

Open innovation strategy: a framework for corporate-startup collaboration

By

Roberto José Vázquez Lucerga

M.S. Engineering (Mechanical), ICAI, 1999

M.S. Physics, UNED, 2004

EMBA, IE Business School, 2009

SUBMITTED TO THE MIT SLOAN SCHOOL OF MANAGEMENT IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN MANAGEMENT OF TECHNOLOGY
AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JUNE 2018

©2018 Roberto Jose Vazquez Lucerga. All rights reserved.

The author hereby grants to MIT permission to reproduce
and to distribute publicly paper and electronic
copies of this thesis document in whole or in part
in any medium now known or hereafter created.

Signature of Author:

Signature redacted

MIT Sloan School of Management
May 11, 2018

Reader :

Signature redacted

Miguel Paredes Sadler
Chief Data Analytics Officer (CDAO), Center for Advanced Analytics
BREIN (Breca Group)

Certified by:

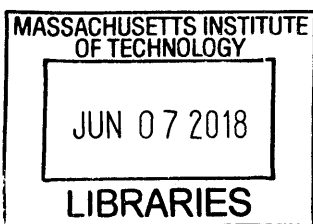
Signature redacted

Nicholas Meyer
Lecturer, MIT Sloan School of Management
Entrepreneur in Residence, Martin Trust Center for MIT Entrepreneurship
Thesis Supervisor

Accepted by:

Signature redacted

Johanna Hising DiFabio
Director, Sloan Fellows and EMBA Programs
MIT Sloan School of Management



THIS PAGE WAS INTENTIONALLY LEFT BLANK

Open innovation strategy: a framework for corporate-startup collaboration

By

Roberto José Vázquez Lucerga

Submitted to MIT Sloan School of Management
on May 11, 2018 in Partial Fulfillment of the
requirements for the Degree of Master of Science in Management of Technology.

Abstract

Recent years have seen important changes in the way corporates compete and the dynamism of this competition. Companies are facing increasing pressure to innovate and generate value for customers in over-satisfied societies demanding more complex business propositions and faster response. These changes lead to greater horizontal and vertical uncertainty, that corporations have to manage while sustaining investment in core assets to ensure short term performance.

Open innovation strategies, leveraging on the internal and external entrepreneurial drive, have been proposed to increase the resilience of corporates while opening the opportunity for nascent ventures to grow in new markets. The design of these programs is an area of active research.

This thesis proposes a specific open innovation program. The design implements an integral strategy combining inside-out and outside-in transitions to lower costs and enhance efficiency. The design is sequential and staged, resulting in a flexible, modular program architecture with multiple, specifically designed components (accelerator, innovation center, incubator and CVC) enabling the management of a wide range of deal flows.

Thesis Supervisor: Nicholas Meyer

Title: Lecturer, MIT Sloan School of Management
Entrepreneur in Residence, Martin Trust Center for MIT Entrepreneurship

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Acknowledgements

I would like to thank my thesis advisor, Nick Meyer, for his continuous support and advice. Entrepreneur-in-Residence and Lecturer at the Martin Trust Center for MIT Entrepreneurship and founder of numerous successful ventures, he infuses passion and optimism wherever he goes, creating a “can do” atmosphere that electrifies and pushes to do better. This thesis would not have been possible without him.

I would like to acknowledge the sponsorship Al Salam Bank-Bahrain B.S.C.. I am grateful to His Excellency Mr. Abdulla Hasan Saif, Mr. Yousif Taqi and Mr. Mukundan Raghavaachari for their support and encouragement in times of difficulty.

My gratitude and appreciation to the Sloan Fellows Class of 2018, and in particular, my summer team (Fred, Junaid, Yuan and Kenta) for their inspiration, encouragement and, above all friendship, and Santiago Guzman and Samuel Ooi for providing me guidance in the venture capital sections.

I would like to thank the program office of the MIT Sloan Fellows Program in Innovation and Global Leadership, and in particular Johanna Hising DiFabio, Marc O'Mansky and Michelle Pierce, for their guidance, support, and assistance.

A special thanks to all the professionals who attended my calls or offered their valuable time at Sloan Fellow speaker series to enrich the thesis with their insights. In particular, my thanks to Chris Howard (The Rattle), Guilherme Lago and Fabiana Tarabal from (PulseHub, Raizen), Fatima Hamad and Prasanth Kalapatapu (Cisco), Christoph Betz (Hochtief), Jim Kizielewicz (Kronos), Alvaro Bernad Danzberger (Calidad Pascual), Luis Casado Padilla (Repsol), Masatoshi Ishikawa and Masato Kaneda (Mizuho Financial Group), Enrique Fragata and Frederick Thomaz Machado Alves (Itau Unibanco) and Patrick Sobalvarro (Veo Robotics).

This thesis has also benefited from the support of Miguel Paredes Sadler, Chief Data Analytics Officer at Brein (Breca Group), reader and responsible for the initial spark that kindled this research.

A very special and heartfelt thanks to my mentor Manuel Alvarez Muñoz for his friendship and advice.

All of this would have been of no avail without my family. Thank you for a lifetime of encouragement, learning, and love.

This thesis is dedicated to my wife and love Sylvia, and my daughters Blanca and Becky.

Cambridge, May 2018

Roberto Jose Vazquez Lucerga

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Table of Contents

List of Figures	10
List of Tables	11
List of Case Studies.....	12
Introduction	13
Corporate venturing	13
Overview.....	14
Open innovation programs based on corporate-startup interfirm collaboration	17
Open innovation and interfirm collaboration	17
Corporate-startup interfirm collaboration	19
Typology of corporate startup collaboration	20
Corporate outside-in open innovation strategies	20
Corporate inside-out open innovation strategies	22
Current open innovation strategies	23
Corporate accelerators	23
Corporate innovation lab/center	23
Corporate incubators.....	24
Corporate venture capital.....	24
Corporate inside-out venture programs.....	32
Other corporate open innovation strategies	36
Problem statement	37
Current designs	37
Target design.....	37
Literature Review	39
Research methods.....	41
Description of the methods	41

Limitations	41
Unstructured interviewing as a data collection method	41
Limitations due to transparency	42
Limitations due to sampling bias.....	43
Analysis of the current competitive landscape.....	45
Increased business complexity	45
Analytics driven business processes. challenges creating supply side value	46
Increased product sophistication. challenges creating demand side value	46
Challenges capturing value: increased horizontal competition	46
Challenges delivering value: controlling the vertical environment.....	47
Highly dynamic business environment.....	47
Open innovation as a response to dynamism and complexity	50
Organizational change in open innovation programs	52
Structural lens: strategic design.....	53
Political lens: the social ecosystem	56
Cultural lens: institutions.....	62
Information flows in open innovation programs.....	68
Agency costs.....	70
Agency costs in outside-in programs.....	71
Agency costs in inside-out programs.....	78
Transaction costs.....	80
Corporate startup portfolio management and transaction costs	80
Information gathering transaction costs	81
Decision making transaction costs	83
Bargaining transaction costs	85
Policing and monitoring transaction costs.....	91

Transaction cost drivers.....	93
Agency and transaction cost analysis: conclusions.....	94
Innovation goals.....	97
Strategic intent of corporations.....	97
Strategic intent of startups.....	103
Premises.....	107
Efficiency gains from integral strategy.....	108
Deal flow management requires a flexible design.....	109
Sequential, staged interaction reduces agency costs.....	110
Inside-out priority in high tech-high growth corporations.....	111
Outside-in priority in mature consolidated corporations.....	112
Staged design leads to capacity to deal with higher complexity.....	112
Modular design enables sequential deployment of the program.....	113
Model for integrated open innovation.....	114
Implementation strategies.....	119
Incubation period and timing of the equity participation.....	119
Sizing of the program.....	127
Conclusions.....	130
Summary.....	130
Critique of the model proposed.....	132
Suggestions for further research.....	133
Glossary.....	134
Bibliography.....	136

List of Figures

Figure 1 Unique CVC investors.....	26
Figure 2 Corporation network	58
Figure 3 Entrepreneurial network.....	59
Figure 4 Establishment births and deaths	82
Figure 5 Establishment survival rates, selected cohorts	82
Figure 6 Portfolio of target companies.....	99
Figure 7 Model for corporate open innovation program.....	118

List of Tables

Table 1 Types of interfirm collaboration	18
Table 2 Forms of corporate-startup innovation strategies	20
Table 3 Outside-in open innovation strategies.....	21
Table 4 Inside-out open innovation strategies	22
Table 5 Expected costs	43
Table 6 Moral Hazard	72
Table 7 Multitask moral hazard	72
Table 8 Adverse selection.....	75
Table 9 Free riding.....	76
Table 10 Holdup	77
Table 11 Window dressing.....	78
Table 12 Underinvestment, asset stripping and risk shifting	78
Table 13 Adverse selection, inside-out programs.....	79
Table 14 Strategic Intent Corporations	97
Table 15 Strategic Intent Startups.....	103
Table 16 Symbols in decision tries	116
Table 17 Business process interaction types	121
Table 18 Nature of assets	122
Table 19 Extent of redundant resources	123
Table 20 Degree of industry risk	124
Table 21 Degree of company specific uncertainty.....	125
Table 22 Corporate-startup competitive dynamics	126
Table 23 Program sizing variables.....	129

List of Case Studies

Box 1 Repsol.....	29
Box 2: Kronos	33
Box 3 The Rattle	48
Box 4: Hochtief-ACS.....	50
Box 5: Cisco	55
Box 6 Calidad Pascual	64
Box 7 Mizuho Bank.....	66
Box 8 Raizen.....	87
Box 9 Itaú Unibanco	101
Box 10 Veo Robotics.....	104

Introduction

Corporate venturing

Corporations seem to struggle to detect entrepreneurial opportunities both in the external startup space and within its own business units (Christensen & Bower, 1996; Henderson & Clark, 1990). Bright ideas are usually weak signals that reach senior management late (or not at all) and are lost or exploited by new entrants. During the last few decades, an extensive number of programs have been designed to enhance corporate innovation and to develop early response capabilities to technological discontinuities. The research and business community are gradually refining individual strategies, leading to models that are increasingly more robust and targeted to specific strategic outcomes.

This thesis proposes open innovation organizational design developing corporate startup interfirm collaboration. The design:

- develops an integral strategy that combines outside-in and inside-out equity open innovation transactions;
- is structured through multiple specific modules adapted to the deal flow and maturity of the ventures; and
- implements a staged transition with well-defined transition gates.

The model aims to contribute to corporate venturing, which in this thesis we define as the entrepreneurial behavior inside firms that leads to the discovery and exploitation of new business opportunities¹. Corporate venturing requires developing and blending together multiple resources in an organization, but, in its core, is a change of culture, a distinctive responsibility of leadership, and widely recognized as one of the most challenging. We hope to contribute with a new option in the leadership's toolbox.

We would also like to contribute to increase the innovation space currently targeted by startups. Until very recently, startups have rarely aimed areas where corporations hold strong strategic assets. Industries like pharma, oil and gas, chemicals and construction had to develop internally all their research and development. Recent developments have proven that alliances with startups can be very beneficial to both parties, particularly in pharma (Ku, 2015). But other

¹ See the Glossary included at the end of this thesis

sectors, where intellectual property appropriability is weaker, have not been able to develop similar strategies. In these cases, a more sophisticated design, with the implementation of a gradual, trust-building process, is needed.

Most of the current academic work researching open innovation programs (see Literature Review for a detailed analysis of recent publications), is focused on outside-in innovation (flowing from the startup space to corporations). Through our interviews (Box 2: Kronos, Box 6 Calidad Pascual) with open innovation pioneers, we have also reached the conclusion that there is ample potential to develop inside-out innovation. Many companies recognize now that there are high-performing employees with great ideas who are willing to take entrepreneurial risk, but that no programs exist to channel these opportunities thus leading to the loss of this valuable talent which has great ideas but cannot implement them. Our aim is to provide an open innovation design organizational design that can capture this entrepreneurial drive, efficiently, and through a mutually beneficial interaction with outside-in innovation initiatives.

Overview

We provide below an overview of the sections in the thesis:

- **Open innovation programs based on corporate-startup interfirm collaboration:** this section contains an introduction to the different open innovation strategies, focusing specifically on those involving interfirm collaboration. We aim to provide precise definitions of accelerator, incubator and innovation center/lab programs, terms that are very frequently used interchangeably but that actually refer to distinct program designs, and an historical background for corporate venture capital, the strategy with longest track record.
- **Problem statement:** We provide a very specific problem statement. The thesis is founded on the premise that there are circumstances in which joint corporate startup development can lead to more efficient innovation, but that opportunities are lost due to poor open innovation program design. New designs are needed to reduce information asymmetries and lower transaction costs, increasing mutually valuable interactions.
- **Literature review:** This thesis draws from foundational literature in the areas of organizational design, agency costs, entrepreneurial and corporate strategy, change management and venture capital investment. We provide a review of the literature used.

