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# UNCERTAINTY MANAGEMENT DURING THE EMERGENCE AND EVOLUTION OF GLOBAL ECOSYSTEMS

# GESTÃO DA INCERTEZA DURANTE A EMERGÊNCIA E EVOLUÇÃO DE ECOSSISTEMAS GLOBAIS

SÃO PAULO
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Projeto apresentado ao Programa de Pós-Graduação em Administração da Faculdade de Economia, Administração, Contabilidade e Atuária da Universidade de São Paulo como parte dos requisitos para obtenção do título de doutor

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**RESUMO**

dos Santos, M. G. (2023). Uncertainty Management During the Emergence and Evolution of Global Ecosystems (Doctoral Thesis). Faculdade de Economia, Administração, Contabilidade e Atuária, Universidade de São Paulo, São Paulo.

Firmas inovadoras colaboram com atores externos, localizados fora de seu país de origem, criando ecossistemas globais para materializar suas propostas de valor focais. Porque o conhecimento é disperso entre pessoas, lugares e tempo, essas firmas focais precisam acessar atores externos dispersos internacionalmente e criar o correto alinhamento entre esses atores para que suas inovações possam entregar valor para um público global. Com o objetivo de entender melhor esse processo nós conduzimos duas fases de pesquisa qualitativa. A primeira fase foi um estudo de caso de quatro firmas focais liderando ecossistemas globais para responder como firmas focais utilizam ecossistemas globais para gerir incertezas locais e globais. A segunda fase dessa pesquisa, baseada na primeira, utiliza uma amostra de sete firmas focais que lideram ecossistemas globais para responder como firmas focais lideram o processo de emergência e evolução de ecossistemas globais sob condições de incertezas locais e globais. Para cada fase de pesquisa nós analisamos trinta entrevistas com gestores de inovação, gestores de ecossistemas, gestores de inovação aberta, investidores, funcionários públicos, e empreendedores, além de analisarmos documentos internos, relatórios, notícias e comunicados. Nosso foco foram firmas focais com operações no Brasil, com a matriz ou subsidiárias localizadas nesse país. O resultado dessa pesquisa são dois frameworks teóricos que explicam a gestão das incertezas em ecossistemas globais, sua emergência e evolução. A primeira fase da nossa pesquisa revela que firmas focais combinam atividades de análise do escopo da incerteza com governança de gestão da incerteza e diferentes estratégias de gestão da incerteza. A segunda fase da nossa pesquisa revela que firmas focais durante o processo de emergência dos ecossistemas globais precisam definir a proposta de valor dos seus ecossistemas locais e globais, além de lidar com a incerteza sobre a estrutura desses ecossistemas. Durante a evolução dos ecossistemas locais e globais, firmas focais precisam definir a sua governança e orquestrar esses ecossistemas. Esperamos que essa pesquisa atraia interesse ao pouco estudado tema dos ecossistemas globais e demonstre para acadêmicos e praticantes que ecossistemas globais importam.

**Palavras-Chave:** Ecossistemas globais; ecossistemas de inovação; gestão da incerteza em ecossistemas; internacionalização de ecossistemas; incertezas locais; incertezas globais

**ABSTRACT**

dos Santos, M. G. (2023). Uncertainty Management During the Emergence and Evolution of Global Ecosystems (Doctoral Thesis). Faculdade de Economia, Administração, Contabilidade e Atuária, Universidade de São Paulo, São Paulo.

Leading firms in a global context have engaged with external actors located outside their home country, creating local and global ecosystems to materialize their innovative focal value propositions. Because knowledge is dispersed between people, places, and time, these focal firms must access internationally dispersed external actors and create the proper alignment between them for their innovations to fully deliver value to their global customers. To better understand this process, we conducted two phases of in-depth qualitative research. Phase one was a multi-case qualitative study of four focal firms leading global ecosystems to answer how these organizations use global ecosystems to manage local and global uncertainties. Phase two builds on this initial research, using a sample of seven focal firms leading global ecosystems to answer how they lead the processes of global ecosystem emergence and evolution under conditions of local and global uncertainty. We used qualitative data, composed of interviews with innovation managers, ecosystem managers, open innovation managers, investors, public employees, and entrepreneurs, as well as documents, reports, press releases, and articles in the business press. We focused on focal firms with operations in Brazil, either headquartered or with subsidiaries in this country. What resulted from these efforts are two complementary theoretical frameworks on uncertainty management in global ecosystems and global ecosystem emergence and evolution. Phase one of our research reveals that focal firms combine uncertainty scope assessment with uncertainty management governance and uncertainty management strategies to successfully mitigate local and global uncertainties. Phase two of our research shows that focal firms face the challenges of defining a local and global ecosystem value proposition and dealing with structure uncertainty during global ecosystem emergence. During global ecosystem evolution, these focal firms must define and implement local and global ecosystem governance and orchestrate their local and global ecosystems. We hope that this research will draw interest to the understudied subject of global ecosystems and convince academics and practitioners alike that global ecosystems matter.

***Keywords*****:** Global Ecosystems; Innovation Ecosystems; Uncertainty Management in Ecosystems; Ecosystem Internationalization; Local Uncertainties; Global Uncertainties

## LIST OF FIGURES

**LIST OF TABLES**

**LIST OF ABBREVIATIONS**

R&D – Research and Development

GIE – Global Innovation Ecosystem

GE – Global Ecosystem

SDK – Software Development Kit

API – Application Programming Interface

IE – Innovation Ecosystem

PoC – Proof of Concept

## Table of Contents

## 1. Introduction

Biontech in 2019 was a company with no product approved for commercial use, yearly financial losses of 180 million euros, and unsure about the future viability of their business (Biontech SE, 2020). Today this German biotechnology startup, founded in 2012, is hailed in the media for its innovation prowess, lightning-quick development, and the global rollout of an effective vaccine against the Sars-Cov-2 virus (Gelles, 2020; Gaviria & Kilic, 2021). Biontech's founders made a strategic choice to partner with Pfizer, an American pharmaceutical company, to lead a global ecosystem that would result in their first product being approved for human use.

We understand global ecosystems to be groups of internationally dispersed, and legally independent economic actors that invest in complementary and ecosystem-specific assets while abiding by mutually agreed-upon rules necessary for an innovative joint value proposition to be materialized under conditions of local and global uncertainty. Biontech led a global ecosystem to engage not only with Pfizer, but also with suppliers of critical technologies in four different continents, with countless research institutes scattered around the globe, international investors, foundations, and a myriad of regulatory agencies to streamline the materialization of their focal value proposition. By doing so this focal firm was able to access the relevant dispersed knowledge about their innovation and align internationally dispersed actors to cooperate for the materialization of their focal value proposition.

The Pfizer-Biontech case illustrates how global ecosystems have become critical for the successful development of new products and services with international reach by leading innovators in a global context. Winning ecosystems balance dynamics of cooperation and competition between actors to create and deliver coherent solutions to their customers (Adner, 2012; Adner, 2017; Hannah & Eisenhardt, 2018), while successful focal firms manage uncertainties by employing collective experimentation strategies (Mahmoud-Jouini & Charue-Duboc, 2017; Gomes et al., 2018; Gomes et al., 2021a). Global ecosystems enable focal firms to do both, while dealing with the added challenges of aligning the efforts of internationally dispersed external actors to discover and manage local and global uncertainties.

Because knowledge is dispersed between people, places, and time the process of perceiving and addressing some uncertainties requires that actors are embedded in specific contexts

(Dew et al., 2004; Foss et al., 2019). Because knowledge is contextual (Nonaka & Takeuchi, 1995) some innovations may require a specific approach to create and deliver value to their customers. The contextual nature of knowledge leads to the existence of local and global uncertainties, which we conceptualize as uncertainties that are relevant in a single country (local) and those that influence multiple countries (global). Global ecosystems enable focal firms to access this internationally dispersed knowledge, engaging with internationally dispersed external actors and addressing the relevant local and global uncertainties that affect the materialization of their focal value propositions.

Despite its relevance for innovation, global ecosystems remain an understudied subject. The innovation ecosystem literature has so far dealt with subjects such as interdependence and complementarity (Adner & Kapoor, 2010; Adner, 2012; Adner, 2017; Gawer, 2022), modularity (Jacobides et al., 2018), governance (Tiwana & Konsynski, 2010), and orchestration (Autio, 2022). It addressed questions regarding ecosystem emergence under conditions of uncertainty (Datée et al., 2018), uncertainty propagation in ecosystems (Gomes et al., 2018; Gomes et al., 2021a), strategy in ecosystems (Hannah & Eisenhardt, 2018), circular ecosystems (Gomes et al., 2023a) and knowledge management in ecosystems (Gomes et al., 2021b). Digital platforms and their attributes have been conceptualized (Gawer & Cusumano, 2002; Gawer, 2022; Hukal et al., 2020) and so have market and technological platforms (Rochet & Tirole, 2006).

The long tradition of research on uncertainty (Knight, 1921) has addressed issues of uncertainty management in radical innovation projects (O'Connor & Rice, 2013), entrepreneurial action (Sarasvathy, 2001), decision-making under uncertainty (Venkataraman and Huettel, 2012), and uncertainty mitigation (Packard & Clark, 2020). The relationship between knowledge dispersion and uncertainty has been conceptualized (Hayek, 1945; Akerlof, 1970; Dew et al., 2004), and so have the strategies employed to deal with uncertainties in project management (O'Connor, 1998). Collective uncertainties have been addressed (Gomes et al., 2018; Mahmoud-Jouini & Charue-Duboc, 2018) and so have the dynamics of uncertainty management for emergent and generative technologies (Cennamo & Santaló, 2019; Kapoor & Klueter, 2021).

However, the literature on innovation ecosystems and uncertainty management has not yet fully addressed the phenomena of global companies and their global operations (Strange & Zucchella, 2017; Nambisan & Luo, 2021). Recent crises such as the Covid-19 pandemic have renewed the interest in how firms respond to external uncertainties generated by global events (Donthu & Gustafsson, 2020; Sharma et al., 2020), but this literature has not yet addressed the specific dynamics of innovation management facing local and global uncertainties. A nascent interest in global platforms and ecosystems has prompted initial efforts to better understand the interplay between innovation in a global context and ecosystem structures and strategies (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) but insofar with limited empirical evidence.

Relevant gaps in our understanding of uncertainty management in global ecosystems persist. The literature on uncertainty management (O'Connor & Rice, 2013; Shaikh & O'Connor, 2020; Madanaguli et al., 2023) has not addressed the role of an international context and how local and global dynamics influence uncertainty management. Research on uncertainty management in innovation ecosystems (Mahmoud-Jouini & Charue-Duboc, 2017; Gomes et al., 2021a; Gomes et al., 2021b) has not yet dealt with how focal firms cooperate with external actors located outside of their home country to discover and manage relevant local and global uncertainties. Research on innovation ecosystem emergence (Thomas & Autio, 2015; Datée et al., 2018; Thomas et al., 2022) currently ignores the international context and its influence on ecosystem emergence and evolution.

Nambisan et al., 2019, Nambisan and Luo, 2021 and Nambisan and Luo, 2022 have more recently directly addressed the phenomenon of global platforms and their ecosystems. Combining extant concepts from the digital platform literature, new internationalization theory, and the loose coupling perspective these authors advance our understanding of global platforms. Governance plays a key role, as leading firms must contend with diverse contexts and employ loose coupling to do so (Nambisan & Luo, 2021). However, gaps remain about the process of governance emergence in global ecosystems, as well as the specific processes and strategies used for global ecosystem orchestration. Additionally, how focal firms leading global ecosystems manage uncertainties and define their value propositions during the stages of emergence and evolution remains understudied.

Closing the gaps discussed above requires a more sophisticated understanding of how focal firms cooperate with internationally dispersed external actors and align their efforts for the successful materialization of a focal value proposition under conditions of local and global uncertainty. This thesis attempts to do so by proposing and answering two different research questions. Our research was, for this reason, structured in two complementary phases, which we refer to in this document as phase one and phase two. Each phase had a specific research question, methodology, sample of focal firms, results, and theorization.

For phase one of our research, we asked how focal firms leading global ecosystems discover and manage local and global uncertainties that affect their focal value propositions. This question addresses the specific dynamics of cooperation with external actors located outside the focal firm's home country. Our goal was to understand the main processes and strategies used to enable the alignment of legally independent, but interdependent actors that are internationally dispersed, to discover and manage uncertainties that affect a single country (local) and those that are relevant in multiple contexts (global).

To guide phase two of our research, we asked how focal firms lead the process of global ecosystem emergence and evolution under conditions of local and global uncertainty. This question addressed how focal firms lead the initial efforts of aligning internationally dispersed external actors around their nascent focal value propositions and the challenges they face when doing so under conditions of local and global uncertainty. Additionally, this question also addressed how global ecosystems evolve, adding more external actors to complement the focal value propositions being materialized. Our goal was to shine a light on the processes and strategies used by focal firms during the emergence and evolution of the global ecosystems they lead.

To answer these research questions, we chose to focus on the specific actions of focal firms with operations in Brazil that lead global ecosystems to materialize their focal value propositions. We used an in-depth case study approach (Eisenhardt, 1989; Eisenhardt et al., 2016; Gioia et al., 2022) with a rich sample of focal firms, based on first-hand and secondary data for both phases of our research. Employing well-structured qualitative research enabled a better understanding of the phenomena at hand and made possible a more sophisticated comprehension of how focal firms lead global ecosystems. This is a novel approach to

understanding this subject, as academic research has not yet fully addressed the international dimension of innovation ecosystems using empirical data (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021). Conducting this research in Brazil, with a rich sample of focal firms headquartered in Asia, Europe, North America, and South America, offered us a novel perspective on this phenomenon.

For phase one of our research, we conducted a rich, in-depth case study of four multinational focal firms leading global ecosystems either headquartered or with subunits in Brazil, with two additional cases to provide saturation. For phase one, thirty interviews were conducted with ecosystem managers, innovation managers, entrepreneurs, and investors who participated directly in the global ecosystems we studied. To enable data accuracy, we also analyzed relevant secondary data, such as investor reports, internal documents, and press releases for triangulation.

We used a similar methodological approach for phase two of our research but with a different sample of focal firms. For this phase, we conducted in-depth case studies of seven focal firms leading global ecosystem emergence and evolution, with subsidiaries or headquartered in Brazil, and four additional cases to provide saturation. We conducted thirty interviews with ecosystem managers, innovation managers, entrepreneurs, and government employees. We also analyzed press releases, media interviews, investor and innovation reports, and internal documents for both triangulation and theory building.

In total and for both phases of research we analyzed eleven different cases of focal firms leading global ecosystems, with a combined market capitalization of over ten trillion Brazilian reais, either headquartered in Brazil or with subsidiaries in this country. Sixty interviews inform the results of our research, as well as dozens of internal documents, press releases, media interviews, and financial reports.

The results of phase one of our research[1] aim to explain how local and global uncertainties are managed by focal firms using global ecosystems. Because global ecosystems face peculiar

[1] The results of the first phase of this research have been published as **Gomes, L. A. V., dos Santos, M. G., & Facin, A. L. F. (2022). Uncertainty management in global innovation ecosystems. *Technological Forecasting and Social Change*, *182*, 121787.** While I was careful to completely rewrite the text for this thesis, which included remaking the contents of all the figures and tables, similarity between the text presented here and the published work is expected to preserve conceptual clarity. While I participated directly in the analysis of the case stories,

challenges related to the complex relationship between the focal firm's headquarters and its subsidiaries, uncertainty management governance matters as it details how the subsidiary may experiment in the local context to identify and manage relevant local and global uncertainties. Different focal firms have different portfolios of uncertainty management strategies available to them, based on internalizing specific stages of uncertainty management during the materialization of their focal value propositions, engaging with external actors to discover and manage relevant local and global uncertainties, or enabling these actors to autonomously manage such uncertainties.

The second phase of our research[2] builds on the first to offer an initial explanation of the emergence and evolution of global ecosystems, from the initial vision and value proposition to the orchestration of local and global ecosystems. We discovered that this is a complex, non-linear process of identifying the characteristics of the focal value proposition, its potential for international complementarity and to face the challenges of international interdependence. Uncertainty about the best structure of the global ecosystem, the actors, roles, links, and activities, is managed using experimentation approaches. The results of these experiments lead to an understanding by the focal firm of the appropriate global ecosystem governance, the rules and enforcement mechanisms implemented worldwide, creating the conditions that enable ecosystem evolution. Once a global ecosystem is in place, the focal firm must orchestrate it, a process that relies on persuading external actors to constantly join their local and global ecosystems.

In the next section, we further detail the methodological approach for both phases of our research. Our choice of methods follows from and is coherent with our ontological and epistemological assumptions. Ontologically, we understand global ecosystems and that organizations that participate in them to be socially constructed phenomena. Epistemologically, we believe our informants to be knowledgeable and able to articulate their views about their work leading or participating in global ecosystems. Our methods aim,

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the conceptualization, and construction of the theoretical frameworks, the interviews themselves were not personally conducted by me, but by other members of our research team.

[2] The second phase of this research has not by the date of submission of this thesis (September 28th, 2023) been published, submitted for publication, or presented in academic congresses or other types of events. For this second phase I participated directly in all interviews.

therefore, to understand how managers participating in global ecosystems make sense of their goals, processes, and strategies.

### 1.1 Research Design and Methodology

In this thesis, we conducted two phases of research, to answer our research questions separately and use different data samples, data collection, and data analysis protocols. We chose for both phases to employ a qualitative, multi-case study methodological approach based on both theory building and theory improvement to answer our research questions (Christensen, 2006; Eisenhardt & Graebner, 2007). Our research setting was the operations of focal firms in Brazil that lead global ecosystems and face local and global uncertainties.

We dealt with the phenomenon of local and global uncertainty management in global ecosystems, which is not currently sufficiently addressed by extant theories on innovation ecosystems and uncertainty management. This requires that we employ a theory-building approach, as we will seek new concepts and new causal connections to explain how focal firms manage uncertainty during global ecosystem emergence and evolution (Eisenhardt & Graebner, 2007; Gioia et al., 2013). However, we will also build on existing notions of uncertainty management in innovation ecosystems (Gomes et al., 2018; Gomes et al., 2021a; Datée et al., 2018), bringing an element of theory improvement to our research efforts (Christensen, 2006).

#### 1.1.1 Phase 1: Research Design and Methodology

The first round of research we conducted for this thesis was based on a multiple-case study of four focal firms leading global ecosystems with operations in Brazil, with two additional saturation cases to ensure proper data collection. We used a theoretical sampling approach, looking for cases that enabled both theory improvement and theory building (Eisenhardt, 1989; Christensen, 2006; Eisenhardt & Graebner, 2007; Gioia et al., 2013). In total, we conducted thirty semi-structured interviews, collected, and analyzed documents, reports, press releases, and additional documents to build coherent case stories, the narratives that were later used for data analysis.

We employed a well-structured data analysis process, using both within-case and across-case analysis (Eisenhardt, 1989). Triangulation was used, comparing first-hand and secondary data to ensure data validity. We used a coding approach (Gioia et al., 2013; Patton, 2014), initially

looking for meaningful first-order categories that emerged from our data analysis efforts that could be relevant for uncertainty management in global ecosystems. Numerous such codes were created, contrasting our data with the existing literature, and enabling the emergence of initial insights into how global ecosystems enable the discovery and management of local and global uncertainties. We then were able to move on to create the second-order themes, aggregating these initial categories to create concepts that explain the main tasks actors in global ecosystems go through to discover and manage local and global uncertainties. Finally, we were able to create our aggregate dimensions, which further refined and combined the codes and concepts that emerged from our data.

The data analysis process was iterative, as new codes and insights continuously emerged from our analysis of the cases. We constantly revisited our data, extant research, and refined our codes. Relevant insights emerged from this data analysis process regarding the differences between local and global uncertainties, how focal firms define an uncertainty management governance and ultimately choose between three different strategies for uncertainty management in global ecosystems.

What resulted from these efforts was an initial, tentative theoretical framework to explain uncertainty management in global ecosystems. Based on this first round of research and its results, we were able to further refine our questions on global ecosystems. We realized that to better understand this phenomenon we need additional data and theorization on global ecosystems' life cycle, from emergence to evolution.

### 1.1.2 Phase 2: Research Design and Methodology

We then conducted a second phase of qualitative research, with a different sample of cases of focal firms leading processes of global ecosystem emergence and evolution with operations in Brazil. The final sample had seven cases of focal firms leading global ecosystems, with four additional cases to ensure saturation. We created a theoretical sample (Eisenhardt, 1989) with a high degree of variability, composed of startups, incumbent organizations, and medium-sized firms, headquartered in North America, Europe, South America, and Asia, leading global ecosystems centered around radical and incremental focal value propositions. We conducted thirty semi-structured interviews, collected, and analyzed reports, press releases, and articles in the business press. We used triangulation to ensure data validity.

Based on the first-hand and secondary data we created case studies, coherent narratives on how focal firms leading global ecosystem emergence and evolution manage local and global uncertainties (Eisenhardt & Graebner, 2007). We conducted both within-case and across-case analyses, looking for emergent patterns in our data (Patton, 2014). We also employed a well-structured data analysis protocol, based on a coding approach (Gioia et al., 2013).

We began our data analysis by creating first-order categories, looking for initial insights, and generating codes regarding uncertainty management during global ecosystem emergence and evolution. We then refined these codes, looking for patterns that enabled moving to define the second-order themes, the concepts that emerged from our data on uncertainty management during the stages of global ecosystem emergence and evolution. Finally, we combined the second-order themes to create aggregate dimensions.

### 1.2 Results and Contributions of Our Research

Each phase of our research resulted in a tentative theoretical model, providing initial answers to our research questions. First, we created a theoretical framework for uncertainty management in global ecosystems. Then, based on these initial concepts and our second stage of research we developed a theoretical model of global ecosystem emergence and evolution. Finally, we combined both results looking for possible relationships between the emergent constructs to create a theoretical framework that addresses uncertainty management during global ecosystem emergence and evolution.

#### 1.2.1 Phase 1 Results and Contributions

The main result of the first stage of our research is a set of concepts and their relationships that combine to form an initial, tentative theoretical framework on uncertainty management in global ecosystems. We identified that focal firms go through a process of uncertainty scope assessment, understanding if each specific uncertainty is relevant in a single country or influences multiple contexts. We also discovered that focal firms use specific rules, roles, and mandates that constrain which actors (internal and external) can engage in uncertainty discovery and management in their global ecosystems, which combine to form the uncertainty management governance concept.

Different uncertainty management strategies are used by focal firms leading global ecosystems. Uncertainty management can be internalized by the focal firm before being

shared with external actors, which we conceptualized as internal uncertainty management strategy. Focal firms may also employ cooperative uncertainty management strategies, with strong coordination with external actors, or rely on autonomous uncertainty management strategies, using digital platforms and artifacts (i.e., SDKs, APIs, digital training) that enable cooperation with weak coordination.

This framework argues that focal firms in global ecosystems go through a process of first identifying relevant uncertainties, then assessing uncertainty scope, defining the uncertainty management governance, and employing an uncertainty management strategy to manage local and global uncertainties. We demonstrate that uncertainty management governance and uncertainty management strategies are connected, as the portfolio of uncertainty management strategies available depends on uncertainty management governance. There is a relevant interplay between strategies and governance, as changes to the strategies require adaptations to uncertainty management governance and vice versa.

Phase one of our research contributes to the literature on uncertainty and uncertainty management (O'Connor & Rice, 2013; Gomes et al., 2018; Packard & Clark, 2020) by providing a new typology of uncertainties, local and global, as well as introducing the concept of uncertainty scope assessment. We show that uncertainties can be relevant in a single country, local, or affect multiple countries, global. Managers must make sense of these dimensions, the process of assessing uncertainty scope, to properly identify and manage them.

We further contribute to the debate on governance in innovation ecosystems (Tiwana & Konsynski, 2010; Gawer & Cusumano, 2014; Jacobides et al., 2018; Shilipov & Gawer, 2020), by introducing a novel concept, uncertainty management governance. We show that focal firms leading global ecosystems must define the rules, roles, and mandates that determine who can discover and manage uncertainties and how. Uncertainty management governance also defines the portfolio of available strategies that can be employed to identify and manage local and global uncertainties in global ecosystems.

We also add to the debate on ecosystem strategy (Adner, 2017; Hannah & Eisenhardt, 2018; Gomes et al., 2021a) by identifying, categorizing, and conceptualizing the three main strategies that focal firms employ in global ecosystems to discover and manage local and global uncertainties. Focal firms can internalize part of the uncertainty management process,

using their own global R&D infrastructure before sharing these uncertainties with other actors in their ecosystems. Alternatively, they may employ a collaborative uncertainty management strategy using strong coordination with external actors (startups, universities, firms, regulatory agencies) to discover and manage local and global uncertainties. Further, they can employ an autonomous uncertainty management strategy, using digital artifacts (digital platforms, SDKs, APIs) to enable external actors to discover and manage relevant local and global uncertainties using weak coordination.

### 1.2.2 Phase 2 Results and Contributions

The main result of the second stage of our research is a set of concepts and their relationship that offer an initial explanation of global ecosystem emergence and evolution. An initial result is the understanding that global ecosystems are better explained as sets of local ecosystems in the focal firm's home and host countries. In the same way a multinational is a set, comprised of the headquarters and its subsidiaries, the global ecosystem is a set of local ecosystems led by the subunits of the focal firm.

We propose that global ecosystems go through two main stages. During the initial emergence stage, the central tasks are defining the local and global ecosystem value proposition and conducting the local and global ecosystem structure experimentation. The second stage, global ecosystem evolution, relies on defining and implementing local and global ecosystem governance and orchestrating local and global ecosystems.

Focal firms face an initial challenge of defining what we conceptualize as the local and global ecosystem value proposition, the opportunities for value creation and capture for internationally dispersed external actors. This is a task of understanding if the focal value proposition has the potential for international complementarity when internationally dispersed external actors can add value to a focal value proposition or must deal with international interdependence, when internationally dispersed actors must participate in the global ecosystem for the focal value proposition to be materialized. Additionally, during global ecosystem emergence, focal firms must deal with structure uncertainty, the lack of information about the appropriate structure (actors, roles, links, and activities) for the local and global ecosystems they lead. Structure experimentation takes place to manage structure uncertainty, as the focal firm changes the actors, roles, links, and activities in each local ecosystem. When external actors are perceived as being able to manage global uncertainties,

focal firms can also change this structure by upgrading them from local to global actors, fostering new links between internationally dispersed actors.

Focal firms leading global ecosystems face different challenges during the evolution stage. A key task is to define and implement global ecosystem governance, the rules and enforcement mechanisms for the ecosystem structure, value creation and value capture. Focal firms in our sample either employed a more standardized approach, with similar rules for all local ecosystems, or a more flexible approach with subunits defining the rules for the local ecosystems they lead. Additionally, focal firms must orchestrate global ecosystems, continuously persuading external actors to participate in local ecosystems, using processes and contracts either based on reducing participation uncertainty or enhancing the perceived value of participation for external actors.

These results contribute to the literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by first conceptualizing the notion of local and global ecosystems, therefore introducing a novel typology of innovation ecosystems. This literature so far has not formally conceptualized the idea that there are local ecosystems, location-bound alignment structures of actors that cooperate for the materialization of a focal value proposition, and global ecosystems, the set comprised of more than one local ecosystem and centered around a focal value proposition.

We further add to the innovation ecosystems literature (Adner, 2017; Jacobides et al., 2018) by offering a new typology and conceptualization of value propositions in global ecosystems. We show that value propositions in global ecosystems are defined based on international complementarity or created to deal with international interdependence. We further add to this debate by introducing the concept of defining the global ecosystem value proposition, the task of identifying if the focal value proposition being materialized can benefit from complementors located around the world or must account for internationally dispersed and interdependent actors.

We further add to the literature on uncertainty management in innovation ecosystems (Gomes et al., 2018; Datée et al., 2018; Gomes et al., 2021a) by proposing a new typology of uncertainty: local and global structure uncertainties. Focal firms leading global ecosystems face uncertainty regarding the appropriate structure (value proposition, actors, roles, links,

and activities) for their local and global ecosystems. They also face the choice of upgrading or not external actors in local ecosystems, reconfiguring the links and connecting them to other local ecosystems led by the focal firm. Further, we also introduce the novel concept of local and global ecosystem structure experimentation, the trial-and-error process of configuring and reconfiguring the local and global ecosystem structure to find the appropriate value proposition, actors, roles, links, and activities that enable value creation and value capture.

We contribute to the literature on ecosystem governance (Tiwana & Konsynski, 2010; Gawer & Cusumano, 2014; Jacobides et al., 2018; Shilipov & Gawer, 2020) and global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by creating a new typology and conceptualization of governance in global ecosystems. We argue that focal firms leading global ecosystems may choose to employ a more standardized set of rules and enforcement mechanisms, which we conceptualized as standardized local and global ecosystem governance. Alternatively, focal firms may provide their subsidiaries with the autonomy to define the rules and enforcement mechanisms for the local ecosystems they lead, which we conceptualized as flexible local and global ecosystem governance.

Finally, we contribute to the literature on innovation ecosystem orchestration (Dhanaraj & Parkhe, 2006; Valkokari et al., 2017; Autio, 2022) by proposing the novel concept of local and global ecosystem orchestration. Focal firms leading global ecosystems employ processes, programs, and contracts to enhance the value perception of external actors about the benefits of participating in their local and global ecosystems. Further, they also employ processes, programs, and contracts that shield external actors from the potential negative consequences of participating in their local and global ecosystems. We conceptualized these activities as either enhancing global ecosystem value perception for actors or reducing participation uncertainty in global ecosystems, respectively.

### 1.2.3 Combining the Results (phase 1 and phase 2) to Create the Uncertainty Management During Global Ecosystem Emergence and Evolution Theoretical Framework

We combined the results that emerged from phases 1 and 2 of this research into a coherent, tentative theoretical framework to explain uncertainty management during global ecosystem emergence and evolution. This results in a matrix, relating uncertainty scope (local and global) with the global ecosystem life cycle (emergence and evolution). Four quadrants represent the main activities and challenges of focal firms leading global ecosystems.

Quadrant one, materializing the focal value proposition, relates global uncertainties and global ecosystem emergence. Focal firms face challenges of international interdependence resulting from global uncertainties and form global ecosystems to access the dispersed knowledge to address these challenges. Structure experimentation enables discovering and engaging with internationally dispersed external actors to manage the relevant global uncertainties and materialize the focal value proposition.

Quadrant two, enabling complementor value add, relates local uncertainties and global ecosystem emergence. Local uncertainties create opportunities for internationally dispersed external actors to add value to the focal value proposition. Structure experimentation in local ecosystems enables identifying and engaging with external actors to manage relevant local uncertainties.

Quadrant three, focal value proposition evolution, relates global uncertainties and global ecosystem evolution. Ecosystem governance enables the focal firm to continue to engage with external actors and evolve their focal value propositions. Uncertainty reduction enables the focal firm to attract relevant and critical external actors and evolve their focal value propositions.

Quadrant four, leading global platforms and ecosystems, relates local uncertainties and global ecosystem evolution. Global ecosystem governance enables the focal firm to continuously engage with external actors to discover and manage relevant local uncertainties. Value-enhancing orchestration enables continuous access to internationally dispersed external actors.

Combining these concepts presents its contribution to the nascent literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021). Our model relates the global ecosystem life cycle (emergence and evolution) with uncertainty scope (local and global uncertainties). It further makes clear the relationship between international interdependence, international complementarity, and uncertainty scope, a novel result of our research.

Having introduced our research, we move on to detail the structure of our thesis in the next section. Because this thesis was based on two phases of research, we chose to identify them clearly as phase 1 and phase 2 in the methodology, results, and discussion chapters.

### 1.3 Thesis Structure

We begin our thesis with a review of the relevant literature (chapter 2), covering the central themes that informed our research efforts. We structured our review of the literature to first introduce the debate and extant literature on innovation ecosystems (section 2.1). We then moved on to address the prior research on uncertainty management (section 2.2). Finally, we deal with the literature on uncertainty management in innovation ecosystems (section 2.3). After reviewing the literature, we present our conceptual model (chapter 3). This is a preliminary, tentative exercise in theory building, that served the purpose of guiding both stages of our research.

A methodology chapter (chapter 4) follows, detailing our research design, how we built and implemented the data collection and analysis protocols for both phases of research that compose this thesis. We begin by addressing the methodology for phase one of our research (section 4.1) before moving on to detail the methodology for phase two of the research (section 4.2).

Following the methodology chapter, we present our results and discussion in two separate chapters for Phase 1 (chapter 5) and Phase 2 of our research (chapter 6). First, we address the results of the first phase of our research and present our theoretical framework on uncertainty management in global ecosystems (section 5.1), review these results (section 5.2), and discuss them (section 5.3).

We then move on to a chapter (chapter 6) detailing the results of phase 2 of this research, on global ecosystem emergence and evolution. We present the main results of this research on global ecosystem emergence (section 6.1), global ecosystem evolution (section 6.2), recapitulate these results (section 6.3), and discuss them (section 6.4)

We close this thesis with our concluding remarks in chapter 7. In this chapter, we go over the main limitations of our research (section 7.1) and highlight what we believe to be promising future avenues for research on global ecosystems (section 7.2). Chapter 8 contains the references for the citations in this work. In Chapter 9 we present additional data that was used for phase two of our research, detailing our code-building process (9.1) and the timelines of the cases (9.2).

## 2. Review of the Literature

The literature on strategy and innovation management continues to highlight the need for research that adds to our understanding of innovation ecosystems (Dattée et al., 2018; Foss et al., 2023) and the emerging phenomena of global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021). In this chapter, we review the relevant literature on uncertainty management and global ecosystems, with a focus on detailing the specific gaps our research attempts to close. This chapter is structured in three sections: section 2.1 addresses innovation ecosystems and global ecosystems; section 2.2 deals with uncertainty management; and section 2.3 reviews the literature on uncertainty management in innovation ecosystems.

### 2.1 Innovation Ecosystems

Moore (1993) first introduced the idea of ecosystems as a metaphor, highlighting that businesses and natural ecosystems have relevant similarities regarding interdependence and their processes of emergence and evolution. Adner (2006) builds on this metaphor to propose a connection between business strategy and ecosystems, which would later evolve into a view of innovation ecosystems as structures for value creation. Adner & Kapoor (2010) and Adner (2012; 2017) proposed the initial theoretical model to understand innovation ecosystems, which they define as the alignment structure of interdependent actors that must cooperate for a focal value proposition to be materialized. Interdependent co-innovators, non-generic complementors, and intermediaries all need to successfully cooperate with the focal firm for the focal value proposition to deliver value to its customers. Innovation ecosystem structures are composed of focal firms, the companies that lead the development of a focal value proposition, components, responsible for co-innovation, and complementors, which add value to a focal value proposition (Adner, 2017).

At the core of this theory is the idea that if a single actor fails, the whole ecosystem fails (Adner, 2017). Complementors are as critical as co-innovators, and so are the intermediaries that stand between the focal firm and its final customers and users. Focal firms and their managers should consider the actions of the complementors, intermediaries, and components and strategize to enhance their probability of success, which has become the famous wide-lens model of innovation management in ecosystems (Adner, 2012).

Interdependence and complementarity are the key characteristics that make innovation ecosystems unique and what differentiates them from open innovation initiatives, value chains, or innovation networks (Adner, 2017; Jacobides et al., 2018; Foss et al., 2023). Interdependence is a characteristic of innovation ecosystems, which require cooperation by different actors during the development and commercialization to successfully deliver value to final customers and users (Adner & Kapoor, 2010; Adner, 2017). A focal firm, for example, leads the development of a new car model, which has many suppliers working together to co-develop new, specific versions of their inputs. This focal value proposition will only be successfully materialized if all actors are successful in their development efforts to deliver that specific value proposition to a final customer (Adner, 2012). Complementors, such as repair shops, play the key role of enabling this focal value proposition to fully deliver value to the customers (Adner, 2012).

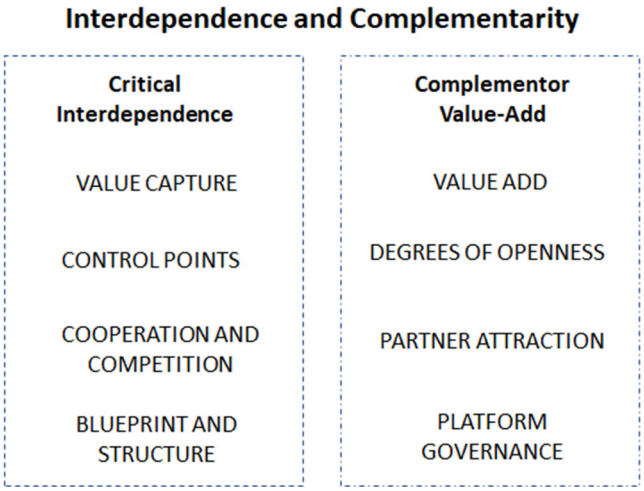
Interdependence is defined in this literature as a characteristic of certain focal value propositions that require the participation of external actors to be fully materialized (Adner & Kapoor, 2010; Adner, 2017). Components, the suppliers of critical technologies, complementors, which add value to the focal value proposition, and focal firms leading innovation ecosystems are interdependent (Adner & Kapoor, 2010). All actors in an ecosystem must cooperate for the materialization of a focal value proposition without the benefits of hierarchical relationships (Adner, 2017; Teece, 2018; Jacobides et al., 2018).

Complementarity is an established concept in microeconomics, referring to the complementary characteristic of certain goods or services (Allen, 1934; Hicks, 1970; Teece, 1986). A car runs on gasoline, a razor needs a razor blade, and a computer needs electricity. Certain products, however, have what is called non-generic complementarity, meaning that the focal firm responsible for a given product must enable through design or organizational fiat that complementary products work with the focal value proposition (Teece, 1986; Jacobides et al., 2018; Foss et al., 2023). Not all software applications will run on an operational system, not all partners are approved to participate in a consulting project. A single product may have a myriad of non-generic complementors, with the most famous example being the iOS operational system developed by Apple Computer Inc. which boasts over seven million individual complementary software applications.

We can view the innovation ecosystem literature as two complementary streams of research, mostly concerned with similar and overlapping phenomena. One relevant stream of research on innovation ecosystems is mostly concerned with open or semi-open technological platforms that use specific interfaces, governance, rules, and incentives to attract complementors that can add value to their focal value proposition once it is available in the market, sometimes called the ecosystem as affiliation literature, but more aptly named, in our view, as the complementor value add camp (Gawer & Cusumano, 2002, 2014; Rochet & Tirole, 2006; Jacobides et al., 2018; Nambisan et al., 2019; O'Mahony & Karp, 2022).

Another stream of research is concerned with the co-development of novel value propositions and the critical role played by suppliers, regulatory agencies, intermediaries, and complementors, often referred to as the ecosystem as structure field, but more aptly named, in our view, as the critical interdependency camp (Adner, 2006; Adner & Kapoor, 2010; Autio & Thomas, 2014; Adner, 2017; Hannah & Einsehardt, 2018; Kapoor, 2018; Dattée et al., 2018; Adner & Feiler, 2019). One stresses the importance of attracting classes of complementors to add value to a focal value proposition that is being commercialized, the other stresses the importance of attracting critical components and complementors, without which the value proposition will not be fully materialized.

Figure 1 Interdependence and Complementarity in the Current Literature




Source: Authors

The figure above summarizes the main managerial issues that are considered critical by each camp of the innovation ecosystem literature. The authors concerned with critical interdependency (e.g., Adner, 2017) highlights the relevance of mapping the structure of the

ecosystem and defining its initial blueprint, while the complementor value-add camp stresses the importance of defining the platform governance rules and incentives early on (in line with Gawer & Cusumano, 2014). Value creation, for the customers and other actors in the ecosystem, is central to the critical interdependency camp, while partner attraction is the key concern in the value-add literature. The establishment of control points, which ultimately enable value capture (Datée et al., 2018) is a critical task in the critical interdependency literature, while the strategic use of degrees of openness takes center stage in the complementor value-add theories (O'Mahony & Karp, 2022). Ultimately, the critical interdependency theories highlight efforts guided towards value capture by the focal firm (Adner, 2017), while the complementor value add literature highlights the efforts to enhance the overall value of the focal value proposition, often using strategies that do not involve direct value capture (Jacobides et al., 2018).

An innovation ecosystem facing conditions of interdependence will no doubt require that all participants succeed for the original value proposition to be materialized. However, the same is not true for innovation ecosystems where complementarity is the dominant condition. A company failing to develop or commercialize a digital application created for the iOS platform is not going to jeopardize the whole iPhone ecosystem. Failure to attract a critical mass of complementors, however, can be deadly for focal firms orchestrating such digital platforms. Different conditions, therefore, may require different approaches to orchestrate innovation ecosystems.

Recent research has called for more theoretical rigor in innovation ecosystems (Foss et al., 2023). These authors build on the well-established tradition of transaction cost economics (Coase, 1937; Williamson, 2010) to suggest that innovation ecosystems emerge to solve coordination and cooperation issues that result from the costs of using the price mechanism in markets. Focal firms lead these coordination and cooperation efforts by defining ecosystem governance, a set of rules and incentives for participation in an innovation ecosystem.

These authors define innovation ecosystems as "legally independent, but interdependent economic actors that invest in complementary and possibly ecosystem-specific assets and abide by mutually agreed upon rules and agreements necessary for an innovative joint value proposition to be materialized" (Foss et al., 2023, p.2). This definition highlights the role of

governance in innovation ecosystems, as well as the existence of ecosystem-specific assets. Asset specificity is a fundamental concept in transaction cost economics (Williamson, 2010) and the notion of ecosystem-specific assets builds on this idea. Assets can have different degrees of specificity which influences the make-or-buy decision of firms (Williamson, 2010). While these authors do not offer a formal definition of ecosystem-specific assets, it is implied that they refer to investments made in assets that can only generate value with the collective participation of external actors (Foss et al., 2023).

Ecosystem governance has received attention in the innovation ecosystem literature (Tiwana & Konsynski, 2010; Gawer, 2020; O'Mahony & Karp, 2022). It is increasingly recognized that focal firms leading ecosystems play the pivotal role of determining the set of rules and incentives to be followed by actors in their ecosystems, and that this is a critical task for ecosystem success (Gawer, 2022; O'Mahony & Karp, 2022). Governance in ecosystems refers mostly to what actors can participate in the ecosystems, what activities are performed by each actor, how value is shared between actors in ecosystems, and the enforcement mechanisms that create alignment between legally independent actors.

In the absence of well-defined hierarchical relationships between organizations in innovation ecosystems, authors employ a specific metaphor to refer to the managerial actions undertaken by the focal firm: orchestration (Dhanaraj & Parhke, 2006; Nambisan & Sahwney, 2011; Autio & Thomas, 2014; Valkokari et al., 2017; Autio, 2022). Unlike supply-chains which rely on dyadic contractual relationships, IEs rely on the ability of the focal firm to attract a myriad of partners, often to perform different tasks and to cooperate around a given value proposition (Autio, 2022). Because there is no hierarchy, this is a task of persuasion and of providing the proper incentives often in the form of value creation and value capture opportunities (Dattée et al., 2018; Autio, 2022). There is a tension in the literature regarding ecosystem orchestration, with some authors highlighting the role of the focal firm (Iansiti & Levien, 2004; Adner & Kapoor, 2010; Adner, 2012; Adner, 2017; Datée et al., 2018) while others underline the shared responsibilities of all actors in the ecosystem for its success (Autio & Thomas, 2014; Valkokari et al., 2017; Suominen et al., 2019; Autio, 2022).

It is generally accepted that the focal firm is responsible for establishing and communicating the innovation ecosystem blueprint and leading the initial efforts of engaging with external

partners to cooperate for the materialization of a focal value proposition (in line with Datée et al., 2018). However, because many innovation ecosystems lead to monopolistic or duopolistic markets over which the focal firm will exercise relevant control these organizations may face active resistance from potential external actors (Valkokari et al., 2017). Lack of hierarchy does not imply equitable value capture for all actors in the ecosystem (Adner, 2017).

Attracting such partners thus becomes a key challenge in the orchestration efforts of focal firms (Adner, 2012; Adner, 2017; Robaeyst et al., 2021; Autio, 2022). Uncertainty may exist regarding the proper value proposition for each actor or class of actors in the ecosystem, how to best communicate this value proposition, how to establish and enforce the control points, and how to select which partners to engage with (Datée et al., 2018; Gomes et al., 2021a). Establishing the proper governance for the ecosystem, the right selection methods and the optimal partner search mechanisms are all challenges identified in the IE literature (Adner, 2012; Adner, 2017; Datée et al., 2018; Autio, 2022).

### 2.1.1 Ecosystem Life Cycle

The notion that innovation ecosystems have a life cycle has been addressed since the pioneering work of Moore (1993) in the early 1990s. This early model differentiates between four idealized stages of business ecosystems: birth, expansion, leadership, and renewal (Moore, 1993). Competition and cooperation play a key role, as focal firms will face different challenges during each stage of their ecosystem life cycles. During ecosystem birth, for example, defining the value proposition (cooperation) and protecting intellectual property (competition) are the main challenges faced by focal firms (Moore, 1993). The renewal stage, for comparison, presents the challenges of working with external actors to bring in novel ideas (cooperation) and maintain barriers of entry to dissuade other firms from entering the market (competition) or face the eventual death of the ecosystem (Moore, 1993).

Later research (Iansiti & Levien, 2004; Adner, 2006; Adner & Kapoor, 2010) adds to the ecological metaphor by highlighting the relevance of ecosystem robustness and survival, notions that echo the idea of a life cycle. Adner (2012) tackles ecosystem emergence as a process of understanding the minimum viable ecosystem, the initial structure of actors that must cooperate for the materialization of the focal value proposition. Ecosystem evolution (or development) comes from adding new actors that in turn add value to the focal value proposition (Adner, 2012).

Ecosystem emergence is later addressed in the literature as a process of discovery regarding the ecosystem value proposition and the purpose of the ecosystem structure, both activities that facilitate resource and knowledge flow between actors (Ansari et al., 2016; Kapoor & Agarwal, 2017; Dattée et al., 2018). Collective discovery, the process by which actors understand how their own participation adds value to the ecosystem, takes center stage during emergence (Ansari et al., 2016; Thomas et al., 2022). Uncertainty during ecosystem emergence may lead to changes in the value proposition and activities, roles, positions, and links may be reconfigured (Dattée et al., 2018) as focal firms and other ecosystem actors lack a *priori* knowledge about the best ecosystem configuration for the value proposition being materialized (Dattée et al., 2018).

Governance also plays a relevant role during ecosystem emergence, as minimal rules regarding participation must be defined and the innovation ecosystem must account for the institutional context in which it is embedded (O'Mahony & Karp, 2020; Thomas et al., 2022). During the stage of emergence, collective bargaining, and negotiation take place between ecosystem actors to define the initial rules for participation, structure, value creation, and value capture (Thomas et al., 2022). Focal firms lead this process, but because innovation ecosystems are not hierarchical this may lead to specific challenges related to persuading other actors about the proper rules and enforcement mechanisms to be adopted (Thomas et al., 2022).

Innovation ecosystems are embedded in specific contexts and must be perceived as legitimate structures (Autio & Thomas, 2018; Thomas & Ritala, 2022; Thomas et al., 2022). Incumbent actors and players may feel threatened by emerging ecosystems and failure to establish their activities as being legitimate may lead to relevant regulatory or political intervention, undermining the process of ecosystem emergence (Thomas & Ritala, 2022). Cases such as Uber's legal battle against the incumbent taxi industry or Air BnB's struggles with incumbent hotel chains illustrate the relevance of legitimacy for emerging innovation ecosystems and platforms.

