Libra Association as a case study of ecosystem emergence

Sandra Brand

A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in
partial fulfillment of the requirements for the degree of

Master of Applied Science
in
Technology Innovation Management

Carleton University
Ottawa, Ontario

Copyright © 2020 S. J. Brand

ABSTRACT

The ecosystems construct in combination with interorganizational network theories have been used to evaluate the emergency of the Libra Association ecosystem in a case study. Ecosystem formation is considered from the perspective of interdependencies, orchestration, and network structure; roles and phases are identified. The qualitative assessment of these features finds general consistency with the innovation ecosystem construct; however, differences were observed in the interdependencies between partners and the role of the orchestrator in the early stages of formation. Theories regarding the evolving role of the ecosystem orchestrator were not confirmed by the network position of the ecosystem leader; however, alliance building roles of entrepreneurs were confirmed. Network structure and the technological diversity of firms in the ecosystem was consistent with exploratory and exploitative theories regarding alliance formation and helped to explain the departure and entrance of firms in the emerging ecosystem.

Libra Association as a case study of ecosystem emergence.

ACKNOWLEDGEMENTS

I offer an inspired and heart felt thank you to Professor Michael Weiss for generously sharing his knowledge, providing guidance and most importantly for his patience and understanding as I found my way through the learning process.

I would also like to thank professors Steven Muegge, Mika Westerlund, Tony Bailetti and Stoyan Tanev for their comments and helpful suggestions on this thesis but also for their invaluable contributions to my education; you have grown me greatly.

I thank my son, Zackary Steele, for his love and support as well as the supply of “magic milk”, and other provisions, along this journey.

TABLE OF CONTENTS

Abstract.....	ii
Acknowledgements.....	iii
Table of Contents	iv
List of Figures.....	vii
List of Tables.....	viii
1 Introduction.....	1
1.1 Objective.....	3
1.2 Deliverables	3
1.3 Relevance.....	3
1.4 Contribution.....	4
1.5 Method.....	5
1.6 Organization of the document.....	6
2 Literature review.....	7
2.1 Ecosystems.....	8
2.2 Ecosystems Construct.....	10
2.2.1 Ecosystem Types.....	19
2.3 Interorganizational Network Theory and Alliance Formation.....	23
2.3.1 Network Structure and Alliance.....	24
2.3.2 Exploratory and Exploitative Alliances	26
2.3.3 Technological Diversity in Alliances.....	28
2.3.4 Social Network Analysis Application to Ecosystems in Alliances	29
2.4 Cryptocurrency & Libra Association.....	32
2.5 Summary and Synthesis of Key Findings from the Literature	35
3 Research design and method.....	38
3.1 Theoretical Framework.....	38
3.1.1 Choice of Ecosystem Construct.....	42

Libra Association as a case study of ecosystem emergence.

3.2	Research Method and Case Study.....	45
3.3	Research Design.....	47
3.3.1	Definition of Libra Association membership.....	47
3.3.2	Study timelines.....	47
3.3.3	Combined qualitative and quantitative approach.....	48
3.3.4	Data collection	49
4	Libra Association as an Ecosystem Construct	60
4.1	Overview.....	61
4.2	Libra Association and the Ecosystem Construct.....	66
4.2.1	Interdependent Genesis Roles in Libra Association	68
4.2.2	Summary of Ecosystem Genesis Roles.....	77
4.2.3	Interdependent Relationships.....	80
4.2.4	Orchestrator – Ecosystem Lead	83
4.2.5	Co-Evolution - Definition of Ecosystem Formation Phases.....	90
5	Network Analysis of Alliance Formation	95
5.1	Network Structure and Alliance Formation	95
5.1.1	Orchestrator Role and Network Structure.....	97
5.1.2	Entrepreneur Role in Network Structure	98
5.1.3	Exploratory and Exploitative Alliance Behavior	99
5.1.4	Technological Diversity and Alliance Behavior	102
5.2	Results.....	104
5.2.1	Facebook Betweenness Centrality	105
5.2.2	Entrepreneur Betweenness Centrality.....	106
5.2.3	Ecosystem Phases and Network Structure.....	107
5.2.4	Technological Diversity and Alliance Structure	114
5.2.5	Technological Diversity Using Heat Maps and Network Clusters	117
6	Discussion and Conclusions	127
6.1	Qualitative Assessments.....	127

Libra Association as a case study of ecosystem emergence.

6.1.1	Interdependent Roles	127
6.1.2	Interdependent Relationships.....	130
6.1.3	Ecosystem Orchestration	130
6.1.4	Emerging Ecosystem Phases.....	131
6.2	Quantitative Analysis.....	132
6.2.1	Orchestrator Role in Network Structure	132
6.2.2	Exploratory and Exploitative Ecosystem Structure	135
6.3	Limitations	139
6.4	Contributions and Further Research	141
7	References.....	146
8	Appendixes	156
8.1	Appendix A - Libra Timeline	156
8.2	Appendix B - Libra Association Spreadsheet of Company Data.....	158
8.3	Appendix C - Sample template of data capture: company websites & Factiva	160
8.4	Appendix D - Crunchbase Media News Search Output	161
8.5	Appendix E - Crunchbase – Sample Company Data Collection Template...	162
8.6	Appendix F - Libra Association network matrix	163
8.7	Appendix G - Libra Association adjacency lists for each Phase	164
8.8	Appendix H - List of Industries by Libra Association Member	166
8.9	Appendix I - Technological Distance Tables – Pairwise Comparison by Phase	168
8.10	Appendix J - Technological Distance Tables – Pairwise Comparison by Roles	170
8.11	Appendix K - Orange Model – Technological Diversity	171

LIST OF FIGURES

Figure 1. Growth in the Literature of Ecosystem Articles by Year.....	10
Figure 2. Integration of Ecosystem Construct and Interorganizational Networks.....	39
Figure 3. Libra Association June 18, 2019	60
Figure 4. Libra Association Governance Structure.....	62
Figure 5. Libra Ecosystem Network - Phase 1 – Preparation Phase.....	111
Figure 6. Libra Ecosystem Network - Phase 2 – Formation Phase	112
Figure 7. Libra Ecosystem Network Phase 3 – Pre-Operation Phase.....	113
Figure 8. Technological Diversity Heat Map – Phase 1	118
Figure 9. Technological Diversity Heat Map – Phase 2	119
Figure 10. Technological Diversity Heat Map – Phase 3	120
Figure 11. Network Cluster – Technological Diversity – Phase 1	121
Figure 12. Network Clusters – Technological Diversity – Phase 2	123
Figure 13. Network Clusters – Technological Diversity – Phase 3	124

List of Tables

Table 1: Insights from the Management Literature.....	8
Table 2: Systematic Literature Review Comparison of Constructs	21
Table 3: Comparison of Libra Association to Innovation Ecosystem.....	44
Table 4: Research Methods Summary	45
Table 5: Qualitative Assessment of Ecosystem Elements.....	67
Table 6: Libra Association Roles Identified by Phase	93
Table 7: Facebook Centrality by Phase.....	105
Table 8: Entrepreneur Betweenness Centrality – Phases 1 – 3	107
Table 9: Libra Association - Firm Degree Centrality.....	109
Table 10: Summary of Firm Links – Phase 1	110
Table 11: Company Industry Listings from Crunchbase	114
Table 12: Technological Diversity by Libra Genesis Phase	116
Table 13: Expert & Champion Technological Diversity Across Phases.....	125

1 Introduction

Ecosystems constructs have been used to understand a number of concepts in business and the new digital economy. A broad range of topics have been touched on by ecosystem research. The structure of new business relationships, the means to create and capture value, innovation and management strategies have all been assessed through the ecosystem lens. One stream of ecosystem research in particular, innovation ecosystems, focuses on nascent technologies such as cloud computing and big data. The emergence of cryptocurrency and the Libra Association appears to be a good opportunity to test some of the propositions in the innovation ecosystem construct. And test the applicability and benefit of using the construct elements of interdependency, orchestration, and emergence to understand the utility, and potential strategies, of alliances for firms.

Libra Association was chosen as case study to address the ecosystem construct because of its focus on innovation and due to its wide-ranging membership; Libra represents large and small firms as well as newer and older firms from a range of sectors. Libra Association was announced as a consortium of members with the objective of developing a cryptocurrency on 18 June 2019; in the White Paper released at the launch of the Libra Association it referred to itself as an ecosystem. A Libra Association case study provides an opportunity to evaluate whether the ecosystem construct helps explain the roles of different actors and how the early formation of an ecosystem evolves. The research considers the impact of network structure and technological diversity on the emergence of the ecosystem.

This thesis considers the overall problem of balancing exploratory alliances which provide long term rewards and future business opportunity with more conservative approaches of exploiting existing assets. Closer, exploitative, partnerships provide certainty and have more immediate short-term benefits. This thesis looks at the emergence process of the ecosystem with the intention of gaining a better understanding of where and how firms might fit within an ecosystem. In particular, the balance between exploratory and exploitative opportunities but also to better understand potential roles in an ecosystem as it evolves.

To address the problem systematically, the Libra Association case study assesses whether ecosystem constructs are reflected in the genesis of the Libra Association ecosystem. Propositions from the ecosystem literature regarding early roles and phases of genesis are measured against the Libra experience. Libra Association interdependence and orchestration roles are compared to those defined in the literature. Interorganizational network theory that has been developed regarding the impact of exploratory and exploitative alliance behavior is evaluated for its effect on Libra Association ecosystem formation. This is undertaken by examining the phases of ecosystem genesis and the roles in those phases using network structure and technological diversity. Exploratory and exploitative alliance theories are used to consider if they can help explain why certain firms joined or left the ecosystem.

This research does not consider ecosystem elements other than interdependency as it relates to the roles of emerging partners in the ecosystem and focuses primarily on

the orchestrator of the ecosystem, in this case Facebook. Only the initial emergence phases of the ecosystem are considered as part of this research. Network structure and technological diversity are limited to the ego-centric relationship between firms and thus the ecosystem in this case does not consider the interaction with other ecosystems. It also limited the qualitative research to interdependent relationships within Libra Association.

1.1 Objective

The objective of this study is to determine if the emergence of the Libra ecosystem can be understood using ecosystem constructs and interorganizational network theory regarding exploratory and exploitative alliances.

1.2 Deliverables

This thesis has 3 deliverables: (1) evidence that the Libra Association ecosystem emergence is consistent with innovation ecosystem constructs related to interdependence, orchestration and emergence; (2) the identification of roles, ecosystem emergence phases and firm relationships in Libra Association; and (3) Results of testing exploratory and exploitative alliance theory using betweenness centrality, degree centrality and technological diversity.

1.3 Relevance

This research problem is relevant to 1) companies interested in innovation and cryptocurrency alliances. The primary interest for this group would be an understanding of their role in an evolving Libra Association and the balance between exploratory and exploitative alliance choices. This research can also assist top management teams (TMT) to decide on alliance choices in the rapidly evolving technology and cryptocurrency

market. And perhaps more importantly, understanding the evolution process of an ecosystem could also help TMTs judge the timing for joining an ecosystem.

The research problem is also relevant to 2) the academic community. The evaluation of emerging ecosystem constructs and the ability to use network analysis to test exploratory and exploitative alliance theory to help explain the formation of innovative ecosystems contributes to academic research. The relevance of network structure to ecosystem formation and roles will help strengthen theories regarding both emerging ecosystems and the use of network analysis. The ability to evaluate the innovation ecosystem constructs can serve to strengthen and support ecosystem constructs. And: 3) regulators who must consider how emerging technologies such as cryptocurrencies are evolving and how the alliance behaviour could affect regulatory decisions, particularly for monetary policy and competition in the marketplace.

1.4 Contribution

The research makes the following contributions. First, by confirming the Libra Association emergence is consistent with the ecosystem construct elements of interdependency, orchestration and emergence. In particular, that ecosystem roles and phases could be identified in the Libra ecosystem and that the qualitative evidence could be corroborated by quantitative analysis. Second, using ecosystems constructs and interorganizational network theory to evaluate exploratory and exploitative alliance formation and confirming that exploratory and exploitative firms could be identified in the network structure and technological diversity of Libra Association. Third, by introducing the use of network analysis to the early emergence phases and roles to

improve the understanding of ecosystem emergence. Finally, the study demonstrates that network analysis tools such as network clustering and heat maps can provide new insights into how the technological diversity between firms confirms exploratory and exploitative alliance behaviors in emerging ecosystems and supports the qualitative analysis of roles in the Libra ecosystem.

1.5 Method

A combination of ecosystem constructs and interorganizational network theory is used to evaluate the Libra Association ecosystem genesis. A qualitative assessment is used to initially review elements of the Libra Association that are consistent and inconsistent with the innovation ecosystem constructs including interdependence, orchestration and emergence. Similarities and differences between the ecosystems construct and Libra Association are used to evaluate the benefit of the innovation ecosystem construct and what the construct contributes to understanding the evolution and formation of the Libra Association ecosystem.

The Libra Association case study combines the innovation ecosystem construct with interorganizational networks theories to look at specific elements of the Libra Association evolution over its first 12 months from 18 June 2019. The network structure in three stages of ecosystem emergence were identified and compared to understand how network structure, both centrality and diversity, impacted the ecosystem development phases.

This hybrid methodology which combines qualitative assessment with quantitative network analysis is consistent with other ecosystem – network studies

(Teixeira, Robles, & González-Barahona, 2015). That is, this case study uses a “mixed method” which bridges qualitative analysis with quantitative social network analysis.

Data was collected from individual Libra Association member websites, media sources such as Factiva and Crunchbase and the Libra Association website and development portal.

1.6 Organization of the document

This research thesis is organized in 6 chapters, each structured into sections and subsections. Chapter 1 is the Introduction. Chapter 2 is the “Literature Review,” which is divided into four sub-sections for each of the three literature streams and lessons learned. Chapter 3 “Research design and method” covers the theoretical approach to the research, the research design and methods as well as data collection. Chapter 4 presents the comparison of Libra Association with the innovation ecosystem construct. Chapter 5 provides the results of the network analysis of ecosystem roles and phases of alliance formation and Chapter 6 is the discussion and conclusions of the research.

2 Literature review

As outlined in Table 1, the literature review is organized into three streams. The first stream looks at ecosystems; this is consistent with the June 2019 announcement that Libra Association was launched as a new ecosystem (Libra Association Press Release, 18 June 2019). The second stream reviews interorganizational network literature to better understand the impact of network structure on alliance formation in the ecosystem, specifically exploratory and exploitative alliances. This stream also covers the convergence of interorganizational networks with the ecosystem construct particularly on from the perspective of social network analysis which is a tool that has been used to bridge interfirm collaboration and ecosystems. Finally, a separate stream of the literature review looks at the limited literature available on the Libra Association in the emerging blockchain technology. The first three sections of this chapter covering each of the streams are followed a final section summarizing lessons learned which synthesizes the salient research.

Table 1: Insights from the Management Literature

Stream	Key highlights of the stream	Key references
Eco-systems constructs	Types of ecosystem constructs Elements of innovation ecosystems Roles and structure of innovation ecosystem Genesis of ecosystems	Adner (2017) Dedehayir et al. (2018) Dhanaraj & Parke (2006) Jacobides et al (2018) Gawer (2014) Moore (1993) Scaringell& Radziwon (2018)
Interorganizational Networks	Interfirm alliance networks Network embeddedness, firm centrality, network diversity Exploitation and exploration interorganizational learning Exploration and exploitation innovation Social network analysis	Baum et al. (2010) Gulati (1998) Gilsing et al. (2008) March (1991) Ozman (2017) Shipilov & Gawer (2020) Vanhaverbeke et al. (2006)
Libra Association	Financial regulation & licensing Monetary policy Digital currency Payment instruments Distributed ledger technology & smart contracts	Brühl (2020) Mayer (2019) Senarathne (2019) Taskinsoy (2019) Tomić, (2020) Tischer 2020) Zetsche (2019)

2.1 Ecosystems

The literature on ecosystems is growing and varied across several perspectives. Although it is considered a relatively recent construct centered around understanding business behaviors particularly in the context of emerging digital technology, it still covers a wide range of perspectives. Ecosystems have been viewed from the perspective of business, innovation, technology platforms, entrepreneurship and knowledge systems. The ongoing evolution of the ecosystem construct means there is not yet a consensus on an agreed construct. A significant body of conceptual literature on ecosystems and a more

limited body of empirical literature have been contributed to the research. This review will briefly cover the various streams of ecosystem literature, particularly as it relates to Libra Association, and examine the differences between the current streams. Some of the findings highlighted in the literature surveys that attempt to differentiate the various streams are also included. A more detailed look is undertaken on the innovation ecosystem literature given its proximity to the Libra Association.

Ecosystems literature has grown steadily particularly in recent years. Figure 1 captures the number of articles identified in the Business Source Complete database between 2010 and 2019 for two separate search results. The first search conducted included the terms “ecosystem” and “business”; this result is represented by the bottom blue line. The second search conducted used the terms “ecosystem” and “management” represented by the top orange line.

The following two sections review the elements of the ecosystem construct and the different sub-streams that have grown out of the ecosystem construct, namely business ecosystems, innovation ecosystems, platform ecosystems, and knowledge-based or entrepreneur ecosystems.

Figure 1. Growth in the Literature of Ecosystem Articles by Year

Source: Business Source Complete, 13 July 2020

2.2 Ecosystems Construct

This first literature stream starts by reviewing the overall body of work on ecosystems. It covers many of the basic elements of ecosystem constructs including interdependencies, diversity and niche creation, roles, coopetition, co-evolution, co-creation, and the modular development of value creation. It is noteworthy that the ecosystem construct evolved at a time when there was a high degree of attention on anticompetitive behavior in industry. In the 1990s, the regulatory context focused on antitrust activities by firms and overall competitiveness concerns, for example, the monopolistic position of Microsoft. The concept of a collaborative ecosystem was contrary to ideas that firms were natural competitors in the marketplace. There was a skepticism that collaborative behavior could provide value and benefits to customers in an economic, fair, and equitable way (Moore, 2006).

Ecosystem literature emerged from the work of James Moore who looked at how business adapts to innovation and change. He highlighted the growing importance of “... new ideas and tools ... for making tough choices when it comes to innovations, business alliances and leadership of customers...” (1993: 75). Moore felt the traditional approaches to business development were inadequate to address contemporary challenges and proposed that companies be viewed as part of business ecosystem that co-evolves around new innovations, particularly in technology. Moore recognized that companies work cooperatively and competitively to support new products and address customer needs. In his seminal article from 1993, he identified four stages of ecosystem evolution, birth, expansion, leadership, and renewal. In looking at the Libra Association case study, the elements Moore highlights in the birth phase are particularly important. For example, Libra Association provides member firms with an ecosystem environment where innovative ideas around cryptocurrency can be tested and solutions for customers can be identified. Moore understood that testing new ideas and concepts is more difficult to do in the internally established corporate culture within a firm (1993: 79). Participating and operating within an ecosystem provided opportunities to think outside the constraints of corporate company culture. This argument could be applied to some of Libra Association’s original corporate members such as the older well-established firms of Mastercard and Visa.

The “birth” phase of the ecosystem processes outlined by Moore captures some of the considerations potential Libra members may have needed to consider when joining a

blockchain alliance. That is, whether to cooperate on a value proposition around a new innovation or whether to compete on similar technologies and hope to identify and attract lead customers, suppliers and channels, essentially be a “first mover”. These two options are outlined in his article *Predators and Prey* published in *Harvard Business Review* in 1993. Following the early work by Moore, the eco-system literature focused on the structure, leadership and interdependencies within the ecosystem, less literature was dedicated to the early formation of ecosystems (Dedehayir, Mäkinen, & Ortt, 2018: 18). The limited literature available on formation focuses on the overall ecosystem or the business opportunities around ecosystem formation. For example, Fernández, Jiménez, & Roura researched into business incubation:

... defines and relates all the key elements that are the source of innovation and value added... service provision according to ownership, size and partnership of the business incubators and show the efficacy of the cooperation of the private and public sectors and the universities.
(2015: 783)

Work by Hu, Lu, & Huang (2009) on the evolutionary path of e-business ecosystems focuses on clusters. Thomas and Autio (2013) looked more closely at the process of ecosystem formation and in an analysis of “digital services” identified three stages within the birth, or formation, phase identified by Moore; these were initiation, momentum, and optimization.

More recently, research into the roles and evolution of the “birth”, or formation, phase of ecosystems has been undertaken by Dedehayir et al. This work combined earlier work by Thomas and Autio (2013) on phase identification in the ecosystem emergence

process with their own work on role identification in the ecosystem genesis. Through a broad literature review of 60 articles on the topic of ecosystem genesis, a set of roles were identified. These roles include previously highlighted ecosystem roles such leader and complementor but add several new roles such as expert, user and entrepreneur as well as roles from supply chain theory assembler and supplier. The roles were combined with the genesis phases that were broken down into similar sub-phases identified in the previous literature. However, the genesis phases were renamed to the sub-phases “preparation”, “formation” and “operation”. Thus, the work of Dedehayir et al. (2016) is important construct from which to consider the Libra Association emergence.

One of the elements of Moore’s ecosystem concept which gained early recognition and endures today in the literature is the idea of collaboration across industries. The idea that linkages are made across industries is still considered a distinguishing feature of business ecosystems (de Vasconcelos Gomes, Facin, Salerno, & Ikenami, 2018: 42). The work of Iansiti and Levien in 2004 is considered a foundational reference in early ecosystem literature (de Vasconcelos Gomes et al., 2018, Scaringell & Radziwon, 2018). Their work on collaboration identifies the structure of an ecosystem as a collection of actors that “... affect, and are affected by the creation and delivery of a company’s own offerings” (Iansiti & Levian, 2004: 69). Their research confirmed Moore’s similar conclusion that ecosystems are co-evolving interconnected companies. They expanded this concept to highlight the importance of interdependencies within the business community. Iansiti and Levian noted that “A company’s performance is

increasingly dependent on the firm influencing assets outside its direct control” (2004: 78). The research on interdependence has grown to the point that propositions have been made that “A firm cannot create value unless all [ecosystem] components are present” (Hannah & Eisenhardt, 2018: 3164).

The importance of understanding interdependencies was recognized early in the literature. In 2006, Adner began looking at “... the collaborative arrangements through which firms combine their individual offerings into a coherent, customer facing solution” (2006: 98). Ecosystems began to be recognized as having the ability to create value that firms could not generate independently. In Adner’s case, he began evaluating interdependencies from a risk perspective; he looked at calculating the impact of ecosystem approaches on project times and delivery schedules. He used a number of case study examples to profile the impact of ecosystem interdependences on the introduction of high-definition televisions, fuel cell technology, run flat tires and music streaming (Adner, 2006).

As the ecosystem literature began considering a set of assessment criteria around the health of an ecosystem, an important contribution from Iansiti and Levien focused on “niche creation”. Niche creation reflects the need for an ecosystem to support diversity; this diversity augments the ability to “... absorb external shocks and the potential for productive innovation” (2004: 73). An important element of niche creation is the extent to which emerging technologies are integrated into a variety of business and products.

This consideration is applicable to the Libra Association case study from the perspective of the technology itself but also in terms of the diversity of members within the alliance.

Another important element in the ecosystem literature is the role of the ecosystem leader or “keystone” organization (Gawer & Cusumano, 2002; Iansiti & Levien, 2004). Keystones improve the overall health of the ecosystem by providing stability. A keystone, or hub, organization leads the evolution of the ecosystem. In their work on orchestrating innovation networks, Dhanaraj and Parkhe (2006) provide a detailed breakdown of this role which touches on many of the elements highlighted in the ecosystem literature including increasing productivity by connecting participants, growing the ecosystem and sharing value. Dhanaraj and Parkhe identify network design elements and “orchestration processes” which are reflected throughout the ecosystem literature particularly more recently as the body of ecosystem literature has expanded. Three primary processes are identified, “managing knowledge mobility”, “managing innovation appropriability” and “managing network stability”.

Knowledge mobility is managed by supporting knowledge transfer and absorption within the ecosystem; this allows new technologies to be adapted in novel ways. Knowledge mobility is supported by promoting a common identity among members and socialization linkages (2006: 662). These latter two elements help break down barriers to sharing knowledge. Appropriability of innovation is an important and specific element in the ecosystem construct. Orchestrators must be able to promote value creation but ensure that members, particularly complementors in the case of ecosystems, have equitable

opportunities to exploit value. In addition, orchestrators must manage free riders and opportunism (Dattée, Alexy, & Autio, 2018; Gulati, 1998).

Dhanaraj and Parkhe suggest appropriability can be achieved through trust, procedural justice, and joint asset ownership (2006: 663). Trust among members avoids costly and time-consuming litigation and facilitates information sharing and joint problems solving. Procedural justice supports voluntarily cooperation and discourages the hoarding of ideas (Kim & Mauborgne, 1998), it provides transparency and fairness to the treatment of each member. Joint asset ownership creates a shared vested interest that provides an incentive to work together.

The orchestrator's role in network stability is significant for ecosystems since the relationship between members is loosely coupled and interdependent. The degree of autonomy between members and lack of hierarchical structure is a hallmark of ecosystems (Jacobides, Cennamo & Gawer, 2018; de Vasconcelos Gomes et al., 2018), this creates a challenge for the orchestrator who lacks more formal means of enforcement such as the rule of law, adopted standards or rules of procedure. Stability created by interfirm networks supports value creation (Lorenzoni & Lipparini, 1999). Orchestrators can support stability through several means including their reputation, forecasting a positive future (so called "lengthening the shadow of the future" according to Parkhe, 1993) and combining relationships. As Stuart confirmed "... high levels of technological prestige increased the alliance formation rate" (1998: 689). The incentive to be associated with an influential hub increases stability and discourages members from leaving because

reputation attracts alliances. In addition, a strong hub has been found to increase the variety of relationships between members in a network which also enhances stability (Gulati, 1998: 302; Dhanaraj & Parkhe, 2006: 664).

The ecosystem literature also considers the roles of other players in the ecosystem beyond the keystone or orchestrator role. Early literature by Iyer, Lee, & Venkatraman, (2006) used social network analysis to identify roles in the ecosystem. Through network linkages they identified three key roles, hubs with the highest number of links, brokers which linked clusters and bridges which linked players across the network. Hubs could act as keystones, dominators or niche players in the ecosystem. The bridge position had five separate roles, liaison, representative, gatekeeper, itinerant broker and coordinator; these were primarily focused on how information was communicated and distributed with the technology sector (Iyer, et al., 2006: 44-45). The bridge position in the network was focused on creating interoperable software between companies; these were referred to as “middleware” developers. Not all these definitions continue to be reflected in the ecosystems literature as it has evolved beyond technology applications.

The role of complementor which could encompasses several of the roles defined by Iyer et. al. including niche, bridge and coordinator, has been a theme in the management literature going back to Teece in the 1980s and in the ecosystem literature in the work of Adner when he identified complementors as those adding to innovations with their own innovations (2006:102). Complementors diversify the ecosystem with additional products built from the original innovation; they grow value by building upon

the network. As outlined in the interdependence ecosystem literature, complementors can be autonomous from the innovator but can also have access to the ecosystem customer base (Jacobides et al., 2018: 2258). This element of complementor interdependence reflects the ecosystem elements of co-creation and co-evolution. As the ecosystem evolves, complementors contribute to the growing product and service offers available from the ecosystem. Another important feature of growing importance is the concept of modularity which has been used to better define the features of co-creation and the co-evolution of innovation. The concept of modularity was gained prominence in the work of Baldwin and Clark (2000); however, it was quickly applied to platform ecosystems by Gawer and Cusumano, 2002. Early work in modularity helped to better define the complementary nature of product development; however, the concept of modularity has been expanded to customer focused ecosystems. Various product components that are built within the ecosystem reflect this modular design which “allows interdependent components of a system to be produced by different producers, with limited coordination required” (Jacobides et al., 2018: 2260).

The concept of ecosystem modularity and complementarity has also been linked to alliances and alliance formation. Research by Shipilov and Gawer highlighted that “Modularity in an industry is likely to be related to its alliance-building activities” (2020: 98). In the research by Shipilov and Gawer, the role of modularity was considered significant in diverse industries with changing customer demand. Thus, alliances in ecosystems with a variety of companies are important to compiling products in response

to, but also in collaboration with, customer demand. Research into the influence of network diversity and structure regarding alliance formation across ecosystems is covered below in the following section on interorganizational networks. In the meantime, it is worth considering different approaches to the ecosystem construct.

2.2.1 Ecosystem Types

The various approaches to the ecosystem construct have begun to coalesce around specific streams of work. These are reflected in the descriptions of ecosystem constructs captured in several *systematic literature reviews* that have recently been undertaken. Generally, these streams fall into the categories of business ecosystems, innovation ecosystems, platform ecosystems and entrepreneur or knowledge ecosystems. It is valuable to review the various types of ecosystem constructs to better position the Libra Association case study within the appropriate ecosystem construct.