- **Research methods:** This section discusses both the primary and secondary sources used, in particular the in-depth interviews that support the case studies.
- **Analysis of the current competitive space:** This section presents how the competitive landscape has changed in recent years, justifying the need to invest in open innovation programs. It discusses business complexity, dynamism and product sophistication.
- **Organizational change in open innovation programs:** Implementing an open innovation program requires managing an extremely complex organizational change. We analyze this change through strategic design, political and cultural lenses.
- **Information flows:** This section contains the core theoretical foundation of the thesis. Corporate open innovation programs are resource intensive, and corporate managers have to assess the tradeoff between improving the interaction with the startup space and the investment in the internal development of core technologies. We explore how the reduction of information related costs can lead to an efficient, low friction, open innovation design that can unleash untapped potential in the corporate-startup interfirm collaboration space.
- **Innovation goals:** Pure financial returns of the capital invested (considered in isolation from the corporate strategy and its long-term returns) is not sufficient to justify the allocation of capital to corporate venture funds. Conversely, startups that are only seeking funding and cannot articulate the reason to approach corporations (indeed, a specific corporation) are limiting themselves unnecessarily and most probably reducing the overall efficiency of the venture capital fund channel due to strategic misalignment. We discuss the strategic intents reported by corporations and startups to involve themselves in open innovation programs.
- **Premises:** Based on the theoretical and primary research of the previous sections, we present and justify the premises considered for the open innovation program design. Specifically, we discuss the benefits of an integral (combined inside-out and outside-in), sequential, staged and modular architecture.
- **Model description:** On the basis of the assumptions above, this thesis proposes a modular open innovation design integrating a corporate accelerator, a pilot lab center and a corporate incubator, managed by an internal venturing program unit, a corporate venture capital unit and a program managing team for the accelerator, pilot and incubator modules.

- **Implementation strategies:** After presenting the model, we discuss implementation strategies. This section takes into account some of the context dependent decisions, providing frameworks for analysis. In particular we discuss incubation periods, the timing of equity participation and sizing criteria of the program.
- **Conclusions:** This section summarizes the findings and presents a critique of the model proposed.

Open innovation programs based on corporate-startup interfirm collaboration

Open innovation refers to the creation of organizational structures that construct pathways for the movement of ideas between a corporation and its external cooperators. This involves both the use of external sources to spur innovation inside the firm (outside in) and the creation of entrepreneurial ventures from initiatives generated within the corporation (inside out). Different models (competitions, hackathons, corporate accelerator programs), and agents engaged (from clients, providers, employees) lead to a wide variety of proposals.

Open innovation programs can articulate this flow is through interfirm collaboration, i.e. creating channels for knowledge and technology transfer between firms. Other strategies involve the interaction with isolated individuals or teams, academic institutions, governments, non-for-profit organizations, and will not be discussed in this thesis.

Open innovation and interfirm collaboration

Interfirm collaboration can be broadly defined as a formal or informal agreement between two or more companies to perform or develop certain functional activities, each firm retaining its own legal status (Farrell & Doutriaux, 1996). Though this definition is very broad, it requires the design of knowledge transfer systems that exceed the mere transfer of goods or services.

There are multiple interfirm collaboration structures. We will consider here the classification in three main types (McNally, 1997) based on the nature of the contractual relationship and the existence or not of equity transaction. We present below an updated list of the current forms of arrangements, extending McNally's initial summary

Informal arrangements (**)	Contractual non-equity arrangements	Equity arrangements
Trade associations (industry trade group, business associations, sector association)	Vertical or horizontal cooperation agreements: R&D, production, purchasing, commercialization, standardization agreements	Minority investments (direct investment, direct and indirect corporate venture capital)
Joint purchase (*)	Technology exchange	Equity joint ventures (*)
Trust-based relationships		Equity consortia (*)

“Skunk work” with outsiders	Licensing agreements
Personnel secondment	Franchising
	Training
	Upstream and downstream
	platform-based
	collaborations

Table 1 Types of interfirm collaboration

(*) Some forms of collaboration cover a wide variety of collaboration arrangements and may or may not involve equity transactions under the same name. For example, a consortia may range from the standard collaboration of banks in a syndicated loan to a complex layered structure of consortia like the Eurofighter, managing requirements and acting as the primary customer interface (for NATO and the partner nations, Germany, Italy, Spain and the UK), coordinating the program across industry participants (national aerospace companies like Airbus, BAE Systems and Leonardo) and overseeing production and maintenance of the EJ200 engine (EUROJET, comprising Rolls-Royce (RR), MTU Aero Engines, Avio and Industria de Turbo Propulsores).²

(**) The importance of informal arrangements, like those involving individuals performing undeclared work on company time collaborating with employees from other firms, or those within customer-supplier relationships in which both parties takes each other’s interests into consideration, is usually underestimated, but a European study (Hakansson & Johanson, 1988) found that two thirds of the cooperative relationships between firms in areas of technological development are informal. We will consider these relations further on when discussing networks.

We have listed here a comprehensive list of interfirm relationship for several reasons:

- Forms of collaboration are becoming gradually more complex, with multiple options sometimes coexisting as ties between competing companies and requiring high degrees of creativity in the design of the alliances. The word “coopetition” has been coined to

² <https://www.eurofighter.com/about-us>

refer to this dynamic and complex interaction, a active field of active research, that is leading to new theoretical approaches (Bengtsson, Kock, Lundgren-Henriksson, & Nosholm, 2016; Bouncken, Gast, Kraus, & Bogers, 2015; Tidström, 2014). We will argue that the strategic, tactical and operational complexity of interfirm collaboration (and of the broader competitive space that corporations face) justifies the investment in dedicated resources in medium and large-scale corporations.

- Inter-firm collaboration offers a continuum of degrees of integration, from a non-contractual joint purchase to equity transactions just short of full-blown acquisitions. This flexibility enables the design of strategies that are not available to independent venture capital funds. We will leverage on this continuum in the design of our equity open innovation program.
- Equity agreements is only a particular case within a wide variety of inter-firm collaboration options. As we will see, deals involving equity are extremely resource consuming and result in a small deal pipeline, even for the largest corporations. After setting up an open innovation program, deciding to target the equity of a specific startup or start up an internally originated idea as a separate firm should be the result of a thoughtful, highly critical revision process that considers and eventually excludes other strategic options.

Corporate-startup interfirm collaboration

Though interfirm collaboration can happen between companies at any development stage, corporate startup collaboration offers a unique opportunity of leveraging complementary capabilities. Corporations typically control strategic resources and have easier access to funds, whereas startups offer flexibility and risk-taking culture.

We believe that this corporate-startup complementarity has the potential of adding significant value, and that current collaboration programs are inefficient due to poor architectural design.

Based on this view on the value adding potential of corporate-startup interaction, this thesis focuses exclusively on corporate-startup open innovation strategies, currently a very active area of research.

Typology of corporate startup collaboration

Innovation centered corporate startup-engagement practices can be structured in two broad categories depending on the flow direction of ideas and resources: inside-out and outside-in. In inside-out transitions, ideas are generated within the corporation and are developed drawing initially from its own resources as a separate firm. Outside-in flow refers to flows or resources from the startup ecosystem into the corporation. Although some of the resources are provided by the corporation, the entrepreneurial initiative and the key human resources are provided by external founders.

We will structure our analysis based on the direction of the innovation flow and the equity involvement.

		Ideas and resources flow direction	
		Outside in	Inside out
Equity transaction	No	Open innovation contest Accelerator programs for external ventures Incubation programs for external ventures Corporate innovation lab/center	Accelerator programs for internal ventures Incubation programs for internal ventures
	Yes	Corporate Venture Capital Spin-in Acquisitions	Spin-out Spin-off

Table 2 Forms of corporate-startup innovation strategies

We provide below a summary of each innovation strategy. The reader can refer to the glossary at the end of the thesis for precise definitions.

Corporate outside-in open innovation strategies

Program	Innovation flow	Equity
Open innovation contest	Innovation competition focused on particular	No

	corporate problems, targeting external sources of talent	
Accelerator programs for external ventures	Corporate engagement with early startups (idea stage) using a cohort-based program	Not at the beginning. May involve small seed funds after graduation, awarded to top projects.
Incubation programs for external ventures	Continuous intake startup support organization funded by the corporation, providing business development support.	Not necessarily, but corporates may take equity positions in the most promising ventures.
Corporate innovation lab/center	Corporate facility supporting startups with early stages of conception, design and production of products and services. Aimed to develop prototypes.	Not necessarily, but corporates may take equity positions in the most promising ventures.
Corporate venture capital	Form of financing involving the creation of financial intermediary between corporate funds and external startups.	Yes. Like conventional venture capital funds, CVC invest in early-stage firm in exchange of equity, preferred equity and/or convertible debt..
Spin-in	Corporate acquisition of companies started up with money from the corporation.	Yes.
Acquisitions	Acquiring company establishes itself as a new owner. Target company ceases to exist.	Yes.

Table 3 Outside-in open innovation strategies

Corporate inside-out open innovation strategies

Program	Innovation flow	Equity
Accelerator programs for internal ventures	Corporate program to develop internal ideas at very early stage (idea) using a cohort-based program	No
Incubation programs for internal ventures	Corporate program aimed to provide a nurturing environment to internally generated ventures.	The venture may have been established as a separate entity.
Spin-out	Corporate realignment involving the separation of a unit to form a new independent firm. The spin out company takes with it the operations of the segment and associated assets and liabilities.	Yes
Spin-off	The creation of an independent company. The equity owners of the parent company receive and equity stake in the newly spun-off company.	Yes

Table 4 Inside-out open innovation strategies

Current open innovation strategies

We proceed to analyze the particularities of each of these open innovation strategies.

Corporate accelerators

Seed accelerators are startup support programs that have been widely adopted by governments and some private groups to promote entrepreneurship. What characterizes seed accelerators is that they are fixed-term, cohort-based "boot camps" for startups that offer educational and mentorship programs for founders, exposing them to wide variety of mentors, including former entrepreneurs, venture capitalists, angel investors, and corporate executives. Cohorts are admitted through a selective process and each wave culminates in a public pitch event, or "demo day," during which the graduating cohort pitch their businesses to a large group of potential investors (Lerner & Stern, 2016).

This thesis focuses specifically on corporate accelerators. As regular seed accelerators, they share their selective, fix term, cohort design. But what differentiates corporate from other types of accelerators is that:

- The scope of the ventures is aligned with the strategy of the corporate. Startups bring ideas for products and services within the industry of the corporate, are complementary to the products of the corporation, or are upstream or downstream activities extending vertically the corporate core business activities.
- Supporting resources are provided by the corporation. Accelerator programs are usually run in or very close to corporate facilities, enabling the interaction between entrepreneurs and employees.
- Successful ventures are either seeded by the corporation or are nurtured to develop complementary products or services as independent companies.

Corporate innovation lab/center

Innovation centers are a very broad category of facilities aimed to support startups with the early stages of conception, design, and production of products and services. They typically provide lab and/or production manufacturing equipment startups cannot easily access. Its main aim is to help startup teams in their development efforts to produce prototypes or minimum viable products.

Corporate innovation centers refer to the specific case in which the center is run by a corporate.

Corporate labs are particularly effective when prototyping and sample engineering are needed to continue with product development. They focus on system design and engineering, particularly concept analysis, system viability and exploratory analysis. The jointly created product specifications and proof of concept can be transferred to a global design center to optimize for production.³

Corporate incubators

Corporate incubators are continuous intake startup support organizations funded by a corporate, aimed to develop feasible business ideas with workable business plans. Like regular incubators, startups receive business development support like legal, accounting, intellectual property, information services, etc.

Similar to corporate accelerators, incubatee selection process ensure that the scope of the ventures is aligned with the strategy of the corporate.

In some cases, the corporation does not own the infrastructure, relying on an existing conventional incubator run publicly or privately (sometimes within or close to academic institutions). Recent innovation hubs⁴ already plan for corporates dedicated space, allowing close interaction with the incubatees.

Corporate venture capital

Venture capital is a form of financing involving the creation of a financial intermediary between source of funds (typically institutional investors) and entrepreneurial firms. Venture capital funds invest in this early-stage firms in exchange of equity or preferred equity. The funds a typically structured as limited partnerships.

A particular form of venture capital is corporate venture capital (CVC). In this case, funds are provided by the corporation. We will distinguish between two types of CVC:

³ <https://flex.com/sketch-to-scale-solutions/prototype-creation>. A well run example of corporate lab following these guidelines is Flex Sketch-to-Scale. The author thanks Babak Movassaghi, former VP of Innovation and New Ventures and GM of Boston Innovation Center of electrical/electronic manufacturing Flex for his lecture to the Sloan Fellows 2018 at MIT on November 29, 2017 and the following discussion with the author about the value of innovation labs, a usually missing component in corporate innovation programs.