As ecosystems move from emergence to evolution, also referred to in the literature as expansion or growth, focal firms face different challenges. Initial understanding of the ecosystem value proposition leads to consensus between actors about their roles and

activities (Datée et al., 2018). Stabilization, however, does not mean stasis as actors and the focal firm may continue to adjust the value proposition and structure as the ecosystem evolves (Hannah & Eisenhardt, 2018).

Evolution is characterized by more stability regarding the value proposition, but growing challenges related to ecosystem governance and legitimacy as more actors join the innovation ecosystem (Moore, 1993; Thomas et al., 2022). While minimal governance is required during ecosystem emergence, empirical research has shown that ecosystem evolution poses additional governance challenges to ensure alignment between heterogeneous actors (Thomas et al., 2022). Actors in evolving ecosystems change from a firm-centric perspective to an ecosystem perspective, as activities and opportunities for value creation and capture are better understood (Adner, 2012; O'Mahony & Karp, 2020). Thomas et al. (2022) identify a higher frequency of governance-related activities during the stage of ecosystem evolution, which is explained by the increase in the number and heterogeneity of external actors.

Challenges related to legitimacy also take center stage during ecosystem evolution. During the initial stage of emergence, incumbent actors may ignore or not feel threatened by the initial efforts of competing ecosystems (Thomas & Ritala, 2021). As the ecosystem evolves, attracting more actors, there is also a parallel need to account for issues of legitimacy, which is contextual in nature (Cennamo, 2018; Thomas & Ritala, 2021; Thomas et al., 2022).

### 2.1.2 From Local to Global Ecosystems

While the idea of global ecosystems might be novel and undertheorized, there is a well-established tradition of studies on international partnerships and alliances, a core theme in the international business literature (Ghoshal & Bartlett, 1990; Chi & McGuire, 1996; Coviello & Munro, 1997; Inkpen & Beamish, 1997; Buckley & Strange, 2015; Martin et al., 2022). Studies in this tradition highlight the relevance of global inter-organizational networks for production and sales (Ghoshal & Barlett, 1990); alliances between organizations as a mode of entry into foreign markets (Chi & McGuire, 1996; Martin et al., 2022); dispersed production structures and the challenges of managing international partners (Buckley & Strange, 2015); and the relationship between internationalization and use of external partners for R&D (Hagedoorn, 2002).

Another close and relevant line of inquiry within international business is concerned with global research and development, the international organizational structures used by multinational enterprises to develop novel products or services (Gassman & Von Zedtwitz, 1999; Von Zedtwitz & Gassman, 2002; Ito et al., 2021; Morris et al., 2023). This literature is mainly focused on understanding two challenges faced by multinational companies that have a dispersed R&D structure: the challenges related to location choice; and the challenges related to project management due to distance between the headquarters and the R&D units located in different countries (von Zedtwitz & Gassman, 2002; von Zedtwitz & Gassman, 2016; Fu et al., 2023).

A specific line of inquiry about international R&D has emerged to study the phenomena of innovations developed by subsidiaries that go on to become global products, referred to in the specialized literature as reverse innovation or reverse knowledge integration (Frost, 1998; Frost, 2001; Frost & Zhou, 2005; Borini et al., 2012; Govindarajan, 2012; Wei & Xia, 2022; Hou & Li, 2023). Traditional international business perspectives could lead to the logical conclusion that the headquarters are responsible for innovation and the subsidiaries for the commercialization of such products (Johanson & Vahlne, 1977; Dunning, 1988). Reverse innovation research shows that subsidiaries play a key role in innovation for MNEs, mostly via innovation co-practice, when two or more subunits cooperate in the same innovation project (Frost & Zhou, 2005; Govindarajan, 2012; Borini et al., 2012). The research to date on global R&D can be summarized as an effort to understand three main challenges faced by multinational enterprises: how to coordinate innovation practices with multiple subunits dispersed around the globe; how to choose the best locations for the R&D departments; and how to create the proper managerial structures that allow knowledge created by the subsidiaries to be integrated in the headquarters (Frost & Zhou, 2005; Govindarajan, 2012; Von Zedtwitz & Gassman, 2016; Cantwell, 2017).

Despite this decades-long tradition of studies in the intersection between international business and innovation management, most research to date has not yet fully explained the distinctive nature of global ecosystems and how they enable uncertainty management in a global context. Calls for more research on this subject span the international business, innovation management, and entrepreneurship literature (Zahra & Nambisan, 2011; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan, 2022). Some authors underline the importance

of digital platforms that enable entrepreneurial activities in different countries (Zahra & Nambisan, 2011; Nambisan et al., 2019; Rossi et al., 2022). Digital platforms give entrepreneurs located in different countries a novel way to develop their products and services, offering access to a large potential customer base and a set of well-defined and relatively easy-to-use technological artifacts in the form of software development kits (SDKs) and application programming interfaces (APIs) (Zahra & Nambisan, 2011; Nambisan et al., 2019).

Because knowledge is contextual in nature (Nonaka & Takeuchi, 1995), innovations increasingly require highly contextualized knowledge to deliver meaningful value to customers (Zahra & Nambisan, 2011). Platform leaders will choose to engage with external actors, such as high-technology new ventures to access this local, contextual knowledge (Zahra & Nambisan, 2011). This study identifies three possible roles for entrepreneurial firms in global ecosystems, as breeders, feeders, or niche leaders (Zahra & Nambisan, 2011). Niche leaders leverage their expertise in narrow domains (market, technological or geographic) to reach a dominant market position in a well-specified niche. Feeders are responsible for transforming a given technology into a market-ready product, leveraging the knowledge in the business ecosystem. Breeders explore the frontiers of knowledge, focusing on developing research that may lead to innovations in the future (Zahra & Nambisan, 2011).

Because digital technologies decrease transaction costs and enable economies of scale, firms developing and commercializing such solutions have a natural advantage during their internationalization processes (Zahra & Nambisan, 2011). Partnering with global digital platforms offers, then, the dual benefits of access to a well-established global customer base and the use of a technological platform and its artifacts for innovation (Zahra & Nambisan, 2011; Gawer & Cusumano, 2014; Nambisan et al., 2019; Nambisan & Luo, 2022). Platforms have a positive impact on innovation precisely because they offer complementors access to the required components to innovate while reducing the cost of market entry (Gawer & Cusumano, 2014) and this dynamic extends to international markets as well (Zahra & Nambisan, 2011).

Recent theoretical studies have attempted to begin filling the gap between international business and innovation ecosystems, mostly by publishing theoretical essays and books on

global digital platforms and ecosystems (Nambisan et al., 2019; Nambisan & Luo, 2021, Nambisan & Luo, 2022). This nascent theory builds on the ideas of coupling and looseness to explain how focal firms lead global digital platforms, combined with extant concepts of international business, mostly related to partnerships, joint ventures, and other collaborative management structures (Nambisan & Luo, 2021).

Loose coupling theory was originally developed to propose a systems view of organizations, which are both open and closed systems, both rational and irrational, both spontaneous and deliberate according to fundamental authors in this literature (Meyer & Rowan, 1977; March, 1987; Weick, 1976). Weick argues that loose coupling is perceived when elements influence each other in each system (or organization) "suddenly (rather than continuously), occasionally (rather than constantly), and eventually (rather than immediately)" (Weick, 1982, p. 380 *apud* Orton & Weick, 1990). Nambisan & Luo (2021; 2022) argue that using a (loose) coupling view of digital platforms, combining well-known concepts in the digital platforms' literature (digital openness, digital affordances, digital generativity) with extant ideas in the loose coupling literature (responsiveness, distinctiveness, causal indeterminacy, fragmentation) help explain how MNEs lead global platforms.

This theorization effort leads to a compelling explanation of global platforms as loosely coupled systems, using digital openness, affordances, and generativity to be simultaneously responsive and distinctive, while dealing with causal indeterminacy in fragmented internal and external environments (Nambisan & Luo, 2021). An example clarifies: "The recent success of Ola, the Indian ride-sharing company, in international markets (e.g., UK, Australia, New Zealand) can partly be attributed to its loose coupling with partners in different foreign markets that enabled them to incorporate location-bound partner FSAs (e.g., related to payment systems and identity management) to fit local needs." (Nambisan & Luo, 2021, p. 1653). FSAs are firm-specific advantages, a widely used concept in international business (e.g., Birkinshaw et al., 1998).

The authors propose a list of theses on global platforms and ecosystems, mostly proposing causal relationships between concepts in the digital platform tradition and in the loose coupled theory of organizations (Nambisan & Luo, 2021). For example, they propose that "dispersed stimuli (that arise from digital openness and non-exclusivity of digital platforms)

and incompatible expectations regarding asset bundling (that arise from diverging partner goals and digital affordances) imply high external fragmentation in digital globalization. The greater such external fragmentation, the greater the need for incorporating looseness in MNE organizing, including regional elements built in global platforms and ecosystems" (Nambisan and Luo, 2021, p. 1655). Digital platforms, therefore, adapt to local contexts and partner with external actors in this process, without hierarchically controlling them. They benefit from the understanding of external actors about local contexts, without directly controlling their activities.

Despite the relevance of these early contributions the global digital platforms literature remains in its infancy, with fundamental authors recently underlining how the dynamics of internationalization and the influence of different contexts are still poorly explained by the global digital platforms' literature (Nambisan, 2022). Most of the extant literature is theoretical in nature, with little to no use of structured analysis of empirical data (e.g., Zahra & Nambisan, 2011; Nambisan et al., 2019; Nambisan & Luo, 2021; Nambisan & Luo, 2022). Valkokari et al. (2017) is the only published work, to the best of our current knowledge, that addresses the phenomena of global ecosystems using empirical research but does so in a tangential manner.

Valkokari et al. (2017) contribute to our understanding of global ecosystems and their dynamics by proposing a novel categorization in a four-dimensional model, where actors in ecosystems play the role of either hub or spoke, with local or global structures. Hub and spoke refers to the role of the firm as either the focal firm or the complementor, with local ecosystems being constrained in their structure and operations to a single country (in the subjective view of the interviewees) and global ecosystems being present in more than a single country (Valkokari et al., 2017). The authors also underline a common issue in ecosystem research, defining the precise borders of innovation ecosystems, where they begin and end, where are they geographically located, and how to best determine their geographical dimensions (Iansiti & Levien, 2004; Valkokari et al., 2017).

Recent studies have drawn attention to the fact that most IEs are not confined to a single country and that there is growing interest in the so far understudied and undertheorized phenomena of global ecosystems (Zahra & Nambisan, 2011; Valkokari et al., 2017; Nambisan

et al., 2019; Nambisan & Luo, 2021; Nambisan, 2022). Few, if any, studies have, however, tackled the subject of global ecosystems with the purpose of offering novel theoretical insights that may challenge our current understanding of the phenomena based on empirical data. The challenges of orchestrating global ecosystems, the influence of dealing with both local and global uncertainty, and how to face conditions of interdependence and complementarity are all questions that remain open and are addressed by our research.

**2.2 Uncertainty and Uncertainty Management**

Uncertainty was initially conceptualized by Knight (1921) as the absence of a probability distribution for a given future event. The context of his conceptualization, often overlooked in posterior uses of this definition in the management literature, was the ongoing debate on the benefits of a centrally planned economy given the alternative model proposed by socialist and communist economists and the emergence of mathematical-statistical models with alleged predictive power in the neoclassical economic traditions (Knight, 1921). Knight (1921) argued that no degree of mathematical or theoretical sophistication can lead to predictions of relevant future economic events, those related to innovation and entrepreneurial activity which generate real profits, as the lack of a known probability distribution makes the use of statistical models innocuous and the creation of causal models impossible (Knight, 1921).

Uncertainty as a concept was further refined by organizational scholars mostly concerned with its influence on organizational structure and strategy (Cyert & March, 1963; Lawrence & Lorsch, 1967; Thompson, 1967; Miliken, 1987). These authors argue that uncertainty exists in the organizational environment, and managers attempt to make sense of their decisions, its consequences, and responses while operating in an unpredictable, uncertain context. Thompson goes as far as to claim that “coping with uncertainty is the essence of the administrative process” (Thompson, 1967, p. 159).

Different refinements of uncertainty as a concept have been offered in academic literature. Novel typologies, adding dimensions to the idea of uncertainty (e.g., epistemic and aleatory, market and technical) have proliferated. The table below presents what are the main types of uncertainty relevant to the innovation management literature and the concept’s evolution over time.

Table 1: Uncertainty Typology in Extant Literature

| Scholars | Area of Interest | Typology | Definition |
|---|---|---|---|
| Knight (1921) | Economics | True Uncertainty | Absence of a probability distribution for future events |
| Arrow (1966) | Economics | Subjective Uncertainty | Subjective sensation that an action may not uniquely determine the consequences to the agent |
| Simon (1955) | Decision Making | Information Uncertainty | Payoff for a decision depends both on the strategy selected and knowledge on the joint probability distribution of environmental variables |
| Cyert and March (1963) | Decision Making | Ambiguity as Uncertainty | Goals for a decision are vague, problematic, inconsistent or unstable |
| Terreberry (1968) | Organizations | Turbulent Environments | Accelerating rate and complexity of interactive effects in the environment exceeds the component systems' capacities for prediction and control of the consequences of their actions |
| Thompson (1967) | Organizations | Expectation of Uncertainty | A system contains more variables than we can comprehend at one time, or that some of the variables are subject to influences we cannot control or predict |
| Duncan (1972) | Organizations | Perceived Environmental Uncertainty | Perception by managers that organizational environments are dynamic and their changes are unpredictable |
| Cohen, March & Olsen (1972) | Organizations | Organizational Uncertainty | Boundaries of the organization are uncertain |
| Jauch & Kraft (1986) | Organizations | Uncertainty Stimulation | Organizations influence the degree of uncertainty in the environments they operate in |
| Miliken (1987) | Organizations | State, Effect, and Response Uncertainty | Unpredictable environment (state uncertainty), impact of unpredictable environmental changes (effect), and unpredictability about the adequate responses to uncertain environments (response uncertainty) |
| Sarasvathy & Kotha (2001) | Innovation & Entrepreneurship | Market, Technological, and Resource Uncertainty | Uncertainty has different dimensions (technology, market, resources) that must be managed by innovative firms and entrepreneurs |
| Dequech (2011) | Innovation & Entrepreneurship | Weak and Strong Uncertainty | Subjective probabilities may be used to determine likelihood of future events (weak) or no probability distribution can be used (strong uncertainty) |
| O'Connor and Rice (2013) | Innovation & Entrepreneurship | Uncertainty Criticality and Uncertainty Latency | Degree with which uncertainties can be perceived or anticipated (latency) and degree of which resolution of the uncertainty is required for project survival |
| Gomes et al (2018) | Innovation & Entrepreneurship | Collective Uncertainties | Uncertainties that affect a group of actors that participate in innovation ecosystems |
| Packard and Clark (2020) | Innovation & Entrepreneurship | Mitigable and Immitigable Uncertainties | Mitigable ignorance of knowable information or immitigable indeterminancy of alleatory events |

Source: Authors

The notion of uncertainty has been addressed, as the table above shows, by scholars from different fields and with different research interests during the past century. Early work in

economics (Knight, 1921; Arrow, 1951) was concerned with the implications of uncertainty for the utility function and how mathematical models of preference influence economic theory. Decision-making scholars (Simon, 1955; Cyert & March, 1963) were interested in understanding how uncertain environments, combined with information acquisition and processing costs, influenced the decisions made by consumers and managers.

Organization scholars (Thompson, 1967; Terreberry, 1968; Duncan, 1972; Cohen et al., 1972; Jauch & Kraft, 1986; Miliken, 1987) employed a systems perspective and were concerned with how open systems such as organizations respond to uncertain environments such as competitive markets. Innovation and entrepreneurship scholars have studied how different dimensions of uncertainty influence the strategies and actions of managers and entrepreneurs leading innovation projects and new ventures (Sarasvathy & Kotha, 2001; O'Connor & Rice, 2013; Gomes et al., 2018; Packard & Clark, 2020). While different perspectives and dimensions of uncertainty have been conceptualized, at its core the main issue relates to the unpredictable nature of management in organizations and the dilemma of using planning and prediction-based approaches to deal with unpredictable events.

We can build on Hayek (1945), Akerlof (1970), and Dew et al. (2004) to explain uncertainty as the result of knowledge dispersion between people, places, and time. Because not all individuals and organizations have access to the same information or equal ability to process information, knowledge is dispersed (Hayek, 1945; Akerlof, 1970). Markets are characterized by information asymmetries, as actors engage in transactions without the same knowledge about supply and demand (Hayek, 1945) or characteristics of the transacted goods (Akerlof, 1970).

Technical and market knowledge is thus dispersed between people, places, and time (Dew et al., 2004). Entrepreneurship results from the identification of opportunities to address the uncertainties that emerge from knowledge dispersion (Dew et al., 2004). Integrating dispersed knowledge to address uncertainties is, therefore, the central challenge of innovation (Dew et al., 2004).

The academic interest in how organizations deal with uncertainty has been revitalized by studies on entrepreneurship and innovation management in the past decades (Sarasvathy, 2001; Dew et al., 2004; O'Connor & Rice, 2013; Bingham & Eisenhardt, 2014; Packard & Clarke,

2020). We can make sense of the contemporary literature on uncertainty management as mostly consisting of two complementary lines of research on uncertainty, one in the project management tradition (e.g., O'Connor & Rice, 2013) and one in the uncertainty in entrepreneurship tradition (e.g., Sarasvathy, 2001). Both address decision-making for innovative activities under uncertainty and how uncertainty can be managed using experimentation approaches (Sarasvathy, 2001; Dew et al., 2004; O'Connor & Rice, 2013; Bingham & Eisenhardt, 2014; Packard & Clarke, 2020; Thomke, 2020).

More radical innovation projects must account for uncertainty (Rice et al., 2008; O'Connor & Rice, 2013; Teece & Leih, 2016; Gomes et al., 2019; Datée et al., 2018; Kapoor & Klueter, 2021; Bremner & Eisenhardt, 2022). Different dimensions of uncertainty have been conceptualized, with the differentiation between technical and market uncertainties becoming dominant in this literature (in line with Rice et al., 2008). Technical uncertainties refer to unknown factors regarding the performance of innovations and mostly consist of engineering challenges of discovering and resolving uncertainties related to the functionality of a novel product or service (Rice et al., 2008). Market uncertainties mostly relate to how customers respond to novel products or services, and the difficulties of estimating demand curves for more radical innovations (Rice et al., 2008).

The key insight of this literature is that discovering and managing uncertainties rely on using experimentation, and not planning, approaches (Rice et al., 2008; O'Connor & Rice, 2013; Gomes et al., 2019; Kapoor & Klueter, 2021; Bremner & Eisenhardt, 2022). Facing technical and market uncertainties, managers should employ a structured method of experimentation, collecting data, and testing hypotheses regarding the focal value proposition being developed (Rice et al., 2008). Creating, analyzing, and integrating relevant information using experimentation enables uncertainty management (O'Connor & Rice, 2013).

Experimentation as an activity to manage uncertainty has been studied in the innovation management literature over the past two decades (Thomke, 2001; Thomke & Bell, 2001; Sarasvathy, 2001; O'Connor & Rice, 2013; Mahmoud-Jouini & Charue-Duboc, 2017; Thomke, 2020; Packard & Clark, 2020). When data that is not readily available to make a business decision is needed, either technical or managerial in nature, experimentation is used to generate this relevant information (O'Connor & Rice, 2013). Technical experiments will

provide managers with relevant data about performance, while business experiments will provide data on consumer behavior (Thomke, 2020).

The related field of studies on uncertainty management in entrepreneurship has further contributed to our understanding of this subject (Sarasvathy, 2001; Sarasvathy & Kotha, 2001; Dew et al., 2004; Sheperd et al., 2007; Foss & Klein, 2017). Non-predictive strategies employed by entrepreneurs conceptualized as effectuation (Sarasvathy, 2001; Sarasvathy & Kotha, 2001) or entrepreneurial judgment (Foss & Klein, 2017) enable uncertainty management in nascent organizations. As entrepreneurs face conditions of uncertainty, they employ non-predictive learning approaches based on generating relevant knowledge to support their decisions (Sarasvathy, 2001; Foss & Klein, 2017). Flexibility resulting from weak governance in nascent firms enables quick adaptation to the value proposition, business model, and organizational structure to account for the learning generated from implementing non-predictive strategies (Sarasvathy & Kotha, 2001; Ries, 2012).

Recent contributions to the uncertainty management debate (Packard et al., 2017; Packard & Clark, 2020) attempt to provide a robust theoretical treatment for the notion of uncertainty management. Uncertainties in this model can be aleatory or epistemic. Aleatory uncertainties arise when a causal factor is unknowable in principle, it is immitigable and unmanageable (Packard & Clark, 2020). Epistemic uncertainties refer to the ignorance of knowable information, thus enabling uncertainty management and mitigation by accumulating and integrating relevant information (Packard & Clark, 2020).

As we have shown, the debate on uncertainty management contributes to our understanding of how firms discover and manage uncertainties about their innovations using experimentation and employing non-predictive strategies (Saravasthy & Kotha, 2001; O'Connor & Rice, 2013; Gomes et al., 2019; Packard & Clark, 2020). However, this literature has not yet fully addressed the specific issues of managing uncertainty in multiple countries and contexts. Relevant questions, therefore, remain regarding the processes of discovering and mitigating uncertainty in a global context.

While knowledge dispersion between people, places, and time is recognized (Hayek, 1945; Akerlof, 1970; Dew et al., 2004) the process of integrating globally dispersed knowledge remains undertheorized in the context of innovation. Additionally, the use of experimentation

in a global context has not yet been fully explored in this literature. The role of external actors for both uncertainty discovery and mitigation in a global context also requires additional research to be addressed.

A nascent stream of research on uncertainty management in innovation ecosystems has recently dealt with uncertainty sharing in ecosystems (Gomes et al., 2018; Gomes et al., 2021a), ecosystem emergence under conditions of uncertainty (Datée et al., 2018), and collective experimentation in ecosystems (Mahmoud-Jouini & Charue-Duboc, 2017). In the next section, we review this literature and its contributions.

### 2.3 Uncertainty Management in Innovation Ecosystems

The literature on uncertainty management in the context of innovation ecosystems attempts to explain why and how firms cooperate under conditions of uncertainty to develop and commercialize a novel value proposition. Under conditions of uncertainty, when there is no known probability distribution for future events (Knight, 1921; Packard & Clarke, 2020), the traditional managerial wisdom could lead one to conclude that internalizing the process of innovation management is either a requirement (i.e., how can we engage with external partners without a clear expectation about future revenues, costs and profits for this project) or a rational choice (i.e., how can we engage with external partners without a clear expectation about *our* revenues, *our* costs or *our* profits for this project). However, companies continue to cooperate with external partners to develop novel value propositions under conditions of uncertainty (Dattée et al., 2018; Gomes et al., 2018; Brea, 2023) often with successful results (Hannah & Eisenhardt, 2018; Gomes et al., 2021a), begging the question: 'what is going on'?

During the COVID-19 pandemic, several pharmaceutical companies used innovation ecosystem strategies to develop novel value propositions based on different and competing technological platforms (Gaviria & Kilic, 2021). Applying a traditional view of innovation ecosystems (Adner, 2017) would logically lead scholars and analysts to predict that such efforts were bound to fail at an alarming rate. After all, as Adner & Feiler (2019) put it, interdependence in innovation ecosystems means that the already low probabilities of success by different actors during the development stage should be compounded in such collective projects. A development stage with an overall probability of success of 10% by actor A, when combined with a development stage with an overall probability of success of 10% for

actor B, would lead to an overall success rate of 1% (Adner & Feiler, 2019), meaning that out of 100 potential value propositions, only 1 would be materialized in a simplistic, two-actor project. Consider the odds for complex innovation ecosystems, with dozens of actors involved, for a more puzzling scenario.

However, many focal firms succeeded in leading ecosystems to develop novel solutions for the COVID-19 pandemic. Innovation ecosystems have proven to be resilient structures to manage uncertainty and risk for the development of novel value propositions, despite the initial skepticism by keystone scholars in the field (Adner & Kapoor, 2010; Adner, 2012; Adner 2017) and giving rise to a specific line of research on uncertainty management in innovation ecosystems (Gomes et al., 2018; Datée et al., 2018; Gomes et al., 2021a, 2021b). Although stories of failure to lead innovation ecosystems are illustrative, such as the notorious Michelin PAX run-flat tires case or the failure by Microsoft to attract complementors to the Windows phone digital platform, they may conceal as much as they reveal.

Uncertainty and risk are the underlying conditions in any innovation activity and remain a constant in all different approaches, practical or academic, towards IEs. Different aspects of uncertainty management have been studied in the literature, such as the relationship between uncertainty and innovation project life cycle, from conceptualization to implementation (Adner, 2012; Edelman, 2015; Dattée et al., 2018); the relationship between uncertainty management and knowledge management in innovation ecosystems (Gomes et al., 2021b); the importance of uncertainty propagation in ecosystems (Gomes et al., 2018); and how strategy and ecosystem bottlenecks relate to uncertainty management (Hannah and Eisenhardt, 2018).

The debate on uncertainty management in innovation ecosystems echoes the literature on uncertainty management in related fields, such as project management (Rice et al., 2008) or entrepreneurship (Sarasvathy, 2001; Packard & Clark, 2020), offering a new riff on the old planning versus experimentation tradition. Two characteristics of IEs, however, make them unique regarding uncertainty management: the relevance of external actors, and the lack of hierarchical control by the focal firm over such actors. Unlike traditional innovation projects, focal firms face the choice of sharing or not the perceived uncertainties with their partners (Gomes et al., 2018). Unlike traditional supply-chains, innovation ecosystems face the

challenge of not knowing *ex-ante* the value proposition to be developed and the best ways to capture the value it creates (Dattée et al., 2018).

It is generally accepted that IEs emerge with the creation of an ecosystem blueprint by the focal firm (Adner, 2012), the initial vision of the focal value proposition, the key partners, the main positions adopted by each actor in the ecosystem, and the control points that enable value capture (Dattée et al., 2018). New businesses have business models, new projects have business plans, and new ecosystems have blueprints. This engineering metaphor has the purpose of highlighting that innovation ecosystems are built, consciously, by a focal firm rather than emerge as a structure from continuous interactions such as business networks (Adner, 2012).

Because more radical innovations are developed under conditions of uncertainty using IE strategies and structures, such blueprints are not fixed, linear plans to be followed and implemented by the focal firm and other actors in the ecosystem (Adner, 2012; Datée et al., 2018). Collective experimentation orchestrated by the focal firm regarding the focal value proposition being materialized is the standard approach for uncertainty management in innovation ecosystems (Mahmoud-Jouini & Charue-Duboc, 2017; Dattée et al., 2018; Gomes et al., 2018).

Because of the collective nature of innovation ecosystems, experimentation may be simultaneously conducted by several actors cooperating to materialize a focal value proposition, leading to relevant coordination and information asymmetry challenges for the focal firm (Mahmoud-Jouini & Charue-Duboc, 2017; Gomes et al., 2018). Each actor will experiment to manage their own uncertainties and in doing so collaborate towards uncertainty management for the whole ecosystem. However, choices about communicating uncertainties and experiment results (Gomes et al., 2018), the correct strategy and position for the focal firm (Hannah & Eisenhardt, 2018), issues of ecosystem evolution (Datée et al., 2018), and ownership of intellectual property rights in ecosystems (Moerchel et al., 2022) may arise during this process.

A key feature of uncertainty management in IEs is the issue of uncertainty sharing (Gomes et al., 2018; Gomes et al., 2021a). While experimentation and non-predictive approaches may be suitable for managing uncertainties regarding the focal value proposition (technical

viability, potential market demand, best market segment), focal firms in IEs are also concerned with controlling how these uncertainties propagate to other members of the ecosystem (Gomes et al., 2021a). When engaging with external actors, full disclosure about the nature of the uncertainties faced by the focal firm and therefore the whole IE may hinder the development of the ecosystem (Gomes et al., 2018). Focal firms are careful to not propagate all uncertainties they face, enhancing the perception of external partners about the value to be gained by joining the ecosystem (Gomes et al., 2018; Gomes et al., 2021a).

It is recognized in the literature that mutual adaptation and evolution by ecosystem actors are influenced by how focal firms manage uncertainties and their propagation in the IEs they lead (Jacobides et al., 2018; Datée et al., 2018; Gomes et al., 2018; Gomes et al., 2021a). Alignment in IEs relies not only on balancing cooperation and competition dynamics while materializing or commercializing a focal value proposition (Hannah & Eisenhardt, 2018), but also on the use of specific communication tools, common cognitive models, use of sequential learning strategies, and use of controlled environments for experimentation (Gomes et al., 2021a).

However, relevant questions persist about uncertainty management in ecosystems in a global context. How focal firms leading ecosystems use their international structures to discover and manage uncertainties has not yet been addressed by this literature. The process of finding and engaging with suitable external actors given the additional challenges of operating in a global context also remains undertheorized. Additionally, how focal firms leading ecosystems create and conduct collective experiments to manage uncertainties in a global context remains an open question.

In the following chapter, we show how we built a conceptual model that guided both stages of our research. Mostly, we built it by adding a geographical dimension to the notions of innovation ecosystems and uncertainty. This conceptual model is a tentative theoretical framework built on initial insights from our review of the literature and analysis of the phenomena we wish to explore. We also situate this research in an epistemic paradigm (in line with Gioia et al., 2022 and Gomes et al., 2023b) and provide the definitions of the concepts that guided our research efforts.

## 3. Conceptual Model

In this chapter, we present our conceptual model, which is an *a priori* and explicit theoretical model, created based on existing concepts, and that was used to guide our research efforts (Robson, 2002; Somekh & Lewin, 2005; Green, 2014). The use of such artifacts is not consensual in qualitative research, as authors in the grounded theory tradition argue it may bias the results and constrain the emergence of insights from empirical data (Corbin & Strauss, 2008). However, making the theoretical model used by the researchers explicit, rather than implicit and dispersed, can aid communication, improve clarity and transparency regarding theoretical assumptions, as well as provide a solid foundation for theory building and improvement (Robson, 2002).

Recent research in the field of innovation management, uncertainty management, and innovation ecosystems has used conceptual models and we follow in their footsteps (Gomes et al., 2021a; Chaparro, 2022). We begin by making explicit some epistemological assumptions that underly our work. We then move on to offer the definitions used in our research for each key concept. We finalize with a visualization of our conceptual model and the links between the constructs that inform it.

When researchers are concerned with theory building and improvement, it is recommended that the theoretical assumptions of the researcher are made explicit and that the foundations of the theory being developed or improved are clearly stated (Kuhn, 1962; Gioia & Pitre, 1990). All theories in social and natural sciences are built either following an established paradigm or challenging such paradigm (Kuhn, 1962), and without a clear exposition of what the theorist understands as the scientific paradigm of his specific field, theory building becomes subjective and potentially innocuous (Gioia & Pitre, 1990). Calls for clarity on the process of theory building have been a constant in qualitative research for the past decades (Gioia & Pitre, 1990; Langley, 1999; Hambrick, 2007; Shepherd & Suddaby, 2017; Gioia et al., 2022) and clarity begins with identifying a paradigm before building a conceptual model to be confronted with empirical data.

We adopt a subjective research paradigm, based on Burrell & Morgan's (1979) paradigmatic dichotomy between subjective and objective views on social sciences. This paradigm postulates that reality is subjectively and socially constructed, with researchers and informants both creating their own subjective views and interpretations of social phenomena

(Burrell & Morgan, 1979; Guba & Lincoln, 1994; Gomes et al., 2023b). We further understand that our research methods, theory-building approaches, and theory improvement efforts are constrained by this paradigmatic position of our research, which requires coherence between the methods employed and the paradigm we adopt (Gioia et al., 2022; Gomes et al., 2023b).

We follow Gioia's suggestion to make explicit our ontological, epistemological, and methodological assumptions (Gioia et al., 2022). Ontologically, we understand organizations and their ecosystems to be socially constructed structures, which means that managers and other actors in organizations create structures, using their own agency and that they believe in the reality of what they created (Gioia et al., 2022). Global ecosystems are no less fictitious than organizations, and no less real. Both are socially constructed by people, who then believe that they are relevant, define the rules to guide their actions, and follow (or sometimes do not follow) these rules, to face the appropriate consequences.

Epistemologically, we understand that it is necessary and useful, therefore, to take into consideration the actions and discourse of the people who socially created and participate in the organizations and global ecosystems we are researching. Moreover, we believe that the managers involved in global ecosystems and the organizations that participate in them are knowledgeable about their work, the challenges they face, and the processes employed to deal with these challenges (in line with Gioia et al., 2022). Researchers, therefore, are not responsible for explaining to managers their own work, but rather for organizing their actions and discourse into coherent, more general categories.

Doing so requires a specific methodological approach, one which enables the researcher to look for patterns in discourse and behavior to organize the dispersed knowledge of managers working in different organizations, participating in different global ecosystems, and using different processes to deal with the challenges they encounter. For us, this is based on a structured qualitative methodology that organizes empirical data collected with informants into patterns, codes, concepts, and dimensions that inform theory-building and improvement efforts (Gioia et al., 2013). Data structure takes central stage, as it enables researchers to approach this work in an organized manner, but also helps the researcher to better communicate how he did it to a larger academic and practice-oriented audience (Gioia et al., 2022). As with any scientific endeavor, transparency is the main goal.

Once the research is positioned within a paradigm, we can move on to offer the formal definitions of the concepts that will be used in our research. We understand innovation ecosystems to be “groups of legally independent but interdependent economic actors that invest in complementary and possibly ecosystem-specific assets and abide by mutually agreed upon rules and agreements necessary for an innovative joint value proposition to materialize” (Foss et al., 2023, p 1). This research is also based on the assumption that ecosystem leaders, here referred to as focal firms, are the organizations that use their “effort and investments to influence, control, and constrain other (potential) ecosystem participants with the purpose of establishing and maintaining a robust ecosystem” (Foss et al., 2023, p.2).

We offer, then, an initial definition of global ecosystems building on novel theoretical advances (Foss et al., 2023). Global ecosystems are formally defined for the purpose of this research as groups of internationally dispersed, legally independent economic actors that invest in complementary and possibly ecosystem-specific assets and abide by mutually agreed upon rules and agreements necessary for an innovation joint value proposition to be materialized under conditions of local and global uncertainty.

We understand uncertainty in this research to mean epistemic uncertainty, defined as ignorance of knowledge that is knowable in principle (Packard & Clark, 2020). It emerges because there is a limit on both the understanding of causal relationships and the ability to process information to predict future outcomes in business contexts (Knight, 1921; Packard & Clark, 2020). Epistemic uncertainty can be managed, or mitigated, once sufficient information, cognitive awareness, and capacity accumulate to eliminate the epistemic components of uncertainty (Packard & Clark, 2020). Uncertainty mitigation, then, enables a better understanding and prediction of future outcomes associated with business decisions.

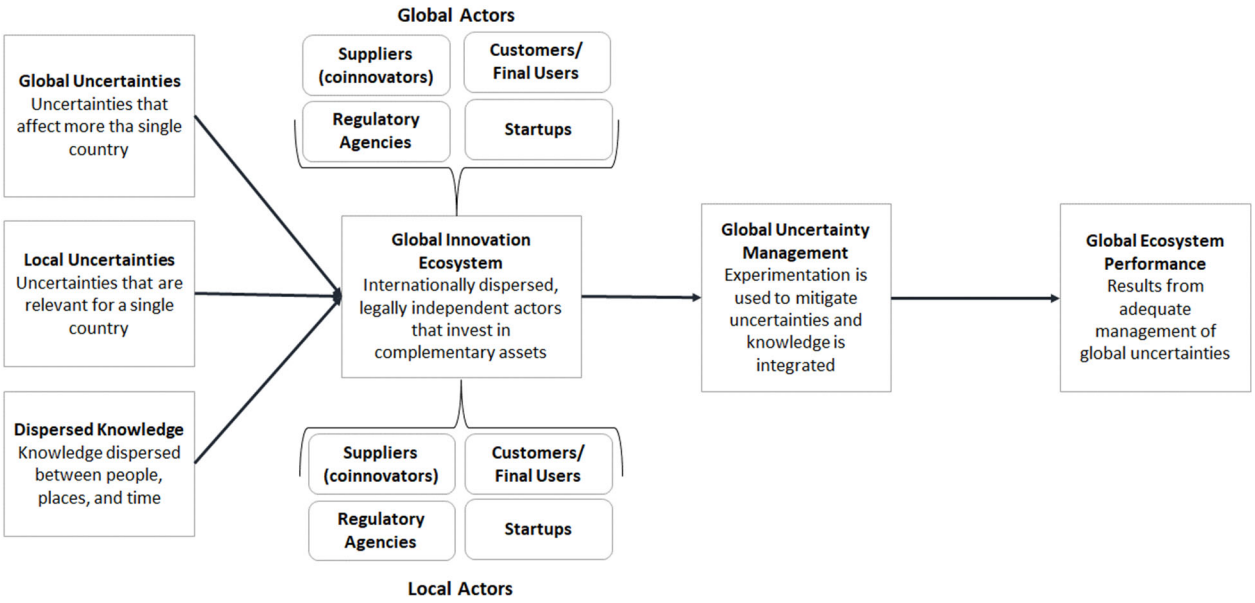
A key feature of this research is the differentiation between local and global uncertainty. We postulate that knowledge dispersion between people, places, and time (Hayek, 1945; Akerlof, 1970; Dew et al., 2004) leads to a geographical dimension of knowledge, which is contextual in nature (Nonaka & Takeuchi, 1995). Uncertainties (the absence of knowable knowledge) therefore, have a geographical dimension and can be local, relevant in a single country, or global, affecting more than one country. Mitigating local and global uncertainties requires accessing, processing, and integrating this knowledge that is dispersed in different countries.

We understand ecosystem governance as the set of rules, roles, mandates, incentives, and enforcement mechanisms defined by focal firms in ecosystems with the purpose of aligning the efforts of independent actors around the materialization of a focal value proposition, enabling value creation and constraining value capture (in line with Jacobides et al., 2018; Gawer, 2022; and Foss et al., 2023). In this sense, one of the key tasks of focal firms leading ecosystems is to define its governance, who can participate in the ecosystem, how they can participate (roles, links, activities), and what are the rules for value capture. Governance is dynamic, as the inputs from external actors, changes in the business landscape, and institutional contexts matter (Foss et al., 2023).

We understand ecosystem orchestration as the combination of actions, deliberately taken by the focal firm, to "encourage voluntary value co-creation inputs and effect coordination among hierarchically independent actors of the ecosystem" (Autio, 2022, p. 107). This definition is in line with early work on orchestrating innovation networks (Dhanaraj & Parkhe, 2006). We employ this concept to refer exclusively to the actions of the focal firm.

We built on this extant literature to create a conceptual model that had the purpose of guiding our research efforts, grounding our data collection and the initial analysis in the pre-existing concepts that inform our research. We built this model by adding a geographical dimension to the ideas of innovation ecosystems (Adner, 2017; Foss et al., 2023), value propositions (Payne et al., 2017), uncertainty management in innovation ecosystems (Gomes et al., 2018; Datée et al., 2018; Adner & Feiler, 2019; Packard & Clark, 2020), and knowledge dispersion (Hayek, 1945; Akerlof, 1975; Dew et al., 2004).

Figure 2: Conceptual Model for Uncertainty Management During Global Ecosystem Emergence and Evolution




Source: Authors

Our conceptual model postulates that global ecosystems emerge because focal firms encounter three conditions: i) developing the focal value proposition requires collaboration with external actors located in different countries (Zahra & Nambisan, 2011; Nambisan et al., 2019); ii) there is a need to discover and manage relevant uncertainties that cannot be mitigated by the focal firm (Gomes et al., 2018) and in a single country; and iii) that there may be the need to access geographically dispersed knowledge to identify and mitigate relevant uncertainties using experimentation approaches (Dew et al., 2004).

Global ecosystems enable the focal firm, therefore, to discover and manage the relevant local and global uncertainties by engaging with external actors in different countries. This process is based on the creation and integration of dispersed knowledge by the focal firm, a process similar to that identified in global R&D operations (Von Zedtwitz & Gassmann, 2002; Von Zedtwitz & Gassman, 2016). Collective experimentation processes are used to generate the information that allows the firm to mitigate these local and global uncertainties (Gomes et al., 2018; Mahmoud-Jouini & Charue-Duboc, 2017). Global ecosystem performance results from this process of local and global uncertainty management.

Once we have defined a conceptual model, we can move on to detail our methodological approach. The same conceptual model was used to guide both phases of this research. In the

next section, we will explain how we designed the structured data collection and analysis protocols that enabled us to create our theoretical models that explain uncertainty management in global ecosystems, and global ecosystem emergence and evolution.

## 4. Methodology

We adopted a qualitative research design to answer the two questions that guide this thesis: i) how focal firms manage local and global uncertainties using global ecosystems; and ii) how focal firms lead the process of global ecosystem emergence and evolution under conditions of local and global uncertainty. This choice for a qualitative methodology reflects the nature of our research questions, as well as our ontological and epistemological assumptions. When new data contradicts or adds to existing theoretical frameworks there emerges an opportunity for theory building and theory improvement (Eisenhardt, 1989; Langley, 1999; Christensen, 2006; Eisenhart & Graebner, 2007; Eisenhardt, 2021; Gioia et al., 2022). Facing limited theory, evidence, and insights regarding our research subject, global ecosystems, we have chosen to model our methodological approach after other recent endeavors that have encountered similar conditions in related fields (eg., Hannah & Eisenhardt, 2018; Datée et al., 2018; Gomes et al., 2021a).

Qualitative research is concerned with understanding a phenomenon and how it relates to existing theories to derive either new or improved insights (Gioia et al., 2013; Patton, 2014). The phenomena of global ecosystems are not fully explained by the extant theories on uncertainty management, international business, and innovation ecosystems. To answer these questions, we used a research design focused on theory-building from case studies and using a structured qualitative data collection and analysis protocol (Eisenhardt & Graebner, 2007; Gioia et al., 2013; Gioia et al., 2022).

However, much of what we have studied in this research has partial explanations in the extant literature. Innovation ecosystems have been theorized (Adner, 2017), uncertainty management in innovation ecosystems has been examined (Gomes et al., 2018), and initial theoretical frameworks explain global platforms and their ecosystems (Nambisan et al., 2019; Nambisan & Luo, 2021). The purpose of both phases of our research was not only to build a new theoretical framework to understand global ecosystems but also to improve the existing theories by contrasting them with the, insofar, unexplained phenomena of uncertainty management in global ecosystems as well as the emergence and evolution of global ecosystems. We employed, therefore, both theory-building methodologies (Eiseinhardt, 1989; Eisenhardt, 2021) and theory improvement methods (Christensen, 2006).

The objective for phase 1 of our research was to engage in theory-building *vis-à-vis* uncertainty management and global ecosystems, a subject we perceived as being under-theorized. Theory-building is required in this case, as opposed to other approaches such as theory-testing, precisely because there is an absence of adequate theoretical explanations for the phenomenon at hand (Eisenhardt & Grabner, 2007). We filled this gap by deriving concepts and propositions from qualitative data that help explain why some focal firms have chosen to use global ecosystems to discover and manage the relevant local and global uncertainties for their focal value propositions. We also had the objective of improving existing theories on uncertainty management and innovation ecosystems. Uncertainty management in innovation ecosystems has, so far, been treated with little concern for the implication of using international structures (Adner, 2017). Using these existing concepts as the foundation of the first stage of our research we were able to improve the existing theories by adding new constructs with adequate explanatory power (Christensen, 2006).

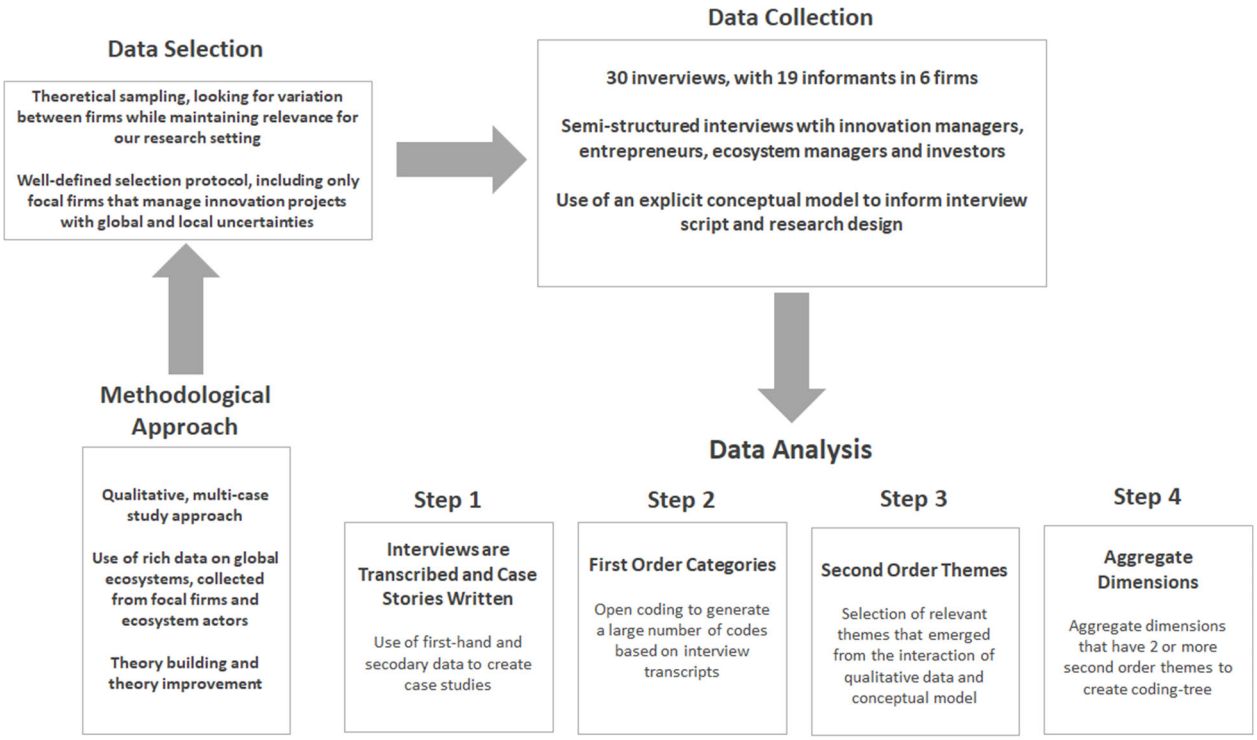
Phase two of our research emerged from our understanding of global ecosystems after the initial research on uncertainty management. Our initial study made clear that we lacked more data and conceptualization regarding the life cycle of global ecosystems, how they emerge and evolve over time under conditions of local and global uncertainty. The objective for phase 2 of our research was, therefore, to deepen our theory-building efforts, based on what we discovered in our first study on uncertainty management in global ecosystems. We realized that the processes of global ecosystem emergence and evolution still lacked an adequate theoretical framework. We filled this gap by conducting a second round of case studies on how focal firms deal with the emergence and evolution of global ecosystems and deriving adequate concepts to explain how these processes take place.