A number of *systematic literature reviews* have been undertaken to better understand the various directions of the ecosystem construct and to differentiate between the different approaches currently represented in the literature. The fact that ecosystem constructs have evolved to a point where several systematic reviews have been undertaken is an indication of the interest and breadth of ecosystem research. This trend to systematically review ecosystems literature is recent; five reviews that include hundreds of ecosystem articles have been published in the literature since 2016.

Aarikka-Stenroos and Ritala (2017) reviewed an initial set of 240 articles that were identified through the search term “ecosystem”; these were filtered to 129 articles, 71 of which were fully reviewed, coded and categorized. The articles were placed in five

ecosystem streams, business, innovation, entrepreneurial, platform and service.

Dedehayir et. al. (2018) published a literature review of innovation ecosystems that considered 60 publications from a total of 371. The ecosystem articles were filtered to focus on ecosystem emergence and were used to identify roles and phases in ecosystem genesis. De Vasconcelos Gomes et al. (2016) reviewed business ecosystems and innovative ecosystems; this study filtered an initial 499 studies down to 125 articles. Using bibliometric analysis and social network analysis tools, the most cited authors and articles along with the evolution of common themes for ecosystems were identified by de Vasconcelos Gomes. In the same year, 2018, Scaringell & Radziwon undertook a similar analysis identifying 354 articles that were filtered to 104 studies. Four ecosystem streams, business, innovation, entrepreneurial and knowledge were identified in this work. Finally, in 2020 Shipilov and Gawer reviewed networks and ecosystems in which business, innovation and platform ecosystems were identified. Table 2 provides a summary of the literature reviews. This list includes articles in the literature that referred to themselves as *systematic literature reviews*. There are many additional articles that include a review of the ecosystem literature, many of these have been included in this literature review. However, only those articles that have self-identified as systematic reviews of the literature are included in the table.

Table 2: Systematic Literature Review Comparison of Constructs

Authors	Business	Innovation	Platform	Entrepreneur	Other
Aarikka-Stenroos & Ritala	✓	✓	✓	✓	Service ecosystem
Dedehayir et. al.		✓			
De Vasconcelos Gomes et. al.	✓	✓	Within innovation		
Scaringell & Radziwon	✓	✓		✓	Knowledge ecosystem
Shipilov & Gawes	✓	✓	✓		

As highlighted in these ecosystem literature reviews, the three most common constructs are business ecosystems, innovation ecosystems and platform ecosystems. There is a large body of literature dealing with knowledge sharing and knowledge transfer (Alexy, George, & Slater, 2013; Duysters & Lokshin, 2011; Phene & Tallman, 2014; Tsai, 2000, 2001); however, it tends to be affiliated with elements of strategic management, interfirm collaboration and innovation that is separate from the ecosystem literature.

The business ecosystem elements focus on the community of inter-related players with a greater emphasis on collaboration and supply chain elements (Aarikka-Stenroos, & Ritala, 2017). The business ecosystem construct has its foundations in the work of Moore lining back to the biology construct. The development phases of co-evolution such as, emergence, diversification, consolidation, and renewal are a focus. Co-evolution over time tends to converge and align roles (Scaringell & Radziwon, 2018: 62). The business ecosystem tends to focus on roles, connections, and interactions. Business ecosystems center on the firm and their environment (Jacobides, 2018: 2256).

The innovation ecosystem is distinguished from other ecosystem constructs by its focus on innovation or a new value proposition. Some of the key features highlighted in the literature are the importance of the orchestrator role and the fact that this role can be more fluid in an innovative ecosystems Scaringell & Radziwon, 2018: 63) There is a focus on value creation rather than value capture (de Vasconcelos Gomes et al., 2018: 41). And, there is an assumption that customers will respond to innovation; reflecting the lack of focus on value capture. The focus of the innovation ecosystem are the customers who use the end product, in many cases the customer is a key stakeholder. The roles in innovation ecosystems are broader than firms expanding to include non-government organizations, government organizations and resource providers (Scaringell & Radziwon, 2018: 63)

For the platform ecosystem construct, the focus is on a core technology, complementors connect their complementary products and services, often via standardized or open interfaces (Gawer & Cusumano, 2002). The common architecture, often with design parameters, may be set by a hub; however, there is a large degree of autonomy in how participants design, price, and operate their respective modules, as long as they interconnect with others in agreed and predefined ways (Jacobides et al., 2018).

Entrepreneur ecosystems have a greater emphasis on geographic proximity of firms. In addition, the support of government and research is a key element which also focuses the ecosystem on overall economic benefits and contributions to the broader economy. The support of policy makers is more important in entrepreneurial ecosystems

and there are stronger ties to institutions such as universities and think-tanks, or research facilities (de Vasconcelos Gomes et al., 2018; Scaringell & Radziwon, 2018).

The literature provides a number of possible ecosystem definitions which can be applied to the case study. A review of which definition is best suited to the case study is discussed further in section 3.1.1.

2.3 Interorganizational Network Theory and Alliance Formation

The case study for Libra Association can be considered from the perspective of the ecosystem construct; however, when considering the alliance structure of Libra Association, it is also relevant to consider research work in the interorganizational network theory. An important body of research and analysis has been undertaken on alliance and interfirm collaboration in this theoretical perspective and linked to ecosystems. Considering the importance of partner alignment in ecosystem constructs (Adner, 2017, Shipilov & Gawer, 2020), it is appropriate to consider how interorganizational network theories have been combined with the ecosystem construct to help understand the evolution of ecosystems. However, interorganizational network theory encompasses a broad range of management and business considerations such as partnership strategies, knowledge sharing, structural analysis of networks. This literature review draws from the elements of interorganizational network theory that intersect with the ecosystem construct and elements specifically related to early alliance formation.

In the following section, the literature review includes work on interorganizational network theory and social network analysis as it applies to alliance formation.

Interorganizational network theory considers the importance of alliances to share and

grow knowledge that supports new innovation. Vanhaverbeke, Gilsing & Duysters observe “A growing number of studies have shown that strategic alliances and interfirm networks are particularly relevant for innovation and the development of new technology” (2012: 784). However, as the ecosystem research has also pointed out, there are risks with collaborating and the alliance research has focused on balancing the benefits and costs of collaboration. From the perspective of alliance formation, three areas of the literature are particularly relevant for this research. First, the link between network structure and alliance formation. Second, the exploratory and exploitative approaches firms use for alliance formation. And third, research around the impact of technological diversity in ecosystem alliance formation. Previous literature which highlights the combination of network analysis and ecosystems or alliance formation is also considered.

2.3.1 Network Structure and Alliance

Ranjay Gulati published a paper on the social network perspective and strategic alliances in 1998 which has been highly cited (Google Scholar) particularly in the interorganizational network literature. The timing of this work seemed to represent a shift in the research to considering network structure, or network position, and alliance formation. Following Gulati’s work, Tsai published work on the formation of intraorganizational linkages and centrality within the firm network. This research was combined with alliance research which considered the impact of a firm’s alliance experience, something Tsai referred to as “strategic readiness” (2000: 929). This initial analysis focused on the centrality of units within a firm; the analysis confirmed a

correlation between network centrality and linkage creation between units. Following this work Tsai published a second paper in 2001 that confirmed the positive impact of network centrality within the firm to support better innovation and performance. However, this impact was mitigated by absorptive capacity, that is, the ability of a unit to replicate knowledge, something previously identified in the literature by Cohen and Levinthal (1990).

Similar findings to Tsai's work on intraorganizational networks, Schilling and Phelps considered network structure on interorganizational networks. They tested clustering and network connectivity in the distribution of information across interfirm networks; this research confirmed 2005 work by Uzzi and Shapiro that "small world networks" support greater innovation and creativity as information is shared across the network (2007: 1124). The research supported the concept that sparse networks, or structural holes (Burt, 1992), extend the reach of firms and had beneficial impacts on new products. However, the finding by Shilling and Phelps on the benefits of information sharing within closely connected networks was challenged in the literature. Gilsing, Nooteboom, Vanhaverbeke, Duysters & van den Oorda, 2008 used network analysis techniques including connectedness and network density to postulate that proximity within networks lead to reductions in novelty and limited innovation. The impact of interfirm loyalties, governance structures that reinforce common behaviors and redundant information sharing between close partners in a network was considered detrimental to alliance formation focused on exploring new value creation opportunities. Thus, the

literature is not consistent on the impacts of network structure and alliance formation.

Ongoing research efforts have attempted to address these differences. The work of Yan, Zhang, and Guan (2020) considered a combination of factors within the network structure that affect innovation collaboration strategy including structural embeddedness and relational embeddedness as they affect exploratory and exploitative alliances. The study found that alliance formation could benefit from considering the role of both the structural embedded position of firms in a network and the social embeddedness of firms. In addition to the network position of firms, recent work on the influence of network structure on alliance formation has also considered the role of the focal firm in the structure of the network. Song found the more significant the role of the focal firm with the upstream components of a network, the higher the cooperative innovation performance (2016: 26).

2.3.2 Exploratory and Exploitative Alliances

In the interorganizational network literature, research into alliance formation has been influenced by organization learning approaches. Organizational learning considers two approaches. On one hand, existing knowledge and resources are exploited to create value and maintain a competitive advantage in the market. On the other hand, new opportunities are sought through exploration. Exploitation behaviors favour close relationships where knowledge can be transferred through trusted relationships; innovation grows incrementally (Baum, Cowan, & Jonard, 2010: 2106). Exploration requires more risk because knowledge is acquired from less known and more distant sources, it is affiliated with radical innovation (Baum et al., 2010: 2106). The exploratory

and exploitative research has been largely attributed to work by James March (1991). The paper outlining the tradeoffs between exploratory and exploitative organizational learning is quoted extensively throughout the literature. March was careful to delineate that organizations need a balance between exploratory and exploitative approaches (1991: 71), this is commonly referred to in the literature as ambidexterity (Ozman, 2017: 129). This research has had a significant influence on interorganizational network theory. The early work on learning and knowledge sharing has led to extensive research in the area of firm behavior that also shifted to include a focus on exploratory and exploitative relationships between organizations (Dittrich, Duysters, & de Man, 2007; Hoppmann, Choi, & Stumpe Mauter, 2014; Partanen, Kohtamäki, Patel, & Parida, 2020; Zhiang, Yang & Demirkan, 2007).

While the exploratory and exploitative literature was expanding into alliance formation, it was also being integrated with social network analysis. The work by Dittrich et al. for example combined an analysis of IBM partnership changes over time using network analysis techniques. The study concluded that “Learning strategies aiming at exploitation require different alliances and alliance partners than learning strategies aimed at exploration” (2007:1507). The research began to consider the impact of network structure on exploratory and exploitative behavior to better understand alliance strategies and partner selection (Baum et al., 2010; Vanhaverbeke, Beerkens, Gilsing, & Duysters, 2006). The work by Gilsing et al. 2008 which considered network structure combined betweenness centrality and network density with technological distance of partners to

evaluate successful exploration strategies. Their work confirmed that exploration requires a balance of novelty creation and the ability to absorb information. Central firms had the strongest results from explorative innovation. Later work by Karamanos using biotechnology patenting confirmed the theory that highly ego-centric networks support exploitative innovation where "...little additional gains in coherence and reliability of knowledge received from the network because it restricts access to novel information beyond the focal firm's ego-network neighborhood". Furthermore "... ego-network structural holes support exploratory innovation because they provide ... non-redundant flows of information and knowledge..." (2016: 272).

2.3.3 Technological Diversity in Alliances

The third area of research on alliance formation in interorganizational network theory reviewed in the literature is diversity. The benefits of diversity in strategic partnerships is well established in the literature (Ahuja, 2000; Gulati, 1998, 1999) and this work has been augmented by network approaches, including those that consider exploratory and exploitative behavior. Recently work by Zhang, Tang, and Qi confirmed the importance of balancing exploratory and exploitative approaches; this work considers industrial, geographic and functional diversity on innovation ambidexterity (2020: 11). Earlier work by Quintana-García and Benavides-Velasco (2008) supported the proposition that technological diversity was better suited to exploration than exploitation. This finding was later confirmed by Phelps in a longitudinal study of telecommunications equipment manufacturers (2010). Subramanian and Soh (2017) tested the impact of technological diversity in the relationship between focal firms and portfolio partners; they

found explorative alliance experiences to be beneficial while exploitative alliance experiences were not.

Outside of exploratory and exploitative approaches, Van der Borgh, Cloudt & Romme stated “Without a diverse set of firms in place, the likelihood will increase that the ecosystem falls into learning traps that favor specialization and inhibit experimentation” (2012: 165). The research found that the co-evolution of an ecosystem’s business model helped explain firm choices to stay and leave the eco-system.

2.3.4 Social Network Analysis Application to Ecosystems in Alliances

The use of social network analysis (SNA) in interorganizational networks has created a bridge in the research between ecosystems and interorganizational network theory. There is a body of literature dating back to the early 2000s that combines SNA with alliance behavior while also considering an ecosystem perspective. The concept of embeddedness and the roles of network structure (Gilsing et al., 2008; Gulati, 1998; Tsai, 2000, 2001) were not introduced by social network analysis tools. However, these concepts were combined with new social network analysis visualization tools when graph drawing algorithms were integrated with readily accessible software tools.

Network structure refers to the connections a firm has in a network. Social network analysis tools use nodes and edges to measure the network. Nodes can generally be considered firms and edges represent the relationships between firms. Centrality measures the importance of nodes in the network. The number of connections a firm has in a network is the degree centrality. Ego-centric networks represent networks with one degree of separation meaning a direct connection from one node to another node.

Closeness centrality measures the distance to every other node in the network and betweenness centrality measures the percentage of shortest paths to a node from other nodes (Golbeck, 2013).

Venkatraman and Lee, noting "... strong calls for recognition of a relational view of strategy in which firm's critical resources may span firm boundaries and may be embedded in interfirm routines and process" (2004: 876), conducted research into network structure impacts in the video game industry. The network structure of interorganizational networks was used in this case to predict game developer platform choices. Interestingly, this research considered the role of central actors, or hubs, in networks for reasons of legitimacy and stability (2004: 879). This work has parallels to Iansiti & Levian work on keystone organizations in the ecosystem literature in which keystone organizations provide "... a stable and predictable set of common assets" (2004: 73).

Not long after Venkatraman and Lee used the combination of regression analysis and social network analysis to look at affiliations in game developer platform, Iyer, Lee, and Venkatraman (2006) published a paper using social network analysis to explore interfirm linkages between software companies in "small world ecosystems". Social network analysis was used to identify roles in the network (e.g. hub, bridge, broker), the average degree of partners, linkages between firms, network density and clustering to consider the influence of network structure on software companies. The analysis concluded that, based on the five-network metrics assessed, the software sector as a small

world ecosystem (2006: 41); these interconnections between firms facilitated resource exchange (2006: 42). Network intelligence was considered important for managers to understand how firms access complementary resources through relationships.

During the same period, similar network analysis techniques were used by Quaadgras (2005) to consider the formation of a new ecosystem around radio-frequency identification (RFID) technology. This work is particularly relevant to the Libra Association ecosystem case study since it looks at an emerging ecosystem. Quaadgras studied the factors that supported the alliance behavior of large firms including the role of previous alliance behavior, exploratory versus exploitive learning approaches and the availability of slack resources. The research revealed that previous alliance behavior and slack resources were predictors of firm alliance behavior in this case. Research and development spending, diversity and patenting activity were not predictors of whether firms joined the alliance in this research. However, diversity was correlated to when firms joined an alliance. Firms with greater diversity joined the alliance earlier; this result supported the theories of March (1991) that a firm's exploratory behavior is correlated to diversity.

More recent work by Basole & Park (2019) used network analysis to evaluate ecosystem formation in cloud computing. This study is significant because of the parallels between the emergence of cloud computing as a nascent technology and cryptocurrency as a nascent technology. The research into cloud computing used network

size, diversity, and connectedness to evaluate firm value. The study confirmed the ability of social network analysis tools correlate network structure with firm value.

2.4 Cryptocurrency & Libra Association

Given the recent formation of Libra Association there is limited research available in the academic literature. Trade literature is the primary source of information on the developments in the creation of the Libra Association ecosystem and for information on individual ecosystem members.

Academic work has been published primarily in the finance, monetary policy, and economic domains. The financial literature has focused on regulatory research related to securities, commodities, payment instruments and deposits. Monetary policy reviews digitizing currency and global and central banking policies. The research on money identifies different options for the creation, supply, and regulation of currency. A small amount of the literature considers Libra's technical elements such as distributed ledger technology (Mayer, 2019; Taskinsoy, 2019) and its ability to scale (Salmony, 2019), smart contracts (Schmeiss, Hoelzle, & Tech, 2019) as well as whether Libra is a blockchain. Tischer stated "Libra is not maintained and verified by a distributed, decentralised network of computers that participate in the process of transaction verification via a competitive process" (2020: 22).

The financial or "fintech" literature focuses on regulatory matters and the most exhaustive of this research is likely work by Zetzsche, Buckley and Arner (2019) who considered the regulatory, or licensing, implications of Libra from the perspective of money and currency, which they point out is not the same entity as securities,

commodities, and derivatives. This research considers the view of consumers, regulators, service providers and the overall market. Considerations of risk, identity and data protection, monetary policy, taxation, and cross border cooperation are all included in their review of Libra. The overall conclusion by Zetzsche et al. is that the greatest challenge for Libra will be multilateral regulation and supervision across states. However, the authors make the observation that the greatest challenge from Libra could be in the gathering and use of data captured from clients (2019: 15).

Research by Rirscher and Tomanek (2019) compared Libra currency to a payment instrument, a retail investment product, a deposit, or transferable asset and an “alternative investment fund” under European law. The primary conclusion of the paper is that Libra will be regulated under “capital market law” and the unique elements of blockchain technology and the Libra reserve make Libra both a payment instrument and a security. A more detailed comparison of payment instruments conducted by Milkau (2019) concluded that options introduced by Libra’s blockchain alternatives are attractive for customers and provide competitive considerations, including the potential for disruption, for incumbent providers offering international payments.

The research into monetary policy addresses the supply of stable currency to the Libra Reserve and its impact on the money supply, interest rates and developing countries (Tomić, 2020:19). Related to the impacts on individual countries is discussion on the management of exchange rates (Mayer, 2019: 3). Indeed, the former Managing Director of the International Monetary Fund and the current European Central Bank President,

Christine Lagarde, is supporting research into European Bank digital currency. Central bank digital currency has been proposed as a viable competitor to Libra (Mayer, 2019).

Senarathne reviews the impact of Libra on the crypto currency market stability, supply and volatility finding that the stable coin could have a stabilizing effect on all cryptocurrencies in the long run (2019: 95).

Brühl (2020) considers Libra Association as a potential component of broader interdependent ecosystems. The financial ecosystem, in particular links to capital markets, credit supply and liquidity, are considered a potential area of impact for Libra. However, there is no research that specifically considers Libra Association as an ecosystem and thus no observations in the academic literature regarding the formation of the alliance or the ecosystem. However, the Libra research has discussed issues that impact the formation of the ecosystem including the governance structure. The cap on the voting rights of each member to 1% will create disproportionate representation for members with smaller shares within the Libra Association. Zetzsche et al. have questioned whether the governance structure will be able sustainable (2020: 8). This is issue is especially important when considering the role of the ecosystem orchestrator. As previously highlighted in the ecosystem literature, a focal firm such as Facebook plays an important role in sharing value and managing stability (Iansiti & Levian, 2004; Dhanaraj & Parkhe, 2006). This could be particularly difficult for Facebook as the originating orchestrator where they are limited to a 1% vote through their subsidiary Novi (formerly Calibra).

The financial incentives and benefits created for members within the Libra Association ecosystem have also been questioned in both trade and academic literature (Tischer, 2020; Zetzsche et al., 2019). Initial indications in the Libra Association White Papers indicated interest on the reserve would "... pay dividends to investors who provided capital to jumpstart the ecosystem" (2019:7); however, White Paper 2.0, released in April 2020, clarified that "Libra Coin holders will not receive a return from the Reserve" (Libra White Paper, 2020:13). The ability for the focal organization to balance the distribution of financial assets, data assets, customer and market access will be an important element of the Libra Association ecosystem. There is virtually no academic literature on issues beyond financial opportunism. Although, Mayer observed that the ecosystem of Libra members broadens support for the cryptocurrency and takes those members "... out of reach of potential competitors for cryptocurrencies such as Apple, Amazon or Google" (2019:1).

2.5 Summary and Synthesis of Key Findings from the Literature

Both the ecosystem construct and interorganizational networks theories can make contributions to assessing and understanding the evolution of the Libra Association. The literature review has resulted in a number of key findings for the Libra Association case study that have been used in the research.

The ecosystem elements of interdependency, niche player diversity, orchestration, co-evolution and modularity which have been defined through in the ecosystem literature provide an outline from which to evaluate Libra Association as an emerging ecosystem. The role of orchestrator has been highlighted as key to ecosystem formation in the

literature (Dhanaraj & Parkhe, 2006; Gawer & Cusumano 2002; Iansiti & Levian, 2004). Elements such as reputation, governance and appropriation are necessary contributions from the orchestrator, and these can be used to evaluate the role of Facebook in the case study. According to the literature, Facebook will need to undertake these elements in order to successfully launch a cryptocurrency ecosystem.

The ecosystem literature has defined co-evolutionary steps that can be tested in the case study including sub-phases in the birth, or genesis, phase (Dedehayir et al., 2018; Moore, 1993; Thomas & Autio, 2013). These are defined as preparation, formation, operation. Specific roles identified in the literature with ecosystem genesis can be used to evaluate the emergence of Libra Association as an ecosystem. These roles include leader, user, entrepreneur, complementor, expert and champion among others.

Interorganizational network theory suggests that the structure of a network, that is centrality or connectedness, can be correlated to alliance formation (Gilsing et al., 2008; Gulati, 1998; Ozman, 2017). The ecosystem literature on roles can be combined with interorganizational network theory to evaluate whether identified ecosystem genesis roles reflect the correlation to network centrality suggested in the literature. Connections in the network vary depending on the exploratory and exploitative behavior of the firm. Exploitative firms are characterized by closer degree centrality and greater network density. Exploratory firms have less density and a more sparse network that is characterized by focal firms that have high levels of betweenness centrality (Baum et al., 2010; Hu, et al., 2015; Vanhaverbeke, et al., 2006). There is a link between technological

diversity and exploratory alliances, and furthermore, exploratory ecosystem are at risk without diversity (March, 1991).

The use of social network analysis on ecosystem alliance formation has had mixed results in establishing links between network structure and alliance behavior, the work of Quaadgras (2005) found correlations to a firm's previous alliance behavior but not to network structure. Similarly, Basole and Park (2019) was able to correlate firm value with network size, and network diversity but partner network interconnectedness had inconsistent results. Work by Dittrich et al. (2007), Karamanos (2016) and Zang (2018) did find correlations between exploratory and exploitative alliance and network structure.

The academic literature that considers Libra Association has not considered the ecosystem construct or the genesis of the ecosystem. This chapter has reviewed the scholarly literature. The next chapter presents the research design and method.

3 Research design and method

The chapter is structured into 3 sections. The first section outlines the theoretical framework; the second section outlines the research methods and the selection of a single case study research method. The final section explains research design and data collection.

3.1 Theoretical Framework

Building on the ecosystem constructs and interorganizational network theory outlined in the literature review, this thesis uses Libra Association as a case study of the emergence of an ecosystem. The ecosystem construct is used to understand the roles, interdependencies and orchestration of the Libra Association ecosystem and to identify the events that mark the phases of evolution and the relationships within that emerging ecosystem. Interorganizational network theory is used to evaluate the impact of network structure on the roles and phases of the Libra Association ecosystem evolution and on decisions to join or leave the ecosystem. The figure below is intended to provide a conceptual context for how the ecosystem constructs and interorganizational network theory have been integrated to look at the Libra Association ecosystem as a case study. This approach follows the Gawer research which suggested it would be interesting “...to connect the literature on platforms to the literature on inter-organizational network dynamics to derive insights on patterns of emergence and evolution of platform ecosystems as networks of innovators” (2014: 1248).

The qualitative assessment sets the foundation for a quantitative review of the network structure. Network analysis is used to bridge ecosystem research with

interorganizational network theory as has been done elsewhere in the literature (Battistella et al., 2013; Jacobides et al., 2018; McIntyre & Srinivasan, 2020; Shipilov & Gawer, 2020; Teixeira et al., 2015). The assessment of interdependencies, roles, development phases and member attributes in the qualitative step is used to test propositions on the link between network structure and exploratory firm behavior on ecosystem genesis and decisions to join or leave the ecosystem.

Figure 2. Integration of Ecosystem Construct and Interorganizational Networks

As a first qualitative step, Libra Association is reviewed as a case study of an emerging innovative ecosystem. The elements of interdependence, leader/orchestrator and co-evolution emergence are the primary focus of the case study. However, elements

such as cooperation/competition, niche player diversity and modularity are also discussed in the review of the Libra Association ecosystem. The features of interdependent roles within the ecosystem genesis are considered from the propositions developed by Dedehayir et al. (2018). Libra Association is analyzed against the roles as defined in this literature; that is, leader, user, complementor, expert, champion, and entrepreneur. Ecosystem orchestration by Facebook is also evaluated against the ecosystem constructs, specifically elements such as governance, legitimacy, reputation, appropriability. In the literature, the co-evolution “birth” phase of the ecosystem constructs has been further separated into genesis sub-phases of “preparation”, “formation” and “operation”. The experience of the Libra Association evolution over its first 12 months is assessed against these sub-phases. Based on the qualitative evaluation, the three genesis phases and the emerging roles were assembled into a matrix outlined on Table 6. The matrix is used in the quantitative assessment.

For the quantitative assessment of Libra Association, a network analysis is used to evaluate whether the role of the ecosystem orchestrator, Facebook, changed as proposed by the theories on early ecosystem leadership and evolution. In this case, betweenness centrality is used to evaluate Facebook’s ability to manage the network and control information. As such, the betweenness centrality of Facebook for each of the three ecosystem genesis phases is measured to examine whether changing roles in the ecosystem genesis phases have a corresponding change in network position as measured by betweenness centrality. According to the propositions made for ecosystem genesis, the

orchestrator role morphs from ecosystem builder in the “preparation phase” to governance responsibilities in the second phase and complementor seeking activities in the third phase (Dedehayir et al., 2018). The network analysis examines whether the changing roles in each phase are also reflected in the structure of the network as proposed in the literature (Gisling et al., 2008; Golbeck, 2013; Ozman, 2017; Vanhaverbeke et al., 2006). The same analysis is used to test the changing role of entrepreneurs since this group of ecosystem actors undertakes roles that overlap with the orchestrator. The quantitative analysis is combined with the qualitative elements of the Libra Association case study to confirm the changing roles of the leader and entrepreneurs during ecosystem genesis.

According to interorganizational network theory, alliance formation is influenced by exploitative and explorative behaviors (Cui, Yang, & Vertinsky, 2018; March, 1991; Ozman, 2017; Subramanian & Soh, 2017; Vanhaverbeke et al., 2006, 2012). These theories are tested to examine whether they can help explain why firms left or joined Libra Association. Because exploitative firms are leveraging existing knowledge to create value, they have a greater degree of centrality; that is, more links to firms in the network. Exploratory firms have weaker links in the network and thus lower density. Based on the theory, firms leaving Libra Association should have characteristics associated with exploitive behavior and those firms choosing the alliance should reflect more exploratory characteristics. Hypothesis are developed to explore these concepts.

One final element explored in this research is the correlation of technological diversity to exploratory and exploitative alliance behavior. Exploratory innovation is affiliated with access to new knowledge and novel information gained through more distant or weaker ties to partners (Ozman, 2017; Subramanian & Soh, 2017) whereas exploitative innovation is affiliated with incremental innovation (Baum et al., 2010; Karamanos, 2016) and more homogeneous alliance portfolios where partners are closer to each other. The technological diversity of Libra Association members is measured to determine if their level of diversity helps explain exploratory and exploitative behaviors of players and thus supports the premise that exploratory firms will be more likely to stay in the alliance and exploitative firms more likely to leave the alliance.

The application of network analysis, measured as network structure, exploitative/exploratory behaviors and technological diversity, to early ecosystem evolution provides a perspective that has not been previously considered in the research. For example, the impact of network structure and diversity has been evaluated for its impact on performance (Basole & Park, 2019); however, the impact of network structure on the formation phases and roles of an innovation ecosystem has not been addressed. The current evolution of Libra Association provides a unique opportunity to evaluate how network structure may affect the role of ecosystem players in the evolution phases of the ecosystem and to help understand members' decisions to join or leave the ecosystem.

3.1.1 Choice of Ecosystem Construct

As outlined in the literature review, there are several streams in the ecosystem construct. While it may seem obvious that Libra Association would be considered an

innovation ecosystem, there are important elements of the innovative ecosystem construct that distinguish it from a business ecosystem or a platform ecosystem construct.

