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The X-Collider
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Evaluating and Shaping an Initiative for Field Experimentation at Nova School of Business and Economics

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Abstract

This thesis examines Nova SBE's "X-Collider", an initiative of the Data Science Knowledge Center. Using qualitative methods, including the Gioia method, it evaluates the initiative's necessity for research and external actors and discovers a dichotomy between the need for practical A/B tests and comprehensive research experiments. Findings underscore the imperative for strategic positioning of X-Collider. The study proposes distinct roles for X-Collider in community organization, strategic connection, and experimentation enablement, stressing the alignment of diverse stakeholder objectives and adaptation to complex collaborations. Enhancing its role in academia and the industry, these insights inform recommendations for X-Collider's strategic focus.

Keywords:

Field Experiments, Innovation Challenges, Orchestration Roles,
Lab Implementation

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1 Introduction

In our modern world, social processes have grown increasingly intricate and multifaceted (Mize and Manago 2022). Compared to two decades ago, organizational boundaries are blurring, and companies, in particular, find themselves needing to respond to international competition and changes in customer demands due to the "*quickened pace of innovation*" (Jacobides, Knudsen, and Augier 2006; Chesbrough and Rosenbloom 2002). In response, the use of causal experimentation has experienced a notable resurgence. Especially within the realms of business, public policy, and academia, field experiments have emerged as a powerful tool for informed decision-making, being conceived as "*a bridge between lab and naturally occurring data*" (List 2007). Contrasting earlier days when field research in firms might have entailed "*chatting with the cab driver on the way to the airport*", companies are now increasingly open to employing experiments as a feasible and effective method of testing business hypotheses (List 2011). Despite the benefits of experimentation, conducting field experiments within and across enterprises can be a challenge, particularly as experiments become increasingly data-driven (Frick 2014). "*Companies experiment when they don't know what will work best*"; however, many experiments today are run incorrectly (Hauser and Luca 2015). In response to the evolving landscape of business and academia, Nova School of Business and Economics' Data Science Knowledge Center (hereafter Nova SBE DSKC) is building the "X-Collider" initiative (hereafter "X-C"), aiming to enhance and prioritize field experimentation within research and practical fields with the notion of an ecosystem (see Appendix A). The X-C is poised to offer a suite of pivotal activities, such as matchmaking between external partners and researchers, or the design and management of field experiments. However, the underlying value and potential of such an initiative remain under examination. This thesis investigates the significance of the X-C within the Nova SBE ecosystem, questioning its impact on researchers and industry practitioners. It seeks to define how Nova SBE can ascend as an orchestrator within this domain.

The study commences with a thorough literature review, revisiting the increasing engagement with field experiments, defining foundational concepts, and engaging with key frameworks of orchestration in platforms and ecosystems. This thesis will highlight the status and internal alignment of the initiative's staff team and then proceed to present a problem assessment for the X-C, based on hurdles and challenges encountered by academic and external partners. Subsequently, it will explore hypothetical roles and strategies for the X-C, extending contemporary orchestration frameworks from academic literature through derived orchestration dimensions. Lastly, this thesis will offer practical recommendations for the X-C, grounded in the analyzed findings and applying the expanded framework.

Research questions:

- 1) What is the importance of the X-Collider initiative for the ecosystem of Nova SBE?
- 2) How can the Nova SBE Data Science Knowledge Center orchestrate an ecosystem for field experimentation with the X-C, bridging the gap between research and practical application?

2 Theoretical Background

2.1 Experimentation

To comprehend the significance of the X-C, this initial section of the literature review is dedicated to providing an overview of field experimentation methods, their importance, the resurgence of these methods, and their evolution into a data-driven decision-making tool applicable across various fields.

The experimental method has a long-standing history, being pivotal in "*building and testing causal theories, identifying the causal effects of interventions, and determining mechanisms underlying causal effects*" (Mize and Manago 2022). It has established the groundwork for numerous theories across academia, business, and the social sciences (Druckman and Green 2021; Thye 2014). Despite its extensive use, the method has faced criticism for its perceived

lack of internal validity (McDermott 2011), and for challenges in maintaining experimental control, particularly in virtual environments (Reips 2000). Some caution against viewing this method as a universal solution for problem-solving in business (Mize and Manago 2022). Nonetheless, experiments have the capacity to yield compelling evidence of causality in real-world behaviors, foster theoretical progress, and shape social policy (Baldassarri and Abascal 2017). Experiments rely on the logical comparison of outcomes across various conditions to evaluate the effects of interventions when "*determinations of causality are necessary*." They are distinguished by the manipulation of an independent variable - be it categorical or continuous - and by random assignment (Mize and Manago 2022; Fisher 1936). The randomization of participants into treatment conditions ensures an equitable distribution of their characteristics, thus enabling researchers to isolate the true causal impact of an intervention without the compulsion to measure all conceivable confounding variables, a distinct advantage of experimental research (Gerber and Green 2012).

Field experiments "*serve as a useful bridge between data generated in the lab and empirical studies using naturally-occurring data*" (List 2007) and have seen a resurgence in popularity in recent years. A common methodology within field experiments is the randomized controlled trial (RCT), where participants are randomly assigned to a treatment group (subjected to an intervention) or a control group. A/B testing, a specific form of RCTs, has gained substantial traction in the business sector as a systematic method to evaluate changes and innovations prior to full-scale implementation. It involves testing two versions of a product, service, or feature to determine which performs better, such as different website features or designs. A/B testing can be an effective strategy for ensuring that decisions are data-driven and optimized for a desired outcome (Gallo 2017). Overall, researchers found a significant rise in the use of experiments for testing hypotheses and demonstrating causality in academia. While some attribute this to "*higher standards for causal inference, the success of the counterfactual approach in statistics,*

and recent methodological advancements that facilitate the analysis of field-experimental and quasi-experimental data” (Baldassarri and Abascal 2017), others emphasize the availability of multiple types of experiments for experimental studies (Mize and Manago 2022), especially in online settings (Peterson, Westwood, and Iyengar 2021). Data-driven field experimentation, which generally requires fewer resources than traditional face-to-face experiments, is increasingly utilized (Manago, Mize, and Doan 2021) and is progressively supplanting experiments that were once restricted to laboratory environments (Arechar, Gächter, and Molleman 2018). The advancement of artificial intelligence (AI) has further accelerated this trend, transforming many facets of daily life (Diamandis and Kotler 2020). According to an unpublished working paper of the university of Cambridge, large language models (LLMs), a subset of AI trained on vast amounts of text data to comprehend and generate human-like text (Perkins 2023), can significantly enhance experimental research. This includes aspects such as experimental design, implementation, data analysis, and the proposal of a scientific governance framework to maximize benefits while minimizing risks (Charness, Jabarian, and List 2023). In practice, field experiments within firms aim to resolve agency issues and motivate employees, while experiments across firms strive to exogenously vary the availability of key inputs to identify constraints that firms face (Bandiera, Barankay, and Rasul 2011). However, the application of this methodology is not devoid of challenges. Potential obstacles include a lack of expert knowledge about the subject and market, the absence of an appropriate control group, insufficient sample sizes, an unstructured experimental design, theoretical expertise, the absence of a champion within the organization, commitment issues, corporate structures, cost burdens, unrealistic expectations, short-term mindsets, and ethical considerations (List 2011). In conclusion, while the method of experimentation offers means for facilitating data-driven decision-making, there are significant challenges associated with its implementation.

2.2 Key Definitions – Innovation Value Networks and Ecosystems

This section lays out foundational definitions of value networks and innovation ecosystems, establishing the conceptual framework within which the X-C functions.

In a broad sense, value networks are “*the context within which the firm identifies and responds to customers' needs, procures inputs and reacts to competitors*” (Christensen and Rosenbloom 1995). Innovation networks, a more focused segment of the wider innovation ecosystem, are composed of a distinct constellation of actors and resources within a particular structure. These actors and resources interact to create value by addressing pressing problems (Jacobides, Knudsen, and Augier 2006). The literature distinguishes between producer innovation networks, which are optimized for market value estimation, production, and profit maximization, and user innovation networks, where value emerges from solving problems perceived subjectively by the users (Baldwin and Von Hippel 2011). These different value networks are unlikely to change due to “*compatibility, interoperability, regulation, and existing preferences*” (Ansari and Krop 2012).

In recent years, ecosystems, especially innovation ecosystems have become subject of a plethora of studies (de Vasconcelos Gomes et al. 2018). In today's dynamic market environment, actors must engage in collaboration and build relationships to innovate on a global scale, highlighting the significance of innovation ecosystems in value creation (Lusch, Vargo, and Tanniru 2010). An innovation ecosystem is defined as an “*evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors*” (Granstrand and Holgersson 2020). Concisely, innovation ecosystems are networks that bring together various actors whose contributions are vital for value generation (Adner and Kapoor 2010). Consequently, value creation within these ecosystems is realized through coordination and alignment at the organizational level (Jacobides, Cennamo, and Gawer 2018).

2.3 Orchestration of Innovation Ecosystems

In the academic literature, orchestration is highlighted as essential for ensuring effective coordination of actors, value creation, and benefit capture. Dhanaraj and Parkhe describe orchestration as a deliberate and strategic suite of actions aimed at generating and capitalizing on the collective capabilities of a network (Dhanaraj and Parkhe 2006). The orchestrator, typically a hub firm, is crucial for the success and sustainability of a network or ecosystem. Coordination activities can encompass the sharing of product-development resources, the establishment of governance rules for access and use of the platform, the formulation of a pricing structure to control participant groups through selection or screening (Panico and Cennamo 2022; Wareham, Fox, and Cano Giner 2014), the fostering of competition within the platform (Cennamo and Santaló 2015) and the facilitation and orchestration of feedback between actors (Jacobides, Cennamo, and Gawer 2020). From a role-based perspective, Cennamo, Oliveira, and Zejnilovic identify three orchestration roles: community organizer, market matchmaker, and innovation manager. Each role corresponds to distinct orchestration activities. The community organizer focuses on facilitating knowledge exchange, certifying information, and managing actor engagement. The market matchmaker connects innovators with resource-equipped product producers interested in new ideas and amplifies information flow. The innovation manager facilitates "*transition possibilities*," orchestrating the innovation process among all involved actors from regulatory approval to market commercialization (Teece et al. 2022; Cennamo, Oliveira, and Zejnilovic 2022). They also define the innovation value shaper role as one that establishes critical connections between innovation value networks, transforming the dual user-producer paradigm into a singular innovation continuum. On a procedural level, orchestration involves promoting knowledge mobility, ensuring innovation appropriability, and maintaining network stability (Dhanaraj and Parkhe 2006). Knowledge mobility refers to the ease of knowledge sharing, acquisition, and deployment

within the network, preventing its confinement within individual actors. This includes knowledge absorption, network identification, and interorganizational socialization, which can bolster knowledge mobility by fostering a shared identity among network members and serving as a motivational factor. Innovation appropriability acts as a governance mechanism, protecting innovation efforts and ensuring equitable distribution among actors, thus mitigating free-rider problems and bolstering trust. Finally, network stability aims to preserve the equilibrium between flexibility and coherence, averting silos or isolation, and promoting collaboration. In essence, orchestration within innovation ecosystems is a strategic endeavor that aligns various roles and processes to facilitate knowledge exchange, protect, and distribute innovation benefits, and sustain the equilibrium of the network for collective success.