⁴ For example the UMASS innovation hub in Lowell, <https://www.uml.edu/Innovation-Hub/> visited by the author on March 19, 2018.

- **Indirect corporate venture capital:** The corporation is a limited partner in a venture capital fund, which is externally managed by general partners. The fund can be multi-investor or a captive fund (client based, with the corporate as a unique or majority investor). Typically has a mandate to invest in targeted industries.
- **Direct corporate venture capital:** The corporation manages directly the venture capital fund through an autonomous unit with operational independence.

Direct CVC implies direct management and close interaction between corporate and investees. In the case of indirect CVC, although there can be some strategic alignment between corporation and investees (based on a mandate to invest in certain sectors or technologies), in general, the involvement of the corporation is lower, since the management of the fund is in the hands of general partners and investment is decided almost exclusively from the perspective of the financial returns of each individual investment and not of the value creation potential of the future interaction with the corporate.

Corporate venture capital started in 1914, when DuPont invested in a still private 6-year-old General Motors. The investment was done for both strategic and financial objectives: besides the returns from a quick growing company, GM allowed DuPont to boost the demand of its own goods: artificial leather, plastics and paints (CBInsights, 2017).

The 60's and the 70's saw a second wave of CVC, mostly led by conglomerates targeting to expand their business: 3M, Boeing, Dow, GE, Monsanto to name a few. Models for their CVC programs varied. Some started to include both inside-out and outside-in programs and were able to successfully spin out internal innovation (3M and Post-it). Exxon Ventures was an iconic CVC in the 1970s. It started with the objective of exploiting underutilized technologies from Exxon's corporate labs, but then expanded into less related industries like high-speed printers, text-editing machines, surgery equipment and solar heating panels. It actually ended up investing in computers and produced and released a PC in 1982. When Exxon shut down the program in 1984, losses on computers alone exceeded \$2B. Shortly after, Exxon had again decided to remain a "narrow-technology oil company" (CBInsights, 2017).

A third wave of CVC grew with the development of computers between 1978 and 1994. It mostly followed the boom in venture capital. This wave nurtured and expansion of models: indirect and direct venture capital, direct investments, dedicated VC run by external fund managers and

inside-out programs. Still, many of these programs were short lived. The average lifespan of a CVC program between 1988 and 1996 was 2.5 years, one-third of the duration of an independent VC (Dushnitsky, 2006).

The dotcom bubble triggered a final boom-bust cycle, from the late 90’s to 2001. Gompers and Lerner (2001) describe how the publicity around early high-profile success stories like eBay and Yahoo “triggered the interests of may CEOs, who south to harness some of the same energy in their organizations”. When the economy took a turn for the worse in 2001, corporations were forced to write down more than \$9.5B (Cortese, 2002).

Current situation of CVC

Recent years (2012-2017) have seen significant growth in the CVC space. The number of unique CVC investors has approximately doubled since 2012.

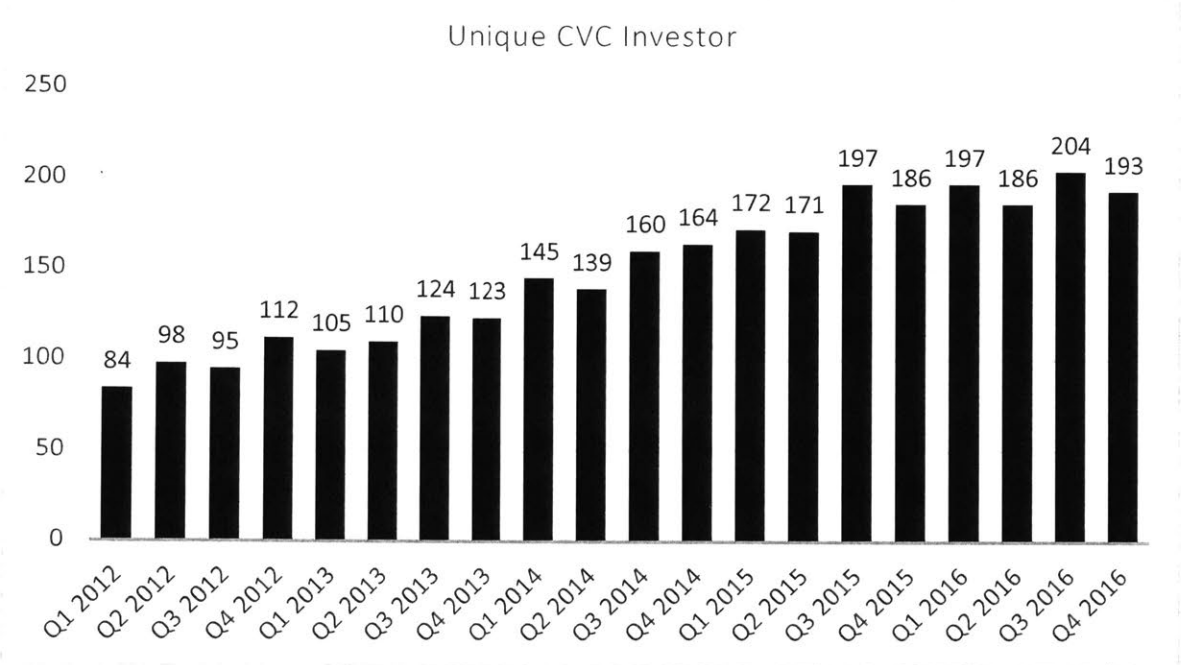


Figure 1 Unique CVC investors⁵

This chart actually captures only part of the growth of the investment of corporates into the startup space. Off balance sheet corporate round funding has also increased very significantly, almost quadrupling in the same period. Based on the information from CBInsights, CVC current

⁵ Global CVC in 2017 CBInsights webinar, supporting documentation. Webinar assisted by the author on February 1, 2018.

leaderboard includes Google Ventures (GV), with over 70 unique investees in 2017, Intel Capital, Salesforce ventures, Qualcomm Ventures and GE Ventures⁶.

CVC play now a central role in open innovation programs. According to Thelander- CVI² 2015 CVC Compensation Report (J. Thelander Consulting, 2016):

Companies use corporate venture capital as a compelling means to drive outside-in ('open') innovation for: access to new and disruptive technologies, the development of new business models and participation in emerging markets, all of which may provide meaningful contributions to corporate growth. Furthermore, as the traditional venture capital industry has consolidated, CVCs are playing an increasingly important role in assisting startups with commercialization, providing their portfolio companies with operational and market development support as well as financing.

The same report refers to the involvement of CVC in a broader set of strategies, including participation in private equity majority investments, commercial piloting and innovation-centered M&A, leading to significant interaction with business units.

Globally, corporate venture funds participated in US\$31.2B invested across 1791 companies in 2017⁷

The complexity of the CVC programs

Depending on the design of the CVC, there can be important differences between corporate and independent VC in terms of incentives and risks, which can, in turn, influence the contracts with the investees (D. J. Cumming & Johan, 2014) and the incentive strategies of the fund managers.

- Limited VC funds are autonomous investment vehicles, established with long term contracts (10-13 years), in which institutional investors cannot interfere with the day to day operations of the investee. This results in potential agency problems in the reinvestment of capital. Therefore, contracts between general and limited partners need to provide for covenants to control the assignment of rights and obligations (D. J. Cumming & Johan, 2014). In the case of CVC, the autonomy of fund team (the discretion of corporate management) can vary greatly and leads to broad range of CVC investment strategies. According to the survey included in the *2015 CVC Compensation Report* carried

⁶ *Ibid.*

⁷ *Ibid.*

out by Thelander - CVI² (2016) the most common CVC unit structure (42%) is yearly award funding with a dedicated team and operating budget. Approximately 18% rely on obtaining investment funds from the parent company on a case-by-case basis or operation through an LLC or off-balance sheet with an annual investment budget (24%). All these funding options result in a tight control of the investment strategy by the corporate managers. The rest of the corporations (16%) have set up more autonomous units, operating as a completely separate entity.

- Compensation of partners is different. IVC partners typically receive 1 to 2% fixed fees based on the size of the fund and 20% of the profits of the fund (carried interest), which results in extremely variable remuneration. When adopted by CVC, this form of compensation of partners has generated conflicts within the corporation by altering the coherence of the remuneration structure across the rest of the business units. The adoption of carried interest remuneration in corporate programs is therefore very low. According to the *2015 CVC Compensation Report*, only 4% of the CVC managers were receiving payment of carried interest, while 7% reported a program to calculate or 'shadow' carry as a component of compensation to their CVC executives. Lower, uncompetitive remuneration has led to problems, with IVC recruiting from the CVC pool of fund managers, so there is a trend of increasingly more complex remuneration schemes, with a mixed approach that takes into account the CVC unit results, as well as the corporations' (through options or shares, or directly with cash bonuses).
- Investment characteristics can be also different. A large quantitative analysis carried out by Guo, Lou and Pérez-Castillo (Guo, Lou, & Pérez-Castrillo, 2015), showed that, for instance, CVC-backed startups have higher investment levels than IVC-backed start-ups. (US\$52 million, vs. US\$26 million) statistically significant at the 1% level and consistent with earlier studies (P. Gompers & Lerner, 1998). Additionally, the research by Guo *et al.*, showed also differences in the average investment duration (CVC-backed start-ups, 5.3 years, vs. IVC-backed start-ups is 4.5 years). These differences may have implications on trade flow (lower in CVC, with higher number of financing rounds and more mature exits), success rate (higher with increased investment levels) and exit strategy. In particular, regarding the exit strategy, these researchers argue that shorter durations and greater investment levels lead to a greater likelihood of IPO exits, and that these two effects cancel out in CVC, leading to similar exit pathway probability.

- Corporate venture capital may have a different risk appetite profile than a regular VCs. Specifically, it may be more focused on limiting the downside than promoting upside potential (D. J. Cumming & Johan, 2014). This risk aversion can be further incentivized by the remuneration packages of the CVC fund managers.
- Due to the requirements of strategic alignment, CVCs may have a narrower range of firms that regular VCs in which to invest (though there is a gradual tendency in VC to become more specialized). This leads to less flexibility and diversification
- CVC may need stronger control rights (drag-along and redemption rights, for example) to enable the fund to force a corporate acquisition exit over an IPO.
- It is typically affirmed that CVC primary objective is not to maximize the financial returns of the fund, but that there are other strategic objectives. What this actually means is that the corporation is trying to maximize the *combined* value of corporation and the fund, by taking into account the returns that the effect of the program will generate on the returns of the corporation. As a result of this, calculating the total return on the investment of the fund is much more complex. This ties with the difficulty of setting up efficient remuneration packages for the managers.

Box 1 Repsol

Repsol, redefining a Corporate Venture Capital strategy⁸

Repsol is one of the largest energy companies, present in the entire value chain: exploration and production, transformation, development and commercialization. It has a strong presence in the oil and gas upstream sector, with a diverse asset portfolio, both in terms of operations (onshore, shallow water, and unconventional assets) and geography (North America, Latin America, and Southeast Asia). The company's average production stands at 700 kboe/d, with net proved reserves as of December 31st, 2015 of 2.373 bboe. Gas now takes up 65% of their asset portfolio, significantly expanded with the purchase of Talisman⁹.

⁸ Based on interviews with Mr. Luis Casado Padilla, New Ventures Director at Repsol, on April 9 and 11, 2018. Information about the company taken from <https://www.repsol.com/en/index.cshtml>, accessed on May 2, 2018.

⁹ <https://www.repsol.com/en/press-room/press-releases/2014/12/16/repsol-reaches-agreement-with-talisman-energy-to-acquire-the-canadian-oil-company.cshtml>

Their downstream area encompasses refining in Spain and Peru with one million barrels of capacity, fuel retail (4,700 service stations throughout Spain, Portugal, Italy, and Peru), LPG, trading and chemicals. Together, these businesses form a fully integrated value chain, with a net income in 2016 amounted to €1.738 billion euros

The oil, gas and petrochemical industry operates in the context of a highly competitive energy sector. Although Repsol holds a strong vertical position, tight margins due to horizontal competition from very large multinational corporations (both private and state owned) supplying commoditized products requires sustained operational excellence and the ability to anticipate and adapt to the market, with continuous investments in technological advances and new business models.

