both suppliers' facilities. Shared performance	The need is to exchange technical knowledge in advance to avoid constraints in the development activities by the 2nd-tier supplier; to do so, there was colocation of buyer's engineers on 1st-tier supplier's facilities and use of a platform	The buyer is the sole responsible of integrating the system in the final aircraft, so there is the need to exchange technical knowledge about components development and potential integration issues. To do so, other than formal exchanges in project meetings, the buyer

		measures, periodic progress meetings and cross-functional teams to support supplier integration were also used as coordination mechanisms.	for joint development activities with both suppliers. Cross-functional teams to support supplier integration and periodic progress meetings were used as coordination mechanisms.	requested sharing of design and development documents as a contract condition. Cross-functional teams to support supplier integration, definition of cost-benefits mechanisms, ad-hoc NDA documents and suppliers' training on quality aspects were used as the coordination mechanisms.
Behavioral Biases	*Strategic Misrepresentation*			The buyer trusted the suppliers' ability to work in coordination with each other without full visibility on the aircraft model.
	Optimism Bias	The buyer and both suppliers underestimated the project complexity and the project timeline.	The buyer and the 1st-tier supplier underestimated the project complexity.	The buyer underestimated the complexity of integrating the system in the final product without full supplier visibility on the aircraft model.
	Uniqueness Bias			The buyer treated this project unique, so collaboration mechanisms and contractual aspects where defined ad-hoc.
	Planning Fallacy	The buyer poorly planned the time and efforts needed to coordinate integration with the suppliers in the project.		
	Overconfidence Bias			
	Hindsight Bias			
	Availability Bias		The buyer overemphasized the risk of ineffective integration of suppliers, which lead to overallocation of resources.	
	Base Rate Fallacy			The buyer did not consider similar integration issues faced in other projects.
	Anchoring		The buyer planned the project activities and supplier relationship configuration	

			based on other failure experience rather than successful collaborations.	
	Escalation of Commitment	The buyer did not delegate to the 1st-tier supplier more power to manage the relationship with the 2nd-tier supplier when the first issues arose.		
Innovation project performance	*Cost*	The project remained on budget.	15% overrun due to increased resources for coordination and materials.	17% overrun due to additional resources for coordination.
	Quality	Both the control system and stroller met initial design requirements.	The system and toy met the initial design requirements.	The system met design requirements, but integration issues delayed the full-scale launch.
	Time	The control system was delayed by one month, and the stroller faced a 2.5-month delay due to material and safety testing issues.	The system was delayed by three weeks, and the toy faced a two-month delay due to additional quality control.	The system was developed on time, but integration into the aircraft took longer due to additional quality control.

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