3 Methodology

3.1 Sample and Data Privacy Considerations

The selection of interview participants for this study followed the principles of purposive sampling (Cook, Campbell, and Shadish 2002), chosen for its strategic emphasis on garnering in-depth insights from a target group with direct experience and expertise relevant to the X-C. This method was instrumental in collecting rich, qualitative data aligned with the research objectives. Participants were categorized into three groups: external actors (outside of NOVA SBE), research actors (within NOVA SBE), and X-Collider staff (the orchestrators). External actors were selected from the X-C's existing partnership network (see Appendix C), focusing on those who had engaged with the program prior to the commencement of this thesis. This group was further divided into four subcategories: startups, service providers, public entities, and large companies. Research actors, representing various knowledge centers, institutes, and labs within the NOVA SBE ecosystem, included professors, Ph.D. candidates, and staff. All participants were informed about the study's objectives, the usage of the information they provided, and their data privacy rights. Before the interviews commenced, participants gave

verbal consent for the use of their information and the recording of the interviews, acknowledging the voluntary nature of their involvement and the measures taken to ensure confidentiality and anonymity. To protect identities, each participant was assigned a unique identifier, and sensitive data was either omitted or generalized to prevent individual identification. Interview data was securely stored on Microsoft Teams, accessible only to the research team. The study complied with the General Data Protection Regulation (GDPR), adhering to the highest standards of data privacy. A detailed overview of the interview participants, excluding personal data, is available in Appendix B.

3.2 Data Collection and Ethical Methodology

To investigate the central research questions posited by this thesis, a mainly qualitative research design was employed, collecting data through semi-structured interviews (Cassell 2015). An exception to this was the provided secondary source input by the X-C staff team, which was used for the status quo assessment of the initiative, complementary to the input from staff member interviews (for overview, see Appendix D). The qualitative method was selected for its efficacy in eliciting the intricate experiences of participants connected to the phenomenon under study, understanding the personal standpoints and individual needs of all actor groups (Cassell 2015). The employment of interviews was integral in addressing the research questions to *"obtain both retrospective and real-time accounts from those experiencing the phenomenon of theoretical interest"* (Gioia, Corley, and Hamilton 2013). Through interviews, I was able to collect nuanced data for the assessment of the X-C, the actor needs and practical implications. At the outset of the X-C, this qualitative approach was favored over surveys, which may conceal underlying complexities due to inherent biases and limitations in respondents' self-perception. Grasping the complex nature of individual value networks, needs, perceptions, and challenges faced by the selected actor groups was imperative. Initial engagement with the actors was established through various channels - direct interactions at Nova SBE for research actors and

email introductions facilitated by the Nova SBE DSKC for external actors (see Appendix E). The interviews, conducted via Microsoft Teams, were approached with a heightened sensitivity to ethical considerations, notably the autonomy and consent of participants. The semi-structured interviews adhered to meticulously crafted guides specific to each actor group (available in Appendix F). These guides included a broad array of questions - ranging from personal to open-ended inquiries and custom follow-up questions that occasionally diverged from the script. A mix of thematic and dynamic questioning techniques was employed (Kvale and Brinkmann 2009). Echoing Cassell's methodology, the interview framework provided the flexibility to accommodate the diverse experiences and backgrounds of the participants, thereby allowing them to delve more deeply into aspects of the guide relevant to their expertise. Transcripts were produced following a straightforward transcription approach (Cassell 2015).

3.3 Analysis

This study honored Gioia's advocacy to “*see differently and not impose a way of seeing on another's way of seeing*” (Gioia 2022). The interviewees are acknowledged as “*knowledgeable agents*” (Gioia, Corley, and Hamilton 2013), and accordingly, an inductive analysis was applied. First, the X-C is introduced as an initiative and scrutinized within empirical frameworks (Yin 2018), aiming to present the status quo of the X-C as a sort of case study. The interviews were coded deriving common themes around strategy and vision for the X-C, potential clients, operational structure, and team composition, following a conventional content analysis approach, where codes are derived from data (Hsieh & Shannon, 2005). Second, to evaluate the importance for the X-C, the analysis of actor needs began with the coding of informant narratives, progressing from first-order concepts to second-order bottleneck themes and ultimately to aggregated innovation challenge dimensions following the Gioia method (Gioia, Corley, and Hamilton 2013). For the analysis, refer to Appendices I-M. These dimensions, along with the provided doubts and criticism, were used to evaluate the

significance of the X-C. To explore how Nova SBE's DSKC can effectively become an orchestrator within this context, the innovation challenge dimensions served as first order codes that were aggregated to overall innovation challenge themes and possible orchestration dimensions (see Appendix N). I then engaged in a directed content analysis (Neuendorf 2017; Hsieh and Shannon 2005), enhancing the previously derived dimensions against established orchestration roles, including and extending those proposed by Cennamo, Oliveira, & Zejnilovic (2022) and Cusumano et al. (2019). In this process, I analyzed how the X-Collider can manage knowledge mobility, innovation appropriability, and network security, as proposed in the orchestration framework by Dhanaraj & Parkhe (2006), adding to the descriptions of the orchestration roles. MAXQDA was the chosen software for coding, valued for its sophisticated analytical features, which aided in the organization and distillation of intricate qualitative data. The amalgamation of these methodological approaches offers a nuanced portrayal of the X-C's role within the Nova SBE's ecosystem of field experimentation, leading to a practical recommendation part in the last section of the results and discussion.

4 Results and Discussion – Evaluation and Recommendations

4.1 Internal View - Status Quo of the X-Collider

The X-Collider initiative from Nova School of Business and Economics Data Science Knowledge Center embodies the strategic push towards integrating field experiments into the core activities of the Nova SBE ecosystem (for all planned activities, see Appendix G). It emerges in response to an increased recognition of this method's value and seeks to seamlessly connect academic research with real-world applications (Appendix A; Interview 3, Pos. 17, 24). The success of Nova SBE's Behavioral Lab, which has engaged students in laboratory experiments, acts as a proof of concept, with the X-C expanding the scope of experimentation to include external partners (Interview 1, Pos. 49). Within the X-C team, there is a shared vision

to use field experiments as a bridge between theory and practice. Yet, perspectives diverge on the approach: some advocate for a research-centric direction to enhance Nova SBE's reputation as a knowledge hub (Interview 1, Pos. 102), while others see digital experimentation as a means to provide pragmatic benefits to companies (Interview 2, Pos. 4; Interview 4, Pos. 7, 17). A third view suggests a dual-focused structure that enables the X-C to act both as a consultancy and as a research facilitator within the ecosystem (Interview 3, Pos. 9). Currently, the X-C team plans to support “*any kind of experiment*”, ranging from long-term RCTs to data-driven A/B testing (Interview 4, Pos. 9, 21). The target audience for the X-C's services also prompts discussion. Certain team members prioritize engagement with companies and researchers, leveraging existing Nova SBE partnerships (Interview 1, Pos. 25; Interview 2, Pos. 4), whereas others propose serving a wider array of stakeholders, including the public sector (Interview 3, Pos. 26; Interview 4, Pos. 7, 37). Operationally, there is consensus on the X-C's role in facilitating field experimentation. However, views differ on whether it should act solely as an intermediary between entities or engage directly as a research partner or consultant (Interview 1, Pos. 73; Interview 2, Pos. 46-51; Interview 3, Pos. 32, Interview 4, Pos. 27). Identifying the primary challenges for users, such as defining the problem and understanding experimentation's value, is recognized as a priority (Interview 2, Pos. 14, 22). Expectation management and harmonizing the divergent worlds of research and external actors are anticipated as key challenges (Interview 1, Pos. 78). Team roles are another focus area, with a need for management, scientific, and administrative expertise (Interview 3, Pos. 27-28). Team members currently see themselves fulfilling specific roles, with some focusing on sales and expectation management (Interview 2, Pos. 20, 66) and others on the scientific and experimental aspects (Interview 1, Pos. 117). However, the distribution of administrative responsibilities remains to be clarified (Interview 2, Pos. 14). Considering the offerings, the X-C contemplates bundled services that combine educational modules with practical research support (Appendix H),

aiming for financial sustainability beyond initial grant funding (Interview 1, Pos. 82, 90). Further, they are considering offering an executive education course at Nova SBE (Interview 4, Pos. 27). Nonetheless, current challenges include navigating bureaucracy and augmenting human capacity to meet demands (Interview 3, Pos. 12). This leads to some staff members already raising doubts about the feasible execution of all anticipated features as shown in Appendix G (Interview 4, Pos. 27-28). In conclusion, the X-Collider initiative stands at a pivotal juncture where its foundational objectives are well-established, yet its strategic trajectory remains open to refinement. As the X-C navigates the complexities of diverse stakeholder needs and internal roles, its success will hinge on the ability to adapt and evolve, ensuring that its offerings remain relevant and impactful in the ever-changing landscape of research and industry collaborations.

4.2 Understanding the Ecosystem

To evaluate the importance of the X-C for the ecosystem, it is crucial to delve into the innovation ecosystem concept. This ecosystem, as defined by Adner and Kapoor (2010), encompasses all actors contributing to innovation and value creation. For Nova SBE, this includes diverse actor groups, each with unique innovation and value networks. Innovation networks, as reviewed in the literature section, are constellations of actors and assets structured in a way that their interrelations address pressing problems, creating value (Jacobides, Knudsen, and Augier 2006). For actors engaging in private markets, we can differentiate between the startup, service provider, and large corporation. The startup (in this exemplary case) was marked by an open, dynamic innovation network, engaging investors and clients in collaborative efforts to execute innovative solutions, often involving feedback loops. In contrast, the large corporation and service provider (in this exemplar case) tended to express a linear value chain logic, where innovation is confined within the boundaries of standardized processes. The public agency actor leaned towards a linear value chain approach, adhering to

strict regulations and guidelines. Overall, external side of the ecosystem brings capital, practical expertise, and specific problems to be solved, for example with the goal to maximize their chances of increasing their revenues digitally (Interview 4, Pos. 17). On the researcher side, the value creation process varies significantly between knowledge centers and faculties. Despite differences in familiarity with experimentation methods and research interests, there was a shared goal among researchers to add value to Nova SBE. This actor group contributes expert knowledge, scientific methods, and already existing relationships with companies, showing willingness to collaborate with external experts if it aligns with their interests. Overall, the ecosystem is characterized by close relationships between external partners and the university.