Through Repsol New Ventures, Repsol invests in companies that have potentially scalable technologies or innovations that are of interest to the company's activities. It targets companies proposing solutions in six specific areas: reliability in operations, circular economy, advanced mobility, new downstream, new materials and products, and new technologies applied to E&P (exploration and production)¹⁰:

Mr. Luis Casado Padilla took over as Director of Repsol New Ventures in 2017, inheriting a number of legacy investments. During the earlier stages of the program, the venture capital strategy had not been well articulated. The emphasis was on "diversification", and many investments were not aligned with the overall strategy of the company or addressed the needs of the business units. Additionally, the dramatic fall oil prices during the second half of 2014 and a complex and, arguably, expensive acquisition of Talisman for \$8.3 billion along with assumed debt of \$4.7 billion¹¹, also in 2014, put strain on Repsol's financial performance and led to slowdown of the venture program.

In 2017, with the work of Mr. Casado, Repsol's operational model for corporate venture capital was redefined, extending the temporal horizon of the investment commitments and improving the strategic alignment of the investments with the corporation, in an effort to avoid the two key mistakes of the early CVC program.

¹⁰ From https://www.repsol.com/imagenes/global/en/2017_Integrated_management_report_tcm14-123306.pdf

¹¹ <https://www.ogi.com/articles/2014/12/repsol-to-acquire-talisman-in-13-billion-deal.html>

In terms of commitment and investment horizon, the new design now comprises five-year fund allocations. For the 2016-2020 fund, Repsol has committed to making a contribution of €85 million. In 2017, the fund had €7 million invested.

In order to ensure strategic alignment and buy-in from the business units, Mr. Casado launched a series of internal workshops to discuss and define the investment priorities of Repsol New Ventures. Invited to the workshops were the teams in charge of innovation in each of the business units. The exercise resulted in the definition of the six investment areas listed above. These workshops have evolved into regular quarterly meetings between Repsol New Ventures and the BU to assess opportunities and participate in the investment decisions.

Mr. Casado considers this buy-in critical. Many investments require access to installations in production, with tests that can be conceptually simple but that require coordination with multi-billion refinery maintenance shutdowns or that introduce the risk of production loss. But the rewards can be equally valuable. An example would be the Rocsole Project, Repsol's investment in a Finnish company that owns a technology based on Electrical Capacitance Tomography (ECT) to generate imagery of the flow of multiphase fluids (water, crude oil, air) inside piping. This technology can be used to monitor the rates of deposition build-up, thus optimizing maintenance costs and preventing unscheduled stoppages.

Repsol is also using their CVC strength to move into new adjacent markets, coherent with their existing competences. The Graphenea Project is an investment in a graphene production company based on San Sebastian, Spain. Graphene is a cutting-edge material for which multiple applications are being discovered in a number of sectors, including energy (a component of batteries, photovoltaic panels, catalyzers, etc.). In 2017, the company completed numerous important milestones in collaboration with Repsol: start-up of its new pre-commercial graphene oxide plant, half million euros revenue mark, and extension of exports to more than 40 countries.

According to Mr. Casado, Repsol New ventures received 354 proposals in 2017, with 11 finalists and 8 final investment decisions. In addition to direct investments in start-ups, Repsol takes part, along with its partners, in OGCI Climate Investments (OCGI-CI)¹², a vehicle for channeling

¹² <http://oilandgasclimateinitiative.com/investments/>

\$1 billion investment committed over ten years to develop and accelerate the commercial rollout of innovative technologies of low greenhouse gas emissions¹³. In 2017, the first investments were made in this vehicle: Solidia Technologies, a US company that can produce cement in a way that generates lower emissions; Achates Power, a company that is developing more efficient vehicle engines; and a project that aims to design a large-scale gas-fueled electrical plant with carbon capture and storage, including the industrial capacity to capture CO₂.¹⁴

Corporate inside-out venture programs

As mentioned earlier, innovation centered startup-corporate engagement practices can be grouped in two broad categories depending on the flow direction of ideas and resources: inside-out and outside-in. In inside-out transitions, ideas are generated within the corporation by its own employees and are developed drawing initially from the corporation resources to form a separate firm.

The logic behind these inside-out programs is that ideas initiated within the corporate environment sometimes cannot grow within the corporate environment due to poor fit. There are many reasons that can prevent an internal innovation to grow within the business units of the organization:

- When the idea appears outside the units responsible of research and development, the “not invented here syndrome” (the tendency of units to reject knowledge because of its external origin) can create a significant barrier for its development (Box 1 Repsol).
- New ideas that can lead to important cannibalization of the corporation’s current products are a threat to the business units in charge of them (see Box 2: Kronos).
- The success of certain initiatives may involve important shifts in power structures. For example, business analytics are currently undermining the power of conventional

¹³ All oil and gas multinationals recognize carbon pricing as a critical element of climate policies. For investment decision-making in new projects, Repsol has established an initial internal carbon price of \$25/t CO₂, with the aim of attaining \$40/t CO₂ in 2025.

¹⁴ https://www.repsol.com/imagenes/global/en/2017_Integrated_management_report_tcm14-123306.pdf

“intuitive” marketing, that relied on experience-based, qualitative knowledge of the market.

- The development of certain products or services require the creation of new business model that clashes with the existing incumbent processes and culture.

Box 2: Kronos

Kronos, a disruption from within¹⁵

Kronos started with a simple idea from Mark S. Ain: there had to be an easier way to record employee time transactions. His idea came to life with the first patented microprocessor-based time clock. The time clock automatically recorded, totaled, and reported employee hours, transforming an industry that had not seen innovation in many years. Since then, the firm has expanded to cover multiple workforce management needs besides time and attendance, like employee scheduling, absence management, payroll, etc. In the late 80's, they completed the first of many dealer acquisitions as the company focused on transitioning to a direct sales channel. The final wave of innovation involved verticalizing the operations in a major go-to-market strategy shift, developing even deeper industry-specific expertise and product functionality (1997-2006).

At the end of the last transition, the company became aware of the disruption potential of cloud computing and, in particular, software-as-a-service new business model (SaaS). As Jim Kizielewicz, Sr. VP, Corporate Strategy recognized, implementing SaaS required not only developing new software (central corporate host and thin user software operated through a browser), but also changing the licensing and delivery model, from an upfront license-consulting model to a per person per month (PPPM) subscription service.

The technological and commercial challenges were huge. On the technology front, the company had relied on customized client-hosted server software and hardware interphases. Redesign was now needed to be able to cover 80% of the client's need through pre-configuration. The former model was built on revenues earned with the initial deployment licenses followed by support and consulting services throughout the life of each product. Sales

¹⁵ Visit and discussion with Kronos Incorporated, March 19, 2018, and following discussion with Jim Kizielewicz, Sr. VP, Corporate Strategy. Information about the company taken from <https://www.kronos.com/about-us/kronos-history>, accessed on April 21, 2018.

teams' incentives were aligned with this revenue model. The SaaS model required a new pricing strategy and a commercial team with a different skillset. Despite this, the CEO Aron Ain was determined to innovate from within. He decided to create a separate 25-person team and place it 20 miles from the headquarters, with funds to run for a year. The objective, as Mr. Kizielewicz explained us, was to "put Kronos out of business".

The initial team worked to achieve "feature parity" and develop sales to targeted 100-150 early adopters in different industry segments. The team was then reabsorbed after getting the buy-in from the main business units. By 2014, cloud was the fastest growing part of the business with 90 percent of all new customers choosing cloud solutions. That same year, the company surpassed \$1 billion in annual revenue. At the time of our conversation with the management of the company (March 2018), the company had more than 30,000 customers, 22,000 of them using SaaS.

According to Kronos' management, the company succeeded because it recognized early the tensions that were going to arise from cannibalization and the profound technical and cultural changes that SaaS implied. It also understood the need of fast decision-making and iteration. The company was, nevertheless, confident about the internal entrepreneurial drive of a portion of its employees and leveraged on it to develop the missing internal competences.

Though Kronos case is a CEO lead initiative, the appearance of ventures inside corporations is usually a bottom-up process and requires specific emergent behaviors at the operational level. Nurturing a culture that promotes employee lead initiatives is the only way to deliver sustained inside-out innovation. Burgelman (1983) concludes after extensive fieldwork with internal ventures that:

[...] the motor of corporate entrepreneurship resides in the autonomous strategic initiatives of individuals at the operational levels in the organization. High-technology ventures are initiated because entrepreneurially inclined technologists, usually at the group-leader level, engage in strategic initiatives that fall outside the current concept of corporate strategy. They risk their reputations and, in some cases, their careers, because they are attracted by the perceived opportunity to become the general manager of an important new business in the corporation. This stream of autonomous strategic

initiatives may be one of the most important resources for maintaining the corporate capability for renewal through internal development.

It is therefore a key element of success of inside-out programs to foster a culture of proactiveness and risk-taking. Burgelman highlights also the crucial role of middle management in linking the autonomous strategic behaviour at operational level with the corporate strategy.

Ignoring internal entrepreneurial initiatives can be costly for corporations. Human capital is mobile: employees are under limited organizational control, free to quit at will, and may leave expropriating their employer's know-how. In fact, as Agarwal *et al.* point out, firms with abundant knowledge may be more prone to leave to compete because opportunity recognition and investor confidence are heightened (Agarwal, Echambadi, Franco, & Sarkar, 2004):

The place of employment may influence an employee's ability to perceive an entrepreneurial prospect. Employees of firms with abundant knowledge may possess unique and idiosyncratic information that enables them to discover potential opportunities ahead of others. Since knowledge asymmetry lies at the heart of entrepreneurship, such access to valuable knowledge can be a source of advantage. [...]

Affiliation benefits may make it easier for employees of leading firms to raise the financial and other resources needed to start new ventures. Raising capital is a process that is fraught with information asymmetry between provider and recipient. The newer the technology and the more nascent the market, the greater the information asymmetry and associated uncertainty about a venture's prospects. In the absence of unambiguous quality measures, investors depend on certification cues in making judgments. [...] Affiliation with a high-status organization influences not only perceptions of employees' skills and trustworthiness, but also perceptions of the importance of innovations in emerging areas of technology.

The same information asymmetry that gives an advantage to the corporation's employee in evaluating the potential of a venture reduces the effectiveness of incentive mechanisms that increase the exit costs due to the inherent agency costs.

It is therefore key for leading technological corporations to create avenues to capture at least part of this value, that will be developed as an entrepreneurial venture anyway. The discussion above leads to the conclusion that the greater the technological advantage of the firm, the stronger the inside-out program should be. Noncommercialized technologies and unexploited market

opportunities, particularly those that are substantial and path-breaking, increase employees' confidence about venturing out, and thus their entrepreneurial propensity (Eisenhardt, 1989)

Other corporate open innovation strategies

Corporates have many other open innovation options. For example, **innovation contests**, open competitions focused on particular corporate problems, targeting external sources of talent, **product platforming**, involving the early introduction of a partially completed product, providing access to contributors so that they can explore and customize, or **customer immersion**, a strategy fostering extensive customer-corporate development team interaction in the host organization.

These strategies rarely involve interfirm collaboration, and do not lead to equity transactions. Though very active fields of research, they have usually very distinctive strategic intents, so we have decided to exclude them for our research.

Problem statement

Over 80 percent of leaders believe innovation is important for their future success, but less than 30 percent of the total are satisfied with their current level of innovation (Legrand & Weiss, 2011). One way of spurring innovation is through corporate-startup interfirm collaboration, articulated through open innovation programs.

Though sometimes the development of new ideas as internal projects within the corporation or as independent startups may be efficient, there are ventures where joint, hybrid development, leveraging on the startup flexibility and entrepreneurial drive and the existing strategic resources of the corporation, could have led to a faster, more efficient business growth. If this is the case, and if the additional value created by the joint development of these ventures exceeds the cost of the corporate-startup collaboration programs, the investment in these programs would be justified.

Information asymmetries and transaction costs drive the efficiency of corporate-startup interfirm collaboration programs. Both information asymmetries and transaction costs are direct consequence of the design of corporate-startup open innovation programs. New designs are needed to ensure efficient information flows.

Current designs

During the last few decades, an extensive number of programs have been designed to enhance corporate innovation leveraging on corporate-startup interaction (corporate accelerators, corporate incubators, innovation centers/labs, corporate venture capital). Research and business communities are gradually refining individual strategies, leading to models that are increasingly more robust and targeted to specific strategic outcomes.

Despite this, corporate venturing seems to be peaking in relative terms to total venture capital funding ("Quarterly Global Active Corporate VC Investors," 2017). Our research, based on multiple unstructured interviews, has led us to conclude that corporates are developing multiple parallel open innovation programs without a coherent, comprehensive plan.