### 4.1 Research Phase 1: Methodological Overview

The setting for the first stage of our research was the operation of multi-national enterprises leading global ecosystems with at least one business unit (subsidiary or headquarters) located in Brazil. We have purposefully chosen focal firms that operate in different markets and contexts, as this enabled a richer understanding of the management of local and global uncertainties using global ecosystems. This choice reflects the requirement for variance in our cases. Under-theorized phenomena, such as global ecosystems, can benefit from multiple perspectives, and limiting our research to a single setting or a single market could create a

narrow view of our research subject. The figure below summarizes how we designed an appropriate methodology to answer the question of how focal firms use global ecosystems to manage local and global uncertainties.

Figure 3: Overview of the Methodology Research Phase 1




Source: Authors

The level of analysis is the global ecosystem, orchestrated by a focal firm, to materialize a focal value proposition under conditions of local and global uncertainty. We have limited our focus to a single project, as it is the main unit of analysis for traditional innovation ecosystems, which provides an adequate contrast between local and global ecosystems. Each case in our sample represents a focal project, headed by a focal firm, engaging with ecosystem actors located in different countries, forming a global ecosystem. In the next section, we detail how we selected and collected the relevant data for each case in our sample.

### 4.1.1 Research Phase 1: Data Selection and Collection

We began our sampling efforts by creating a preliminary list of possible interesting cases, based on an *a priori* analysis following our conceptual model. We used reports available in the business press, personal connections, and specialized websites to identify eleven relevant cases. This sample was then refined to reach a final sample of four focal firms leading the

global ecosystems and two additional focal firms to provide data saturation. Each company in our final sample received a formal invitation and agreed to participate in our research, as well as specific instructions about the research proposition. We initially focused on the focal firms, due to their relevance for uncertainty management, but for some cases, we also interviewed other actors that participate in their ecosystems.

Because other researchers have identified that focal firms orchestrating global ecosystems centered around digital platforms were of interest (Nambisan et al., 2019) we decided to include two such cases in our sample. Digital platforms are often present in several countries and the focal firms leading these platforms deal with relevant local and global uncertainties. These characteristics led to the inclusion of these focal firms in our sample. However, not all global ecosystems are centered around digital platforms. For this reason, we also chose to add two focal firms leading global ecosystems centered around non-digital technologies, which provided us with a richer sample of cases as the challenges faced by these organizations complemented our understanding of the nature of uncertainty management in global ecosystems. Our final sample consisted of four main cases and two saturation cases, with a mix of digital and non-digital global ecosystems.

We used fictionalized names to preserve the anonymity of the focal firms and the managers who participated in this study. Lineplus is a multinational firm, headquartered in Colombia and with operations in Brazil, Mexico, Chile, and Peru. This focal firm leads a global ecosystem developing novel solutions for the maintenance of powerlines using drones (unmanned aerial vehicles), engaging via the Brazilian subsidiary with a local startup and a local university. As this project evolved, other units of the focal firm in different countries also became active participants in the development.

Masterplan is a multinational enterprise headquartered in a European country and leads a global ecosystem centered around its industrial software solutions. In the past years, Masterplan engaged with actors in several countries to develop radical innovations using artificial intelligence, cloud computing, and big data technologies.

Bioleader is a startup headquartered in Brazil which leads a global ecosystem for the development of second-generation ethanol (a biofuel) using novel bioprocessing technologies. In this project, Bioleader engaged with actors that lead the development of

biofuel technologies around the world to answer the needs of its main customer, located in the United States.

Smartplat is a multinational firm, headquartered in a European country, leading a global ecosystem for the development of equipment for the energy and health sectors using internet of things (IoT) technologies. Their global ecosystem includes startups located around the world, including Brazil. The table below summarizes the organizations that participated in the first research stage of this thesis[3], a brief description of each case, examples of local and global uncertainties, and the managers we interviewed.

Table 2: Information Regarding the Cases Phase 1

| Case#Number | Description | Local and Global Uncertainties | Data Sources |
|---|---|---|---|
| Case 1 - Lineplus | Lineplus is a multinational, headquartered in Colombia, with operations in Brazil and leading a global ecosystem centered around the development of a focal value proposition based on digital maintenance for powerlines using drones | **Local Uncertainties**: regulation in Brazil for the use of unmanned aerial vehicles; drone model for use over sensitive areas such as favelas in Brazil or the Andes in Peru **Global Uncertainties**: definition on how to approach the co-developmet partnerships with external actors (startups); reliability of drones for powerline maintenance; integrating the software side of the solution with existing I.T. infrastructure in different countries | For this case eight (8) interviews were conducted with a senior innovation manager (3), an innovation manager from outside of Brazil (1), with entrepreneurs (3), and with an innovation analyst (1). We also analyzed documents, press releases, and financial reports. |
| Case 2 - Masterplan | Masterplan is a multinational, headquartered in a European country, with operations in Brazil and leading a global ecosystem centered around a focal value proposition of providing industrial software solutions to global clients | **Local Uncertainties:** Defining software functionalities for the Brazilian industrial market; response and adoption of new solutions by external actors in Brazil **Global Uncertainties:** Identifying, developing, and implementing the software functionalities for a novel generation of their software platform; evolution of the focal value proposition in the coming years | For this case five (5) interviews were conducted, with the chief of digital transformation (1), the startup engagement manager (2); ecosystem vice-president (1), and the sales and channels manager (1). We also analyzed documents, reports, and press releases. |
| Case 3 - Bioleader | Bioleader is a Brazilian startup, leading a global ecosystem centered around a focal value proposition for R&D and production of second-generation ethanol | **Local Uncertainties:** Reaction of their main suppliers to changes in operations and new operational standards in Brazil; defining the proper uses for the required raw materials **Global Uncertainties:** Pricing in the second-generation ethanol global market; definition and development of the appropriate production technologies for second-generation ethanol | For this case six (6) interviews were conducted, with a co-founder (1), executives (2), potential suppliers (1), and public investors (2). We also analyzed documents and reports in the business press. |
| Case 4 - Smartplat | Smartplat is a multination enterprise, headquartered in a European country, and leading a global ecosystem centered around a focal value proposition for Internet of Things technologies | **Local Uncertainties:** leading the scale-up for their digital platform; addressing regulatory issues in Brazil and other countries **Global Uncertainties:** definition and communication of the value proposition for a global audience; scaling-up the platform and global ecosystem | For this case four (4) interviews were conducted, with innovation managers (2), and ecosystem managers (2). We also analyzed documents, reports, and press releases. |

Source: Authors

This rich sample of focal firms enabled that we gained an in-depth understanding of the phenomena of global ecosystems and how these are used to identify and manage local and global uncertainties. All companies in this sample lead their respective global ecosystems, deal with local and global uncertainties, and employed specific governance mechanisms and

[3] We further analyzed two saturation cases of focal firms leading global ecosystems (Luna and Saturno) for which we conducted additional seven interviews (4 with managers from Luna and 3 with managers from Saturno). We did not include these cases in the phase 1 research results because there was sufficient data from the four cases detailed above.

strategies during this process. Four focal firms (cases 1 through 4 in the table above) provided the main cases we analyzed, with two other cases being used for saturation, which occurs once the case studies have sufficiently provided the researchers with the relevant data required to answer the research questions at hand.

Data was collected for each case using semi-structured interviews and following a strict protocol defined *a priori* (Langley & Meziani, 2020) with informants in the focal firms that were actively engaged in the efforts of materializing the focal value proposition and leading their respective global ecosystems or managers from other relevant ecosystem actors, all located in Brazil. Some informants were interviewed more than once, to provide additional clarity about the cases.

We used a triangulation approach, contrasting data collected from different sources (interviews, documents, reports), to ensure data validity (Eisenhardt, 1989) as well as a combination of longitudinal and retrospective data collection approaches to further ensure data validity (Hannah & Eisenhardt, 2018). Some interviews were conducted face-to-face, while others were conducted using digital meeting software. On average, interviews lasted between 40 and 90 minutes. Once data was collected, we moved on to analyze it using a well-structured process based on existing guidelines for multiple cases (Eisenhardt, 1989; Eisenhardt & Graebner, 2007) and employing an iterative coding process (Gioia et al., 2013).

### 4.1.2 Research Phase 1: Data Analysis

Data analysis for multiple case studies requires the use of a well-structured approach to enable the adequate emergence of concepts and a rich understanding about how they relate to each other (Eisenhardt, 1989). We based our within-case and across-case analysis on the Eisenhardt approach to qualitative research (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Eisenhardt, 2021) and we used a well-defined coding approach based on the Gioia method (Gioia et al., 2013) for concept development and to establish the relationships between concepts. We used a multi-stage approach for data analysis.

We began with the within-case analysis, elaborating for each case a single story based on the primary and secondary data that was collected on how the focal firms used global ecosystems for uncertainty management. In this stage, we analyzed the ecosystem structure (value proposition, actors, and roles) to identify the relevant uncertainties and how the focal firm

addressed them locally (in a single country) or globally (in several countries simultaneously). As is common in research on uncertainty management (O'Connor & Rice, 2013; Gomes et al., 2018; Gomes et al., 2021a) this was a challenging process, as interviewees often face difficulties articulating the idea of uncertainty. Based on an open-coding approach (Corbin & Strauss, 2008) we began coding uncertainty when discourse mentioned gaps in knowledge, challenges for prediction, absence of information, or absence of knowledge. The same open-coding approach was used to look for patterns in the actions of the focal firm to identify and manage these uncertainties. This led to improvement of the initial case stories as we began to differentiate between local and global uncertainties (our second order codes).

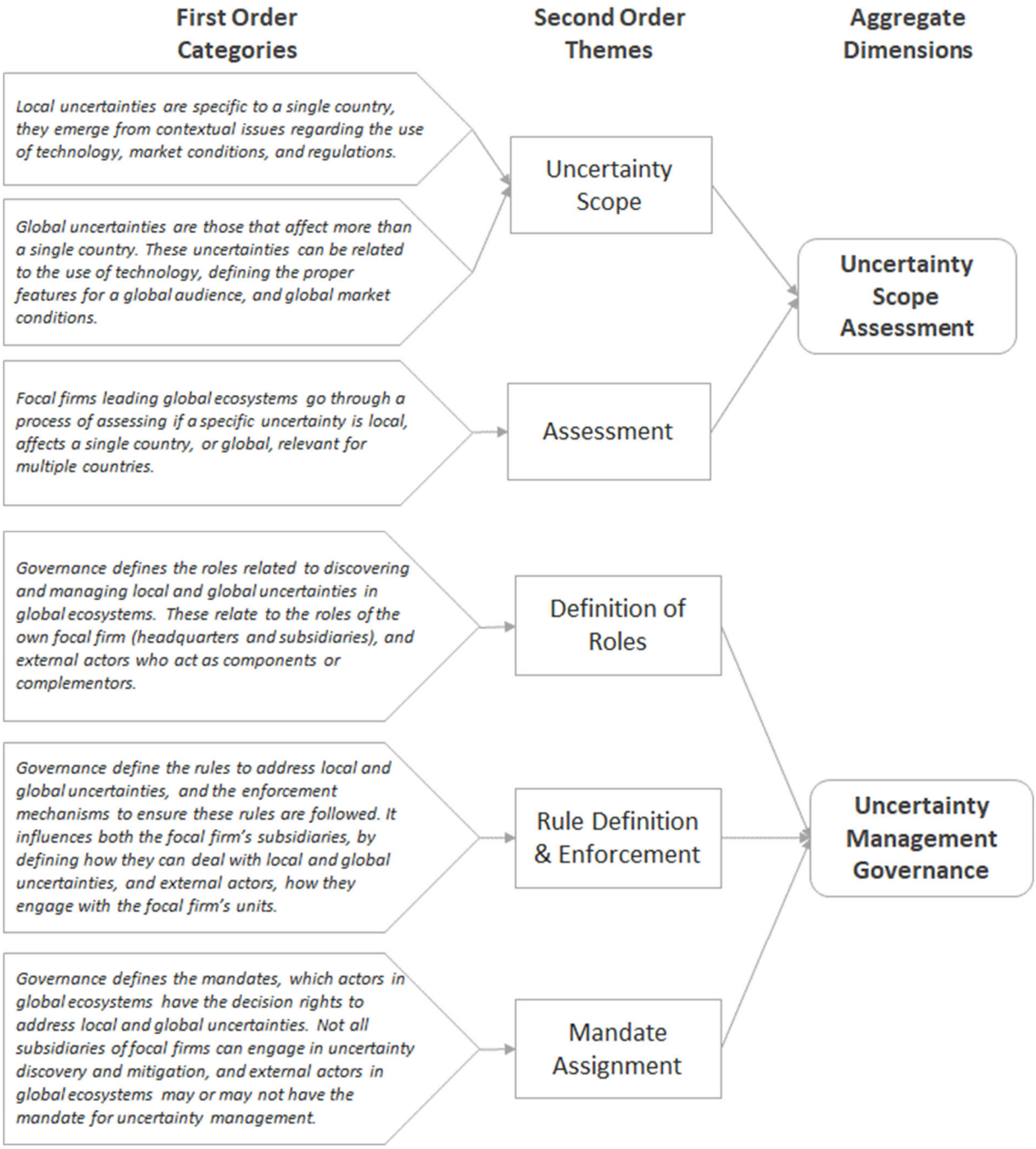
The next step in the data analysis process was based on generating and refining second-order themes. We discovered, for instance, that focal firms in our sample employed three different strategies to manage uncertainties in global ecosystems. Some focal firms internalized part of the uncertainty management using their own R&D infrastructure, which we coded as internal uncertainty management. Codes were created for two other strategies used for uncertainty management by the focal firms, based on either partnering with external actors using formal contracts, which we coded as collaborative uncertainty management, or using digital artifacts (such as digital platforms) to enable autonomous collaboration, which we coded as autonomous uncertainty management.

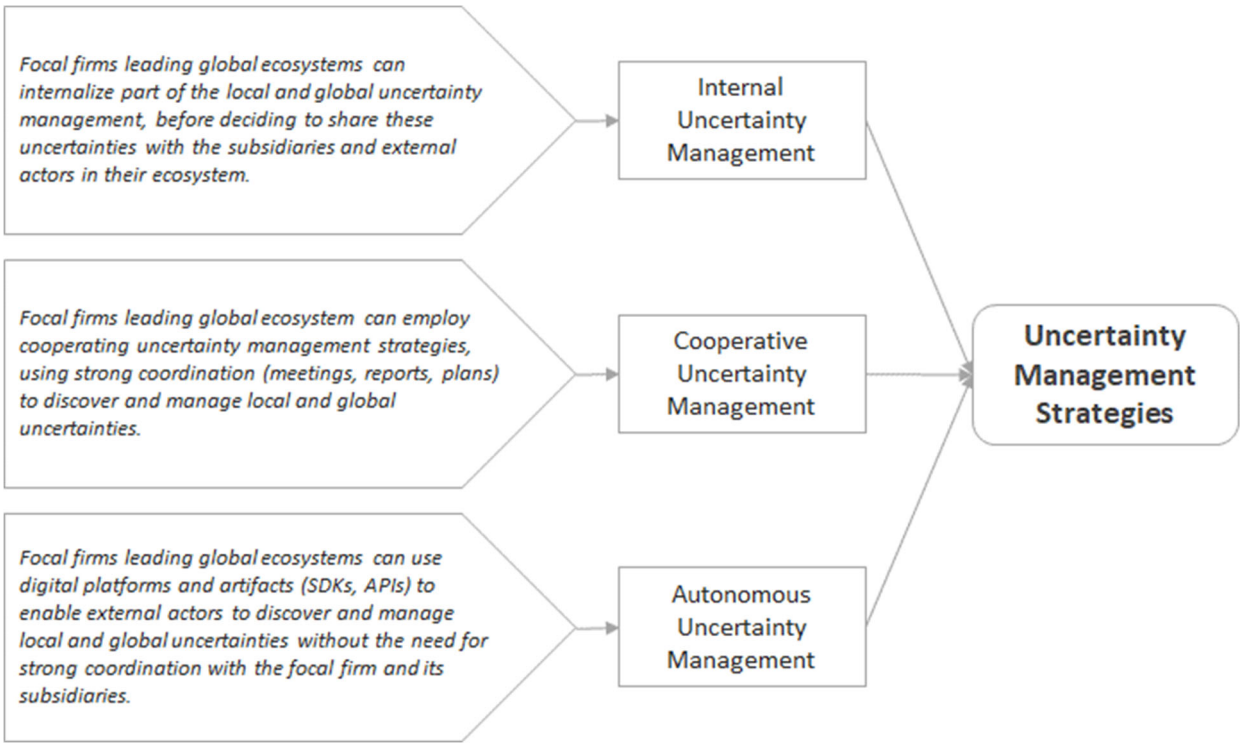
We further discovered during this data analysis stage that some subsidiaries of the focal firms in our sample had the autonomy to identify and manage local and global uncertainties while others did not. This led to our understanding about the relevance of uncertainty management governance in global ecosystems. During this process, which involved intense discussion efforts with other members of our research team, we were able to generate the aggregate dimensions of our coding tree.

We further refined our understanding about the cases and emergent concepts, leading to the conclusion that because uncertainties have a geographical dimension (either local or global), focal firms and other actors in global ecosystems perform a task of uncertainty scope assessment. Based on the extant literature about strategy in ecosystems (Hannah and Eisenhardt, 2018) and insights that emerged from the data analysis process we proposed three main strategic actions for uncertainty management in global ecosystems. We built on

the existing notion of governance in ecosystems (Jacobides et al., 2018) to organize the rules, roles, and mandates that combine to form the uncertainty management governance in global ecosystems. These data analysis efforts result in a coding tree that summarizes the results of this process and organizes it into first order codes, second order themes, and aggregate dimensions. The resulting coding tree is presented below.

Figure 4: Coding Tree for Phase 1 of the Research






Source: Authors

We underline that this coding tree is the result of an intense, iterative process of data analysis and of contrasting our insights with the extant literature. During this process several such coding trees were created, with the first order codes, second order themes, and aggregate dimensions being refined over time as we gained a better understanding of the cases, our insights, and how these could contribute to the existing theories about innovation ecosystems. Once the coding tree was established, we moved on to an effort of articulating the relationship between the concepts. This effort is detailed in the results section.

It was based on phase 1 of this research that we were able to articulate an initial understanding of uncertainty management in global ecosystems. Because not all relevant questions were answered during this initial discussion, mainly those related to global ecosystem's life cycle, we decided to continue our investigation on global ecosystems by conducting additional research to answer the questions that remained open or that emerged from the first research phase. For instance, while we gained a better understanding of uncertainty scope, its assessment and the interplay between strategies and governance to manage such uncertainties, we still lacked data about the emergence and evolution of global ecosystems. Why do focal firms first invest their resources for the emergence of global ecosystems while leading the materialization of their focal value propositions? What are the

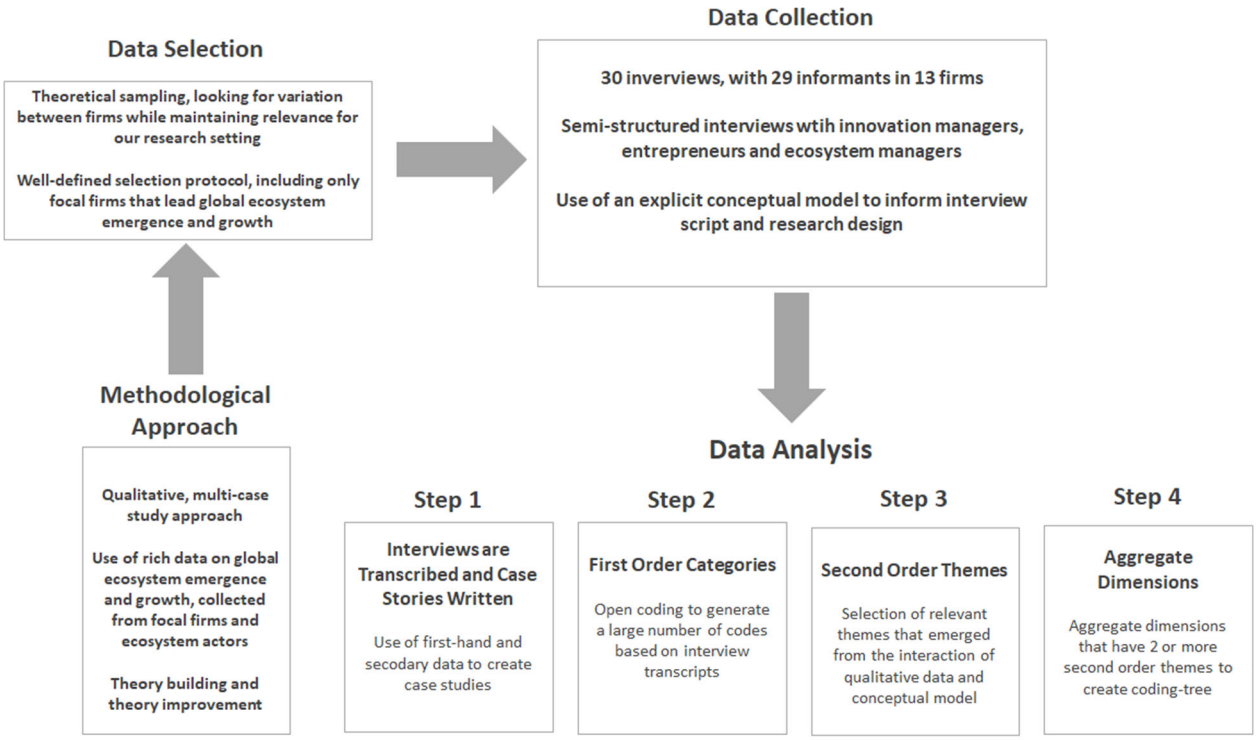
challenges faced by focal firms when leading global ecosystem emergence and evolution under conditions of local and global uncertainty? We created a well-structured qualitative methodology to answer these questions, with a different sample of focal firms. We detail this methodology in the following section.

### 4.2 Research Phase 2: Methodological Overview

We followed a similar methodology in the second phase of our research, with the main change coming from the sample of firms used in this stage. A qualitative research design was employed, due to the nature of the research question, concerned with understanding the process of global ecosystem emergence and evolution. Because no data or extant theory was available, we decided to use a rich, multiple-case study approach for theory building and theory improvement (Eisenhardt, 1989; Eisenhardt, 2021). Because our goal was to better understand the process that focal firms that lead global ecosystems go through, from the initial vision about the potential use of such structures to its establishment and evolution, answering a 'how' question, a qualitative, multiple-case study approach is the recommended method (Eisenhardt, 1989; Eisenhardt & Graebner, 2007) and one that has been employed in the past by researchers in related fields (Datée et al., 2018; Gomes et al., 2018; Hannah & Eisenhardt, 2018).

This study aimed to close a relevant gap in the literature, the lack of theories or empirical evidence about how global ecosystems come to be and how they evolve, with a focus on how focal firms lead this process. The multiple-case study approach we adopted enabled an in-depth and rich understanding about this process, allowing the generation of meaningful data that informed our tentative theory of global ecosystem emergence and evolution. This was an exercise of both theory improvement and theory building. Existing explanations about ecosystem emergence (Datée et al., 2018), ecosystem orchestration (Autio, 2022), global platforms (Nambisan & Luo, 2021), and uncertainty management in innovation ecosystems (Gomes et al., 2018) created the possibility of theory improvement. But there was still an opportunity for theory building, as the specific dynamics of global ecosystem emergence and evolution remain undertheorized. This study, therefore, attempted to seize the opportunities for both theory improvement (Christensen, 2006) and theory building (Eisenhardt, 1989; Eisenhardt, 2021). The figure below outlines how we designed this research.

Figure 5: Methodological Overview for Phase 2 of the Research




Source: Authors

We began by defining the proper methodological approach, based on the nature of our research question, the lack of empirical data on the phenomena of interest and the definition of our goal as both theory improvement and theory building. We employed a theoretical sampling approach, looking for cases of focal firms leading global ecosystems and that could help us better understand their emergence and evolution. We use a well-structured sampling approach, looking for global ecosystems led by focal firms with a Brazilian subsidiary, or the headquarters located in Brazil. We collected first-hand data using semi-structured interviews with managers from focal firms that were involved directly with the global ecosystem emergence and evolution efforts, as well as secondary data to enable triangulation and ensure data validity. We employed a well-structured data analysis protocol, based on combining first-hand and secondary data to create case stories for each focal firm in our sample. In the following section we detail our sampling strategy and how we selected the focal firms that participated in this study.

### 4.2.1 Research Phase 2: Data Selection and Collection

Focal firms leading global ecosystem emergence and evolution, with operations in Brazil, constitute the setting for this research. We employed a theoretical sampling strategy, based

on identifying and selecting the proper cases to help us understand the phenomena at hand, based on our conceptual model and results of the first stage of our research. Our goal was to identify focal firms that were either leading global ecosystems during their emergence or focal firms that lead the evolution of established global ecosystems. To do so we began by mapping potential focal firms, based on an initial analysis of articles published in the business press, our existing connections with ecosystem managers operating in Brazil, and looking through corporate websites of focal firms with global operations and leading innovation projects in Brazil. This effort resulted in an initial list, with some 20 focal firms. This list was later refined, as we gained a better understanding of the cases.

We created a sample with a high degree of variability, in terms of company size, country of origin, type of innovation project being managed (incremental and radical), and underlying technology. In total, thirteen focal firms make up our sample, with seven being the main cases and the rest providing theoretical saturation. The selection of the main cases was based on two main criteria: the richness of the case to explain ecosystem emergence and evolution; and the availability of first-hand data. Because most of the projects were in the early stages of development, not all focal firms in our sample enabled proper data collection due to confidentiality issues, changes in internal policies, or due to the sensitive nature of the projects.

The seven main cases were those that combined both a rich account of global ecosystem emergence and evolution and access to sufficient data for theorization. This sample includes large, established organizations (Bionic Platform, PharmaVax Corp, Quantum Inc., and Deep Blue Consulting), successful startups (Quick Delivery, Uprising Mobile) and medium-sized organizations (Master Business School). Companies in our sample are headquartered in the United States, Brazil, Europe, and Asia. Combined, they have a total market capitalization exceeding 10 trillion Brazilian reais, individually ranging from below one hundred million reais to over one trillion reais. They lead global ecosystems based on digital technologies, mobile gaming, logistics, consulting, quantum computing, and biotechnology. We adopted fictional names for the companies in our sample to preserve their anonymity and that of our informants.

Bionic Platform is a global player in the smartphone industry headquartered in the United States and responsible for leading an established global ecosystem centered around their digital platform for mobile applications. In Brazil, this focal firm uses a series of programs to constantly engage with local actors, both startups and established companies, to support the development of digital applications using Bionic Platform's technologies (e.g., cloud services, artificial intelligence, programming interfaces, email services).

Quantum Inc. is a multinational headquartered in Japan and a global player in the hardware sector, leading an emerging global ecosystem centered around the development of a new generation of specific purpose processors based on quantum computing principles. In Brazil, this focal firm engages with local actors, universities, startups, innovation hubs, and established organizations, to test the technical and market viability of this radical innovation.

Deep Blue Consulting is a global player in the innovation consulting industry, headquartered in Europe and leading a global ecosystem centered around the offering of digital transformation services to established organizations and government agencies. In Brazil, this focal firm uses a combination of structures and processes to discover and engage with local technology companies and startups to improve their offering to local clients.

PharmaVax Corp. is a global player in the pharmaceutical industry headquartered in the United States, leading a global ecosystem centered around the development of vaccines based on a novel biotechnology platform. In Brazil this focal firm engages with local actors such as government agencies, research institutes, and local firms to test, commercialize and manufacture this radical innovation.

Uprising Mobile is a multinational company headquartered in the United States and a global player in the digital gaming industry, leading a global ecosystem centered around a competitive mobile digital game. In Brazil this focal firm engages with local actors such as electronic sports teams, streaming services, cloud computing providers, television networks, and mobile operational system developers to create a competitive league for this innovation.
Quick Delivery is a multinational company, headquartered in Brazil and leading a nascent global ecosystem centered around their logistics for restaurants digital platform. This focal firm recently began engaging with local actors in other Latin American countries to

internationalize their platform, engaging with restaurants, delivery drivers, cloud service providers, and regulatory agencies in this process.

Master Business School is a local player in the executive education industry, leading a nascent global ecosystem for the development of education solutions using artificial intelligence technologies co-developed with an American technology conglomerate. This focal firm partners with technology providers located in the United States to create and commercialize this innovative solution. The table below[4] summarizes the cases, offering a brief description of each focal firm, their global ecosystem, the challenges they face regarding complementarity and interdependence, as well as the informants and secondary data we used for each case.

Table 3: Information Regarding the Cases Phase 2

| Case#Number | Description | Examples of International Interdependence or International Complementarity | Data Sources |
|---|---|---|---|
| Case 1 - Bionic Platform | Bionic Platform is a global software firm, operating in the smartphone sector.<br>The global ecosystem we studied involves dozens of subsidiaries, global acceleration programs and startup incubators in seven different countries, as well as partnership programs to engage with incumbent firms. | Bionic Platform's global ecosystem leverages International Complementarity, searching and developing partners in different countries to be complementors on their digital platform. Using a combination of technological artifacts, such as SDKs and APIs, training material translated to several different languages, and specific partnership programs they can attract local actors in many different countries to their digital platform. | For this case we conducted three (3) interviews: with a program manager for the startup acceleration program in Brazil, a platform engineer in Brazil and a Brazilian entrepreneur that participated in their startup engagement program. We analyzed secondary data on their acceleration programs, incubation initiatives, contracts, and other public information. |
| Case 2- PharmaVax Corp. | PharmaVax Corp. is a leading pharmaceutical company developing anti-viral solutions based on mRNA technology. The global ecosystem we studied involves dozens of subsidiaries responsible for clinical trials and partnerships with local governments, regulatory agencies, and pharmaceutical companies to develop and commercialize their solutions | PharmaVax Corp. ' global ecosystem was created to deal with international interdependence, as critical partners that must either participate in co-development or adopt their solution are dispersed around the world. In Brazil this company partnered with local research institutes to conduct clinical trials, government agencies for sales and logistics, regulatory agencies for approval, local logistics company for development of novel trasportation boxes, and a local pharmaceutical company for production. | For this case we conducted two (2) interviews: with a supply chain manager, in Brazil and an informant in the Brazilian Ministry of Health. We also read and analyzed interviews from top executives involved in this ecosystem, read financial statements for two players in the ecosystem, and relevant contracts that were made public. |

[4] We further analyzed six additional cases for the phase 2 of our research (Lab Test, Clean Energy, Life Forces, Finantex, Coffee Start, and Pegasus) for which we conducted additional eight interviews. We did not include these cases in our research because either we could not progress and access other informants for interviews (Clean Energy, Finantex, Pegasus) or the cases were not adding novel information to our research (Coffee Start, Lab Test).

| | | | |
|---|---|---|---|
| Case 3 - Quantum Inc. | Quantum Inc. is a leading company in hardware development, working on quantum computing solutions. The global ecosystem we studied is centered around a quantum inspired solution developed in Japan and Canada, with the global ecosystem involving dozens of subsidiaries and their local partners. | Quantum Inc.'s global ecosystem deals with international interdependence. For their solution, there is a high degree of uncertainty concerning the possible uses and experimentation is carried out globally using proof of concept tests with partners in different countries and industries. In Brazil this company partnered with universities to scout for researchers in operations management to make sense of possible uses in the Brazilian context, with startup incubators, and with local companies in the transportation and logistics sector. | For this case we conducted five (5)interviews: two with the sales director for the Brazilian subsidiary, responsible for managing the project, the leading technical engineer in Brazil, the head of startup engagement, and a manager involved in digital services. We also read and analyzed financial reports, news, press releases, and innovation reports. |
| Case 4 - Quick Delivery | Quick Delivery is a local leader in the logistics for restaurants industry. The global ecosystem we studied is based on their attempt to internationalize their digital platforms to two other countries in Latin America, using two subsidiaries and thousands of local partners (restaurants and delivery drivers). | Quick Delivery's global ecosystem was created to leverage International Complementarity by attracting a large number of partners. Because their ecosystem requires that both restaurants and delivery drivers join their ecosystems in the countries they operate in, this leads to a strategy focused on attraction which faced intense competition from well established local players. | For this case we conducted three (3) interviews: with the leader of open innovation, the head of strategic projects, and a former manager for legal issues. We also read and analyzed press releases, news reports, and webinars. |
| Case 5 - Uprising Mobile | Uprising Mobile is a global leader in the e-sports and competitive gaming industry. The global ecosystem we studied is based on their mobile game, which uses dozens of subsidiaries to establish local competitive e-sports leagues, creating local gaming communities, using local low latency cloud servers, and partnering with OS developers' subsidiaries in these countries. | Uprising Mobile's global ecosystem is built to take advantage of International Complementarity by creating similar local ecosystems with the same main actors: e-sports professional teams that form their own league, streamers that draw attention to the game, television networks that broadcast the competitions, and the subsidiaries of smartphone OS developers that cooperate with Uprising Mobile in this process. | For this case we conducted two (2) interviews with the head of community engagement and the lead of competitive operations in Brazil. We also analyzed press releases, financial statements, and official blog posts made by Riot managers. |
| Case 6 - Master Business School | Master Business School is a business school that partnered with a leading digital technology firm to create an online learning platform based on artificial intelligence. The global ecosystem we studied is based on the co-development partnership between a Brazilian business school and an American technology firm, with operations in Brazil and expanding into neighboring countries. | Master Business School' global ecosystem was created to deal with international interdependence. The focal firm required key technologies that were being developed abroad and their key partner, the technology provider, was scouting for an education provider that would be interested in using their own AI platform. | For this case we conducted three (3) interviews: with the COO of Master Business School, the vice-dean, and a professor involved in the project. We also analyzed press releases and public access documents about the platform. |
| Case 7 - Deep Blue Consulting | Deep Blue Consulting is a global leader in consulting services for innovation and digital transformation. The global ecosystem we studied is based on delivering digital transformation products to clients, leveraging a structure with dozes of subsidiaries, local acceleration programs for startups, formal partnerships with established organizations, and corporate venture capital programs. | Deep Blue Consulting's global ecosystem leverages International Complementarity by attracting local partners in the software sector and integrating their offerings to create coherent customer facing solutions. They have sophisticated acceleration and incubation programs to attract and develop local startups in several different countries and a robust corporate venture capital global program. | For this case we conducted four (4) interviews: with the digital transformation and innovation director, the digital transformation for industry director, the open innovation manager, and the head of human resources, all working in the Brazilian subsidiary. We also analyzed financial reports, innovation reports, press releases, and corporate videos. |

Source: Authors

All companies in our sample lead emergent and evolving global ecosystems, facing interdependence and complementarity with external actors located in different countries, and dealing with local and global uncertainties. This diverse sample of cases enriched our

understanding of the phenomena, improving our theory building and theory improvement efforts (Eisenhardt & Graebner, 2007). We also included other cases to provide our sample with saturation during data collection, as recommended in the literature (Eisenhardt & Graebner, 2007).

We used semi-structured interviews for data collection and the script was created based on our conceptual model and the insights from our initial research into global ecosystems. Most interviews followed a similar structure, with an initial question about the informant and their involvement in the focal projects, moving on to understand the ecosystem structure (actors, value proposition, links), the governance of the ecosystem, and how it deals with local and global uncertainties. We mostly looked for diverse viewpoints, avoiding multiple interviews with the same informant (a single exception was made in the Quantum Inc. case). We mostly interviewed ecosystem managers located in Brazil, directly involved in the materialization of the focal value propositions, and when relevant we also interviewed managers from related areas (i.e., software development, open innovation, legal and compliance). Interviews were conducted in the period between 2019 and 2023 and mostly using digital meeting software.

A central concern of our research protocol was the use of triangulation to ensure data validity, which we did by constantly contrasting the information provided by the interviewees about the cases and using a series of second-hand data sources to check for accuracy. For each case we looked for, read, and analyzed press releases, news in the business and general press, investor reports, innovation reports, online videos, and interviews given by top managers in the media when available. We also kept a field journal, with personal comments about the cases, as well as formalizing the insights from discussing the cases with other researchers in our research group. Because most cases in our sample have received ample media coverage in Brazil and abroad, we were able to enrich our analysis and understanding of the cases as well as triangulate information to check for validity using this rich and diverse database (Eisenhardt, 1989). In the following section we detail the data analysis protocol for this research.

### 4.2.2 Research Phase 2: Data Analysis

We employed a well-structured process for data analysis, based on a combination of replication and comparison approaches, following well established qualitative methodology guidelines in management (Eisenhardt, 1989; Eisenhardt, 2021) with a coding approach (Gioia

et al., 2013; Patton, 2014; Gioia et al., 2022) for theory building and improvement. Other researchers (Dattée et al., 2018; Gomes *et al*., 2021a) adopted a similar data analysis protocol, with the guidelines from Eisenhardt and colleagues (Eisenhardt & Graebener, 2007; Eisenhardt, 2021) used for within-case and cross-case analyses, while the Gioia method (Gioia et al., 2013; Gioia et al., 2022) was used for the development of novel concepts, and ultimately both combined for theory building. Our data analysis efforts took place in three main iterative stages: creating stories for each case based on the first and second-hand data collected and analysed; creating an extensive list of open codes based on the careful analysis of our interviewees' discourses; and finally comparing the patterns that emerged from these efforts to create a coherent theoretical framework that explains how focal firms manage uncertainty in global ecosystems.

We used both within-case and cross-case analyses, focusing on replication and comparison, to check the consistency of our codes and themes. This was done for the specific case that led to the emergence of the code as well as for the other cases in our sample. We created a narrative on how focal firms use their international structures, composed of the headquarters and subsidiaries, to orchestrate global ecosystems. This narrative was improved over time, trying to make sense of the structure, strategies, decisions, and processes used by the focal firms during the emergence and evolution of global ecosystems.

We followed Corley & Gioia (2004) and Gioia et al. (2014) which propose a data structure comprised of first order categories, second order themes and aggregate dimensions. First order concepts were numerous, intuitive, and served as a preliminary analysis of the data. Over 150 such categories were identified. First order categories are concerned with generating insights (Gioia et al., 2014), as we identified specific passages in the interviews which lead to a better understanding on how focal firms lead the processes of global ecosystem emergence and evolution.

We faced initial challenges related to coding the concepts related to global ecosystem emergence and evolution, due to the lack of an established terminology for this phenomenon in business practice and in academic literature. When interviewees mentioned 'local partners', 'looking for promising companies and startups', 'partnering with firms' and added a geographical dimension (e.g., 'partners in Europe and Brazil') we initially understood this as

defining a global ecosystem value proposition. We later refined this idea as we gained a better comprehension of the different dynamics depending on the type of focal value proposition being materialized and the complex interplay between local and global structures. We learned that we needed to incorporate the idea of a local ecosystem, the fundamental structures that combine to create a global ecosystem. We used this idea of local and global in all our codes, as it enables a richer understanding about the dynamics of global ecosystem emergence and evolution.

We realized during this process, for example, that there were two main types of focal value propositions in global ecosystems, those that have the potential for international complementarity, when complementors located around the world can add value to the focal value proposition, and those that have international interdependence, when materialization of the focal value proposition required engagement with specific actors located around the world. We were able, then, to refine our understanding about how focal firms discover the characteristics of the focal value proposition that lead to the initial efforts of global ecosystem emergence. We coded this as 'identifying international complementarity' and 'unveiling international interdependence'.

We also discovered during this process that focal firms face a specific type of uncertainty, which we coded as 'local and global ecosystem structure uncertainty' and use an experimentation approach to discover the proper structure for their local and global ecosystems. During the emergence phase of global ecosystems, focal firms lack a clear understanding of who should participate in their ecosystems and how. Using experimentation, based on re-configuring the local and global ecosystem structure, these focal firms can gain a better understanding of the appropriate structures required to materialize their focal value propositions. We coded this as 'local and global structure uncertainty'. We learned that focal firms can also re-configure the global ecosystems by connecting an actor that participates in a local ecosystem (e.g., in Brazil) to other local ecosystems (e.g., in Switzerland and Canada). A process we coded as 'upgrading actors from local to global'.

It was during this coding effort that we understood the underlying differences between the phases of global ecosystem emergence and evolution. After the initial definition of a value proposition and experimentation with local and global ecosystem structure, we learned that

focal firms choose between two different approaches to global ecosystem governance, either based on standardization of a governance defined by the headquarters or a flexible approach, enabling each subsidiary to create and enforce the governance for their local ecosystems. We coded this as 'local and global ecosystem flexible governance' and 'local and global ecosystem standardized governance'.

We also learned that focal firms employ different local and global ecosystem orchestration approaches, as the task of persuading actors to join their local and global ecosystems is a key challenge. While some of these orchestration activities were based on enhancing the perception of value to persuade actors to join their local and global ecosystems, others were based on reducing the uncertainties associated with participation in the local and global ecosystems. We coded this as 'enhancing local and global ecosystem value perception' and 'reducing participation uncertainty in local and global ecosystems'.

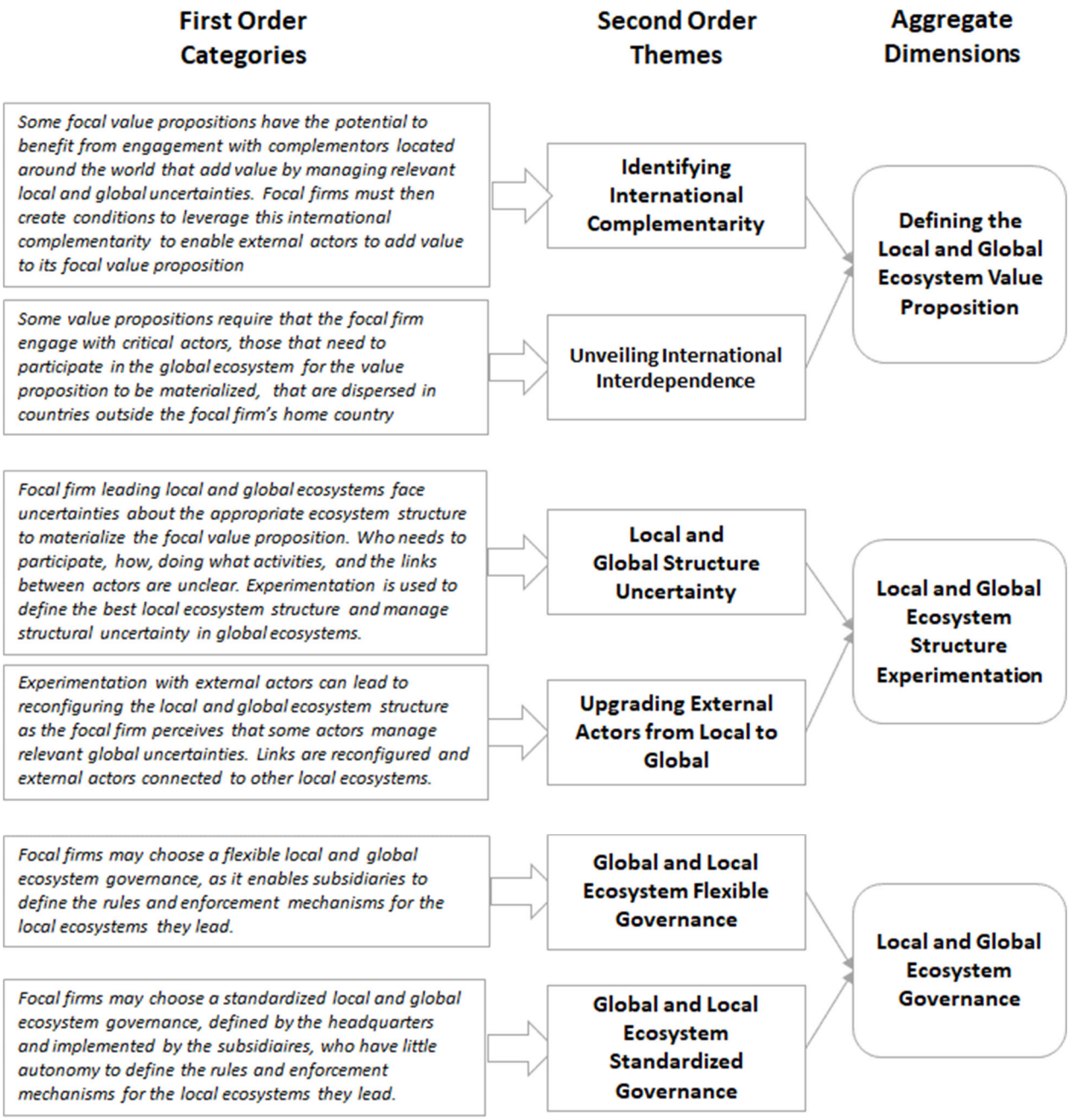
Codes were then used to establish convergent categories (Gioia et al., 2013). These were required to meet two criteria: internal homogeneity and external heterogeneity. Internal homogeneity indicated that the data in each criterion belong together, that there is a sensible commonality to this category. External heterogeneity ensures that the different categories are meaningful and have clear, relevant boundaries (Gioia et al., 2013). We created four such convergent categories based on our codes.

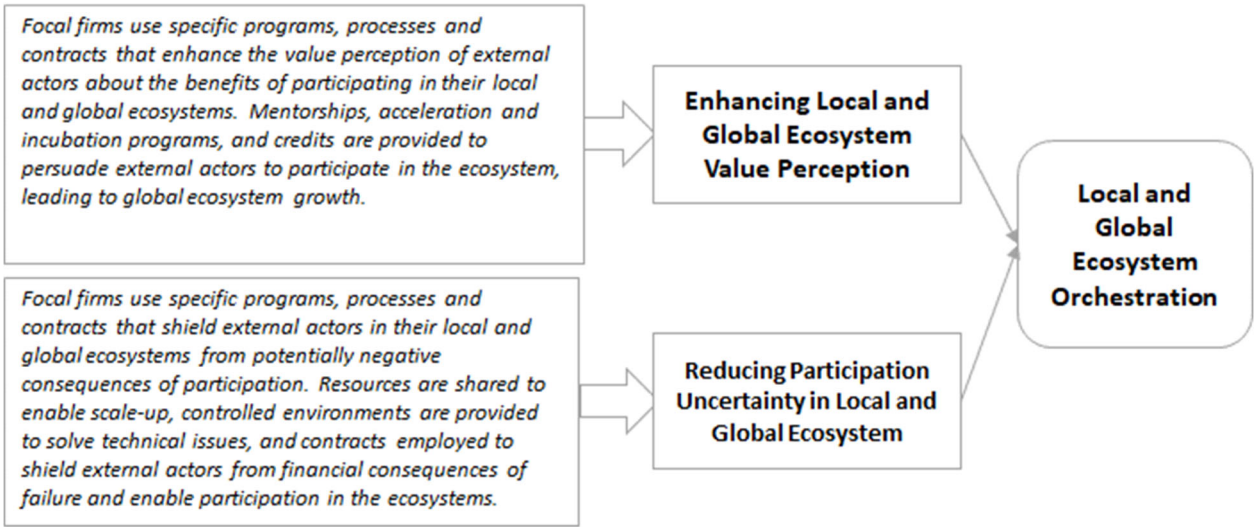
Combining the codes 'identifying international complementarity' and 'unveiling international interdependence' in a single process, we were able to categorize it as 'defining the local and global ecosystem value proposition'. The same was done for the other categories in our coding scheme. 'Local and global structure uncertainty' and 'upgrading actors from local to global' combine to create the 'local and global ecosystem structure experimentation' category. 'Local and global ecosystem flexible governance' and 'local and global ecosystem standardized governance' combine to create the local and global ecosystem governance. And finally, 'enhancing local and global ecosystem value perception' and 'reducing participation uncertainty in local and global ecosystems' combine to create the 'local and global ecosystem orchestration' category.