4.3 Evaluation of the importance of the X-Collider

The evaluation of the X-C's importance draws on insights from stakeholder interviews, which have highlighted several challenges shared among different actor groups. A key issue identified is the struggle with resource scarcity and its effective allocation, which hampers the ability to employ experimental methods for testing interventions and making informed decisions (Interview 6, Pos. 27; Interview 9, Pos. 9, 77, 183; Interview 10, Pos. 45, 89; Interview 11, Pos. 7, 9, 39). Additionally, there is a noted lack of awareness about the importance of field experiments in general (Interview 8, Pos. 11; Interview 9, Pos. 93, 217; Interview 11, Pos. 19). This is coupled with a deficit in knowledge regarding the setup and design of experiments, as well as a lack of experience with these methods (Interview 6, Pos. 11-13; Interview 8, Pos. 11; Interview 9, Pos. 6, 64-67; Interview 10, Pos. 73, 57; Interview 11, Pos. 5). When actors collaborate or are in the process of collaborating to conduct experiments, a lack of common understanding and alignment regarding the definition and scope of field experiments becomes apparent (Interview 5, Pos. 8; Interview 7, Pos. 19; Interview 8, Pos. 17). This issue is underscored by a staff member of the X-C, who observed a distinct need to manage expectations, particularly between researchers and companies who often desire different

outcomes from these experiments (Interview 2, Pos. 14). While this observation is partially correct, the interviews reveal a more nuanced perspective on the overall expectations of actors regarding field experiments. Generally, actors expressed demand for two types of field experiments. On one hand, there is a call for detailed, long-term studies such as randomized controlled trials (Interview 7, Interview 8, Interview 11). These studies align with the academic research goals at Nova SBE and are crucial for large corporations and policymakers involved in long-term strategic decision-making. Here, the X-C is perceived as highly important for facilitating collaboration between external and research actors, ensuring smooth execution of field experiments to test causality over time. However, it should be noted that each project and actor group have individual needs, requiring a high degree of personalization in the X-C's involvement (Interview 8, Pos. 9, 17). Some researchers at Nova SBE already have a high expertise in conducting field experiments and do not need assistance in their design or execution but more in matchmaking with policy makers (Interview 7, Pos. 21, 25). The importance of the X-C as a facilitator and matchmaker for field experimentation is clear, aligning to their self-understanding as being an extension of knowledge (Interview 4, Pos. 63) and a “*matchmaker*” (Interview 2, Pos. 16). On the other hand, practically oriented knowledge centers at Nova SBE, the startup, and service provider preferred quicker, more flexible testing methods like A/B testing for immediate business process improvements or product feature testing (Interview 6, Interview 9, Interview 10). For these faster-paced experiments, the necessity of support from the X-C is not as evident, since they can be managed by existing online services without a strong research focus. The potential of the X-C initiative, therefore, becomes contingent upon its strategic orientation. Should it gravitate towards facilitating operational business needs through methods like A/B testing, or should it anchor itself within the realm of fostering research-driven, long-term collaborations? The skepticism expressed by some researchers at Nova SBE (Interview 5, Pos. 12; Interview 7, Pos. 41) points towards the latter, urging the

initiative to eschew pursuits of perceived triviality in favor of endeavors that hold substantive academic value, opposed to generating revenue through acceptance of non-research-oriented projects which should “(...) *not be the core activity of the school.*” (Interview 7, Pos. 41).

Figure 1 – Overview over exemplary Actors in the Ecosystem

	Actor Group	Interest		Evaluation of X-Collider Importance
External Actors	Startup	Quick A/B Testing for MVP features	➤➤	Low Interested in completely outsourcing experimentation, want to engage more in data-driven decision making
	Service Provider	Feature Testing of Client Deliverables	➤➤	Medium Only want to experiment if client demands it as part of their service (currently not demanded)
	Public Entity	Testing of Unemployment Intervention Outcome	➤➤	High Need help to test unemployment interventions, highly interested in collaborating with Nova SBE
	Large Corporation	Testing of Advertisement Effectiveness	➤➤	Medium-High Currently already involved in field experiment with Nova SBE, need help in set up and management of field experiment
Researchers	Researchers at Nova SBE	Quick A/B Tests and/or RCTs	➤➤	N.a. Different evaluations depending on individual researcher/ staff

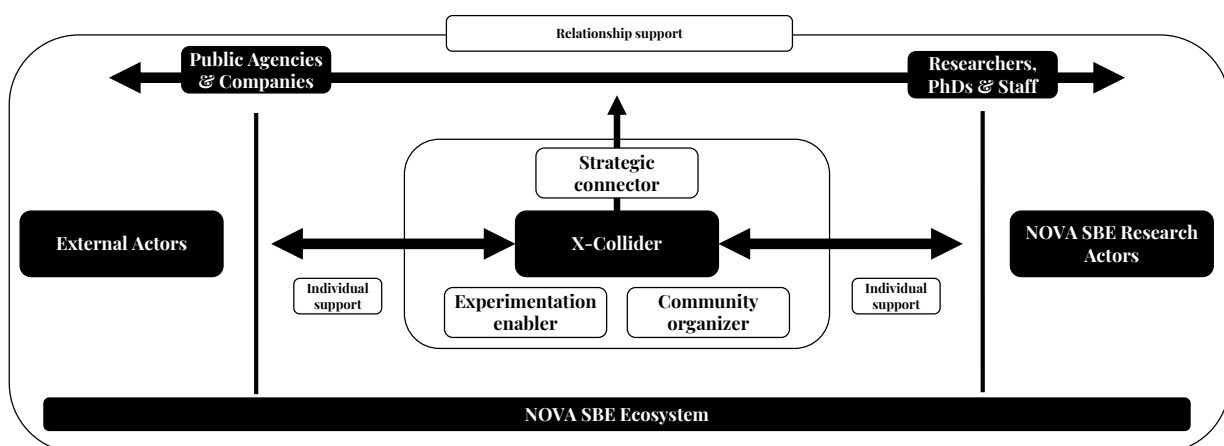
Some stakeholders, particularly those interested in long-term RCTs (Interview 11, Pos. 39), show a keenness to learn more about experimental methods, however, practical concerns like immediate execution often take precedence over educational pursuits (Interview 9, Pos. 55-57, 61). As outlined in the ecosystem paragraph, certain partners within a close and linear value network face the challenge of client dependency. If the actors' clients do not recognize the value of field experiments, there is little interest in conducting them (Interview 9, Pos. 86-87, 91-95; Interview 11, Pos. 9, 11, 19). The importance of an initiative like the X-C is diminished when translating the value of field experiments to clients incurs more costs and administrative work (Interview 9, Pos. 93, 293). Cultural resistance to experimentation methods is also an issue for some actors (Interview 9, Pos. 91). Creating mutual understanding and overlapping interests between research actors and external actors when conducting experiments together is further challenging (Interview 5, Pos. 12; Interview 7, Pos. 19). Finding a potential match between researchers and practitioners is difficult and sometimes not demanded by certain groups, particularly when actors, like the startup, are not interested in long-term research-focused field

experiments (Interview 10, Pos. 17, 29, 61, 80-81, 85, 89). In summary, the X-C's value propositions are not uniformly important across all actor groups. The importance of the X-Collider initiative is thus multifaceted. It has the potential to be a key player in applying rigorous methodology in practical contexts and fostering collaborations that benefit academia and industry alike. Realizing this potential, however, will depend on making strategic decisions that align with the diverse goals of stakeholders and effectively navigate the complexities of collaborative experimentation.

4.4 A theoretical Framework - Crafting Orchestration Roles

Following up on the challenges by actors in the ecosystem mentioned, the X-C must adopt multiple roles, drawing parallels to the patient innovation platform case mentioned in the literature review but with nuanced distinctions due to its unique attributes. While the framework by Cennamo et al. offers a foundational orchestration model for platforms in healthcare (Cennamo, Oliveira, and Zejnilovic 2022), it requires expansion and customization to align with the multifaceted nature of the X-Collider operating in an ecosystem for field experimentation and cannot be applied without adaptation.

Figure 2– Proposal for ecosystem orchestration with three orchestration roles



Based on synthesized insights from interviews, challenges, and innovation bottlenecks identified by research actors and external stakeholders, this thesis proposes three pivotal roles

to actualize the orchestration of a field experimentation ecosystem, introducing an expansion and adaptation of the contemporary framework of orchestration introduced in the literature. For this, the individual innovation bottlenecks and challenges were aggregated.

In the role of a *Community Organizer*, the Nova SBE initiative harmonizes the diverse innovation nodes, or partners in the Nova SBE ecosystem. This role reflects the coordination endeavors showcased in patient innovation networks, as delineated by Cennamo, Oliveira, and Zejnilovic (2022), where unrecognized value networks were unveiled and seamlessly integrated into a cohesive healthcare innovation ecosystem. Echoing the findings highlighted in the results section, the X-C seeks to mend the fragmentation prevalent among field experimenters. As one key activity, the X-C is poised to serve as a crucible for the creation, dissemination, and application of knowledge around experimentation. Put differently, the X-C aims at becoming an extension of knowledge. This aligns with the literature, particularly the insights from Dhanaraj and Parkhe, which underscore the significance of knowledge mobility - the unobstructed dissemination and practical application of knowledge across the ecosystem (Dhanaraj and Parkhe 2006). By channeling its efforts into knowledge absorption, network identification, and interorganizational socialization, the X-Collider transcends its role as a mere facilitator. Furthermore, it acts as a relationship manager, tasked with fortifying and nurturing research partnerships within and beyond Nova SBE, as seen for actor's needs for a shared understanding of the joint study and clear expectation management. Recognizing that partners enter collaborations with varied expectations, the X-Collider works to align these divergent outlooks, fostering a conducive environment for knowledge flow. It also champions a dual culture that values both academic rigor and practical application, addressing the need for proactive network identification to instill a culture of experimentation and to surmount bureaucratic impediments and cultural disparities within the ecosystem. Lastly, as an engagement manager, the X-C ignites motivation among participants, catalyzing increased field

Table 1 – Innovation Challenges and Orchestration Roles adapted and enhanced for the X-Collider Initiative based on the Work by Cennamo, Oliveira and Zejnilovic (2022) for the Patient Innovation Platform Case

Orchestration role	Main innovation challenge (incorporation experiments)	Type of bottleneck	Recommended organizational response	Orchestration type/activity
Community Organizer	Lack of common understanding between sides, different expectations	Communication and alignment	Organization of joint brainstorming sessions with all actors Creation of joint learning opportunities	Knowledge exchange facilitator* – “Orchestrator provides the venue and coordinates knowledge exchange among peers in the form of solutions and feedback”
	Lack of resources (HR & Time) to engage in effective relationships with partners	Resource allocation and setting priorities	Facilitate organized sessions with the partnered research and external actor match Set up joint project plans and provide material (e.g. digital planning tools or presentations) to support relationship and alignment	Relationship manager - Support the establishment and maintenance of partnerships
	Lack of awareness for the importance of field experiments	Knowledge and awareness	Conduct informational/ educational campaigns, workshops, and seminars (potentially even through an executive education course) for potential upselling of experimentation services within the NOVA SBE ecosystem	Engagement manager* - “Orchestrator directs community an urgency of action, engages users’ focal attention, creates and motivates members to adopt solutions”
Strategic Connector	Actors are often depended on client requirements and need help explaining the value to other players	Dependence on client requirements	Develop value propositions, case studies, and tailored presentations for value demonstration Show and quantify the value of data driven decision making to create mutual understanding with partners	Value translator – Articulate and communicate the value of experimentation to various stakeholders