Target design

This thesis proposes a comprehensive, staged, bidirectional open innovation design that, we believe, can lead to more efficient corporate startup interfirm collaboration. We target therefore:

- An integral strategy combining inside-out and outside-in transitions to lower costs and enhance the efficiency of the program.
- A flexible, modular program design with multiple, specifically designed components, enabling the management of a wide range of deal flows.
- A staged transition through sequential program components to reduce information asymmetries, leading to lower agency costs. Information sharing should happen in a non-coerced, mutual, trust-building way.
- A design has able to engage with a wide range of venture maturities. The dynamism of today's business environment, its increased complexity and the high internal efficiency of large multinationals justify early engagement with both the internal and the external entrepreneurial initiatives.
- The design has to be able to allow sequential deployment, delaying corporate venture capital programs until the deal pipeline is already delivering ventures well aligned with corporate strategy and of value for the business units.

Literature Review

This work is grounded on the Herbert A. Simon's concept on bounded rationality (1961) in its interpretation of how managers make decisions. Rational decision-making is limited by the tractability of the decision problem, the cognitive limitations of their minds, and the time available to make the decision. In particular, when allocating resources, managers have to consider numerous tradeoffs in terms of short term and long-term performance, access to capital markets, resilience to horizontal and vertical competitive pressures and evaluation of technological discontinuities (evaluating not only the current but also the future impact of technologies in the performance of the firm). We pay particular attention to how information reaches different agents, the time delays involved, and the resulting limitations for effective, timely corporate and entrepreneur decision-making.

The theoretical foundation of the thesis relies on the concepts of asymmetry of information and transaction costs. These concepts have been taken from George Akerlof (1970), Michael Spence (2002), and Joseph Stiglitz (1981), who jointly received the Nobel Memorial Prize in Economic Sciences in 2001, for their research related to asymmetric information. We analyze also moral hazard from a multitask perspective based on work from Holmstrom and Milgrom (1991)

Transaction costs are analyzed based on the important study on externalities from Carl Dahlman (1979). Ultimately, the origin of externalities lies in the transaction costs, that prevent agents to attain pareto-optimal situations. Dahlman formal framework for transaction costs is used in this thesis to analyze reasons for suboptimal corporate-startup interactions.

Robert Burgelman's (1983) research on venturing funding considers the provision of venture capital in a dynamic agency model. It analyzes the value of the venture projects from the perspective of uncertainty and information flows during the development of the project (intertemporal risk-sharing between venture capitalist and entrepreneur).

We have used frameworks for analysis presented during Sloan Fellow's 2018 lectures at the MIT Sloan School of Management: John E. Van Maanen, Professor of Organization Studies (three lenses) and Scott Stern, David Sarnoff Professor of Management (competitive dynamics scenarios for incumbent-startup interaction, developed together with J. Gans (2003)). We have relied on published work and documentation provided in class.

Latest research on venture capital, corporate incubators and accelerators include work from Anderson and Xiao (2016), Bauer, Obwegeser and Avdagic (2016), Colombo and Dawid (2016), Guo, Lou and Pérez-Castrillo (2015), Hamm and Jung (2018), Kanbach and Stubner (2016), Klonowski (2018), Ku (2015), Lin and Wang (2015) and Weiblen and Chesbrough (2015).

We have also relied on the most recent industry reports, particularly documentation from CBIInsights and J. Thelander Consulting.

Research methods

Description of the methods

To get a current view of the latest designs and challenges corporate open innovation programs, we conducted 10 unstructured interviews with managers of corporate accelerators, incubators, labs and corporate venture capital funds, as well as startup teams participating in these programs. Corporate programs included those associated with firms such as Cisco, Raizen, Hochtief-ACS, Pascual, Repsol, Mizuho and Itau Unibanco. The interviews sought to identify the strategies of effective open innovation programs and to generate insights on how improve selection, engagement and exit. Primary interview data was complemented with publicly available material including CVC industry reports and corporate databases (IQ Capital and Pitchbook). Each interview was recorded, analyzed and extended with public data into case studies.

Another group of case studies were prepared based on the meetings of the author and other MIT Sloan Fellows as part of corporate visits or events. This was the case of Kronos and Veo Robotics. Notes were again evaluated and extended with public data into case studies.

Case studies are incorporated as text boxes and presented as practical examples supporting the premises of the open innovation design included at the end of the thesis.

This primary research is complemented with extensive secondary research, as described in the literature review section above.

Limitations

Unstructured interviewing as a data collection method

As discussed, primary research is based on unstructured interviews with corporate managers, entrepreneurs and open innovation program operators. Research has proven that, to some extent, both the interviewer and the interviewing situation have an impact on the reconstruction of the experiences by the respondents. Interviewers themselves become part of the “interviewing picture” by asking questions and responding to the respondent and sometimes even sharing their experiences with interviewees (Hofisi, Hofisi, & Mago, 2014). Working with the interview data, selecting from it, interpreting and describing and analyzing it, we have been at risk of introducing our own biases, regardless of our discipline and dedication in keeping the interview data as the product of the respondent.

We have tried to be to ensure the validity and reliability of the interview data by researching intensively secondary sources to limit our own biases, subjectivities and lack of interviewing skills.

Limitations due to transparency

Despite the increased interest, there is still limited quantitative analysis related to the performance of corporate-startup interaction (spinouts, corporate venture capital, corporate incubators, etc.).

Recent studies (Hamm, Sophia J.W., Jung, 2018) have highlighted the lack of transparency in the disclosure of financial information by companies on the returns of their corporate venture capital programs. In general, there is little or no disclosure of investees and invested amounts. Sometimes, the acquisition is made public (usually at the initiative of the startup, that may have different interests), but financial terms are rarely disclosed. The individual returns of each investment are almost impossible to compute: multiple rounds, direct and indirect investments, undisclosed exit events, undisclosed write-offs make it very complex to obtain individual or even aggregated performance metrics.

Though some information can be achieved through financial data providers (Capital IQ) and information aggregators (CB Insights, Crunchbase, Factiva), we have detected a lot of inconsistencies in the datasets and disclosures contained in 10-K and 8-K filings.

This creates not only a problem in research, but also a higher-level concern regarding information asymmetries, that can potentially lead to moral hazard risks (with management taking on more risk than the shareholders would have taken). As the entrepreneur controls the allocation of the funds and the investment effort is unobservable to the investor (Bergemann & Hege, 1998), there is already significant moral hazard risk in the interaction of the entrepreneur and the venture capitalist. The problem could be even more worrying if there is another layer of information disclosure inefficiency between the CVC and the shareholders of the corporation.

The control over the funds implies that the entrepreneur also controls the flow of information about the project. Risks are typically managed by the VC with staged financing, enabling the enforcement of sequential arrival of information. While this strategy is also available for CVC's, additional monitoring and policing processes must be in place to ensure that for the stockholder of a firm owning a CVC has also access to this information.

Complicating this further, it has been noted that firms that run CVC programs tend to acquire more goodwill and intangible assets (Hamm, Sophia J.W., Jung, 2018) than other investment vehicles, with more complicated valuations as a result of the managerial discretion in determining the impairment amounts and the complexities of the rules (for example the SFAS 142¹⁶ in the United States).

Limitations due to sampling bias

We would like to highlight a limitation affecting most of the research on interfirm alliances in general, that inevitably this thesis also inherits. Agents take decisions based on their expectations of the deal: of the cost to engage, and the return from the engagement. These expectations can be correct or not, so we can classify outcomes in four types:

		Expectations	
		Correct	Incorrect
Interaction	Engagement	I	III
	No-engagement	II	IV

Table 5 Expected costs

In case I, the agents correctly estimate that the cost of resources is low enough for them to engage. The engagement takes place (in our case, between corporate and startup): the interaction is efficient. In case II, the agents correctly estimate that the engagement would consume resources in excess of the value created, and the engagement does not take place. Again, the outcome is efficient.

In case III, the interaction takes place but, ex-post, agents realize that it was value destroying. In case IV engagement does not take place because the agents belief that it would be too costly is incorrect, but the decision is not efficient: more value could have been created through the interaction.

¹⁶ Financial Accounting Standards Board (FASB), Statement of Financial Accounting Standards No. 142 (SFAS 142, Goodwill and Other Intangible Assets)

Deciding whether the expectations were correct or not is complex as it requires build a counterfactual. But in the cases where engagement takes place (cases I and III), both the entrepreneur and the corporation have significant access to information, and the counterfactual implies creating a model of an independent startup. Non-engagement scenarios, for a corporation running an open innovation program, requires working with poorer information and generating a model that estimates the value that the collaboration would have produced. The difficulty of the tasks analyzing cases II and IV leads to asymmetry in data availability, and sampling bias in the study of corporate-startup interaction, leading to limited research on missed opportunities. Actually, we have not been able to find any corporation that assigns resources to follow up a sample of startups where engagement did not take place.

This thesis relies on the hypothesis that cases IV are frequent (agents deciding not to engage, based on a flawed estimation of benefits and costs) but that go undetected. In the case of inside-out flows, a potentially viable entrepreneurial initiative born inside the corporation is not detected or scaled. For outside-in potential transitions, the start-up that does not collaborate with a corporation either folds or evolves to a smaller scale.

Further research is required in this area to estimate the size of case IV cases and understand better the reasons for the suboptimal decision not to engage. We believe that corporate open innovation programs should expand their research to include ex-post analysis of successful and unsuccessful ventures (internal and external) and identify missed opportunities.

Analysis of the current competitive landscape

We will present below our view on the current competitive landscape and its relation to open innovation. Recent years have seen important changes in the way corporates compete and the dynamism of this competition. Companies are facing increasing pressure to innovate and generate value for customers in over-satisfied societies demanding more complex business propositions and faster response. At the same time, they need to sustain the investment in core assets to ensure operational excellence.

All these changes lead to greater uncertainty (horizontally and vertically) and faster rates of change in the dynamics of business, which, in turn, increase the risk of discontinuous innovation events.

Open innovation strategies, leveraging on the internal and external entrepreneurial drive, are proposed to increase the resilience of corporates while opening the opportunity for nascent ventures to grow in new markets.

Increased business complexity

We are gradually moving towards more complex value propositions. As a result of a relentless pressure to innovate, individual products or services are transitioning to complex, integrated combinations of products, services, experiences and information. The list of Fortune 500 companies in 2010 was composed predominantly by oil and gas, retail, pharma and telecommunication companies. While these companies undoubtedly relied on complex business processes, they delivered, essentially, a portfolio of single product or services. The current list of 2017 is dominated by companies with complex, integrated value propositions: Apple, Alphabet, Amazon and Alibaba cannot be described as a portfolio of products: today's iPhone, every different from the product launched in 2007, is a composite offer including multiple hardware and software products, a market place of applications, developer ecosystem (tools, community of programmers), etc.. Transportation is more than selling a car and its fuel.

This increased complexity is affecting all the components of the firm's strategy (the way they create, capture and deliver value). We highlight below a number of drivers of complexity that we judge relevant in the context of open innovation.

Analytics driven business processes. challenges creating supply side value

There are basically two ways of creating value: with supply side and with demand side strategies. On the supply side, organizations create value increasing their market size by reducing costs through efficiency. Reduction in costs are achieved by innovating in operational excellence.¹⁷

Arguably, the highest contributor to improved operational efficiency is, currently, the development of business analytics. It is out the scope of this thesis the discussion about analytics and how operations research is affecting processes. But there is no doubt that there has been a very recent takeoff in data driven decision-making, and that the activities involved in sourcing data, modeling and implementation of the results of the prescriptive analytic models have increased the reach and complexity of all the business units in the organizations.

Increased product sophistication. challenges creating demand side value

Corporations can also focus on the demand side to create value by improving customer experience, value they have to be able to search or infer.

But creating value for the consumer is increasingly difficult. As Daniel Pink describes (2005), abundance in many developed countries has over-satisfied the material needs of many sectors of the population in advanced economies. This has resulted in the “increased importance of beauty and emotion, accelerating the individual’s search for meaning”. The consequence of this transition is an increasing demand of sophisticated experiences, which lead, again, to composite, complex value propositions.

Challenges capturing value: increased horizontal competition

Creating value is not enough. Corporations need to horizontally control the environment. Organizations compete through market power by building sustainable competitive advantages.

Many leading companies have pioneered architectural changes that are difficult to implement, and result in a difficult to replicate competitive advantage. To compete horizontally, other firms need to change many aspects in parallel. The effects of these changes are confounded and appear with significant delays, and lead to outcomes that are “path dependent”.

¹⁷ Business Strategy Framework. Creating, Capturing, and Delivering Value. Duncan Simester, PhD – NTU Chair in Management Science, M.I.T. Sloan School of Management

The implementation of these architectural changes is complex but enables the leading firm to capture value.

Challenges delivering value: controlling the vertical environment

To build solid strategies, corporations need to deliver value through the vertical control of the environment. This requires building upstream and downstream bargaining power.