This data analysis process was iterative, as we created and validated the codes and categories, constantly going back to our data and communicating within our research team to ensure that

the codes and categories correctly express the underlying concepts. Several coding trees were created during this process, to enable easy visualization and communication of our theory building and improvement efforts within the research team and with our informants in the focal firms. The final coding tree summarizes the *de facto* concepts which emerged from our analysis, in an inductive manner, from the collected data and which are at the core of our theory-building and improvement efforts (Eisenhardt, 1989). The figure below presents the final coding tree which summarizes our data analysis and its main results.

Figure 6: Coding Tree for Phase 2 of the Research






Source: Authors

We considered all aggregate dimensions and second order themes in the coding tree as relevant concepts that emerged from our analysis of the data and that constitute the building blocks of our theoretical framework. They were created based on a combination of researcher insights, discussions with other researchers involved in the project, and analysis of existing related concepts and theories.

### 4.2.3 Research Phase 2: Building Concepts from Structured Qualitative Data

Following recent recommendations in the literature on employing qualitative methodologies for theory building and improvement (Gioia et al., 2022) we also present a more detailed analysis on how we conducted the coding procedure for phase 2 of this research. Because of the recent misuse of templates as means to confer an appearance of structured qualitative data analysis without the underlying rigor, authors have suggested that researchers make explicit how they built their codes based on qualitative data (Gioia et al., 2022). The idea here is not only to show the researcher knows something, but how and based on what evidence they can claim to know it (Gioia et al., 2022).

Table 4: From First Order Categories to Second Order Themes

| First Order Categories (Illustrative) | Second Order Themes | From First to Second Order |
|---|---|---|
| *We needed partners. This was a novel subject for our company. So we partnered with a Canadian firm called (Bits), as we realized that If we have to mimic quantum* | **Unveiling International Interdependence** | Discourse from informant highlights that the company 'needs' partners, external actors. This indicates a relationship of interdependence, that the focal |

| | | |
|---|---|---|
| *phenomena the ideal scenario is to have a software that is created to deal with quantum phenomena. But we cannot develop everything, processors, and software. (Sales Director, Quantum Inc.)* | | value proposition cannot be materialized without external actors (we cannot develop everything). Discourse, supported by company documents, show that this was done by engaging with an external actor outside the focal firm's home country in Japan. This indicates an international dimension, which we underline by using the word international, but other words are also suitable (global, foreign, multinational). |
| *When I design a digital transformation project for a customer (…) I think about assembling a Lego, I assemble this Lego where each piece is a partner, a new technology (…). What do I deliver to my customer? This assembled Lego. This is my job, to build a Lego (informant #1) (CRM Brazil) was like that, the area understood that it would make no sense for Deep Blue Consulting to develop a CRM, (CRM Brazil) had a better cost-benefit relationship, it would make no sense for Deep Blue Consulting to develop a CRM for each customer if we could just plug in that solution (Digital Transformation Director, Deep Blue Consulting)* | **Identifying International Complementarity** | Discourse highlights how complementors add value to their digital transformation focal value proposition (i.e., they are pieces of Lego, it would make no sense to create this solution if one already exists). This shows complementarity, value-add of external actors to a focal value proposition. The company may create the solution, but chooses not to. The managers are talking about the Brazilian subsidiary of a global firm headquartered in Europe, so it shows how these complementors can be outside of the focal firm's home country. To account for this international dimension we chose the word international, but other words are also suitable (multinational, globalized, foreign). |

Source: Authors

The table above shows how we went from discourse, first-order categories, to concepts, second-order themes. We chose to present this based on illustrative quotes, that provide in our understanding the best narratives to explain our insights. The real process of coding, which is messy in nature (Gioia et al., 2022) was based on selecting interesting qualitative data from interviews and documents and using an Excel spreadsheet to organize them, thus creating initial convergent categories (Patton, 2014).

We also present how we defined the second-order themes using the actual qualitative data we collected. This was done by combining existing ideas that inform our worldview as

researchers (uncertainty, complementarity, interdependence) with the actual managerial discourse we analyzed. We provide in this manner a link between data and theorization, making explicit what is often an opaque process.

For example, we identified in the case of Quantum Inc. that the managers did not perceive the use of external actors as a choice, but rather as a necessity to develop their innovative focal value proposition. The idea of needing partners, needing external actors is a fundamental concept in innovation ecosystems which received the name of interdependence. The context of the case, the fact that this was a focal firm headquartered in Japan needing an external actor they could only find in Canada evoked the notion of international interdependence, so we based our second-order theme on this idea. Data indicated that this was also a complex process, requiring communication and decisions made by the headquarters and supported by the subsidiaries. Because we did not want to convey the notion that this is an easy process, that managers know upfront and with clarity that they face international interdependence but rather discover it as the project progresses, we chose to use the word unveiling. From a wealth of unstructured, qualitative data, we created a second-order theme to organize it: unveiling international interdependence.

This process described above refers to the within-case analysis of Quantum Inc. We then moved on to further analyze the discourse of managers from other focal firms, across-case analysis, to check if this was a specific process that only Quantum Inc. had gone through or if similar challenges appeared in other cases. We learned that some cases (Quantum Inc., Master Business School, and PharmaVax Corp.) had the same pattern, with managers also perceiving there was a need to engage with external actors located outside the focal firm's home country to materialize a focal value proposition. Other cases, however, did not.

Discourse from managers at Deep Blue Consulting, for example, highlights that there is a choice when engaging with external actors located outside the focal firm's home country. They could develop the solutions, they had sufficient resources, knowledge, and know-how to do so in Brazil or elsewhere. But doing so made little sense as external actors had already built better versions of these solutions. The task was to assemble these solutions developed by external actors into a coherent focal value proposition to be delivered to a client, or as one informant put it 'to build a Lego'.

This discourse reminded us of a fundamental concept in innovation ecosystems, complementarity. External actors can add value to a focal value proposition (in this case, digital transformation services for B2B clients) using their own innovative solutions. We coded the second-order theme as complementarity for this reason. However, this choice in this context was for a subsidiary in Brazil to enable that Brazilian external actors add value to a focal value proposition which was developed as a global service by a company headquartered in Europe. To bring this notion of international without repeating the same word we had used for interdependence, we chose to use the word global, creating an initial second-order theme of international complementarity. In the same vein of international interdependence, we did not want our concept to imply that this was an automatic, easy process. We then added the verb identifying to our concept, to communicate that this is a challenging process that focal firms go through.

Again, this process refers to the within-case analysis of Deep Blue Consulting, so we needed to check if this idea of identifying international complementarity appeared in other cases in our sample. Which we did, to find that Bionic Platform, Quick Delivery, and Uprising Mobile all went through similar processes. This provided the researchers involved in this process with an interesting insight: there are different types of global ecosystems, some based on international interdependence and others on international complementarity.

We went back to literature on global ecosystems, looking for research that addressed these ideas in a similar manner to see if this indeed was a relevant insight or if it had been conceptualized before. We found that some authors recently reached similar conclusions about complementarity in a global context (Nambisan & Luo, 2021; Nambisan & Luo, 2022) but that their model was only focused on digital platforms and their complementors, without addressing if this could be used in other types of businesses such as consulting services and digital games. Furthermore, they did not consider the notion of international interdependence which enabled this insight on the existence of two main types of global ecosystems. We considered this to be sufficient justification to accept the second-order themes as novel concepts and incorporate them into our emergent theoretical framework.

We did so by creating an aggregate dimension, which means that we believe that both concepts refer to the same process focal firms go through, of understanding and defining how

the focal value proposition enables value creation and capture opportunities for actors in their ecosystems. This triggered a structured process of testing definitions for this aggregate dimension within the setting of our research group, which we had initially conceptualized as defining the global ecosystem value proposition. We realized that there was confusion between researchers about the ecosystem boundaries. What is a global ecosystem, after all? How can we define it, know where it begins and ends? There was little clarity about the roles of headquarters and subsidiaries, between local dimensions in Brazil and global dimensions abroad.

We concluded then that the very notion of global ecosystems was not being clearly communicated. We went back to the concept and literature on global ecosystems looking for existing explanations, but with little success. Changing directions, we began looking at the early days of research on multinational enterprises, figuring that researchers might have also faced similar challenges. We discovered that an initial and relevant insight in this literature was defining multinational enterprise structure as a set comprised of the headquarters in the home country and the subsidiaries in host countries (Fouraker & Stopford, 1968; Schollhammer, 1971).

This more deductive approach led to another insight, that there are no global ecosystems without local ecosystems and that in fact it was helpful to conceptualize global ecosystems as a set of local ecosystems in the home country and host countries the focal firm operates in. The same way that a multinational enterprise is not the headquarters or the subsidiaries, but an abstract set containing both types of business units, a global ecosystem is not a local ecosystem in the home country or a local ecosystem in the host countries, but an abstract set containing all local ecosystems. After validating this idea with the research group, with positive results, we then chose to make this explicit in the aggregate dimension, which we conceptualized as assessing focal value proposition in local and global ecosystems.

Table 5: From Second Order Themes to Aggregate Dimensions

| **Aggregate Dimension** | **From Second Order to Aggregate Dimensions** | **Why It Matters** |
|---|---|---|
| Defining the Local and Global Ecosystem Value Proposition | We understand that international complementarity and international interdependence are | Our contribution is to both make explicit the notion of a geographical dimension of |

| | | |
|---|---|---|
| | perceptions by managers in focal firms about the focal value propositions being materialized. Some require external actors (we cannot develop everything) others benefit from the value added by complementors (makes no sense to develop internally, they are pieces of Lego in our solution) located outside the focal firm's home country. However, managers must make sense of this characteristic, a process of assessment, of understanding the ecosystem level value proposition. We underline that this is dynamic, taking place in local ecosystems (i.e., Brazil) and global ecosystems (i.e., Japan, Canada, and Brazil). To highlight all these ideas we chose to aggregate them under the concept `Defining the Local and Global Ecosystem Value Proposition'. | complementarity and interdependence, but more importantly to discuss the effects of this geographical dimension. Managers in focal firms assess, understand the focal value proposition in relation to its international aspects. These are the questions that ultimately explain why focal firms use their resources to lead the emergence of global ecosystems and explain their fundamental differences. Conditions must be created for external actors located around the world to add value to the focal value proposition by discovering and managing local and global uncertainties. These may include, but are not limited to, the use of digital platforms and digital artifacts, either generative or based on multiple sided markets as is often assumed in current literature (e.g., Nambisan et al., 2019; Nambisan and Luo, 2022) |

Source: Authors

Above we attempted to engage in an exercise to add clarity on how we built our theoretical framework from a methodological perspective. We presented how we did it for unveiling international interdependence and identifying international complementarity and the aggregate dimension of assessing focal value propositions in global ecosystems, but the same exact process was repeated for all concepts in phase 2 of this research. Even within the relatively ample space of a doctoral thesis, it would be too long to go over the process for all

concepts[5], which is further explained in the results section (chapter 6) using a more narrative-driven approach.

In the following chapters we present the results and discussion for both studies that were conducted during the elaboration of this thesis. First, we present the results for our phase 1 research on uncertainty management in global ecosystems. Then we move on to present the phase 2 results of our research on global ecosystem emergence and evolution.

We sometimes used illustrative quotes in the results chapters below to provide a clear, transparent relationship between the concepts and the actual data we worked with for both stages of our research. All interview quotes were translated from Portuguese to English, and we opted for preserving the original discourse as much as possible. We often had to change the names of companies mentioned in these quotes, opting for generic names that communicate the meaning without revealing the specific firms mentioned (i.e., American Cloud Corp. was used to replace the name of an actual firm that provides cloud services headquartered in the U.S.). All words in parenthesis were additions by the researcher to provide clarity, for example when we add specific words to clarify the object of a sentence (i.e., this partner (a startup) was important). Discontinuous citations are marked with an ellipsis within a parenthesis (i.e., we began looking at this company (…) later it was revealed this was a relevant actor). While quotes can be nitpicked to serve specific narratives and are subject to researcher bias, their use is commonplace in qualitative research (e.g., Datée et al., 2018) as an effective way to illustrate the phenomena at hand. The quotes are not used to ensure the validity of the concepts, but rather to help visualize them in relation to the day-to-day business discourse used by our interviewees.

[5] The tables for all other concepts can be found in the appendix of this document (section 9.1)

**5. Phase 1: Result Summary**

The main result of the first stage of our research into global ecosystems is a theoretical framework that offers an initial, tentative explanation on how focal firms use global ecosystems to discover and manage local and global uncertainties. Focal firms face the initial challenge of identifying uncertainties related to the focal value proposition being materialized. Uncertainty identification leads to a process of assessing whether that specific uncertainty is relevant in a single country (local) or if it affects more than one country (global).

We conceptualized this process as uncertainty scope assessment, the task of identifying the geographical dimensions of an uncertainty. Uncertainty scope assessment is a dynamic process, as focal firms make sense of the contextual nature of the uncertainties they identify. Uncertainties initially assessed as being local can later be reassessed as being global, as the focal firm refines the understanding about the focal value proposition being materialized and the different contexts it operates is.

Focal firms also define an uncertainty management governance, the rules, roles, and mandates regarding which actors in the global ecosystem (which include the subsidiaries of the focal firms) can manage the relevant local and global uncertainties. This governance defines who can engage in uncertainty management and what strategies can be used in this process. It also defines the rules that guide this process, the roles undertaken by actors in global ecosystems, and the mandates to engage in uncertainty management. We conceptualized this process as uncertainty management governance in global ecosystems.

Because focal firms orchestrating global ecosystems may have an international structure, composed of a headquarters and the subsidiaries, uncertainty management governance also defines which units of the focal firm have the mandate to manage local and global uncertainties. Not all subsidiaries, for example, may have a mandate to manage local and global uncertainties related to the focal value proposition being materialized. Some subsidiaries may additionally be constrained in their autonomy to manage even relevant local uncertainties in the contexts they operate in.

We further identified in this research that focal firms employ three distinct strategies to manage local and global uncertainties in global ecosystems. They may choose to internalize part of the uncertainty management process, using their own global R&D infrastructure,

before sharing these uncertainties with other actors in their global ecosystem. This is line with previous findings from the uncertainty management in innovation ecosystems literature (Gomes et al., 2018; Gomes et al., 2021a) which underlines the complex dynamics of uncertainty sharing in innovation ecosystems.

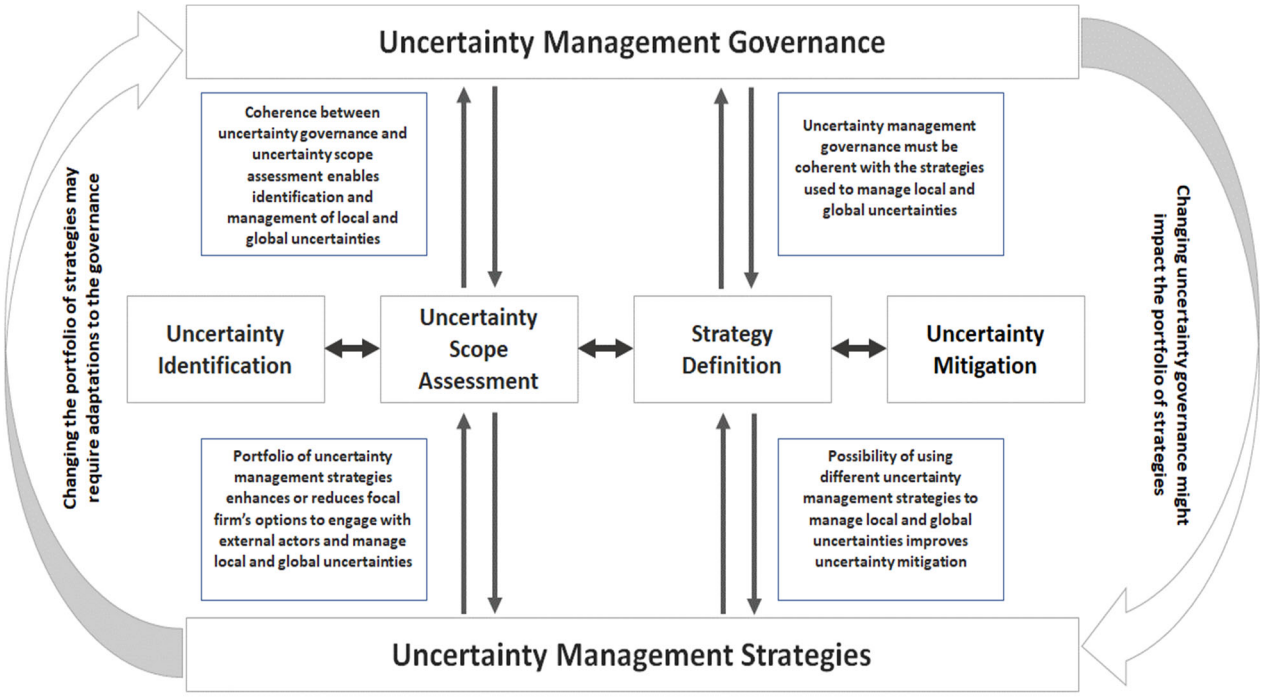
Focal firms may also use collaborative uncertainty management strategies, based on strong coordination with external actors located in different countries to both discover and mitigate uncertainties related to the focal value proposition being materialized. Engaging with local startups, organizations, universities, and regulatory agencies, for example, in each context enables access to dispersed knowledge (Dew et al., 2004) which is then integrated by the focal firm to manage relevant local and global uncertainties. Strong coordination includes, but is not limited to, the use of co-innovation agreements with external actors, engaging with local startups to solve technical and market uncertainties, and partnerships with universities to conduct research.

Additionally, we identified a third uncertainty management strategy used by focal firms in global ecosystems which we conceptualized as autonomous uncertainty management. This strategy relies on using digital platforms to enable external actors to discover and manage relevant local and global uncertainties using weak coordination with the focal firm. Technological artifacts such as SDKs and APIs enable these external actors to use the focal firm's technological platform to discover and manage uncertainties, without requiring strong coordination with the focal firm.

There is a relevant interplay between uncertainty management governance and uncertainty management strategies. Rules, roles, and mandates constrain the portfolio of strategies available to the focal firm to address local and global uncertainties. Conversely, changes to this portfolio of strategies may also require adaptations to the uncertainty management governance in global ecosystems.

The figure below shows the theoretical framework which provides an initial explanation regarding uncertainty management in global ecosystems. At the center there are the main processes, uncertainty identification, uncertainty scope assessment, and strategy definition that result in uncertainty mitigation. Two-sided arrows underline the iterative nature of moving from one process to the next.

Figure 7: Uncertainty Management in Global Ecosystems Theoretical Framework




Source: Authors

At the top of the model with have uncertainty management governance, connected with uncertainty management strategies. These arrows underline the interplay between rules, roles, and mandates for uncertainty management and the type of uncertainty management strategy (internal, collaborative, autonomous) that can be employed by the focal firm and its subsidiaries. The model further highlights the connections between uncertainty management strategies, uncertainty management governance, and the processes of uncertainty scope assessment and strategy definition. Alignment between governance and uncertainty scope assessment is relevant, as it creates the conditions for dealing with local and global uncertainties.

In the following sections we detail how we built the theoretical framework presented above. We begin by addressing how focal firms assess uncertainty scope. We move on to deal with the definition of uncertainty management governance in global ecosystems. We finalize this results section by showing how focal firms in global ecosystems choose between three strategies to manage local and global uncertainties.

### 5.1 Assessing Uncertainty Scope

Analysis of our case-study data shows that focal firms leading global ecosystems encounter specific challenges to deal with uncertainty scope assessment. We offer an initial definition of uncertainty scope as the geographic dimension of uncertainties, if a given uncertainty is specific to a single country or is relevant in multiple countries. The table below illustrates some of the local and global uncertainties that focal firms leading global ecosystems in our sample identified and managed.

Table 6: Evidence on Uncertainty Scope

| Case | Examples of global uncertainties | Examples of local uncertainties | Illustrative quote |
|---|---|---|---|
| Lineplus | Use of unmanned aerial vehicles (drones) for powerline maintenance in Colombia, Brazil, Chile, and Peru; | Dealing with regulation on use of drones and effects on time to market for this solution in Brazil; Operation of unmanned aerial vehicles over sensitive locations such as favelas in Brazil | "Some challenges are global. Others are specific to us". Innovation Manager at Lineplus. |
| Masterplan | Response of industrial clients to the new platform generation in France, Brazil, Argentina, Italy and Germany | What is the best way to develop modules that address specific tax standards in Brazil | "These are big questions that we don't have an answer for yet.... We are addressing disruptive technologies that affect all clients worldwide". Senior Executive at Masterplan |
| Bioleader | Defining the appropriate pricing strategy for ethanol in the United States, Brazil, and European countries; competitor response in the United States, Brazil, Germany, and Itally. | Engaging with and contracting with local suppliers of raw materials in Brazil | "This was a moment of tension. We were in a room with the best guys in these topics. We have more questions than answers. (...) We never thought about a number of uncertainties, problems that we faced when operating this plant" Senior Innovation Managemer at Bioleader. |
| Smartplat | The appropriate set of technologies for the global platform in Brazil, Germany, and the United States; defining the best platform functionalities for a global audience | Brazilian clients adoption and response to more radical changes in the platform | 'We work with partners to explore unsolved issues of our national clients...we just don't know' Innovation Manager at Smartplat |

Source: Authors

We build on the concept of uncertainty scope, the local and global dimensions of uncertainty, to introduce the notion of uncertainty scope assessment. Assessing uncertainty scope is the process of understanding if a specific uncertainty is local or global. Focal firms leading global ecosystems encounter the dual challenge of identifying relevant uncertainties and assessing their scope. The case of Lineplus illustrates how this process takes place in global ecosystems. Lineplus is a focal firm headquartered in Colombia that used its Brazilian subsidiary to engage with a local start-up and co-develop a digital platform for the maintenance of energy transmission powerlines using drones. At first, both actors focused on technological uncertainties related to the creation of a proof of concept, attempting to understand if the

use of drones for powerline maintenance was viable, if the technology was reliable, and what type of drone should be used.

Ecosystem managers involved in this project initially assessed these uncertainties to be local, relevant only for Lineplus' operations in Brazil and not considering if they were relevant to other actors in different countries this company operates in. As the project evolved, however, the headquarters in Colombia and other subsidiaries in Peru and Mexico signalled their interest in using this solution in their countries. Lineplus' innovation managers involved in the project reassessed the uncertainty scope as some of the relevant uncertainties were shown to be global. This process required specific investments to design and conduct experiments that enabled dealing with these uncertainties, by generating information and knowledge that could then be shared with other actors in their global ecosystem. By investigating and assessing uncertainty scope, this innovation managers from the focal firm in Brazil and the entrepreneurs from the start-up that participates in this ecosystem gained a more refined understanding of the uncertainties of the focal value proposition being materialized. This process of uncertainty scope assessment revealed which uncertainties (technical, market, regulatory) were specific to some countries and which were global in nature.

We further illustrate the relevance of uncertainty scope in global ecosystems. Lineplus' subsidiaries encountered local uncertainties related to the regulatory framework on the use of drones for powerline maintenance. As is expected, regulatory uncertainties were specific to each country depending on the local laws and norms regarding the use of unmanned aircrafts. However, the same technological uncertainty was relevant in all countries Lineplus operates in, the efficiency of using drones to generate relevant diagnostics for powerline maintenance.

Data from our cases indicates that dealing with global uncertainties can lead to the discovery of local uncertainties. Technical uncertainties related to the use of drones in rainforest climates typical in Brazil and Colombia (type of drones, durability, and feasibility) differed from the technical uncertainties related to operating drones in the drier climates of the Andes, in Peru. Integrating the start-up's digital platform with the information technology infrastructure in place in the different units (headquarters and subsidiaries) of the focal firm raised relevant

concerns from the managers, revealing additional local and global uncertainties for this project.

Subjective assessment of local and global uncertainties thus shaped the actions of managers involved in this project. Understanding uncertainty scope, in the case of Lineplus, had relevant consequences because the actors in this ecosystem had to refocus their attention and commit resources to address both local and global uncertainties. Ecosystem actors faced the challenge of managing technological local and global uncertainties regarding the focal value proposition being materialized, while simultaneously addressing local regulatory uncertainties for each country this focal firm operates in.

Another focal firm in our sample further illustrates the relevance of uncertainty scope assessment. Bioleader is a Brazilian startup leading a global ecosystem centred around the development of second-generation ethanol, which involves building one of the first factories in the world using this novel technology for production. Uncertainty scope assessment during this process further clarifies the challenges focal firms face to deal with local and global uncertainties. Bioleader engaged with an external actor, a European organization that developed promising technologies to produce ethanol. This startup also started partnerships with two other European organizations that would be responsible for processing cellulose and use of biotechnologies for production, respectively.

Managers from Bioleader identified relevant global uncertainties related to the price of second-generation ethanol, defining the appropriate production technology, and identifying the proper production equipment. However, they also discovered local uncertainties that influenced only their operations in Brazil, such as selecting the best raw materials suppliers, determining their future demand for said raw materials, and how to deal with local regulations. Our data shows that Bioleader used a specific organizational structure and strategically allocated resources to simultaneously manage both local and global uncertainties for this project.

A third case in our sample further clarifies the challenges of dealing with uncertainty scope. Masterplan is company headquartered in Europe and leading a global ecosystem centred around the development of industrial software solutions for global clients. Our data reveals that focal firms leading global platforms must also deal with uncertainty scope and address

local and global uncertainties. The headquarters of this focal firm managed relevant global technological and market uncertainties for this focal value proposition to define the core functionality, which affects all markets Masterplan operates in.

The implementation of cloud computing and the use of artificial intelligence technologies in this platform, for example, was addressed by global teams, which were responsible for dealing with uncertainties that are common for all international markets. Local uncertainties, however, related to the specific context of industrial clients in Brazil were addressed by the R&D department of Masterplan's subsidiary by engaging with local startups. This subsidiary engaged with a local Brazilian startup to use artificial intelligence and address tax and accounting standards in Brazil, for example. Similar patterns regarding uncertainty scope assessment also emerged from the case of Smartplat, a European focal firm leading a global ecosystem using internet of things technologies.

Uncertainty scope assessment is, therefore, a relevant challenge faced by focal firms and other actors in global ecosystems. These actors must first understand if a given uncertainty is either local or global, a complex task. Furthermore, they must deal with the dynamic nature of uncertainty scope, as addressing local uncertainties may reveal global uncertainties and vice-versa. Firms leading global ecosystems must allocate, then, both resources and attention to manage these local and global uncertainties. Our research shows that to properly address uncertainty scope focal firms leading global ecosystems must also define the governance regarding who can identify and manage such uncertainties. In the following section we detail how defining the uncertainty management governance influences how actors in global ecosystems discover and mitigate local and global uncertainties.

### 5.1.1 Uncertainty Governance: Rules, Mandates and Roles for Uncertainty Management

Managing local and global uncertainties in global ecosystems further requires that focal firms define the uncertainty management governance, the rules that determine the sequence, mandates, structures, processes, and roles for uncertainty mitigation. Sequence defines if uncertainties will be addressed in parallel or one at a time. Mandates define which actors in the global ecosystem, which includes the subsidiaries of the focal firm, have the decision rights to identify and manage local and global uncertainties. Structures and processes address who the focal firm can engage with to discover and mitigate uncertainties, and the roles to be played by each actor in the global ecosystem.

These findings show that uncertainty management governance enables focal firms to deal with the challenges of coordination, cooperation, and directionality in global ecosystems (in line with Jacobides et al., 2018). It creates the basic conditions for actors in global ecosystems, the headquarters and subsidiaries of the focal firm, components, and complementors, to deal with the relevant uncertainties and cooperate to contribute to the materialization of a focal value proposition.

The case of Lineplus, a focal firm leading a global ecosystem for digital maintenance of powerlines using drones, illustrates. The headquarters and the Brazilian subsidiary of this focal firm decided that the Brazilian subsidiary and local external actors (a university and a startup) should deal with global technological uncertainties related to the definition of the appropriate drone models and platform features before enabling other subsidiaries, in Peru and Mexico, to mitigate their own local uncertainties for this focal value proposition.

Our research shows that uncertainty management governance defines relevant priorities in global ecosystems. Lineplus, for example, and other external actors in their global ecosystems were initially tasked with addressing technological uncertainties about the drones (components) and the cloud systems and applications being developed (complements) before the definition of the business model for this focal value proposition. Uncertainty management governance also determines how resources can be allocated in global ecosystems.

Managers from Lineplus, our informants, stated that certain informal rules determined that the Brazilian subsidiary should employ its own internal resources (personnel and technological infrastructure) and engage with external actors to deal with technological uncertainties regarding the appropriate drone model. These rules further determined the knowledge flow resulting from experimentation with other units in Peru, Colombia, and Mexico. Although the experiments regarding the viability of using drones for powerline maintenance were all conducted in Brazil, the results and future expectations were shared with the headquarters and other subsidiaries.

Rules defined by uncertainty management governance determine how emergent local and global uncertainties are mitigated. Masterplan illustrates. In this global ecosystem, the headquarters were responsible for manging uncertainties about the technological features of a new software platform for industrial clients. The subsidiaries, however, were expected to

deal with local uncertainties in their countries, such as the specific needs of local clients, specific regulatory issues, technical challenges by engaging with external actors. Uncertainty management governance in this global ecosystem also defines a framework to analyse and categorize external actors regarding their capacity to deal with complex, uncertain challenges.

These rules further define the uncertainty management mandates, the decision rights of each actor to address local and global uncertainties that are relevant for the global ecosystem. Both Masterplan and Smartplat formally assign decision rights for their subsidiaries to deal with specific types of local and global uncertainties. Masterplan's Brazilian subsidiary, for example, has a mandate to deal with local uncertainties for industrial clients in Brazil and other Latin American countries. These mandates, then, also consider the types of uncertainties that can be addressed dependent on each actors' position within the global ecosystem (component, complementor, headquarters, subsidiary).

Lineplus further illustrates how uncertainty governance influences the discovery and management of local and global uncertainties. In this global ecosystem an external actor, a local Brazilian startup, has the rights related to addressing uncertainties about the use of drones and platform features for this focal value proposition. The focal firm has the mandate to define the ecosystem business model, who to partner with and how.

The global ecosystem led by Bioleader also illustrates. The external actors located in Europe have mandates to deal with uncertainties related to the use of biotechnology for second-generation ethanol production, such as the appropriate assemblage of microorganisms, technological performance, and ethanol conversion rate. The focal firm is responsible for mitigating uncertainties related to technology integration, production, and commercialization of the focal value proposition.

This research shows that uncertainty management governance also determines the processes that can be used to address local and global uncertainties. The Brazilian subsidiary of Masterplan, for example, used specific programs and processes to deal with local uncertainties, such as creating a co-innovation laboratory, a startup acceleration program, providing mentorship to external actors, a training platform for external actors, a formal program for experimentation with local startups, and a digital marketplace. Formal rules define that these processes and programs can be used to communicate business

opportunities with external actors to develop innovations, digital applications, that add value to the platform's focal value proposition.

Masterplan's digital marketplace includes a protected space to enable experimentation with selected clients and innovative solutions. Integrating a solution developed by a local startup, however, follows specific guidelines that are global and defined by the headquarters. Similar patterns also emerged from Smartplat's case, as the Brazilian subsidiary was tasked with creating a business unit to engage with local startups, complementors that can add value to their focal value proposition. These startups have autonomy to experiment using Smarplat's technological platform, with little coordination by the focal firm's units to discover and manage relevant market uncertainties. However, integrating the solutions developed by these external actors in Smarplat's digital marketplace depends on a formal assessment and authorization that can only be granted by the focal firm's headquarters.

This research further shows that the roles of uncertainty management orchestrator and evaluator are defined by the uncertainty management governance. Bioleader illustrates. This focal firm, a Brazilian startup, leads technological and market developments for this global ecosystem under conditions of uncertainty. Even though Bioleader partnered with incumbent organizations in the second-generation ethanol industry, the entrepreneurs leading this startup took on the role of ecosystem leaders and orchestrators. This involves the definition of who should deal with local and global technological and market uncertainties, when should they do so, and how.

Bioleader defines the quality parameters that guide technical experiments and validation. This focal firm also chose to exclude actors from the global ecosystem due to disappointing technical and market results, and what it perceived to be inadequate capacity to answer to technological uncertainties that emerged during the scale-up process. This resulted in reconfiguring the global ecosystem structure, introducing a new actor responsible for technological development regarding second-generation ethanol production.

As we have demonstrated, uncertainty management governance plays a critical role in the management of local and global uncertainties. It does so by defining the conditions under which the focal firm and external actors in different countries can address these uncertainties. Governance structure is also pivotal for the coordination of uncertainty mitigation in global

ecosystems, a task undertaken by the headquarters, subsidiaries, and external actors located in different countries. Governance determines, for instance, the sequence in which the uncertainties identified should be managed, as well as when should a given uncertainty be mitigated. It further defines the specific mandates and roles for actors in global ecosystems involved in uncertainty management. More specifically, governance determines what uncertainty management strategies can be employed in global ecosystems. In the next section, we address how focal firms use a rich portfolio of strategies to discover and manage relevant local and global uncertainties.

### 5.1.2 Uncertainty Management Strategies

Success in leading global ecosystems to manage local and global uncertainties relies on complementing uncertainty scope assessment and uncertainty management governance with the use of uncertainty management strategies. This finding is consistent with previous literature on ecosystem strategy (Hannah & Eisenhardt, 2018; Gomes et al., 2021a), as our research shows that focal firms leading global ecosystems face the critical challenge of deciding to internalize or cooperate with external actors to manage local and global uncertainties. As we have demonstrated, uncertainty management governance defines the proper conditions for actors to deal with uncertainties strategically and dynamically. We identified that focal firms leading global ecosystems choose between three main uncertainty management strategies, based on internalization, cooperation, and autonomous uncertainty management.

Data analysis of our cases show that focal firms leading ecosystems may choose to internalize part of the management of local and global uncertainties, using their own international R&D infrastructure, before sharing these uncertainties with external actors (in line with Gomes et al., 2021a). Masterplan, for example, chose to address the critical technological and market uncertainties about the new generation of their focal value proposition internally at first, before deciding to engage with external actors in the different countries they operate in to identify and deal with emergent local uncertainties. We conceptualized these strategies as internal uncertainty management strategy.

A second strategy employed by focal firms leading global ecosystems takes place when the focal firm chooses to directly collaborate with external actors to deal with local and global uncertainties. We conceptualized this as a cooperative uncertainty management strategy.

Lineplus, for example, used formal contracts and strong coordination (regular meetings, exchange of reports and plans) with a Brazilian university and a local startup to deal with relevant local and global uncertainties regarding their focal value proposition, the digital maintenance of powerlines using drones. Bioleader, a Brazilian startup, used a similar strategy to collaborate with established companies in Europe to deal with critical global technological uncertainties regarding the production of second-generation ethanol.

Masterplan further illustrates how focal firms leading global ecosystems may employ collaboration uncertainty management strategies. This focal firm chose to share some relevant uncertainties with external actors in their global ecosystem, using a co-innovation laboratory to engage with local startups in Brazil. By doing so, they transformed individual uncertainties, those that initially only affect the focal firm, into collective uncertainties. Collaborating with startups in Brazil enabled Masterplan to discover and manage relevant market and technological local uncertainties that were relevant to their Brazilian industrial clients.

We also identified that focal firms leading global ecosystems also choose to outsource uncertainty discovery and management to external actors without using strong coordination mechanisms, such as *ad hoc* contracts and face-to-face meetings. We conceptualized this strategy as an autonomous uncertainty management strategy. Focal firms leading global ecosystems may not be able to perceive and respond to all local and global technological and market uncertainties that are relevant for their focal value propositions. Thus, they employ a specific strategy that enables external actors to autonomously discover and manage uncertainties that are beyond the focal firm's capacity or interest to identify and manage mostly based on using semi-open digital platforms. This pattern mostly emerged from the cases of Masterplan and Smartplat.

Masterplan developed a digital platform to enable external actors, mostly startups, to discover and manage local and global uncertainties without the need for strong coordination between their managers and entrepreneurs in their global ecosystem. This is enabled by combining this digital platform with supporting digital artifacts such as SDKs, APIs, and an online learning platform providing training about their technologies. Smartplat employed a similar strategy. This focal firm developed a series of processes and digital artifacts, such as a structured

learning community, SDKs, and APIs to streamline the process of engaging with external startups, without the requirements of strong coordination. As these cases demonstrate, digital platforms are key enablers in the use of autonomous uncertainty management strategies, as they allow the focal firm to outsource part of the local and global uncertainty management to many external actors, which would make the use of strong coordination costly and resource consuming.

Focal firms are not limited to employ a single uncertainty management strategy. Rather, our data shows that global ecosystem leaders combine and dynamically shift between such strategies. Bioleader, for example, chose initially to use a cooperative uncertainty management strategy, directly engaging with external actors to deal with global uncertainties. Because some of these actors failed to properly address these uncertainties, Bioleader changed strategies and decided to internalize the management of these global uncertainties.

Overall, what this research shows is that focal firms leading global ecosystems use a rich portfolio of uncertainty management strategies to discover and manage the local and global uncertainties that influence the materialization of their focal value propositions. Focal firms mix and match internal, cooperative, and autonomous uncertainty management strategies. However, we highlight that the choice of strategy is constrained by the uncertainty management governance in place. Employing an autonomous uncertainty management strategy, for instance, will often require adaptations to the uncertainty management governance.

### 5.2 Recapitulation: Local and Global Uncertainty Management in Global Ecosystems

Phase one of our research reveals how focal firms manage local and global uncertainties in global ecosystems. Most constructs that emerged from the first phase of our research can be identified for all cases. This was expected, as these are fundamental concepts that attempt to explain the phenomenon of uncertainty management global ecosystems. The main differences between cases emerged for the use of different uncertainty management strategies, as some focal firms leading global ecosystems employ all three types of strategies we conceptualized, and others do not. The table below shows the construct-case evidence, a binary yes or no for the existence of existential evidence for each construct and each case analyzed for phase 1 of our research.

Table 7: Construct-Case Evidence Table Phase 1 of the Research

| Constructs for the first research stage | Lineplus | Masterplan | Bioleader | Smarplat |
|---|---|---|---|---|
| Uncertainty Scope | Y | Y | Y | Y |
| Assessment | Y | Y | Y | Y |
| Definition of Roles | Y | Y | Y | Y |
| Rule Definition & Enforcement | Y | Y | Y | Y |
| Mandate Assignment | Y | Y | Y | Y |
| Internal Uncertainty Management | Y | N | Y | Y |
| Cooperative Uncertainty Management | Y | Y | Y | Y |
| Autonomous Uncertainty Management | N | Y | N | Y |

Source: Authors

Uncertainty management in global ecosystems is a process that begins with the identification of a given uncertainty (technological, market, regulatory) that affects the focal value proposition being materialized and an initial assessment by managers from the focal firm regarding its scope, local or global. This is a dynamic and complex process, as uncertainties initially perceived as local can be reconceptualized as being global and vice-versa. To manage these uncertainties focal firms may employ three types of uncertainty management strategies: internal, collaborative, and autonomous, which are constrained by the uncertainty management governance that details the rules, roles and mandates for uncertainty discovery and mitigation. Because focal firms leading global ecosystems are multinational enterprises, this governance also applies to the subsidiaries, as the headquarters may choose to constrain what subunits can discover and manage local and global uncertainties.

Focal firms leading global ecosystems may choose to internalize part of the uncertainty management before engaging with external actors. They may also employ cooperative uncertainty management strategies, using strong coordination with external actors (face to face meetings, ad hoc contracts) to manage a given local or global uncertainty. Finally, focal firms may employ autonomous uncertainty management strategies, using digital artifacts that enable the discovery and mitigation of local and global uncertainties using weak coordination mechanisms (i.e., SDKs, APIs, training resources).

We highlight that there is a relevant interplay between uncertainty management strategies and uncertainty management governance. Focal firms may perceive that the best strategy to discover and manage local uncertainties is a collaborative one, using strong coordination with external actors, for example, and update their uncertainty management governance to use this type of strategy. Different subunits of the focal firms leading global ecosystems have different portfolios of uncertainty management strategies, constrained by the uncertainty management governance defined by the headquarters.

What results from this process is the mitigation of local or global uncertainty that affects the materialization of a focal value proposition. Coherence between governance and strategies for uncertainty management plays a key role. A richer portfolio of uncertainty management strategies also provides the focal firms with more alternatives to discover and mitigate local and global uncertainties. In the following sections we offer a well-structure discussion of our results and how they relate to the existing literature on innovation ecosystems and uncertainty management.

### 5.3 Phase 1: Discussion

In this section we discuss the results from phase one of our research, contrasting it to the existing concepts and theories in the academic literature. Our goal in this section is to engage in a structured theorization effort to show how our results add to the extant literature on innovation ecosystems and engage in a transparent dialogue with other authors in our field. We do so for each aggregate dimension in our model, beginning with uncertainty scope, moving to uncertainty governance, and ending this chapter with a discussion on uncertainty management strategies.

#### 5.3.1 Unpacking the Uncertainty Scope Dimension

This research introduces both a new concept, uncertainty scope assessment, and a novel uncertainty typology by differentiating between local and global uncertainties. We contribute, therefore, to the debate on uncertainty conceptualization (O'Connor & Rice, 2013; Gomes et al., 2018; Gomes et al., 2019; Packard & Clark, 2020) by introducing a new dimension to the idea of uncertainty in innovation projects. Focal firms in global ecosystems face uncertainties that are restricted to a single country, which we conceptualized as local uncertainties and uncertainties that affect more than one country, which we conceptualized as global uncertainties.

This uncertainty typology can be used in combination with previously identified uncertainty dimensions, such as the differentiation between technical, market, organizational, and resource uncertainty in the context of radical innovations (O'Connor & Rice, 2013). A given uncertainty may be local and technical or global and technical, for example, as a technology may be suited for one context and not for another. Being aware of this contextual nature of uncertainties is critical for focal firms in global ecosystems.

Assessing uncertainty scope is the process by the focal firm of understanding whether a specific uncertainty (technical, market, regulatory) is local or global. Focal firms employ specific perception and assessment capabilities during this process as gaining an adequate understanding of uncertainty scope may be critical for the materialization of the focal value proposition. This is also a dynamic process, as uncertainties that were initially perceived as being local can later be reconceptualized as being global by the focal firm.

Focal firms in global ecosystems face both local and global uncertainties, often simultaneously, and must use specific structures to manage them. This contribution leads to a more contextual view of ecosystem management and decision-making under conditions of uncertainty (Foss et al., 2019). Different countries have different institutions, market dynamics, and technological conditions that influence the decision-making of focal firms leading global ecosystems under conditions of uncertainty. By highlighting this contextual nature of uncertainty and uncertainty management, we enrich the current understanding on how focal firms identify and manage the relevant uncertainties to materialize focal value propositions in global ecosystems.

### 5.3.2 Uncertainty Governance in Global Ecosystems

We further contribute to the literature on innovation ecosystem governance and strategy (Adner, 2017; Hannah & Eisenhardt, 2018; Jacobides et al., 2018; Shilipov & Gawer, 2020) by introducing the concept of uncertainty management governance. Our theoretical framework shows that dealing with uncertainty scope leads to changes in the existing ecosystem governance practices. Identifying and managing local and global uncertainties is not an automatic process, but rather one that requires a specific set of rules and enforcement that enables the focal firm and other actors in the ecosystem to address these challenges.

Uncertainty governance defines the mandates, who can manage these uncertainties and under what constraints. This process of discovering and managing local and global uncertainties requires dealing with knowledge flows and employing collective experimentation. Uncertainty management governance defines the rules that guide these processes.

Multinational enterprises must define the mandates, rules, and roles for uncertainty management for their subsidiaries. This may constrain the ability of the subsidiaries to discover and manage relevant local and global uncertainties and to engage with local actors in collective experiments to do so. Allowing these business units to engage with local startups (and other actors) may be critical to enable the discovery and management of emergent local and global uncertainties and ultimately seize relevant market and technological opportunities. We further contribute to the literature on ecosystem governance (Tiwana & Konsynski, 2010; Gawer & Cusumano, 2014; Shilipov & Gawer, 2020) by showing how uncertainty management governance defines the uncertainty management strategies that can be employed by the focal firm. The choice to internalize part of the uncertainty management efforts, collaborate using strong coordination with external actors or use an autonomous uncertainty management strategy will depend on the uncertainty management governance adopted by the focal firm.

### 5.3.3 Uncertainty Management Strategies in Global Ecosystems

Our research adds to the literature on ecosystem strategy (Adner, 2017; Hannah & Eisenhardt, 2018; Gomes et al., 2021a) by showing that focal firms in global ecosystems choose between three strategies for uncertainty management: internalizing uncertainty management, collaborating with external actors for uncertainty management, or autonomous uncertainty management. All three strategies are based on ecosystem strategic perspectives employed by the focal firm to manage local and global uncertainties and enable value creation and value capture (in line with Adner, 2017; Hannah & Eisenhardt, 2018). Global ecosystems also require that these strategies are approached with an international perspective, ultimately leading to a global effort to discover and manage local and global uncertainties.

The first strategy uses internal resources to address a particular uncertainty. Our framework suggests that focal firms can use domestic R&D capabilities to address local uncertainty and simultaneously use established global R&D infrastructure to cope with global uncertainties. Firms may also use a particular country's competencies to address a global uncertainty. Firms

may also employ internalized uncertainty management strategies when dealing with critical components of a specific platform to avoid commitment to external actors during the early stages of development, which may, in turn, mitigate uncertainty propagation in the ecosystem (in line with Gomes et al., 2019, 2021a).

The cooperative strategies to manage uncertainties identified in this study extend the notion of cooperation in ecosystems (Thomas & Autio, 2015; Hannah & Eisenhardt, 2018) to address uncertainties effectively. Collaborative strategies require that firms strategically recognize that each type of uncertainty demands engagement with a specific external actor and that to select a proper external partner is a crucial decision. The use of cooperative strategies also implies transforming individual uncertainty into collective uncertainty (coherent with Gomes et al., 2018).

Finally, the third strategy represents a novel approach to cope with uncertainty. This strategy recognizes the cognitive, managerial, and strategic limitations of focal firms in mapping and addressing all potential uncertainties concerning the value proposition as opportunities for value creation. This strategy involves creating the right incentives and mechanisms for external actors to identify, respond to, and reduce uncertainties without solid coordination with the focal firm. This strategy is fundamental for generativity (Cennamo & Santaló, 2019), a process in which actors generate variations on the focal value proposition by addressing hidden (from the focal firm) and unmapped uncertainties. Our framework indicates that this strategy requires a specific innovation ecosystem structure centered around digital platforms and the availability of some digital assets (technological toolkits) and knowledge structures (communities), which enable experimentation without strong coordination by the focal firm.

We contribute, therefore, to the ecosystem strategy research (Adner, 2017; Hannah & Eisenhardt, 2018; Gomes et al., 2021a, 2021b) by proposing three strategies for uncertainty management. Expanding on prior research (Adner, 2017; Hannah & Eisenhardt, 2018), we suggest that ecosystem strategies to manage local and global uncertainties involve thematic areas where the focal firm may allocate its attention and resources to detect and manage uncertainties and delegate the task of identifying and coping with uncertainties to external actors. This process may occur without solid coordination or relevant participation by the focal firm. For the first thematic area, ecosystem strategies for uncertainty management consist of:

i) perceiving a particular uncertainty; ii) assessing whether this uncertainty is global or local; and iii) defining whether the focal firm should handle this uncertainty internally or cooperate with external actors to do so. Concerning the second type of thematic area, ecosystem strategy involves creating the right conditions for external partners to identify uncertainties, experiment and mitigate such uncertainty, and integrate the knowledge generated by external actors in the local and global ecosystem knowledge flows.