Orchestration role	Main innovation challenge (incorporation experiments)	Type of bottleneck	Recommended organizational response	Orchestration type/activity
	Ensuring mutual understanding and interests between researchers and external players	Collaboration	Facilitate regular alignment meetings, joint workshops, and shared goal-setting sessions	Information amplifier* - “Orchestrator selects, validates, and diffuses only relevant information”
	Missing research partner match, lack of knowledge about other party’s interests	Networking and matchmaking	Leverage Nova SBE connections and match actors for joint field experiments Create a comprehensive database of interests and capabilities, organize networking events	Value networks bridging* - “Orchestrator facilitates market access by connecting innovators market and healthcare value to key players from the local chain”
Experimentation Enabler	Lack of knowledge about experimentation setup and design	Expertise and methodological knowledge	Creating standardized documents and best practices for field experimentation Overseeing study design Create learning opportunities about field experimentation (exec course) Become a hub of knowledge for field experiments (especially in digital)	Knowledge champion - Act as a central repository for field experiment knowledge and best practices
	Lack of experience with experiments	Operational efficiency and technical know-how	Ensuring data management best practices, providing consultation, and ensuring compliance with regulations (to ensure consistence & guidance) Either/or short term, medium term and long-term experimentation Introducing specific GenAI tools as means to experiment	Research consultant - Advise on the design, implementation and management of field experiments, facilitate the use of AI tools for experimentation

Based on the work of “Unlocking Innovation in Healthcare” by Cennamo, Oliveira and Zejnilovic (2022) – terms with a *were taken from the from Table 4 “Innovation Challenges Faced by Patient Innovators and Orchestration Activities Designed as Organizational Responses to the Challenge”

experimentation activities. In sum, the X-C facilitates knowledge exchange and collaboration as well as enhancing the potential of existing relationships while nurturing new ones.

In the *Strategic Connector* role, the X-C goes beyond simply pairing research and external actors; it strategically merges knowledge, expectations, and interests across the ecosystem. This function is pivotal for crafting and communicating value propositions that resonate across the stakeholder spectrum, improving market understanding and appreciation for field experimentation. Interviews revealed that a significant barrier to utilizing experimentation is the difficulty in communicating its value to stakeholders, which often stems from organizational culture. Thus, a primary function of the Strategic Connector is to act as a value translator, articulating the benefits of experimentation to various stakeholders and bridging the gap between theory and market realities. Additionally, the Strategic Connector tackles the challenge of mutual misunderstanding and disinterest among collaborators, particularly in joint experimentation efforts. By serving as an information amplifier, the X-C facilitates shared understanding and fosters collaboration between research actors, thereby enhancing the collective experimental endeavor. Lastly, the role includes a transactional aspect. Here, the X-C engages in matchmaking to ignite new field experiment collaborations. This matchmaking ensures the practical application of research ideas, bridging the gap between hypotheses and actionable projects. It is a role that ultimately contributes to innovation appropriability, ensuring that ideas are not just conceived but also executed, leading to tangible advancements and applications. Through these orchestrated efforts, the X-C solidifies its position as an essential bridge builder within the Nova SBE ecosystem.

The X-C, as an *Experimentation Enabler*, is set to be a nexus of expertise and methodologies in field experimentation, addressing the knowledge gaps and inexperience among stakeholders. This role is dual-faceted: Firstly, the X-C will serve as a knowledge champion, offering essential insights into field experimentation. This involves cultivating internal expertise,

simplifying complex data concepts, and devising both personalized and standardized approaches. Key responsibilities include developing procedural guides, supervising study designs, and offering executive courses that meld theoretical concepts with practical execution. This may entail the incorporation of advanced technologies like GenAI to refine the process, enabling swift, data-informed decisions. Secondly, the X-C will act as a research consultant, providing tailored advice on methodologies and overseeing field experiments across various projects, thereby bridging the efficiency and technical gaps. This role is pivotal in fostering network stability and facilitating knowledge mobility. Through education, the X-C promotes a culture of methodological integrity and equips actors with the tools for robust experimentation. Ultimately, the Experimentation Enabler is dedicated to infusing the ecosystem with actionable knowledge and practical consulting services to transform experiments from theoretical constructs into tangible realities.

4.5 Practical Recommendations for the X-Collider Initiative

In this section, this thesis presents practical steps and recommendations for the X-C, acknowledging that full-scale implementation of all orchestration activities from the beginning, though ideal, is not feasible. When considering the internal assessment of the X-C and the evaluation section, it becomes clear that it is inadvisable for the X-C staff to aim to cover all experiment types from the start. Given the current constraints, attempting to pursue short-term, pragmatic A/B testing (focused on immediate outcomes) and long-term, comprehensive randomized control trials (geared towards innovation and research) simultaneously is overly complex and beyond current capacity. The discussion leads to the recommendation that the X-C team should initially focus on facilitating research-focused, long-term field experiments. This approach aligns with suggestions from researchers and involves engaging in all three orchestration roles. The X-C should first act as an experimentation enabler, providing support for the design, setup, and execution of experiments. This support should strike an optimal

balance between standardization and personalization. Their involvement in an ongoing pilot project, which includes such an experiment, offers a valuable opportunity for rapid learning and community organization. This project also highlights the significant need for strategic matchmaking among research actors, policymakers, and large corporations. However, if the X-C team chooses to prioritize quick A/B testing, the focus would shift towards managing individual actors as an experimentation enabler. This shift would reduce the need for extensive strategic matchmaking and community organization, repositioning X-C primarily as a facilitator of data-driven experiments. Regardless of the chosen focus, given the limited financial and human resources, prioritizing specific areas is essential to create a unique selling point for the X-C.

Next, addressing the divergence within the X-C team, it is critical to selectively identify initial partners. Contrary to incorporating all actor groups, this thesis suggests focusing on large corporations and policymakers already partnered with Nova SBE and interested in long-term studies, as well as research-oriented actors at Nova SBE. These groups share aligned interests, which facilitates functional and effective R&D collaborations and high-quality research outputs. Working directly with experiment conductors, rather than intermediaries, simplifies managing an extensive value chain and its associated actors. Once the X-Collider initiative has established internal expertise and initial successful projects generate revenue, it can consider expanding into smaller practical testing projects. The interviews indicate that field experiment needs are complex and highly specific, especially when involving multiple organizations. Hence, X-C should adopt a project-by-project partnership approach, avoiding a generalized revenue model like bundled services, which could lead to unmanageable complexity. The interviews also revealed limited willingness among startups and service providers to pay for X-C's services, indicating that these are not viable target groups. A sustainable revenue model might involve billing long-term experiment projects on an hourly basis, similar to consulting

projects, aligning with the research consultant role in the presented framework. Regarding team composition, it is vital to determine who will assume each orchestration role, with the scientifically inclined member serving as the Experimentation Enabler and the member with managerial expertise assuming the roles of Strategic Connector and Community Organizer.

5 Limitations

This exploratory thesis acknowledges several limitations affecting the validity and generalizability of its conclusions. The number of interviews per actor group was limited, and the perspectives gathered may not fully represent the broader community. Subsequent research should expand the interview pool to include a wider array of research and external actors. There is also a potential bias as all external actors interviewed were part of the X-C network; future studies should aim to include a more diverse sample from the wider public and private sectors. Social organizations, or training partners were not within the scope of this research but should be considered in future studies to provide a more comprehensive view. Additionally, the ethical implications of this research warrant careful consideration to ensure that the dissemination of findings does not adversely affect the participants or their organizations.

6 Conclusion

This thesis has critically evaluated the significance of the X-Collider, an initiative for field experimentation at Nova School of Business and Economics. To assess how the Nova SBE DKSC can orchestrate an ecosystem for field experimentation, it has further proposed three essential orchestration roles necessary for bridging theoretical research with practical application.

The study reveals that the X-C operates within a richly diverse ecosystem, comprising both research and external actors, with the X-C playing a central orchestrating role. Research interests range from A/B testing for immediate product development outcomes, such as button

color changes, to long-term oriented field experiments, including randomized controlled trials that aim to understand causal relationships in broader applications, like advertising effectiveness. The investigation has shown multifaceted importance for an initiative for field experimentation, calling for strategic decisions on the X-C's positioning. After a thorough analysis, this thesis highlights a strategic imperative to prioritize long-term, academically rigorous field experiments. Actors within the ecosystem face several common obstacles: a disconnect in understanding and expectations among collaborators, resource constraints, dependencies on client or stakeholder requirements, difficulty in finding the right research partners, and a general lack of knowledge and experience with field experimentation methodologies. In response, this thesis has introduced three pivotal orchestration roles: the Community Organizer, the Strategic Connector, and the Experimentation Enabler. Each role is instrumental in surmounting the innovation challenges and bottlenecks within the ecosystem. The Community Organizer excels in managing relationships between different research actors, nurturing a culture ripe for experimentation, and breaking through bureaucratic and cultural impediments. The Strategic Connector matches actors for potential collaborations and skillfully clarifies market complexities, ensuring alignment between research aims and industry needs. As an Experimentation Enabler, the X-Collider stands as a beacon of expertise for methodological knowledge. Acknowledging the limitations of this exploratory study, future research could expand upon these findings by exploring a broader range of ecosystem actors and their interactions within the Nova SBE context. Such research might also examine whether these orchestration roles are applicable across different types of ecosystems, potentially leading to a generalized framework for ecosystem management and orchestration.

In conclusion, the X-Collider initiative represents a microcosm of the broader pursuit of knowledge and innovation, reflecting the dynamic interdependencies that characterize the intersection of academia and industry in today's rapidly evolving landscape.