Global reach of customer search and the supply chain of corporations, with an increasing number of platforms, is yet another source of business complexity. eBay and Amazon in the retail space and Alibaba in B2C comes to mind. Distribution channels, once under fierce control of the corporations as a strong complementary asset, have proven to be less resilient than expected. Consider the automotive industry, where Original Equipment Manufacturers (OEMs) have historically relied on a global and deeply connected dealership network to control their extensive, multilayered vertical environment. OEMs are now facing strong competitive pressures as a result of ride sharing, autonomous driving and electrification, that are opening the door to important shifts in vertical bargaining power in the offer of mobility services. Another example is the music industry, that has also faced radical technological changes in its distribution channels (Box 3 The Rattle).

Highly dynamic business environment

Resorting to 'resourced-based strategies', accumulating valuable technology assets and employing an aggressive intellectual stand has proven not to be enough. Examples like IBM, GE or Phillips come to mind. To be able to grow in the global marketplace, firms have had to demonstrate responsiveness and rapid product innovation, coupled with the management capability to effectively redeploy internal and external competences (D. Teece & Pisano, 2004).

To convey this dynamism, organizational and managerial processes play a critical role, in particular reconfiguration and transformation processes: the ability to sense the need to reconfigure, and to implement this internal and external transformation efficiently.

The Rattle, shaking the music business model¹⁸

Housed inside the incredible Grade-1 listed Tobacco Dock in Wapping, East London, *The Rattle* is the space where talented artists, tech makers, and entrepreneurs in music mix to produce music.

The Rattle is organized as a club, where community members, after undergoing a highly competitive selection process (acceptance rate is around 1:9), pay a low monthly fee to have access to facilities, workshops and mentorship. In the music studios, members create new music, rehearse, record and hone performances in an inspiring atmosphere.

The strict curation process ensures the quality of the members, forming a community of like-minded individuals all learning from one another. The club has also attracted 30 expert mentors in music production, writing, performing, business, startups, marketing, entrepreneurship and funding.

Mr. Howard works hard to create a creative environment by carefully designing the club operations. The Rattle does not take equity so that members can collaborate on art and business without worrying about future royalties or equity squabbles. He caps advertisement and corporate sponsorship and ensures that mentors are focused in making tangible impact on the club members and not developing personal business. The conditions in which artists and music entrepreneurs mingle are carefully engineered to foster serendipity and trust. They continuously experiment and gather data to understand what works and what not.

The Rattle is an extraordinary development in an extremely concentrated business, where industry participants, despite numerous dramatic technological changes (digitalization, online distribution, streaming), have been, until now, structured around the same traditional roles. Universal Music, Sony Music and Warner Music control almost 70% of the total recorded music market share. Market concentration and incumbents are the same in emerging channels, like

¹⁸ Based on interviews with Mr. Chris Howard, CEO at The Rattler, on March 8, 2018. Information about the company taken from <https://www.therattle.space>, accessed on May 2, 2018.

downloaded music and streaming.¹⁹ Overall, the industry is on a healthy growth path. Consumption of albums, songs and audio on-demand streaming grew 12.5% year over year in 2016/2017. A 59% increase in on-demand audio streams offset track and album sales declines.²⁰

But *The Rattle* is a perfect example of how traditional lines that once divided singers, instrumentalists, publishers, record companies, distributors, retail and consumer electronics have become blurred. The club blend of artists, tech and entrepreneurs is a factory not just music but business models. Mr. Howard gives as an example of this new competitive environment the case of Amanda Palmer, an American singer-songwriter who is the lead vocalist, pianist, and lyricist of the duo The Dresden Dolls. Mrs. Palmer made a conscious choice to avoid labels and develop other distribution channels. On April 20, 2012, Mrs. Palmer announced on her blog that she was launching a new album pre-order on Kickstarter. The Kickstarter project was ultimately supported by 24,883 backers for a grand total of \$1,192,793 — at the time, the most funds ever raised for a musical project on Kickstarter.²¹ She now relies on Patreon, a crowdfunding platform that allows artists to get paid by running a membership business for their fans. Members pay a subscription amount of their choice in exchange for exclusive experiences and behind-the-scenes content. Amanda began soliciting financial support Patreon in early 2015. In 2016, she released her first completely Patreon-funded song, "Machete"²².

It is unclear if unconventional business models like Mrs. Amanda's will eventually disrupt the market, but there is no doubt that the industry as a whole has had to navigate an extremely dynamic business environment during the last two decades, including a brutal collapse in 2000, only to be rescued by streaming. As Spotify, the world's biggest streaming music service, makes its debut as a public company, the music industry holds its collective breath again.²³

¹⁹ <https://www.musicbusinessworldwide.com/global-market-shares-2016-sony-and-warner-gain-on-universal-as-indies-rule/>

²⁰ <http://www.nielsen.com/us/en/insights/reports/2018/2017-music-us-year-end-report.html>

²¹ <https://www.techdirt.com/articles/20120601/01173819160/amanda-palmer-raises-12-million-kickstarter-crowd-goes-wild.shtml>

²² <https://www.thestar.com/entertainment/music/2016/11/10/amanda-palmer-answers-to-herself-and-her-fans.html>

²³ <https://www.nbcnews.com/business/consumer/music-industry-needs-spotify-be-successful-not-too-successful-n862341>

Open innovation as a response to dynamism and complexity

This increased business dynamism and complexity leads to a much more challenging environment to identify new ideas and to develop them. Successful, highly integrated corporations are not immune to the risks of this new environment. On the contrary:

- Weak signals from new internal or external ideas are more difficult to detect as a result of the inertia of successful, hard to replicate competitive advantages
- Including new elements in a highly integrated and complex proposition implies higher transaction costs as more elements of the existing operation is affected by the new addition

In this context, we argue that the particular ability of corporates to understand and quickly profit from both external and internal entrepreneurial innovation is key, and that strong open innovation programs are needed, particularly in industries with significant noncommercialized technologies and geographical expansion opportunities.

Box 4: Hochtief-ACS

Hochtief-ACS, complexity in the construction industry²⁴

The construction and services company Hochtief is a clear example of increased business complexity, and how it impacts the innovation process. The firm was founded by two brothers, Balthasar and Philipp Helfmann, a mechanic and a mason respectively. Phillip moved to the Bornheim district of Frankfurt to start up in business as a lumber merchant and then expanded as a building contractor. He was joined shortly after by his brother Balthasar, and the company grew on the wave of industrialization and population growth of the region. Construction projects led to industrial buildings and civil engineering contracts such as sewage treatment plants. At the end of 2017, the company was handling EUR 30,443M in new orders, with EUR 19,908M sales and producing a consolidated net profit of EUR 421M. It had 54,000 employees spanning America, Europe, Asia

²⁴ Based on interviews with Christoph Alexander Betz, Innovation project manager at HOCHTIEF, Cologne Area, Germany on March 15, 2018. Information about the company taken from http://www.hochtief.com/hochtief_en/974.jhtml , accessed on April 22, 2018.

To achieve this growth, the group had to extend its original focus in infrastructure to other sectors like energy, social and urban projects, followed by contract mining, public-private partnerships (P3) and services.

Together with the expansion in sectors, the company, like other competing firms, had to expand their scope in individual projects to respond to increasing clients' needs. In addition to developing their core competences required to build (engineering, project management, logistics), Hochtief had to acquire new ones, like optimization of real estate and industrial systems, management of P3 projects and operation and maintenance of not only infrastructure, but also raw materials (contract mining of surface and underground mines), water, energy and real estate.

This expansion in scope has led to a shift in risk from clients to construction companies like Hochtief. The integration of risk management and innovation under the same Risk, Organisation and Innovation Office, to which Mr. Betz belongs, is an indication of the importance of project risk management has now in this sector. For example, Mr. Betz's team is investing in adaptive programming, a structured, systematic process that requires performing quantitative analysis of multiple project scenarios, measuring results and building feedback mechanisms for the decision process. Initial pilot projects optimizing earthworks (that can represent up to 25% of the overall costs of an infrastructure project) have delivered savings of up to 10-15%. Hochtief needs to build capabilities in data analytics, an area that was not part of their traditional core business but is now required under a much more complex environment. Mr. Betz and his team are evaluating the possibility of relying initially on an open innovation strategy, attracting talent from startups and academia. Hubs are under consideration in Germany, Spain and Australia.

Organizational change in open innovation programs

Implementing an open innovation program in a corporation requires managing an extremely challenging organizational change. The complexity of this process has been highlighted to us in all the interviews with the people leading these programs. We discuss here our findings.

After the recent spur of open innovation programs, many have raised concerns and highlighted the limited success of initiatives in this space (Viki, 2016). We believe that this inadequate success can be explained, in part, by the formidable changes in organizational behaviour implied in the setup of these programs: firms have not fully recognized the organizational capabilities that need to be built to handle corporate-startup interaction. Kahneman and Tversky (1982) led groundbreaking research around the heuristics people rely on to take decisions and the biases they produce, not only in laboratory experiments but in important social, medical, and political situations as well. These heuristics are highly economical and usually effective, but they lead to systematic and predictable errors. The case studies presented in this thesis, describing the iterations that managers had to go through to develop effective programs, seem to support this systematic underestimation of efforts (see for example Box 1 Repsol, Box 5: Cisco, and Box 6 Calidad Pascual).

From the perspective of innovation, a firm needs to, first, generate great ideas and, subsequently, recognize and select the best ideas for further development and commercialization. Knowledge transfer is fundamental in this process. Although knowledge is created at a fundamental level by individuals, its amplification is an organizational process. As Nonaka explains in his dynamic theory of organizational knowledge creation (Nonaka, 1994):

At a fundamental level, knowledge is created by individuals. An organization cannot create knowledge without individuals. The organization supports creative individuals or provides a context for such individuals to create knowledge. Organizational knowledge creation, therefore, should be understood in terms of a process that "organizationally" amplifies the knowledge created by individuals, and crystallizes it as a part of the knowledge network of [the] organization.

Consequently, the development of innovative capability requires firms to invest in supporting organization-level processes to enable interactions that foster modes of knowledge conversion.

In open innovation programs, the required processes depend on the direction of the flow.

- **For inside-out transitions:** the internally generated business idea that, in most cases, has a bad fit within the organization (non-core activity, different growth rate, conflicting objectives), is spun-out to the open competitive space. New business processes, linkages, networks and, potentially, culture, has to be nurtured to be able to operate as an independent organization.
- **For outside-in transitions:** a young, but nevertheless formed, firm, has to be integrated in a complex and less flexible organization, requiring the modification of processes, power structures, and merging assumptions and interpretations associated with two potentially very distinct cultures.

To analyze these complex transitions, we will consider organizations through the three lenses framework, evaluating structural, political and cultural changes involved in managing the transition of ventures into and from corporations²⁵:

- **Strategic Design:** Organizations are machines. An organization is a mechanical system crafted to achieve a defined goal. Parts must fit well together and match the demands of the environment. Action comes through planning.
- **Political:** Organizations are contests. An organization is a social system encompassing diverse, and sometimes contradictory, interests and goals. Competition for resources is expected. Action comes through power.
- **Cultural:** Organizations are institutions. An organization is a symbolic system of meanings, artifacts, values, and routines. Informal norms and traditions exert a strong influence on behavior. Action comes through habit.

Structural lens: strategic design

Integrating employees, product, services and operations, systems and processes of acquired companies in outside-in transitions can be extremely challenging (“Business Management Case Study - Cisco,” 2007). Similarly, an inside-out strategy may require the creation of new operations and processes in the corporation.

In terms of organizational design, corporate startup open innovation programs require setting up specific linking mechanisms:

²⁵ From class notes of MIT course 15.322, Leading Organizations, John van Maanen, 15 September 2017

- **Inside-out:** The most obvious process in the formation of an internal venture is grouping. There is an evident challenge to create a venture group that differentiates itself from the rest of the structure of the corporation. Many programs fail because the internal venture continues to operate as a task force group completely immersed in the original business unit, maintaining the same business process, and the same information, human resources and management systems. If the new initiative does, indeed, rely on the same processes and systems, the corporation should reassess the decision of spinning off the venture and, instead, consider the development of the innovation within one of the internal business units, as there could be no real internal “fit” problem and the transaction costs inherent in the spin-off would not be justified.
Another challenge, less obvious, is to foster linkage of the new venture with the “external ecosystem”. Former employees now part of the venture relied, in their previous positions, on other corporate units to interact with other agents in the competitive space (suppliers, clients, competition, complementary products), and more broadly, other stakeholders (government, industrial organizations, labour unions, etc.). Explicit support to build this network should be considered in the open innovation program.
- **Outside-in:** The integration of a start up with the corporate organization is, from a strategic design perspective, an internal linking process. The autonomous unit will eventually integrate by shedding all non-core activities that are already efficient within the corporation, as a result of economies of scale and scope. The process will require the alignment of the startup with the internal processes: compensation schemes, information and management system, etc. This process has to be managed to increase the chances of “fit” between incubatee and corporation.