However, there are elements of business and platform ecosystems that also fit well for Libra Association. For example, Libra currency will be built on an open-source platform which is arguably the most important feature of the Libra ecosystem, particularly in the genesis phase. Features of the platform ecosystem construct may be considered a better fit for Libra Association due to the focus on building a blockchain using unique platform ecosystem constructs such as sponsoring innovation through platform leadership that is centered around a core technology and open interfaces. Similarly, the business ecosystem focus on player interdependencies and a more systematic approach to product development could certainly be considered an appropriate fit for Libra Association given the structure Facebook has created around the alliance itself. For this reason, the table below, which highlights distinguishing features for innovation ecosystems in the literature, has been created to document the reasons for using the innovation ecosystem in the case of Libra Association.

It is important to also note that the interorganizational network theory elements of exploitative and exploratory alliance collaboration highlight innovation (Gilsing et al., 2008; Phelps, 2010; Quintana-García & Benavides-Velasco, 2008). This focus on exploratory and exploitative innovation is an additional reason the innovation ecosystem construct integrates well with interorganizational network theory. And, this further supports the choice of the innovation ecosystem construct in the case study of Libra

Association.

The innovation ecosystem elements represented by Libra Association are outlined in Table 3.

Table 3: Comparison of Libra Association to Innovation Ecosystem

Innovation Ecosystem Features	Libra Association
Orchestrator role – less fixed and changes over time – increases & decreases in importance	Role of FB strongly supports.
Innovation focus – no specific product focus, products and services can be undefined – more focus on firms	Application of cryptocurrency and smart contracts not fully established.
Interfirm collaboration and interdependencies between firms are fluid and change over time – firms can enter and leave, roles can change	Libra Association has experienced changing participation from partners. Leadership roles such as recruitment are shared and changeable.
Stakeholders have a wider range of industries than other ecosystem constructs	Multiple industries and non-government organizations; no government/academia.
Stakeholder independence – more autonomy of participants	Strong governance rules may leave less flexibility than the literature suggests.
Collaboration can be virtual although some researchers claim innovation ecosystems are regionally based	Virtual participation through various open-source portals, Swiss registration.
Governance structure is more fluid, rigid structure in formation stage can change to informal complementor relationships in the future	Early governance structure suggests a rigid approach; open-source platform participation suggest future flexibility for participants.
Unique innovation knowledge sharing; greater emphasis on knowledge creation than knowledge sharing; synergistic processes lead to innovation & co-creation	Open source portals including testnet site and github participation.
Trust is based on mutual dependence rather than contracts, patents, legal agreements	Open source.

Libra Association can also be distinguished from interorganizational networks. Interorganizational networks focus on the nature of ties between firms, the differences

from value network structures and hierarchical relationships are highlighted. This is not consistent with the ecosystem construct.

3.2 Research Method and Case Study

Table 4 summarizes the steps of the research method and outcomes of each step.

Table 4: Research Methods Summary

Step	Description of activity undertaken	Outcome
1	Review Libra Association white papers and the Libra blog to evaluate the membership structure, interdependencies, roles and responsibilities.	Summary of Libra Association structure and member roles and responsibilities.
2	Gather data on alliances and member attributes within Libra Association. Build a timeline of alliance events in the Libra Association emergence.	List of former and existing members of Libra Association over a timeline. Profile of Libra Association members. Industries affiliated with Libra firms.
3	Qualitatively compare Libra Association to innovation ecosystem constructs defined in the literature – interdependency, orchestrator, genesis roles and genesis phases (part of co-evolution construct).	Libra Association similarities & differences to innovation ecosystem constructs. Definition of genesis phases. Identification of Libra members genesis roles.
4	Develop hypotheses to compare Libra Association emergence roles and phases with exploratory and exploitative alliance theory Quantitative analysis of member data to centrality and technological diversity.	Betweenness centrality of orchestrators. Data and visualization of firm's degree centrality, technological diversity by phase and role.
5	Correlate betweenness centrality of orchestrators, the networks structure and technological diversity of firms, roles and emergent phases to exploratory and exploitative theory.	Data and visual results correlating exploratory and exploitative alliance behavior with network structure and technological diversity.

The selection of a single case study to evaluate Libra Association is a common research method (Eisenhardt, 1989; Yin, 2017). In a dynamic evolving environment, a single case study provides an opportunity to test propositions and corroborate evidence against the theoretical constructs developing around ecosystems (Battistella, 2013).

Facebook's Libra Association was chosen as a case study for these reasons.

As Dittrich et al. (2007) points out a case study is an opportunity to "... replicate our theoretical predictions" and it is an opportunity to extend theory by testing it in an

empirical environment. This is the approach used in the current research, in addition to the theoretical value, Libra Association is also interesting for contemporary and practical reasons.

Profile – Facebook is a key player in business development and new technologies and innovation. Their role of as an orchestrator in the emerging cryptocurrency market has the potential to provide a significant step forward in the broad deployment of distributed ledger technologies. The very early stages of the ecosystem formation with Libra Association and the partners affiliated with the launch of the project provide an opportunity to study ecosystems constructs and specifically the formation stages of the ecosystem construct. This opportunity is unique in the timing of this emerging market and unique in the size of players in the alliance.

Diversity – Libra Association represents a range of experienced and new market players from veterans such as Visa and Mastercard, to established players such as Ebay and PayPal to new players such as Shopify. The diversity of market strength is also represented by (relatively) smaller financial players such as Anchorage, Bison Trails, Woman's World Banking and giants like Facebook. A range of sectors are also represented from venture capitalists and cryptocurrency members to traditional fiat players, telecommunications and non-profits.

EcoSystem – The ecosystem is clearly defined by its very public membership and alliance commitment; it is well defined as a closed ecosystem.

Motivation – The \$10 million price of admission acts as an initial screen which

clearly defines the motivation and commitment of the membership. It also helps establish the alliance as closed. This provides a unique case study environment since the information regarding the cost of membership was made public and each member is publicly committed.

There is a caveat to the use of Libra Association as a case study. As outlined above, the use of a case study is intended to test theory against empirical evidence. Libra Association is in some respects atypical. There are few self-identified ecosystems in the area of technological innovation with the size reach of players such as Visa, Mastercard and Facebook; this means drawing generalizations from the research will be more difficult and potentially less relevant. The application of the ecosystem construct to a unique ecosystem which has few equivalents may create limits to the applicability of the research. While the genesis of a new technology could be an important contribution to academic theory, the use of a single case study on an atypical ecosystem creates risks for approaches of pattern matching theory in this example.

3.3 Research Design

3.3.1 Definition of Libra Association membership

For the purposes of this study Libra Association membership is defined as:

1. Any member listed on the Libra Association website as of June 18, 2020.
2. Any previous member identified on the Libra Association website between June 18, 2019 and June 18, 2020.

3.3.2 Study timelines

For analytical purposes (Yin, 2017: 294), the study will cover a period from the

official announcement regarding the launch of Libra Association on June 18, 2019 to June 18, 2020. This period is specific to elements such as role definition and events in the genesis formation.

For the purpose of investigating formation activities prior to formal announcement a one-year period prior to the official announcement was used. For researching alliance relationships between Libra Association members, the length of time was a 5-year period between June 2015 and June 2020. The purpose of setting this 5-year period was to create a consistent and standard methodology for data collection regarding alliance activities and establishing relationships between Libra Association members. Since search tools such as Crunchbase and Factiva have standard search periods in their algorithms, it was necessary to choose a time period that could be consistently applied across all units of analysis (Libra Members).

3.3.3 Combined qualitative and quantitative approach

In this research a combination of qualitative and quantitative approaches is used. Qualitative observations and data from firms and the Libra Association ecosystem are augmented and integrated with quantitative data on the relationship between firms. As Eisenhardt pointed out:

“... case study research can involve qualitative data only, quantitative data only or both. Moreover, the combination of data types can be highly synergistic. Quantitative evidence can indicate relationships which may not be salient to the researcher. It also can keep researchers from being carried away by vivid, but false, impressions in qualitative data, and it can bolster findings when it corroborates those findings from qualitative data.

The qualitative data are useful for understanding the rationale or theory underlying relationships revealed in the quantitative data or may suggest directly theory which can then be strengthened by quantitative support.” (1989: 538)

3.3.4 Data collection

Qualitative Data Collection Methods

The qualitative analysis required detailed information on Libra Association. In evaluating the ecosystem construct, the primary source of information was documentation published directly from the Association. This information is available on the Libra Association website and is sourced and catalogued in the references.

In some cases, additional data was collected from testimony before the United States Congress. Media sources were used to gather direct quotes from the company or from the websites of Libra Association or individual members. Data regarding Libra Association activity and partnership activity was also collected from company websites. Data collection steps from websites were as follows:

1. Review each member website to collect the following data (manual):
 - a. Press release on Libra Association membership
 - b. Press releases related to Libra Association
 - c. Information on existing alliance or partnerships – e.g. Woman’s World Bank lists 49 “Network Members” as well as a separate list of “Partners” – only listed “partners” were collected for the ecosystem data.
 - d. Blog posts or other communications related to the Libra Association partnership.

Data from website data collection were captured in company folders both using text files and screen capture (.PNG). Partnership data collected did not include customer relationships. In some cases, other Libra Members were listed as customers on member websites but not as partners. In these cases, a Libra Member was only identified as having a partnership or alliance if there was a specific reference to a partnership or alliance. Company folders also captured data collected from Factiva as outlined below. The data from folders was transcribed to Excel spreadsheets for the purposes of inputting data to the adjacency matrixes and adjacency lists used in social network analysis. Examples of the folder data template, text files and screen capture, is shown in Appendix C and the Excel spreadsheets are shown in Appendix B.

Data was also gathered from Factiva as a general media source. Factiva was chosen as the data collection tool based on its broad reach across media sources “With nearly 8,000 sources from 118 countries and 22 languages, Factiva is the best source for global business information. And with more than 120 continuously updated newswires.” (<http://factiva.com/sources/facts.asp>: 1). In addition, Factiva research tools provided filters that collate information by media source, industry, subject, executive members, regions, companies, languages, authors, and key words. Media sources include newspapers, journals, radio, blogs, video, and television.

Data collected from Factiva was used to compile company profiles, build the Libra Association events timeline and corroborate information gathered for the quantitative analysis from Crunchbase. Systematic search parameters were used in

searching Factiva, the following steps were used:

1. Search term Libra Association AND Facebook
2. Search Time period – June 18, 2019 to June 18, 2020
3. Search Results = 2822
4. Factiva Industry Filter = “Blockchain technology”
5. Search Results = 291
6. Article Review of the top four media sources listed = CoinDesk.com (55),
The Cointelegraph (24), Forbes (20), Blockonomi (12).

The large number of Factiva results on the main search term in step 3 above required a further filtering of results. The industry filter provided by Factiva was chosen for its systematic and consistent treatment of large volumes of information. This approach has been adopted in similar analytical work specifically on interfirm network analysis (Wu Li, Li, Huang, Wang, 2017) but also more generally in alliance and ecosystem research (Hannah & Eisenhardt, 2018; Hoppmann et al., 2014; Shipilov & Gawer, 2020; Wassmer, Li, & Madhok, 2017). Following the identification of specific information sources, article titles and summaries were manually reviewed for relevance to Libra events and member activities. The full text of selected articles was downloaded and reviewed manually to compile company profiles and the Libra Association timeline of events, Appendix A. The data for each company and event identified in the text files downloaded from Factiva was captured in Excel spreadsheets, Appendix B provides a sample of the data spreadsheet.

For the purpose of augmenting the data on partnerships news media sources searches were performed in Factiva on partnerships using the search term [Libra Association Member] AND partner*. The Factiva filter “Partnerships/Collaboration” was used on each result and results were downloaded into text files and searched manually for references to other Libra Association members. Results were stored in company folders and results were transcribed into Excel spreadsheets for use in the adjacency matrix.

Quantitative Data Collection – Network Analysis.

In order to record the relationships between each Libra Association member for the purposes of network analysis, it was necessary to create an adjacency matrix that could be used in the social network analysis tool Gephi. The adjacency matrix captures relationships between members of the Libra Association ecosystem.

Crunchbase Data Collection

Crunchbase was used to search for partnerships and alliances between Libra Association members announced by any company in the ecosystem. Similar to the qualitative analysis only relationships identified by the company as an alliance or partnership were included in the data collection. Customer relationships were not included in the data. This information is the basis of the adjacency matrix developed to evaluate the evolution of the network structure in Libra Association.

Crunchbase provides a media news service which captures business media by company; this information captures company press releases and reported news media by various sources including business journals, marketing media, technology blogs and

traditional newsprint. Verification of media sources is done by “... artificial intelligence and machine learning algorithms that validate data accuracy, scan for anomalies, and alert [our] data science team of conflicts in the data” (<https://support.crunchbase.com/hc/en-us/articles/360009616013-Where-does-Crunchbase-get-their-data->)

Search results provide article name, URL reference, title, author, publisher, and date. A listing of the entities mentioned in the article is also provided by Crunchbase. An example of the Crunchbase output for companies is provided in Appendix D.

Initially the following terms were searched separately for each company name in Crunchbase and a separate .csv file was saved for each term output: “partner”, “partnership”, “alliance”, “collaborate” and “collaboration”. The term “cooperate” was considered as a search term, however, after a small random search with no relevant results, and for time cost reasons, it was decided only the five search terms would be used in the analysis.

For the first 5 companies, i.e. Visa, Mastercard, Uber, Thrive Capital and PayPal, outputs for each of the 5 search terms were saved in separate files for the purpose of comparing results for each of the search terms. It was possible to count duplicate articles and identify unique references to partnership arrangements between the Libra Association members using these files. A sample of file outputs is provided in Appendix D.

Based on the comparison of the first 5 companies, it was determined that new unique results were produced for each term. As a result, all 5 terms were retained in the data collection. Based on the outputs from Crunchbase for each term it was confirmed

that the search function in Crunchbase was cumulative. That is, the results for the term “partnership”, “partner”, etc. were added to the results for each term searched. Based on this information, all company searches after PayPal were not saved in separate .csv files. All 5 searches were saved in a single file to make it possible to conduct further analysis using one file rather than multiple files. The separate .csv files for the first five companies were combined into a single file as an MS Excel spreadsheet.

For the purposes of this research, a relationship, or an edge in network analysis, is defined as a partnership, agreement or arrangement between two companies within the Libra Association that has been acknowledged and described by the companies themselves. Relationships outside Libra Association have not been included in the analysis even though references to relationships outside the Libra ecosystem were noted. No assumptions, inferences or interpretations of information are made to create a relationship. The alliance information needed to be verified by press release, company blog reference or information on the company website.

In a number of cases the search of the 5 terms did not result in any outputs from Crunchbase, rather than save empty files the following field notes below were noted. The notes reflect a search conducted between August 11 and August 14, 2020.

- Women’s World Banking had no alliance news – total of 2 news articles are listed
- Anchorage had no alliance news – total of 1 news article listed
- Bison Trail had no alliance news – 10 articles listed

-
- Mercado Pago - no alliance news – 6 articles listed: NOTE: pymnts.com news item – “PayPal, Mercado Libre Integrate Payments Systems In Brazil and Mexico” (July 2020)
 - Breakthrough Initiatives - no alliance news – 36 articles listed
 - Ribbit Capital - no alliance news – 349 articles listed
 - Tagomi - no alliance news – 7 articles listed
 - Paradigm Crypto– no alliance news – 1 article listed
 - Slow Ventures - no alliance news – 88 articles listed

The list of firms identified on Crunchbase with downloaded results were the following.

1. Visa	14. Mercy Corps
2. Mastercard	15. Stripe
3. Thrive Capital	16. Lyft
4. Uber	17. Vodafone
5. Paypal	18. Union Square Ventures
6. Ebay	19. Xapo
7. Spotify	20. Creative Destruction Lab
8. Facebook	21. Farfetch
9. Coinbase	22. Andreessen Horowitz
10. PayU	23. Shopify
11. Kiva	24. Checkout.com
12. Iliad	25. Hiefer International
13. Booking Holdings	26. Temasek Holdings

Firm by Firm Review of Data

The process to identify relationships as defined for the purposes of this study, was the following:

1. Downloaded .csv files were saved in MS Excel files to allow for easier data manipulation. The .csv files were difficult to save and some formatting features could not be saved reliably.
2. Manual scan of files to ensure consistent data transfer and to ensure data integrity, match results from downloaded .csv to Excel file.
3. Search each excel spreadsheet for each Libra Association member firm.
4. For each search result, the article title, description and entities mentioned were manually reviewed.
5. On the Excel spreadsheet, highlight partnership references between two Libra Association members in yellow.
6. Duplicate articles were highlighted in orange and not counted.
7. Where a clear relationship is not possible to determine in the title or description of the article, the website reference was checked to confirm if a partnership is identified in the news article – for example, an article with the company name Mastercard which does not have a specific reference to a partnership/collaboration/alliance with another Libra Association member resulted in a separate search of the article to verify whether or not there was a reference to a relationship in the attached link.

8. The results of the Excel spreadsheet search were captured on separate Word files with dates and other data collection notes. The sample template is reflected in Appendix E.
9. The data from each company search was entered onto the adjacency matrix created for Libra Association in Excel. The matrix is found in Appendix F.

In Crunchbase data was available from 2020 to 2001, only partnerships between June 2020 and June 2015 were counted. References to partnerships between 2002 and 2015 were included in the count if there was a reference to a partnership that could be verified through a separate web search as continuing to exist.

It was not possible to download all of Facebook's results between 2001 and 2020 so only the previous 5 years (2015-2020) were downloaded from Crunchbase. A 1000-line maximum download limit prevented the same time period to be used as other companies. To address the limits, separate searches were done for each of the search terms and then combined. A total of 965 results were identified using the 5 search terms. The manual process required for the analysis of Crunchbase outputs limited options for reviewing the Facebook partnerships data before 2015. Because all other company relationships in the data set were found between 2015 to 2020 and only 2 to 3 relationships were identified outside of this time period for the other 34 Libra companies and the 595 potential links in the Libra Network, it was decided to limit the Facebook search period to 5 years.

Data Search Results for Partnerships and Alliances

A total of 3499 articles were reviewed for 35 companies. In addition, a total of 39 article were downloaded from links separately to verify potential relationships according to the study definition.

Technological Diversity Data

In addition to using Crunchbase to build the relationship matrix, data was also collected from Crunchbase on the industry types listed for each company. Crunchbase uses a list of 744 industries clustered into 47 groups. The definition of industries and groups is defined as follows on the Crunchbase website:

The Crunchbase News team will often base its analysis of various industries on one or more of the industry categories defined by Crunchbase. However, we may augment these lists by including companies that use related keywords in their descriptions. We do this to ensure we're deriving as complete a survey as possible of a given sector. (<https://news.crunchbase.com/methodology/>)

In the case of Libra Association, the industries listed for each member firm was captured from the Crunchbase website and included in company profile spreadsheets. The data from the spreadsheet was then used to compare the technological diversity of firms based on the various industries in which they were listed. Appendix H provides the list of industries for each Libra Association member. The Crunchbase industry lists are used in a similar way to the technology fields that appear on patents (Ozman, 2017) in the measurement of technological diversity.

Industries data was input to the Orange software using a table containing company name and the list of industries for each company. Three stop words where used in the

analysis to eliminate outliers in the labelling. The terms “e-commerce platform”, “saas” and “web developer” were included in the stop words since these labels appeared only in one company. The distance and distance map widgets were used to calculate the pairwise overlap of each firm’s industry types. Using the cosine distance metric, Orange calculated the overlap of technologies listed for each pairwise firm. Orange output a matrix, or “distance table”, that calculated the industry matches for each company which ranged between 0, perfectly similar industry types, and 1, no similarity in listed industries between the two companies. The matrixes for each phase of the Libra Association is shown in Appendix I; the matrixes for roles is in Appendix J.

4 Libra Association as an Ecosystem Construct

The Libra Association was announced on June 18, 2019. At that time, 28 firms led by Facebook joined in a collective announcement of the Libra Association. Figure 3 was captured from the Libra website (Libra.org). A White Paper was issued to explain the “mission, vision and purview” of the initiative. The “testnet” site used to develop and support the blockchain technology behind Libra was launched on the same day. Libra was announced as “... a new decentralized blockchain, a low-volatility cryptocurrency, and a smart contract platform that together aim to create a new opportunity for responsible financial services innovation” (White Paper, 2019, p. 1). The highlighted goals included “banking the unbanked”, reducing cost, and increasing access to financial services globally but particularly in the developing world.

Figure 3. *Libra Association June 18, 2019*

The Libra Association was announced as an independent, not-for-profit

membership organization headquartered in Geneva, Switzerland. The members of the organization formed the network of validator nodes that would operate the Libra Blockchain. However, the Association was given a mandate to work with the community to research and implement the Libra network ecosystem. The 2019 White Paper highlighted the diversity of membership with “geographically distributed and diverse businesses, nonprofit and multilateral organizations, and academic institutions”.

4.1 Overview

In order to support a detailed evaluation of Libra Association for specific ecosystem constructs, it is necessary to have an overview of the Association. This overview serves as both context and as a status of the Association up to June 2020.

A primary objective of Libra Association is to create a “simple global payment system and financial infrastructure that empowers billions of people”; that is, a digital currency that is widely accessible and cost effective to operate. Libra’s goal to develop a digital currency using a blockchain based payment system is integrated with fiat currency. This type of digital currency is referred to as a stable coin; it is supported by a reserve of global currencies that help create financial stability for the Libra currency.

The Libra blockchain is built on an open-source platform. This is significant because it is an important element of building the Libra ecosystem. The Libra Blockchain Paper (2019) highlighted the role of the ecosystem: “To validate the design of the Libra protocol, we have built an open-source prototype implementation — *Libra Core* — in anticipation of a global collaborative effort to advance this new ecosystem.” (Libra Blockchain, 2019: 1). It is the emphasis on the new ecosystem that provides the

opportunity to look at the Libra Association as a case study from the perspective of ecosystem construct in the business management literature.

The Libra Association structure includes the Libra Association (LA) Council, a “Libra Network” which serves as the legal arm of the ecosystem, a blockchain open-source platform and multiple ancillary bodies. The graphic in Figure 4, outlines the main components of the structure.

Figure 4. Libra Association Governance Structure

While the development of the Libra blockchain is managed through open-source protocols, there are also sophisticated parallel governance structures shepherding the ecosystem (Libra, Overview, 2019; Libra White Paper, 2020). Members of the Libra Association serve as nodes, or validators, on the blockchain and are entitled to vote on

the policies and protocols that implement the blockchain. The governance structure of Libra Association is established around a non-profit organization; however, the association is run by the LA Council. Each Association member has a seat on the council with one vote. A number of affiliated bodies support different functions under the Libra Association Council. The council operates Libra Networks as a subsidiary of the association; this is the legal entity responsible for developing and operating the Libra payment system, issuing and retiring Libra coins, managing the reserve and hosting the technical roadmap and open-source community. It is not possible for an association to be licensed for financial services under Swiss law; thus, Libra Networks will undertake this function. Application was made to Financial Market Supervisory Authority (FINMA) on April 16, 2020 for a payment system license.

The Council is supported by a Board of five to 19 members which has an Executive Team headed by a Chief Operating Officer. The Board and Executive manage the day-to-day operations of the Association Council and have oversight functions for the technical roadmap, the Social Impact Advisory Board and the Technical Steering Committee. The Council acts as the governance structure for the nodes, or validators, operating the Libra Blockchain.

The Technical Steering Committee has a mandate from the council to “oversee and coordinate the technical design and development of the Libra network” (Libra.org). The committee is responsible for directing the technical roadmap for the Libra network, forming Technical Working Groups to fast-track research into selected specific issues,

guiding codebase development and building a healthy and engaged Libra developer community.

The Social Impact Advisory Board is planned to establish a social impact grant-making program in support of financial inclusion. Social impact organizations are defined by Libra Association as nonprofit and multilateral organizations as well as academic institutions. The Advisory Board was yet to be constituted, however, commitment to the Board was reiterated in the April 2020 White Paper. An application process for grants and contributions is available on the libra.org portal (https://developers.libra.org/partner_form).

The Financial Inspection Unit was announced as part of the White Paper 2.0 to address regulatory concerns regarding compliance and safety on the blockchain. The Financial Inspection Unit has a mandate to monitor Libra network activity and work with both government authorities and service providers to detect and deter inappropriate use of the platform and its products and services. It will be closely aligned with law and securities enforcement agencies.

The implementation of the Libra coin and payment system will be through “Designated Dealers” who are “regulated, well capitalized financial institutions”. Specific criteria have been established to verify the ability of Designated Dealers to buy and sell coins from the Libra Network; this ensures customers do not transact Libra directly with the Network and supports compliance and safety controls. The transaction of Libra will be conducted through regulated Virtual Asset Service Providers. These

providers include over the counter dealers and wallets. Initially only regulated providers will be entitled to transact Libra currency. The definition of regulated is set by the local jurisdiction in which providers operate but generally requires government licensing and government regulatory oversight. As indicated in the green text on Figure 4, Libra Association anticipates that Virtual Asset Service Providers will eventually include “certified” providers; these are providers certified by Libra as well as “unhosted wallets”. Unhosted wallets are essentially virtual accounts that can be hosted globally by uncertified entities; these are considered important for extending Libra currency to the unbanked since regulated and certified VASP are expected to have margins that are too low to extend service to the developing world. Unhosted wallets would be subject to specific security protocols on the blockchain. However, they will be phased in as the technical work that supports the verification and security on the blockchain for these users is progressed.

A number of vulnerabilities are created by permissionless distributed ledger technologies that have stymied the development of blockchain technologies; some examples include money laundering, the funding of terrorism activities and other criminal behavior. To address these concerns, a compliance framework was introduced by the Libra Association in its April 2020 White Paper 2.0. A majority of the updates from version 1 to version 2 of the White Paper have been on the methods and means of addressing these challenges. The compliance framework is supported by the Libra Association and the Financial Inspection Unit.

4.2 Libra Association and the Ecosystem Construct

Libra Association captures many of the elements discussed in the ecosystem and interorganizational network literature. In addition, as highlighted in the literature review, there are recent ecosystem constructs around the birth, or genesis, of ecosystems.

Blockchain technology provides a unique perspective on both innovation and ecosystem creation; this is particularly true given that products beyond cryptocurrency are still being defined. Libra Association provides the opportunity to test the ecosystem constructs specifically in an environment of innovation due to its focus on blockchain technology. In addition, the propositions around the genesis of ecosystems can be evaluated through the Association. To systematically evaluate constructs of innovation ecosystems and ecosystem genesis, Table 5 outlines the key elements from the literature considered in the case study. Each element in the table is reviewed in the qualitative assessment of the Libra Association using data from the Libra Association White Papers, the published Libra technical documentation and selected academic and media sources as outlined in the literature review and methods sections of the paper.

Table 5: Qualitative Assessment of Ecosystem Elements

Name	Description of Construct	Assessed Elements	References
Interdependence genesis roles	Interdependent roles in ecosystem genesis stages	<ul style="list-style-type: none"> ecosystem roles – suppliers, expert, complementors, champions, entrepreneurs & users 	Dedehayir et al. de Vasconceos – Gomes et al.
Interdependent relationships	The need of multiple interdependent firms to create value	<ul style="list-style-type: none"> Level of firm autonomy Relationships not decomposable 	Jacobides et al. Adner
Orchestrator	Ecosystem leadership required by an orchestrator	<ul style="list-style-type: none"> Alliance formation (foraging) Governance and appropriation of resources (value management) Network stability 	Dedehayir et al. Iansiti & Levian Scaringell & Radziwon Dhanaraj & Parkhe Stuart
Co-evolution genesis	Stages of ecosystem development, stages of ecosystem genesis Collaborative evolution (platform)	<ul style="list-style-type: none"> Moore's phases of birth, expansion, leadership, self-renewal (Rong - emerging, diversifying, converging, consolidating and renewing) Genesis stages of preparation, formation & operation Customer need and innovative technologies symbiosis/synergy 	Moore Rong Dedehayir Rohrbeck Scaringell & Radziwon

For the purposes of evaluating interdependencies within the Libra Association, the first point on Table 5 highlights the importance of various roles within the ecosystem. The ecosystem research considers a range of roles; the table reflects many of those most commonly identified in the literature. However, particular, although not exclusive, emphasis has been put on the work of Dedehayir et al. 2018 regarding genesis roles for the following reasons. The work by Dedehayir and his colleagues is a consolidation of ecosystem research on roles; therefore, the step of identifying the most common role

definitions has largely been undertaken in the work of Dedehayir et al. Additionally, the work in this study focuses directly on emerging ecosystems making it highly relevant to the Libra Association case study.

The identification of roles in the ecosystem also help identify the network of relationships which supports the analysis of interorganizational network theories on exploration and exploitation. In order to evaluate the exploratory and exploitative elements of the Libra ecosystem network it is helpful to understand each partner. Roles are one method of understanding the relationships in the ecosystem. Data on the nature of the relationships between players can be acquired by reviewing the roles each member holds, particularly those around alliance building and collaboration.

The ecosystem and interorganizational literature on interdependency highlight the importance of leadership; this is referred to as the role of the orchestrator in the ecosystem construct. As outlined in the literature review, the orchestrator role in an ecosystem has specific elements that will be considered in the Libra Association case study. In considering role and interdependence, the orchestration elements are considered separately as indicated in Table 5. However, the role of the orchestrator also has an important role in the exploratory and exploitative alliance theory due to its position in the network and the ability to share information and support collaboration. Roles in the ecosystem literature include a supplier role, however, as pointed out in the literature review, this role has been distinguished from roles in supply chain theory.