We presented above the results and discussion from our research on uncertainty management in global ecosystems. In the following chapter we present the results and discussion of the second phase of our research, on global ecosystem emergence and evolution. The two are intertwined, as we built our investigation for the second phase of our research based on concepts, insights, and questions that emerged from the initial investigation on uncertainty management in global ecosystems. We realized, for example, that we needed additional data and theorization on global ecosystem life cycle and how focal firms lead this process from emergence to evolution. We also identified a relevant gap concerning the need for additional data and concepts that could provide a richer understanding about defining the global ecosystem value proposition, its structure, governance, and orchestration The results of this inquiry, based on new case studies and theorization efforts, are presented in the following chapter.

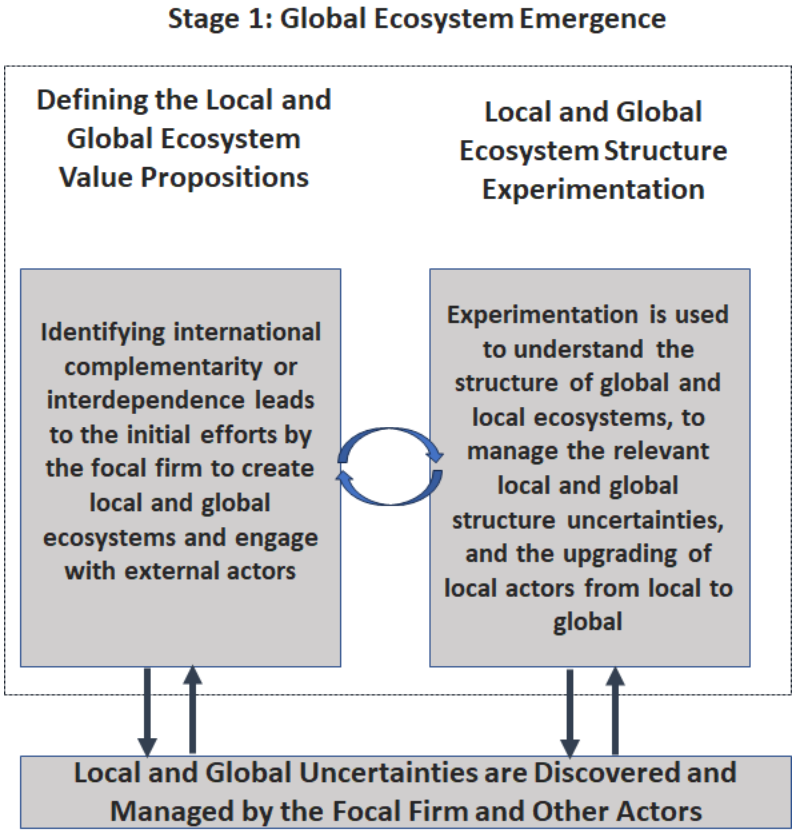
## 6.Research Phase 2: Result Summary

In this chapter we present the main results of the second phase of our research, on global ecosystem emergence and evolution. A relevant initial finding is that a global ecosystem is a set of all the local ecosystems organized around the same focal value proposition being materialized and led by a focal firm. This duality is highlighted in all our concepts, as there is no local ecosystem without a global ecosystem and there are no global ecosystems without local ecosystems. The same way that a multinational enterprise is a set of all subsidiaries and the headquarters, the global ecosystem is a set of all the local ecosystems in the focal firm's home country and host countries. This interplay between local and global ecosystems, the actions of subsidiaries and headquarters, is a fundamental building block to understand global ecosystem life cycle.

We also identified in this research that focal firms leading global ecosystems go through two main stages: global ecosystem emergence and global ecosystem evolution. We discovered that focal firms leading global ecosystem emergence face the initial challenge of defining the value proposition for the local and global ecosystems and understand if the focal value proposition being materialized has the potential for international complementarity or must face the challenges of international interdependence. Identifying international complementarity refers to the envisioned value add of complementors located outside the focal firm's home country to the focal value proposition being materialized. Unveiling international interdependence refers to the interdependence between the focal firm and external actors outside the focal firm's home country for the materialization of a focal value proposition.

During this initial stage of global ecosystem emergence, the focal firm also conducts a process of experimentation to manage relevant uncertainties regarding the local and global ecosystem structure, defining the actors, roles, links, and activities in the local and global ecosystems. As local uncertainties managed by local actors are perceived to be global by the focal firm, which means that they are relevant in more than a single country, the focal firm may choose to upgrade actors in their local ecosystems and link them to actors in other local ecosystems where the same uncertainty must be managed. We labeled this process as upgrading external actors from local to global. We conceptualized these combined processes as local and global ecosystem structure experimentation.

Figure 8: Global Ecosystem Emergence Theoretical Framework




Source: Authors

The interplay between the definition of a value proposition for the local and global ecosystem and the experimentation process to deal with local and global ecosystem structure uncertainty is highlighted in our model. Defining the value proposition for local and global ecosystems requires additional efforts when compared with traditional ecosystems, because actors in different countries respond differently to the proposed value creation and capture opportunities defined and communicated by the focal firm. Almost all companies in our sample struggled to define and communicate a value proposition that resonated with actors in different countries and constantly refined it, as experimentation during the creation of local ecosystem structures enabled them to gain a better understanding of each context.

Because there is also relevant local and global structure uncertainty about who should participate in the global ecosystem and how, focal firms employed an experimentation strategy based on engaging with and disengaging from external actors and dynamically changing the local ecosystems configuration. Uncertainties managed by actors in local ecosystems that were initially perceived as being local can be perceived as being global and

the focal firm reconfigures the local and global ecosystem structure by upgrading a local actor to a global position to deal with it.

Ecosystem emergence is, therefore, an experimentation process that enables the focal firms leading global ecosystems to make sense of the ecosystem value proposition and structure that best enables value creation and capture. Because focal firms face local and global uncertainties that influence the focal value proposition being materialized and because knowledge is dispersed between organizations, focal firms leading global ecosystems choose to engage with internationally dispersed external actors. This leads to the identification and management of local and global structure uncertainties, as the focal firm makes sense of who should participate in their local and global ecosystems to manage local and global uncertainties. These processes are at the core of global ecosystem emergence.

Different challenges are faced by focal firms as the global ecosystem moves from the initial emergence stage to the evolution stage. Experimentation efforts to understand the value proposition and structure during the initial stage of ecosystem emergence influences the creation and implementation of local and global ecosystem governance, the rules and enforcement mechanisms for participation in the local and global ecosystems. Additionally, during this stage of global ecosystem evolution focal firms further engage in orchestration efforts to continuously persuade external actors to participate in the local and global ecosystems they lead.

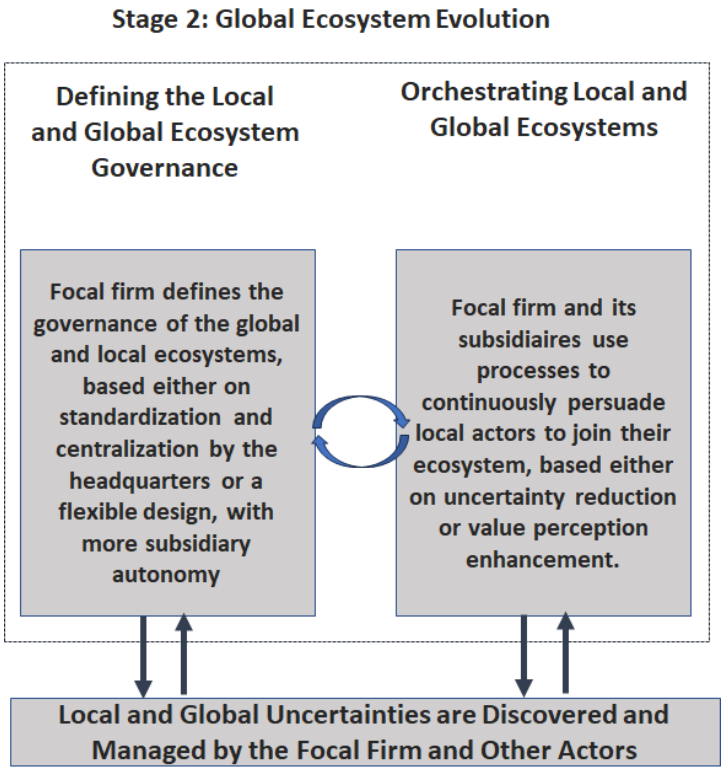
Global ecosystems evolve both by adding new actors and expanding into new countries. Focal firms face the choice of adopting a centralized, more standardized governance defined by the headquarters where focal firm's subsidiaries will follow a similar governance and standardize the rules and enforcement mechanisms for all the local ecosystems. Another approach we identified in our research is based on enabling the subsidiaries to define the rules and enforcement mechanisms for the local ecosystems they lead. Governance in global ecosystem addresses ecosystem structure, who can participate in the local ecosystems, and the rules for value creation and value capture.

Finally, the focal firms leading global ecosystems also face the challenge of continuously persuading actors to join their local and global ecosystems, using either uncertainty reduction programs, processes, and contracts or value perception enhancement programs, processes,

and contracts to do so. Both these core activities combine in the second phase, which we conceptualized as the global ecosystem evolution stage.

This second stage is further characterized by the interplay between defining and implementing the local and global ecosystem governance, either based on more standardized local ecosystem rules and enforcement mechanisms or enabling the subsidiaries to define the governance for their local ecosystems and orchestrating the local and global ecosystems. Because local and global ecosystems are not hierarchical in nature, there is a constant need for the focal firm to persuade other actors that participation in their ecosystem is beneficial to them (Autio, 2022). In global ecosystems, this leads to use of processes, programs, and contracts that both enhance the value perception by other actors regarding the benefits of participating in the global ecosystem and reduce participation uncertainty.

Figure 9: Global Ecosystem Evolution Theoretical Framework



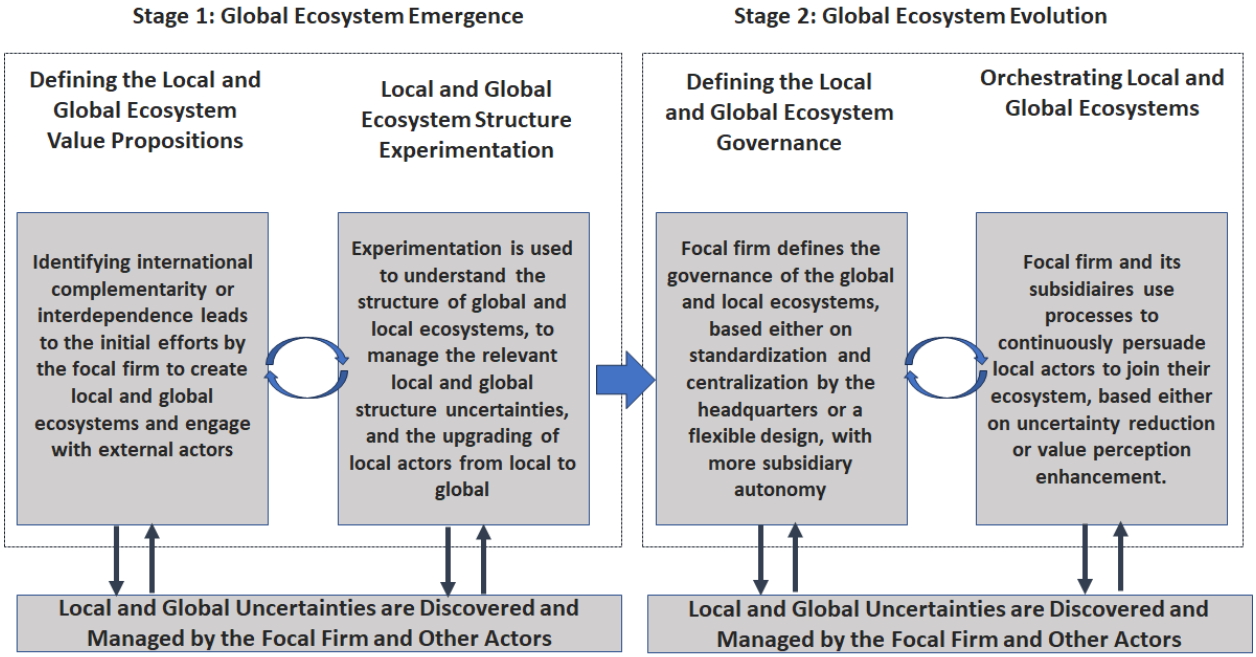

Source: Authors

The main result of the second phase of our research is a theoretical framework that explains how global ecosystems emerge and evolve under conditions of local and global uncertainty. The dotted lined boxes in the model define the stages, global ecosystem emergence and global

ecosystem evolution. Inside each stage are the critical tasks and challenges, which are in constant interplay as highlighted by the circular arrows that connect them.

As the focal firm defines an initial value proposition and starts experimenting to deal with the local and global ecosystem structure uncertainties, new local and global uncertainties about the focal value proposition are discovered and managed, which in turn leads to changes in the global ecosystem value proposition. The move from the emergence stage to the evolution stage happens once the ecosystem value proposition and the initial structure uncertainties are identified and managed. The focal firm then faces the challenge of implementing the local and global ecosystem governance and begin the orchestration efforts that lead to global ecosystem evolution. As the governance for the local and global ecosystems is implemented, the challenges of orchestrating the local and global ecosystems become apparent, which may require changes in the rules and enforcement mechanisms for participation in the local and global ecosystems.

Figure 10: Global Ecosystem Emergence and Evolution Theoretical Framework




Source: Authors

This tentative theoretical model also highlights the uncertain nature of global ecosystem emergence and evolution, as the focal firms face the challenges of defining the local and global ecosystem value proposition, structure, governance, and orchestration under conditions of

local and global uncertainty. These uncertainties are continuously discovered and managed by the focal firm and other actors in their ecosystem during both stages.

In this section we have presented a summary of the main results of our research on global ecosystem emergence and evolution. In the next sections we present an in-depth analysis of how these concepts emerged from our cases. We begin by discussing how focal firms lead the process of global ecosystem emergence, creating the initial ecosystem value proposition and the experiments to deal with local and global structure uncertainty.

**6.1 Understanding Global Ecosystem Emergence**

In this section we will detail how our research revealed that focal firms leading global ecosystems go through an initial emergence phase consisting of efforts to define a value proposition for the local and global ecosystems and experimenting to deal with local and global structure uncertainties. The local and global ecosystem emergence stage involves the focal firm's headquarters and subsidiaries who engage with local actors to reveal new local and global uncertainties to the focal firm about the focal value proposition being materialized. A dynamic process takes place, as the structure being formed influences the ecosystem value proposition and vice versa. The result of this process is an initial understanding by the focal firm about the proper value proposition for the local ecosystems and global ecosystems, enabling a better understanding about how to lead the process of ecosystem emergence. The table below details the concepts, definitions, sources of evidence, and illustrative quotes about global ecosystem emergence that inform our results.

Table 8: Evidence on Global Ecosystem Emergence

| Concept | Definition | Evidence | Illustrative Quote |
|---|---|---|---|
| Identifying International Complementarity | A characteristic of the focal value proposition, the envisioned value add of complementors located in countries other than the focal firm's home country to the focal value proposition | Bionic Platform (Interviews 1, 2 and 3); Deep Blue Consulting (Interviews 1, 2, and 4); Quick Delivery (Interview 2) | "I can bring it (a startup) to our ecosystem, can make it a part of a solution, an approach we have for certain client, can put it under our umbrella, for example" (DT Director Deep Blue Consulting). |
| Unveiling International Interdependence | A characteristic of the focal value proposition that requires cooperation (co-development and/or adoption) by critical external actors located outside the focal firm's home country for the focal value proposition to be materialized | Quantum Inc (Interviews 1, 4, and 5); Uprising Mobile (Interviews 1 and 2); PharmaVax Corp (Interviews 1 and 2) | "We needed partners. This was a novel subject for our company. So we partnered with a Canadian firm. (… )We cannot develop everything, processors, and software." (Sales Director Quantum Inc.) |
| Local and Global Structure Uncertainty | Lack of clarity by the focal firm about what actors should participate in their local and global ecosystem, and what are the appropriate customer value proposition, roles, links, and activities to be performed by each actor | Uprising Mobile (Interview 1 and 2); Quantum Inc. (Interview 1, 2, 4 and 5); PharmaVax Corp (Interview 1 and 2); | "So our plan to first launch the game in the Americas, in Brazil, using (China Corp. Cloud), it fell through" (Community Manager at Uprising Mobile) |
| Upgrading External Actors from Local to Global | Reconfiguration of links in local and global ecosystems led by the focal firm connecting external actors in one local ecosystem to actors in other local ecosystems | Deep Blue Consulting (Interview 1, 2, and 4); Quantum Inc. (Interview 1 and 5); Bionic Platform (Interview 1 and 2); Uprising Mobile (Interview 1) | "Once you have this work being done with a startup here in Latin America and we see the potential to take this to other clients around the world (...) Sometimes the client demands it, so for example we have something for (Chocolat Corp), one of our clients in Brazil, and (Chocolate Corp) in Canada, in the United States wants to do the same thing." (DT |

Source: Authors

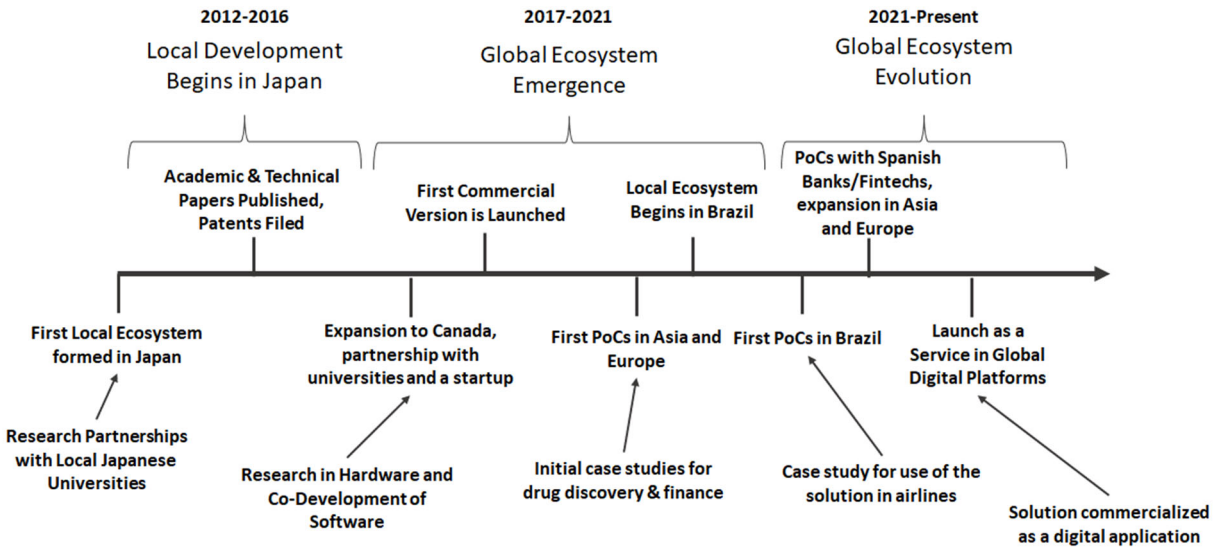
The table above helps illustrate the main concepts that resulted from our research on global ecosystem emergence. These concepts were identified from analysis of our interviews with informants in focal firms, enabling a more refined understanding of the main challenges of global ecosystem emergence. There is an initial challenge of identifying international complementarity and unveiling international interdependence. In parallel, these managers also dealt with local and global ecosystem structure uncertainty and the possibility of

upgrading actors from local (in a single local ecosystem) to global (participating in more than one local ecosystem).

Emergence does not imply lack of intent or planning by managers, but rather that because of local and global uncertainties focal firms cannot know *ex ante* how their focal value propositions enable external actors to create and capture value, nor know who these external actors are in a global context (in line with Datée et al., 2018). Global ecosystem emergence is a process of understanding if a focal value proposition can benefit from international complementarity or must deal with international interdependence, while the focal firm conducts structure experimentation to understand what actors should participate in their local ecosystems.

Focal firms in our sample went through different processes of global ecosystem emergence. Some initially formed local ecosystems in their home countries before expanding to other geographies. Quantum Inc., for example, at first led the local ecosystem to develop the hardware side of their solution with local universities in Japan, then led a local ecosystem in Canada (Canadian universities and a Canadian startup) to co-develop the software side of their focal value proposition, before leading local ecosystems in Europe, other Asian countries, and Latin America to lead the co-development projects based on their focal value proposition.

Figure 11: Quantum Inc. Global Ecosystem Timeline

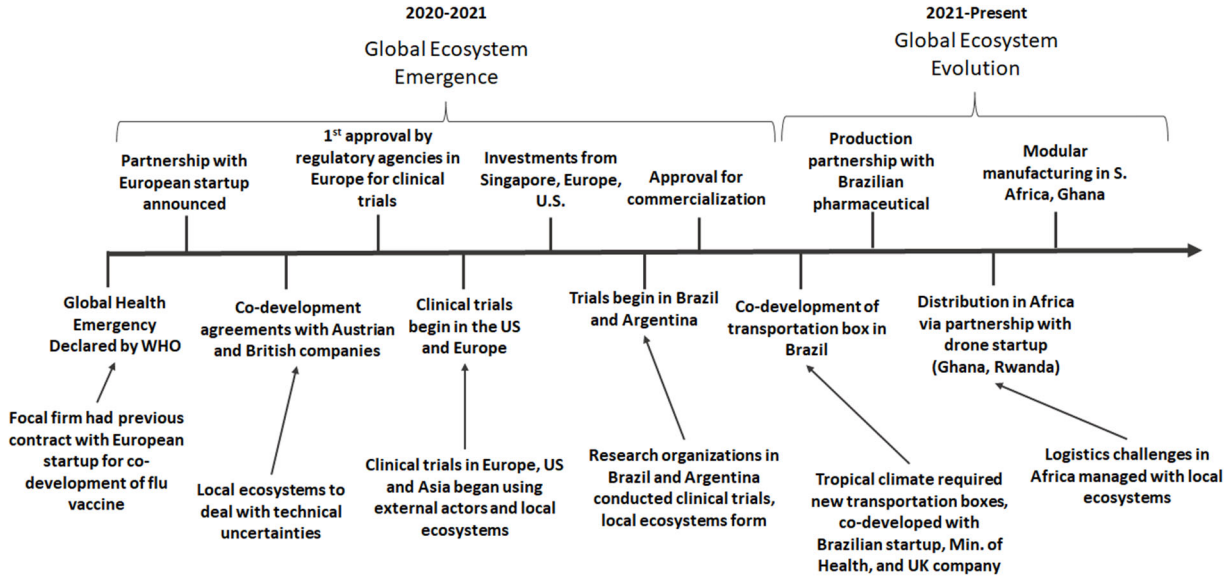



*Source: Authors*

Other focal firms in our sample began the development of their focal value proposition by engaging with external actors located in different countries. PharmaVax Corp., for example,

engaged with a European startup and other external actors in the U.S., Austria, United Kingdom, Brazil, Singapore (and many other countries) during early stages of development, and during the pre-clinical and clinical trials. This focal firm led several local ecosystems before the focal value proposition was available for sale anywhere in the world. The global ecosystem was then expanded to include external actors to identify and manage local and global uncertainties regarding production and logistics in Africa and South America, for example.

Figure 12: PharmaVax Corp. Global Ecosystem Timeline




*Source: Authors*

We begin the following section by addressing the dynamic nature of the global ecosystem value proposition and how focal firms in our sample faced the challenges of understanding issues related to international complementarity and international dispersed interdependence. We then move on to address how experimentation to deal with local and global structure uncertainty takes place. We finalize this section by addressing the interplay between the processes of defining the local and global ecosystem value proposition and the experimentation to deal with local and global ecosystem structure uncertainty, with an emphasis on the transition between this stage and the second stage in our model, as global ecosystems transition from emergence to evolution.

### 6.1.1 Defining the Local and Global Ecosystem Value Proposition

Focal firms in global ecosystems face the challenge of first articulating an initial vision about how their focal value proposition defines value creation and capture opportunities for other ecosystem actors located around the world. This process is different from the traditional value

proposition definition efforts in emergent ecosystems (Datée et al., 2018), as it depends on an understanding by the focal firm about the local and global uncertainties that influence their local and global ecosystems and the challenges related to international complementarity and international interdependence.

Table 9: Illustrative Quotes on International Complementarity and International Interdependence

| **Case Name** | **Illustrative Quotes on International Complementarity** | **Illustrative Quotes on International Interdependence** |
|---|---|---|
| Deep Blue Consulting | *When I design a digital transformation project for a customer I think about assembling a Lego, I assemble this Lego where each piece is a partner, a new technology (…). What do I deliver to my customer? This assembled Lego. This is my job, to build a Lego (DT Director, Deep Blue Consulting)* | *Not Applied* |
| Bionic Platform | *We also have a community, right? Bionic Startups, where I can engage with other entrepreneurs, there are events they do and they invite me to go. There is also the documentation for cloud services, technical guides, and a dedicated support for startups (Entrepreneur who the used Bionic Startups program in Brazil)* | *Not Applied* |
| Quantum Inc. | *Not Applied* | *We needed partners. This was a novel subject for our company. So we partnered with a Canadian firm called (Bits), as we realized that If we have to mimic quantum phenomena the ideal scenario is to have a software that is created to deal with quantum phenomena. But we cannot develop everything, processors, and software. (Sales Director, Quantum Inc.)* |
| Master Business School | *Not Applied* | *We knocked on their door and said: do you want a case study, want to start working on it? (…). But we are not Harvard, with 20 billion dollars in donations each year, we can't afford it, are you still interested? It is not reasonable for a business school, from the perspective of starting a project, from the perspective of work hours required, to use AI you know…* |

| | | |
|---|---|---|
| | | *(Vice-Dean, Master Business School)* |
| PharmaVax Corp. | *Not Applied* | *We had to develop the box that could hold temperatures below minus 70, so this was developed with a partner. The box was tested. We put this box under the sun to see what was the temperature variation, so we could be sure it would hold for a period of time. (Manager, PharmaVax Corp.)* |
| Quick Delivery | *In Colombia, for sure, in Colombia there was a merger with a relevant delivery company to bother (a competitor). (…) And there was a lot of competition with (competitor) about sales, either QuickDelivery was closing a contract with a big company, a relevant restaurant or the competitor was coming on to us to interfere with our contracts, pay the fines, take a restaurant to put in their platform. (Legal Manager, Quick Delivery)* | *Not Applied* |
| Uprising Mobile | *All the games that we launch as main products have this theme of being a hyper competitive game. To be an online game and with the possibility of becoming a sports ecosystem as well. (…) In parallel the big sports organizations that work with other titles they start contacting us, asking when the league will start, how can they join, what the rules are going to be. (Ecosystem Manager, Uprising Mobile)* | *Not Applied* |

Source: Authors

The table above illustrates that some focal firms use global ecosystems to deal with international interdependence (Quantum Inc., PharmaVax Corp., and Master Business School), while others use global ecosystems to address international complementarity (Deep Blue Consulting, Uprising Mobile, Quick Delivery, and Bionic Platform). The perception of managers about how the focal value proposition being materialized enables value creation and capture by external actors is what ultimately explains the initial efforts and investments by focal firms to lead the emergence of global ecosystems. This perception is dynamic and evolves as the project evolves and local and global uncertainties are discovered and mitigated. In the following section we address how focal firms in our sample dealt with defining a local

and global ecosystem value proposition to deal with international interdependence. We then move on to detail how focal firms face different challenges to define ecosystem value propositions to leverage international complementarity.

### 6.1.2 Unveiling International Interdependence

Quantum Inc. illustrates how the process of unveiling international interdependence takes place in the stage of global ecosystem emergence for the materialization of a focal value proposition. This focal firm first began by exploring the potential of using a novel technological platform that incorporates principles of quantum computing to enable faster and more accurate combinatorial analysis, a mathematical technique widely used in operations research. During the first stages of R&D, Quantum Inc.'s headquarters partnered with universities in Japan to better understand the technology and how to use it to develop a hardware solution, based on a strategy to focus on computer processors for specific purposes.

Once the initial uncertainties about the viability of this technology were managed with local partners in Japan, Quantum Inc. managers realized that to deliver a coherent solution to their customers, business clients located around the world, they would need to incorporate a software solution as well. As the project evolved, what was first identified as local uncertainties about the feasibility of the solution became a global uncertainty as the focal firm gained a better understanding of the dispersed nature of the knowledge required to materialize this focal value proposition. Managing these global uncertainties required accessing knowledge and know-how that the focal firm did not possess, namely on software development for quantum-inspired technologies. This process shows how the perception about the focal value proposition evolves as the focal firm makes sense of the technological and market uncertainties that influence the materialization of the focal value proposition. In this case, international interdependence was unveiled, and the focal firm realized that the external actors that needed to participate in this ecosystem could not be found in their home country of Japan.

A scouting process began to manage this global technological uncertainty, looking for the best potential external actors to handle software development, involving subsidiaries located in countries with potential to handle this complex development challenge. Quantum Inc.'s subsidiary in Canada, a well-established hub for research on quantum computing, was involved in the process and began scouting for potential external actors to develop the

software side of their quantum inspired solution. Canadian universities engaged with the Canadian subsidiary creating a local ecosystem to conduct further research and a local Canadian startup was identified as being the best suited actor to handle the development of the software for their solution, due to its existing experience designing software for quantum computers. A director from Quantum Inc.'s subsidiary in Brazil illustrates.

*We needed partners. This was a novel subject for our company. So we partnered with a Canadian firm called (Bits), as we realized that If we have to mimic quantum phenomena the ideal scenario is to have a software that is created to deal with quantum phenomena. But we cannot develop everything, processors, and software. (Director in the Brazilian Subsidiary, Quantum Inc.).*

Once the initial technological uncertainties were managed by leveraging the global structure of the company and partnering with external actors in Canada for research and software development, local and global market uncertainties about the best customers and monetization strategies took center stage. Who would buy this solution? How could Quantum Inc. best market it? And in which countries?

Other subsidiaries were involved in the process, as the focal firm continued to deal with an evolving understanding about the ecosystem value proposition. In Brazil, the managers of Quantum Inc.'s subsidiary began their own process of understanding how this focal value proposition would enable value creation and capture by external actors, while working to identify and manage relevant local uncertainties about pricing, the best way to sell this solution, and how to engage with local customers in Brazil. During our research we discovered that this process can be complex, as the managers located around the world must create their own understanding about the focal value proposition being materialized and come up with strategies to successfully engage with external actors in their local ecosystems.

*Our work began, in the headquarters and subsidiaries, as we became aware of the challenges in this project, to understand the 'what if'. What if I take a problem and try to solve it with our solution? Will it fit? (Director in the Brazilian Subsidiary, Quantum Inc.).*

During this process, the global ecosystem value proposition continued to change and adapt as relevant local and global uncertainties were discovered and managed by the focal firm and external actors in its ecosystems. We formally define the global ecosystem value proposition

as the initial vision of the focal firm about how its focal value proposition generates value to other actors in the local and global ecosystems.

While some relevant technological uncertainties were discovered and managed by the headquarters, the Canadian subsidiary and other external actors, relevant market uncertainties became apparent to the focal firm's headquarters and its subsidiaries. The traditional approach used by Quantum Inc. is to offer free proof of concept implementation to potential customers, engaging with clients by proposing co-development projects via their R&D departments, that demonstrate the benefits of their solutions, generating revenues only if the solution is adopted and scale-up required. However, it became clear that for this focal value proposition this was not the best approach, as the results of the initial test were already valuable and organizational wide implementation and scale-up were often superfluous. Quantum Inc. decided that the use of free of charge proof of concept agreements should be abandoned and that they should begin charging for these tests. This represents a change in their understanding of the local and global ecosystem value proposition.

*A business model was developed based on paid for PoCs (proofs of concept). In the United States and in Japan, this was ok with the customers. But the Brazilian customers are not used to paying for a PoC (Brazilian Ecosystem Manager, Quantum Inc.)*

The Brazilian subsidiary soon discovered that what may work in Japan, Canada and other developed countries was not viable in the Brazilian context, where resources for innovation are limited. A local market uncertainty was discovered regarding the best way to engage with external actors in Brazil and the need to adapt the local value proposition to the context they operate in became clear. Quantum Inc. illustrates the complex and dynamic nature of defining a value proposition that works for the local and global ecosystems. Eventually, this focal firm changed course and started first directly selling consulting services to improve operations for local Brazilian clients using their quantum inspired technologies, and only after these are successful and show the potential of their focal value proposition Quantum Inc. offers the possibility of co-developing other solutions based on their technology.

In our research we discovered that different characteristics of the focal value proposition being materialized lead to different challenges for focal firms during the initial phase of defining the value proposition for their local and global ecosystems. Some focal value

propositions have what we call international interdependence, as other organizations must either participate in the co-development or adopt the focal firm's solution so that it can be materialized. This results from the geographical dispersion of relevant knowledge (about technology, market, regulation) in different countries that is responsible for the existence of local and global uncertainties and accessing actors who have this critical knowledge is a key task in global ecosystems. We formally define international interdependence as a perceived characteristic of the focal value proposition that requires cooperation (co-development and/or adoption) with critical external actors located outside the focal firm's home country for the focal value proposition to be materialized.

Quantum Inc. illustrates the complexities that emerge when focal firms need to use their international structure to gain access to dispersed knowledge to manage local and global uncertainties and deal with international interdependence. The headquarters are responsible for integrating the knowledge that is accessed by the subsidiaries and external actors in their local ecosystems. Additionally, and in parallel the headquarters and subsidiaries must also define the local and global ecosystem value proposition that enables value creation and capture for external actors. Other cases in our sample further illustrate.

PharmaVax Corp. leads a global ecosystem centered around the development of vaccines based on a novel technological platform and further illustrates the challenges of dealing with international interdependence. This focal firm faced specific local uncertainties in Brazil related to the transportation of their vaccines, which required very low temperatures. The combination of a tropical climate and the large number of vaccines required created a local uncertainty about logistics and transportation.

Failure in temperature control would lead to relevant financial losses as all vaccines would have to be discarded, and relevant negative publicity during a global health crisis. To deal with this local uncertainty this focal firm engaged with two external actors to co-develop a logistics solution to enable the materialization of this focal value proposition. A specific box and cold chain solution was co-developed, involving the focal firm, two external actors specialized in logistics, and the Brazilian Ministry of Health agency responsible for the national vaccination program. International interdependence was addressed by an American company, engaging

in co-development with a British multinational, a Brazilian startup, and an agency from the Brazilian Ministry of Health.

Master Business School, a Brazilian focal firm that specializes in selling executive education and training programs to local clients, further illustrates. Managers from this focal firm realized that a move to the competitive online education market would require developing new software solutions that could enable scale-up while preserving the quality of their education programs. However, this focal firm had limited technological capabilities and know-how in software development that was required to materialize this focal value proposition.

Creating their own digital platform for executive learning was defined as the objective, but to do so they would need external actors to handle technological development. This focal firm engaged with the subsidiary of an American technology company which has a solution for the use of artificial intelligence but had struggled to find organizations that were willing to test how this A.I. technology could be used for education. Necessity met opportunity and they decided to co-develop a digital learning platform, a first in the world incorporating the American partner A.I. technologies. From the perspective of Master Business School this was a case of international interdependence, as they needed access to critical technologies that could not be found in their home country, but that could be accessed via the Brazilian subsidiary of a company headquartered in the United States.

We have shown, in this section, how defining the global ecosystem value proposition to deal with international interdependence presents specific challenges to focal firms. In the following section we detail how focal firms in our sample dealt with identifying international complementarity.

### 6.1.3 Identifying International Complementarity

Not all focal value propositions being materialized by focal firms in our sample faced the same challenges encountered by Quantum Inc. Some focal firms encountered a different challenge, as their focal value propositions enable complementors located around the world to add value to the focal value proposition by managing local and global uncertainties. We called this characteristic of focal value propositions the potential for international complementarity, formally defined as the envisioned value add of complementors located in countries other than the focal firm's home country to the focal value proposition.

Deep Blue Consulting illustrates how global companies can overcome the challenges of defining local and global ecosystem value propositions to leverage international complementarity. As a leading consulting firm with global operations, this focal firm needs to constantly create novel solutions for its customers, mostly large business organizations and government agencies. To sell digital transformation and automation projects for their clients worldwide, they employ a strategy that leverages a global array of complementors that add value to their customer value proposition by managing local and global uncertainties.

Deep Blue Consulting challenge was to initially scout for and engage with complementors that can add value to their digital transformation local and global ecosystems. The global ecosystem value proposition needs to make sure that this focal firm, and its many subsidiaries, can engage with local actors and ensure that they participate and add value to their global ecosystem. The value proposition for the global ecosystem, however, evolved over time and was not clear from the start. This becomes apparent when we analyze how their relationships with local high-technology new ventures began in Brazil during the days the preceded the emergence of this local ecosystem.

When Deep Blue Consulting started the formal process of engaging with Brazilian startups and other external actors in 2015, this focal firm's subsidiary in Brazil partnered with a local Brazilian bank and the Brazilian subsidiary of an American software developer to create an innovation hub, without a well-defined value proposition for this local ecosystem effort. The quote below from a senior ecosystem manager illustrates.

*Back then our goal was to help grow the ecosystem, create partnerships, collaborate with (Black Bank), one of our customers, to make some noise, introduce people, bring in the executives, it was almost an innovation culture initiative. We wanted to take the executives there (to the innovation hub) to oxygenate their ideas, not to do business. (Ecosystem Manager in Brazil, Deep Blue Consulting)*

Eight years later, this focal firm has learned from their efforts of leading the emergence of a local ecosystem in Brazil to leverage international complementarity. Initially, the focus was on employing traditional open innovation initiatives, connecting with other organizations, local startups, and local clients using an innovation hub to show that innovation matters. As this focal firm continued to engage with external actors, it learned that simply fostering connections was not enough.

*The level of maturity of this ecosystem and the companies changed. For the whole ecosystem, it changed. (…) Deep Blue Consulting started doing a lot of business with startups, doing a lot of business, and we learned from it. Being in this (innovation hub) is no longer the objective for us. (Ecosystem Manager in Brazil, Deep Blue Consulting).*

The focus now is no longer to engage with startups without a clear business objective or to act as an intermediary between their clients and local Brazilian startups. As a manager in the Brazilian subsidiary put it using a metaphor based on the famous Danish plastic construction toys, Lego, the ecosystem value proposition changed over time. Today external actors are seen as complementors, that can either add value or not to their focal value propositions.

*When I design a digital transformation project for a client, I think about assembling a Lego, I assemble this Lego where each piece is a partner, a new technology (…). What do I deliver to my client? This assembled Lego. This is my job, to build a Lego. (Digital Transformation Director, Deep Blue Consulting).*

The results of this learning process are materialized in the value proposition for this local ecosystem, centered on how the Brazilian subsidiary can leverage local actors that act as complementors to deliver value to their customers. Not all external actors are welcome, as not all are perceived by the managers as being able to add value to their focal value propositions. Searching and finding the right complementors is still a challenge, but one that is overcome by using specific metrics and parameters to understand their value add.

*These are the two main global metrics we look at, influenced sales and total revenues. We also look at the total deal value, that involved startups, influenced sales and direct sales. Why do we do it? Because (the client) will not always close the deal with a startup, but this does not mean that we did not work to search for solutions. It works like a sales funnel. (Ecosystem Manager at Deep Blue Consulting).*

Influenced sales refer to those where the client did not choose to incorporate a solution developed by a startup. Direct sales where the startup contributes directly to the total value of the deal. This type of metric enables the focal firm to understand the value add of complementors in a more nuanced manner.

*We mapped 30 companies (startups), talked to 10, introduced you to 5 and none closed the deal. Why? What happened? This is my purpose, what I am working for here. (Ecosystem Manager at Deep Blue Consulting)*

All managers we interviewed from Deep Blue Consulting Co. underlined the importance of external actors in their local ecosystem and how this focal firm's Brazilian subsidiary can leverage international complementarity to add value to its digital transformation solution. The initial vision of a local ecosystem based on simply being connected to external actors evolved into a clear vision of how to create and capture value by leveraging the technical and market capabilities of local actors in Brazil to deliver value to local and global clients. This whole process enables lowering the costs of the solution, as well as discovering and managing relevant local and global uncertainties by collaborating with external actors.

*The business case is the following: I compile everything I have to design, design what we discussed (with the client), institutionally, technically, development, software integration, which is very important, testing, everything. But instead of using a customization approach, develop the code, I develop it with the Legos I talked about. I see how much it costs, we say setup and monthly run costs, Capex and Opex, sum everything up and see if it is cheaper than what the client has today. I mean, if it is more expensive the client will not want it. He just wants it if it's cheaper. Got it? (Director for Digital Transformation, Deep Blue Consulting).*

What is now a structured approach to leverage local complementors in Brazil, to the point of being obvious to our informant above (got it?), did not begin as such. This focal firm had to learn from doing business with local startups, going from a quasi-philosophical quest to show that innovation matters to having a robust set of processes and tools that enable external actors in their local ecosystem to add value to their focal value proposition of selling digital transformation services to clients. Startups create value by enabling the focal firm to focus on their core activities, consulting services, which in turn reduces the costs of creating and selling digital solutions in a competitive and cost-sensitive market.

We also identified similar patterns in other focal firms leading global ecosystem emergence. Quick Delivery is a Brazilian startup leading a global ecosystem centered around logistics solutions for restaurants. When this focal firm started their internationalization process, they faced challenges to define the local and global ecosystem value propositions. The ecosystem value proposition that enabled this focal firm to attain a dominant market position in Brazil did not resonate with external actors in other South American countries, leading to initial challenges to adequately materialize their focal value proposition in host countries during

global ecosystem emergence and that eventually led to issues that threatened the move from emergence to evolution.

Uprising Mobile, a multinational headquartered in the United States and owned by a Chinese conglomerate, further illustrates. This focal firm leads a global ecosystem centered around a digital competitive game for smartphones. During the initial launch in the Brazilian market the Brazilian subsidiary faced local uncertainties related to pricing for this focal value proposition. Initially, they adopted the same pricing strategy used in other markets, in the United States and Europe. Uprising Mobile was contacted by the main developer of the operational system for mobile phones in Brazil which alerted them to potential pricing issues with their solution and suggested the use of a novel pricing strategy and promotion programs. This external actor generates revenues with each sale made using their platform, by charging fees on each transaction, and has a dominant market position in Brazil. Uprising Mobile's pricing thus directly affected this external actor in the local Brazilian ecosystem and its possibilities of value creation and capture. Managers leading the local ecosystem in Brazil engaged directly with this external actor, changing their pricing, and creating a joint promotion program for their mobile digital game.

Bionic Platform leads a global ecosystem centered around their software platform for smartphones. Initially this focal firm relied mostly on digital assets (SDKs, APIs, training material) to engage with external actors in Brazil, but later decided to also incorporate other programs and processes to better identify and directly engage with local complementors, mostly startups. This focal firm also uses its own internal databases and external databases (i.e., Crunchbase, PitchBook, contacts with local venture capital firms) to choose the best startups to engage with.

What the cases described above illustrate is the dynamic nature of the global ecosystem value proposition, the relevance of local and global uncertainties in this process, and the challenges of dealing with international complementarity and international interdependence. A clear and coherent value proposition for global ecosystem results from a process of identifying the potential for international complementarity, as in the case of Deep Blue Consulting, or dealing with the challenges of international interdependence, as in the case of Quantum Inc. It is further influenced by the different contexts in the countries that participate in this process.

The headquarters play a key role, as knowledge created by the efforts of the business units leading local ecosystems enables a more refined understanding about how the focal value proposition being materialized creates value creation and capture opportunities for external actors.

Focal firms in our sample dealt differently with the challenges of defining value propositions that worked for the local ecosystems in different countries. The level of technological development, the differences in laws and regulation, and the specific market dynamics all combine to create specific conditions that must be addressed by the focal firm, lest the local ecosystems fail leading to a failure for the global ecosystem. Quantum Inc., for example, at first focused on the benefits of their novel technology, a new to the world innovation. When this failed to attract external actors in Brazil and Europe, they changed course. Instead of focusing on the technology as the main driver to engage with external actors, they instead began focusing on the business benefits the use of quantum-inspired specific purpose processors could bring to the external actors in their local ecosystems. This was not an easy or automatic process. The focal firm matured their understanding about how their focal value proposition enables value creation and capture in a global context over time.

*The clients working with Quantum Inc. could not develop productive solutions. They all encountered the same issue, a pitch based on technology. Oh, this is quantum computing, are you really gonna plug that into our ERPs? So it all died in the R&D departments. Even in developed countries, where you have real money for R&D like the U.S. or Japan. They sold a lot of projects, but it was all R&D. (Sales Director at Quantum Inc.)*

Some local ecosystems were successful using the initial value proposition defined by the headquarters based on exploring the technological aspects of a quantum-inspired processor. In the United States where the focal firm's subsidiary was successful by engaging with the R&D departments of external actors to propose co-development opportunities, managers were less bothered by the global ecosystem value proposition. Others, as was the case in Brazil, struggled during this process as the R&D resources in the country are limited and so are the technological capabilities of the local actors.

*In the United States, they were happy with the R&D, but Japan was bothered with this situation of just getting R&D (co-development contracts). So this was led by Japan and Europe. Because the people in*

*Europe were also bothered by just getting R&D contracts, Japan and Europe pushed a lot. (Brazilian Director at Quantum Inc.)*

Ultimately, it is the headquarters that defines the local and global ecosystem value proposition, though not without facing resistance. It is in a privileged position to do so, not only because of hierarchy but also because it is the business unit with a global view of the project. Knowledge generated by subsidiaries leading local ecosystems is integrated by the headquarters and informs how they define the local and global ecosystems value proposition. While failure to attract partners in Europe may not be an issue for the American subsidiary, it is an issue for the global ecosystem and therefore for the headquarters.

As the initial understanding about the local and global ecosystem value propositions change, the focal firm must in parallel understand who should participate in their local and global ecosystems and how, dealing with relevant local and global structure uncertainties. Focal firms' efforts to deal with these local and global structure uncertainties may additionally enable discovery and management of relevant local and global technological, market, and regulatory uncertainties. Focal firms use experimentation, constantly reconfiguring the local and global ecosystem structures, as it struggles to make sense of who should be a part of their global ecosystems and how. We discovered that there is a relevant structure uncertainty in global ecosystems and that becomes apparent as the focal firm starts creating their initial local ecosystem structures to materialize their focal value propositions.

### 6.1.4 Local and Global Ecosystem Structure Experimentation

During our research it became clear that the focal firms in our sample faced the challenge of understanding the best external actors to engage with and create the local and global ecosystem structures. We labeled this as the local and global ecosystem structure uncertainty, which we formally define as the lack of clarity by the focal firm about what actors should participate in their local and global ecosystem, and what are the appropriate customer value proposition, roles, links, and activities to be performed by each actor. Focal firms experiment by changing the configuration of the local ecosystem, engaging with, and disengaging from different types of actors, generating information, and learning about how these configurations enable value creation and capture in the global ecosystem.