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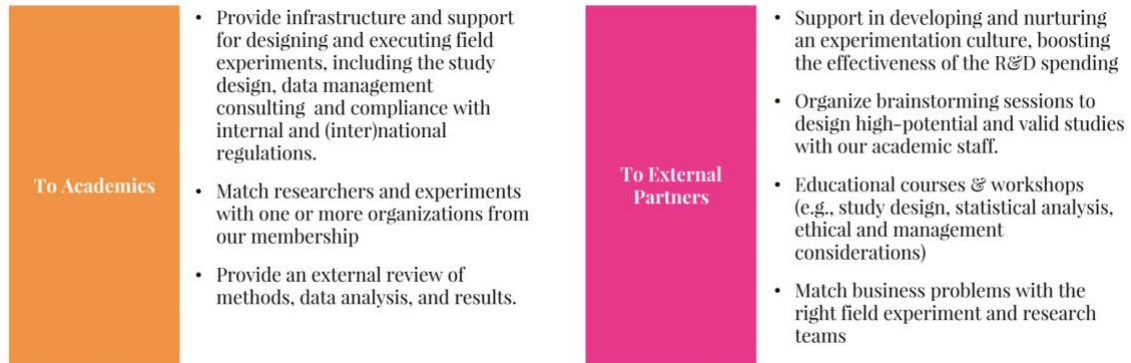
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Appendix

Appendix A: Goals of the X-Collider Initiative at Nova SBE



Appendix B: Interview Participants excluding personal Data

Table: Anonymized Interview Participant sorted by Actor Category

Interview Number	Department/Position	Actor
1	Nova SBE DSKC	X-Collider staff
2	Nova SBE DSKC	X-Collider staff
3	Nova SBE DSKC	X-Collider staff/ Research actor
4	Nova SBE DSKC	X-Collider staff/ Research actor
5	ERA Chair, Social Innovation, Leadership for Good	Research actor
6	Nova SBE Co.Innovation Lab	Research actor
7	Nova AFRICA Knowledge Center	Research actor
8	Nova SBE DSKC	Research actor
9.1	Service Provider	External actor
9.2	Service Provider	External actor
10	Startup	External actor

Interview Number	Department/Position	Actor
11	Public Agency	External actor

Source: own illustration

Appendix C: External Partner Network of the X-Collider



Appendix D: Data Sources used for Analysis

Source	Description	Data
X-Collider presentation material	A shared pitch deck of the Data Science Knowledge Center	Secondary
Interviews with researchers at Nova SBE	Semi-structured interviews	Primary
Interviews with X-Collider staff	Semi-structured interviews	Primary
Interviews with external actors	Semi-structured interviews	Primary

Appendix E: E-Mail to External Actors (Introduction)

Dear (name) team,

I hope that this email finds you well.

As part of our ongoing collaboration, and more particularly, in the area of field experiments, I'd like to introduce you to Eva Hohn, a student doing the thesis with us on the development of a specialized platform, which we affectionately refer to as "X-Collider." This platform is geared towards enhancing our cooperation with innovative companies like yours and streamlining the validation process of causal hypotheses through field experiments.

Eva's work involves exploring the role and orchestration requirements of the X-Collider, and your insights and expertise are of great importance in ensuring its success. She is eager to gain a deeper understanding of the challenges you face in the field of experimentation, your vision for the ideal implementation of such a platform, and your expectations from it. Your feedback will play an important role in shaping the platform's design and features.

To that end, **I would like to ask if you would be open to participating in an interview (roughly 1h). If so, please provide two or three available dates and times at your convenience. Eva will then schedule the meeting accordingly.**

Thank you very much for your help

Have a great weekend.

Appendix F: Interview Guides

Interview Guide for External Partners

Introduction

1. Mapping the Individual Value Networks:

- Please describe your company
- How does your organization make decisions? Are experiments involved in the decision-making process? Why/why not? If yes, between firms or across firms?

2. Innovation Bottlenecks and Challenges in Field Experimentation:

- What are the primary challenges your organization faces when it comes to experimentation? (depending if you already use field experiments or not)
- Are there any specific bottlenecks in the innovation process related to field experiments?

3. Ideal State:

- How would you describe the ideal state for decision making for your organization? Is it based on data? Experimentation?
- What resources or support would be needed to achieve this ideal state?

4. The X-Collider:

- Why have you agreed to commit to a collaboration with Nova SBE to conduct field experiments? What is your objective?
- How do you see the collaboration benefiting your organization?

5. Expectations of Nova SBE:

- What do you expect from Nova SBE in the collaboration? (roles or responsibilities)

6. Recommendations for the Orchestrator: (Here: define orchestrator)

- What recommendations would you give to the orchestrator to ensure the success of the X-Collider initiative?
- What are three things Nova SBE should do to make the collaboration a success?
- Put yourself in the shoes of Nova SBE, what would you consider? Any specific hurdles or roadblocks? Anything they must do to succeed?

Closing - Is there anything you want to say that has not been asked?

Interview Guide for Research Actors

Introduction

1. Mapping the Individual Value Networks:

- How close is your research connected to practical fields?
- Who are your primary collaborators or stakeholders in your research? Do you work together with companies?
- Do you conduct field experiments? (why not?)
- How would describe the culture of experimentation at Nova SBE? Do many people experiment? Do they know how to?

2. Innovation Bottlenecks and Challenges in Field Experimentation:

- What challenges do you encounter when conducting your research (especially in experimentation)?
- Are there specific bottlenecks in process (e.g. study design, data management, compliance with international regulations,...)?

3. The X-Collider:

- What is your general impression of the X-Collider? Would you become an active member? (why not?)
- Do you have any concerns, potential roadblocks or challenges you see for its implementation?

4. Expectations of Nova SBE:

- What role and support do you expect from Nova SBE / the Data Science Knowledge Center for the X-Collider?
- Is there anything you would specifically wish for and would like to highlight?

5. Recommendations for the Orchestrator: (Here: define orchestrator)

- What recommendations would you give to the orchestrator to ensure the success of the X-Collider initiative?
- What are three things Nova SBE should do to make the collaboration a success?
- Put yourself in the shoes of Nova SBE, what would you consider? Any specific hurdles or roadblocks? Anything they must do to succeed?

Interview Guide for X-Collider Staff (Orchestrators)

1. The X-Collider :

- Tell me about the X-Collider. When did it start? Who was involved in the process of building it? When did you start it? Where are you right now?
- What problem or need is the X-collider taking on? Why have you started working on it?
- Who are the primary stakeholders or collaborators for the X-Collider (actor groups)? (who is primary user(s))? What are the main paths (researcher – user matching, only researchers and the X-Collider)
 1. How do you see their individual networks right now? Why have you decided to connect them?

2. The vision/product:

- What is the vision for the X-collider?
- What is its USP and value proposition?
 1. Its functionality purpose
 2. Technology features
 3. User Types
 4. Organizational process related to the features
- Why did you target companies?
- How do researchers benefit from the collaboration?
 1. Matching?
 2. Capacity?
- What is the revenue model?
- Do you have any priorities what you want to start with or push forward the most?
- What is the concrete way forward for the next months?

3. Community Roles and Expectations of Nova SBE:

- What expectations do you think you will have from researchers and companies?

4. Recommendations for the Orchestrator:

- As orchestrators, what do you think are going to be your activities? Do you have learnings from previous experiences when it comes to orchestration?
- In one sentence, how do you envision bridging the gap between academic research and practical application?

Appendix G: X-Collider potential Core Features and Overview

Table – X-Collider anticipated core features and value proposition

Value proposition	Technology feature	Main user type	Organizational process
Provide infrastructure and support for designing and executing field experiments, including the study design, data management, consulting, and compliance with (inter)national regulations	Manage & Design Field Experiments, Analyze Data	Researchers—who design and execute experiments using the provided infrastructure. External partner—that provide context and resources for the experiments.	Overseeing study design, ensuring data management best practices, providing consultation, and ensuring compliance with regulations (to ensure consistence & guidance)
Match researchers with one or more organizations or business problems with the organization and researcher	Matchmaking	Researchers—seeking suitable organizations for their experiments. External partner —looking for relevant research expertise or vice versa	Facilitating the matchmaking process, ensuring alignment between researchers and organizations, managing data base and ensuring alignment between business problems and research teams.
Provide an external review of method, data analysis, and results	Manage & Design Field Experiments, Analyze Data	Researchers —relying on external reviews to validate their methods and results.	Conducting external reviews, validating research methods, and ensuring accurate data analysis.
Support in developing and nurturing an experimentation culture, boosting the effectiveness of the R&D spending (e.g. with brainstorming session on high potential study fields)	Facilitate Collaborative Sessions, Conduct Training Sessions	Researchers & External partner - participating in sessions to foster a culture of experimentation and enhance R&D effectiveness.	Organizing and facilitating sessions, promoting an experimentation culture, and monitoring R&D effectiveness.
Educational courses and workshops	Conduct Training Sessions	Researchers & External partner - attending courses and workshops to enhance their knowledge and skills in experimentation.	Designing and conducting educational courses and workshops, ensuring content relevance (Executive Education)

Source: X-Collider Presentation and Interviews

Appendix H: Membership Information and Types

Nova SBE Membership types

Research

- All Nova SBE researchers are, by default, part of the initiative
- Each member accepts to respect the intellectual property of ideas, authorship agreements, and ethical norms, acting in good faith and collaborative spirit to promote research and knowledge creation, contributing to the good name and reputation development of Nova SBE
- X-Collider will actively search for matching faculty but cannot guarantee fair distribution if the researchers do not maintain interest and deliver their fair share of work to complete mutually agreed-upon targets

Intra-organizational partners

- X-Collider is led by the DSKC and advised by an Advisory Board comprised of Faculty from different Knowledge Centers and Institutes
- Any organization within the School can partner to bring projects, partnerships, etc., and share the profit and costs under fair agreements and respecting the general norms

5. Partners

6. Team

7. Advisers

8. Benchmark

9. Credentials

10. Courses

Academic Membership types

Affiliate

- University that wants to learn with us
- Has research staff or students joining us on projects
- Can provide research ideas under the condition that the research includes at least one Nova SBE academic as a contributor/co-author

Community member

- University that brings partners and shares profit and costs of projects
- Has research staff or students joining us on projects
- Can organize sponsored education with our co-participation, with at least one Nova SBE professor offering one or more courses
- Can provide research ideas under the condition that the research includes at least one Nova SBE academic as a contributor/co-author

5. Partners

6. Team

7. Advisers

8. Benchmark

9. Credentials

10. Courses

Source: X-Collider presentation

Appendix I – Startup Challenges and Bottlenecks with Proof Quotes

The first key actor in the ecosystem is a Portuguese technology startup focused on "improving the experience of a real estate transaction by bringing together all parties involved." (Unlockit 2023). In an interview, the founder elucidates: "*A startup is like, you have to survive.*" (Interview 10, Pos. 49). In this operational survival mode, their main challenges center around building a sustainable business (Interview 10, Pos. 29). The startup's current approach to test their products is "*based on qualitative input, not on data-driven A/B testing*" (Interview 10, Pos. 14). However, there is an expressed intent to integrate more rigorous, data-driven experimentation methods into their research and development processes, particularly in the testing of their forthcoming MVP (Interview 10, Pos. 39, 41). Put differently, experimentation is mainly planned to be conducted within the firm (Bandiera, Barankay, and Rasul 2011) for their business building and across the firm for their product development and research and development. Derived from the interview, their main innovation challenges are individual resource allocation and prioritization, business model discovery, product development and achieving market fit, research and development effectiveness, and data-driven decision-making.