4.2.1 Interdependent Genesis Roles in Libra Association

In order to identify roles as defined in the literature, the qualitative assessment

drew on the data collected in the company profiles, the Libra timeline, the spreadsheets of company data from Factiva media sources and Libra member websites. Information from these sources was used to qualitatively evaluate the most suitable role for each member. The purpose of the assessment was two-fold; to confirm the ecosystem genesis constructs in Libra Association and to gather data for the purpose of testing quantitative hypotheses on the impact of roles on network structure.

Of the 11 roles identified in the work of Dedehayir et al., four are identified with the final “operation” phase (2018: 26). These are dominator, supplier, assembler and complementor. Based on the evaluation of the phases discussed in section 4.2.4, the “operation” phase has not fully evolved in Libra Association and as such the roles of dominator and assembler are not evident. For this reason, these roles are not considered in the analysis.

The role of sponsor was considered a key role in the genesis literature due to their role in facilitating financial resources (Dedehayir et al., 2018: 25). However, since Libra Association is largely comprised of high net worth partners capable of contributing a \$10 million entry fee, the financial resources required for the initial creation of the ecosystem did not appear to be in question. The resources provided by the high net-worth companies appear to be supporting the participation of non-profit organizations. Although data to support this assumption cannot be verified. For this reason, the role of sponsor was considered a role that would be more significant when complementors, assemblers and suppliers require support to join the ecosystem.

The role of regulator is described as a supporter that provides favourable economic, political, and regulatory conditions for the ecosystem; these supports could be regulatory “sandboxes”, credit guarantees or interest free loans. In the case of Libra Association there was no such supportive role by regulators. Based on the reaction of the G7, the United States Congress and the European Central Bank (<https://www.reuters.com/article/us-imf-worldbank-facebook-idUSKBN1WW33B>), the role of the regulatory was not considered to be supportive and given that no regulator had affiliated itself with Libra, the role of regulator was not considered in the genesis phases of Libra.

As outlined in Table 5 the role of orchestrator, or ecosystem leader, is considered separately from other roles due to its importance in ecosystem genesis. The roles that were considered in the Libra Association case study are supplier, user, complementor, expert, champion and entrepreneur.

4.2.1.1 Supplier

Suppliers from the perspective of the Libra Association are still being defined as the ecosystem evolves. Given that products have not yet been produced, consideration of suppliers in the ecosystem is preliminary. However, the ecosystem has generated a platform, a portal and prototypes that are precursors to new products. Thus, the open-source approach to the blockchain suggests that contributors to the blockchain can be considered suppliers. Nonetheless, banks or other financial institutions capable of providing currencies and other securities could also be important potential suppliers for the cryptocurrency stable coin. The lack of participation from banks has been noted in the media (Noonan & Armstrong, 2019). The recent decision of Temasek Holdings, a State-

owned financial investment company, could support the contention by Libra Association that there is interest in Libra from the banking community (Khatri, 2019).

4.2.1.2 Experts

Current Libra Association blockchain companies such as Xapo Holdings Limited and Bison Trails could be considered suppliers. Both companies have the capability to supply cryptographic infrastructure which, for example, interfaces between wallets and currency exchanges. However, Dedehayir et al. suggested that in the nascent stages of ecosystem development prior to value creation the role of ‘expert’ undertakes key activities in the genesis of innovation ecosystems; experts provide advice on the development of products and services (2018: 24). The expert role appears more appropriate for blockchain technology firms at this point in the evolution of the Libra ecosystem given the lack of product but also considering that most of these firms are participating on the Technology Steering Group which is guiding the development process of the blockchain and its products. Treating blockchain technology companies as experts is also consistent with the timing outlined in the ecosystem genesis literature. “These knowledge creation and dissemination activities are likely to take place in the early stages of ecosystem birth, providing the knowledge base upon which the innovation and a corresponding ecosystem of actors can be constructed” (Dedehayir et al., 2018: 24).

4.2.1.3 Complementors

Complementors in the literature are defined as those firms who build on focal point innovations, or platforms, to create new and auxiliary products that meet additional or new customer needs (Gawer & Cusumano, 2002; Muegge, 2013). They are an important

part of modular development (Jacobides et al., 2018). For Libra Association, the early development of the blockchain means that complementors have not necessarily emerged. However, since cryptocurrency and a payment system are the ecosystem's primary focus, firms that look beyond these features could be considered complementors at this stage of the Libra ecosystem evolution. From this perspective, smart contracts may fall into the complementor category given their low level of adoption and the uncertainty regarding how they will be manifested in the marketplace (Schmeiss et al., 2019). Thus, the role of complementor may be fitting for the telecom and internet providers in Libra at this stage of the ecosystem. The business models around providing telecommunications and internet services may benefit from payment options; however the application of blockchain technology to new business delivery, for example metering services to time of day or merging services with third party service providers are potential complementary applications of the technology.

4.2.1.4 Champions

Social impact partners, such as Kiva, Heifer International, Mercy Corp, that are seeking support for banking the unbanked and supporting social development could also be considered complementors. The products and services these firms will use to shape Libra into supporting social mandates have not yet been defined but may be modular or complementary to payment and cryptocurrency products. However, given the early emerging status of Libra, a more fitting role for social impact partners is considered the role of champion. The role of champion supports "... building connections and interacting with different partners during ecosystem birth..." (Dedehayir et al., 2018: 24).

In addition to supporting connections, champions can also legitimize and provide credibility to the ecosystem (Dattée et al., 2018; Dhanaraj & Parkhe, 2006). In fact, the work of Stuart (1998) specifically measured the role of reputation in the high technology industry during alliance formation. For Facebook, the ecosystem orchestrator of Libra Association, a champion is an important contribution due to the struggles of the company with credibility issues related to information sharing, privacy and scandals such as Cambridge Analytica. Each of the social impact partners have provided public support for Libra Association and its mandate to create more affordable access to financial resources (Cheney, 2019, Crawley, 2019). In addition, the Women's World Bank appeared before the United States Senate Committee on Banking, Housing and Urban Affairs (United States Senate Committee Banking, Housing and Urban Affairs, 2019) with David Marcus to address questions regarding Libra Association.

4.2.1.5 Entrepreneurs

Entrepreneurs bring innovation and new ideas to market; they focus on the commercialization step. Thus, entrepreneurs have an important role in bringing players and resources together to support the launch of new products and services. Their role is seen as essential in the ecosystem construct (Dedehayir et al., 2018; Gawer & Cucumano, 2002; Zahra & Nambisan, 2012). In the case of the Libra Association, many of the blockchain technology companies could fall into this category. However, as stated above, given their fundamental expertise in supporting blockchain technology, entrepreneurs such as Xapo, Anchorage and Bison Trail are also considered experts. Dedehayir et al. argues that ecosystem genesis happens in phases. Following this proposition, it could be

argued that blockchain entrepreneurs will act as experts in the “preparation” phase of the ecosystem genesis but move into the entrepreneur role in the “operating” phase of the ecosystem genesis when products and services are being created. This appears to be the case for Libra for the following reasons. As of July 2020, the Libra blockchain had no products or services in the market. Thus, consistent with the definition by Dedehayir et al., Libra Association has not fully implemented the “operation” phase of ecosystem genesis. Furthermore, a number of the entrepreneurs participating in Libra Association, Bison Trail, Anchorage and Coinbase are also participating in another blockchain alliance, Celo Foundation’s *Alliance for Prosperity*; this provides additional opportunities to find synergies for new products and services. For these entrepreneurs, this is an indication that all options are being kept open for blockchain product and service development. The fact that key players are spreading their resources across ecosystems by participating in multiple alliances is an indication of both the uncertainty and the recent emergence of the technology. Finally, it is possible for blockchain companies to move from expert to entrepreneur roles in the genesis ecosystem because this is anticipated in the literature. Dedehayir et al. observe, “...actors are likely to enter the innovation ecosystem at various times across the birth phase, and also assume a sequence of different roles as the genesis process unfolds.” (2018: 27).

In the Libra Association, the category of entrepreneur can also be applied to venture capitalists. Venture capitalist firms could be considered a third-party contributor closer to the role of sponsor or complementor since they do not directly link to the ecosystem

priorities of payment and cryptocurrency. However, venture capitalists have been considered entrepreneurs in this instance because of their role in supporting the interdependencies in the ecosystem. Linking networks are important role of entrepreneurs (Dedehayir et al., 2018: 24; Scaringell & Radziwon, 2018: 63). Venture capitalists in the Libra Association have links across a number of Libra Association members and thus contribute to the alliance formation elements by intermediating between partners. For example, Marc Andreessen, of Andreessen Horowitz, is a former Board Member of Facebook. Matt Huang at Paradigm collaborated on blockchain policy papers with Xapo and Ribbit Capital (https://www.paradigm.xyz/Bitcoin_For_The_Open_Minded_Skeptic.pdf). Sam Lessin, founder of Slow Ventures, is a former Vice President of Facebook. Paradigm's Fred Ehrsam is the co-founder of Coinbase. Xapo's CEO and founder Wences Casares, is on the Board of PayPal. And, Ribbit Capital is an investor in Xapo. Furthermore, Libra Association venture capital firms specialize in blockchain technology and in some cases, such as Paradigm, invest exclusively in "crypto focused investment" (paradigm.xyz). Venture capital firms such as Thrive Capital, Slow Ventures and Union Square Ventures all have histories with blockchain technology investments. As such, venture capital firms have been grouped into the entrepreneur role in the genesis phase of the Libra Association ecosystem. The role of Shopify in rapidly commercializing many entrepreneurs on its e-commerce platform and the unique network of internal and external collaborators on its platform placed it in the entrepreneur role.

4.2.1.6 Users

The role of user has also been identified as key to the emergence of the ecosystem

in the construct; this role is particularly important for open-source projects where users contribute to deliverables. Open-source contributors provide technical support as well as feedback on product and service design, functionality, effectiveness and usability; they supply ideas for new uses and modifications. For Libra Association, the open-source project on the blockchain makes the user an important role. One of the measures of this contribution can be tracked through the number of contributors and the number of contributions provided at <https://github.com/libra/libra/graphs/contributors>

Besides purchasing and using products, users in the emerging ecosystem identify problems and needs, provide fresh ideas and integrate complementarities (Dedehayir et al., 2018; Gawer & Cusumano, 2002). In the case of Libra Association, users can be defined as alliance members who support and benefit from the new Libra payment services. For example, PayU, Stripe, PayPal, Visa, and Mastercard integrate and expand payment options. These users potentially increase the reach of their market through new payment options or services not available in existing markets. The beneficiaries of payment services also extend to merchants selling services such as Booking, Farfetch, Uber, Ebay, Lyft and Mercado Pago. These merchants benefit from new payment methods as a convenience to their clients. However, the additional competition that blockchain products introduce into the payment sector, have the potential to make payment rates more affordable. For this reason, these firms have been identified in the Libra Association ecosystem as users. However, it is likely some become complementors at a future phase in the evolution of the ecosystem.

4.2.2 Summary of Ecosystem Genesis Roles

Based on the qualitative assessment of Libra Association, five roles in addition to the orchestrator were identified in the first 12 months of the ecosystem. As discussed, in some cases, more than one role can be assigned to a member; this is acknowledged in the literature (Adner, 2017; Battistella, 2013; Dedehayir, 2018, Dhanaraj & Parkhe, 2006). However, the most likely role during the stages of genesis was based on the qualitative analysis above. No supplier role was identified.

4.2.2.1 Orchestrator

Facebook was defined as the orchestrator based on its actions in announcing the Libra Association, its actions in identifying and soliciting partners prior to the 18 June 2019 announcement and its representations of Libra Association to the United States Congress, the G7 and individual State governments. This includes the acknowledgement of its role in testimony before the U.S. Congress (House Financial Services Committee Hearing; Congressional Documents and Publications, July 17, 2019)

4.2.2.2 Experts

Firms with existing expertise in blockchain technology were identified as experts. “Existing expertise” was defined as having operated a business on or off a blockchain or of having built or provided more than financial support for the development of cryptocurrency infrastructure, that is wallets, exchange services, etc. Seven firms were identified, Creative Destruction Lab, Bison Trail, Coindesk, Xapo, Anchorage, Tagomi and Breakthrough Initiatives.

4.2.2.3 Complementors

Complementors were identified as firms having business models that could deploy new blockchain technology outside of the initial focus of cryptocurrency. The potential smart contract application of blockchain technology to the intellectual property rights of musicians for Spotify's is an example. The use of metering services on blockchain for telephone/data use were considered another. Three firms were identified, Spotify, Vodafone and Iliad.

4.2.2.4 Entrepreneur

The category of entrepreneur captures firms looking to fund and commercialize new technology and firms with an entrepreneurial business model suited to blockchain. In the Libra ecosystem, this group is characterized by venture capital firms with a role in alliance building due to their relationships with other members in the ecosystem. The members identified were Thrive Capital, Union Square Ventures, Ribbit Capital and Andreessen Horowitz, Slow Ventures, Paradigm and Shopify.

4.2.2.5 Champion

The role of ecosystem champion for the purposes of Libra Association includes the non-government organizations and non-profit organization who do not have expertise in blockchain technology. One non-profit organization, Creative Destruction Lab, was put in the category of expert due to their work in promoting and developing blockchain technology. The specific mandates of each organization to social justice issues such as banking the unbanked, categorized them as champions for Libra Association. The four firms identified in the role were Kiva, Women's World Banking, Mercy Corp. and Heifer

International.

4.2.2.6 Users

Users were defined as those firms with a business application which would first be operationalized by a currency or token for business transactions. Recognizing that multiple potential roles for each member are possible, the criteria used was “initial best-use” of Libra technology. In most cases, this will be the cryptocurrency. For example, Uber Technologies may have a high likelihood that the Libra blockchain could support security technologies for flying automobiles in the future; however, based on the existing business model of Uber, it was assumed the initial best-use of blockchain technology would be payment for ridesharing services. Thus, the opportunity for the initial use case to be replaced by a new application of blockchain technology was treated as secondary to the “initial best-use” case based on the existing business operation of the company. The firms identified were Mastercard, Visa, eBay, PayPal, PayU, Farfetch, Mercado Pago, Stripe, Uber, Lyft, Booking and Checkout.com.

In considering interdependency as it relates to the ecosystem constructs, roles are an important consideration in the literature going back to Moore. In considering the impact of roles on interdependencies within the Libra Association the following conclusions can be made from the forgoing review.

1. There are consistent correlations between the roles in Libra Association and the roles defined in the ecosystem construct literature. There is evidence that the emerging Libra Association ecosystem includes suppliers, experts, complementors, champions, entrepreneurs and users.

-
2. Some of the roles proposed in the emerging ecosystem literature, such as “sponsor”, “assembler” and “regulator” may not have appeared in the Libra Association ecosystem in the first twelve months of evolution. Regulators have interfaced with Libra but there is not evidence that any have affiliated themselves with Libra Association.
 3. Linkages exist between individual members as defined in the interorganizational network theory. The role of entrepreneur that is emerging in the Libra ecosystem acts as an intermediary between partners. Entrepreneurs have several links to other partners in the ecosystem, particularly later in the ecosystem evolution. The identification of these linkages through the qualitative review are used to augment the data collection process done in Crunchbase for the quantitative review and to support the analysis of network structure related to orchestrators as well as exploratory and exploitative alliances.

4.2.3 Interdependent Relationships

With regard to ecosystem interdependencies, the literature reflects a number of considerations beyond roles which can be assessed from the perspective of the Libra Association. In fact, Adner argued that ecosystems are reflected less in actor roles and more in the activities between partners which are “not decomposable” (2017: 42). In the case of Libra Association, the objective of a universal payment system based on a blockchain has the potential to create interdependent activities between partners that are not decomposable; however, without a fully functioning platform that is generating product (cryptocurrency), this exercise is speculative. Nonetheless, as the Libra

ecosystem forms it is possible to evaluate interdependencies from the perspective of the forming governance structure. The governance structure is reflected in the Libra Association documentation.

The Libra “Overview” document outlines some of the responsibilities and expectations for partners in their role on the Council. The Council has been designed, through its voting structure, to ensure a collective decision-making format that represents the interest of the blockchain operation. The Council is made up of blockchain nodes (validators). Voting rights are capped at one each for “Founding Members” to avoid concentration of power (Libra Overview, 2019: 3). Key decisions require a two thirds majority vote. Key decisions include changes to the reserve management policy, removal of Council members, creation of committees and changes to guiding principles. The intention of the governance format is to transition away from a structure initially launched using a Founding Member format to a proportional representation format. The Founding Member format is designed to have a balance of power between validator nodes, no Founding Member can have more than one vote regardless of the number of tokens held (Overview Document, 2019: 4, bullet 4). Where the number of tokens held by any member would entitle them to more than one vote on a proportional basis, social impact partners are expected to have a role in distributing voting rights amongst Council members (Overview Document, 2019: 4, bullet 4, sub-bullet 3). The governance documents are structured to reflect the intention to migrate from the Founding Member format to a proportional representation system. This is accomplished as new validator

nodes are added to the Council thereby reducing the influence of Founding Members as the blockchain becomes larger and more diversified (Overview Document, 2019: 4, bullet 2).

In addition to the governance structure, early signs of ecosystem interdependencies are evident in the relationships between Libra Association Members. As outlined in the previous subsection on entrepreneur roles, it is possible to identify a multitude of interfirm relationship between partners. However, despite the presences of certain interdependent elements, at this point in the Libra ecosystem formation, no inseparable integration of firms or relationships were identified in the research. The open-source platform which is building the Libra blockchain through individual and collective contributions is building the interdependence of the technology. However, at the end of the study period, while the relationships of nodes in the governance structure suggest the future ecosystem will lead to activities which are not decomposable; there are none in evidence at the moment.

Partner autonomy is a distinguishing feature of the ecosystem construct that is different from management theory supply chains and value chains (Iansiti & Levian, 2006, Jacobides et al., 2018). The governance structure set out in the “Overview” document for Libra puts control over the blockchain into the collective. As a result, from a governance perspective, this brings into question ecosystem propositions regarding firm autonomy within the ecosystem. The proposition, affiliated with the innovative and platform ecosystem construct, is that orchestrators set the overall rules of the platform

and complementors, suppliers, assemblers, etc., are free to use the resources of the ecosystem to develop their own products and services somewhat independently as long as they conform to platform standards (Gawer & Cusumano, 2002). This approach provides members of the ecosystem with a degree of autonomy. However, for the Libra ecosystem, the functional rules of the platform will not be established by the orchestrator but rather by the Libra Council. The collective decision-making process calls into question the autonomy of network partners. The role of nodes on a distributed ledger blockchain has the potential to limit certain aspects of member autonomy given the inter-related dependencies created by the immutable distributed ledger. The formation of the ecosystem is not developed enough to confirm or contest the proposition unequivocally. And, there is room for complementarities to grow once the blockchain has been established and the first products have been rolled out.

4.2.4 Orchestrator – Ecosystem Lead

There remains a general consensus in the literature that the orchestrator plays a fundamental role in the ecosystem. This has been confirmed in recent systematic literature reviews (Scaringell & Radziwon, 2018; de Vasconcelos Gomes et al., 2018) and in recent research by on ecosystem genesis (Thomas & Autio, 2013). In fact, five specific leadership activities have been defined for ecosystem leaders in the formation of ecosystems; these are governance, platform management, foraging partnerships, value management and dominator (Dedehayir, et al., 2018). These activities are consistent with earlier interorganizational network theory around leadership which focused on similar elements represented as managing “knowledge mobility”, “innovation appropriability”

and “network stability” (Dhanaraj & Parkhe, 2006). Facebook has been clear that it has undertaken the leadership role in Libra; it testified as such before the U.S. Senate, and is reflected in the White Papers issued by Libra Association.

In examining how well Libra fits the ecosystem construct from the perspective of an orchestrator, the three elements in Table 5 summarize the main components in the literature, 1) alliance formation, 2) governance and appropriation of resources and 3) network stability. Beginning with alliance formation, the activities of Facebook to recruit partners for Libra had limited public exposure prior to the 18 June 2019 announcement. A Factiva media search for “Facebook AND partnership OR alliance” one year prior to the announcement yielded 456,088 documents, not one cryptocurrency news sources appeared in the top 100 news sources of these stories. When these results were filtered by “cryptocurrency” and “Facebook”, 17 articles were found, the majority of these articles dealt with Facebook’s advertising policy for cryptocurrency (Factiva, 2020). The work that Facebook undertook to recruit 27 partners prior to June 18, 2019 was accomplished outside of media coverage; this is significant given the size of partners such as Visa, Mastercard, Ebay, and PayPal.

The importance of trust and credibility in developing partnerships is highlighted in the literature. According to Dhanaraj and Parkhe “Given high levels of outcome uncertainty typical in an innovation process, compounded by uncertainties of potential partner behavior, reputation provides the signaling effect of trustworthiness and is significant in attracting alliances...” (2006: 664). The ability of Facebook to protect its

partners and gain the necessary trust to secure their participation is consistent with the ecosystem leader construct. The lack of media information prior to the announcement demonstrates the ability of Facebook to negotiate with partners while protecting the privacy of discussions. The success of this effort was demonstrated by the fact that of the 15 media publications tracking Facebook between June 2018 and June 2019, none mentioned partnerships or alliances prior to May 2019 (Factiva, 2020). This is significant because media was watching Facebook activity in the cryptocurrency sector; this was evident by articles published when Facebook advertised blockchain job vacancies (Baydakova, 2019). It was also evident from media statements regarding “its very secretive stance when it comes to their blockchain/cryptocurrency project...” (Linzerd, 2019: 2) and “zero statements from the company formally on the [cryptocurrency] matter” (Kelso, 2019: 1).

Facebook invested effort in protecting the alliance formation exercise. The ability of Facebook to gain the trust of partners during this period demonstrated some degree of success and an understanding on behalf of Facebook of the importance of trust and the protection of partners information.

The need for orchestrators to build collaboration between partners in an ecosystem can be challenging since some of the typical control mechanism in a hierarchical structure are not present in ecosystems. The lack of contractual relationships and written agreements are part of the ecosystem construct, along with the fact that these types of arrangements do not cover all stakeholders in the ecosystem. The means to leverage

collaboration between partners focuses on building trust and using reputation (Stuart, 1998). In the case of Facebook, there was also a lack of public and political trust (Tonin, 2019). The ability of Facebook to overcome public trust issues and the vulnerabilities of its reputation to bring the Libra Association partners together speaks to some of the collaborative competencies identified in the literature. Visa, one of the largest and most established partners, went the additional step of issuing a separate press releases in support of Libra. An action undertaken by only a few of the partners on June 18, 2019; Ebay, Illiad and Farfetch being the others.

The success of Facebook to bring 27 partners together into the Libra Association is consistent with the elements attributed to the ecosystem construct. Media reports (Popper, 2019) indicate that non-disclosure agreements were used in discussions with potential partners. Furthermore, Facebook tightly controlled Libra information as captured by earlier media statements (Kelso, 2019; Linzerd, 2019). This information suggests a more tradition approach of formal agreements were typical of the early Libra alliance work. The use of these formal agreements by Facebook at the very inception of the ecosystem bring into question ecosystem constructs that informal and less structured approaches are typical of ecosystems. It could be argued that the use of tools such as non-disclosure agreements reflect a more hierarchical supply chain approach.

De Vasconcelos Gomes et al. suggested in an innovation ecosystem where products are not necessarily defined in advance, the network actors vary according to the ecosystem evolution and there is a lack of stable governance since partners can change

independent of formal contracts (2018: 42). However, in the early stage of the Libra Association genesis the more traditional strategies used by Facebook appear inconsistent with the ecosystem construct. Facebook appeared to leverage control over the process through the use of legal contracts and media management. In addition, later in the genesis process, a signed charter is used to establish alliance governance. The genesis of the ecosystem may need the certainty of the stronger platform structure provided by formal agreements as the ecosystem is evolving. Once the platform has been established and complementors are able to grow out of the initial ecosystem offerings, fewer formal arrangements may be necessary within a broader ecosystem as the construct suggests. Unfortunately, it is premature to consider this proposition and more detailed research beyond that which is publicly available would likely be required to investigate further.

Alliance formation theory found in the literature identified the need for the orchestrator to support diversity and the creation of niche opportunities. Facebook as the recruiter has collaborated with a wide range of potential partners. From the perspective of the role of the orchestrator, Facebook has emphasized its effort to look beyond its own sector. The diversity of the Libra ecosystem from both firm size and age, the spectrum of users from transportation to merchandizing and the inclusion of social impact partners indicate the awareness of Facebook in its role to open dialogue across a broad representation of ecosystem users. The need for diversity was highlighted in the first White Paper which stated: the association represents “...geographically distributed and diverse businesses, nonprofit and multilateral organizations, and academic institutions.”

(Libra White Paper, 2019: 4). This approach was strengthened and reiterated in the second version of the paper.

The orchestrator has key responsibilities in appropriating knowledge, value and perhaps most importantly for Libra Association, opportunity. Facebook has chosen to do this through its governance structure. In the interorganizational network and ecosystem literature the ability to appropriate was underlined by trust (Gulati, 1998; Hannah & Eisenhardt, 2018; Quaadgras, 2005). It is difficult to establish trust prior to active collaboration which is one of the means leaders can use to build trust (Lorenzoni & Lipparini, 1999: 330). During early genesis of the ecosystem and the open-source platform, Facebook has used governance mechanisms to facilitate collaboration in the development towards products.

In terms of appropriating knowledge, the Libra documentation sets the standards for the open-source blockchain sharing of information and Libra has provided regular and ongoing updates for developer participation. (<https://community.libra.org/>; <https://github.com/libra/libra>, <https://www.coindesk.com/libra-fireblocks-ceo?jwsourc=cl>; Baker, 2020a). Open-source information has been updated more often than the Libra White Paper. Furthermore, a new process was launched in the Spring of 2020, Libra Improvement Proposals (LIPs); this process allows the Libra developer community, or any interested party, to propose changes on the blockchain or engage in discussion about a proposal on the blockchain. This means, in addition to coding contributions, broader proposals and issues can be discussed openly amongst the Libra

community.

The Libra documentation appropriates power and control in the governance structure of the full ecosystem. The rules regarding Libra Association voting rights appropriate this according to established formula which are clear and transparent explained by “The voting powers in the Council are proportional to stake (initially in the Libra Investment Token and, in the future, in Libra), which is a reflection of the level of commitment of the member (validator node) toward the network” (Libra Overview, 2019: 3). In addition, efforts have been made to circumvent issues regarding the apportionment of power with rules such as: “The Libra Association Council will prevent related entities from presenting themselves as two distinct Founding Members in order to avoid the circumvention of the above measure” (Libra Overview, 2019: 4). Thus, efforts have been made to ensure one vote per member. The documentation also appropriates resources: “...the financial return received from the Libra Investment Tokens ... is proportional to the size of the investment” (Libra Overview, 2019: 4).

The appropriation of opportunity outside the Libra ecosystem is unclear. The ecosystem concept does not currently reflect the ecosystem approach envisioned in the ecosystem construct where partners can independently participate without formal contracts (Adner & Kapoor, 2010). The \$10 million entry fee will act as a significant barrier to external complementors at least for potential on-chain products and services. However, until the Libra currency is launched it is difficult to speculate on how external actors will interface with the ecosystem.

The final component in ecosystem leadership to be evaluated in the Libra ecosystem is network stability. Libra has been relatively volatile over the first 12 months of its existence. Of the 28 original members, seven left in the first four months, followed by an eighth in January of 2020. However, since that time, seven new members have joined Libra. In addition, a new open-source blockchain alliance was formed in March, 2020 by Celo Foundation, *Alliance for Prosperity*. Some of the Libra members have decided to participate in both alliances, including the technical experts Bison Trails, Anchorage and Coinbase. However, the number of contributors to the open-source platform has grown steadily and new membership to the Association has continued into its second year.

The growing level of engagement on the open platform and continued success in attracting additional partners into the second year (Baker, 2020b) demonstrate stability in the early platform despite the volatility in membership.

4.2.5 Co-Evolution - Definition of Ecosystem Formation Phases

These phases reflect descriptions in the literature that have built on the “birth phase” outlined by Moore. Dedehayir et al. has provided more specific time periods within the initial “birth” or formation stage which have been used to assess the Libra Association. The identified phases follow from the work such as Rong, who identified ecosystem phases such as “emerging”, “diversifying”, “converging”, “consolidating” and “renewing” (de Vasconcelos Gomez et al., 2018: 40). The work of Thomas and Autilo looked more specifically at genesis phases; they identified “initiation”, “momentum”, “optimization” (2013: 17). There seems to be some consensus in the literature that the

formation of ecosystems can be divided into stages.

The Libra Association timeline in Appendix A has been used to identify the three phases most recently identified in the literature, the preparation phase, the formation phase and the operation phase of genesis.