Table 10: Illustrative Quotes on Local and Global Structure Uncertainty and Upgrading Actors from Local to Global

| **Company Name** | **Illustrative Quote on Local and Global Structure Uncertainty** | **Illustrative Quote on Upgrading Actors from Local to Global** |
|---|---|---|
| Deep Blue Consulting | *So what do I do? I screen the startups, usually I'll have quick meetings when I talk to a startup, half an hour, but if its very robust, if I think there is something there that might be interesting, then maybe I can do a one hour meeting. Technology and business, I look at it more in depth. Once I did the screening, qualified it, understood that the startup is good, the team is amazing, talked with others, looked at it, for example, with investors, I sometimes talk with investors to get to know it better. (Ecosystem Manager, Deep Blue Consulting)* | *Once you have this work being done with a startup here in Latin America and we see the potential to take this to other clients around the world we begin exploring this portfolio in other geographies. (...). Sometimes the client demands it, so for example we have something for (Chocolat Corp), one of our clients in Brazil, and (Chocolate Corp) in Canada, in the United States wants to do the same thing. So the client can trigger it. (DT Director, Deep Blue Consulting)* |
| Bionic Platform | *We use a lot of external research tools, so we have Crunchbase, in Latin America we use (a VC firm), and a lot of internal analytics, because this startups are in our house, so we have a lot of information in the (Brazilian) business unit (Ecosystem Manager, Bionic Platform)* | *We are opening a space for entrepreneurs in Sao Paulo, the city has a prosperous young startup community, we have offices there to offer support and mentorship, and we also believe that Sao Paulo based startups can have a global reach. (Press Release, Bionic Platform, 2016)* |
| Quantum Inc. | *You have to open this barrier of entry to sell a solution. But once you are inside the client, with your feet in the door, you bring with you the operational optimization services. And you show the client that the same way you solved a problem, you can solve other problems. But then we are talking about co-development, because I don't have this product yet. (Sales Director, Quantum Inc.)* | *We go to the headquarters, the main technology unit, the (quantum) BU, raise the flag and say: I have a new case in Brazil for which I found no references in our knowledge base and that I want to register and eventually if it is successful include as part of our solutions that can be replicated (Sales Director, Quantum Inc.)* |
| Master Business School | *We had tried a lot of things. One time we watched a (American Partner) lecture, one of many lectures we had been to. We watched this lecture and they sell a dream... So (A.I. Solution) can do it all? Let's see if it's all that. We decided to pay and see. And the* | *Experimentation, testing, remaking, redoing. That's when I understood why we became a global case study for (American Partner), of the most intense use of A.I. in education. We uploaded a corpus, remade the corpus one hundred times. That's not a figure* |

| | | |
|---|---|---|
| | *thing that intrigued us was, fuck, will (American Partner) do all that with us? Kind of for free, buying this project, why don't you do it with Yale, with Harvard? And they were very transparent with us: because Yale and Harvard don't want to do it. (Vice-Dean, Master Business School)* | *of speech, one hundred times. So it's a lot of work. (Vice-Dean, Master Business School)* |
| PharmaVax Corp. | *The next guy wants to read the contract again. So this change of Ministers delayed everything. Every four months we had a new Health Minister, so negotiations began from scratch. (Manager, PharmaVax Corp)* | *PharmaVax Corp announces that (Afrika Drones, HQ in Rwanda) successfully delivered Covid vaccines under minus 70 degrees in Ghana. (Press Release, PharmaVax Corp., 2021)* |
| Quick Delivery | *Quick Delivery had no intention to invest in Mexico like it did in Brazil, there was this decision that we could no longer burn cash in Mexico for a business that just isn't working (Legal Manager, Quick Delivery)* | *Not Applied* |
| Uprising Mobile | *(China Corp.) (the parent company) was very concerned with how we would launch the game in China. In our launch cycle, China was the last country. We launched it all over the world. Once we saw that the product was ok. As we were launching the game in other countries, we continued the approval process with the Chinese government. (Ecosystem Manager, Uprising Mobile).* | *I am giving you this specific example, because our consulting firm for CSR, it is in France. And these guys did all this research on (Brazilian Delivery Company) and they brought me all these episodes, said: man, this happened, this may damage your reputation. (Ecosystem Manager, Uprising Mobile).* |

Source: Authors

As the quotes above illustrate, focal firms employ processes that enable the identification of promising external actors that should participate in their local and global ecosystems. This goes beyond a simple task of research, as evaluating and engaging with these actors requires the allocation of resources, from the financial costs of participating in innovation hubs to the time dedicated by managers to scout for, screen, and engage with external actors. While this is not constrained to local startups, with focal firms in our sample facing challenges to also identify the best incumbent organizations and universities to engage with, new ventures pose

additional challenges due to the uncertain nature of their organizations. In the following section we detail how focal firms in our sample dealt with local and global structure uncertainty.

### 6.1.5 Local and Global Structure Uncertainty

Uprising Mobile illustrates how focal firms deal with local and global structure uncertainty. This focal firm, headquartered in the United States and owned by a Chinese conglomerate, orchestrates a leading global ecosystem centered around an online multiplayer competitive game for personal computers. Managers from Uprising Mobile decided to create a mobile game, based on this existing and successful product, with similar playability but for smartphone digital platforms. Initial development began in the United States, where this firm is headquartered, using a partnership with Chinese gaming development studios specialized in mobile gaming software development.

During the development of this solution some local and global uncertainties were discovered by the focal firm about their focal value proposition. When an initial version of the product was sent to the Brazilian subsidiary for testing, for example, the local Brazilian managers provided the headquarters with relevant feedback about the Brazilian smartphone market. The initial version was designed to run on the smartphone models sold in the United States and when the Brazilian managers tried to play the game it would not run on the less powerful smartphone models usually sold in the country.

*Our cellphones don't have the same disk space, capabilities are limited. When we had the first internal trials here, the alpha version, they (the HQ) asked us if we wanted to try it. Half the people in our office couldn't even run the game. And we are talking about very privileged people, with good salaries. (Community Manager in the Brazilian Subsidiary, Uprising Mobile).*

The identification of this technical uncertainty led to further changes in the solution, as it needed to account for the different smartphone markets if the product was to become a global success. During the launch of the product the focal firm decided to experiment in different countries to make sure that they understood the proper local ecosystem structures. Because China was considered the main market for this solution, it would be the last country they would launch the product to make sure that the focal firm can use the learning that was created from the experience in other countries.

*(China Corp., the parent company) was very concerned with how we would launch the game in China. In our launch cycle, China was the last country. We launched it all over the world. Once we saw that the product was ok as we were launching the game in other countries, we continued the approval process with the Chinese government. (Community Manager in the Brazilian Subsidiary, Uprising Mobile).*

When the game was launched in Brazil, the managers in this subsidiary became aware about the challenges of creating a local ecosystem to enable that this value proposition delivers value to its customers and external actors. Being a mobile game that was designed for competitive play, they knew that some key actors would need to participate in this local ecosystem, such as streaming services, professional e-sports teams, and television networks. Because the experience of the players depends on low latency, having the right cloud computing infrastructure was critical. Changes made by the headquarters due to political disputes between China and the United States about who should be this cloud provider led to structure uncertainties that affected the launch in Brazil.

*Brazil is a high potential market for mobile games, we were supposed to be the first country to get the beta version of the game in the world. Then Trump and Biden's dispute began... There was this veto to any type of Chinese technology accessing data from US citizens. So our plan to first launch the game in the Americas, in Brazil, using (China Corp. Cloud), it fell through. Because of this political dispute we had to change our plans. We went back to the implementation stage, switched (China Corp. Cloud) for (American Corp. Cloud) so we could launch it here (in Brazil). (Community Manager in the Brazilian Subsidiary, Uprising Mobile)*

This case illustrates how the efforts to create the local ecosystem involved discovering and managing local and global structure uncertainties. Uprising Mobile, for example, faced some global uncertainties regarding the ecosystem configuration, having to change the main cloud service provider in several countries. Dealing with structure uncertainty requires reconfiguring the local and global ecosystem structures, often to account for unforeseen events.

To launch the game in Brazil this focal firm needed first to create a local ecosystem. Being a mobile game, it would be distributed using application stores controlled by the companies that develop operational systems for smartphones. One of these companies decided to contact Uprising Mobile's subsidiary in Brazil to discuss their launch strategy in the country,

as it was concerned that their pricing strategy could lead to less-than-optimal value capture to other external actors.

*We have a very strong partnership with (Zeta) and (Teta). (…) (Zeta) realized that our prices were too high. They were all very expensive when compared to the rest of the market. The cheapest in-game item we offered was fifteen reais. So (Zeta) showed us some studies and told us that we need to get the first sale. Once the customer paid for it once, then he will continue buying (Community Manager in the Brazilian Subsidiary, Uprising Mobile).*

During the initial launch in Brazil, it was a local external actor, Zeta's Brazilian subsidiary, that alerted them to change the pricing policy. Because this external actor captures value based on fees charged for every transaction in their digital platform, they were invested in making sure that Uprising Mobile's product was successful in the country. It was only because Uprising Mobile had engaged with this external actor, by distributing their mobile game through their platform, that they were able to further discover issues with the local ecosystem value proposition.

Further experimentation took place to manage structure uncertainties, as this focal firm knew that they would need external actors to make the local e-sports ecosystem based on a mobile game work. Uprising Mobile started then expanding the local ecosystem, engaging with external actors to create a competitive e-sports ecosystem in the country. Local streaming services specialized in mobile gaming, local e-sports teams that may be interested in the professional league, and sponsors for the first professional tournaments were added to the ecosystem. This process takes time and there is a strategic approach to foster the local playing community and find the right timing. Each country where this focal firm operates in goes through a similar process, as the game launch leads to the creation of an infrastructure side of their ecosystem (cloud providers, intermediaries, payment solutions) and a e-sports league (streaming services, local e-sports teams, television networks, sponsors). Not all went according to plan, though.

*We realized after a two-year journey in competitive (mobile game), that it didn't have the same depth, that we did not achieve the same results we had, from the e-sports perspective. Number of sponsors, viewership KPIs, audience, relevance in the Western markets that Uprising Mobile products require. (…) So the company, after two years of operation in e-sports, decided to end the investments that we make*

*for the development of the e-sports ecosystem in Western countries and just maintain it in Asia due to a strategic decision, because there the market is more mature. (Ecosystem Manager, Uprising Mobile).*

Creating a competitive ecosystem in western countries, which entails local leagues, sponsors, streamers, and contracts with television networks was not successful, as this focal firm struggled to engage with relevant external actors. The casual audience continues to grow in Brazil and so does the local ecosystem, but without a local e-sports ecosystem. However, the same is not true in Asia where the game is still played competitively, and local e-sports ecosystems are thriving.

Our research reveals that focal firms face the choice between different structures for the local ecosystems that combine to form the global ecosystems, which often results from a process of experimentation and reconfiguration. When we began our conversations with managers from Uprising Mobile the local ecosystem was still in its infancy and their expectation was to replicate the ecosystem structure that had worked for previous games. After attempting to lead local ecosystems that had similar structures for all countries, (i.e., Brazil, the U.S., South Korea, Philippines, China) and experimenting with local structures, they realized that what worked in some regions (Asia) did not in others (Europe, Americas).

Local and global structure uncertainties are thus discovered and managed during this process, as the focal firm gains a better understanding about who should participate in their local ecosystems and how. Experimentation, a process of engaging with and disengaging from different external actors, enables these uncertainties to be managed. Case studies that summarize the successes or failures from engaging with these partners help the communication between the subsidiaries and with the headquarters. There is a key challenge of integrating this dispersed knowledge and creating a coherent vision about the local and global ecosystem structures.

All focal firms in our sample faced local and global structure uncertainties. Our research reveals that there is a challenge in understanding who are the best external actors to participate in the local ecosystems. Searching for and engaging with local startups, which is often considered a strategic activity to be conducted by the subsidiaries, poses the additional challenge of scouting, screening, engaging with and analyzing if these uncertain high

technology new ventures can add value to the focal value proposition or help deal with critical uncertainties to manage international interdependence.

A common trend we identified is the participation in innovation hubs, incubators, and accelerators. These organizations reduce the information asymmetry (in line with Akerloff, 1970 and Dew et al., 2004) between focal firms and entrepreneurs by conducting an initial screening and selecting only promising local startups to participate in their programs. Focal firms use these hubs as a starting point to select the startups they engage with, which helps managing local structure uncertainties related to finding promising startups.

Quantum Inc. further illustrates. This focal firm faced structure uncertainties regarding their local ecosystem in Brazil as there is an ongoing challenge of scouting for and engaging with local startups that can use their technology to develop new solutions. Scouting for startups is new for this focal firm's Brazilian subsidiary, which is used to engage with large, established organizations. Quantum Inc. then participates in innovation hubs, engages with local universities, and actively promotes their focal value proposition looking for Brazilian startups that may be interested in using their technology to develop their own solutions.

Bionic Platform also shows how focal firms face structure uncertainties and must employ specific processes to manage them. This focal firm faces the challenge of constantly scouting and engaging with promising local startups that can add value to their focal value proposition. To deal with these structure uncertainties they constantly communicate with external actors in the local ecosystem, such as venture capital firms, open innovation hubs, and startup accelerators to identify startups that have the potential to add value to their focal value proposition. While they also have their own programs for local startups in Brazil (and several other countries), they still see value in engaging with innovation hubs to help manage relevant local structure uncertainties.

During this process focal firms may discover that actors in local ecosystems may help manage relevant global uncertainties. When this happens, focal firms may choose to change the links between actors and connect them to other local ecosystems they lead. In the next section we detail how this process takes place.

### 6.1.6 Upgrading Actors from Local to Global

During our research we also uncovered that local and global structure uncertainties may be dynamic, as local actors can become global actors by participating in more than a single local ecosystem. A startup discovered by the focal firm's subsidiary in Brazil may, for example, start offering its services to a European company because of the focal firm. Focal firm's may help these organizations internationalize their operations by re-configuring the links in the local and global ecosystem. We conceptualized this as upgrading actors from local to global, which we formally define as the reconfiguration of links in local and global ecosystems led by the focal firm connecting external actors in one local ecosystem to actors in other local ecosystems.

Deep Blue Consulting shows how focal firms use their leading position to change the links between actors in local ecosystems, often creating global actors by stimulating and enabling their participation in several local ecosystems simultaneously. This focal firm's subsidiary in Brazil is constantly discussing the needs of its global clients with the headquarters and the other subsidiaries. When a promising actor enters the local Brazilian ecosystem, this is quickly communicated to the other units of the focal firm. Constant communication attempts to leverage the power of these international complementors.

*Besides, because here in Brazil some startups are very well developed, we get contacted by the United States, Indonesia, the Philippines, India, Europe asking about the startups that I use here in Brazil. We also make our own calls, deliveries, conversations, so there is a lot of exchange. Usually because our currency is devalued, international startups are not very interesting to us. So we end up using a lot of local, Brazilian startups, and when I offer them abroad (to Deep Blue Consulting units in other countries), for them it's all very cheap. (Director for Digital Transformation, Deep Blue Consulting).*

As we can see, being part of a global ecosystem may offer specific benefits for the actors. Access to external markets, for example, by using the focal firm's international footprint as in the case of Deep Blue Consulting. Because some of the actors in the Brazilian local ecosystem are also subsidiaries of global companies, this process of re-configuring the global ecosystem structure is mainly characterized by shifting the links between actors in the ecosystem.

*Once you have this work being done with a startup here in Latin America and we see the potential to take this to other clients around the world we begin exploring this portfolio in other geographies. (...). Sometimes the client demands it, so for example we have something for (Chocolat Corp), one of our*

*clients in Brazil, and (Chocolate Corp) in Canada, in the United States wants to do the same thing. So the client can trigger it. (Director for Digital Transformation, Deep Blue Consulting).*

This dynamic structure uncertainty is managed by experimentation, with the focal firm constantly changing the local and global ecosystem structure. New actors, new links, new activities, and new positions are constantly being created. The focal firm learns from this process and gains a better understanding of what structure works for each local ecosystem in their global ecosystem.

Our research shows that this process of structure experimentation is critical in global ecosystems. Focal firms constantly look for external actors, either to deal with international interdependence or international complementarity. However, focal firms leading global ecosystem emergence do not know *ex ante* which external actors can truly contribute to value creation and capture. These focal firms initially experiment by engaging with different types of organizations (startups, universities, innovation hubs, government agencies, established organizations) to refine their understanding about the best external actors for their local and global ecosystems.

Quantum Inc., for example, began the process of engaging with external actors in Brazil looking for universities and scouting for local startups, which was the pattern established in other local ecosystems (Japan, United States, Canada, and Europe). They realized, though, that Brazilian universities were not the ideal actors for their local ecosystems, as the technological side of the solution was mostly addressed in the local ecosystems in Japan and Canada. They also learned that local startups lacked the technological capabilities and structured databases to properly use their quantum inspired technologies for their own products or services.

Initially Quantum Inc. initially used a simplified scoring system, which they called the ideal customer profile, to make sense of who to partner with in Brazil. As they experimented by engaging with and disengaging from external actors, mostly universities and startups, they improved this scoring system to account for their learning. Going from an ideal customer profile to an ideal partner profile, which accounts for other characteristics such as technological capability and structured operations data, they were able to better identify which external actors can benefit from participation in their local ecosystem in Brazil. Learning from this process is communicated to the headquarters and other subsidiaries of the focal

firm in the form of case studies, which detail the success and failures resulting from engaging with external actors. In the following section we further discuss how focal firms lead the process of global ecosystem evolution.

### 6.2 Unpacking Global Ecosystem Evolution

Once the focal firm has managed the critical local and global uncertainties for the materialization of its value proposition, the main challenge during global ecosystem emergence, it will face different tasks related to the evolution of the global ecosystem. We identified that there are two main challenges during this stage. One is to define and implement local and global ecosystem governance. The second is orchestrating the global ecosystem as actors must be continuously persuaded to engage with the local and global ecosystem. We understand evolution in global ecosystems to mean both the addition of new geographies, as the focal firm expands into other territories, or the addition of external actors, as the focal firm adds more actors to their local and global ecosystems.

The result of the initial experimentation process during global ecosystem emergence for the focal firms in our sample was the definition of a local and global ecosystem governance, considering what structure is best suited to enable value creation and value capture in the local and global ecosystem, and the rules for value creation and value capture. For some organizations in our sample (Uprising Mobile; Quick Delivery; Bionic Platform), this manifested as a more standardized global ecosystem governance, with similar rules and enforcement mechanisms being defined by the headquarters and implemented by the subsidiaries (in line with Nambisan & Luo, 2021). For other organizations the result was a more flexible governance (Deep Blue Consulting; Quantum Inc.; Master Business School; PharmaVax Corp) enabling the subsidiaries to define some of the rules and enforcement mechanisms for their local ecosystems, which complements the extant understanding about governance in global ecosystems (Nambian et al., 2019; Nambisan & Luo, 2021; Nambisan & Luo, 2022).

Once global ecosystems begin to evolve, adding more external actors to deal with international interdependence and international complementarity, traditional corporate governance of multinationals and uncertainty management governance is insufficient as it does not address the rules for how these external actors can add value to or help materialize a focal value proposition. Furthermore, rules and enforcement mechanisms are specific to the focal value proposition being materialized. A focal firm may have different governance for

their ecosystems, as leading a digital platform for smartphones and leading a cloud-computing solution require different approaches to governance.

Governance must, to some extent, be agreed upon and negotiated by ecosystem actors in a global context, without the benefits of hierarchy, in multiple countries, and often including disputes, appeasement, winners, and some discontents. What our research reveals is that governance in global ecosystems becomes a complex and critical challenge for focal firms once their local and global ecosystems begin to grow. Governance creates the formal conditions for participation in local ecosystems, formalize the incentives for participation, determine how actors add value, and the dynamics of value capture.

Table 11: Evidence on Global Ecosystem Evolution

| Concept | Definition | Evidence | Illustrative Quote |
|---|---|---|---|
| Local and Global Ecosystem Flexible Governance | Rules and enforcement mechanisms for participation in local and global ecosystems defined and implemented by the subsidiaries, adapted to their local contexts | Deep Blue Consulting (Interview 1, 2, and 4); Quantum Inc. (Interview 1, 2, 3, and 5); PharmaVax Corp (Interview 1 and 2); Master Business School (Interview 1 and 2) | "Engaging with startups, there is a register, the company is registed with Deep Blue. To begin a partnerships, there is an NDA, something like that. But it is all managed locally, of course this is formalized between the companies, but there is a local autonomy, in Latin America, we don't have to discuss this with other geographies" DT Director Deep Blue Consulting |
| Local and Global Ecosystem Standardized Governance | Rules and enforcement mechanisms for participation in local and global ecosystems defined by the headquarters and implemented by the subsidiaries | Bionic Platform (Interviews 1, 2 and 3); Uprising Mobile (Interviews 1 and 2); Quick Delivery (Interview 2) | "Everything follows a global standard. Like I said, the headquarters will design the structure of the global programs and we adapt them here. But there is always a plan and established parameters that we must follow. " Ecosystem Manager Bionic Platform |
| Enhancing Global and Local Ecosystem Value Perception for External Actors | Processes, programs, and contracts used to enhance the perceived value by external actors about the benefits of participating in the local and global ecosystems | Bionic Platform (Interviews 1, 2 and 3); Uprising Mobile (Interviews 1 and 2); Deep Blue Consulting (Interview 1, 2, and 4) | "They say it in the welcome email. That they deposited in your account the one hundred thousand dollars, ten thousand a month that you receive. They also say you have five hundred dollars to spend on training. (...) There are a lot of valuable offerings if you are starting a business for the firs time." Brazilian Entrepreneur who participate in the Bionic Platorm for Startups Program. |
| Reducing Participation Uncertainty in Local and Global Ecosystems for External actors | Processes, programs, and contracts used to reduce the uncertainty related to external actors participation in the local and global ecosystems | Deep Blue Consulting (Interview 1, 2, and 4); Quantum Inc. (Interview 1 and 5); Uprising Mobile (Interview 1) | "The customer hires Deep Blue Consulting, not the startup. This is why it is so easy for me to engage with these startups because we internalize it, we make the startup part of our solution, as a piece of Lego in our solution. " DT Director Deep Blue Consulting |

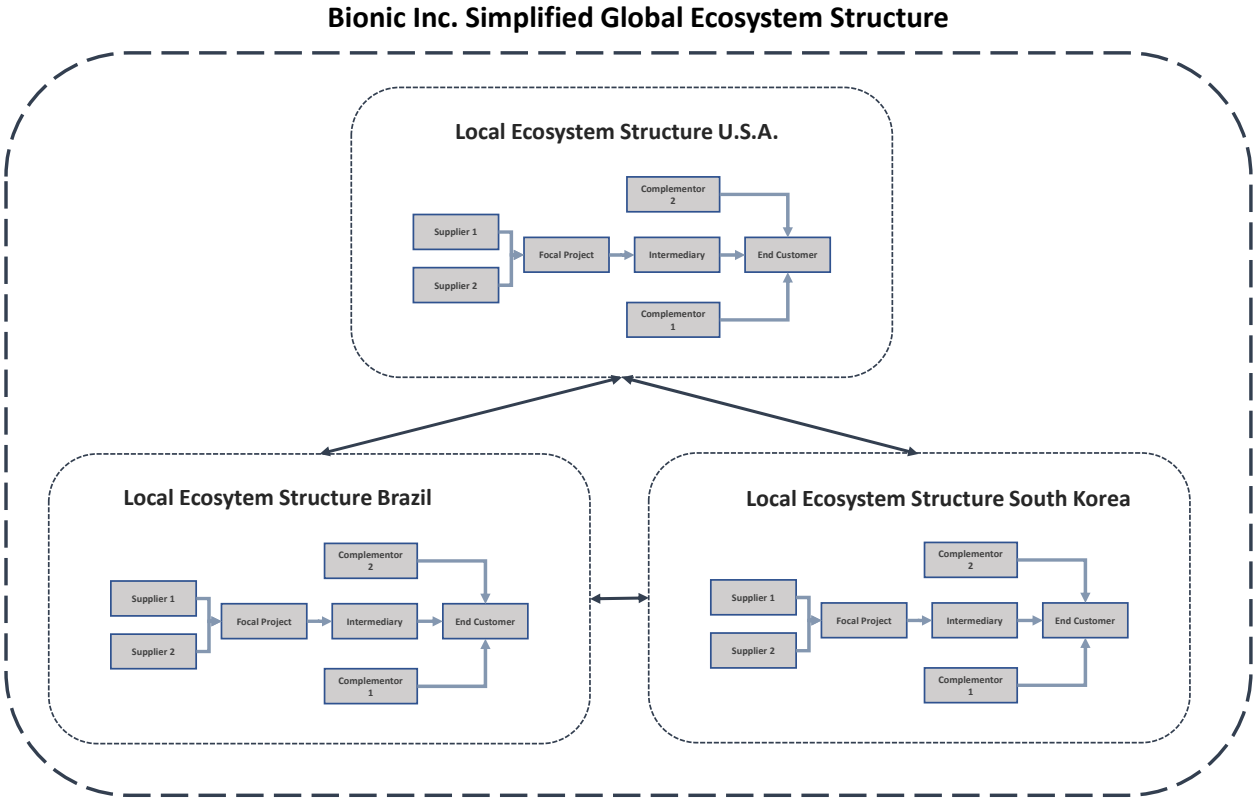
Source: Authors

Global ecosystem governance must account for three main themes: structure, value creation, and value capture. Governance about structure formalizes the rules about which external actors may participate in the local and global ecosystems and how. Focal firms leading global ecosystems go through an initial experimentation stage regarding structure during the emergence phase and the information created from these experiments enable a more sophisticated understanding of the proper local and global ecosystem structure. Governance will either employ a more standardized approach for ecosystem structure, with similar structures for all local ecosystems, or a more flexible approach, enabling each subsidiary to define the best structures for the local ecosystems they lead. This is a dynamic process that evolves over time and there are shifts between more standardization and more flexibility in the cases we studied.

Uprising Mobile, as we have seen, initially considered creating local structures with both a casual and a competitive ecosystem in all countries they operate in. Based on their learning about what worked in each context, they focused instead on developing competitive e-sports ecosystems in Asia, but not in Western countries. The governance that emerged accounts for this, with subsidiaries in Asian markets being able to form local structures with both casual and competitive ecosystems, while subunits in Western countries chose to focus on local ecosystems for casual play. Different structures emerged in local ecosystems, and therefore in the global ecosystem, based on their governance. Their governance evolved from a more standardized approach (i.e., all subsidiaries follow the same blueprint) to a more flexible approach (i.e., not all subsidiaries need an e-sports ecosystem).

What results from this interplay between governance and structure can be visualized in the local ecosystem structures that compose the global ecosystem. The precise actors in each local ecosystem, the organizations themselves, may vary. What is standardized or flexible is the type of organization that must be a part of each local ecosystem and the rules that constrain such participation.

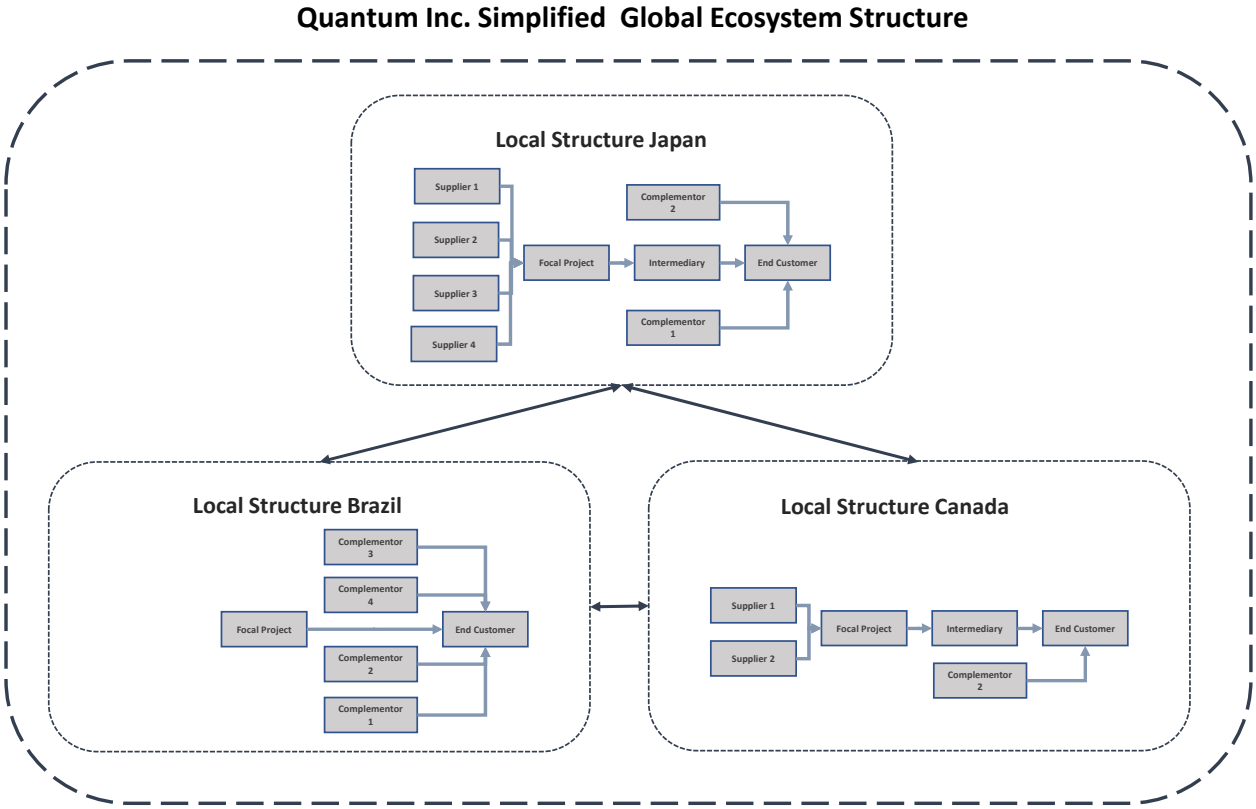
Figure 13: Global Ecosystem Structure Under Standardized Governance




Source: Authors

Using a more flexible approach, on the other hand, will lead to each country and each local ecosystem taking on a specific structure so that the focal firm can deliver value to its customers. Each subsidiary leading their local ecosystems, when the global ecosystem adopts a more flexible governance, will have increased autonomy to define the rules for discovery and management of local uncertainties and global uncertainties. Local actors solve local problems for local clients, with the focal firm playing the role of aligning them, of fostering the right links, and helping them understand what activities to perform. What differs from standardized governance is the fundamental activity of the focal firm's subsidiary, which is based on creating rules and enforcement mechanisms that allow external actors to discover and manage local and global uncertainties.

Figure 14: Global Ecosystem Structure Under Flexible Governance




Source: Authors

Governance in global ecosystems additionally defines the rules for value creation, how external actors can contribute to focal value proposition and enhance the overall value of the local and global ecosystems. Focal firms in our sample used different approaches regarding governance for value creation, such as defining the rules for external actors to participate in co-development initiatives centered around the focal value proposition and setting the governance of digital platforms to enable international complementarity. Firms may standardize the rules for value creation, with all local ecosystems using similar governance regarding how external actors can contribute to the focal value proposition or opt for a flexible approach with each subsidiary defining the rules for value creation in the local ecosystems they lead.

Deep Blue Consulting, for example, defined a specific governance for value creation in their local ecosystem in Brazil. To enable external actors to participate in their digital transformation ecosystem without jeopardizing their relationship with their clients, this focal firm created a set of intricate rules for value creation. Local startups, for example, go through both business

and technical screening to ensure that they are compliant with the standards set by the focal firm. Issues such as data privacy and cyber security are critical, from a technical perspective, and startups first experiment in the controlled environment of the focal firm before being allowed to engage with the clients. Business considerations include a cost benefit analysis, and comparisons with existing solutions in the Brazilian market, to ensure that these external actors indeed add value. Furthermore, a due diligence process also takes place to ensure that external actors follow the rules for participation and will not pose legal issues for the focal firm in the future.

Governance in global ecosystems must also account for issues of value capture. Rules define who captures which portion of the overall value created in local ecosystems, using specific contracts and fee structures for external actors. Focal firms may opt to use the same value capture governance for all local ecosystems or adapt it to each context. Bionic Inc., for example, uses a more standardized value capture governance for all the local ecosystems they lead. A standardized fee for transactions using their platform is used in all countries they operate in. This has led to specific conflicts with their international complementors, which may perceive the value capture governance to be too advantageous for the focal firm to the detriment of their own profit lines.

Another key challenge faced by focal firms during the global ecosystem evolution stage is persuading external actors to join their local and global ecosystems, which we conceptualized as global ecosystem orchestration (in line with Autio, 2022). Our research reveals that focal firms employ two main processes to attract external actors, either based on enhancing the perception about the value of participating in their local and global ecosystems or reducing the uncertainty associated with this participation.

Enhancing value perception for orchestration refers to the use of specific processes, programs, and incentives to attract external actors. A common approach we identified is the use of mentoring programs, offering acceleration and incubation opportunities, as well as direct financial incentives in the form of credits to be used on the focal firm's services. Value, however, is a perception and is subjective, as external actors may no *a priori* know if participation will truly benefit their organizations.

Reducing participation uncertainty, on the other hand, refers to specific programs and contracts used to shield external actors from the traditional business and legal consequences of participating in local ecosystems. An arrangement with an external actor co-developing and delivering services to an established client, for example, can be made viable by the focal firm if it chooses to internalize the uncertainties involved in case the innovative value proposition fails. Focal firms employ specific contracts to shield external actors, mostly startups, from the real life consequences of doing business with the purpose of attracting them to their local and global ecosystems.

In the following section we will detail how focal firms in our sample dealt with the challenges of defining the global ecosystem governance and orchestration. We begin by addressing the definition of the local and global ecosystem governance and show that focal firms choose between two main approaches, one based on creating a standardized governance for the local and global ecosystems and centralizing its design in the headquarters and one based on giving the subsidiaries autonomy to define the governance for the local ecosystems they lead. We then move on to discuss how focal firms orchestrate global ecosystems, the tasks and challenges associated with continuously persuading other actors to engage with the local ecosystems to enable value creation and value capture.

### 6.2.1 Defining Local and Global Ecosystem Governance

During our research we discovered that after the initial phase of experimentation to better understand the local and global ecosystem value proposition and initial structure takes place, focal firms face the challenge of defining the local and global ecosystem governance, the rules and enforcement mechanisms that enable ecosystem evolution (in line with Lingens et al., 2021). Unlike traditional ecosystems, this is a task with the additional challenge of understanding how operations in different countries will influence the local ecosystems and how to deal with the autonomy or centralization dilemma. Firms in our sample dynamically shift between two approaches, one based on more flexibility and adaptation to the local context to deal with the relevant local and global uncertainties, when the subsidiaries have the autonomy to define the local ecosystem governance; and another based on more standardization and a set of pre-defined rules for structure, value creation, and capture, where local ecosystem governance is defined by and centralized in the headquarters.

Table 12: Illustrative Quotes on Local and Global Ecosystem Standardized and Flexible Governance

| **Case Name** | **Illustrative Quote on Local and Global Ecosystem Standardized Governance** | **Illustrative Quote on Local and Global Ecosystem Flexible Governance** |
|---|---|---|
| Deep Blue Consulting | *Not Applied* | *Engaging with startups, there is a register, the company is registed with Deep Blue. To begin a partnerships, there is an NDA, something like that. But it is all managed locally, of course this is formalized between the companies, but there is a local autonomy, in Latin America, we don't have to discuss this with other geographies (DT Director, Deep Blue Consulting)* |
| Bionic Platform | *Bionic Platform has several business units but sometimes startups approach us, and this is a key point, we mostly focus on early-stage startups. When these approach us they face difficulties navigating all these Bionic Platform business units. Bionic Startups is a central entity, with distinct parameters, positioning, branding, all standardized(...) Everything follows a global standard. Like I said, the headquarters will design the structure of the global programs and we adapt them here. But there is always a plan and established parameters that we must follow. (Ecosystem Manager, Bionic Platform)* | *Not Applied* |

| | | |
|---|---|---|
| Quantum Inc. | Japan started sending people to the subsidiaries to deal with this subject, in each subsidiary, so U.S. and Canada were led by the Japanese and so was the hub in Europe. In Brazil we did it ourselves, Germany as well... But we got all initial information from Japan, and the governance structure was organized over time. So today we have a much clearer governance structure. Japan leads all the offerings, how we position it in the market, how we can talk about it. It (Japan) leads the platform, how it will be sold. (Sales Director at Quantum Inc.) | This model works in other countries, but one of our main challenges here is that the Brazilian customer is not used to pay for a proof of concept. He often can't justify paying for it, there is no budget al.located to it, so these are barriers we face in this development. Let's say, to adapt what works out there to our local reality. (Ecosystem Manager, Quantum Inc.) |
| Master Business School | *Not Applied* | We are evaluating it, but we already submitted a patent application, because we created this with them (an American partner), a way, for example, to teach (their A.I. platform) something more complex. (Ecosystem Manager at Master Business School) |
| PharmaVax Corp. | *Not Applied* | It will all depend on how the contract is done, right? Pharma companies have different types of contracts. We can impose it, can give the (local Brazilian partner) the authorization, can import the active ingredients. Or we can make it all locally. They can manufacture it, send it to us and we just sell it. Or they can manufacture it and sell it with our brand. It will all depend |

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| | | on the contract. (Supply-chain Manager at PharmaVax Corp.) |
| Uprising Mobile | Competitive Operations, my area, has a global leader so we have weekly or bi-weekly rituals to talk about it. (...) Basically when it is decided that something will change the ecosystem, how it is today, how it will be tomorrow, they design the initial draft, the global team. Then they contact the Americas hub and us (in Brazil) to get our feedback on how this will impact the business. (Ecosystem Manager at Uprising Mobile) | The company (headquarters), after 2 years of e-sports operations decided to end all Investments for the development of the e-sports ecosystem in Western countries and continue investments in Asia only. (Ecosystem Manager at Uprising Mobile) |

Source: Authors

Defining and implementing governance for the local and global ecosystem is a complex challenge faced by focal firms during the stage of global ecosystem evolution. Our research reveals that governance in global ecosystems can be dynamic. Some focal firms initially chose a more flexible approach (Quantum Inc., for example) and later transitioned to a more standardized governance as the global ecosystem evolved. Other focal firms (Uprising Mobile, for example) started with a more standardized governance, and later transitioned to a more flexible one based on their learning from operating in different countries. Deep Blue Consulting, however, has employed a flexible governance and did not change course during our research and Bionic Platform opted for more standardized governance and maintained it during the period of our research.

A more nuanced view of governance in global ecosystems is required to make sense of what is going on. There is no completely standardized governance, and there is no pure flexibility. Focal firms face this challenge in a dynamic manner, standardizing part of the governance, for example regarding structure, and letting subsidiaries define governance for value creation and capture and vice-versa. This mix and match approach is what enables focal firms leading global

ecosystems to benefit from adaptation to different local contexts, while maintaining alignment of all actors.

However, it is still useful in our view to differentiate between standardized and flexible governance, treating them as archetypes that explain how focal firms implement rules for participation in their local and global ecosystems. In the following section we will go over the main differences between governance approaches. We begin by addressing focal firms that employed a more standardized global ecosystem governance. We then move on to illustrate how focal firms use more flexible governance for their local and global ecosystems.

### 6.2.2 Standardized Local and Global Ecosystem Governance

Bionic Platform illustrates the benefits of using a more standardized ecosystem governance. This focal firm is a leading company in the smartphone sector and orchestrates a well-established, complex global ecosystem centered around their solutions for mobile devices. Complementors located around the world can join the Bionic Platform ecosystems to develop novel applications and commercialize them, reaching a global audience. In Brazil, this focal firm has a structure of incubators, acceleration programs, partnership programs, and financial credits for local Brazilian companies to join their mobile ecosystem and develop their own solutions. This focal firm specifically targets local Brazilian startups, operating a robust set of programs, processes, and structures in the country to help scout and connect with promising local actors.

*Bionic Platform has several business units but sometimes startups approach us, and this is a key point, we mostly focus on early-stage startups. When these approach us they face difficulties navigating all these Bionic Platform business units. Bionic Startups is a central entity, with distinct parameters, positioning, branding, all standardized (Ecosystem Manager in Brazil, Bionic Platform).*

Bionic Platform, however, did not create this set of startup engagement programs only for the Brazilian market. They operate similar structures in dozens of countries, often opting for locating their subsidiaries in major urban centers (London, Madrid, Tel Aviv, Seoul, Tokyo, Sao Paulo) and using a standardized approach to design the local ecosystems. In both London and Sao Paulo, Tel Aviv and Seoul, a promising local startup can participate in the same programs, be incubated in similar offices, gain credits to use in the same services (e.g., cloud infrastructure), and receive similar coaching from Bionic Platform's staff. Governance of the

local ecosystems is centralized, defined by the headquarters, and standardized across all countries.

*Everything follows a global standard. Like I said, the headquarters will design the structure of the global programs and we adapt them here. But there is always a plan and established parameters that we must follow. (Ecosystem Manager in Brazil, Bionic Platform).*

Standardization, however, does not imply a static approach to ecosystem management. Constant exchanges of information between the units in different countries, within a fixed framework, lead to fast and effective communication. Local results are shared constantly, and feedback loops are created between subsidiaries and headquarters.

*I participate in weekly global meetings. Someone from Europe will tell us what they are doing, someone from Japan will tell us what they are doing, so we are constantly receiving updates. We exchange information and copy what is being done elsewhere. (Ecosystem Manager in Brazil, Bionic Platform).*

Standardization is reinforced by this continuous process of information exchange between managers and isomorphism between local ecosystems. Because the orchestration of local ecosystems faces similar challenges, managers can communicate effectively about how to overcome them, share their strategies, and implement suggestions from other managers located in different countries. The local ecosystems follow a global governance standard, and the result is an interesting global ecosystem structure characterized by the similarity of local ecosystems. While a promising startup in Seoul and a promising startup in Sao Paulo are dealing with different, context specific local uncertainties, Bionic Platform benefits from having both participate in its smartphone ecosystem and add value to its solution for both Korean and Brazilian users and customers.

When a local Brazilian startup enters an acceleration program provided by Bionic Platform in Brazil, the terms and conditions they must agree to are defined by the headquarters and valid for several countries. The governance of the program is publicly available on the company's website, detailing what the complementor is entitled to and stating that all legal claims are to be solved in the country the company is headquartered in. This degree of standardization creates a global governance for the ecosystem, with similar rules and enforcement mechanisms for external actors.

Uprising Mobile further illustrates. This focal firm defines a blueprint of who to engage with and how, what rules must be followed, and enforcement mechanisms employed, that is standardized for all local ecosystems. Because this global ecosystem initially relied on having local leagues in different countries, external actors such as streaming services, professional e-sports teams, cloud computing providers, and event sponsors must follow the same rules. Leagues are all standardized to enable global competitions, for example, as who participates in the world championship is defined by their performance in the local leagues. Who the focal firm's subsidiary can engage with goes through a global vetting process, defined by the headquarters to ensure all partners follow their global standards. However, failure to materialize this e-sports ecosystem in Western countries led to changes in governance. A more flexible approach was implemented, with subsidiaries in Asian countries leading both a casual and an e-sports ecosystem, while subunits in Western countries should focus on casual gameplay ecosystem and abandon the efforts to lead competitive e-sports ecosystems.

Quick Delivery further illustrates. This focal firm internationalized to other South American countries using the same rules and enforcement mechanisms used in Brazil, such as the requirements to participate in their ecosystem, vetting mechanisms, and use of similar pricing and fees. They faced challenges attracting external actors, though, and what worked in their home country did not work in the same way in other countries. Facing different competitive landscapes, with other platforms in Colombia and Mexico dominating the markets, this focal firm was not successful in its implementation of the governance and eventually abandoned both markets.

While there will always be a degree of adaptation, which is expected in international operations due to differences in legislation and culture, more standardized ecosystem governance will attempt to reduce these differences. Firms in our sample, even those that used standardized governance, must include small adaptations to their governance to account for local differences. But the overall governance, the rules and enforcement mechanisms, are very similar for all local ecosystems and subsidiaries have limited autonomy to change them.

The cases above illustrate the benefits of standardizing the local and global ecosystem governance. During our research we discovered that focal firms that successfully lead global ecosystems may opt for a different approach, based on enabling the subsidiaries to define the

governance of their local ecosystems. For some focal firms and focal value propositions, it makes sense to choose this flexible approach, with each local ecosystem creating their own rules and enforcement mechanisms.

### 6.2.3 Flexible Local and Global Ecosystem Governance

Deep Blue Consulting Co. illustrates the benefits of using a more flexible global ecosystem governance. As we have seen, this focal firm is a leading player in the global consulting market that relies on leveraging the power of international complementarity to continuously add value to its global ecosystem centered around digital transformation services. Unlike Bionic Platform, however, they do it by allowing a greater degree of freedom for the subsidiaries to experiment with promising local actors and discover what rules and enforcement mechanisms work in each country. As an ecosystem manager in Brazil put it:

*No one waits for me to look for a startup, everybody in Deep Blue Consulting is talking to startups. And I don't have a clue who is talking to whom or where. Of course, if I am involved, I may be able to facilitate this process, but we realized that we don't need a person, a division, a team dedicated to this (Ecosystem Manager in Brazil, Deep Blue Consulting Co.).*

The idea here is to use flexibility, not standardization, to engage with external actors in their local ecosystem in Brazil. All areas have the mandate to search for and connect with local startups. Processes and tools are used to facilitate the task of finding and attracting promising local technology companies, but not to constrain it to a single department or program. Different countries use different approaches, searching for what works best in their specific context.

Deep Blue Consulting offers a global playbook of best practices for startup engagement, detailing what is the standard process, which begins with signing a non-disclosure agreement to protect both parties from opportunistic behavior. However, the programs and the strategies to engage with startups are defined by the subsidiary and each area has a high degree of flexibility to define the rules to connect with external actors. While this leads to benefits, mostly related to attaining a more sophisticated understanding about the local context, the lack of standardization also makes communication and cooperation with other subsidiaries a challenging task.

*If I identify an interesting company that can do business with Deep Blue Consulting in Argentina, I have to talk to the guy in charge of Argentina to see if he can link me to the right people so I can introduce this company (Ecosystem Manager in Brazil, Deep Blue Consulting).*

Flexible governance enables local managers to creatively scout for, connect with, and ultimately bring local actors into their ecosystems in ways that are mindful of the specific challenges in that context. General guidelines define the minimal governance of this process, but in the case of Deep Blue Consulting each area in the Brazilian subsidiary is free to scout for international complementors, for example. Once discovered, they can go on to become global actors in the ecosystem, receive funding from Deep Blue's corporate venture capital initiative, and become an integral part of their global digital transformation ecosystem.

The governance of the local ecosystem when the focal firm adopts flexible governance is mostly defined by the subsidiaries, creating the right rules, roles, and enforcement that works best for the specific country they operate in. The focal firm gives the subsidiaries autonomy to define their own governance for the local ecosystem, resulting in a complex and highly variable framework to respond to local challenges, market changes, and political uncertainties. Who the focal firm can engage with and how is defined locally.

Quantum Inc. further illustrates. This focal firm initially employed flexible governance, with each subsidiary being able to define the local rules and enforcement mechanisms to engage with external actors. Some subsidiaries (Canada, for example) had to deal with co-development of fundamental aspects of the focal value proposition (software platform, for example) with external actors, other subsidiaries (i.e., Brazil, Spain) only participated in the commercialization of the focal value proposition and engaged in more limited co-development agreements.

Quantum Inc.'s Brazilian subsidiary initially created its own set of rules and enforcement mechanisms to engage with external actors, as did other subsidiaries. The headquarters attempted to align the efforts of the subsidiaries by fostering constant communication between the business units, but without creating and implementing standardized governance. As this global ecosystem grew, however, there was a push for more standardization.