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Resource Allocation and Prioritization		"It was about the business, not about the product itself, OK. So the building a startup, it's really complex" (Interview 10, Pos.17)
		"A startup is like you have to survive. You know, that's the first rule. First rule you need to survive. In terms of to be perfect or not, that's another thing because startups have phases (...) " (Interview 10, Pos. 49)
	Lack of financial resources	"But we have the knowledge, you know, the problem is that I do not have the person to do it and not the money" (Interview 10, Pos. 85)
	Lack of human resources	"I said we are in a survival mode is that we cannot do everything. We are not corporate, we don't have infinite money." (Interview 10, Pos. 89)
	Need for operational guidance	

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Business Model Discovery	Expertise in business building and operational excellence	“I mean the beginning of the of the process of this business discovery process”.(Interview 10, Pos. 29) "It was about the business, not about the product itself, OK. So the building a startup, it's really complex" (Interview 10, Pos. 17) “So I'm really open minded person and what I want is more feedback, more open minded people here bringing their value, bringing their knowledge and that's the path to build a great company.” (Interview 10, Pos. 53) “(…) monetize it and how we will position the product in terms of our stakeholders” (Interview 10, Pos. 37)
	Internal and external knowledge sharing	“(…) how can we monetize the product and how will. (...) Um position in terms of all the competitors you know, so we are trying to find the path. (Interview 10, Pos. 29)
Product Development and Market Fit	Testing the new minimal viable product	“We are with our MVP right now, our minimum viable product you, you know (...) build from scratch the application because the first application was not correct (...) we will have some problems in the near future.” (Interview 10, Pos. 41) “(…) bring the product to life through business and engineering” (Interview 10, Pos. 39)
	Lack of knowledge about market positioning	“So I decided to take it to the to the garbage and to start building another, and right now we are building another like for the last year and we will launch it in February of 2024 and that's the time where we will start making some AB testing.” (Interview 10, Pos. 41)
	Lack of knowledge about customer preferences for certain product features	“(…) you need to start building a dashboard to discover where we are losing people where people are having some difficulties in the application.” (Interview 10, Pos. 45)”

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Research and Development (R&D)	High complexity of new products and workflow development	“Uh, you have a lot of variables. Of all the pieces that you are putting together at the right time” (Interview 10, Pos. 19)
	Need for R&D partnerships and collaboration	“It was not a product driven experiment. OK, it was like researching development on the business side.” (Interview 10, Pos. 21)
	Lack of capacity to conduct field experiments	“What I think is that my people as to concentrate on developing other things, so my decision is to hire someone or to have to have their kind of partnerships” (Interview 10, Pos. 61)
		“Defying the pain points of every workflow” (Interview 10, Pos. 65)
	Balancing client feedback with product vision	“(Need for) highly motivated and qualified people” (Interview 10, Pos. 73)
Data-Driven Decision Making		Eva Hohn: “OK, so basically you would outsource all the AB testing to someone another in the ideal case”, Tiago: “That's it. Yes, if I like the person, and if I if I like the deal, yes” .(Interview 10, Pos. 80-81)
	Lack of capacity for A/B testing	"We will start making some AB testing." (Interview 10, Pos. 41)
Regulatory Compliance and Legal Expertise	Lack of knowledge about field experiments	“(…) building a dashboards to discover where we are losing people where people are having some difficulties in the application." (Interview 10, Pos. 45)
	Understanding of regulation and legislation in new technologies	“What I need is some, well, qualified people in terms of regulation, legislation" (Interview 10, Pos. 57)

Appendix J – Service Provider Challenges and Bottlenecks with Proof Quotes

A second actor in the current innovation ecosystem of the X-Collider is a service provider, a “high-tech system integrator providing professional services focused on creating business value through Analytics and Cognitive solutions” (Celfocus 2023). Their day-to-day operations predominantly involve managing client-driven projects with key account partners, constrained by specific requirements and established processes. As one interviewee reflects, “*We have mainly requirements from the client; we just implement (...) which means that there's not a lot of space, in fact, for field experimentation*” (Interview 9, Pos. 2). The main innovation challenges center around enhancing operational efficiencies and product development to add value to their software development endeavors. Within the realm of product development, the company faces the challenge of limited expertise in field experiments, with a development model that is primarily requirement-driven and focused on functional testing. A significant hurdle is in translating the value of digital experimentation to clients. The difficulty lies in demonstrating experimentation as a billable and valuable service, necessitating a compelling value proposition to secure client engagement. Lastly, company culture stands as a challenge, with a general lack of knowledge in conducting field experiments, which is further exacerbated by internal resistance and the rigidity of established processes.

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Resource Allocation and Prioritization		“We have mainly requirements from the client, we just implement them and test them and then well, we just deliver it to the customer, which means that there's not a lot of space in fact for field experimentation” (Interview 9, Pos, 2) “I believe there could be some space for experimentation on that part. Of course, projects are heavily pressured by client and delivery. Uh, so there is not always time for that, but there are also some internal projects going on where that where those types of methodologies could be useful in more on the training part. Yeah, I believe there could be some space.” (Interview 9, Pos. 63) “We want to do the things in the more efficient way, but we are used to do something in a in a straight line and if we have to deliver a product within a certain date, there's not that much room for experimenting. Different methods and things like that. So you just go with what you're used to.” (Interview 9, Pos. 69) “But the majority of the of the cases we have really tight timelines that we need to accomplish with the clients. (Interview 9, Pos. 77)” “Typically, that's done by clients and when they reach us, they come with a bunch of specific requirements and masks and needs for us to develop software that that part of research normally is done by our clients, and we don't go too deep there.” (Interview 9, Pos. 102) “So those types of testing on a software are interesting, but when those things come to us, or typically it's the client that defines it, not us, of course we can suggest, but normally the requirements come pretty much more closed and we just have to implement them.” (Interview 9, Pos. 183) “As for doing experimentation with clients and projects and having researches and things like that within our teams, (...) within our methodology of working normally it doesn't work.” (Interview 9, Pos. 207) “If it's something that we would like to offer to our clients within our, let's say, our methodology of delivering software, OK, that would be the first step because typically and that is the role of validation that our customers want to do themselves right, because they have to validate what is being implemented.” (Interview 9, Pos. 259)
	Strict adherence to client specifications limits experimentation.	
	Project resources are fixed, with high pressure from clients.	
	Clients often conduct experiments themselves, reducing the opportunity for the company to innovate.	

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Going more Digital	Standard processes inhibit efficiency and innovation improvements.	“(…) our typical projects don't require that, but it's something that we at Celfocus as a whole are trying to address and mainly with some automated cases with the artificial intelligence machine learning and those types of technologies (…) especially for customers and customer relationship management” (Interview 9, Pos. 36)
	Lack of knowledge about digital experimentation methods.	„In the scope of what you could be trying to do normally, um, I would see it in two, two big areas, one on the operational deficiency of the organizations (…) where can we experiment different approaches, let's say um and changing the process, testing it during one week, two weeks or one month and see and compare the results within that. And that's sort of AB testing more less and it that could be useful. (Interview 9, Pos. 40-43) “I don't have any experience with field experimentation” (Interview 9, Pos. 6)
Product Development		“Um and then more on the revenue side or the product development. (…) From my experience here at Celfocus, but I believe in our company there could be product owners or Scrum masters. That's when they try to design a certain feature and understand if it works and do like focus groups testing and with real customers alpha and beta launches and things like that. Um, when we are developing a product or a software, maybe that could also be relevant for some companies testing with, let's say a group of customers. If the solution works, if it corresponds to its expectations and try to feel how the customer is interacting with the new development or with the new solution, that could also be interesting. Another different approach on this I would say more on the revenue or experience, right.” (Interview 9, Pos. 45-52)
		“We also have an area here in Celfocus that is more related with testing then functional testing. I think automated testing. Maybe more regarding software development of course. And I think that area could benefit also from some new skills or some type of training regarding new methodologies and things like that, yeah.” (Interview 9, Pos. 64-67)
	Limited knowledge about field experiments.	“It's on a requirement base. So for each requirement there is a set predefined. What is the expected result?” (Interview 9, Pos. 140)
	Development primarily focused on functional testing based on client requirements.	“Yeah, but usually we test against an expected result, so we know when we when we are performing the test, we know that we are expecting these results to happen.” (Interview 9, Pos. 153-154) “If the buttons should be on the right side or on the left side or depending on the function that the button must do or the action, you could recommend from our experience, so those that that is what I would believe that could be more interesting from a testing point of view.” (Interview 9, Pos. 174)

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Translating Value of digital Experimentation to Clients	Difficulty in demonstrating the value of experimentation as a billable service.	Eva Hohn: And coming from your projects, um, like do you think that there will be a demand from the client side phone to try more experimentation?" Interviewee 2: "Well, we work with different (client names) as I told you, the one that I spent most of the time here in Celfocus. I would say no." (Interview 9, Pos. 86-87)
	Need for a compelling value proposition to encourage client buy-in.	"Like as they are really big company, it's really hard for them to change and to try different things. Eventually we could have that, but at least from the beginning, at least for (client name) Group, I would say that will have some resistance on trying to convince them." (Interview 9, Pos. 91) "Yeah, the added value would have to be very explicit and um, it would have to pitch it very well and for them to acknowledge and understand that it would be an advantage for them." (Interview 9, Pos. 93) "So maybe it needs a good value proposition for them to agree and go forward with different types of methodologies." (Interview 9, Pos. 95) „Yeah, I think that would we would need to analyze because if that would mean an extra cost for the client, I would say that it would need to be really well explained why it would be beneficial if there would be no extra cost for them and no extra time spans or they would need to, they wouldn't need to wait more time to get it.“ (Interview 9, Pos. 217) "It's all about the price that what would cost to the to the client, right?" (Interview 9, Pos. 293)
Company Culture	General lack of knowledge in conducting field experiments.	Eva Hohn: "So do you guys know how to conduct field experiments and how it works, scientifically speaking?" Interviewee 2: "I Haven't and I don't know." Interviewee 3: "Well, I've had some, I would say some workshops or some training in the past more related with I would say more of the product development part." (Interview 9, Pos. 55-57)
	Internal resistance and set processes.	"Well, I'm not sure on how keen um the development teams or the team leads on development side would be regarding that" (Interview 9, Pos. 61) "It would depend if people would understand and see. Yeah, this could be really cool or very nice to introduce in our project. Let's try to do things a bit different than we do, and let's test it, but and see if the client accepts it." (Interview 9, Pos. 197-199)

Appendix K – Public Agency Challenges and Bottlenecks with Proof Quotes

A third pivotal entity within the X-Collider ecosystem is a public institution dedicated to addressing employment and professional training in Portugal. In an environment where actions are closely tied to government decisions and mandates, the IEFPP navigates a complex web of operational constraints, including a scarcity of human resources and a workload that leaves little room for exploratory practices. Furthermore, the pursuit of innovation is constrained by the need to secure government sponsorship and the management of a compact team that is still in its formative stage of professional development. Despite these challenges, there is an expressed interest in adopting more advanced data-driven approaches to better understand and serve the regional employment markets, "*...they are specific to the regions*" (Interview IEFPP, Pos. 25), indicating a need to align national employment measures with regional specificities. The conversation with an IEFPP employee reveals an ambition to leverage external expertise and data to enrich their understanding of the labor market. The IEFPP has already collaborated with Nova SBE on an experimentation project during the Covid pandemic, developing an algorithm aiming to refine their approach to addressing long-term unemployment through algorithmic insights, which did "work really well" (Interview IEFPP, Pos. 57).