Preparation Phase

The first phase is identified as June 18 - October 13, 2019; this is the preparation phase focused on “... constructing a premise and the establishment of necessary conditions to stimulate the genesis process” (Dedehayir et al., 2018: 25). This phase includes the initial announcement of Libra Association where potential member had signed a letter of intent but not made a formal commitment to Libra Association and no money was paid. The initial reaction to the Libra Association announcement by public and government is captured in this phase. Near the end of the phase, the departure of key firms occurred which was shortly before the formal signing of the Libra Association Charter.

Formation Phase

The second phase is identified as October 14, 2019 - February 20, 2020. This is the formation phase; where collaboration between actors is enabled and the role of entrepreneurs, champions and sponsors are activated in the network. For Libra Association, this phase includes the period when public and government media coverage was waning, the focus of the alliance was on governance, the Charter was signed, the Libra Association White Paper was updated and the Technical Steering Committee was

constituted to develop the technical roadmap and support the developer community.

Pre-operations Phase

The third phase is identified as February 21 - June 30; this phase is referred to as the “pre-operation” phase. It is characterized by a redefinition of roles, moves by the orchestrator to enhance collaboration and resource flows as well as continued work by experts, champions and sponsors to solidify the network. In the literature this phase would normally be an “operating” stage. However, there is currently limited value creation in the current state of the Libra Association ecosystem. As a result, for the purposes of this study, the third phase is referred to as the “pre-operating” phase.

The rationale for including a third phase despite there being limited operational activity rather than maintaining this time period (February 21– June 30) in Phase 2 are the following. Consistent with the third phase as defined in the literature, this phase saw a resurgence of memberships in Libra Association with the addition of seven new members starting with Shopify on February 21 and ending with Temasek, Paradigm and Slow Ventures on May 14, 2020. The addition of significant member such as Shopify and the State-operated Temasek Holdings reflects strong potential in the shifting of roles in the organization; this is a phase three characteristic. In addition, a significant portion of the formal governance structures were established in Phase 2.

Summary of Co-Evolution Genesis Phases and Roles

In Table 6 the roles of each member have been divided into the appropriate phase. The phase reflects the point at which each member joined the Association. The roles have

been assigned to each member as outlined in section 4.2.1.

Table 6: Libra Association Roles Identified by Phase

	Phase 1 – Preparation	Phase 2 - Formation	Phase 3 – Pre-Ops
Leader	Facebook	Facebook	Facebook
Dominator	*	*	*
Assembler/Supplier	*	*	*
User	MasterCard Farfetch Visa eBay PayU Mercado Pago Stripe Uber Lyft PayPal Booking Holdings	Farfetch PayU Uber Lyft Iliad	Farfetch PayU Uber Lyft Iliad Checkout
Complementor	Spotify Vodafone Iliad	Spotify Vodafone	Spotify
Expert	Creative Destruction Bison Trails Coinbase Xapo Anchorage Breakthrough	Creative Destruction Bison Trails Coinbase Xapo Anchorage Breakthrough	Creative Destruction Bison Trails Coinbase Xapo Anchorage Breakthrough Tagomi
Champion	Kiva Women's World Banking Mercy Corps	Kiva Women's World Banking Mercy Corps	Kiva Women's World Banking Mercy Corps Heifer International
Entrepreneur	Thrive Capital USV Ribbit Andreessen Horowitz	Thrive Capital USV Ribbit Andreessen Horowitz	Thrive Capital USV Ribbit Andreessen Horowitz Slow Venture Paradigm Temasek Shopify
Sponsor	*	*	*
Regulator	*	*	*
* Roles not identified between June 18, 2019 and June 18, 2020			

The defined phases and roles for Libra Association are used to consider the impact of network structure on the evolution of the ecosystem. As outlined in the following chapter, the network of firms in each phase are used to measure changes in network structure as the genesis of the ecosystem evolves. The data collected on the relationships between Libra Association firms using Crunchbase and the Factiva media scan is used to construct the network of relationships in each phase.

The role of the orchestrator in the network is measured by calculating relationships between the orchestrator and the firms in each phase. To undertake this analysis the separate lists created for each phase were also used (refer to Appendix G).

5 Network Analysis of Alliance Formation

The qualitative review of the Libra Association as an ecosystem led to the identification of three genesis phases of the Libra Association ecosystem along with key roles. For the quantitative assessment of Libra Association, a network analysis is used to further evaluate the roles in the ecosystem and the impacts of the network's structure on alliance formation as it evolved over the three phases. The following chapter addresses the orchestration of alliance formation and emerging ecosystem phases using network structure and technological diversity to evaluate exploratory and exploitative alliance formation.

5.1 Network Structure and Alliance Formation

In this thesis, the first element of network structure considered is the network position of the orchestrator. As Gulati points out "... the position an actor occupies in the structure is a function of the actor's relational pattern in this network" (1998: 298). Network position can be measured through the centrality of a firm within the network (Gilsing et al., 2008; Golbeck, 2013; Ozman, 2017). The importance of leadership and the network position of leaders in alliance formation is highlighted in the both the ecosystem and interorganizational network literature (Dhanaraj & Parkhe, 2006; Gulati, 1998; Iansiti & Levian, 2004; Ozman, 2017; Podolny & Stuart, 1995). Libra Association provided an opportunity to test ecosystem constructs around orchestration and the genesis of ecosystems using network structure. Three types of centrality are commonly considered in network analysis (Lai, 2016). As discussed, network analysis uses the concept of nodes and edges, nodes represent individuals or firms, and edges represent the

relationship between nodes. Closeness centrality measures the distance to every other node in the network. Degree centrality measures the number of connections, or edges, that a node has within the network. One node with many connections would be considered well connected within a network. Path length is used to calculate centrality and a path is one link between two nodes; this is used to compute closeness centrality. Betweenness centrality measures “how important a node is to the shortest paths through the network” (Golbeck, 2013: 30). In a network where information flows between nodes, a node with high betweenness centrality would have more influence over the flow of information by virtue of the fact that it has many short paths in the network linked to it. In some cases, this position in the network is referred to as a “gatekeeper” (Lai, 2016; Sloane & O’Reilly, 2013).

The betweenness of a vertex v in a graph $G: = (V, E)$ with V vertices computed as follows:

For each pair of vertices (s,t) , compute the shortest paths between them.

For each pair of vertices (s,t) , determine the fraction of shortest paths that pass through the vertex in question (here, vertex v).

Sum this fraction over all pairs of vertices (s,t) .

More compactly the betweenness can be represented as:

$$C_B(v) = \sum_{s \neq v \neq t \in V} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

where σ_{st} is total number of shortest paths from node s to node t and $\sigma_{st}(v)$ is the number of those paths that pass through v .

5.1.1 Orchestrator Role and Network Structure

In the case of Libra Association, betweenness centrality is chosen as the measure of centrality given Facebook's role as the ecosystem orchestrator. Betweenness centrality is recognized by Ozman as "controlling information flows; [and] making sure there are no inaccurate information flows" (2017: 225). As Baum et al. outlined "...a higher betweenness centrality for a firm suggests a stronger position in terms of brokerage, i.e., more control (and thus power) over knowledge flows across the network" (2010: 2100). The central role of Facebook in the ecosystem genesis is therefore predictable and expected. However, research by Dedehayir et al. (2018) postulated that the role of the ecosystem leader evolves over the genesis phases of the ecosystem. In the initial "preparation phase", the ecosystem leader has a key role in recruiting partners and acting as a builder. In the second "formation phase", governance responsibilities take over as a focus. And finally, in the third "operation" phase, orchestrating both resource flows and complementarities become a priority (Dedehayir et al, 2018: 26). It is postulated in this thesis that the betweenness centrality as a representation of network structure will be reflected differently in the three stages of the Libra Association evolution.

To address this postulation a hypothesis has been developed to test the concept. The hypothesis regarding the role of the orchestrator and network structure is the following.

Hypothesis 1 - Betweenness centrality in phase one will be higher as a result of Facebook's orchestrator role. In Phase 2, when a greater focus on governance is required, the betweenness centrality of Facebook will decline as other members in the ecosystem take over some of the alliance builder responsibilities. Furthermore, in the third phase of the ecosystem genesis, betweenness centrality will increase due to renewed efforts by the orchestrator to recruit complementors and implement product development within the ecosystem.

The hypothesis is considered confirmed if the betweenness centrality between phases follows the pattern predicted in the literature; higher in Phase 1, lower in Phase 2 and increasing in Phase 3.

5.1.2 Entrepreneur Role in Network Structure

Betweenness centrality is also used to test the changing role of entrepreneurs in the Libra Association ecosystem. As described in the qualitative analysis, specific roles defined within the ecosystem literature have been identified in the Libra Association emergence. Entrepreneurs played an important part in alliance building during the genesis of the Libra ecosystem. According to the literature, entrepreneurs undertake roles that overlap with the orchestrator on the building and recruitment role, meaning entrepreneurs take on responsibilities to "link to other actors" after the formation phase (Dedehayir et al., 2018: 24, 24). Similar to the lead orchestrator role, if betweenness centrality is used as a measure of the function of using information sharing and control to build alliances, the betweenness centrality of entrepreneurs should reflect the role by having an increase in betweenness centrality in Phases 2 and 3. For this reason, it is postulated that the betweenness centrality of the firms classified as entrepreneurs identified in Libra Association would reflect the changes in their responsibility to building the ecosystem in Phase 2 and 3. Thus, the following hypothesis has been formulated to test the theory.

Hypothesis 2 – To reflect increasing roles in alliance building and recruitment, the betweenness centrality of entrepreneurs in the evolving ecosystem would increase in Phases 2 and Phase 3.

The hypothesis is considered confirmed if the betweenness centrality of entrepreneurs in Phases 2 and 3 is higher than their centrality in Phase 1, otherwise the hypothesis will be considered rejected. The betweenness centrality in Phase 1 is compared independently to Phase 2 and Phase 3. The literature only identifies Phases 2 and 3 as the alliance building phase for entrepreneurs. Thus, the betweenness centrality from Phase 1 to Phase 2 and Phase 1 to Phase 3 will be compared.

5.1.3 Exploratory and Exploitative Alliance Behavior

Based on interorganizational network theory, networks with greater density, that is more ties within the network, are affiliated with less innovation and novelty; the reverse is true for so-called “weak ties” and spread out networks where fewer partners have direct relationships with each other (Gisling, 2008; Golbeck, 2013; Granovetter, 2005, p. 46). According to Ozman, cohesive alliance portfolios with closer ties within the network are important for the transfer of “high quality information and tacit knowledge” (2017: 145). On the contrary, sparsely linked networks provide access to novelty. Research on partner selection by Baum et al. found that firms benefit from dense cliques when innovation is incremental and more from spanning cliques when innovation is disruptive (2010: 2096).

This relationship between network structure and firm behavior is based on early work by James March (1991). March originally looked at exploratory and exploitative organizational learning and how resources are allocated to support these activities. Since this early work, exploratory and exploitative behavior of organizations has evolved into

considering how these learning approaches, or knowledge transfer and acquisition, affects strategic alliances. The research of March outlined that firms require a balance between exploitation and exploration “... Both exploration and exploitation are essential for organizations, but they compete for resources” (1991: 71). A great deal of research has focused on understanding exploratory and exploitative behavior and the balance between these two approaches; this is sometimes referred to as “ambidexterity” (Mazur, 2018; Ozman, 2017; Partanen et al., 2020; Wassmer et al., 2017; Zhang et al., 2020).

Exploration and exploitation highlight an important dilemma for firms. Exploration brings new innovation, research and knowledge into a firm; however, it can be risky, expensive and sometimes pose a challenge to integrate this new information into the business enterprise. Conversely, exploitation allows firms to exploit existing knowledge and developed trusted working relationships that make the incremental integration of new knowledge and information easier and more profitable over the short term (Ozman, 2017:130). Interorganizational network theory has considered explorative and exploitative approaches from the perspective of alliance formation.

Interorganizational network tools such as network density, connectivity or “network embeddedness” have developed in the literature as these concepts have been researched in strategic alliances. The work of Dittrich et al. confirmed that exploitation and exploration strategies require different network structures (2007: 1497). Similar to the work of Baum et al. on clique density, network analysis indicates that the network structure is different depending on the exploitative and exploratory approach of the firm.

The work of Karamanos looked specifically at alliance ego-network centrality, and for exploratory innovation suggests “...the best way for a firm to ‘cast its net widely’ to reach new technological fields is to develop structural holes in its alliance ego-network and ties with central ‘gatekeepers’” (2017: 272) The impact of network structure has been further highlighted and refined in empirical studies in the computer industry (Zang, 2018) and linkages between patents and inventors (Yan et al., 2020).

Based on the idea that Libra Association is an innovative ecosystem seeking technology breakthrough in the commercial application of cryptography, it is proposed that the network structure of the Libra Association would reflect and evolve as an exploratory network. Based on this assumption and considering the theories on exploratory and exploitative firm behavior, firms with exploitive behaviors or approaches would be more likely to leave the ecosystem than exploratory firms. Based on the theory, the network of exploitive firms will be more dense than exploratory firms. Because exploitive firms rely to a greater extend on close ties within the network to share knowledge and exploit existing market assets, they have stronger ties and closer networks. To test this theory, the network of the firms who left the Libra Association alliance are compared to the network of firms who did not leave. If Libra Association is consistent with the literature, the firms who left Libra Association in Phase 1 will have higher centrality in the network than those who stayed. The centrality is established by the number of alliances between firms in the Libra Association network at the time the

alliance was announced in June 2018; using social network analysis this is measured as degree centrality (Golbeck, 2013; Zang & Luo, 2020).

To undertake a comparison of phases, the following hypotheses were developed.

Hypothesis 3 – The connectedness of firms who left the ecosystem in Phase 1 will be higher than for the firms which did not leave the ecosystem.

Hypothesis 4 – The network connectivity, measured as degree centrality, in Phase 1 of the ecosystem genesis will be higher than Phases 2 and 3; Phases 2 and 3 will be consistent with exploratory alliance behavior as described in the literature. That is, they will have more sparse networks.

Hypothesis 3 will be confirmed by comparing the connectedness of firms who left with those who stayed using the degree centrality scores in each phase and any patterns in the visual network representations that are consistent with closer and more sparse network patterns. The hypothesis will be considered confirmed if the firms who left the network have degree centrality higher than the firms who stayed in the network.

Hypothesis 4 will be confirmed if Phase 1 degree of centrality is higher than the degree of centrality in Phases 2 and Phase 3.

5.1.4 Technological Diversity and Alliance Behavior

Looking at the role of technological diversity in alliance formation, the literature identifies a correlation between diversity and the exploratory behavior of firms. Song stated, “A longitudinal investigation of 77 telecommunications equipment manufacturers indicated that the technological diversity of a firm’s alliance partners increases its exploratory innovation” (2016: 14). Similarly, Subramanian and Soh found that alliance portfolios with greater technological diversity are more exploratory and this leads to a positive alliance experience (2017: 637). These arguments are similar to strategic alliance

theory on structural holes, exploratory networks provide access to information in other parts of the network.

As such, it is postulated that technological diversity can be used as a measure of a firms exploratory or exploitative behavior. In the case of Libra Association, firms with lower technological diversity should be affiliated with exploitative behavior. Therefore, the firms who left the Libra Association should have lower technological diversity relative to the firms in the alliance that decided to remain. Conversely, if the firms who joined Libra Association in Phase 3 have a higher technological diversity, this could also support the theory on exploratory and exploitative alliances.

Furthermore, if Libra Association firms that have a higher degree of centrality and less technological diversity leave the ecosystem, this would provide two separate sources of empirical evidence that exploitative firms were less aligned with the exploratory nature of Libra Association. Stronger empirical understanding of exploitative and exploratory networks has the potential to addressing the overall research question regarding how firms balance between exploratory and exploitative partnerships.

Hypothesis 5 – The technological diversity of firms which left the ecosystem will have lower technological diversity than firms which did not leave the ecosystem.

If the hypothesis is correct, the technological diversity of the firms that left the alliance in Phase 1 should have a lower average technological diversity score than the firms that remained in the alliance in Phase 2.

The Libra Association case study provides the opportunity to combine the ecosystem constructs regarding roles in ecosystem genesis with the theories regarding

technological diversity. The qualitative analysis yielded a list of companies with different roles in the genesis of the ecosystem including the role of experts responsible for promoting technology commercialization. In addition, the role of champion is affiliated with developing and nurturing innovation (Dedehayir, et al., 2018). Given that these roles have been identified in Libra Association, it is possible to consider whether the roles reflect the exploratory and exploitative alliance positions in the ecosystem phases. To evaluate whether the technological diversity of roles reflect exploratory and exploitative approaches in the literature, the follow hypothesis has been developed.

Hypothesis 6 – The technological diversity of firms in the role of expert and champion will increase as the ecosystem genesis evolves from Phase 1 to Phase 3.

The hypothesis will be considered supported if the technological diversity of the expert and champion roles in Phases 1 and 2 increases in Phase 3. Phases 1 and 2 are combined for both of these roles because membership did not change for either group between Phase 1 and Phase 2.

5.2 Results

As described in the methodology section of this paper, the network was established by documenting existing alliances and partnerships between the network firms in the Libra Association ecosystem through a systematic media search that has been captured and documented in a network matrix. All relationships identified by all firms where captured in the network matrix. Only partnerships or alliances that were publicly announced and acknowledged by the companies themselves were included in the matrix. The companies with more than one partnership or alliance had this data captured in the

matrix and adjacency lists as additional partnerships. For example, where Visa and PayPal had multiple partnerships on different products or in different regions, one linkage for each partnership/alliance is captured in the matrix and adjacency list. In this way, stronger relationships in the network are represented by the higher number of partnerships between firms (Appendix F and G refers).

For the purpose of this study, betweenness centrality is calculated using the open-source software, Gephi. The data on links between Libra Association members was used to calculate the betweenness centrality of the Libra Association network in each phase of the ecosystem emergence. The roles and phases are captured in Table 6. The adjacency matrix of alliances between Libra Members was divided into adjacency lists for each phase and evaluated using Gephi. The adjacency lists used in Gephi are captured in Appendix G.

5.2.1 Facebook Betweenness Centrality

The results of the Gephi modeling are captured in Table 7. The betweenness centrality of Facebook ranges between 309 and 180. This makes sense since Facebook orchestrated the ecosystem and recruited the partners originally announced on 18 June 2019 as described in the qualitative analysis in Chapter 4.

Table 7: Facebook Centrality by Phase

Phase 1 to 3 Facebook	Betweenness Centrality	Normalized
Phase 1 – Ecosystem Preparation	309	0.440
Phase 2 – Ecosystem Formation	180	0.474
Phase 3 - Ecosystem Pre-Operation	309	0.475

In order to compare the betweenness centrality of each phases, it is necessary to normalize the betweenness centrality scores to account for the different number of firms in each phase. This is done by making the betweenness centrality score a proportion (Prell, 2011: 106). For the three betweenness centrality scores in the Facebook results the scores are normalized in the following way.

Phase 1 (28 companies): $309 / (27*26) = 0.440$

Phase 2 (21 companies): $180 / (20*19) = 0.474$

Phase 3 (27 companies): $309 / (26*25) = 0.475$

The results of the normalized betweenness centrality for Facebook does not support Hypothesis 1 that betweenness centrality is lower in the second phase than the first and higher in the third phase than the second. Betweenness centrality as a reflection of Facebook's shifting orchestrator role over the phases of the ecosystem genesis is not reflected in the results.

5.2.2 Entrepreneur Betweenness Centrality

The same data was used to calculate the betweenness centrality of entrepreneurs as was used for the orchestrator role. The Gephi outputs for the adjacency list for each phase calculated betweenness centrality. There are several firms identified in this role, Table 8 shows the results. The betweenness centrality of each member in the group in all three phases is presented. The averages of the betweenness centrality of the firms are used to calculate entrepreneur betweenness centrality for each phase. Using the same methodology as Hypothesis 1, the normalized score is calculated.

Table 8: Entrepreneur Betweenness Centrality – Phases 1 – 3

Firm	Betweenness Centrality	Average	Normalized Average
Phase 1			
Thrive Capital	0	0.125	0.00018
Andreessen Horowitz	0.5		
Union Square Ventures	0		
Ribbit Capital	0		
Phase 2			
Thrive Capital	0	0.125	0.00033
Andreessen Horowitz	0.5		
Union Square Ventures	0		
Ribbit Capital	0		
Phase 3			
Thrive Capital	0	0.1875	0.00029
Andreessen Horowitz	0.5		
Union Square Ventures	0		
Ribbit Capital	0		
Slow Ventures	0		
Paradigm	1		
Temasek	0		
Shopify	0		

The results of betweenness centrality do increase in the second and third phase as predicted in the literature. The betweenness centrality drops in from Phase 2 to Phase 3, although the drop is much smaller than the increase from Phase 1. In the case of the entrepreneur role, the network structure, represented by betweenness centrality supports the hypothesis that the position of orchestrators in the ecosystem are more central and reflect their role as conduits of information. As a result, Hypothesis 2 is considered confirmed.

5.2.3 Ecosystem Phases and Network Structure

Pursuant to the qualitative section of the paper regarding genesis phases, the network matrix has been divided into time periods representing the three phases of the

ecosystem genesis. In order to assess Hypothesis 3 that firms leaving would have a higher connectedness than firms who stayed, the ego-centric degree centrality of the firms who left Libra Association were compared to those who did not. Since the firms who left did so in Phase 1 and only one firm left in Phase 2 and none in Phase 3, only Phase 1 was used in the analysis. Table 9 captures the number of relationships each firm had within the ecosystem. The results have been normalized between each phase to take into account the different number of firms in each phase (Prell, 2011). The 28 firms in Phase 1, had 148 partnerships within the ecosystem, a normalized average number of 5.5 links between firms. The normalized average number of partnerships of those who left Libra Association in Phase 1 was 7.8.

Table 9: Libra Association - Firm Degree Centrality

Firm	TOTAL	Phase 1	Departed	Phase 2	Phase 3
Visa	12	12	12		
Mastercard	7	7	7		
Thrive Capital	1	1		1	1
Uber	11	11		11	11
PayPal	17	17	17		
eBay	5	5	5		
Spotify	5	5		5	5
Novi (Financial) FB	46	46		46	46
Coinbase	3	3		3	3
PayU	2	2		2	2
Kiva	3	3		3	3
Iliad	1	1		1	1
Booking Holdings	1	1	1		
Women World Banking	1	1		1	1
Mercy Corps	1	1		1	1
Stripe	3	3	3		
Lyft	4	4		4	4
Vodafone	3	3		3	3
Breakthrough Initiatives	2	2		2	2
Union Square Ventures	2	2		2	2
Anchorage	1	1		1	1
Xapo	5	5		5	5
Bison Trails	1	1		1	1
Creative Destruction Lab	1	1		1	1
Mercado Pago	2	2	2		
Farfetch	1	1		1	1
Ribbit Capital	3	3		3	3
Andreessen Horowitz	4	4		4	4
Shopify	5				5
Tagomi	1				1
Checkout.com	1				1
Hiefer	1				1
Paradigm	4				4
Temasek	1				1
Slow Ventures	2				2
TOTAL		148	47	101	116
Number of Firms		28	7	21	27
Normalized Average		5.5	7.8	5.1	4.6

As summarized in Table 10, of the 5 firms with the highest number of connections in the network, four departed the Libra Association in Phase 1. The data in Tables 9 and 10 is consistent with the interorganizational network theory that exploitative firms with higher connectedness would not fit as well in an exploratory ecosystem such as Libra Association. The data supports Hypothesis 3 that the firms who left the alliance would have higher connectivity than the firms who stayed. Connectivity in this case, as defined by degree centrality.

Table 10: Summary of Firm Links – Phase 1

Phase 1 – Top Firm Links	
Visa	12
Mastercard	7
Uber	11
PayBal	17
eBay	11

The adjacency lists for each phase of the Libra Association were used in the Gephi software to generate the networks shown in figures 5 to 7. The Gephi visual graphs show the links between Libra members in each of the three genesis phases. The visual graphs representing the network confirm the pattern identified in the data.

Figure 5. Libra Ecosystem Network - Phase 1 – Preparation Phase

Figure 5 shows the Libra Association network in Phase 1, the Preparation Phase. It is possible to visually identify the firms that have more connections than others. The Gephi software indicates the higher number of connections between firms with darker lines. The thickness of each edge in the network represents the number of connections between each node. A number of the firms who left the alliance in Phase 1 have a higher centrality, that is, more and closer ties represented by the thickness of lines and the number of connections to other nodes in the system. According to the literature, these firms represent more exploitive approaches and behaviors. The visual graph is consistent with data in Table 9 on the degree centrality of firms.

The network in Figure 5 indicates Uber, Pay Pal, eBay, Mastercard, Spotify and Visa have more relationships to others in the system than other firms. Four of the six highly connected firms left the ecosystem in Phase 1. In addition, two of the firms that left Phase 1 have direct connections to these highly connected firms. Stripe is connected to both Visa and PayPal and Mercado Pago to Pay Pal.

Figure 6. Libra Ecosystem Network - Phase 2 – Formation Phase

Figure 6 representing the network in Phase 2, visually shows a more sparse network than Phase 1; the network has fewer links between nodes and fewer links with multiple relationships. This is consistent with the data in Table 9 which indicates fewer ties between companies and a lower overall average degree centrality for Phase 2. The

visual graphic and the data confirm Hypothesis 4 that the connectivity of the network declines consistent with an ecosystem seeking exploratory opportunities and alliances.

Figure 7. Libra Ecosystem Network Phase 3 – Pre-Operation Phase

The network in Phase 3, Figure 7 shows an increase in network connections, although the number of connections is less than in Phase 1 with a similar number of partners; seven new partners joined in Phase 3. There are fewer thick lines between nodes. Interestingly the higher number of network connections include a number of firms identified in the entrepreneur role; that is Andreessen Horowitz, Shopify and Slow Ventures. The increased connectivity level of entrepreneurs appears to be consistent with the propositions in the literature that entrepreneurs take on a recruitment and alliance

building role as the ecosystem evolves and this is visible in the network structure for some, but not all, members of the entrepreneur group.

5.2.4 Technological Diversity and Alliance Structure

In order to test Hypothesis 5 that exploratory firms would have greater technological diversity than exploitative firms, data was used from Crunchbase. The various classes and categories of patents technologies are often used as measures of company diversity (Gisling et al., 2008; Quaadgras, 2005; Sampson, 2007; Subramanian & Soh, 2017). As outlined in the methods section, Crunchbase maintains a list of the industries in which a firm is active. For Libra Association firms, these included labels such as “venture capital”, “financial services”, “payments”, “fintech”, “cryptocurrency” and “blockchain”. The range of industries for each company was used as a measure of technological diversity and pairwise comparisons of each company were used to evaluate the technological diversity across the ecosystem. Technological diversity has been calculated using the method outlined in Sampson (2007). To demonstrate the calculation, the pairwise distance between two venture capital firms with a history of investing in blockchain are used, Paradigm and Thrive Capital. Table 11 lists the 5 industries associated with each company.

Table 11: Company Industry Listings from Crunchbase

Industry Type	Paradigm	Thrive
Blockchain	1	0
Cryptocurrency	1	0
Venture Capital	1	1
Finance	0	1
Financial Services	0	1

The numerator of the technological diversity is calculated by taking Paradigms industries (1,1,1,0,0) multiplied by Thrive's industries (0,0,1,1,1); that is, $1 \times 0 = 0$, $1 \times 0 = 0$, $1 \times 1 = 1$, $0 \times 1 = 0$, $0 \times 1 = 0$. Thus, $0 + 0 + 1 + 0 + 0 = 1$. The numerator in this case is 1. The denominator is the square root of Paradigm's industries squared (1×1 , 1×1 , 1×1 , 0×0 , 0×0) multiplied by Thrive's industries squared, (0×0 , 0×0 , 1×1 , 1×1 , 1×1). That is, $1 + 1 + 1 + 0 + 0 = 3$ multiplied by $0 + 0 + 1 + 1 + 1 = 3$. Thus, in this example, three times three is nine and the square root of nine is three; this makes the denominator 3. Technological diversity is calculated as $1 - 1/3 = 0.666$. Technological diversity for all pairwise comparisons varies from 0 to 1. A value of 0 would be firms in the same industries, a value of 1 is the greatest possible diversity between two firms. The technological diversity calculation is made for each pair in the network. This calculation was done for all Libra Association pairs using the Orange software as described in the methods section of Chapter 3. Orange calculated pairwise diversities using the same formula as Sampson (2007).

A separate network calculation was done for pairs of firms in each phase of the Libra genesis and for the firms who left the Libra Association in Phase 1; this is similar to the approach used to evaluating network structure. The same phases and firms were used as those used for the calculations of network structure using Gephi. However, in the case of technological diversity a comparison was also made on the firms who joined Libra Association in Phase 3.

In order to compare the technological diversity between each phase, the technological diversity of every pair of firms in the alliance was summed and divided by the number of possible pairs in the network using the formula $(n)*(n-1)/2$ where n is the nodes in the network (Sampson, 2007: 372). According to the hypothesis, the technology diversity should be higher for the firms who stayed than the firms who left the ecosystem. The results have been summarized in the Table 12.