The headquarters changed its approach and began creating common rules for all local ecosystems, reducing their autonomy to engage with external actors. Based on the learning

from the initial ecosystem emergence stage, it defined that subsidiaries should no longer focus on external actors' R&D departments by offering co-development opportunities, but rather engage first with their finance and operations departments offering cost reduction services based on their focal value proposition. This led to resistance from certain subsidiaries due to loss of autonomy.

Quantum Inc. shows that governance in global ecosystems is dynamic. It may initially be based on a more flexible approach and transition to a more standardized approach, as the focal firm's headquarters integrate the learning from the local ecosystems. This process may also face resistance from the different business units, which might prefer more autonomy to lead their own local ecosystems.

Our research reveals that governance in global ecosystems emerges from a complex and dynamic process. Some focal firms have a more standardized approach to ecosystem governance, with the headquarters creating a common set of rules and enforcement mechanisms for all actors in the ecosystem. Subsidiaries in such ecosystems implement the programs defined by the headquarters and are restricted by the governance to decide what actors they will engage with and how. Other focal firms may opt for a more flexible design, with the local subsidiaries being responsible for defining and implementing the governance of their local ecosystems. Focal firms in our sample have used both approaches successfully, signaling that there is not a single correct design for global ecosystems.

A concomitant process takes place in phase two, as the focal firms continuously act to persuade local actors to join their ecosystems. This process of orchestrating the local and global ecosystems faces specific challenges related to offering the proper incentives for the local actors, based on either enhancing the value perception about participating in the global ecosystem or decreasing the uncertainties related with such participation. In the next section we will detail how focal firms combine the tasks of implementing a global ecosystem design and orchestrating their global ecosystems.

### 6.2.4 Orchestrating Local and Global Ecosystems

Focal firms face the challenge of persuading actors to continuously provide valuable inputs to their ecosystems without the use of direct, hierarchical control, a task called ecosystem orchestration (Autio, 2022). Focal firms in global ecosystems face the additional challenge of

orchestration in multiple local ecosystems, in different contexts, and simultaneously. In our research we discovered that focal firms orchestrating global ecosystems employ a series of processes to continuously persuade actors located around the world to participate in their ecosystems, employing two main strategies, either based on enhancing the perception of value about the ecosystem or reducing participation uncertainty. The table below provides illustrative quotes on global ecosystem orchestration.

Table 13: Illustrative Quotes on Enhancing Value Perception for External Actors and Reducing Participation Uncertainty for External Actors

| **Case Name** | **Illustrative Quote on Enhancing Value Perception for External Actors** | **Illustrative Quote on Reducing Uncertainty for External Actors** |
|---|---|---|
| Bionic Platform | *They say it in the welcoming email. That they deposited in your account the one hundred thousand dollars, ten thousand a month that you receive. They also say you have five hundred dollars to spend on training. (...) There are a lot of valuable offerings if you are starting a business for the first time.* (Entrepreneur that Participated in Bionic Startups program) | *Not Applied* |
| Quantum Inc. | *Not Applied* | *You sign as the responsible part for the contract, the transaction between the company and the client and the partner (the startup) is subcontracted by me. (...)The startups asks for it. (...) They say I (the startup) can't be the prime contractor if we are doing a project for the (local) Port Authority. These projects, this is interesting, when we talk about the MVPs for these projects for this (quantum)* |

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|---|---|---|
| | | *solution we are talking about 500 thousand, a million reais. When it becomes an actual project, it is in the range of ten, twenty million reais. The startup says no... They raise the flag and say: in this case I won't even be approved by the client, for this contract. He will do the financial due diligence and say no, no way. (Sales Director at Quantum Inc.)* |
| Deep Blue Consulting | *These startups often are just starting out, they only have experience servicing middle-sized companies, if that. When they must service an enterprise, a large bank, if they don't have our reinforcements, resources from an experienced team, they fail. (Director for Digital Transformation in Brazil, Deep Blue Consulting).* | *I simultaneously start my team responsible for cyber security to see if everything is ok with the company, if there are no leaks. To make sure that when I put it (the startup) inside one of our digital solutions we won't have a data leak issue. (Director for Digital Transformation in Brazil, Deep Blue Consulting).* |
| Master Business School | *Not Applied* | *We knocked on their door and said: do you want a case study, want to start working on it? (…). But we are not Harvard, with 20 billion dollars in donations each year, we can't afford it, are you still interested? It is not reasonable for a business school, from the perspective of starting a project, from the perspective of work hours required, to use AI you know… (Vice-Dean, Master Business School)* |
| Uprising Mobile | *We adopted a franchise model, like in the NBA. The company has to* | *Not Applied* |

| | | |
|---|---|---|
| | *pay some money to have its slot, and they own the slot. This creates an incentive for continuous Investments. And we have a financial mechanism as well, we divide part of the revenues generated with these companies that participate in our leagues. (Ecosystem Manager at Uprising Mobile).* | |

Source: Authors

Focal firms in our sample used two main approaches for orchestration, one based on enhancing the value perception about participating in their local and global ecosystems and another based on reducing the uncertainty associated with this participation. Bionic Platform, for example, uses a series of programs and initiatives to enhance the perception that local entrepreneurs have about the value of participating in their local ecosystems. Credits that can be used in their services, such as cloud servers or advertising, combine with physical infrastructure such as incubators and open shared offices, and mentoring services to provide entrepreneurs with a perception that participating in their local ecosystems is beneficial to their startups.

*I like telling people, investors, that I participate in Bionic Startups. When you say it, people will think damn this kid was chosen by Bionic! (…) This approval by Bionic, I can put it on my website, in the bottom of my website. (Entrepreneur in Bionic Startups ecosystem).*

This perception of value, as the quote above illustrates, goes beyond the direct financial and technical benefits offered in Bionic programs for startups. Entrepreneurs perceive that participating in this local ecosystem can help attract investments and other resources their startup may need. Coupled with other community building initiatives, such as creating digital spaces for interaction between entrepreneurs, participation in this local ecosystem is perceived as a positive source of value for local startups which helps Bionic continuously persuade external actors, located around the world, to join the local ecosystems they lead.

Another approach used by focal firms to persuade external actors to join their local and global ecosystems is based on uncertainty reduction. Because startups often lack resources

(financial, technical, human) to take on large projects on their own, focal firms act as intermediaries and internalize part of the uncertainty associated with the operation of these external actors. This approach enables startups to participate in local ecosystems, shielding them from the traditional contractual and business requirements, as well as the potential negative financial and legal consequences, of participating in large contracts with established clients.

Deep Blue Consulting, for example, employs a series of processes to enable external actors to add value to their digital transformation focal value proposition. Startups in their local ecosystem in Brazil can test their solutions in the controlled environment of the focal firm's operation, to eliminate technical issues and improve their cyber security and data protection protocols before engaging with a client. Additionally, Deep Blue Consulting even offers their own human resources to enable the scale-up of the solution, training their own employees to operate the local startup's services and ensuring sufficient resources when engaging with a large, established company. Specific contracts are used to shield the external actor from potential negative consequences, as the client hires Deep Blue Consulting and not the startup, which is not responsible for negative financial outcomes.

In the following sections we detail how focal firms in our sample orchestrate global ecosystems. We begin by analyzing focal firms' initiatives to enhance the vale perception about participation in their local ecosystems to external actors. We then move on to address how focal firms use uncertainty reduction approaches to ensure that external actors can add value to their focal value propositions.

### 6.2.5 Enhancing Local and Global Ecosystem Value Perception

During our research we discovered that focal firms employ global ecosystem orchestration processes based on enhancing the value perception of external actors about the benefits of participating in the local ecosystems they lead. The success of any ecosystem ultimately depends on the perception of its value by customers and other ecosystem actors and value perception is influenced by the local context in which partners operate. What is perceived as value generation by external actors in the United States may not be perceived similarly in Brazil, for example. This is particularly critical for focal firms that rely on levering complementarity to add value to their ecosystems, as attracting complementors that can offer

solutions for customer problems in a specific country by managing local uncertainties hidden from the focal firm becomes a central task for the orchestrator.

Quantum Inc. illustrates. This focal firm faced specific challenges to attract startups as complementors in the Brazilian context, a challenge that was not faced in developed countries. Brazilian startups faced difficulties understanding their radical technology based on quantum computing principles and though this focal firm participated in local innovation hubs to connect with local startups the process of engaging with these new ventures was often seen as challenging by Quantum Inc.'s managers during the stage of ecosystem evolution.

*We are still searching for startups that are working with this technology or are interested in this subject, this is our next step. This is a hurdle we are trying to overcome, there aren't that many (startups), as I said, there are actually few of them (Innovation Manager at Quantum Inc.).*

Programs, processes, and initiatives that enhance value perception can be employed by focal firms' subsidiaries in their local ecosystems to overcome this type of challenge related to how context influences value perception by external actors. Among them, we identified that the creation of startup accelerators or incubators is a common practice employed to enhance value perception by local partners. Bionic Platform illustrates. In Brazil, this focal firm has created a physical structure to continuously attract local complementors. Together with specific programs that provide these complementors with credits to spend in their services, it all combines to create a value perception enhancer, providing local support to complementors as a tactic to attract them to their local ecosystem. Additionally, this participation may lead to lock-in effects as complementors use the specific technological platforms of the focal firm to develop their own solutions.

*I am building all my infrastructure based on their applications and to migrate this infrastructure with ongoing production, development environments, production environments, front page API… In the backend, the development data, production, it's all there. Besides all my infrastructure and all my automation being there, all my safety, data security, everything is in their (Bionic Platform) hands. To move this structure, quit and go to the (competitor) would mean an unconceivable amount of work for us (..) I can't think of anything that would make me quit Bionic Platform today. (Entrepreneur in Bionic Platform Ecosystem).*

Startup founders further benefit from credits to use Bionic Inc.'s technology, can be incubated in their local campus, and receive mentoring from managers with experience in key

technologies (cloud computing, search engine optimization, digital sales). The goal here is not to generate short-term direct financial returns and the metrics used to evaluate the success of the program are based on persuasion, not return on investment. As a local ecosystem manager illustrates:

*None of these programs, none, requires anything in return from the startup, our metrics are ecosystem based. Think about it this way, when I approach a startup, I want them inside my business unit, I want to train them to use a given technology. I will spend some time training that startup, and from zero in the beginning I end up with fifty people that can now use my technology. This is enough to hit my metrics with the ecosystem. (Ecosystem Manager, Bionic Platform).*

What the companies in our sample reveal is that it may not be enough to just create the technological interfaces and basic governance that enable complementarity (SDKs, APIs, contracts) for global ecosystem orchestration. By providing complementors with credits for use with their products, incubation, training, and mentoring the Brazilian subsidiary is enhancing the local partner's perception of value about participation in their ecosystem. Some local complementors will evolve and become international complementors themselves. Some will remain as local actors. And some will fail. But the overall perception about the value of the ecosystem in a specific country is enhanced and attracting partners becomes easier, in a self-reinforcing cycle.

*I show everyone that I am part of Bionic Startups, I tell all my entrepreneur friends, tell the community, sign up to Bionic Startups, it's free money! (Entrepreneur in Bionic Platform Ecosystem).*

Continuous persuasion of external actors to join their ecosystems is the main goal, and the main challenge, during the stage of global ecosystem evolution. Some focal firms in our sample struggled with this challenge when moving from the global ecosystem emergence to the global ecosystem evolution stage (i.e., Quantum Inc., Uprising Mobile, Quick Delivery). Our research reveals that orchestration is highly contextual and dependent on the specific competitive landscape of a given country.

Quick Delivery, for example, faced challenges in Colombia and Mexico as local competitors were able to sign exclusivity deals with relevant local actors. Evolving their local ecosystems in these countries was challenging and this focal firm invested relevant resources, including the acquisition of local companies, with disappointing returns. Competition for

complementors is a relevant dynamic in global ecosystems and companies that are market leaders in a country (Brazil) may have to settle for other positions in other countries.

### 6.2.6 Reducing Participation Uncertainty in Local and Global Ecosystems

Master Business School illustrates how focal firms can use uncertainty reduction to orchestrate global ecosystems. This business school headquartered in Brazil partnered with an American multinational which orchestrates a global ecosystem centered around their artificial intelligence platform to develop a novel solution for education in Brazil. There were high costs associated with the project and uncertainty about its market and technological viability. Aware of their resource constraints, the managers from Master Business School used their unique position to attain a strategic position in the ecosystem and reduce the uncertainties associated with participation.

*We knocked on their door and said: do you want a case study, want to start working on it? (…). But we are not Harvard, with 20 billion dollars in donations each year, we can't afford it, are you still interested? It is not reasonable for a business school, from the perspective of starting a project, from the perspective of work hours required, to use AI you know… (Vice-Dean, Master Business School)*

The American partner greenlit the project and decided to fund most of the development to create a case study for the potential use of their technology in the education sector, a first in the world for the company. By internalizing the development costs, they reduced Master Business School's uncertainty for participation in the global ecosystem centered around artificial intelligence platform and lowered the barrier of entry for this specific partner. During the development stages, Master Business School worked together with a team from the focal firm to develop the software solution they would use.

This case illustrates a common trend in our sample of cases. The focal firm, orchestrating a global ecosystem centered around a focal value proposition, needs to attract a diverse array of external actors, located around the world, to participate in their local and global ecosystems. Because there are relevant uncertainties associated with participating in innovative global ecosystems the focal firm will use different processes to reduce participation uncertainty, internalizing the costs that would normally be incurred by the partner in case of failures. It also highlights how complementors and components located around the world can extract benefits from the focal firm, in the form of non-financial resources.

Internalizing these costs, however, is not the only way that focal firms reduce participation uncertainty in global ecosystems. Specific contracts can be used to protect the partners from potential negative outcomes of their participation. Local startups, for example, may lack the managerial and financial resources that would otherwise be required to engage with a focal firm. To solve this issue, some managers use contracts and processes that *de facto* shield these partners from the uncertainties that stem from participation in their ecosystems.

Deep Blue Consulting illustrates. This focal firm engages with many Brazilian startups through its local subsidiary to improve their offerings centered around their digital transformation value proposition. Being aware of their partners' resource limitations, they create specific processes to protect them if they join the local ecosystem. Instead of treating these firms as independent complementors, financially and technically responsible for their own projects, they use a different approach.

*These startups often are just starting out, they only have experience servicing middle-sized companies, if that. When they must service an enterprise, a large bank, if they don't have our reinforcements, resources from an experienced team, they fail. (Director for Digital Transformation in Brazil, Deep Blue Consulting).*

More than just reinforcing the startup's team with their own employees, this focal firm also helps the partners develop the capabilities required to service their customers. Technical issues, such as cybersecurity and scale-up capabilities, are tested first within the focal firm and using their own experts before the services are offered to external clients. This process helps the local startups develop, and increase their robustness, but also reduces the uncertainties associated with participation in this ecosystem.

*I do a proof of concept, we say PoC, a test, a laboratory with that component (the local startup) to see it functions the way we envisioned at first. I check the functional, commercial, and technical pillars to see if it fits with our needs (…). I simultaneously start my team responsible for cyber security to see if everything is ok with the company, if there are no leaks. To make sure that when I put it (the startup) inside one of our digital solutions we won't have a data leak issue. (Director for Digital Transformation in Brazil, Deep Blue Consulting).*

Once the early tests are finished, the startup is ready to participate in this ecosystem. However, offering the startup's services to local customers requires yet another process to shield it from the traditional business uncertainties. The contract is signed between the

Brazilian subsidiary and local clients and the startups are legally registered as internal suppliers to the focal firm, not the final customer. These contracts shield the startups from any potential negative business outcomes, which could otherwise prove too costly for their limited resources.

*The customer hires Deep Blue Consulting, not the startup. This is why it is so easy for me to engage with these startups because we internalize it, we make the startup part of our solution, as a piece of Lego in our solution. The customer knows all about it, nothing is hidden from him. And this makes life easier for the customer, he only pays a single company, and I will handle the project management and governance of the five, six startups that are part of the solution. (Director for Digital Transformation, Deep Blue Consulting)*.

These uncertainty reduction activities conducted by subsidiaries leading local ecosystems serve a dual purpose. First, they lower the barrier of entry into the ecosystem by reducing the costs, and therefore the uncertainties, associated with participation in the local ecosystem. This enables the focal firm to attract local partners, engage with them, and reap the rewards of their participation. And second, by using managerial processes that both scrutinize and enhance their partners' capabilities, the focal firms can better select and retain promising local partners in the global ecosystem they lead.

We also discovered during our research that there is a relevant iterative relationship between the local and global ecosystem governance and the orchestration of local and global ecosystems. Managers in a subsidiary, responsible for leading a local ecosystem, are constrained by the global ecosystem governance. They may have limited autonomy to define the best programs to persuade local actors to participate in their local ecosystems, for example, as is the case of focal firms that adopt standardized global ecosystem designs (Bionic Platform, Uprising Mobile, Quick Delivery). This is particularly relevant, as uncertainty reduction activities rely on deeply contextual programs that understand not only the specific conditions of local actors, but also of other more general characteristics of the local context, such as the legal framework in the country and the role of local regulatory agencies.

On the other end of the spectrum, focal firms in global ecosystems that adopt a flexible design (Deep Blue Consulting, Quantum Inc., PharmaVax Corp.) may lack a global direction and their efforts to persuade local partners may not consider the needs of the global ecosystem. Local ecosystems may add little value to the global ecosystem while consuming relevant resources.

Lack of alignment between local ecosystems being a possible result of such orchestration approach.

### 6.3 Recapitulation: Global Ecosystem Emergence and Evolution

In the result chapter above, we presented the main discoveries of our in-depth case studies and theorization efforts about global ecosystem emergence and evolution. In the table below we present the construct-case matrix for our research, a binary yes or no for the existence of direct evidence for each concept in the cases that we studied. Due to variance in our sample and different approaches used by focal firms, not all concepts are relevant for all cases.

Table 14: Construct-Case Table for Phase 2 of the Research

| Constructs for the second research stage | Bionic Platform | Uprising Mobile | Deep Blue Consulting | Master Business School | Quantum Inc. | PharmaVax Corp. | Quick Delivery |
|---|---|---|---|---|---|---|---|
| Identifying International Complementarity | Y | Y | Y | N | N | N | Y |
| Unveiling International Interdependence | N | Y | N | Y | Y | Y | N |
| Local and Global Structure Uncertainty | Y | Y | Y | Y | Y | Y | Y |
| Upgrading Actors from Local to Global | Y | Y | Y | N | Y | Y | N |
| Local and Global Ecosystem Flexible Governance | N | Y | Y | Y | Y | Y | N |
| Local and Global Ecosystem Standardized Governance Framework | Y | Y | N | N | N | N | Y |
| Enhancing Local and Global Ecosystem Value Perception | Y | Y | Y | N | Y | N | N |
| Reducing Participation Uncertainty in Local and Global Ecosystem | Y | Y | Y | Y | Y | N | N |

Source: Authors

We discovered that global ecosystems initially face the challenges of defining the global ecosystem value proposition and dealing with the relevant local and global structure uncertainties. We conceptualized this stage as global ecosystem emergence. Defining the local and global ecosystem value proposition, the value creation and capture opportunities for internationally dispersed external actors, requires that the focal firm identifies international complementarity or unveils international interdependence. These are characteristics of the focal value proposition being materialized that influence the ecosystem-level value

proposition. Coherence between value proposition and international complementarity or international interdependence is critical in our model.

Focal firms also conduct local and global ecosystem structure experimentation during global ecosystem emergence, a process of reconfiguring the ecosystem actors, roles, links, and activities to deal with structure uncertainty and that involves upgrading external actors from local to global. Structure uncertainty, the lack of *a priori* knowledge about the proper actors how they can contribute to the ecosystem, presents additional challenges in global ecosystems because external actors are internationally dispersed and embedded in different contexts. Focal firms may also perceive that local actors in each ecosystem can solve global uncertainties and upgrade them by linking them to the other local ecosystems they lead.

During the stage of global ecosystem evolution focal firms then face the challenges of defining and implementing global ecosystem governance. We unveiled that this process is based on choosing between a more standardized set of rules defined by the headquarters for all local ecosystems or a more flexible governance, with each subsidiary responsible for the rules and enforcement of their local ecosystems. This is a complex process, as focal firms must account for the different contexts they operate in and be mindful of how their rules are perceived by internationally dispersed external actors.

During the stage of global ecosystem evolution focal firms also face the challenges of persuading external actors to participate in their local and global ecosystems. This orchestration can be based on uncertainty reduction or value perception enhancing activities to persuade external actors to join their ecosystems. Specific programs and contracts are used to ensure that the local ecosystems can attract external actors and continue to evolve.

In the following section we will conduct a structured discussion of our results. Our goal is to present how the novel findings of the second stage of our research contribute to the literature on global ecosystem emergence and evolution. We do so by contrasting our findings to the extant concepts on the innovation ecosystems, global ecosystems, and uncertainty management literatures.

### 6.4 Defining the Local and Global Ecosystem Value Proposition

Our research and data revealed the need to refine the geographical dimensions of the concept of ecosystems, leading to the understanding that a global ecosystem is a set comprised of local

ecosystems. While this may have been implicit in the previous literature (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) we make this relationship explicit and in doing so offer a novel typology of ecosystems: local and global. Local ecosystems are location-bound structures (value proposition, actors, roles, links, and activities) that exist in specific countries. The focal firm subunits (headquarters and subsidiaries) lead the emergence of these structures in each country. The existence of more than a local ecosystem to materialize a focal value proposition (e.g., in Japan and Canada) leads to the emergence of a global ecosystem. The headquarters of the focal firm is responsible for managing their local ecosystem and the global ecosystem, defining the global ecosystem value proposition.

We contribute then to the nascent field of research on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019) by refining the concept of global ecosystems, formally defining it as a set comprised of local ecosystems in the focal firm's home and host countries. Classic cases in innovation ecosystems, such as the failure by French company Michelin to deal with service providers in the United States for their PAX Run Flat tires (Adner, 2012), can be reconceptualized using the notions of local and global ecosystems and international interdependence, for example. Using our model and concepts, this case can be explained as the failure of defining the local and global ecosystem value propositions to address the challenges of international interdependence.

We further contribute to the nascent literature on global ecosystems by showing that the process of defining the local and global ecosystem value proposition (its goals, structure, value creation, and value capture opportunities) poses the challenge of identifying if the focal value proposition being materialized has the potential for international complementarity or unveiling if the materialization of the focal value proposition must deal with international interdependence. These novel concepts, identifying international complementarity and unveiling international interdependence, explain how and why global ecosystems emerge in our theoretical framework.

A focal firm that identifies the potential for international complementarity, the possibility for external actors located in different countries to add value to the focal value proposition being materialized by managing relevant local and global uncertainties, will use its international

structure (headquarters and subsidiaries) to create the conditions for this value add by external actors. In doing so it will create the local ecosystems that combine to form the global ecosystem. Conversely, focal firms may need to deal with international interdependence for a focal value proposition to be materialized. Local and global uncertainties identified by the focal firm will require that specific actors, that possess specific technological and market capabilities, participate in the global ecosystem to be managed. Both international complementarity and international interdependence are in our model critical characteristics of the focal value proposition that lead to the emergence of global ecosystems.

The relationship between uncertainty management, the characteristics of the focal value proposition, and the definition of a global ecosystem value proposition that we establish with these concepts is a second theoretical contribution of this research. International complementarity relies on enabling external actors located outside the focal firm's home country to add value to the focal value proposition by discovering and managing local and global uncertainties that could be hidden from the focal firm. In a global setting the resources required to discover and manage local uncertainties may be out of reach even for large, established focal firms. Thus, these focal firms attempt to leverage the potential for international complementarity by enabling external actors located around the world to do so using specific technologies and managerial actions.

International interdependence requires the participation of specific actors, located outside the focal firm's home country, in the ecosystem for the focal value proposition to be materialized. These actors have unique positions to discover and manage critical local and global uncertainties related to the materialization of the focal value proposition. Unique technologies, specific know-how, position in the value-chain or regulatory power are examples of the conditions that make the participation of these actors in the ecosystem a requirement and that lead to international interdependence.

Defining the global ecosystem value proposition entails, therefore, that the focal firm first understands if the management of local and global uncertainties of the focal value proposition being materialized can benefit from international complementarity or must deal with international interdependence. The local and global ecosystem value proposition defines the focal firm's view of the appropriate structure (actors, roles, links, and activities), the objectives

of the local and global ecosystems, and the solutions to be developed by the actors. Local and global ecosystems based on potential for international complementarity will have a different value proposition from those created to deal with international interdependence. Therefore, in our theoretical model it is the characteristic of the focal value proposition being materialized that explains not only why global ecosystems emerge, but how the focal firm defines the local and global ecosystem value propositions.

We further contribute to the literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by proposing that focal firms face the challenge of defining the local and global ecosystem value propositions and that this definition depends on understanding the potential for international complementarity and dealing with international interdependence in different contexts. Each local ecosystem will require its own value proposition (goals, structure, and offerings) based on a global ecosystem value proposition. Coherence between the local and global ecosystem value proposition and the characteristics of the focal value proposition being materialized is critical for the success of global ecosystems. Because context matters, this is a task of understanding the relevant market, institutional, and technological settings in each country and defining the local ecosystem value propositions accordingly.

### 6.4.1 Understanding Local and Global Ecosystem Structure Experimentation

Our data and research show that focal firms use experimentation to deal with uncertainty regarding the appropriate structure (value proposition, actors, roles, links, and activities) in local and global ecosystems. The literature has conceptualized the use of collective experiments to manage uncertainties in ecosystems (Gomes et al., 2018; Mahmoud-Jouini & Charue-Duboc, 2018) and issues of understanding the appropriate ecosystem structure have been previously identified (Adner, 2012; Adner, 2017; Hannah & Eisenhardt, 2018). The conceptualization of ecosystem structure experimentation in global ecosystems, however, is a novel contribution of our thesis.

Focal firms leading global ecosystems struggle to understand who should participate in the local and global ecosystems and how. Finding and engaging with external actors in a global context faces additional challenges, as the focal firm must account for the differences in the contexts it operates in. Structure experimentation, a process of reconfiguring the local ecosystem structures by adding and replacing external actors, their roles, positions, and links,

may also lead to changes in the ecosystem value proposition as it enables the focal firm to make sense of what works or does not work in each country.

Focal firms employ different processes to search for and engage with external actors to create the local and global ecosystem structures. Subsidiaries play a key role in this process, due to their understanding of the local context and the quicker identification of promising local actors. Local managers use a combination of their personal networks, previous experience with local actors, and engagement with innovation hubs (such as startup accelerators and incubators) to make sense of who should participate in the local ecosystems to create opportunities for value creation and capture.

As the focal firm begins the process of creating local ecosystem structures, it may learn that actors who were previously perceived as being promising members of the ecosystem do not enable proper value creation and capture and that actors that had not been identified can be revealed as relevant for the local ecosystem. Because it is impossible for the focal firm to know and analyze all actors in each country, and because issues of information asymmetry influence this process, there emerges what we conceptualized as local and global ecosystem structure uncertainty. Structures that are appropriate for a given country may not work in other countries, and the focal firm must then change the global ecosystem value proposition to account for the different contexts.

The focal firm plays a key role in this experimentation process as it may also reconfigure the links between actors in their local ecosystems. A local partner that is perceived as being able to manage global uncertainties can be linked to other external actors in other local ecosystems or other units of the focal firm. This process, which we conceptualized as upgrading actors from local to global, further adds to the local and global structure uncertainties faced by focal firms leading global ecosystems.

Building on the process of upgrading or internationalizing suppliers in global value chains (Schmitz, 2004; Cattaneo et al., 2013) we propose that focal firms in global ecosystems also plays a key role in creating the conditions for local actors to become global actors. Because of its position in the global ecosystem, a focal firm leading several local ecosystems may be aware of opportunities in other countries that are hidden from external actors operating in a single country. The focal firm leverages its unique position and creates new links, helping the

internationalization of local actors by connecting them with clients and other relevant players in other local ecosystems.

Local and global ecosystem structures are, therefore, constantly reconfigured as actors join and leave the local ecosystems, new links are created, and existing links transformed. This process, which we conceptualized as the local and global ecosystem structure experimentation, helps the focal firm identify and manage the relevant local and global ecosystem structure uncertainties. Experimentation enables the focal firms to gain a better understanding about the appropriate structure for the local and global ecosystems that they lead.

We contribute, therefore, to the literature on ecosystem structure (Adner, 2017) and global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by conceptualizing the notion of ecosystem structure uncertainty and showing how the processes of ecosystem structure experimentation is used to identify and manage this type of uncertainty. While it may be easy to *a posteriori* identify what actors should have participated in an innovation ecosystem, this is not an automatic process and focal firms face relevant challenges to make sense of who should participate in their ecosystems and how. In a global context, these challenges are augmented by the necessity of accounting for the contextual differences that exist between countries. Using their international structures (headquarters and subsidiaries) multinational enterprises use structure experimentation to make sense of what structure works and what does not for each local ecosystem. In turn, this may lead to changes in the local and global ecosystem value propositions as the knowledge derived from these experiments is integrated by the focal firm.

There is, thus, a relevant interplay between defining the local and global ecosystem value proposition and this experimentation process to deal with local and global ecosystem structure uncertainty. In our theoretical model, these two activities are conducted in an iterative manner and explain the main tasks performed by focal firms during the emergence stage of global ecosystems. It is during this emergence stage of global ecosystems that focal firms both define the local and global ecosystem value proposition and conduct local and global ecosystem structure experimentation.

Focal firms leading global ecosystems based on the potential for international complementarity will encounter specific challenges to create the local and global ecosystem structures that enable external actors to add value to the focal value proposition being materialized. Specific technologies and managerial actions are employed to leverage international complementarity. Subsidiaries play a key role, finding and engaging with promising local actors using an experimentation approach to discover their potential for value add.

Conversely, focal firms leading global ecosystems dealing with international interdependence must create appropriate local ecosystem structures to identify and engage with the critical actors that must participate in their global ecosystems for the focal value proposition to be materialized. Identifying these actors is challenging and focal firms use their international structures to make sense of where these actors are and how to engage with them to ensure value creation and capture in different contexts. Because these specific actors must participate in the ecosystems, focal firms use specific processes to deal with international interdependence which are often based on employing co-development agreements, dealing with opportunistic behavior, and managing dynamics of cooperation and competition.

We further contribute then to the nascent literature on global ecosystems by proposing that there is an initial stage of global ecosystem emergence. The literature on innovation ecosystems acknowledges the existence of different stages, with an initial blueprint being defined by the focal firm and later materialized under conditions of uncertainty (Adner, 2012; Adner, 2017; Datée et al., 2018; Thomas et al., 2022). However, the literature on global ecosystems did not previously differentiate between stages of emergence and evolution (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) and therefore did not make explicit the processes that characterize each stage. By proposing the concept of global ecosystem emergence, we contribute to this debate by refining the notion of global ecosystems and adding a temporal dimension.

### 6.4.2 Local and Global Ecosystem Governance

What results from the initial stage of global ecosystem emergence, based on defining the local and global ecosystem value proposition and conducting the local and global ecosystem structure experimentation, is the challenge of defining the global ecosystem governance to guide global ecosystem evolution. Our data and research revealed that focal firms use

different approaches to define the rules and enforcement mechanisms for participation in local and global ecosystems. While some focal firms rely on standardizing the local and global ecosystem governance, using similar rules and enforcement for all local ecosystems, some focal firms adopt a more flexible approach to ecosystem governance, enabling the subsidiaries to create the local rules and enforcement mechanisms for their local ecosystems.

We conceptualize the use of the same set of rules and enforcement mechanisms defined by the headquarters and implemented by the subsidiaries for all local ecosystems as a standardized local and global ecosystem governance. Standardizing the global ecosystem governance leads to specific benefits and drawbacks for the focal firm. Benefits we identified from the use of a standardized governance are mostly related to the continuous improvement of processes related to searching and engaging with external actors, the emergence of similar local ecosystem structures, and improved communication between subsidiaries regarding their local ecosystems. Drawbacks are related to lack of adaptation to specific contexts, which may lead to missing opportunities to engage with promising local actors as the subsidiaries lack the autonomy to tailor the rules and enforcement mechanisms to each context.

Conversely, we conceptualize the use of flexible local and global ecosystem governance as the autonomy of subsidiaries to define the best rules and enforcement mechanisms for each local ecosystem. Using a flexible approach also leads to specific benefits and drawbacks. The benefits are related to the possibility of tailoring the governance of local ecosystems to suit the context, which in turn expands the possibilities of engaging with promising external actors. However, the use of flexible local and global ecosystem governance leads to the creation of unique local ecosystem structures, can makes communication between subsidiaries about global ecosystem opportunities more challenging, and hinder the coherence between local ecosystem goals and the goals of the global ecosystem.

Recent studies have highlighted the importance of ecosystem governance, specifically with regards to digital platforms (Cennamo & Sataló, 2019; Gawer, 2020; O'Mahonny & Carp, 2022). Our study contributes to this debate by providing a novel typology of ecosystem governance, based on flexibility or standardization. We also contribute to this literature by showing that governance in ecosystems is dynamic and results from previous experimentation

efforts by the focal firm to define the ecosystem value proposition and understand its appropriate structure.

More specifically, we contribute to the nascent literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by conceptualizing local and global ecosystem governance. By proposing that there are two main approaches focal firms can choose for the local and global ecosystem governance, we draw attention to the relevant differences that exist between global ecosystems. While some focal firms may opt for standardized governance, others may choose a flexible approach, leading to different challenges and benefits.

### 6.4.3 Understanding Local and Global Ecosystem Orchestration

The evolution of global ecosystems both shapes and is shaped by the governance adopted by the focal firm. Governance constrains how subsidiaries engage with focal firms and persuade external actors to participate in their local ecosystems. This process of continuous persuasion receives the name of ecosystem orchestration (Autio, 2022). In our research we discovered that focal firms leading global ecosystems use two main types of processes to orchestrate their local and global ecosystems.

Persuading external actors to participate in local ecosystems relies on either value perception enhancement, as the focal firm takes actions that make external actors perceive participation in local ecosystems as being valuable, or reducing participation uncertainty, as the focal firm uses specific processes and contracts that shield external actors from the possible negative consequences of participating in their local ecosystems. Focal firms orchestrating local and global ecosystems rely on a constant flow of actors joining their ecosystems. To do so, they use a combination of specific processes, programs, and contracts.

This research revealed that focal firms leading global ecosystems use specific processes, programs, and contracts to enhance the external actors' perception about the value of participating in their local ecosystems. A common one is the offering of mentorships, acceleration, and incubation programs to engage with promising local actors (startups and technology firms). These programs are usually associated with financial benefits, in the form of credits (non-transferable financial incentives) to use in the focal firm's products or services and training with managers specialized in specific technologies (e.g., cloud computing, digital

applications for smartphones, artificial intelligence) or managerial practices (e.g., customer discovery, validation, scale-up). Local actors thus perceive participation in the local ecosystem as a source of relevant financial and managerial resources, which add to the traditional benefits of participating in innovation ecosystems such as access to an existing customer base or technological platform.

Focal firms may also go beyond these traditional activities and participate directly in the day-to-day management of external actors in their local ecosystems. Human, technological, and financial resources are used to persuade promising local startups to engage with the local ecosystems. Managers from the focal firm may even participate in the development and improvement of the external partner's products and services, ensuring a satisfactory degree of quality and alignment with the objectives of the local ecosystem. Human resources are shared, and the focal firm may use its own employees to work in the scale-up of an external actor's solution. Because markets are dynamic and competitive, it makes sense for focal firms to invest these resources in external actors to persuade them to join their local ecosystems and not their competitors. We conceptualized these efforts by focal firms as enhancing the local and global ecosystem value perception.

Focal firms orchestrating local and global ecosystems also may employ programs, processes, and contracts aimed at reducing participation uncertainty in local and global ecosystems. Getting promising local startups to join their local ecosystems is challenging, as these organizations may lack the managerial capabilities that enable their participation in the ecosystem (e.g., offering their products and services to local established clients or government agencies). Focal firms can use specific programs, processes and contracts that shield these local actors from the potential negative consequences of participating in the local and global ecosystems they orchestrate.

Some programs and processes enable these startups to conduct product tests within the focal firm's subsidiary, identify potential issues (scale-up, cyber security, data privacy) in a controlled setting before the focal firm links it to other actors in the local ecosystem. Specific contracts can also be used, legally shielding these startups from possible negative consequences due to the eventual failure of their innovation projects. Focal firms may also assume the eventual financial losses that might be incurred by the startups for the specific

projects, enabling then that these local actors are linked to specific clients and enter contracts that would otherwise be out of reach due to lack of financial resources or an established operational track record.

Orchestration becomes challenging because there is competition between different focal firms to persuade a limited number of local actors to join their local and global ecosystems. This is particularly true for high-technology startups that can discover and manage relevant local and global uncertainties. Focal firms do not wait for these startups to discover them, but rather use their own resources to search for and engage with these actors, enhance their perception about the value of participating in their local and global ecosystems, and reduce the inherent uncertainty of doing so.

What we conceptualized as the global ecosystem evolution stage is comprised of the tasks of defining and implementing local and global ecosystem governance and orchestrating the local and global ecosystems. There is a relevant interplay between these tasks, as governance can either limit or expand the possibility of actions taken by the subsidiaries to orchestrate their local ecosystems and adapt their efforts to a local context. Focal firms using a standardized governance may lack the proper orchestration processes, programs, and contracts to persuade local actors, while focal firms using a flexible approach may have to deal with differences in the capabilities of their subsidiaries to orchestrate the local ecosystems.

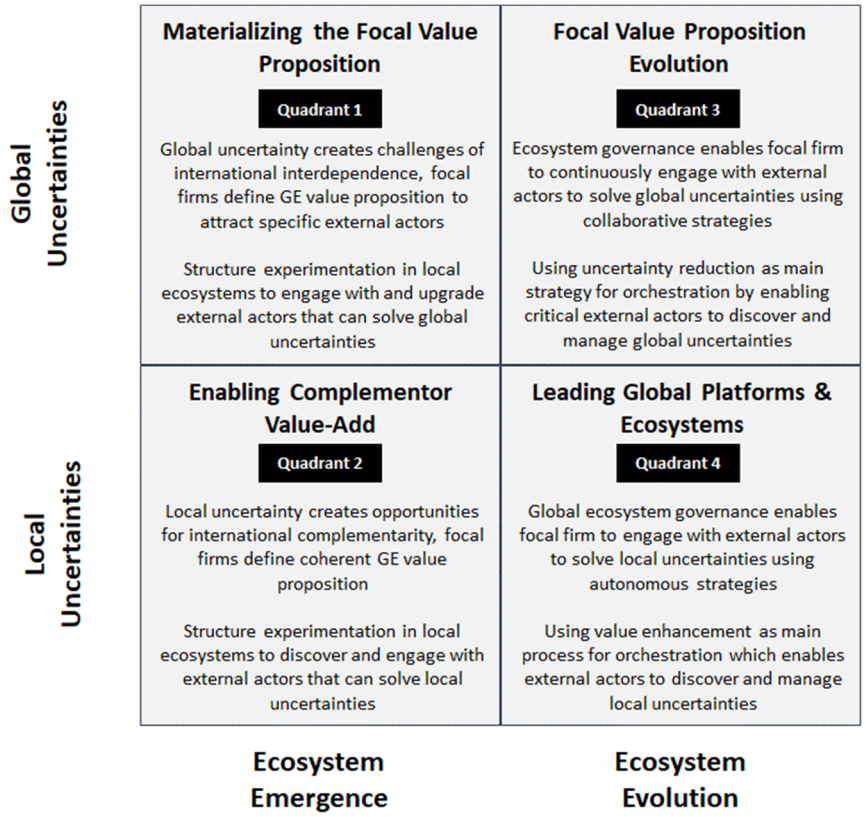
We contribute, therefore, to the literature on ecosystem orchestration (Dhanaraj & Parkhe, 2006; Autio, 2022) by conceptualizing the notions of enhancing value perception and reducing participation uncertainty as the main approaches used by focal firms to persuade external actors to join their ecosystems. We further contribute to the literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by conceptualizing how focal firms orchestrate local and global ecosystems, showing that this a process based on enhancing value perception, reducing participation uncertainty and dependent on local and global ecosystem governance.

### 6.5 Integrating the Findings: Uncertainty Management During Global Ecosystem Emergence and Evolution Framework

In this section we combine the main constructs and their relationships that emerged from both phases of our research to propose a tentative theoretical framework on uncertainty management during global ecosystem emergence and evolution. Following recent

recommendations to use simple frameworks that better communicate the results of qualitative research (Gioia et al., 2022) we created a matrix relating uncertainty scope, local or global, and ecosystem stage, emergence or evolution. Each quadrant in our model accounts, therefore, for the task of managing local or global uncertainties during global ecosystem emergence or evolution. The figure below shows our theoretical framework.

Figure 15: Uncertainty Management During Ecosystem Emergence and Evolution




Source: Authors

Quadrant one, which we labeled as materializing the focal value proposition, refers to the actions and strategies employed by focal firms to manage global uncertainties during the stage of global ecosystem emergence. The key challenge here is dealing with international interdependence, discovering, and engaging with the internationally dispersed external actors that must participate in the global ecosystem for the focal value proposition to fully deliver its value to users and customers. Global ecosystems enable focal firms to engage with actors that have critical knowledge (i.e., universities, startups, enterprises) to manage the relevant technological, market, and regulatory global uncertainties they face. Defining the right ecosystem value proposition is critical, as it will enable or not that the focal firm attract critical

internationally dispersed external actors. Structure experimentation in local ecosystems further enables focal firms to discover and upgrade actors that can help manage relevant global uncertainties.

Quadrant two, enabling complementor value-add, regards the actions and strategies employed by focal firms leading global ecosystem emergence to engage with internationally dispersed external actors to discover and manage relevant local uncertainties. This process enables the actors in local ecosystems to add value to the focal value proposition while simultaneously allowing the focal firm to gain access to the contextual knowledge that is required to manage local uncertainties. The global ecosystem value proposition must attract complementors to the local ecosystems that have the relevant knowledge and know-how to manage local uncertainties. Structure experimentation is also critical during this stage, as the focal firm must learn which complementors truly add value in each specific context and for each local ecosystem it leads.

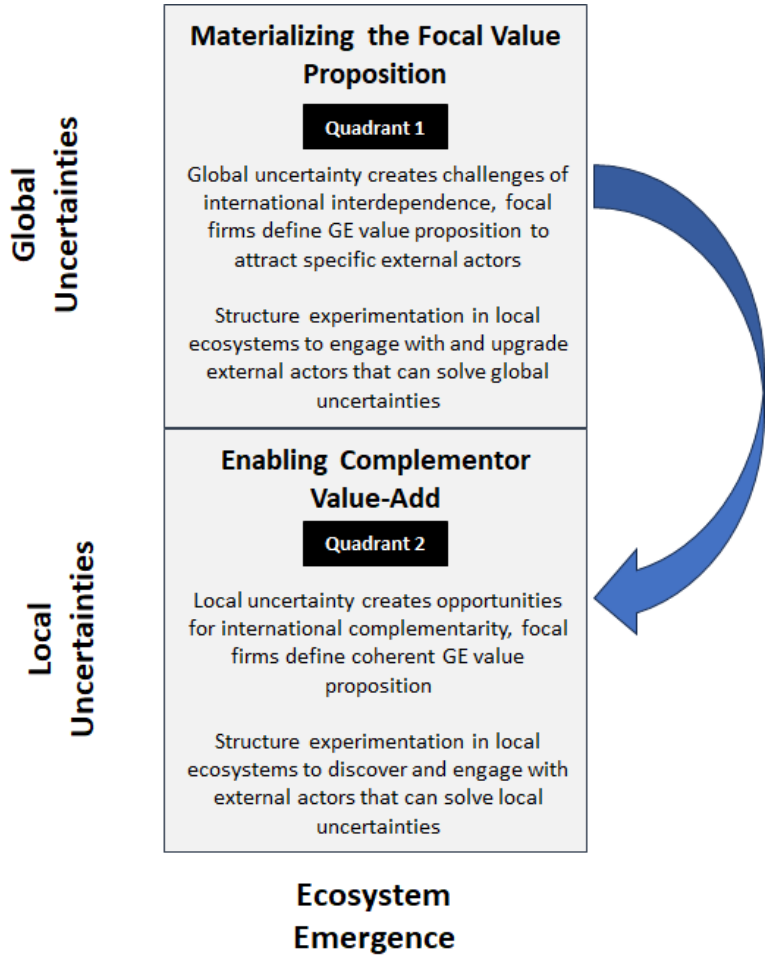
Quadrant three, focal value proposition evolution, refers to the development of new generations or improved versions of the focal value proposition that require the focal firm to manage global uncertainties. The evolution of the global ecosystem enables the focal firm to further identify and engage with external actors to manage relevant uncertainties, using collaborative uncertainty management strategies. Global ecosystem governance plays a critical role, by enabling orchestration via the continuous persuasion of external actors to join the global ecosystem.

Quadrant four, leading global platforms and ecosystems, references the continuous attraction of complementors that add value to the focal value proposition by discovering and managing relevant local uncertainties. Focal firms may employ autonomous uncertainty management strategies and enable this uncertainty management to take place with weak coordination, while benefiting from the knowledge about local contexts of focal firms in their local ecosystems. Governance must enable this process to take place, as specific rules regarding value creation, capture, and ecosystem structure need to be in place to allow this uncertainty management approach to be successful.

Our framework is dynamic, as the different quadrants can refer to activities and strategies pursued by focal firms in parallel (for example, quadrant one and two during global ecosystem

emergence) as well as sequentially (for example, moving from quadrant two to quadrant four). Focal firms may go through all four quadrants of our model, for example engaging with internationally dispersed external actors to materialize the focal value proposition (quadrant one) while creating the conditions for international complementarity (quadrant two), then moving on to both launch a new generation of the focal value proposition (quadrant three) while leading a global platform and ecosystem (quadrant four).

Figure 16: From Quadrant 1 to Quadrant 2

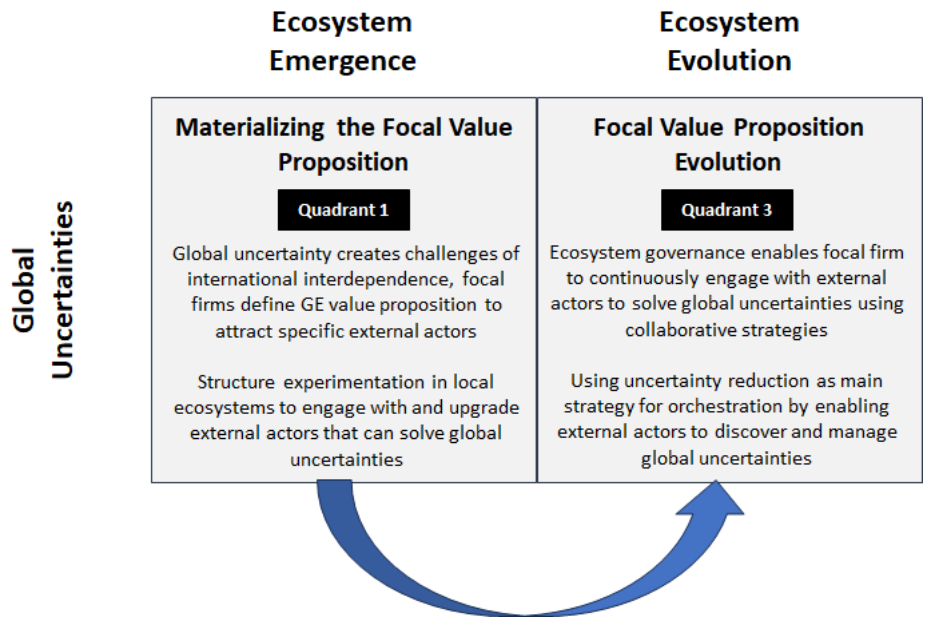



Source: Authors

Focal firms may, for example, transition between quadrant one and two during global ecosystem emergence. A focal value proposition, encountering global uncertainties and facing international interdependence may be materialized using global ecosystems. As the focal firms gains a better understanding about the focal value proposition and the ecosystem it is leading, it may realize that internationally dispersed external actors may add value to it by discovering

and managing local uncertainties in different countries and create an ecosystem value proposition that enables engaging with such actors.