In our research, we have detected a number of strategic design inefficiencies, but we can group them into two types: poor linking and poor alignment mechanisms.

- The interaction between ventures and corporation is not handled by a formalized program management team for liaison and coordination, requiring the startup to spend significant amount of time navigating through the corporate business units. This is particularly relevant when integrating or spinning-off complex ventures, that require significant amount of cross-functional interaction. This lack of formal structures leads to

poor linkage: information does not reach the units that need it, a major cause of integration failure.

- Lack of strategic alignment between ventures and corporations: as a result, teams do not have access to the resources and the motivation to carry out the activities assigned to them. There are multiple reasons: wrong or inexistent performance metrics, poorly designed rewards and incentives, poor resource allocation, deficient human resources planning, etc.

Successful open innovation programs, like Cisco's, rely on a structured and systematic strategy to strengthen the ties of the ventures to the corporation, that includes a set of integration tools, methods, and processes lead by a formal, central integration management team and dedicated, cross-functional teams from departments and business units ("Business Management Case Study - Cisco," 2007).

Box 5: Cisco

Cisco-the complexity of integrating external teams²⁶

Cisco designs and sells a broad range of technologies that have been powering the Internet since 1984. The company made \$48 billion in revenues in 2017, maintaining gross margins at 68% leading to a net income of \$9.6B. CISCO has made growth by acquisition a main strategy, and the effective integration of the targets into the corporation, maintaining not only assets but human capital, a core capability. Just in 2017, the company has bought CloudLock, ContainerX, Worklife, Appdynamics, an advanced analytics team from Sagezza and MindMeld. This portfolio spans multiple sectors: business analytics, collaborative work, cloud computing, AI and cybersecurity.

Their dedicated Corporate Strategic Innovation Group, part of the Corporate Strategy Office, is focused solely on buying, partnering, investing and codeveloping with external partners. These partners include startups, innovation accelerators, universities and colleges, channel partners and developers and independent software vendors.

²⁶ Based on interviews with Prasanth Kalapatapu, Software Monetization, Strategy & Product Management at CISCO, San Francisco Bay Area, CA, USA on March 6, 2018. Information about the company taken from <https://www.cisco.com/c/en/us/about/corporate-strategy-office/corporate-strategic-innovation-group.html>, accessed on April 22, 2018.

Despite their extensive experience and dedication, CISCO still faces continuous challenges managing about inside-out and outside-in innovation.

The process to integrate an acquired startup takes 3-4 years. During this period, and despite the explicit objective of avoiding siloes, the acquired team operates mostly as an independent entity, with limited interaction with the rest of CISCO's business units in many cases, according to Mr. Kalapatapu. The departure of the original founding team usually happens immediately after their contractual obligations expire. Cannibalization, privileges and priorities result in political tensions. All this leads to poor linkages and the perception of CISCO as "company of companies". To encourage interaction and spillover of ideas into the main organization, CISCO has developed a very strong internal social network and promotes demos and gatherings between the teams of the acquired companies and the rest of the organization. Monthly internal sessions include the CEO and other senior managers.

Inside-out innovation has also been a source of political tensions due to risk-reward imbalance. Employee-led startups were developed using business unit support but success accrued mostly to the participants, despite the lack of real entrepreneurial risk (as perceived by the rest of the employees). Mr. Kalapatapu explained to us that new CEO Chuck Robbins, in charge since 2015, did not support internal startup initiatives and switched to a task-force model, *Alpha Projects*, to create focused teams working on single projects, selected through a competitive process open to all employees.

Despite the difficulties, CISCO is still a role model for open innovation, with an extensive track record of successes, delivering sustained margins and sales despite its industry high competitiveness.

Political lens: the social ecosystem

Through the political lens, organizations are social ecosystems in which competition is expected and action comes through power.

There are very few studies focusing on the political issues surrounding corporate open innovation programs in general, and more specifically, corporate incubation. But the social ecosystem that results from a corporate incubation program is, indeed, very complex as relationship networks

span across multiple layers: within the teams of individual startups, with other incubator teams, with the managers for the incubator program (inward or outward looking through a venture capital structure), with the staff of the corporation (potentially different business units), with external organizations (suppliers, clients, competition) and, finally, with other non-professional individuals or groups.

This transition is complex from a political point of view both for inside-out and outside-in movements.

- In inside-out transitions, former corporate employees need to form new network ties with the “outside” environment, to which they were potentially not exposed due to internal task division within the corporation. New leadership positions will be formed. At the same time, the dense and generally lower cost relationship network that existed within the organization now transitions to looser structure with much more internal competition.
- In outside-in transitions, former fully independent entrepreneurs have to manage new stakeholders and sources of power within the organization. Weak (market based) relationships transition to and stronger organizational ties. Her ability to mobilize resources to get things done is now impaired by a much more complex structure of interests (see Box 5: Cisco).

The transition from entrepreneurial to corporate network structure can be visualized below. Each network, evolved as individuals optimize their performance within the limitations of each environment, has its own advantages and disadvantages.

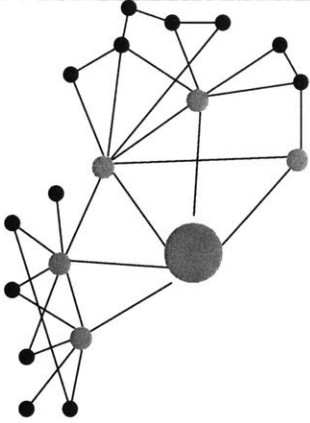
Corporation network ²⁷	Characteristics
	<p>Corporations are much more cohesive networks. Redundancy ensures robustness: the networks efficiency is less impacted by the loss of a link or a node. This redundancy evolves as a way of increasing resilience and reducing risk.</p> <p>This kind of network maximizes group cooperation and control. Dense within the business units of the corporation, with multiple ties between people, it fosters repetitive interaction, required for the coordination of activities and close monitoring.</p> <p>This cohesiveness also permits easier creation of unified fronts towards offending third parties.</p> <p>On the downside, these networks do not encourage mobility, with the risk of managers prioritizing security over innovation and risk taking.</p>

Figure 2 Corporation network

²⁷ Classification and graph from John R. van Maanen, Erwin H. Schell Professor of Management, MIT Sloan School of Management

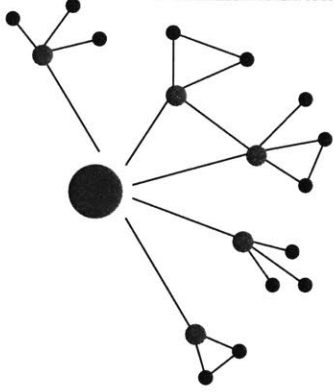
<p>Entrepreneurial network²⁸</p>	<p>Characteristics</p>
	<p>The sparsity of entrepreneurial networks gears towards the maximization of opportunities and diverse information flows, priorities in the discovery process of new ventures.</p> <p>It leads to high levels of autonomy and flexibility, resulting from lower number of ties (less social burden) and greater optionality to build new relationships. Managers can adapt quickly to changes in the environment, but this adaptation comes at the expense of resources, as the perimeter is weak.</p> <p>People in these networks get promoted faster, have higher bonuses, and receive better evaluations.</p> <p>On the downside, these networks are much more prone to “structural holes”, a concept originally developed by Ronald Stuart Burt (1992, 2000). A hole in this context is as a gap between two individuals who have complementary sources to information. These holes are sources of positional advantages or disadvantages, which, in turn, can result in a complex political landscape.</p> <p>Cooperation may be difficult as a result of the lower number of ties (higher bridge count, relation between two individuals if there is no indirect connection between them through mutual contacts) lowering information flow efficiency and unequal distribution of power.</p>

Figure 3 Entrepreneurial network

²⁸ Classification and graph from John R. van Maanen, Erwin H. Schell Professor of Management, MIT Sloan School of Management

The stark difference between network structures increases the complexity of the political process behind a corporate startup transition (in either direction). The difficulties may not be recognized and can be a source of multiple failures. Consequently, open programs need to plan ahead the challenges that can appear at different network layers:

- **Internal team relationships:** In inside-out transitions, the development of innovation through individual ventures promotes very strong relationships within each team (Burgelman, 1983). This is as expected. Indeed, one of the reasons to spin-out innovation through an incubator/accelerator structure is to ensure focus and close collaboration to resolve the innovation challenge by freeing them from the procedural obligations typical in processes within corporations. Autonomy requires, necessarily, departing from company policies and practices. In outside-in transitions, though mostly young, the target company starts with an already strong relationship internal network, probably reinforced by the success of having been targeted by the corporation. The challenge here is to strengthen and develop other networks, specially towards the organization.
- **Program managers:** There are numerous political challenges that program managers responsible for corporate incubators/accelerators need to address. Initially, program managers will inevitably be network bridges between startups and business units. This position of bridge between the two distinct groups allows the these managers act as gatekeepers of valuable information, controlling the transfer from one group to another (Burt, 1992). This leads to positions of power. The temptation for managers to extract excessive value from this privileged position can lead to a collapse of the program due to the lack of legitimacy or support. Risk of this happening can be mitigated by building sufficient redundancy (limiting the ownership of ventures by specific program managers), but maintaining multiple links between distant teams can be time consuming.

The decision to terminate a venture is political and difficult for the program managers, particularly if they have been involved in the idea and approval of the venture (Burgelman, 1983). Studies have shown how startup teams in corporate incubators increase significantly the intensity of the relationship with the incubator's team in moments of danger, when external market conditions deteriorate simultaneously (Evald

& Bager, 2008). Allowing or even encouraging other venture capital firms to take equity in the ventures can help to improve discipline.

- **Inter startup:** Corporate programs should consider the value added by the interaction of startups in the portfolio of the corporation. Forums or spaces where employees share their experience can lead not only to increased efficiency but also spur ideas and reduce tension, avoiding the perception of a competitive space for corporate attention and funding. Of course, the reward and ownership structure of a startup environment in a corporate program, and the protection of relevant intellectual property will limit the intensity of the interaction. Problems arise partly when startups are in substantially different development stages, as the objectives, risk profiles and needs have less overlap. Evald *et al.* (2008) includes a revealing comment of a key employee of an experienced, successful venture in a NKET Corporate incubator:

“We keep an open mind and like to help the other ventures, but there are things we keep to ourselves. Some of the other ventures would like to cooperate with us because we are the oldest venture right now among the entire venture group, and this is of course exciting but, beyond a certain point, you have to stop”

- **Corporation:** The flow of ventures from and into the corporation disrupts power structures within the organization, leading to rivalry. Buy-in from the business units is a key element of success. Conceptual and political capabilities of both managers of the open innovation programs and middle management in the business units will play a major role. In order to overcome internal resistance (and also compensation issues), Intel Capital, that has in 2017 have invested more than a \$1B in AI startups including Mighty AI, Data Robot and Lumiata²⁹, originally placed in its investment branch senior employees who were already deeply invested in the company, including its founder and 4th employee Leslie L. Vadasz. Mr. Vadasz had joined Intel in 1968 and, before becoming the president of Intel Capital, had already successfully run many business units within the company.
- **External stakeholders:** Corporate programs should manage and monitor the interaction of venture teams and stakeholders outside the incubating-corporate environment.

²⁹ CEO Brian Krzanich, at TechCrunch Disrupt SF 2017, <https://techcrunch.com/2017/09/18/intel-capital-has-invested-over-1-billion-in-companies-focused-on-ai/> retrieved on Jan 9, 2018.

Objectives are different depending on the innovation flow direction. In general, for inside-out transitions, ventures must receive support so that they can gradually grow, autonomously, their external stakeholder network. Excessive reliance on the corporate network in later stage portfolio ventures intended for spin-off can limit the success and create political tensions with the business units, that may perceive that corporate entrepreneurs “free ride” on resources while capturing most of the value through equity in case of success (see Box 5: Cisco). Employees not participating in the program must sense a fair risk-reward proposition, requiring the startup to grow its revenues through a self-supporting marketing and sales efforts and internalizing costs.

For outside-in transitions, the program has to focus on nurturing startup-business unit interaction, in order to build ties and increase the chances of success in an eventual spin-in process. But, in parallel and no less importantly, the valuable network of external stakeholders must be preserved and extended to profit other business units.