Table 12: Technological Diversity by Libra Genesis Phase

Technological Diversity			
	Sum Pairwise Diversity	Network Size	Network Average
Phase 1	333	378	0.881
Departing	15.5	21	0.738
Phase 2	188	210	0.895
Phase 3	306.5	351	0.873
Joining	18.3	21	0.871

While the technological diversity of each phase changed only marginally from phase to phase, the technical diversity of the departing firms was clearly lower than the remaining firms. The overall diversity in Phase 2 became marginally higher than Phase 1 which is an indicator of an exploratory ecosystem. However, the diversity became lower in Phase 3 with the addition of 7 new members many of them from the financial services and venture capital sectors. Consistent with exploratory theory, the technical diversity of the firms joining Libra Association in the third phase were higher than those who left in the first phase.

5.2.5 Technological Diversity Using Heat Maps and Network Clusters

In addition to the data tables output for the calculations of technical diversity by phases, a series of heat maps and clustered networks was created in Orange using the pairwise comparisons of technological diversity between Libra firms. Figures 8 to 10 use a blue (low), green (mid), yellow (high) scale to compare the technological diversity firms, white represents no overlapping technologies. This means white represents the score of 1 using the formula from Sampson (2007). The heat map is a visual representation of the data presented in Table 12; however, it is not aggregate by the averaging function. The heat maps and network clusters show firm by firm comparisons of technological diversity and thus provide the opportunity to look more closely at the roles in the ecosystem. The figure 8 heat map of firms in Phase 1 shows the lower levels of technological diversity between payment firms and venture capitalists. These are indicated in the larger red circle containing multiple colours. The widest possible technological diversity between firms, that is, those without overlapping technologies, can be seen in the user role represented by firms such as Lyft, Uber, Facebook and Spotify; these are captured in the smaller red circle on the heat map.

Figure 8. Technological Diversity Heat Map – Phase 1

Figure 9 represents technological diversity between firms in Phase 2, the overall increase in diversity is evident by the increase in white space and reduction in colour. This is consistent with the network scores in Table 12. The technological diversity between firms identified as entrepreneurs and champions and those identified as users and complementors is significant as indicated in the larger red circled area in the figure. As outlined in the literature, technological diversity represents opportunity for firms to explore opportunities in sectors where they are not active (Ozman, 2017). The increased

technological diversity in Phase 2 after firms left the ecosystem in Phase 1 is consistent with the literature.

Figure 9. Technological Diversity Heat Map – Phase 2

In Phase 3 the heat map in Figure 10 shows an increase in overlap between some of the joining and existing firms affiliated with the financial sector such as Temasek and Slow Ventures. However, the overall technological diversity is closer to that in Phase 2. The technological diversity between users and champions continues to have no overlap with the firms affiliated with finance and venture capital; this is indicated in the larger red circle. Even with the significant addition of seven new firms in a small ecosystem of 20 existing firms the technological diversity from Phase 2 is generally maintained.

Interorganizational network theory that firms are seeking exploratory opportunities as opposed to opportunities to exploit existing areas of expertise continues to be supported.

Figure 10. Technological Diversity Heat Map – Phase 3

Similar to the heat maps, network clusters were created from the same data on pairwise diversities in the ecosystem. This was done using the “network from distance” and the “network clustering” widgets in Orange. Appendix K shows the full Orange model used to generate both heat maps and network clusters. The network distance widget uses technological diversities between 0 and 1, per the formula used from Sampson (2007). This range is used as a distance measure of the diversity between firms. Clusters are based on distances between firms. The large number of firms with no

technological overlap and thus scores of 1, caused the network to be too dense to identify clusters. As a result, firms with a score of 0.8 or less was used for the clustering analysis.

The outputs from the three phases are shown in Figures 11 to Figure 13.

Figure 11. Network Cluster – Technological Diversity – Phase 1

In Figure 11, the technological distance of Facebook from the network becomes obvious. Consistent with alliance theory that Facebook would be seeking an exploratory network in search of new innovation, the technological diversity of Facebook and other “users” in the ecosystem, Uber, Spotify and Lyft, is high. Similarly, there is a small cluster of non-profit organizations, C3 with green nodes, that are separate from the main cluster of financial and expert firms that appear in the brown nodes, C4, on the figure. Non-profit organizations have stated that one of the reasons for joining Libra Association

is to find new solutions to solving social issues such as financial inclusion (Cheney, 2019). The need for new technological solutions that are separate from their own existing approaches appear to be evident in the clustering. In addition, the role of “users”, who according to interorganizational network theory would be seeking exploratory alliances, form a separate technologically distant cluster. These users are captured in cluster C5 signified by yellow nodes in Figure 11.

The clustering in Figure 11 also highlights that the firms that left Libra appear in the two most dense cluster of the technological diversity map. The theory that exploitative firms are seeking to expand existing technologies rather than find new ones (Ozman, 2017: 128) is consistent with where these firms fall within the technology overlap clusters. Mastercard, Visa, Stripe and Paypal are in the largest cluster. EBay, Booking and Mercado Pago fall within the second largest cluster.

As Figure 12 demonstrates, the clusters in Phase 1 are consolidated in Phase 2, however, there is less density in the network which is consistent with the higher levels of technological diversity in Phase 2 as shown in the numerical data. The entrepreneur and expert roles continue to be clustered together but in Phase 2 the non-profit organizations are included in the larger red C2 cluster. Users, represented by blue nodes, continue to have significant distance from the main cluster and complementors in the third cluster of green nodes have overlaps with blockchain experts Anchorage and Bison Trails. Although the green cluster is well separated from the main cluster.

Figure 12. Network Clusters – Technological Diversity – Phase 2

Figure 13 has clustered the Libra firms in Phase 3. The addition of several new partners has shifted the clustering significantly. One large cluster has been created encompassing the majority of Libra partners. Two small clusters of non-profit firms and Facebook with Uber and Spotify make up the remainder. As highlighted in the numerical analysis, the overall technological diversity of the phase has not increased significantly. Phase 3 technological diversity is much closer to Phase 2 than to Phase 1. However, network clustering has identified more significant differences for the two small groups. The exploratory theory on alliance formation suggests that firms in the smaller groups may have more to gain from the larger group since the technologies in the larger group are farther away from their own.

Figure 13. Network Clusters – Technological Diversity – Phase 3

Hypothesis 6 assesses whether the technological diversity of experts and champions increases as the ecosystem evolves. The firms in each of the roles were grouped together and run through the Orange model using the same approach as that used for the technological diversity of ecosystem phases. The same list of companies and industries were used to create the matrixes of overlapping industries in the pairwise analysis. The same averaging formula was used to evaluate roles as that used for phases. The firms in expert and champion roles were the same in Phase 1 and 2 but changed in Phase 3 when new firms joined the ecosystem. As a result, the firms in Phases 1 and 2 are compared to Phase 3. Table 13 below summarizes the results.

Table 13: Expert & Champion Technological Diversity Across Phases

Technological Diversity	Sum of		
	Distances	# - Pairwise Distances	Network Average
Expert - Phase 1 & 2	13.34	15	0.889
Expert – Phase 3	17.05	21	0.812
Champion – Phase 1 & 2	2.0674	3	0.689
Campion – Phase 3	306.5	351	0.558

In both cases the average technological diversity of the role did not increase as the ecosystem evolved into the third phase; and thus, the hypothesis was not supported based on this analysis. The results of the averaging formula reflect the fact that expert firms, as a group, have an initial focus on developing blockchain and cryptocurrency in the ecosystem. The results in Table 13 may reflect the genesis phase of the ecosystem, prior to product launch. In an ecosystem where product launch has been achieved and the roles of complementors, suppliers, assemblers and sponsors have emerged, the use of the averaging formula on technological diversity may confirm the exploratory theory. In the current Libra ecosystem, the number of firms is very small. A broader participation in the ecosystem would be expected to affect results as the evolution takes place.

The similar result for the champion role reflects the decision in the qualitative analysis to put non-profit ecosystem supporters into the champion role. Given the social agenda and organizational status of non-profit organizations it is also not surprising the technological diversity between firms was similar. Again, as the ecosystem evolves, the roles are also expected to change. As such, non-profit organization will take on different roles and measures of technological diversity will also change.

What is clear in the results of Hypothesis 6, is that averaging technological diversity across roles is not an appropriate means to measure exploratory and exploitative theories. The results achieved by using network clustering and heat maps to look at technological diversity provided many more insights on the impact of roles as they relate to exploratory alliances.

6 Discussion and Conclusions

The qualitative assessment of the Libra Association was undertaken to test specific ecosystem constructs outlined in the literature. Pattern matching was used to compare concepts in the literature with the experience of Libra Association. Interdependency, orchestration and emergence are the specific elements addressed in the qualitative research. The ecosystem genesis roles identified in the literature were compared to the Libra Association ecosystem. Interdependency constructs such as, autonomy and integrated relationships that are not decomposable were also assessed. These elements along with orchestration and the phases of genesis emergence were considered in the Libra Association case study. The qualitative results were used to assess interorganizational theories on network structure and exploratory and exploitative alliance behavior.

6.1 Qualitative Assessments

6.1.1 Interdependent Roles

Interdependent roles were evaluated in the membership of the Libra Association by comparing propositions in the literature with Libra Association. It was possible to confirm a number of the roles anticipated in the first 12 months of the ecosystem formation. However, a number of roles were not yet in evidence. For example, suppliers have begun contributing to the open-source blockchain platform and these are tracked and well documented on github. Despite these contributions, other suppliers expected to be important to the ecosystem, of stable currency for example, were absent.

Expert roles which are considered particularly important in the early evolution phase of an ecosystem were identified in the Libra ecosystem. Expert roles supported the Libra Association Technical Steering Committee and the Libra open-source platform. There was an overlap between roles in the expert and entrepreneur roles and as outlined in the literature there was evidence that these roles shifted over the evolution of the ecosystem.

Complementors are the subject of a great deal of ecosystem literature; they are fundamental to interdependent non-decomposable relationships that support concepts such as “supermodularity” (Jacobides et al., 2018). However, the complementor role requires the development of products and services which have not yet emerged in Libra. In the genesis phase of the Libra Association ecosystem, complementor roles were marginal and limited to firms identified outside payment systems such as the telecoms and music streaming. Research into complementor activities in the first 12 months of emergence did not reveal evidence related to ecosystem development.

Champions were highlighted in the literature as important to alliance building; these roles were identified in the Libra Association. However, in the case of Libra Association, champions also supported the legitimacy of altruistic objectives to serve the unbanked and addressed credibility issues for Facebook. As noted, the Women’s World Bank appeared before the U.S. Senate with Facebook when they testified before the Committee on Banking, Housing and Urban Affairs.

Typically, the entrepreneur role focuses on commercializing products and ideas. According to the ecosystem constructs entrepreneurs support co-evolving interdependencies and modular development of products and services within the ecosystem. However, the genesis literature identifies a role in recruitment and alliance building during the early phases of ecosystem emergence and this was evident in Libra Association particularly during the third, or pre-operational phase of emergence when several venture capitalists linked to other members in the ecosystem joined Libra.

Users were the final role identified in the Libra ecosystem. This group is largely represented by users of the cryptocurrency product who will benefit from new and potentially less expensive payment options with greater flexibility in the market. The user role in ecosystem formation is affiliated with product definition and product development. The impact of user roles in Libra Association was limited in the first 12 months of formation.

The identification of roles in the Libra Association case study did confirm ecosystem constructs in the genesis literature as outline above. However, a number of roles have not yet emerged. The early, pre-product stage of the ecosystem helps explain the absence of certain roles related to complementarity. Roles, such as the “assembler”, and “sponsor” identified with early emergence literature were difficult to identify in the first 12 months of Libra. Firms can fulfill multiple roles and as such those of the venture capitalists in Libra Association would be an obvious choice for sponsor roles in the

future. It is easier to understand how the role of the assembler, and in some cases, supplier have not yet emerged in the Libra Association prior to product development.

6.1.2 Interdependent Relationships

The interdependent relationships in the Libra Association ecosystem are not completely consistent with those outlined in the literature. In considering ecosystem interdependencies, a separate analysis of governance activities and autonomies in the Libra Association was undertaken. The immutable nature of a distributed blockchain brought into question the autonomy of ecosystem members, particularly those acting as nodes in the validation processes. At least in the early stages of the ecosystem formation, the experience of Libra Association suggests that the governance rules may be more structured and allow less flexibility and autonomy than suggested in the literature.

6.1.3 Ecosystem Orchestration

Both ecosystem literature and interorganizational network theory emphasis the importance of orchestrators in alliance formation. The elements that were considered in the qualitative evaluation of Libra Association - included alliance formation, governance and appropriation and network stability. The comparison of Libra Association emergence to the concepts and theories regarding ecosystem orchestration supported some but not all propositions in the literature.

Facebook's orchestrator role in ecosystem formation is not completely consistent with the literature. The elements of developing trust and the ability to overcome reputational vulnerabilities were evident in the data. Facebook was able to confidentially build a diverse network of partners from multiple sectors and locations to create the Libra

Association. However, there is evidence that Facebook relied on tradition contract arrangements such as non-disclosure agreements to establish the network and this is not consistent with the ecosystem construct which distinguishes itself from interfirm partnerships by the absence of formal legal and hierarchical relationships. Media information was also tightly controlled and ultimately the Libra Association governance structure relies on a Charter signed by each member. The structure around the governance characteristics in the Libra Association charter suggest a more traditional approach to alliance partnerships than those in the ecosystem literature.

The orchestrator role of Facebook reflects many of the ecosystem appropriation functions including sharing opportunities, knowledge sharing and user engagement. Many of these elements were captured in the White Papers and background papers published by Libra and would likely be reflected in the signed Charter. In its first 12 months Libra membership experienced a significant number of departures and new members; however, a stability in the network is evident from the growing and consistent number of contributors to the open-source platform. The ecosystem has also followed the emergence stages of ecosystem formation proposed in the literature.

6.1.4 Emerging Ecosystem Phases

An activity timeline was used to confirm the experience of Libra Association in the emergence phases of ecosystem formation. The timeline was built around the events that led up to and included the first 12 months of Libra Association. Pattern matching was used to correlate the stages, or phases, outlined in the literature. As discussed in the qualitative assessment, the final stage of the genesis is not complete. The Libra

cryptocurrency has not yet been launched. Despite this, it was possible to delineate phases and identify roles within each phase of the Libra Association formation. This evaluation was used as inputs to the quantitative analysis.

6.2 Quantitative Analysis

The results of the quantitative assessment were mixed. The hypothesis that the orchestrator would have a higher betweenness centrality in the first phases of the ecosystem was not supported. However, the betweenness centrality was able to show a shift in role for entrepreneurs. The network structure hypothesis did reflect theories in the literature that exploitative alliances are closer than exploratory alliances. The technological diversity of firms leaving the ecosystem was consistent with the hypothesis regarding exploratory and exploitative firm behavior.

6.2.1 Orchestrator Role in Network Structure

According to the literature, the role of Facebook as the Libra Association orchestrator should be reflected in its position in the Libra network. This was certainly true in looking at the central role of Facebook in the visual and statistical results of the network analysis. However, the theory that Facebook, as the orchestrator, controlled information flow within the network, and thus, would have a higher betweenness centrality was not supported in the network analysis results. The betweenness centrality increased in each phase rather than declining from Phase 1 to Phase 2 and increasing in Phase 3 as hypothesized. The results may reflect a number of different considerations. First, in the genesis of an innovative product such as cryptocurrency, it is not clear whether the orchestrator would have information relevant, or valuable to, other members

in the ecosystem. Without a product or the technical knowledge regarding how a distributed ledger would function in the ecosystem, it is possible the broker role of Facebook was less relevant and thus not reflected in its betweenness centrality in the network. Second, the departure of seven firms may have been a reflection of Facebook's low betweenness centrality and its weak ability to control information. Although the current research did not consider this factor, future research may do so. Third, the ecosystem genesis phases defined for Libra Association did not fully capture the recruitment and alliance building efforts of Facebook. The milestone announcement of Libra Association on June 18, 2019 was used to define the first phase, the preparation phase, of Libra. However, there were recruitment and alliance building events prior to the announcement date. The definition of the phases on the timeline would change the network analysis results. Including events in the preparation phase prior to the announcement on June 18, 2019 may capture more of the alliance building activities and this could change the betweenness centrality of Facebook in the network analysis. A better alignment of the Libra Association events to the phases defined in the literature may result in a betweenness centrality closer to that proposed in the literature. However, suggesting a change in dates also suggests that the criteria for including potential members, as opposed to only including announced members, may also be required. This would require a separate research effort.

Due to the nature of the relationships between members in the early stages of ecosystem formation, the use of betweenness centrality as a measure of leadership

importance could be different than other periods of time in the ecosystem. While betweenness centrality is a commonly used measure in existing ecosystems (Prell, 2011: 107), closeness centrality or eigenvector centrality could be tested in early formation phases of the ecosystem. The number of members in phase one with an exploitative network profile would also impact the betweenness centrality of Facebook, this could also be further investigated.

The hypothesis that the betweenness centrality of entrepreneurs would increase when their involvement in building the network increased was supported by the network analysis. Consistent with the literature, the betweenness centrality increased for entrepreneurs as they moved into the second formation phase of the ecosystem genesis and the third “pre-operation” phase. The network structure seemed consistent with the entrepreneur role of setting up networks within the ecosystem and coordinating collaborations. In fact, these links could be identified in the overall network structure of Phase 3 shown in Figure 7 of the results. The qualitative assessment also confirmed these linkages particularly to firms who joined Libra in Phase 3.

Although betweenness centrality did seem to accurately reflect the orchestration role of entrepreneurs in the Libra ecosystem genesis, betweenness centrality may not be the only appropriate measure of their role especially over time as the ecosystem becomes more complex. As was demonstrated by degree centrality, other measures may also be useful.

6.2.2 Exploratory and Exploitative Ecosystem Structure

In considering the role of network structure in ecosystem formation, the relationships between Libra Association members were used for evaluation. The theory that exploitative players would have a closer network than exploratory players was supported based on the fact that the majority of members who left the ecosystem had more dense connectivity than others in the ecosystem. These results were confirmed using degree centrality and the visualization of network structure for each phase. Perhaps the most telling statistic was that four of the five firms with the highest connections to others in the network left the Libra Association in Phase 1. Consistent with the hypothesis, it was possible to see that Visa, Mastercard, Pay Pal and eBay had stronger ties in the network and also more connections than other members.

In phase two, the connections within the Libra Association network were statistically and visibly reduced with the departure of seven members in Phase 1. The results of the network analysis demonstrate that Phase 2 had a lower overall connectedness when measured by degree centrality but also fewer members with strong ties to others in the network. This network profile is consistent with the literature which links exploratory alliances to more sparse network structures, particularly in the genesis phase. The overall degree centrality of the members remaining in Phase 2 was lower than Phase 1.

As the Libra Association evolved over its first 12 months and through separate phases of ecosystem emergence, the network structure became more sparse. In Phase 3 the network centrality was further reduced as new members joined the ecosystem.

However, the third phase of the Libra Association ecosystem is not fully evolved according to the definition of genesis phases in the literature. As a result, the network could be altered significantly as the ecosystem evolves to the fully operational phase of genesis.

Comparing the technological diversity of the group that left Libra Association in Phase 1 was also consistent with the literature theory that exploitative firms have lower technological diversity (Karamanos, 2016; Ozman, 2017; Subramanian & Soh, 2017). On average the technological diversity of firms that left the ecosystem was lower than those who stayed. This data supported the hypothesis that firms with exploitative characteristics would be more likely to leave the Libra Association than exploratory firms as posed in Hypothesis 5. However, the method of aggregating technological diversity at the detailed role level did not support the sixth hypothesis that roles would also reflect an exploratory alliance. Hypothesis 6 was not supported when the technological diversity of roles within the ecosystem genesis were averaged. The use of heat maps and network clustering to analyze networks at the phase level did however provide evidence that certain roles may reflect technological diversity consistent with exploratory alliances. The position of the ecosystem orchestrator, Facebook, in the clustering of technological diversity highlighted its distance from many other firms in the ecosystem. The fact that Facebook, and some clusters that could loosely be identified by roles, appeared as outliers to larger denser groups in the ecosystem was consistent with exploratory alliance theory. The technological diversity clusters were also able to highlight that firms who left the Libra

ecosystem were set in closer, more dense clusters as anticipated in the exploitative alliance theory.

An important take away come from this analysis is that the methodology chosen to analysis technological diversity made an important difference to the result. The use of network analysis and visual graphs helped identify nuances that were not as obvious in the aggregated data. Refining the well established approach use in Sampson (2007) for calculating technological diversity through the use of tools such as heat maps and network clustering provided a more sophisticated analysis.

Both the measure of technological diversity and the network structure of firms which left the ecosystem were generally consistent with the literature regarding exploratory and exploitative alliances. However, the analysis of network structure and technological diversity used to test the hypotheses were based on aggregated results of the group which left Libra. Individually, the firms that left represent a range of both exploratory and exploitative positions within the ecosystem network. For example, Booking Inc. had a position in the Libra network with no connections to other members; thus, inconsistent with the hypothesis. Similarly, Stripe, did not have a high degree centrality; however, the links it had in the network were to nodes with significant network density. On balance there is a pattern that confirms the hypothesis however, the exploratory and exploitative behavior of firms is likely only a partial explanation for the decisions of firms to join or leave the Libra Association ecosystem. In terms of the costs and benefits of joining an ecosystem such as Libra, two approaches are well defined in

the literature, exploratory alliances are higher risk, take more time and have higher up-front costs. In the case of Libra Association, the cost of entrance is \$10 million. The potential long-term benefits of the technology are high, as are the benefits of being linked to a broad network of potential Facebook users and other firms through Shopify for example. The size and reach of this type of ecosystem is both wide and multisectoral. However, the long-term benefits must be weighed against the short-term opportunities to exploit current assets to remain profitable and competitive in the marketplace. All firms need to understand that a balance between exploratory and exploitative approaches are necessary (Zang & Luo, 2020).

The results of the Libra Association case study confirmed the relevance of exploratory and exploitative alliance theory. However, in Libra, exploratory firms may not have the degree of flexibility suggested in the ecosystem literature specifically around interdependences and autonomy. The ecosystem literature suggests ecosystems do not have the hierarchical nature of supply chain systems and the constraints of formal legal partnerships. It is argued that modularity and integrated value creation has greater exploratory freedom for members within an ecosystem (Gawer & Cusumano, 2002; Jacobides et al., 2018). However, the experience of Libra Association suggests the very early genesis phases of the ecosystem have more traditional approaches to interfirm relationships. Confidentiality agreements, control of the media, a Charter with very fixed governance rules, are more consistent with supply chain approaches or hierarchical business agreements. The Libra Association case study suggests the early genesis of the

ecosystem may be less consistent with some of the ecosystem constructs of interdependencies and complementarity.

6.3 Limitations

There are several important limitations in the research. One key limitation is the availability of information on Libra Association itself. The ecosystem in its current version is closed, with limited access to information on the Charter between members which includes the governance structure, the rights and obligations of members, financial commitments and different memberships. The published papers on governance for example were published prior to the signing of the Charter between Libra Association members. The original Libra Association documentation has been removed from the website (www.libra.org); it is difficult to attain documentation even for historical reference. This challenge is exacerbated by the atypical role of Libra Association as an ecosystem. Libra Association has few parallels in terms of the level and breadth of membership. Significant players such as Visa and Mastercard in the payment sector combined with social media and ecommerce leaders such as Facebook and Shopify encompass a wide swath. As pointed out in section 3.2 on the “research method and case study”, Libra Association is a diverse collection of members. As a case study, the size and closed nature of Libra Association may not represent a typical ecosystem evolution for this reason.

The ability of Libra Association to create a digital currency that would be accepted by regulatory authorities is also a potential limitation. The ability to create cryptocurrency on an open platform may be possible but regulatory impediments could

render the product unviable. This could bring into question many of the assumptions made in this study regarding the functionality and operation of Libra Association as an ecosystem.

The research into partnerships and alliances between Libra members was the subject of a manual review process of publicly available information. While it is likely the public nature of the information means it is relatively robust, the manual approach to searching relationships between companies is subject to human error as well as time and resource limits. A number of tools such as scrapping websites using software tools are now limited by security measures put in place by the companies themselves. As a result, automated processes previously available are more difficult. The ability to guarantee a complete list of all partnerships and alliances between every member was not possible.

The current research considered only the ego-centric network of the ecosystem, the links of members to other networks was not considered. This means the influence of network structures beyond the direct Libra Association members was not considered.

The calculations of technological diversity were based on industry labels from the Crunchbase website. The benefit of using a single source is the consistency of approach and the single source of data. However, as Crunchbase itself pointed out, categories are augmented by company descriptions; this has the potential to introduce subjectivity to the analysis.

Finally, the case study is based on the first 12 months of the Libra Association ecosystem genesis. The phases of genesis defined in the literature were not fully covered

in this initial time period. Since a product was not produced the operation phase was not fully completed. This had an impact on the ability to fully analyze the genesis phases.

6.4 Contributions and Further Research

The emergence of ecosystems has been highlighted as an important topic in the literature (Dedehayir et al., 2018; Gawer, 2014; Quaadrass, 2005). Given the prevalence of collaborative innovation particularly in the field of technologies such as blockchain, improving the understanding of ecosystem genesis will benefit firms considering options for innovation and growth. As noted by Basole:

In a highly complex, dynamic, and global business environment, it is increasingly important to have a better understanding of the structure and dynamics of the various ecosystems a firm is embedded in. Robust and timely ecosystem intelligence can lead to earlier anticipation of risks and opportunities, improved competitive benchmarking and better strategic decision-making. (2020: 1)

A better understanding of roles and the evolution of ecosystems over time help firms make better choices regarding how corporate strategies align with ecosystem opportunities, the balance between exploration and exploitation, their potential roles, the evolving costs and benefits of an ecosystem and risk profiles. The case study of Libra Association has contributed to understanding the roles in ecosystem genesis by examining firm roles within the Libra Association ecosystem and comparing them to the theory. Similarly, the phases of ecosystem emergence were identified. Data on roles and phases were related to connectedness, network position and technological diversity. The case study has contributed empirical data on significant events and actions related to the

evolution of Libra Association in its first 12 months and the interfirm relationships within the ecosystem. The data collected was used to integrate concepts developing in the ecosystem literature on genesis with interorganizational network theories regarding alliance behavior.

The technological diversity research demonstrates that technological diversity can be used to test exploratory and exploitative alliance formation in Libra Association. According to the literature, technological diversity is important for both innovation (Karamanos, 2016, Zhang et al., 2019) and alliance building (Sampson, 2007). Given the early evolution of Libra Association, it would be interesting to track the technological diversity of firms to establish whether technological diversity plateaus as the Libra ecosystem matures. According to the literature, technological diversity has an inverted U-shaped distribution (Ozman, 2017) meaning that at some threshold technological diversity stops being beneficial. This is not yet evident in Libra Association.

This study contributes to the academic literature on exploratory and exploitative alliance behavior by testing the theory using a network analysis of interfirm relationships within the Libra Association ecosystem. By combining the data on network position and network structure, it was possible to evaluate theories of exploitative and exploratory behaviour of firms and demonstrate that the evolution of the Libra Association ecosystem network was consistent with exploratory and exploitative alliance theory. The application of the theory to emerging ecosystems phases and roles is a novel approach to the theory which was not identified in the literature review.

Perhaps a unique contribution was the use of heat maps and network clustering to evaluate pairwise technological diversity and its relationship to exploratory and exploitative alliances. The exploratory and exploitative theory applied to roles such as experts and champions in hypothesis 6 was not confirmed in this study. However, as the ecosystem evolves, it would be interesting to investigate whether this pattern emerges, as it has with phases. The use of network clustering and heat maps could be particularly useful to such research. Another area of further study would be to evaluate the use of these techniques in other ecosystems. This could help establish the benefit of the tools and also whether the findings in the case study could be generalized to broader applications.

The study also compares innovation ecosystem constructs with the emergence of Libra Association and makes distinctions between propositions in the innovative ecosystem literature and the Libra Association case study. While some constructs regarding roles in the early emergence of an ecosystem were confirmed, there were inconsistencies in the expected behavior of the orchestrator and the governance structure. The fundamental role of the “ecosystem leader” was confirmed, specifically the actions undertaken by Facebook in recruitment, ecosystem governance, management of a platform and distribution of value. All these attributes were confirmed in the Libra case study as were the early emergent roles of experts and entrepreneurs. However, the early governance structure of Libra is not consistent with ecosystem constructs that propose, “... platform leaders are required to nurture their ecosystems and cannot resort to the

traditional modes of governance available within firms or supply-chains, namely managerial hierarchy or suppliers–buyers contracts.” (Gawer, 2014: 1247). Differences may be attributed to the early formation phases of the ecosystem; however, this would need to be the subject of further research. The ecosystem genesis process appears to have differences from well-established ecosystems which are the subject of a greater amount of research.