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Resource Allocation and Prioritization	Limited human and time resources available for initiating experiments	"And the problem is we have a short human resource" (Interview 11, Pos. 7)
		"(...) it's so much that we don't have time to experiment." (Interview 11, Pos. 9)
	Long waiting times for financial support for projects	"No, I think it is interesting because uh, we you when we are involved in the process and we can achieve know-how that we don't have. So it is important and in our team our assessment team are only five people, five persons." (Interview 11, Pos. 39)

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Regional Specificity and Data Integration	National measures not reflecting regional specificities	“Maybe to get data from that other sources that will complete our sources and also have the knowledge of experiences.” (Interview 11, Pos. 29)
	Lack of comprehensive data for informed regional decision-making	“(…) experiences, that can be useful for us and mostly regarding the labor market Because we have, we have data from the National Institute of Statistics and we have micro data from banco do Portugal and we only have access to that they published, not to some kind of bring micro data that that can help us to, to see the other, to know better the environment of the Market of employment markets” (Interview 11, Pos. 31)
Expertise in Experimental Design	Absence of internal expertise to design and conduct field experiments	“Yeah, I don't have many experimentation because when we need to do that, we will resource externally. So we don't do it ourselves and more the reason this experience was with Susana and with Nova SBE. And we have a project that was developed by Nova SBE. So that was the last one. I don't think we had in this in the recent years another experiment.” (Interview 11, Pos. 5)
	Dependency on external partners for expertise	
Governmental and Institutional Constraints	Decisions contingent on government and ministry directions	“With our beneficiaries is so much that we cannot and stakeholders when we, when we are talking about data, it's more stakeholders and it's so much” (Interview 11, Pos. 9)
	Challenges in recruitment within the public administration system	“We depend on the decisions of our government and of the ministries.” (Interview 11, Pos. 11) “We have to give answers to Ministry of Labor. And the resource, Uh uhm, how can I say uh, is effect with that and we don't have resources enough to develop another kind of activities.” (Interview 11, Pos. 19)

Appendix L – Large Corporation Challenges and Bottlenecks with Proof Quotes

A Portuguese telecommunications company emerges as a collaborator in a study with researchers from Nova SBE's Data Science Knowledge Center, poised to investigate the impacts of advertising within large language models like GPT. The proposed field experiment, still in the formative stages, aims to discern the spillover effects of advertisements on various products. The company, which has an existing partnership with Nova SBE, seeks the X-Collider's support to navigate the complexities of experimental design and the nuances of corporate-academic collaboration. The initiative stands at the intersection of academic inquiry and practical business application, aiming to execute a randomized field experiment that measures advertising efficacy in a real-world corporate setting. A key challenge in this nascent stage is conceptualizing and communicating the experiment's design to ensure alignment with the company's technological capabilities and data requirements.

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Experiment Design and Implementation	Ambiguity in experiment details and concrete data requirements	"(...) we're still not sure if they want I mean they gave us an OK I mean at the beginning before we even contact X Collider we started me and Rodrigo giving them some scenarios and then they actually like the idea of advertisement and then said OK let's go from there so they have sort of agreed with a vague idea of this project but of course the devil is in the details and we are figuring that out" (Interview 8, Pos. 11)
Technological Integration	Alignment with current technological use of language models	"For (client name), (...) maybe they have some technology already in place in terms of, you know using LLM's and then we can work on it or yeah or come up with the technology ourselves in house and then and provide them which is less probable. But basically yeah, either from our side or their side come up with the technology and then using the technology we do the, the, the field experiments." (Interview 8, Pos. 9)

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Data Analysis and Management	Ideal data acquisition for measuring advertising effects and spillovers	"We have started, you know, like coming up with the presentation of our ideas to communicate with these ideas to, to launch and basically ask for them what kind of technologies are in place, you know, and what we have in mind in terms of experiment design and yeah, what data do we need, uh or ideally, what kind of data do we need?" (Interview 8, Pos. 11)
Communication and Collaboration	Ensuring mutual understanding and interests between researchers and NOS	"But yeah, you know, of course you know our point of view as a researcher is completely different from practice practitioners and two to find a middle ground." (Interview 08, Pos. 17) "I mean, this is where we want support. (...) Make us closer. Make our ideas closer and to help us to get a get a common ground." (Interview 8, Pos. 17)
Project Management and Progression	Managing busy schedules of researchers and the need for timely project advancement	"Of course, during the experiment during the experimentation. Uh, maybe we have to do some adjustments. "Uhm, maybe there they can help and I mean in terms of data analysis probably I mean at that phase we already you know like it's we the researchers will have will have to do most of the stuff ourselves and but yeah, (...) Because Susana has the knowledge of, I mean she has a PhD. She's she has been involved in in research projects and it since they will be, they will be aware of the of all the stages of this this project. They might be able to also help us with help us with data and analysis and. But before that in general." (Interview 8, Pos. 19)
Corporate Culture and Education	Educating NOS on the benefits and processes of field experimentation	"I mean educating is a bit strong word, But yeah, you know, of course you know the, the, the our point of view from as a as a researcher is completely different from practice practitioners and two to find a middle ground" (Interview 8, Pos. 17)

Appendix M – Research Actors Challenges and Bottlenecks with Proof Quotes

In the Nova SBE ecosystem, research actors are driven by individual interests and motivations. While diverse in their focus areas, these researchers share common challenges and bottlenecks that affect their contributions to the fields of innovation and experimentation. A prominent challenge is maintaining a delicate balance between academic research rigor and the operational pace of industry partners. Researchers from interview eight stress the importance of clear communication and the alignment of experimental designs with the technological capabilities and data structures of corporate partners (Interview 08, Pos. 11). Others emphasize the need to translate academic insights into practical applications that resonate with industry stakeholders (Interview 5, Pos. 10; Interview 6, Pos. 11). Managing diverse collaborations with governments, NGOs, companies, and international institutions also presents significant challenges. It involves not only aligning different objectives but also cultivating policy impact awareness and securing commitments from potential partners. Efficient management of the research process, especially when conducting field experiments, is crucial. Legal and contractual complexities can often hinder seamless collaboration with companies. Time management, resource scarcity, and task prioritization are further critical issues, exacerbated by the broad and varied responsibilities of the faculty. Practical aspects of fieldwork, such as establishing a local presence and navigating institutional frameworks for necessary authorizations, also pose substantial hurdles. Lastly, utilizing research outcomes is a challenge that spans the entire ecosystem. Ambiguities in data privacy and management policies can obstruct the effective application of research insights. There is a call for more structured approaches to data-driven testing methods, as noted by interviewee six (Interview 6, Pos. 9). The overarching goal should be to "*get it right rather than just do the new cool thing*" (Interview 5, Pos. 8).

Researcher Challenges and Bottlenecks with Proof Quotes – Interview 5

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Create common Ground of the Experimentation method at Nova SBE	Unclear data privacy and management policies Different pre-requisites of researchers regarding knowledge about experimentation	“(…) what people call data, what people call experimentation is so different that I think it's worth clarification“ (Interview 5 , Pos. 8)
Efficient Research Process Management	Legal and contractual complexities in collaboration with companies Time management and prioritization among faculty due to diverse responsibilities	“But my guess from you know I'm thinking of like someone who is trying to get data from a like someone in digital marketing trying to get data from a company and the big issue is Contract legal, you know, managing the conversation and this and that So I think that they could support. And then the last, the last case you know, maybe there's a way then like so then it means they might have to have a team that is dedicated, but they have their knowledge center.“ (Interview 5 , Pos. 28)
Collaboration and Communication	Balancing academic goals with company expectations Need for a clear service offer and communication of research capabilities	„This kind of project I can imagine can become a way of, you know, making money for the knowledge center which you know again is completely fine. But then might leads to accepting project that are not necessarily research oriented, but more um, you know, cause again research and research. And so like the what do like the faculty? And I think that's why a lot of knowledge center are struggling to really get, you know. The faculty engaged the same way because they have like 2 very different way of thinking. And so to be very clear, for a faculty member, the value for them is. If they can get an article published, OK? Because that's how we've evaluated.“ (Interview 5 , Pos. 12)
Researcher Motivation and Rewards	Aligning project outcomes with faculty interests for publication and academic recognition Attracting faculty engagement in projects that may not directly contribute to tenure or promotion	“The faculty engaged the same way because they have like 2 very different way of thinking. And so to be very clear, for a faculty member, the value for them is. If they can get an article published, OK? Because that's how we've evaluated. But whether it's right or wrong, so that's another question and we can have a lot of long discussion, but that's what you know that what counts for faculty. So you can offer me something, but if I don't think it's going to give me, like super interesting data or if it's not completely fit, it's not really fitting with exactly with the kind of line of research I'm trying to do. But is going to give me my tenure, my promotion. My guess is a lot of people are being like that (Interview 5 , Pos. 12)

Researcher Challenges and Bottlenecks with Proof Quotes – Interview 6

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Experimentation Methodology	Time constraints	“So I mean, AB testing is one of the types of experiments that we could use to test our business idea. But it does require a lot more time. UM, because you know you have to, like, really set up the whole experiments. In order and you have to think about it a lot. And generally, in these kinds of projects, we don't necessarily have so much time. Umm, so it's maybe simpler kinds of experiments that we do rather than, you know, fully.” (Interview 6, Pos. 11)
	Resource limitations	
Market Research and Customer Validation	Lack of in-depth data-driven AB testing due to time constraints	“So yeah, I think also most of the times are when we test experiments, we are testing with a very specific procedure.” (Interview 6, Pos. 13)
	Need for quick outputs and results	
Collaboration with Companies	Need for more detailed market feedback post-prototype testing	“So sometimes the ideas that were found during you know our box modules or during some Nova hackathons or any hackathons, they count the client likes so much that they want to develop those, those ideas and actually make them into real projects in their companies. Sometimes this involves we've already had the case where we were developing in a brand new product or comfortable and so we were working with students, the students who actually came up with that solution during box, who then as well worked with the company and us to actually bring the product to life. And that consisted of going to the market, validating again the solutions are building the features. Testing the features validating with customer in different cycles. So you have different customer validation cycles where you try one experiment and then you adjust the idea and then you validate again you try another experiment and then you adjust the idea. And so it's constantly kind of like a cycle or validation and and you're getting feedback from your customers the entire time. So yes.” (Interview 6, Pos. 39)
	Balancing design thinking with customer validation and data analysis	
Data Management and Digital Experimentation	Ensuring meaningful engagement with companies in session planning and R&D projects	“It's kind of like a Semapa hackathon, but going into a bit more depth in the testing part, the experimentation part and basically what we're doing is we're coming up with the idea and then once we get to the prototype, we actually have the opportunity of testing the prototype and then getting gathering some more feedback and then sharing that with the client, seeing what works, what's in tweaking a little bit the idea based on the market feedback that we get after testing the prototype.” (Interview 6, Pos. 9)
	Need for a structured approach to data-driven testing methods	
	Lack of resources	“I think the way that we're doing things is a certain way. Also, sometimes you know lack of time, lack of resources. We might not be pushing the experiments as much as we could. I'm definitely there's probably many better ways of doing this.” (Interview 6, Pos. 27)