Figure 17: From Quadrant 1 to Quadrant 3

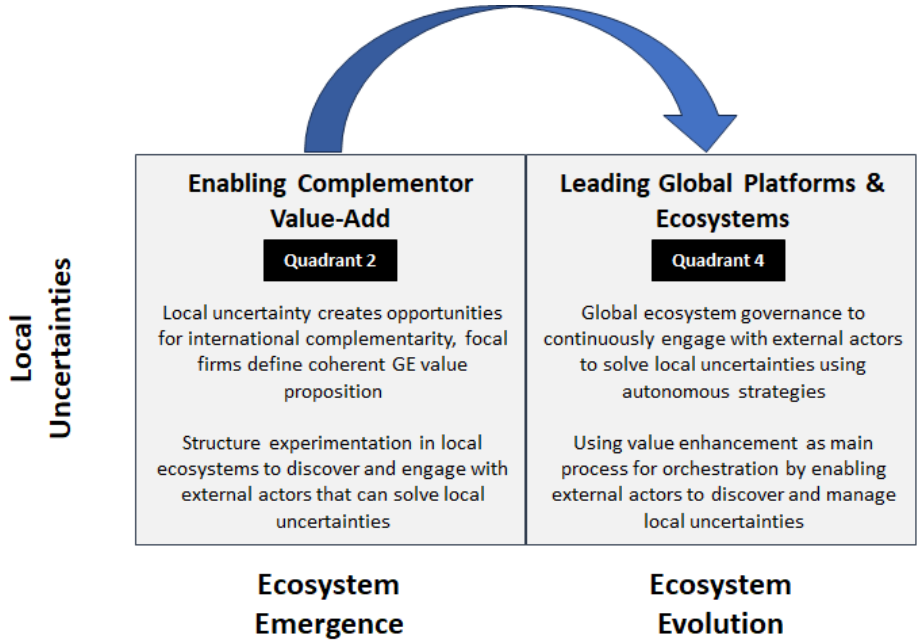



Source: Authors

Another pattern could be the move from quadrant one to quadrant three, as the focal value proposition is materialized using a global ecosystem and refined by evolving this global ecosystem. A focal firm faces international interdependence and global uncertainties and engages with internationally dispersed external actors to materialize the focal value proposition. If this is successful, it may face the need to continuously improve this focal value proposition, to face additional global uncertainties, which in turn requires engaging with other internationally dispersed external actors.

Focal firms may also move from quadrant two to quadrant four, which is a common trend for focal firms leading global digital platforms and ecosystems. A focal firm may initially leverage international complementors to discover and manage local uncertainties by using collaborative uncertainty management. If this is successful, it may move to establish digital platforms and use digital artifacts that enable autonomous local uncertainty management at scale, becoming *de facto* global platforms.

Figure 18: From Quadrant 2 to Quadrant 4




Source: Authors

In this section, we presented our initial, tentative theoretical framework that explains uncertainty management during global ecosystem emergence and evolution. What emerges is a coherent, easy to visualize model to explain how focal firms manage local and global uncertainties during the stages of global ecosystem emergence and evolution. This framework contributes to the academic literature on uncertainty management in global ecosystems and global ecosystem life cycle in the following ways.

First, we further contribute to the literature on innovation ecosystem emergence (Valkokari et al., 2017; Datée et al., 2018; Thomas et al., 2022) by showing that the identification and management of uncertainties in ecosystems is also related to the process of identifying the potential for complementarity and the challenges of understanding interdependence. Complementarity and interdependence are core ideas in innovation ecosystems (Adner, 2017) and so is uncertainty management (Datée et al., 2018; Gomes et al., 2018; Gomes et al., 2021). By making explicit the relationship between these ideas, we contribute to this debate by highlighting that focal firms leading innovation ecosystems must be aware of the interplay between uncertainty management, complementarity, and interdependence during the initial stages of innovation ecosystem emergence.

More specifically, we further contribute to the nascent literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019; Nambisan & Luo, 2021) by providing a set of constructs and their relationships that lead to global ecosystem emergence. The geographical dimension of uncertainty (local and global), complementarity (international complementarity), and interdependence (internationally dispersed) leads to specific conditions that must be addressed by focal firms. It is the relationship between uncertainty scope assessment and the international dimensions of complementarity and interdependence that explains why focal firms use global ecosystems for uncertainty management. By offering this set of constructs and explaining their relationship we contribute to the literature on global ecosystems by offering an initial theoretical explanation for their emergence.

Second, we contribute to the literature on collective experimentation in innovation ecosystems (Mahmoud-Jouini & Charue-Duboc, 2017; Gomes et al., 2018; Datée et al., 2018) by relating the concepts of collective experimentation to manage technical, regulatory, and market uncertainties and experimentation to manage structure uncertainty in innovation ecosystems with the ideas of complementarity and interdependence (Adner, 2017; Datée et al., 2018). We show that to properly address uncertainties related to the focal value proposition (technical, regulatory, market) and uncertainties about innovation ecosystem structure (value proposition, actors, roles, links, and activities), focal firms can employ specific strategies (internal, collaborative, and autonomous uncertainty management) that rely on leveraging complementarity or dealing with interdependence. While the literature on innovation ecosystems has previously conceptualized the issues that emerge from the limited understanding by a focal firm about interdependence (Adner, 2012) and complementarity (Jacobides et al., 2020), the use of collective experimentation to reveal these dynamics had so far been undertheorized.

More specifically, we add to the nascent literature on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019) by making explicit the relationship that exists between collective experimentation in global ecosystems and the definition of a global ecosystem governance. We highlight the role of local ecosystems and how focal firm's headquarters choose between two global ecosystem governance approaches, based on centralization and standardization or subsidiary autonomy and flexibility. We further demonstrate how the governance is influence by international complementarity and

international interdependence and the process of collective experimentation used to manage local and global technical, market, regulatory, and structure uncertainty.

In this section, we have detailed our theoretical framework that provides an initial, tentative explanation of uncertainty management during global ecosystem emergence and evolution. We have also demonstrated how this framework contributes to the existing literature on innovation ecosystems, uncertainty management, and global ecosystems. In the following section we will detail the managerial and policy-making implications that emerge from this research on global ecosystems.

### 6.6 Implications for Practice and Policy Makers

The three theoretical frameworks for uncertainty management and global ecosystems that emerge from our thesis have relevant implications for practitioners and policy makers. Innovation managers, ecosystem managers, and open innovation managers in headquarters and subsidiaries can benefit from adopting a global ecosystem perspective to guide their efforts. So can entrepreneurs and managers in local startups, universities, and venture capital firms, as well as policy makers who create the legal frameworks and incentives for innovation.

Our model provides an explanation for the emergence of global ecosystems that is useful for practitioners. Understanding the role of local and global uncertainties and identifying if the focal value proposition has the potential for international complementarity or must deal with international interdependence can help the successful emergence of global ecosystems. Our theoretical model can aid managers in understanding their focal value propositions by combining the concepts of uncertainty scope assessment and definition of the local and global ecosystem value proposition.

A series of questions can be asked by practitioners to help them in this process. After a traditional process of identifying the main uncertainties for their focal value propositions, managers should attempt to answer the following questions. i) Is this uncertainty relevant in a single country or in more than one country? ii) Can we use external actors located in different countries to help manage these uncertainties and discover other relevant uncertainties about our focal value proposition? iii) Are these external actors able to add value to our focal value proposition by identifying and managing local and global uncertainties? iv) Do we need specific actors to participate in our ecosystem to manage relevant local and global

uncertainties? Practitioners can use these questions to better understand the benefits from using a global ecosystem approach to manage their innovation projects.

Once there is an initial understanding about the uncertainties and the local and global ecosystem value proposition, managers can move on to define the experimentation approach to be used. During this stage, the focal firm must define the uncertainty management governance, if the business units can engage with external actors or how. This will lead to a choice between three types of uncertainty management strategies, internal, collaborative, or autonomous. Managers must be aware of the coherence between uncertainty management governance and strategies.

Again, some critical questions must be answered. i) Who can engage with external actors, where, and how to discover and manage local and global uncertainties about our project? ii) Can we benefit from internalizing part of this uncertainty management before engaging with other actors? iii) Should we employ a collaborative strategy, using formal contracts and constant communication with external actors or rely on an autonomous strategy, creating a digital platform and governance that enables external actors to use our technology to discover and manage relevant uncertainties? iv) What are the criteria used to define who is a suitable actor to participate in our ecosystem? v) What rules and laws (intellectual property, business competition, contracts) must we be aware about the countries we operate in to protect our project when engaging with external actors?

Once these questions are answered, practitioners are better equipped to begin the efforts of leading the global ecosystem emergence stage. They must be aware that this is a process of experimentation which has the objective of enabling the focal firm to gain a better understanding of the uncertainties, the ecosystem value proposition, and the appropriate local and global ecosystem structure. As the initial efforts of global ecosystem emergence begin, these questions should be revisited and updated, creating a structured process of leading local and global ecosystem emergence. Communication with managers in the subsidiaries involved in this process is also critical, and specific channels can be created to aid in this process.

After this initial stage, managers will face the challenge of creating and implementing the local and global ecosystem governance. Doing so entails understanding the benefits and drawbacks

of using a standardization approach or a flexible approach. This can be done by attempting to answer the following questions: i) Are the subsidiaries involved in this project used to operating with a high degree of autonomy or are the relevant decisions usually centralized in the headquarters? ii) Do these subsidiaries have the required resources to select and engage with external actors? iii) Can our innovation benefit from having different types of actors (components, complementors, intermediaries, universities, government agencies) in each country participate in our ecosystem or should we look for a specific type of actor (e.g., only complementors) in different countries?

Answering these questions should clarify the proper governance to be used during global ecosystem evolution. Additionally, focal firms need to define the programs, processes, and contracts they can use to persuade external actors to participate in their local and global ecosystems. This should follow from the definition of the ecosystem governance. If the focal firm requires many external actors participating in their global ecosystem, as is usually the case for business to consumer offerings, programs that enhance value perception (credits, acceleration, mentorships) should be the focus. If the challenge is more related to finding and engaging with specific, high-potential local actors then programs that reduce participation uncertainty should be considered.

Policy makers may also benefit from considering the ideas of local and global uncertainty. Regulation has appeared as a constant source of local uncertainty in our research, as focal firms struggle to understand how regulatory agencies will respond to their focal value propositions. Clarity regarding the approach to regulation may help focal firms deal with these local uncertainties.

Innovation and entrepreneurship have become central topics in government discourse and several laws, regulations, and government programs have been created to promote these activities. These need to consider the nature of global ecosystems and understand that attracting innovative firms may not lead automatically to expected levels of innovation and entrepreneurship in their countries. Ideally, policy makers should strive to promote the creation and evolution of local companies that have the potential to become leading firms in global ecosystems. Fostering the development of complementors that add value to focal value

propositions which rely on foreign technologies may not be the best approach, as it may affect the possibilities of value capture and technological development in their countries.

## 7. Concluding Remarks

This thesis offers initial answers to two complementary questions: i) how focal firms use global ecosystems to manage uncertainties; and ii) how focal firms lead the process of global ecosystem emergence and evolution. To do so we employed two rounds of qualitative research, based on eleven case studies of firms leading global ecosystems to develop and commercialize their innovative solutions. Our setting was their operation in Brazil, which provided a rich context to understand the roles of both the headquarters and subsidiaries in this process.

We contributed to the nascent debate on global ecosystems (Zahra & Nambisan, 2010; Valkokari et al., 2017; Nambisan et al., 2019) by creating three theoretical models. One explains uncertainty management in global ecosystems. The second one explains how focal firms lead global ecosystem emergence and evolution. A third one combines the results from both rounds of research and provides a theoretical explanation on local and global uncertainty management during global ecosystem emergence and evolution.

### 7.1 Research Boundaries and Limitations

This research has relevant limitations due to the qualitative nature of our research, the theoretical sample of focal firms leading global ecosystems, and the methods we employed. Generalizing the findings of our research for other contexts and samples of firms requires additional research, looking for similarities and differences between global ecosystems in different contexts. Further, we did not investigate the specific cognitive processes of decision-making in global ecosystems, how managers frame, make sense, react to, and make decisions facing the specific problems they encounter. Additionally, we focused on the actions of focal firms. We did not focus on how actors in other positions in global ecosystems (components, complementors, intermediaries, government agencies, universities) lead their own processes of uncertainty management, engage with emergent global ecosystems, and deal with global ecosystem evolution.

Qualitative research is subject to both researcher and informant bias (Eisenhardt & Graebner, 2007; Gioia et al., 2013). While we employed structured data collection and analysis protocols, it is not feasible to eliminate all biases from qualitative research. Further research using empirical data on global ecosystems may help in reducing researcher bias by using different perspectives, informants, contexts, sources, and data analysis procedures.

Additionally, this research had a clear theory building and theory improvement objective. Our constructs may require additional refinement and benefit from access to more empirical data and discussions with other researchers. Further empirical research is also required and may benefit from employing theory testing approaches, using the concepts and constructs that emerged from our data to establish causal relationships. Further research is, thus, required to establish the proper measuring instruments for each concept, collect quantitative data, create, and test the relevant business hypotheses. Generalizing our findings, thus, requires a robust theory development and testing program.

### 7.2 Opportunities for Further Research

We identify several opportunities for further research in the subject of global ecosystems. First, there are still open questions about strategy in global ecosystems. How do actors position themselves and strategically use local and global ecosystems to achieve their goals remains an open question. Second, the relationship between types of innovation project (incremental, radical, generative) and uncertainty management in global ecosystems can be explored by other researchers. Additionally, the political nature of global ecosystems must be investigated, as we require a better understanding of how political dynamics in a global setting influence the actions of focal firms leading global ecosystems.

Further research could also incorporate part of the debate on international business. Location choice in global ecosystems can be a relevant line of inquiry, as we know little about why a focal firm chooses to create local ecosystems in a specific country. The role of distance for global ecosystems (geographic, institutional, cultural) should also in our view be investigated by researchers. Questions on how the country of origin influence the perception about focal firms leading global ecosystems also seem promising. A robust program to investigate how extant ideas in strategy and international business apply to global ecosystems seems like a logical next step.

Another relevant line of inquiry regarding global ecosystems relates to the economic and social consequences of their emergence and evolution. Do global ecosystems contribute to social development, entrepreneurship, and degrees of innovation for the countries they operate in? Are firms from developed and developing countries participating in global ecosystems in a similar manner or is there a difference? All these questions also merit, in our view, an adequate answer to be provided by further research.

The goal of our ongoing research program is to establish the initial conditions for the emergence of a novel line of inquiry into global ecosystems. Our view is that the success of our efforts lies upon first demonstrating that global ecosystems matter. We hope to have achieved this modest objective in this work.

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## 9. Supplementary Materials and Annex

In this chapter we provide some supplementary materials of our research. These refer to the data that was collected and that informed our findings for phase two of our research (tables and timelines). We believe that including this information is relevant to improve the transparency of our methodology and give readers access to the wealth of data and information that was used in our research. In the next section we discuss the coding process we used, from discourse and documents to concepts, represented by the second-order themes, and why we chose to aggregate them. Then we also present the timelines for the cases, which also informed our findings.

### 9.1 Coding Process for Phase 2

In this section we present additional information on how we built the codes for phase 2 of our research, which answered the question on how focal firms lead global ecosystem emergence and evolution under conditions of local and global uncertainty. We have already presented the coding procedure for the aggregate dimension 'Defining the Local and Global Ecosystem Value Proposition' in the methodology section of this thesis. We used a similar approach for the other three additional aggregate dimensions.

| First Order Categories (Illustrative) | Second Order Themes | From First to Second Order |
|---|---|---|
| *Brazil is a high potential market for mobile games, we were supposed to be the first country to get the beta version of the game in the world. Then Trump and Biden's dispute began... There was this veto to any type of Chinese technology accessing data from US citizens. So our plan to first launch the game in the Americas, in Brazil, using (China Corp. Cloud), it fell through. Because of this political dispute we had to change our plans. We went back to the implementation stage, switched (China Corp. Cloud) for (American Corp. Cloud) so we could launch it here (in Brazil).* | Local and Global Structure Uncertainty | Discourse shows that defining the structure of the global and local ecosystems is uncertain, cannot be predicted by the focal firm (we had to change from provider A to provider B in Brazil, the U.S., this changed the launching schedule). To account for this unpredictability we used the concept of uncertainty. External dynamics, such as the political dispute between the U.S. and China regarding access to data, leads to reconfiguring the structure (actors, links, roles, activities). To account for this we used the word structure. Uncertainty impacts local structure (in Brazil) and global structure (U.S., China, Europe simultaneously). To account for this local and global dynamic we used the words local and global. |
| *Once you have this work being done with a startup here in Latin America and we see the potential to take this to other clients around the world we begin exploring this portfolio in other geographies. (...). Sometimes the client demands it, so for example we have something for (Chocolat Corp), one of our clients in Brazil, and (Chocolate Corp) in Canada, in the United States wants to do the same thing. So the client can trigger it.* | Upgrading Actors from Local to Global | Discourse shows that focal firms can change the links, connecting actors in the Brazilian local ecosystem to actors in local ecosystems in Europe or the U.S. (explore the portfolio in other geographies). An actor connected to multiple local ecosystems goes from being local to global, so we used this expression to show the process of changing ecosystem links and structure. This process gives additional access to external markets and clients (the client wants, the client can trigger) which evokes the idea of upgrading, of moving up in a global value chain. |

Two concepts emerged from our data analysis regarding the structure of local and global ecosystems. One is related to structure uncertainty, the notion that focal firms do not know *a priori* the optimal structure of the local and global ecosystems for the materialization of their focal value propositions. As discourse in the table above shows, managers struggled to make sense of who should participate in their global ecosystems and how. Lack of *a priori* knowledge is communicated by managers as changes in the ecosystem configuration.

We chose to code this idea as local and global structure uncertainty, a concept that captures this notion. Because global ecosystems are sets of local ecosystems, uncertainty about who should participate in a local ecosystem (for example, in Brazil) also influences the structure of the global ecosystem. Thus, we decided to make this explicit by relating structure uncertainty to both local and global ecosystems.

This was initially perceived in the case of Uprising Mobile, during the phase of within case analysis. We then started searching for similar patterns that could also be categorized as local and global ecosystem structure uncertainty in other cases, the cross-case analysis. We found that other focal firms in our sample also faced this challenge.

Additionally, we also discovered that some focal firms may reconfigure the links between actors in local ecosystems in a specific way, by connecting external actors that participated in a local ecosystem (for example, in Brazil) to other local ecosystems led by the focal firm in other countries. We conceptualized this as upgrading actors from local to global. The idea of upgrading actors comes from the literature on global value chains and global supply-chains.

Deep Blue Consulting, for example, often discovers that a local actor in an ecosystem can help manage global uncertainties, that are relevant in more than a single country. When this happens, the focal firm attempts to connect this external actor to other clients, via their subunits in other countries. This a reconfiguration of the local and global ecosystem links. As the discourse from managers show, this is a process of exploration, of searching for possible opportunities to link these external actors with global clients.

After this initial within case analysis, based on this insight that emerged from the discourse of managers from Deep Blue Consulting, we conducted a cross-case analysis to see if other focal firms also faced similar situations. We discovered that other focal firms used similar processes

of reconfiguring the links and connecting external actors from one local ecosystem to actors in other local ecosystems they lead.

| Aggregate Dimension | From Second Order to Aggregate Dimensions | Why It Matters |
|---|---|---|
| Local and Global Ecosystem Structure Experimentation | We understand that both dealing with local and global structural uncertainties and upgrading actors from local to global relate to the same overall process, the dynamics of understanding the structures that enable value creation and capture in local and global ecosystems. Both second order themes are related to uncertainty (had to change the launch schedule, we explore the portfolio in other geographies). Because dealing with uncertainty requires experimentation (exploring linking actors to other geographies, changing partners midway through), we chose to label this process as structure experimentation. Because it takes place in multiple local ecosystems (i.e., Brazil, China, U.S., Europe) we highlight this by adding the idea of local and global ecosystems. | Works on innovation ecosystems have highlighted the challenges of finding the right ecosystem structure (Adner, 2012; Hannah and Eisenhardt, 2018) to enable value creation and capture. Research on digital platforms initiate the discussion on how focal firms deal with this issue, usually based on the ideas of loose coupling with external actors (Nambisan and Luo, 2021; Nambisan and Luo, 2022). However, the specific processes focal firms go through to deal with the challenge of discovering the appropriate global ecosystem structure have not been conceptualized. While we agree with the claims that there is a challenge to define structure, which we call structural uncertainty in global ecosystems, our research also shows that this is characterized by a relevant interplay between local and global ecosystems. Actors do use platforms to internationalize (Nambisan and Luo, 2021), but this process is not dependent only on digital platforms. Contextual diversity does influence this process (Nambisan and Luo, 2021), but does so in a global and local dynamic that influence local ecosystems and global ecosystem structures alike. Focal firms, even those leading global ecosystems not dependent on digital platforms, play the key role of managing the links between actors in local and global ecosystems, which often explains their role in helping components and complementors internationalize. |

Because uncertainty is managed using experimentation (in line with Rice & O'Connor, 2013 and Gomes et al., 2018) we decided to aggregate the two concepts under the aggregate dimension local and global ecosystem structure experimentation. This aggregate dimension represents the efforts made by focal firms to deal with structure uncertainty in local and global ecosystems, which encompasses the activities of upgrading external actors by connecting them to actors in other local ecosystems.

Regarding governance we identified in the discourse of our informants and relevant documents that some focal firms prefer to employ a more flexible approach, using what we conceptualized as local and global ecosystem flexible governance. This concept emerged from an initial insight from the case of Deep Blue Consulting, when the interviewees repeatedly argued that actions related to engaging with external actors in Brazil were managed locally. We chose to use the word flexible as it communicates the notion of more flexibility from the perspective of local ecosystem managers from focal firms in defining the rules for structure, value creation and capture in the ecosystems they lead. Flexibility does not imply lack of

governance, it implies in our model the notion that managers in local ecosystems have decision rights, granted to them by the headquarters, to define the appropriate rules.

| First Order Categories (Illustrative) | Second Order Themes | From First to Second Order |
|---|---|---|
| *Engaging with startups, there is a register, the company is registed with Deep Blue. To begin a partnerships, there is an NDA, something like that. But it is all managed locally, of course this is formalized between the companies, but there is a local autonomy, in Latin America, we don't have to discuss this with other geographies* | Local and Global Ecosystem Flexible Governance | While there is a minimal global governance (NDAs, registers) discourse from informant shows that focal firm gives the subdisiaries autonomy to engage with external partners (it is all managed locally, local autonomy, don't have to discuss with other geographies). While the word governance is not used directly, we can deduct it from discourse as the informant clearly means the rules that constrain (or in this case, does not constrain) his behavior. And rules always include enforcement, otherwise they are suggestions. We chose to preserve this key idea of governance in the second order theme. Because this influences local ecosystem (i.e., in Brazil) and extends to other geographies (i.e., Latin America) we also use the notion of local and global ecosystem. |
| *Bionic Platform has several business units but sometimes startups approach us, and this is a key point, we mostly focus on early-stage startups. When these approach us they face difficulties navigating all these Bionic Platform business units. Bionic Startups is a central entity, with distinct parameters, positioning, branding, all standardized(...) Everything follows a global standard. Like I said, the headquarters will design the structure of the global programs and we adapt them here. But there is always a plan and established parameters that we must follow.* | Local and Global Ecosystem Standardized Governance | Discourse in this case shows how there is a standardized, global governance that details the rules for this local ecosystem to enable external actors (startups) to engage with the focal firm (parameters, positioning, branding, all standardized, everything follows a global standard). We chose to preserve the original quote for the second order theme, a standardized governance. Because there is also a relevant interplay between local and global (the headquarters define) we also employ the idea of local and global ecosystems. |

This was initially discovered during the analysis of the case of Deep Blue Consulting, the within-case analysis. We then moved on to see if other focal firms also used a more flexible approach to governance, which was confirmed with data from interviews and documents. We highlight that for all cases, even Deep Blue, there is some degree of global standardization (NDAs, registers) but that in our view those are not critical for the governance of local ecosystems.

Other focal firms, however, chose a different approach based on standardizing the governance for all local ecosystems. This initial insight emerged directly from the discourse of an ecosystem manager at Bionic Platforms. This manager directly mentioned that ‘everything follows a global standard’ regarding engagement with external actors in local ecosystems led by this focal firm. We chose to keep the original discourse in our conceptualization, standardized local and global ecosystem governance. After this initial within-case analysis we checked other cases in our sample to see if this approach to governance was also used by other focal firms, which was confirmed.

| Aggregate Dimension | From Second Order to Aggregate Dimensions | Why It Matters |
|---|---|---|
| Local and Global Ecosystem Governance | Both autonomy and standardization refer to the same process, defining the rules and enforcemente mechanisms that govern the work of focal firms and constrain (or expand) their possibilities of engaging with external actors. As governance is a critical idea in innovation ecosystems, and understood in the same way we use it here, we saw it fit to maintain the same concept when creating this aggregate theme. | Prior research has been conducted on what we consider to be the critical interplay between governance and context in global ecosystems (Nambisan and Luo, 2021; Nambisan and Luo, 2022) and the role it plays on how subsidiaries engage with external actors. However, these views based on loose coupling and contextual distinctiveness can be complemented by the distinction we make here regarding autonomy and standardization in governance for global ecosystems. By looking at specific dynamics in local ecosystems, it becomes clear that some subsidiaries have autonomy to define the governance of the ecosystem and that this autonomy does lead to distinctiveness. However, other subsidiaries lack such autonomy and still lead very successful local ecosystems, using standardization to their advantage. Governance standardization in global ecosystems does not lead to the impossibility of accessing relevant contextual knowledge, as it enables the focal firm to interact with a large number of external actors to discover and manage local uncertainties and to so using similar frameworks in different countries, which both streamline this process and make communication between subsdiaries and the headquarters easier. Further, we add to this debate by showing the specific processes that lead to the definition of the governance framework, which is based on our model on enabling the collective identification and management of local and global uncertainties. Complementors play a key role, as has been identified (Nambisan and Luo, 2022), but so do other actors such as components, universities, and regulatory agencies. Further, it is the experimentation process to define structure, manage local and global uncertainties, and understand the global ecosystem focal value proposition that lead to the definition of this governance and the choice between standardization and flexibility. Focal firms may also dynamically shift from one approach to the other, from flexibility to standardization, as they gain a better understanding of what rules and enforcemente mechanisms better enable value creation and capture in global ecosystems. |

We further aggregated the two concepts as local and global ecosystem governance. While governance has been studied in relation to global ecosystems (Nambisan & Luo, 2021) there was still room for a better understanding about different types of approach to uncertainty (flexible or standardized), how these rules influence local ecosystems, and how they relate to ecosystem life cycle. This indicates that local and global ecosystem governance was a valuable new concept that emerged from our research.

For the final two concepts that emerged from our thesis we followed the same coding approach. We identified initially that some focal firms use specific contracts and processes to continuously persuade external actors to participate in their local and global ecosystems based on enhancing the perception of value about participation. This insight emerged initially from an analysis of Bionic Platform's programs for startup engagement in Brazil, which was later confirmed when we interviewed an entrepreneur that participated in one of these programs.

His discourse emphasizes the value, which is subjective, about the credits and other benefits received by his startup for participating in Bionic Platforms startup engagement program. His discourse highlighted the idea of receiving a lot of money in credits to use in cloud services, but he also said that he could not use all the credits initially due to his small customer base and requirement for server space. The amount, around one hundred thousand dollars in cloud servers' credits, was too much for a startup beginning operations, but too little for a startup scaling up. Which confirmed our insight that this approach by focal firms was based on creating a subjective notion in entrepreneurs about the overall value of participating in these programs.

We then moved on, as in the other concepts, to look for other similar situations in other focal firms, the cross-case analysis. This confirmed that some focal firms use similar methods to engage with local actors, more specifically startups. It also became clear that this was relevant for focal firms which are concerned with attracting promising startups and face competition from other actors doing so.

| First Order Categories (Illustrative) | Second Order Themes | From First to Second Order |
|---|---|---|
| *They say it in the welcoming email. That they deposited in your account the one hundred thousand dollars, ten thousand a month that you receive. They also say you have five hundred dollars to spend on training. (...) There are a lot of valuable offerings if you are starting a business for the firs time.* | Enhancing Local and Global Ecosystem Value Perception | This quote from an entrepreneur displays a clear perception of enhanced value due to programs, processes, and contracts used by the focal firm to attract external actors (there are a lot of valuable offerings, they deposited in your account the one hundred thousand dollars). So we chose the idea of value enhancement. However, these are not normal dollars, but credits to be used in the focal firm's services that will only actually be consumed if his startup scales up leading to the necessity of actually buying more credits, so there is an element of influencing perception, of enhancing perception of value to this idea. In this context he is talking about the local acceleration program for startups in Brazil, so we highlight the local aspect. Other sources (interviews, documents, websites) show that this program is global (dollars are deposited in Brazil, afterall) and used in other countries, and to account for that we also use the notion of global in the second-order themes. |
| *You sign as the responsible part for the contract, the transaction between the company and the client and the partner (the startup) is subcontracted by me. (...)The startups asks for it. (...) They say I (the startup) can't be the prime contractor if we are doing a project for the (local) Port Authority. These projects, this is interesting, when we talk about the MVPs for these projects for this (quantum) solution we are talking about 500 thousand, a million reais. When it becomes an actual project, it is in the range of ten, twenty million reais. The startup says no... They raise the flag and say: in this case I won't even be approved by the client, for this contract. He will do the financial due dilligence and say no, no way.* | Reducing Participation Uncertainty in Local and Global Ecosystems | Discourse from this informant shows how focal firms use specific contracts to shield their partner startups, external actors, from the real life challenges most startups face when participating alone in innovative projects (we would never be approved, the client would say no way). To us this is a process of shielding these external actors from the innate uncertainties of innovation, as a solution may be tested and fail, with the prime contractor being financially responsible to the tune of millions of dollars. So we decided to include this idea of uncertainty reduction, of the focal firm reducing the uncertainties faced by external actors with the objective of attracting them to their ecosystems. Because this is a Japanese multinational doing this in Brazil, we find the idea of local ecosystem relevant. Because other sources (documents, interviews) show this is also done in other countries (Japan, Spain, Germany, U.S.) with startups, we also added the notion of global ecosystems. Because participation in the ecosystem depends on these contracts (and other processes and programs) and otherwise the external actor would be excluded we also included the notion of participation. |

We identified another approach for attracting external actors based on reducing the uncertainty of participating in local and global ecosystems. This concept initially emerged from our analysis of Quantum Inc., which employed a series of contracts to shield external actors, startups, from the traditional costs and consequences of doing business. The focal firm internalizes part of these uncertainties, being the *de facto* responsible part for any issues that happen during co-development and delivery of the startup's solution to a local or global client. Again, we looked for similar situations in other cases in our sample and again these were confirmed.

We chose then to aggregate these two approaches, as both relate to attracting external actors, as local and global ecosystem orchestration. While orchestration has been studied in the context of innovation ecosystems, to the best of our knowledge this is the first conceptualization of orchestration for local and global ecosystems. What differs is that in global ecosystems focal firms both face local and global uncertainties and must deal with different contexts.

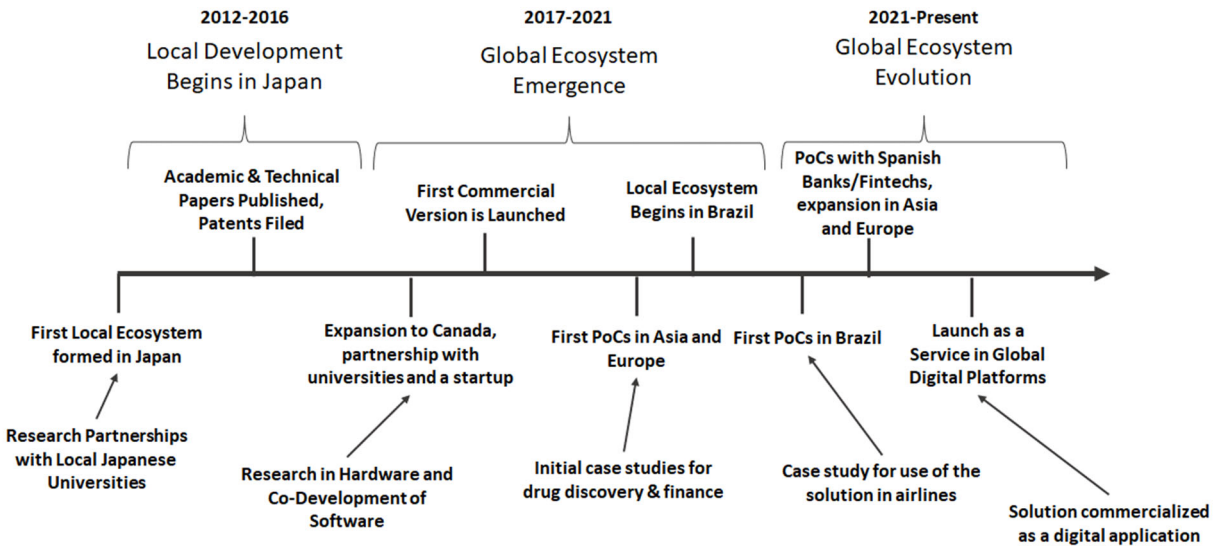
| Aggregate Dimension | From Second Order to Aggregate Dimensions | Why It Matters |
|---|---|---|
| Local and Global Ecosystem Orchestration | Both processes of reducing participation uncertainty and enhancing value perception are part of the same process focal firms use to persuade external actors to participate in their local and global ecosystems. Because persuading external actors has been conceptualized in the innovation ecosystems literature as the central task of orchestration, we kept this concept. We added the notions of local and global to highlight how this is not only done in the headquarters, which may be a logical conclusion, but by subsidiaries in several countries. | To the best of our knowledge no research has conceptualized orchestration in global ecosystems, the task of persuading external actors in different contexts to participate in local and global ecosystems. The literature on innovation ecosystem orchestration and orchestration in innovation networks (Dhanaraj & Pharke, 2006; Thomas, 2020) does not differentiate between types of orchestration approach based on uncertainty or value, as we do in our research. |

In this section we detailed how we conducted our coding process for all concepts created for phase two of our research. In the following section we also present another relevant tool used for our analysis, the creation of timelines for the cases in our sample.

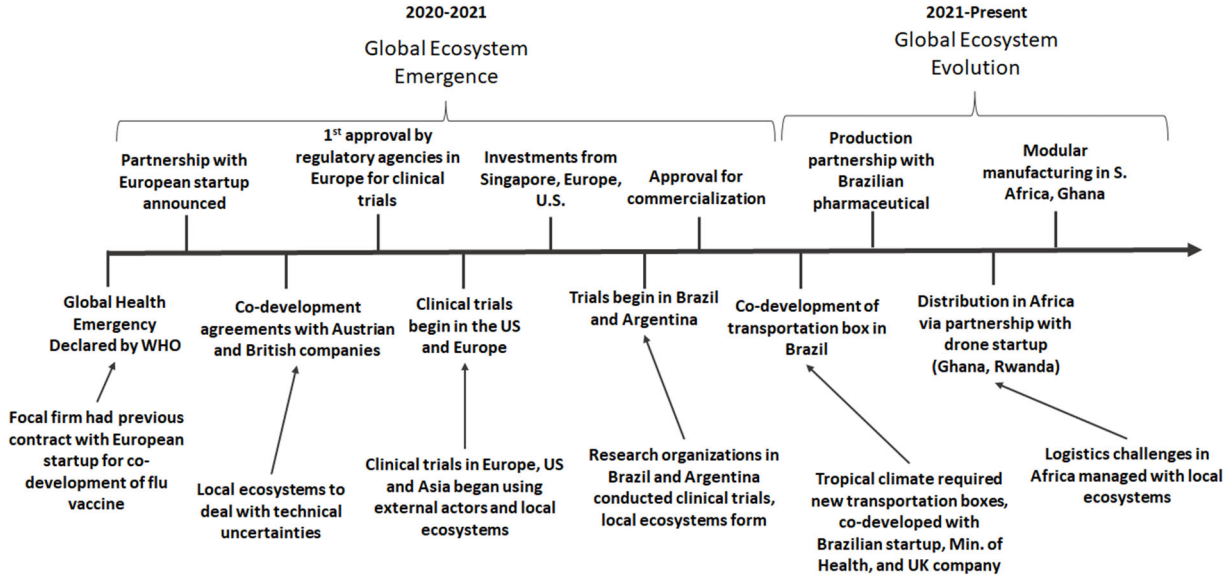
## 9.2 Timelines for the Cases (Phase 2 of the Research)

In this section we present the timelines for the cases that composed the sample of phase two of our research. We were careful to preserve the anonymity of our informants and their organizations, which involved using more generic dates (for example, from 2008 to 2016) instead of the precise years and months these events took place. Additionally, not all relevant events we considered are added to these timelines, as some would reveal the identity of the focal firms in our sample.

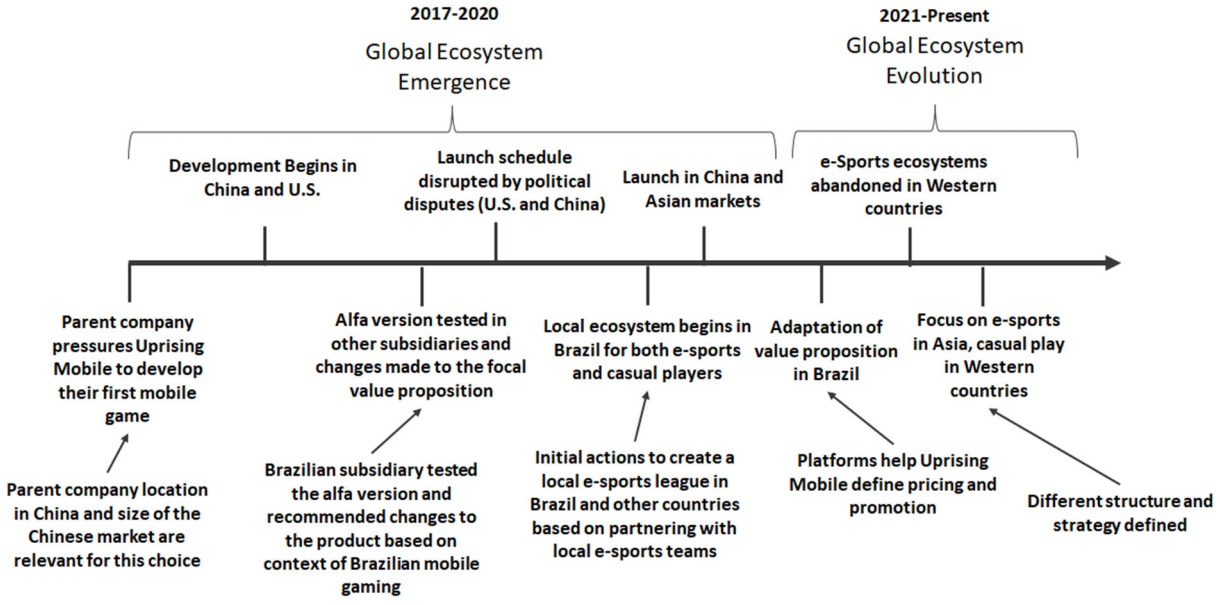
Quantum Inc. Timeline and Ecosystem Life Cycle



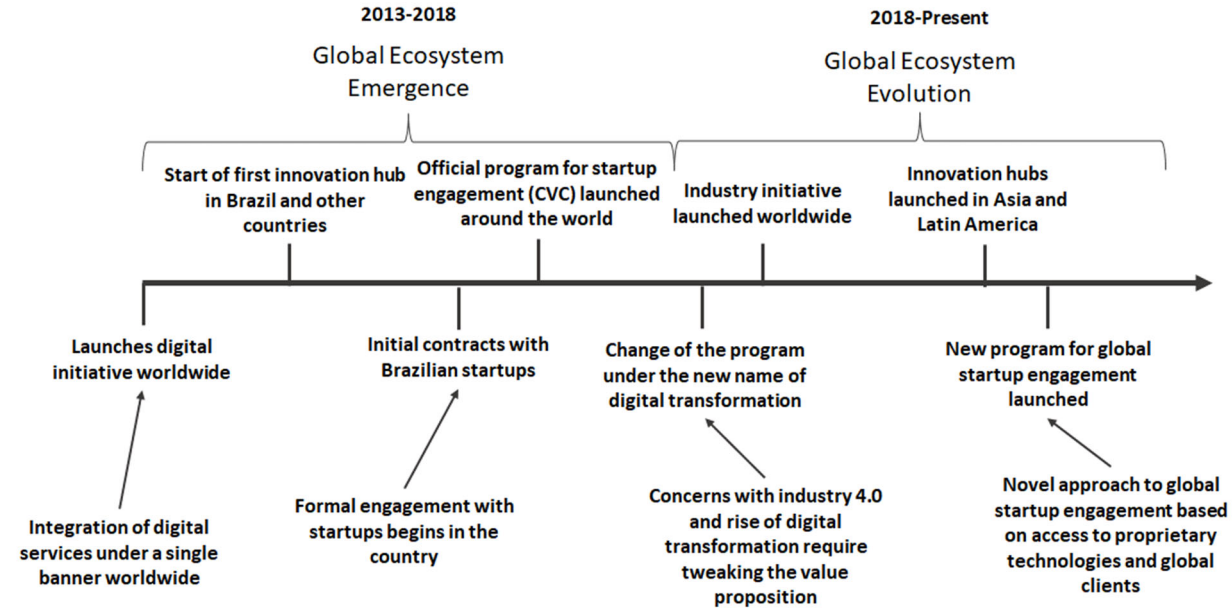
PharmaVax Corp. Timeline and Ecosystem Life Cycle



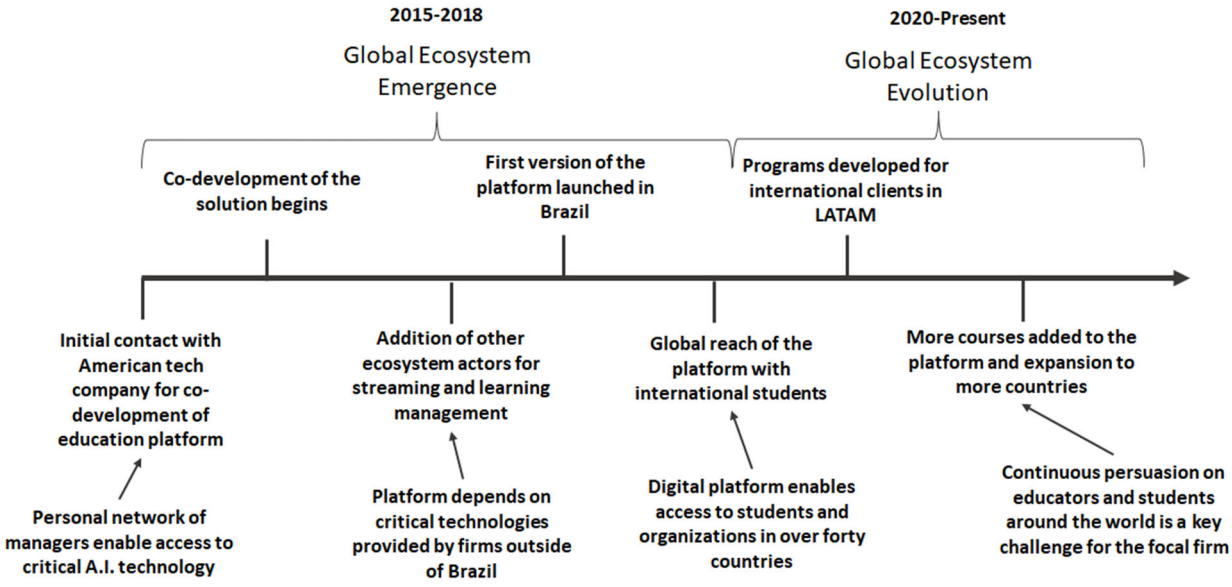

Uprising Mobile Timeline and Ecosystem Life Cycle



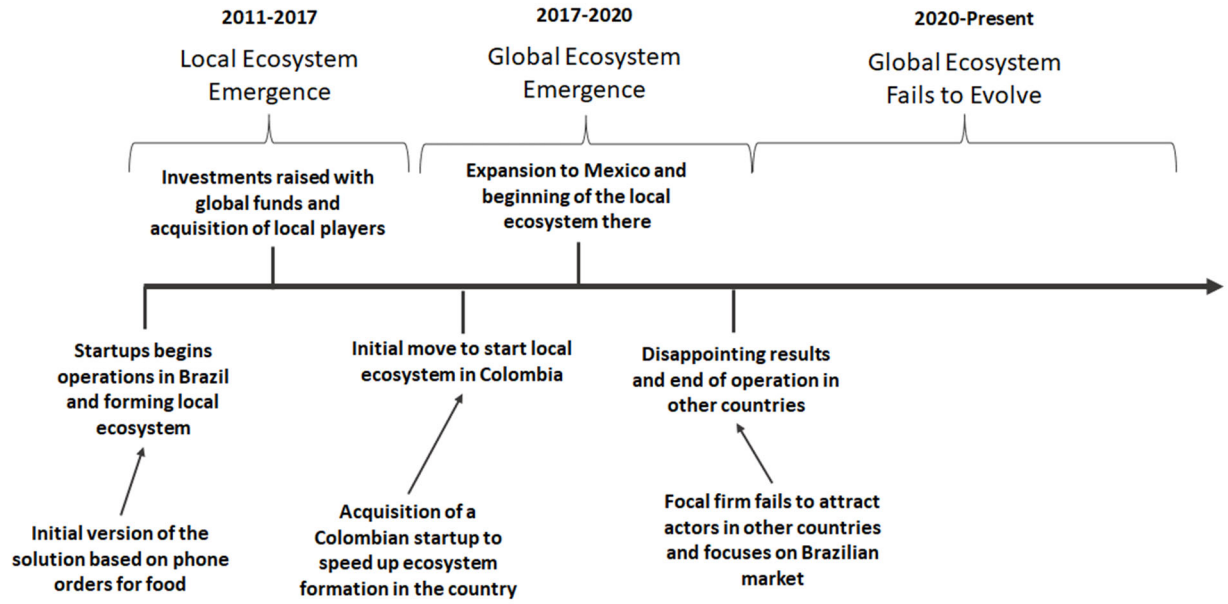
Deep Blue Consulting Timeline and Ecosystem Life Cycle




Master Business School Timeline and Ecosystem Life Cycle



Quick Delivery Timeline and Ecosystem Life Cycle




Bionic Platform Timeline and Ecosystem Life Cycle