The Libra Association case study fills a specific gap in the literature identified by Gawer, (2014) who suggested ecosystem (platform) research be combined with interorganizational network theory. It builds on the work of Dedehayir et al. and others who suggest, “The entrance and exit of actors to and from the ecosystem, as well as their transition between different roles, informs the dynamics of ecosystem birth... we believe that future research can build on the role typology we have proposed to shed further light on ecosystem change...” (2018: 27). This research builds on the typologies identified and used Libra Association to track actors who entered and exited the ecosystem over different genesis phases to explain ecosystem change. Exploratory and exploitative alliance theory and network analysis has been used to help explain the change.

This research used network structure to measure the evolution of the ecosystem, it may also be interesting to consider whether the evolution of Libra Association reflects propositions in the literature regarding modularity. For example, as complementors come onboard within the Libra ecosystem, are the elements of Jacobides’ “supercomplementarity” reflected in the evolution phases? Jacobides et al., “...posited

that modularity is a critical facilitator of ecosystem emergence” (2018: 2267). Since Libra Association has not yet reached the product development stage it is not currently possible to make this assessment. However, it is possible to see some of the elements of this postulation. According to Jacobides et al. “firms that want to encourage ecosystems are likely to push for modular structures with clear interfaces” (2018: 2267). In the Libra Association evolution, some of these elements of modular structure and clear interfaces are already represented in the open-source portal rules, for example, the adoption of the move language and the testnet for checking blockchain protocols, coding guidelines, etc. (<https://developers.libra.org/docs/community/coding-guidelines>). It would be interesting to examine if the modularity evolves as predicted and whether this evolution also moves the ecosystem away from the more structured governance approaches to those more consistent with the ecosystem constructs.

7 References

- Aarikka-Stenroos, L., & Ritala, P. 2017. Network management in the era of ecosystems: Systematic review and management framework. *Industrial Marketing Management*, 67: 23-36
- Adner, R. 2006. Match your innovation strategy to your innovation ecosystem. *Harvard Business Review*, 84(4): 98-107.
- Adner, R. 2017. Ecosystem as structure: An actionable construct for strategy. *Journal of Management*, 43(1), 39-58.
- Adner, R., & Kapoor, R. 2010. Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31(3).
<https://doi.org/10.1002/smj.821>
- Ahuja, G. 2000. Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, 45(3): 425–455.
- Alexy, O., George, G., & Salter, A. J. 2013. The selective revealing of knowledge and its implications for innovative activity. *Academy of Management Review*, 38: 270–291
- Baker, P. 2020a. FireBlocks CEO pours cold water on Libra excitement. *CoinDesk*.
<https://www.coindesk.com/libra-fireblocks-ceo>
- Baker, P. 2020b. Blockchain Capital joins Libra Association.
<https://www.coindesk.com/investment-firm-blockchain-capital-joins-libra-association>
- Baldwin, C. Y., & Clark, K. B. 2000. *Design rules: Volume 1: The power of modularity*. Cambridge, MA: MIT Press.
- Basole, R. C., & Park, H. 2019. Interfirm collaboration and firm value in software ecosystems: Evidence from cloud computing. *IEEE Transactions on Engineering Management*, 66(3), 368-380.
- Basole, R. 2020. Understanding Ecosystems Data. Proceedings of the 53rd Hawaii International Conference on System Sciences | 2020
- Battistella, C., Colucci, K., De Toni, A.F., & Nonino, F. 2013. Methodology of business ecosystems network analysis: A case study in Telecom Italia Future Centre. *Technological Forecasting and Social Change*, 80(6): 1194–1210.

- Baum, J. A. C., Cowan, R. & Jonard, N. 2010. Network-independent partner selection and the evolution of innovation networks. *Management Science*, 56 (11): 2094-2110.
- Baydakova, A. 2019. Social media giant Facebook keeps looking to expand its block-chain-related staff. **CoinDesk**. <https://www.coindesk.com/facebook-blockchain-job-openings-top-20-amid-staffing-spree>
- Brühl, V. 2020. Libra—A differentiated view on Facebook’s virtual currency project. *Intereconomics*, 55(1): 54-61.
- Burt, R. S. 1992. *Structural Holes*. Cambridge, MA: Harvard University Press.
- Cheney, C. 2019. Facebook's digital currency Libra: Why nonprofits are joining. **Devex.com**. <https://www.devex.com/news/facebook-s-digital-currency-libra-why-nonprofits-are-joining-95142>
- Cohen, W. M. & Levinthal, D. A. 1990 Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35: 128-152. <https://doi.org/10.2307/2393553>
- Crawley, N. 2019. Kiva becomes a founding partner of Libra Association. <https://www.kiva.org/blog/kiva-becomes-a-founding-partner-of-libra-association-to-support-financial-inclusion-for-all>
- Cui, V., Yang, H., & Vertinsky, I. 2018. Attacking your partners: Strategic alliances and competition between partners in product markets. *Strategic Management Journal*, 39(12): 3116-3139.
- Dattée B., Alexy O., & Autio E. 2018. Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. *Academy of Management Journal*, 61(2): 466-498. <https://doi.org/10.5465/amj.2015.0869>
- de Vasconcelos Gomes, L. A., Facin, A. L. F., Salerno, M. S., & Ikenami, R. K. 2018. Unpacking the innovation ecosystem construct: Evolution, gaps and trends. *Technological Forecasting and Social Change*, 136: 30-48.
- Dedehayir, O., Mäkinen, S. J., & Ortt, J. R. 2018. Roles during innovation ecosystem genesis: A literature review. *Technological Forecasting and Social Change*, 136: 18-29.
- Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. *Academy of Management Review*, 31(3): 659–669. <https://doi.org/10.5465/amr.2006.21318923>

-
- Dittrich, K., Duysters, G., & de Man, A. 2007. Strategic repositioning by means of alliance networks: The case of IBM. *Research Policy*, 36: 1496–1511.
- Duysters, G. & Lokshin, B. 2011. Determinants of alliance portfolio complexity and its effect on innovative performance of companies. *Journal of Product Innovation Management*, 28(4): 570–585
- Eisenhardt, K.M. 1989. Building theories from case study research. *Administrative Science Quarterly*, 14(4): 532–550.
- Fernández, T. F., Jiménez, F. J., & Roura, J. R. 2015. Business incubation: innovative services in an entrepreneurship ecosystem. *The Service Industries Journal*, 35 (14): 783–800.
- Gawer, A. & Cusumano, M. A. 2002. *Platform Leadership: How Intel, Microsoft, and Cisco drive industry innovation*. Boston, MA: Harvard Business School Press.
- Gawer, A. 2014. Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, 43: 1239–1249.
- Gilsing, V., Nooteboom, B., Vanhaverbeke, W., Duysters, G., & van den Oorda, A. 2008. Network embeddedness and the exploration of novel technologies: Technological distance, betweenness centrality and density. *Research Policy*, 37: 1717–1731.
- Golbeck, J. 2013. *Analysing the Social Web*. San Francisco, CA: Elsevier Science & Technology.
- Granovetter, M. 2005. The impact of social structure on economic outcomes. *Journal of Economic Perspectives*, 19(1): 33–50.
- Gulati, R. 1998. Alliances and networks. *Strategic Management Journal*, 19: 293–317.
- Gulati, R. 1999. Network location and learning: The influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal*, 20: 397–420.
- Hannah, D. & Eisenhardt K. 2018. How firms navigate cooperation and competition in nascent ecosystems. *Strategic Management Journal*, 39: 3163–3192.
<https://doi.org/10.1002/smj.2750>
- Hoppmann, S., Choi, H., & Stumpe Mauter, M. 2014. The impact of technology characteristics on the formation of exploration and exploitation alliances - Insights from the solar photovoltaic industry. DRUID Society Conference 2014, CBS, Copenhagen, June 16–18.
-

-
- Hu, G., Lu, X., & Huang, L. 2009. E-business ecosystem and its evolutionary path: Exploring the phenomenon of e-business industrial cluster in China with a case study of Alibaba Group. *Proceedings of the 3rd International Conference on Risk Management & Global E-business vols. I & II* pp. 902–908.
- Iansiti, M., & Levien, R. 2004. Strategy as ecology. *Harvard Business Review*, 82(3): 68–78.
- Iyer, B. R., & Basole, R. C. 2016. Visualization to understand ecosystems. *Communications of the ACM*, 59(11): 27–30.
- Iyer, B. R., & Henderson, J. C. 2012. Business value from clouds: Learning from users. *MIS Quarterly Executive*, 11(1): 51–60.
- Iyer, B. R., Lee, C. H., & Venkatraman, N. 2006. Managing in a “small world ecosystem”: Lessons from the software sector. *California Management Review*, 48(3): 28–47.
- Jacobides, M., Cennamo, C., & Gawer, A. 2018. Towards a theory of ecosystems. *Strategic Management Journal*, 39: 2255–2276.
- Karamanos, A., 2016. Effects of a firm's and their partners' alliance ego-network structure on its innovation output in an era of ferment. *R&D Management*, 46: 261–276.
- Kelso, E. C. 2019. Facebook coin: \$100 million consortium governed by Visa, Mastercard, PayPal, Uber. *CoinSpice*. <https://coinspice.io/news/facebook-coin-100-million-consortium-governed-by-visa-mastercard-paypal-uber/>
- Khatri, Y. 2019. Banks have shown interest in joining Libra Association, says executive. *The Block*. <https://www.theblockcrypto.com/linked/43425/banks-have-shown-interest-in-joining-libra-association-says-executive>
- Kim, W. C., & Mauborgne, R. A. 1998. Procedural justice, strategic decision making, and the knowledge economy. *Strategic Management Journal*, 19: 324–338.
- Lai, H. C. 2016. When is betweenness centrality useful to firms pursuing technological diversity? An internal-resources view. *Technology Analysis & Strategic Management*, 28(5): 507–523.
- Libra Association. 2019. An Introduction to Libra (White Paper). https://libra.org/en-US/wp-content/uploads/sites/23/2019/06/LibraWhitePaper_en_US-1.pdf, first accessed April 2020.
-

-
- Libra Association. 2019. State Machine Replication in the Libra Blockchain. <https://developers.diem.com/papers/>, first accessed May 2020.
- Libra Association. 2019. The Libra Association: Overview: The Association & Council. https://libra.org/en-US/wp-content/uploads/sites/23/2019/06/TheLibraAssociation_en_US-1.pdf, first accessed June 2020.
- Libra Association. 2019. The Libra Blockchain. <https://developers.libra.org/docs/assets/papers/the-libra-blockchain.pdf>, first accessed August 2020.
- Libra Association. 2020. Move: A Language with Programmable Resources. <https://developers.libra.org/docs/assets/papers/libra-move-a-language-with-programmable-resources/2020-05-26.pdf>, first accessed August 2020.
- Libra Association. 2020. Security on the Libra Network. https://libra.org/en-US/wp-content/uploads/sites/23/2020/04/SecurityOnTheLibraNetwork_April2020.pdf, first accessed August 2020.
- Libra Association. 2020. White Paper v.2. https://wp.diem.com/en-US/wp-content/uploads/sites/23/2020/04/Libra_WhitePaperV2_April2020.pdf, first accessed April 2020.
- Linzerd. 2019. Facebook Blockchain NDA. *CoinSpice*. <https://coinspice.io/icymi/facebook-blog-poloniex-icymi/>, April 13.
- Lorenzoni, G., & Lipparini, A. 1999. The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management Journal*, 20: 317–338.
- March, J. G. 1991. Exploration and exploitation in organizational learning. *Organization Science*, 2(1): 71–87.
- Mayer, T. 2019. A digital Euro to compete with Libra. *The Economists' Voice*, 16(1): 1–6.
- Mazur, K. 2018. The problem of ambidexterity in the context of internationalization *Informatyka Ekonomiczna*, 4:94–107.
- McIntyre, D. P., & Srinivasan, A. 2017. Networks, platforms, and strategy: Emerging views and next steps. *Strategic Management Journal*, 38(1): 141–160.
- Milkau, U. 2019. International payments: Current alternatives and their drivers. *Journal of Payments Strategy & Systems*, 13(3): 201–216.
-

-
- Moore, J. F. 1993. Predators and prey: A new ecology of competition. *Harvard Business Review*, 73(3): 75-86.
- Moore, J. F. 2006. Business ecosystems and the view from the firm. *Antitrust Bulletin*, 51(1): 31-75.
- Muegge, S. M. 2013. Platforms, communities, and business ecosystems: Lessons learned about technology entrepreneurship in an interconnected world. *Technology Innovation Management Review*, 3(2): 5-15.
- Noonan, L., & Armstrong, R. 2019. Banks in no rush to join Facebook 's crypto project. *Financial Times* 23:00, 7 July 2019.
- Ozman, M. 2017. *Strategic Management of Innovation Networks*. New York, NY: Cambridge University Press.
- Parkhe, A. 1993. Strategic alliance structuring: A game theoretic and transaction cost examination of interfirm cooperation. *Academy of Management Journal*, 36: 794–829.
- Partanen, J., Kohtamäki, M., Patel, P., & Parida, V. 2020. Supply chain ambidexterity and manufacturing SME performance: The moderating roles of network capability and strategic information flow. *International Journal of Production Economics*, 221: Article 107470.
- Phelps, C. C. 2010. A longitudinal study of the influence of alliance network structure and composition on firm exploratory innovation. *Academy of Management Journal*, 53: 890–913.
- Phene, A. & Tallman, S. 2014. Knowledge spillovers and alliance formation. *Journal of Management Studies*, 51(7): 1058-1090
- Podolny, J., & Stuart, T. 1995. A role-based ecology of technological change. *American Journal of Sociology*, 100: 1224-1260.
- Popper, N., & Isaac, M. 2019. Facebook and Telegram Are Hoping to Succeed Where Bitcoin Failed. *New York Times*. <https://www.nytimes.com/2019/02/28/technology/cryptocurrency-facebook-telegram.html>
- Prell, C. 2011. *Social Network Analysis*. Sage
- Quaadgras, A. 2005. Who joins the platform? The case of the RFID business ecosystem. *Proceedings of the 38th Hawaii International Conference on System Sciences* – 2005.
-

- Quintana-García, C., & Benavides-Velasco, C. 2008. Innovative competence, exploration and exploitation: The influence of technological diversification. *Research Policy*, 37(3): 492-507.
- Rirscher, R., & Tomanek, S. 2019. Facebook's Libra: A case for capital markets supervision? *Journal of Payments Strategy & Systems*, 13(3): 255-267.
- Rohrbeck, R., Holzle, K., & Gemunden, H.G. 2009. Opening up for competitive advantage - How Deutsche Telekom creates an open innovation ecosystem. *R&D Management*, 39(4): 420-430.
- Salmony, M. 2019. Money and the fear of missing out: How to stay sane in a world shaken by Libra. *Journal of Payments Strategy & Systems*, 13(4): 282-287.
- Sampson, R. 2007. R & D Alliances and firm performance: The impact of technology diversity and alliance organization on innovation. *Academy of Management Journal*, 50(2): 364-386.
- Scaringell, L. & Radziwon, A. 2018. Innovation, entrepreneurial, knowledge, and business ecosystems: Old wine in new bottles? *Technological Forecasting & Social Change*, 136: 59-87.
- Schilling, M., & Phelps, C. 2007. Interfirm collaboration network: The impact of large-scale network structure on firm innovation. *Management Science*, 53: 1113-1126.
- Schmeiss, J., Hoelzle, K., & Tech, R. 2019. Designing governance mechanisms in platform ecosystems: Addressing the paradox of openness through blockchain technology. *California Management Review*, 62(1): 121-143.
- Senarathne, C. 2019. Possible impact of Facebook's Libra on volatility of Bitcoin: Evidence from initial coin offer funding data. *Sciend*, 81: 88-99.
<https://doi.org/10.1515/mosr-2019-0006>.
- Shipilov, A., & Gawer, A. 2020. Integrating research on interorganizational networks and ecosystems. *Academy of Management Annals*, 14(1): 92-121.
- Sloane, A., & O'Reilly, S. 2013. The emergence of supply network ecosystems: A social network analysis perspective. *Production Planning & Control*, 24(7): 621-639.
- Song, J. 2016. Innovation ecosystem: impact of interactive patterns, member location and member heterogeneity on cooperative innovation performance. *Innovation: Management, Policy & Practice*, 18(1): 13-29.

- Stuart, T. E., 1998. Network positions and propensities to collaborate: an investigation of strategic alliance formation in a high-technology industry. *Administrative Science Quarterly*, 43 (3), 668–698.
- Subramanian, A. & Soh, P-H. 2017. Linking alliance portfolios to recombinant innovation: The combined effects of diversity and alliance experience. *Long Range Planning*, 50(5): 636-652.
- Taskinsoy, J. 2019. This time is different: Facebook's Libra can improve both financial inclusion and global financial stability as a viable alternative currency to the U.S. dollar. *Journal of Accounting, Finance and Auditing Studies*, 5(4): 67-86.
- Teixeira, J., Robles G., & González-Barahona, J. 2015. Lessons learned from applying social network analysis on an industrial Free/Libre/Open Source Software ecosystem. *Journal of Internet Services and Applications*, 6(1): 14.
- Thomas, L. D., & Autio, E. 2013. Emergent equifinality: An empirical analysis of ecosystem emergence processes. *Proceedings of the 35th DRUID Celebration Conference 2013*, Barcelona, Spain, June 17-19
- Tischer, D. 2020. Cutting the network? Facebook's Libra currency as a problem of organization. *Finance and Society*, 6(1): 19-33.
- Tomić, N., & Todorović, V. 2020. Potential Negative Implications of Libra Cryptocurrency. *EKOONOMIKA*, 66(1): 13-24.
- Tonin, D. 2019. Facebook's Libra receives frosty reception from US Senate. <https://coingeek.com/facebooks-libra-receives-frosty-reception-from-us-senate/>
- Tsai, W. 2000. Social capital, strategic relatedness and the formation of intraorganizational linkages. *Strategic Management Journal*, 21: 925–939.
- Tsai, W. 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *The Academy of Management Journal*, 44: 996 –1004.
- Uzzi, B., & Spiro, J. 2005. Collaboration and creativity: The small world problem. *American Journal of Sociology*, 111: 447–504.
- van der Borgh, M., Cloudt, M., & Romme, A.G.L. 2012. Value creation by knowledge-based ecosystems: Evidence from a field study. *R&D Management*, 42(2): 150–169.

- Vanhaverbeke, W., Beerkens, B., Gilsing, V., Duysters, G. 2006. Explorative and exploitative learning strategies in technology-based alliance networks. *Academy of Management Best Conference Paper 2006*. BPS: 1-6.
- Vanhaverbeke, W., Gilsing, V., & Duysters, G. 2012. Competence and governance in strategic collaboration: The differential effect of network structure on the creation of core and noncore technology. *Journal of Product Innovation Management*, 29(5):784–802.
- Venkatraman, N., & Lee, C. H. 2004. Preferential linkage and network evolution: A conceptual model and empirical test in the US video game sector. *Academy of Management Journal*, 47(6): 876-892.
- Wassmer, U., Li, S., & Madhok, A. 2017. Resource ambidexterity through alliance portfolios and firm performance. *Strategic Management Journal*, 38: 384–394.
- Wu, F., Li, Q., Li, X., Huang, L., Wang, X. 2017. Dynamic network analysis of inter-firm R&D cooperation based on internet information: A case study of Google. *2017 Proceedings of PICMET '17: Technology Management for Interconnected World*.
- Yan, Y., Zhang, J., & Guan, J. 2020. Network embeddedness and innovation: Evidence from the alternative energy field. *IEEE Transactions on Engineering Management*, 67(3): 769-782.
- Yin, R. 2017. *Case Study Research and Applications: Design & Methods* (6th ed.). Thousand Oaks, CA: Sage
- Zahra, S.A., & Nambisan, S., 2012. Entrepreneurship and strategic thinking in business ecosystems. *Business Horizons*, 55(3): 219–229.
- Zang, J. 2018. Structural holes, exploratory innovation and exploitative innovation. *Management Decision*. 56(8): 1682-1695.
- Zetsche, D. A., Buckley, R. P. & Arner, D. W. 2019. Regulating LIBRA: The Transformative potential of Facebook's cryptocurrency and possible regulatory responses. *European Banking Institute Working Paper Series* 2019/44; University of New South Wales Law Research Series UNSWLRS 19-47. Available at SSRN: <https://ssrn.com/abstract=3414401>
- Zhang, G., Tang, C. & Qi, Y. 2020. Alliance network diversity and innovation ambidexterity: The differential roles of industrial diversity, geographical diversity, and functional diversity. *Sustainability*, 12: 1041.

-
- Zhang, Z., & Luo, T. 2020. Knowledge structure, network structure, exploitative and exploratory innovations. *Technology Analysis & Strategic Management*, 32(6): 666-682.
- Zhiang, L., Yang, H., & Demirkan, I. 2007. The performance consequences of ambidexterity in strategic alliance formations: empirical investigation and computational theorizing. *Management Sciences*, 53(10): 1645–1658.

8 Appendixes

8.1 Appendix A - Libra Timeline

Dates	Events
18-Jun-19	Libra Association Announced
16-Jul-19	David Marcus testifies before Senate Banking Committee
17-Jul-19	David Marcus testifies before the U.S. House Financial Services Committee.
27-Aug-19	Bug Bounty program announced
10-Sep-19	Facebook reveals the list of fiat currencies comprising libra's basket: The U.S. dollar, the euro, the Japanese yen, the British pound sterling and the Singapore dollar
23-Sep-19	Facebook reveals the full breakdown of the basket backing libra: 50 percent USD, 18 percent EUR, 14 percent JPY, 11 percent GBP, 7 percent SGD. (link)
4-Oct	Pay Pal announces they will leave Libra
11-Oct-19	Mastercard, Visa, Mercado Pago, Booking Holdings, eBay and Stripe withdraw from the Libra Association
14-Oct	21 companies sign the Libra Association charter, formally creating the governing council for the stablecoin initiative and electing an executive board
23-Oct-19	Mark Zuckerberg, testifying before the U.S. House Financial Services Committee
11-Nov-19	The Bank for International Settlements announces a new fintech research initiative which will look into stablecoins and digital currencies, among other issues
10-Dec-19	Media notices the White Paper has been edited (remove dividends)
17-Jan-20	The Libra Association announces it has formed a technical steering committee, helmed by representatives from five of its member entities, which will oversee the development of its technical roadmap and try to build a developer community
21-Jan-20	Vodafone withdraws
19-Feb	European Commission Executive Vice-President Valdis Dombrovskis says the body is still unsure how to regulate Libra

21-Feb	Shopify joins, 1st joiner after June 2019
26-Feb	Crypto prime brokerage service Tagomi joins
11-Mar	cLabs, a Silicon Valley mobile payments startup, launches the Celo Alliance with Libra Association members Coinbase Ventures, Andreessen Horowitz, Bison Trails and Anchorage to build a payments infrastructure that is inclusive, echoing many of libra's tenets.
14-Apr	The Financial Stability Board publishes a consultation report advising global financial regulators how they might address stablecoin projects like Libra
16-Apr	Version 2 - Libra Association White Paper released
20-Apr	Heifer International, a global nonprofit organization, joins
28-Apr-20	Checkout.com, a payments processor focused on cross-border transactions, joins
6-May-20	Stuart Levey as its new CEO - former U.S. Treasury Under Secretary
8-May-20	Libra Improvement Proposals announced to engage open discussion about blockchain proposals (lead maintainer also named)
14-May	Singapore state-owned Temasek and San Francisco-based Paradigm and Slow Ventures join the Libra Association, bringing its total membership to 27
26-May	FB Calibra becomes Novi

8.2 Appendix B - Libra Association Spreadsheet of Company Data

Company	Description	Wikipedia	Crunchbase	Website	Partners	Press Release - Factiva	Website
Visa	three companies listed - the categories for the global reflected	payments	Financial Services, Internet, Payments	www.visa.co.uk/		yes	one listing for Libra
Mastercard	two companies one public and one private	payments	Cloud Data Services, Information Technology, Payments	www.mastercard.co.in/en-in.html	Mastercard Inc. and enterprise blockchain software provider R3 collaborated to create and launch a blockchain-enabled cross-border payment solution.	No	No listing for Libra
Thrive Capital	Investment firm - Kushner	venturecap	Finance, Financial Services, Venture Capital	thrivecap.com	New York-based Cedar is a patient payment and engagement platform for hospitals, health systems, and medical groups that elevates the patient experience. Founded by Ariel Lidow and Florian Otto in 2016, Cedar has now raised a total of \$126.0M in total equity funding and is backed by investors that include Andreessen Horowitz , Founders Fund, Jeffrey L. Vacirca, Jerod Mayo, Kaiser Permanente, Kinnevik AB, Lakestar, and Thrive Capital . Over 2,000 public agencies use OpenGov -- including the State of Ohio; the City of Richmond, VA; and Minneapolis, MN. OpenGov was founded in 2012, and is backed by Andreessen Horowitz , Emerson Collective, 8VC, and Thrive Capital .	None listed	No listing for Libra
Uber	Uber develops, markets, and operates a ride-sharing mobile application that allows consumers to submit a trip request.	techmarket	Mobile Apps, Public Transportation, Ride Sharing, Transportation	www.uber.com		no	No listing for Libra in search of site and blog
PayPal	PayPal provides online payment solutions to its users worldwide.	payments	ECOMMERCE, ECommerce Platforms, Finance, Financial Services, FinTech, Mobile Payments, Payments , Transaction Processing	www.paypal.com/home	Pinelabs (india) After investment of \$125 Mn from Temasek & PayPal , the company is in talks with in with international banks to expand its operations to middle east ShipStation's many integration partners include eBay , Jet, PayPal , Amazon, Etsy, BigCommerce, WooCommerce, Shopify Plus, Squarespace, and Magento.	no	No listing for Libra on search of newsroom or blog
eBay	eBay is an online marketplace that connects a global network of buyers and sellers.	techmarket	Auctions, E-Commerce, Internet, Marketplace , Retail, Search Engine	ebay.com	Chris Dixon went from E-bay to Andreessen Horowitz in 2012	yes	Yes, one listing
Spotify	Spotify is a commercial music streaming service that provides restricted digital content from a range of record labels and artists	techmarket	Cloud Computing, Music, Music Streaming, Video Streaming	www.spotify.com		No	Yes, one listing
Novi (Financial) FB	digital wallet , subsidiary of Facebook	blockchain	no listing		Marc Andreessen is a board member of FB	too many - 58 listings	
Coinbase	Coinbase is a digital currency wallet service that allows traders to buy and sell bitcoin.	blockchain	Bitcoin, Blockchain , Cryptocurrency, E-Commerce, Ethereum, FinTech, Personal Finance, Virtual Currency		Huon from Andreessen Horowitz sit on Board AH, Ribbit, USV & Paradigm all raised funds	No	No listing for Libra, David Marcus joins Board in 2017 was listed
PayU	PayU - financial services provider in global growth markets that enables to buy and sell online	payments	E-Commerce, Finance, Financial Services, Fraud Detection, Mobile Payments, Payments	www.payu.com/	Remitly is backed by industry-leading investors including NaspersPayU, Generation Investment Management, Stripes Group	No and No Napster	no listing for Libra
Kiva	international non-profit organization that enables families to make small loans to entrepreneurs in developing countries.	nonprofit	Finance, Financial Services, FinTech, Micro Lending, Non Profit , Social Entrepreneurship	kiva.org		No	one listing for Libra
Iliad	provides Internet access and telecommunication services in France.	telecom	Internet, ISP, Telecommunications	www.iliad.fr		None listed on Factiva but one found on their website	one press release
Booking Holdings	separate from booking.com (Netherlands, private), Booking Holdings = public US co.	techmarket	Internet, Reservations, Travel - Holdings: Booking.com = ECommerce, Hotel, Information Technology, Leisure, Travel, Web Development	www.bookingholdings.com		No	No press release for Libra No listing in "News" for Libra
WomanWB	nonprofit organization that provides strategic support, technical assistance and information to a global network	nonprofit	Banking, Communities, Non Profit	www.womensworldbanking.org		No	Link to Devex.com article Mastercard and Calibra are sponsors, the reference to Ebay and PayPal
Mercy Corps	global organization powered by the belief that a better world is possible	nonprofit	Association, Non Profit	mercycorp.org		No	Two articles on Libra Partnership with Mastercard
Stripe	developer-oriented commerce company helping small and large companies accept web and mobile payments.	payments	Consumer Software, Internet, Mobile, Payments , SaaS, Software	stripe.com	Nigeria-based payments system startup Paystack company has raised USD 8 million in Series A funding from Stripe , Visa and Tencent PureSec, the global leader in serverless security, today announced a \$7 million series A round, led by Square Peg Capital (portfolio companies include Uber , Stripe and Fiverr)	No	No press release for Libra Reference to partnership with Lyft in Featured News Articles