Researcher Challenges and Bottlenecks with Proof Quotes – Interview 7

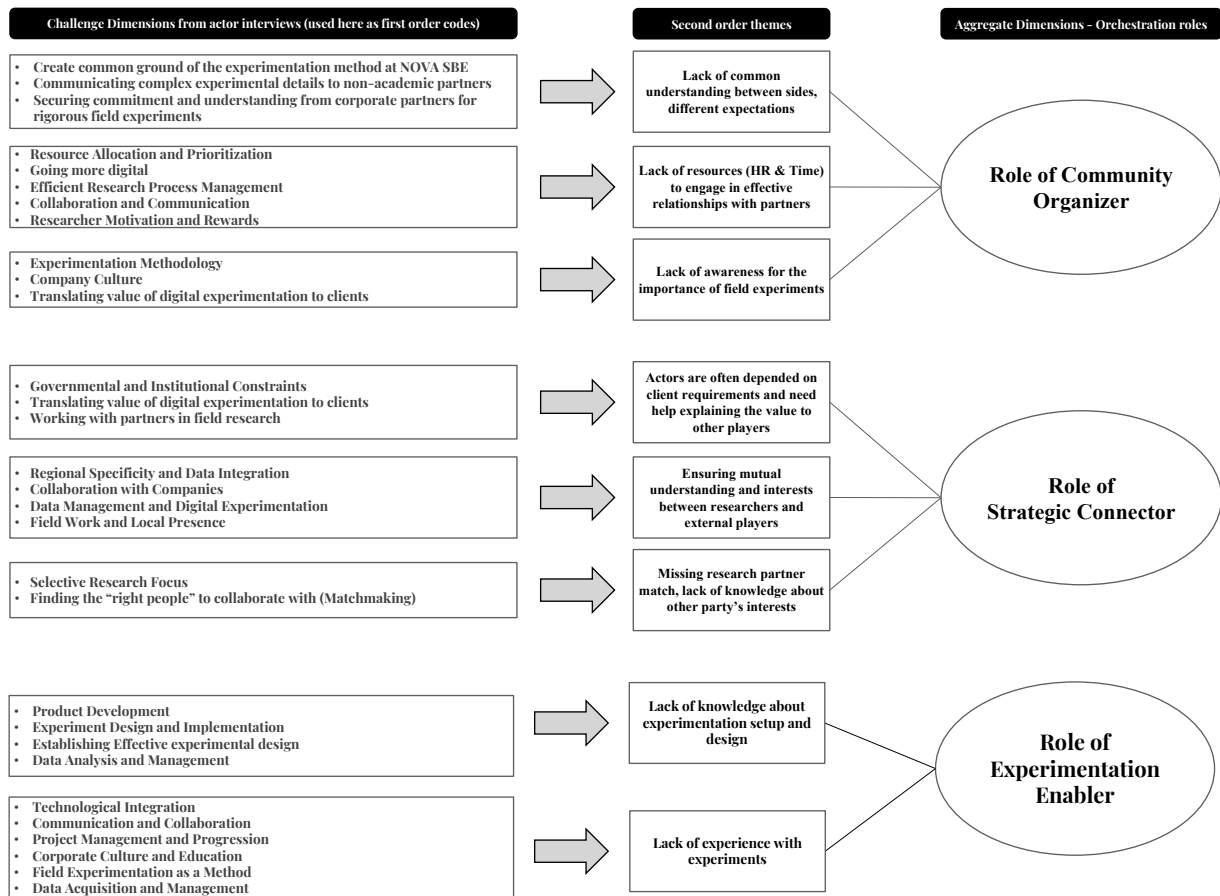
Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Working with Partners in Field Research		“We have the crazy guys on the details and, you know, making sure that the protocol is followed and you know, having something rigorous being done in terms of intervention in terms of measurement.” (Interview 7, Pos. 19)
	Aligning research rigor with partner operations lacking scientific focus	“And sometimes I would have partners. Of course they don't understand which is normal because they are not scientists. You don't understand the details. Importance of little things. And there's delays because it's not a priority for them to do something with us. So I'd say most of the difficulties come from partners.” (Interview 7, Pos. 19)
	Ensuring adherence to detailed research protocols by non-scientific partners (lack of expertise of partners)	“I'd say most of the difficulties come from partnering so. So because you situations have different interests and our interest is very clear on producing science, step of course speaks to policy and for sure.” (Interview 7, Pos. 19)
	Aligning different expectations	
Selective Research Focus	Aligning field experiment opportunities with selective, innovative research interests	“If it is a company, the company needs to care about having a rigorous answer.” (Interview 7, Pos. 27)
	Difficulty in identifying partners for field experiments that meet specific research criteria	“There is people need to care more about research. Generally speaking, need to care about rigorous answers. Need to care about partnering with universities?” (Interview 7, Pos. 27)
		“(…) the little things are not research (A/B Testing) I don't care about it. If people want to make money out of that, it's fine, but it should not be in the core activity of the school.” (Interview 7, Pos. 41)
Field Work and Local Presence	Logistical challenges in establishing a local presence for fieldwork	
	Navigating complex institutional frameworks and obtaining necessary authorizations	„(…) generally speaking field the experiments come with field work, so we need to have a local presence. We need to set up to make sure that somebody is doing a treatment, is doing an intervention.” (Interview 7, Pos. 19)

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Finding the “Right People” to collaborate with (Matchmaking)		“It (the X-Collider) could be potentially helpful is in terms of identifying. Uh people that are interested in testing interventions in interesting settings that are interesting for us in terms of research”. (Interview 7, Pos. 21) “It is interesting, but we are kind of we are a bit picky.” (Interview 7, Pos. 23) “And so it's not the case that, you know, in any project is interesting. Now we are a bit picky. It's not to say that, you know we don't value the potential help from this center but we are speaking so yeah so that's it from our side. I don't see a lot of help with respect to implementation right. Anything like that, because we have been doing that for many years now and. We know how to do it, so I think, uh, at least we know the model and then it's about finding the right people to help us and finding, you know, good students that are interested in this type of research.” (Interview 7, Pos. 25)
	Lack of common ground on research objectives with potential partners	“We have been trying to do that for a while. I mean not us, because I don't work with Portugal, but my colleagues, we have been collectively trying to do that and it's very rarely that you find a policymaker that is (...) really interested in policy impact. First of all and then on top of that, and they're saying: What can experiments do for that? So that's not easy, I would say.” (Interview 7, Pos. 25) “OK, so you know if you guys can help with that and can find opportunities with companies and he can convince people in companies, (...) It's a way to bridge between the school and companies on research, which is something, you know, it's a fantastic thing. I mean it's, uh, if it works, it's fantastic. But again, it's not going to be an easy fight. It's going to be quite difficult, I'd say if we, like we public policy, it's like this and this is our experience.” (Interview 7, Pos. 25)
	Hard to find potential matches for research (especially with policy makers)	
	Lack of qualified students	
Field Experimentation as a Method	Partners don't understand the value of field experiments	
		“And sometimes that field it's slow.” (Interview 7, Pos. 13) “We are doing research and it's actually helpful for, you know, for policy and people need to understand that more. So it's a, it's a slow process” (Interview 7, Pos. 25) “So because otherwise there are much because I feel experiments are expensive, generally speaking you need to collect data. Generally speaking, sometimes there is data but it's not so at least you need to have some. Some feel there forts and uh, and those costs some money, so though people, somebody needs to fund it, right? So who is going to fund it?” (Interview 7, Pos. 27)
	Lack of speed	
	Field experimentation is expensive	

Researcher Challenges and Bottlenecks with Proof Quotes – Interview 8

Challenge Dimensions	Second Order Bottlenecks	First Order Proof Quotes
Establishing effective experimental Design	Time constraints due to teaching and other responsibilities	“And yeah, for now it's we have just started working and like especially this month is a really, really busy month for us and that's why it's going very slowly. We are both teaching me and Rodrigo” (Interview 8, Pos. 11)
Communicating complex experimental Details to non-academic Partners	Difficulty in aligning the academic rigor with corporate partners' operational tempo Potential resistance or slow approval processes within corporate or governmental structures	“I mean educating is a bit strong word, but yeah, you know, of course you know the, the, the our point of view from as a as a researcher is completely different from practice practitioners and two to find a middle ground” (Interview 8, Pos. 17)
Securing Commitment and Understanding from corporate Partners for rigorous Field Experiments	Lack of immediate interest or understanding from corporate partners in the value of randomized control trials (RCTs)	“But yeah, you know, of course you know the, our point of view from as a as a researcher is completely different from practice practitioners and two to find a middle ground.” (Interview 08, Pos. 17) “I mean, this is where we want support. (...) Make us closer. Make our ideas closer and to help us to get a get a common ground.” (Interview 8, Pos. 17)
Data Acquisition and Management	Access to relevant and sufficient data to support experimental design and outcomes	“For (Company name) (...) maybe they have some technology already in place in terms of, you know using LLM's and then we can work on it or yeah or come up with the technology ourselves in house and then and provide them which is less probable. But basically yeah, either from our side or their side come up with the technology and then using the technology we do the, the, the field experiments.” (Interview 8, Pos. 9)

Appendix N – Crafting Orchestration Roles Analysis



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Appendix P – Table of Abbreviations

AI	Artificial intelligence
GenAI	Generative artificial intelligence
LLMs	Large language models
Nova SBE DSKC	Nova School of Business and Economics Data Science Knowledge Center
X-C	X-Collider
RCTs	Randomized controlled trials

Declaration of Ownership

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I hereby declare that I have written this paper on my own and with no other help than the literature and other supportive material listed in the Appendix and Acknowledgements. Citations of sentences and parts of sentences are declared as such, while other imitations are clearly marked and linked to original sources with regard to extent and intention of the statements made. This thesis has never been handed in to any examination authority before, and it is also not yet published. Further, this thesis has been developed in close cooperation with the team of the Nova SBE Data Science Knowledge Center.

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