Company	Description	Wikipedia	Crunchbase	Website	Partners	Press Release - Factiva	Website
Lyft	both public and private entities	techmarket	Mobile Apps, Peer to Peer, Ride Sharing, Transportation	lyft.com	Ben Horowitz, a16z general partner, is leaving Lyft's board (28 April 2020) https://stripe.com/newsroom/stories/lyft-and-stripe	No	No results on search for Libra, blockchain, crypto No press releases or blog results
Vodafone	UK - mobile telecommunications company that offers voice, messaging, and data services	telecom	Internet, Mobile, Telecommunications	vodafone.com		No	No results for Libra
Breakthrough Initiatives	Milner - Russian billionaire Board = Hawking, Zuckerberg?	venturecap	Innovation Management, Project Management, Search Engine	breakthroughinitiatives.org/	Zuckerberg - FB on Board according to website	No	No results for Libra
Union Square Ventures	venture capital firm focused on early-stage, growth-capital, late stage, and startup financing	venturecap	Finance, Financial Services, Venture Capital	www.usv.com	https://techcrunch.com/2019/01/02/union-square-ventures-secures-429m-across-two-new-funds/ Founded in 2003 by Fred Wilson (pictured) and Brad Burnham. USV has supported high-flying companies including Twitter, Tumblr, Etsy and, more recently, Carta and Coinbase.	No	10 blog references to Libra, none on partners
Anchorage	crypto-native digital asset custodian that uses modern security engineering to help institutions safeguard their investments	blockchain	Blockchain, Cryptocurrency, Financial Services, FinTech, Software	www.anchorage.com		Not listed	No results for Libra (except 18 June 2019)
Xapo	bitcoin wallet with the security of a deep cold storage vault	blockchain	Bitcoin, Financial Services	www.xapo.com		No	one result for Libra Wences Casares joins Board
BisonTrails	secure infrastructure on multiple blockchains - hosting platform for nodes	blockchain	Blockchain, Infrastructure, Internet, Software	bisontrails.co/	Coinbase investor in Bison Trails	Not listed	Multiple references, none to partners
Creative Destruction Lab	Canada - seed-stage program for massively scalable, science- and technology-based ventures	venturecap	Advice, Angel Investment, Finance, Quantum Computing, Venture Capital	www.creative destructionlab.com/		Not listed	No results for Libra
MercadoPago - Division	internet payment platform in the Latin American region	techmarket	E-Commerce, Internet	www.mercadopago.com.br/		No	No results for Libra
Farfetch	online luxury fashion retail platform	techmarket	ECommerce, Fashion, Internet, Retail	www.farfetch.com/		Yes	one at launch
Ribbit Capital	venture capital firm that invests in early-stage companies	venturecap	Finance, Financial Services, FinTech, Venture Capital	ribbitcap.com	Raisin was named to Europe's top 5 fintechs by the renowned FinTech50 awards and is backed by prestigious European and American investors such as btov Ventures, Goldman Sachs, PayPal Ventures, Thrive Capital, Index Ventures, Orange Digital Ventures and Ribbit Capital. ZestMoney recently raised Series A round from Xiaomi, PayU, Ribbit Capital and Omidyar Network investor in Xapo & Coinbase - xapo.com	Not listed	No results for Libra
AndreessenHorowitz	Silicon Valley-based venture capital firm	venturecap	Angel Investment, Finance, Venture Capital	www.a16z.com	Mobile app-based lender Branch International Inc. closed a \$170 million series C financing round, led by Foundation Capital and Visa Inc. Existing investors Andreessen Horowitz, Trinity Ventures, Formation 8, the IFC, CreditEase and Victory Park, as well as new investors Greenspring, Foxhaven, and B Capital, participated in the funding round. Fintech startup Branch International, which assesses creditworthiness using smartphone data, has raised \$170 million in Series C financing and announced a new partnership with Visa. Foundation Capital and Visa led the round, which also included B Capital, Andreessen Horowitz	No	blog by Haun at launch
Shopify	multi-channel commerce platform designed for small and medium-sized businesses	techmarket	Developer Tools, E-Commerce, E-Commerce Platforms, Enterprise Software, SaaS, Software, Web Development	www.shopify.com	partnered with Klarna and UPS recently	Yes	No results for Libra
Tagomi	Broker in Crypto. Trading, Custody, Margin, Lending, Shorting, Staking, Financing, all in one account	blockchain	Bitcoin, Blockchain, Cryptocurrency, Financial Services	www.tagomi.com		Not listed	No results for Libra
Checkout.com	payments through one integration	payments	Billing, Financial Services, Mobile Payments, Payments, Retail Technology, Transaction Processing	www.checkout.com	Shopify listed as a "partner" on website	No	blog announcement 27 April 2020
Heifer	works with communities to end world hunger and poverty.	nonprofit	Association, Communities, Non Profit	www.heifer.org/		Not listed	blog announcement 20 April 2020
Paradigm	A crypto asset investment firm. San Francisco	venturecap	Blockchain, Cryptocurrency	paradigm.xyz/	Paper by Huang - lists links to Xapo & Ribbit Capital- https://www.paradigm.xyz/Bitcoin_For_The_Open_Minded_Skeptic.pdf Fred Ehrsam co-founder of Coinbase	No	No result for Libra
Temasek	investment company state owned in Singapore, sustainable returns over the long term	venturecap	Angel Investment, Finance, Financial Services, Venture Capital	www.temasek.com.sg		No	No result for Libra
SlowVentures	invests in companies central to the technology industry	venturecap	Angel Investment, Finance, Venture Capital	www.slow.co	Founder Sam Lessin - former VP at FB -- # of former FB angels. Slow Ventures current portfolio includes investments across industries, including Pinterest, Slack, Casper, Robinhood, Postmates, "In the same month we may be making investments in consumer brands, crypto/blockchain, life sciences, software, and even rockets/space... But many of these investments will be based more on the team than the initial product idea or business model," Collieran said. (Business Insider, 14:39, 11 April 2019, mhenrbroth@businessinsider.com	Not listed	No results for Libra

8.3 Appendix C - Sample template of data capture: company websites & Factiva

Website screen capture: Stripe Partnerships

Kiva - Search Summary - Factiva

Text	Kiva AND partner*
Date	In the last 2 years
Source	All Sources
Author	All Authors
Company	All Companies
Subject	All Subjects
Industry	All Industries
Region	All Regions
Language	English
News Filters	Subject: Partnerships/Collaborations
Results Found	70
Timestamp	8 August 2020 22:23

34 members searched, no relationships were identified

8.4 Appendix D - Crunchbase Media News Search Output

Union Square Ventures Search Output: “partner”, “partnership”, “alliance”, “collaborate” and “collaboration”.

Article Name	Title	Date	Mentioned Entities	Press Reference Link
Aon and CoverWallet announce commercial partnership	Aon and CoverWallet announce commercial partnership		Aon plc, CoverWallet, New York Stock Exchange (NYSE), Union Square Ventures, Zurich Insurance Group	https://www.prnewswire.com/news-releases/aon-and-coverwallet-announce-commercial-partnership-300859580.html
Rebecca Kaden joins Union Square Ventures as general partner	Rebecca Kaden joins Union Square Ventures as general partner	5/30/2019	Rebecca Kaden, Union Square Ventures	https://techcrunch.com/2017/10/20/rebecca-kaden-joins-union-square-ventures-as-general-partner/
Koko Raises Series A Funding; Launches Chatbot on Kik, Telegram and Facebook Messenger; Announces Partnership With Kik	Koko Raises Series A Funding; Launches Chatbot on Kik, Telegram and Facebook Messenger; Announces Partnership With Kik	10/20/2017	Facebook, Google, Kik, MIT Media Lab, Northwestern University, Omidyar Network, Shriya Mahesh, Ted Livingston, Union Square Ventures, University of Maryland, University of Pennsylvania, Wikipedia	http://www.prweb.com/releases/Koko_SeriesA_KikPartnership/0808/prweb13598794.htm
UBS and SigFig to Form Strategic Alliance for Wealth Management Technology Development	UBS and SigFig to Form Strategic Alliance for Wealth Management Technology Development	8/8/2016	Bain Capital Ventures, Innovation Lab, Mike Sha, SigFig, UBS, Union Square Ventures	http://www.businesswire.com/news/home/20160516005979/en
Benchmark€’s New General Partner: Scott Belsky	Benchmark€’s New General Partner: Scott Belsky	5/16/2016	Behance, Benchmark, Bill Gurley, Eric Vishria, Kayvon Beykpour, Matt Cohler, Mitch Lasky, New York, Pinterest, Twitter, Uber, Union Square Ventures, Warby Parker	http://abovetherowd.com/2016/02/08/benchmark-s-new-general-partner-scott-belsky/
Private List Collaboration: The Simplest Way for Your Team to Track Markets, Portfolio Companies and Potential Deals	Private List Collaboration: The Simplest Way for Your Team to Track Markets, Portfolio Companies and Potential Deals	2/8/2016	Bill Gurley, CB Insights, Fred Wilson, Union Square Ventures	https://www.cbinsights.com/blog/private-list-collaboration/
Private List Collaboration: The Simplest Way for Your Team to Track Markets, Portfolio Companies and Potential Deals	Private List Collaboration: The Simplest Way for Your Team to Track Markets, Portfolio Companies and Potential Deals	12/20/2015	Bill Gurley, CB Insights, Fred Wilson, Union Square Ventures	https://www.cbinsights.com/blog/private-list-collaboration/
Millennial-Focused Lending Application Lenny Announces Partnership with Dwolla and New Funding	Millennial-Focused Lending Application Lenny Announces Partnership with Dwolla and New Funding	12/20/2015	Andreesen Horowitz, Apple, Ben Milne, CME Group, Dwolla, Union Square Ventures	http://www.businesswire.com/news/home/20151208005515/en
Millennial-Focused Lending Application Lenny Announces Partnership with Dwolla and New Funding	Millennial-Focused Lending Application Lenny Announces Partnership with Dwolla and New Funding	12/8/2015	Andreesen Horowitz, Apple, Ben Milne, CME Group, Dwolla, Union Square Ventures	http://venturebeat.com/2015/12/08/millennial-focused-lending-application-lenny-announces-partnership-with-dwolla-and-new-funding
YouNow And Roker Labs Announce Production Partnership At TVOT To Develop Live-Streaming Shows For The YouNow Network Content To Reflect Most Popular Millennial Interests	YouNow And Roker Labs Announce Production Partnership At TVOT To Develop Live-Streaming Shows For The YouNow Network Content To Reflect Most Popular Millennial Interests	12/8/2015	Comcast Ventures, Food Network, HGTV, Instagram, Oren Zeev, Peter Thiel, Sanghit Arora, Union Square Ventures, Venrock, YouNow	http://www.prnewswire.com/news-releases/younow-and-roker-labs-announce-production-partnership-at-tvot-to-develop-live-streaming-shows-for-the-younow-network-300187686.html
Twitter scores a touchdown as NFL extends their partnership - CNET	Twitter scores a touchdown as NFL extends their partnership - CNET	12/4/2015	Adam Bain, Alex Iskold, Ayah Bdeir, Etsy, Facebook, GE Healthcare, General Assembly, Gilt Groupe, Google, Jack Dorsey, LinkedIn, Marc Albanese, Michelle Peluso, New York University, NFL, NY Tech Meetup, PayPal, Smart Vision Labs, Tesla, The We Company, Tumblr Inc., Twitter, Union Square Ventures, Yaopeng Zhou, YouTube	http://www.cnet.com/new/twitter-and-the-nfl-extend-their-partnership/
Music Collaboration Suite Splice Raises \$4.5M From True And DJs, Launches Public Beta TechCrunch	Music Collaboration Suite Splice Raises \$4.5M From True And DJs, Launches Public Beta TechCrunch	8/10/2015	Dropbox, GroupMe, Series A - Splice, Steve Martocci, True Ventures, Union Square Ventures	http://techcrunch.com/2015/08/11/splice-music-collaboration/
CircleUp Lands Virgin America€’ Partnership	CircleUp Lands Virgin America€’ Partnership	9/17/2014	Andreesen Horowitz, CircleUp Growth Partners, Crunchbase, General Mills, GV, Le Grand Courtaige, Omidyar Network, Rory Eakin, Ryan Calbeck, TSG Consumer Partners, Union Square Ventures, Virgin America, Virgin Group	http://techcrunch.com/2014/03/12/circleup-lands-virgin-america-partnership/
A GitHub For Musicians, GroupMe Founder€’s €’€’Splice€’ Aids Collaboration With Song Version€’ Control	A GitHub For Musicians, GroupMe Founder€’s €’€’Splice€’ Aids Collaboration With Song Version€’ Control	2/12/2014	Bitworks, David Tisch, Dropbox, First Round Capital, GroupMe, Kickstarter, LivingSocial, Matt Almonetti, Microsoft, Rob Wiesenthal, Skype, Sony, SoundCloud, Splice, Spotify, Steve Martocci, SV Angel, Techstars, True Ventures, Union Square Ventures, Warner Music Group	http://techcrunch.com/2013/10/09/splice-music/
GroupMe Co-founder’s Latest Project, Splice, Helps Musicians Collaborate	GroupMe Co-founder’s Latest Project, Splice, Helps Musicians Collaborate	10/9/2013	First Round Capital, GroupMe, Jared Hecht, Splice, Steve Martocci, SV Angel, The White House, True Ventures, Union Square Ventures	http://mashable.com/2013/10/09/groupme-co-founders-latest-project-splice-helps-musicians-collaborate/
Ask A VC: Early Twitter Investor And Spark Capital Partner Bijan Sabet On Founder Personality, Investment Syndicates And More	Ask A VC: Early Twitter Investor And Spark Capital Partner Bijan Sabet On Founder Personality, Investment Syndicates And More	10/9/2013	Boxee, Comcast, FitnessKeeper, Foursquare, OKAGPOP, Spark Capital, thePlatform, Tumblr Inc., Twitter, Union Square Ventures, Zynga	http://techcrunch.com/2013/09/13/ask-a-vc-early-twitter-investor-and-spark-capital-partner-bijan-sabet-on-founder-personality-investment-syndicates-and-more/
Twilio & Google partner to bring cloud communications to App Engine VentureBeat Cloud by Sean Ludwig	Twilio & Google partner to bring cloud communications to App Engine VentureBeat Cloud by Sean Ludwig	9/13/2013	Bessemer Venture Partners, Google, Jeff Lawson, Microsoft, Twilio, Union Square Ventures	http://venturebeat.com/2013/04/02/twilio-google-partner-to-bring-cloud-communications-to-app-engine/
Cloud tag team: SendGrid & Twilio partner on email, SMS, & voicemail solutions for the enterprise VentureBeat Cloud by Sean Ludwig	Cloud tag team: SendGrid & Twilio partner on email, SMS, & voicemail solutions for the enterprise VentureBeat Cloud by Sean Ludwig	4/2/2013	Bessemer Venture Partners, Founders Fund, Foundry Group, Highway 12 Ventures, LivingSocial, SendGrid, Twilio, Union Square Ventures	http://venturebeat.com/2012/12/04/sendgrid-twilio-partners/
Greylock And Benchmark Lead \$15M Round In Social Collaboration Platform For Classrooms Edmodo	Greylock And Benchmark Lead \$15M Round In Social Collaboration Platform For Classrooms Edmodo	12/4/2012	Benchmark, Edmodo, Facebook, Greylock, Learn Capital, LinkedIn, Netflix, Reed Hastings, Reid Hoffman, Union Square Ventures	http://techcrunch.com/2011/12/08/greylock-and-benchmark-lead-15m-round-in-the-facebook-for-classrooms-edmodo/
Our Partner Andy	Our Partner Andy	12/8/2011	Andy Weissman, Betaworks, Union Square Ventures	http://avc.com/2011/10/09-partner-andy/
Independent Firms With Single Limited Partner Histories	Independent Firms With Single Limited Partner Histories	10/20/2011	AT&T, Bank of America, Bessemer Trust, Bessemer Venture Partners, Brad Burnham, Chiratae Ventures, Fidelity Ventures, Fred Wilson, Union Square Ventures, Venrock, Volition Capital	http://larrycheng.com/2011/03/05/independent-firms-with-single-limited-partner-histories
Wondering Which Partner at a VC Firm to Pitch? TheFunded Now Breaks Out Individual VCA Ratings.	Wondering Which Partner at a VC Firm to Pitch? TheFunded Now Breaks Out Individual VCA Ratings.	3/5/2010	Bill Tai, First Round Capital, Fred Wilson, HVP, Hummer Winblad Venture Partners, John Doerr, John Hummer, Mark Kvamme, Michael Moritz, New Enterprise Associates (NEA), Rolf Botha, Sequoia Capital, Steve Jurvetson, The Funded, Tim Draper, Union Square Ventures	http://techcrunch.com/2008/04/14/wondering-which-partner-at-a-vc-firm-to-pitch-the-funded-now-breaks-out-individual-vc-ratings/
		4/14/2008		

8.5 Appendix E - Crunchbase – Sample Company Data Collection Template

Spotify Example – Manual Partnership Identification Process

Visa = 0

Mastercard = 0

Thrive = 0

Uber = 1

Uber and Spotify hope music collaboration drowns out recent woes (Nov 21 2014)

PayPal = 0

Ebay = 0

Facebook = 2

Spotify and Facebook are set announce a partnership to provide streaming music within the social network, according to reports.

By Shane Richmond *and* Shanerichmond 26 May 2011 • 15:50 pm

Facebook brings Will Smith to its video-on-demand platform, reveals Spotify partnership (Mar 14, 2019)

Coinbase = 0

PayU = 0

Kiva = 0

Iliad = 0

Booking = 0

Mercy = 0

Stripe = 0

Lyft = 0

Vodafone = 1

Australia - "...following on from the company's bundle agreements with Spotify" (Feb 2015)

Vodafone Australia introduces exciting offers on Amazon Prime, Spotify Premium and Netflix, in partnership with DOCOMO Digital (Dec 3 2019)

Union Square Ventures = 0

Xapo = 0

Creative Destruction = 0

Farfetch = 0

Andreessen = 0

Shopify = 0

Checkout.com = 0

Hiefer = 0

Temasek = 0

8.6 Appendix F - Libra Association network matrix

[illegible]

8.7 Appendix G - Libra Association adjacency lists for each Phase

Appendix G - Adjacency Lists for Genesis Phases - EDGES						
List for Preparation Phase			List for Formation Phase			List for Pre-Operation Phase
Source	Target		Source	Target		Source Target
1	2		3	8		3 8
1	4		4	7		4 7
1	4		4	8		4 8
1	5		4	8		4 8
1	5		4	8		4 8
1	5		4	22		4 22
1	5		4	28		4 28
1	8		7	8		7 8
1	8		7	8		7 8
1	10		7	8		7 8
1	16		7	18		8 9
2	5		8	9		8 10
2	5		8	10		8 11
2	5		8	11		8 12
2	8		8	12		8 14
2	11		8	14		8 15
2	17		8	15		8 17
3	8		8	17		8 19
4	5		8	18		8 19
4	5		8	19		8 20
4	7		8	19		8 21
4	8		8	20		8 22
4	8		8	21		8 23
4	8		8	22		8 24
4	22		8	23		8 26
4	28		8	24		8 27
5	8		8	26		8 28
5	8		8	27		8 28
5	8		8	28		8 29
5	18		8	28		8 30
5	11		9	20		8 31
5	22		17	28		8 32
5	25		22	27		8 33
6	8					8 34
6	8					8 35
6	8					8 35
6	11					29 8
7	8					29 4
7	8					9 20
7	8					9 33
7	18					17 28
8	9					22 27
8	10					22 33
8	11					27 33
8	12					
8	13					
8	14					
8	15					
8	16					
8	17					
8	18					
8	19					
8	19					
8	20					
8	21					
8	22					
8	23					
8	24					
8	25					
8	26					
8	27					
8	28					
8	28					
9	20					
17	28					
22	27					

Appendix G - Adjacency List for Genesis Phases - NODES							
List for Preparation Phase		List for Formation Phase		List for Pre-Operation Phase			
<i>id</i>	<i>label</i>	<i>id</i>	<i>label</i>	<i>id</i>	<i>label</i>		
1	Visa	3	ThriveCapital	3	ThriveCapital		
2	Mastercard	4	Uber	4	Uber		
3	ThriveCapital	7	Spotify	7	Spotify		
4	Uber	8	Facebook	8	Facebook		
5	PayPal	9	Coinbase	9	Coinbase		
6	eBay	10	PayU	10	PayU		
7	Spotify	11	Kiva	11	Kiva		
8	Facebook	12	Iliad	12	Iliad		
9	Coinbase	14	WWB	14	WWB		
10	PayU	15	Mercy	15	Mercy		
11	Kiva	17	Lyft	17	Lyft		
12	Iliad	18	Vodafone	19	Breakthrough		
13	Booking	19	Breakthrough	20	UnionSquare		
14	WWB	20	UnionSquare	21	Anchorage		
15	Mercy	21	Anchorage	22	Xapo		
16	Stripe	22	Xapo	23	BisonTrails		
17	Lyft	23	BisonTrails	24	CreativeD		
18	Vodafone	24	CreativeD	26	Farfetch		
19	Breakthrough	26	Farfetch	27	RibbitCapital		
20	UnionSquare	27	RibbitCapital	28	AndreessenHorowitz		
21	Anchorage	28	AndreessenHorowitz	29	Shopify		
22	Xapo			30	Tagomi		
23	BisonTrails			31	Checkout		
24	CreativeD			32	Hiefer		
25	MercadoPago			33	Paradigm		
26	Farfetch			34	Temasek		
27	RibbitCapital			35	SlowVentures		
28	AndreessenHorowitz						

8.8 Appendix H - List of Industries by Libra Association Member

Organization Name	Industries
Creative Destruction Lab	Advice, Angel Investment, Finance, Quantum Computing, Venture Capital
Facebook	E-Commerce, Mobile Apps, Social, Social Media, Social Network, Video Streaming
Checkout.com	E-Commerce, FinTech, Payments, Transaction Processing
Uber	Mobile Apps, Public Transportation, Ride Sharing, Transportation
Spotify	Cloud Computing, Music, Music Streaming, Video Streaming
MasterCard	Cloud Data Services, Information Technology, Payments
Farfetch	E-Commerce, Fashion, Internet, Retail
Shopify	Developer Tools, E-Commerce, E-Commerce Platforms, Enterprise Software, SaaS, Software, Web Development
Lyft	Mobile Apps, Peer to Peer, Ride Sharing, Transportation
Stripe	Consumer Software, Internet, Mobile, Payments, SaaS, Software
Kiva	Finance, Financial Services, FinTech, Micro Lending, Non Profit, Social Entrepreneurship
PayPal	E-Commerce, E-Commerce Platforms, Finance, Financial Services, FinTech, Mobile Payments, Payments, Transaction Processing
Bison Trails	Blockchain, Infrastructure, Internet, Software
Coinbase	Bitcoin, Blockchain, Cryptocurrency, E-Commerce, Ethereum, FinTech, Personal Finance, Virtual Currency
Visa	Financial Services, Internet, Payments
eBay	Auctions, E-Commerce, Internet, Marketplace, Retail, Search Engine
Xapo	Bitcoin, Financial Services
Vodafone	Internet, Mobile, Telecommunications
Iliad	Internet, ISP, Telecommunications
PayU	E-Commerce, Finance, Financial Services, FinTech, Fraud Detection, Mobile Payments, Payments

Anchorage	Blockchain, Cryptocurrency, Financial Services, FinTech, Software
Tagomi	Bitcoin, Blockchain, Cryptocurrency, Financial Services, FinTech
Booking Holdings	Internet, Reservations, Travel
Mercado Pago	E-Commerce, Internet
Mercy Corps	Association, Non Profit
Breakthrough Initiatives	Innovation Management, Project Management, Search Engine
Women's World Banking	Banking, Communities, Non Profit
Heifer International	Association, Communities, Non Profit
Thrive Capital	Venture Capital, Financial Services, Finance
Union Square Ventures	Finance, Financial Services, venture capital
Ribbit Capital	Finance, Financial Services, FinTech, Venture Capital
Andreessen Horowitz	Angel Investment, Finance, Venture Capital
Slow Venture	Angel Investment, Finance, Venture Capital
Paradigm	Blockchain, Cryptocurrency, venture capital
Temasek	Angel Investment, Finance, Venture Capital, Financial Services

8.9 Appendix I - Technological Distance Tables – Pairwise Comparison by Phase

Phase 1

	Phase 1 - Pairwise Distance Between Firms															
Facebook	0															
Unionsquare	1	0														
Cornbase	1	1	0													
RibbitCapital	0.113975	0.823223	0													
Xapo	1	0.591752	0.75	0.644447												
Spatfly	0.776393	1	1	1	1	0										
Uber	0.776393	1	1	1	1	1	0									
Merry Corps	1	1	1	1	1	1	0									
Andressen Horow	0.133333	1	0.42265	1	1	1	1	0								
Lift	0.8	1	1	1	1	1	0.32918	1	1	0						
Women's World E	1	1	1	1	1	1	0.591752	1	1	0						
Anchorage	1	0.741801	0.525658	0.552786	0.683772	1	1	0.8	1	0						
Ferretch	1	0.823223	1	1	1	1	1	1	1	0						
Creative Destruct	1	0.485602	1	0.552786	1	1	1	0.225403	1	1	0					
Pavai	1	0.561564	0.732739	0.430303	0.732739	1	1	0.781782	1	1	0					
Kiva	1	0.528955	0.556562	0.387628	0.711325	1	0.711325	0.764298	0.634852	1	0.814726	0.53709	0			
Illad	1	1	1	1	1	1	1	1	1	1	0					
Thrive Capital	1	1	1	1	1	1	0.33133	1	0.741801	1	0.48362	0.563564	0.528955	1	0	
Breakthrough	1	1	1	1	1	1	1	1	1	1	1	1	1	0		
Bison Trails	1	0.823223	1	0.591752	1	1	1	0.776393	1	0.552786	0.75	1	1	1	0.711325	1
Vodafone	1	1	1	1	1	1	1	1	0.711325	1	1	0.33333	1	0.711325	0	
Vicon	1	0.666667	1	0.711325	0.591752	1	1	1	0.741801	0.711325	1	0.583564	0.764298	0.666667	0.666667	1
Mainstreamc	1	1	1	1	1	1	1	1	1	0.781782	1	1	1	0.666667	0	
Prophit	1	0.591752	0.75	0.486867	0.75	1	0.795876	1	0.683772	0.823223	0.844886	0.566887	0.591752	1	1	0.666667
eBay	1	1	0.556562	1	1	1	1	1	0.387628	0.845697	1	0.764298	1	0.74298	0.795876	0.764298
Stripe	1	0.563564	0.732739	0.430303	0.732739	1	1	0.781782	1	0.661938	0.810108	0.830699	3.33E-16	0.53709	0.563564	1
MaradeoFund	1	0.75	1	1	1	1	1	1	0.732739	1	0.591752	1	1	0.666667	0.591752	0.781782
Bookings	1	1	1	1	1	1	1	1	1	1	1	0.666667	1	1	0.764298	1
Booking	1	1	1	1	1	1	1	1	1	1	1	0.666667	1	1	0.764298	1

Phase 1 – Departed Firms

Pairwise Distance Between Firms - Departed Libra						
Visa	0					
Mastercard	0.666667	0				
PayPal	0.591752	0.795876	0			
eBay	0.764298	1	0.855662	0		
Stripe	0.563564	0.781782	1.198216	0.845697	0	
MercadoPago	0.591752	1	0.75	0.42265	0.732739	0
Booking	0.666667	1	1	0.764298	1	0.591752

Phase 2

[illegible]

Phase 3

[illegible]

Phase 3 – Joined Firms

Pairwise Distance Between Firm - Joined							
Paradigm	0						
Shopify	1	0					
Temasek	0.711325	1	0				
Slow Ventu	0.666667	1	0.133975	0			
Heifer	1	1	1	1	0		
Checkout.c	1	0.75	1	1	1	0	
Tagomi	0.483602	1	0.776393	1	1	0.776393	0

8.10 Appendix J - Technological Distance Tables – Pairwise Comparison by Roles

Expert Role – Phase 1 and 2

	Phase 1 & 2 - Pairwise Distance Between Experts					
Coinbase	0					
Xapo	0.75	0				
Anchorage	0.525658	0.683772	0			
Creative Destru	1	1	1	0		
Breakthrough	1	1	1	1	0	
Bison Trails	0.823223	1	0.552786	1	1	0

Expert Role – Phase 3

	Phase 3 - Pairwise Distance Between Experts						
Coinbase	0						
Xapo	0.75	0					
Anchorage	0.525658	0.683772	0				
Creative Destru	1	1	1	0			
Breakthrough	1	1	1	1	0		
Bison Trails	0.823223	1	0.552786	1	1	0	
Tagomi	0.367544	0.367544	0.2	1	1	0.776393	0

Champion Role – Phase 1 and 2

Phase 1 & 2 - Pairwise Distance Between Champions			
Mercy Corps	0		
Women's World Banki	0.591752	0	
Kiva	0.711325	0.764298	0

Champion Role – Phase 3

Phase 3 - Pairwise Distance Between Champions			
Mercy Corps	0		
Women's World Banki	0.591752	0	
Kiva	0.711325	0.764298	0
Heifer	0.183503	0.333333	0.764298

8.11 Appendix K - Orange Model – Technological Diversity