Cultural lens: institutions

From the cultural lens perspective, an organization is a symbolic system of meanings, artifacts, values, and routines. Edgar Schein (Schein, 2010) defines culture as “a set of basic assumptions [that] defines for us what to pay attention to, what things mean, how to react emotionally to what is going on, and what actions to take in various kinds of situations.” We are interested in this thesis in those basic assumptions that can potentially be different and can therefore create a barrier in the transition between start up and corporation. We will consider culture at three levels based on the degree to which the different cultural phenomena are visible to the observer. Again, using Schein’s framework, we can differentiate between:

- Artifacts include any tangible, overt or verbally identifiable elements in an organization.
- Espoused values are the organization's stated values and rules of behavior. It is how the members represent the organization both to themselves and to others.
- Shared basic assumptions are the deeply embedded, taken-for-granted behaviors which are usually unconscious, but constitute the essence of culture.

In the case of outside-in transition, it is sometimes said that synergies emerging from corporation-startup collaboration are a result of the complementarity of the material assets of the former and the behavioral assets of the latter (McNally, 1997). But physical assets of the corporation are not

provided in a vacuum: the have to be accessed through corporation's employees and process. Therefore, a successful open innovation program needs to be able to deal with the interaction of two very different cultures, each the product of radically dissimilar scale and complexity. We should therefore recognize that a culturally aware planned transition, and not a mere absorption or graft, has to be considered when designing equity transactions to spin-in a startup. The clash may not be apparent in the initial stages of the program, were interaction is low and equity participation is limited. But if left unplanned, the spun-in venture may remain as a completely autonomous unit with no value added to either acquired team or corporation.

Similarly, spinning out an internally generated venture from a corporation can be culturally challenging. In this case, the initial creation of the team may imply lower risk from a cultural perspective, but to ensure success, the newly formed startup needs to be able to acquire the necessary entrepreneurial traits, characteristic of the competitive landscape in which it has to succeed. This transition, therefore, also needs careful planning.

We will focus on two particular cultural traits: control and failure, and the perception of time. The contrast in culture between startups and corporations can be both a source of conflict and an opportunity to manage change, as we will see in two specific examples (see Box 6 Calidad Pascual and Box 7 Mizuho Bank)

Control and failure

Entrepreneurs have to manage a very highly unpredictable business environment, but carry very little structure, allowing opportunistic behaviour. Side effects are small, and implementation can be risky. There is a lot of intrinsic satisfaction when creating a new business. In this context, in terms of espoused values, it is easy to develop "fail fast" culture based on transparency, early recognition of failure and "pivoting". Since the stakes are much lower, trials, simulations, repeated iterations are clear, identifiable elements in creative process. Employees are more willing to speak up and make suggestions without repercussions.

As products mature, volumes increase, clients become more quality sensitive and demanding, the development of products increasingly relies on cross-selling, and, specially, brand value becomes a major asset, experimenting through iterations can become much costlier.

In an outside-in transition, an independent accelerator or incubator environment allows the corporation to manage reputation and diversify risk by investing in multiple ventures. But,

eventually, the transition to a less flexible environment is needed, and this transition can be stark if the final exit is an acquisition into the corporate environment, as opposed to a more gradual development through organic growth.

An inside-out transition is equally challenging, as the team needs to build an entrepreneurial venture from an initially cohesive corporate environment. The risk here is that they never adapt to a low resource, high risk environment. The new high risk-high reward position has to be perceived not only by the new venture employees, but by the rest of the organization, that will then accept returns as fair.

Box 6 Calidad Pascual

Calidad Pascual-open innovation to change company culture³⁰

Calidad Pascual (Pascual) is an iconic food and beverage company in Spain, with a broad portfolio of products (milk and other dairy products, bottled water, soybean derivatives, juices, coffee drinks) and holding multiple household names. This family owned business, founded in 1969 by Mr. Tomás Pascual, and still under the control of the family, was running in early 2018 6 industrial plants and 27 regional commercial offices, managing more than 400 distributors throughout the country.

Under the pressure of a commoditized milk market, white labels and other local brands, Pascual's sales dropped to EUR 642.2M in 2016, 8.6% less than the previous year, resulting in a positive EBITDA of EUR72.9 M but losses of EUR23.7M. Nielsen reports a further 0.2% drop in market share from November in 2016 to November 2017.³¹ The company's strategy in 2018 targets internationalization (South America, Africa and Asia) and growth in its vegetable drink and fruit juice/milk fruit drink products.

Pascual has historically been a leader in F&B innovation in Spain. The company introduced the ultra-high temperature processed (UHT) milk brick for the first time in Spain in 1973, and later continued leading categories with the introduction of the functional milks (skimmed and semi

³⁰ Based on interviews with Alvaro Bernad, Director Innovación Disruptiva (Director for Disruptive Innovation), Calidad Pascual, Madrid, Spain, on March 27, 2018. Information about the company taken from <http://www.calidadpascual.com/conocenos> , accessed on April 22, 2018.

³¹ <https://www.economiadigital.es/directivos-y-empresas/pascual-perdidas-resultados-23-millones-524993-102.html>

skimmed), fruit-milk beverages, and, lately, new varieties of oatmeal, almond and rice drinks and lactose free milk.

Pascual has made open innovation a key strategy for growth. They target three areas of innovation: nutritional and health products, consumer relationship through information and communication technologies and environmental projects.

The team lead by Mr. Bernad, Director for Disruptive Innovation, seeks, above all, cultural change. Internal cultural traits that he targets to challenge are short-termism, lack of innovative thinking, siloed mentality, fear of failure and excessive inward focus at the expense of client needs. According to Mr. Bernad, “we still struggle to share information with third parties, and to recognize that we don’t know everything”. The company launched in 2016 “Pascual Startup”, a pioneering open innovation program in Spanish Agri-business. The firm started with an accelerator design, with 252 candidates that were narrowed to 24 pitches that have led to 2 viable businesses. The second edition counted with 360 candidates. At the moment of the interview, the company was running its third wave.

A surprise for the company was to receive proposals from employees during its first edition. The company already had an internal program to channel internal innovation (that has already received more than 600 ideas or contributions, of which 70 are being developed). Nevertheless, though explicitly excluded from applying to the accelerator program, management was surprised to find 10 applications of employees not only bringing innovative proposals, but willing to take entrepreneurial risk. This is a sizable number for a company with a 2,100 headcount.

Perception of time

Corporate executives and entrepreneurs will probably have different perceptions of time. In terms of monitoring or results, most large corporations work within strict, short term time horizons, with systematic measurement of performance, growth and delivery. Entrepreneurs consider lengthier time horizons, recognizing the longer time required to develop their business plans. The tension that results from these differences in perception can be magnified if the entrepreneur has overpromised or if there is strong information asymmetry, as is often the case

between a much more informed entrepreneur and the venture capital financing the startup (Botkin & Matthews, 1992).

On the other hand, startups need faster decision-making to implement their quick iteration development strategies. We have heard many startups complaining about the significant amount of time they have to spend seeking corporate attention for meetings, and corporates complaining about startups' lack of planning and definition of priorities.

This difference perspective can be seen as a potential source of risk, but, if managed properly, offers also an opportunity to shape the culture of a corporation. Exposure of employees to projects executed with different time horizons can help management infuse in the workforce a more mature analysis of the tradeoffs between short term results and long-term capability building. It also allows management to isolate ventures that have require an incubation time that would not be compatible with the regular dynamics of the corporation.

Box 7 Mizuho Bank

Mizuho Bank and Blue Lab, resolving time conflicts in Banking³²

Mizuho Bank, Ltd. (MHBK), with a capital of JPY 1,404.0 billion and 29,800 employees as of March 31, 2017, is the second largest bank in Japan. It is a full service financial group, providing financing (corporate, syndicated, structured), transaction banking (trade finance, cash management, etc.), institutional services (foreign exchange, derivatives, yen clearing services, etc.), and advisory solutions. It has growing global profile, with a connected banking platform that spans the Americas, EMEA and Asia (it was the first foreign bank granted local bank status in China).

In July 2017, Mizuho Financial Group and World Innovation Lab (WiL³³) established a joint venture, Blue Lab, to foster new business creation³⁴. The lab is focused specifically on the creation and commercialization of next-generation business models through FinTech initiatives such as the creation of global settlement platforms, the use AI and big data to automate

³² Based on interviews with Masato Kaneda, Joint General Manger, Incubation Project Team, Mizuho Financial Group, Japan, on April 12, 2018. Information about the company taken from <https://www.mizuho.com/company/info/profile/index.html> , accessed on April 30, 2018.

³³ <https://wilab.com>

³⁴ https://www.mizuho-fg.com/release/pdf/20170710_2release_eng.pdf

operations and the optimization of supply chain management and trade finance through blockchain and IoT. The program design is an incubator, with startups joining Blue Lab with no fixed time horizon. Most of the ventures are at idea-stage or an early-stage (1-2 years).

In our interview, Mr. Kaneda explained that their intention was to create a totally independent environment to allow effective interaction between Mizuho, FinTech startups, vendors and research institutes. The lab is purposely constituted as a non-consolidated structure and aim to reach JPY1B (USD9.1M) capital by 2023.

Facing negative interest rates and an aging population, Japanese banks critically need to find new sources of cash, either through new products or by geographical expansion. But management found it could not trigger interest of business units in new financial technology due to short term BU performance pressure and the small contribution to bottom line results of the new ventures. Blue Lab was created to provide a protected environment of agile decision-making, and, at the same time, allow for longer incubation times in order to scale before transitioning to the main organization.

Mr. Kaneda foresees the creation of a new CVC fund to grow Blue Lab startups, together with an intrapreneurship program for inside-out innovation.

Information flows in open innovation programs

Corporate open innovation programs, particularly the most complex ones, are resource intensive. A research study published by the Harvard Business Review (Gimmy, Kanbach, Stubner, Konig, & Enders, 2017) based on more than 60 in-depth interviews with executives at large corporations and founders of startup showed that it takes at least 12 months between first touchpoint of the CVC with a startup and the kickoff of the pilot with a business unit, and that the fixed costs range from \$1M to \$2M per venture (not including administrative and variable costs of the pilot itself) for a \$100M CVC fund that closes five to 10 investments a year.

But transactions summarized in an income statement give only a partial view on the net effect of the open innovation programs. Bad program design can lead to the loss of investment opportunities or employees leaving the company with important tacit knowledge, setting up competing businesses. Efficient open innovation programs can not only produce important financial returns but also positive externalities like spurring additional internal innovation, better business unit collaboration and geographical expansion into new markets.

The organizational structure proposed in this thesis requires therefore the solid foundation of a cost-benefit analysis. An efficient, low friction, open innovation design can unleash untapped potential in the corporate-startup interfirm collaboration space. Friction results from either actual high costs or because participants are not able to assess correctly the costs associated with the interaction, i.e. despite being wealth-maximizing, the agents misestimate the cost of carrying out the actual transaction (either inside-out or outside-in) as greater than the expected benefit and do not engage.

There are two frameworks that help to understand the information related costs incurred by any economic transaction: the agency costs theory and transaction cost theory. These two perspectives are complementary and deal with information availability and flow within the participants. Agency cost framework focusses on the asymmetry of information, while the transaction cost perspective focuses on the information flow frictions that have to be overcome in order to transact. Concretely:

- **Agency cost analysis:** result from the use of agents by an organization to act on its behalf. These costs arise in two forms: as costs inherently born by the principal as a result of using the agent (the use of organizational resources by agents in their own benefit) and the

costs incurred by the principal to minimize these costs. Agents will be entrepreneurs, program managers, partners in CVC's, senior management and employees in corporations. Principals will be the providers of capital: shareholders in the corporation or the corporation as investor in the startups (the partners of the funds, the program managers, etc.). Note that some market participants can be principals or agents in different settings.

- **Transaction cost analysis:** From the perspective of transactions, we will focus on the costs incurred by both the corporation and the startup in the financial operation involving the transaction of equity for funds. These are essentially information flow related costs in the different phases of the exchange process, in particular, the costs incurred in, gathering information and informing each other of the exchange opportunity, decision making, bargain; and police and monitoring,

Both frameworks will provide insights about how to set up efficient open innovation programs.

Agency costs

A key feature of the open innovation program structure presented in the thesis is its staged design. The theoretical foundation for the staged design is its contribution to the reduction of agency costs through improved information sharing that minimizes information asymmetry.

Open innovation programs, particularly those involving equity transactions, are a source of important principal-agent interactions:

- Entrepreneur as manager and employees within the startup
- Entrepreneur as manager and shareholder and the corporation as investor
- Shareholders of the corporation and its managers
- Interactions introduced by the agents of the open innovation program acting on behalf of the corporation (for example corporate venture capital managers/partners and the corporation management and its shareholders)
- Other venture capital (besides the corporation) providing funds for the investees.

All these additional principal-agent interactions can be the source of agency costs as principals engage with agents in conditions of incomplete information. We will analyze the agency costs arising from these interactions and propose a design aimed to minimize them.

An agency cost is an economic concept concerning the costs to a "principal" (an organization, person or group of persons), when the principal chooses or hires an "agent" to act on its behalf. Because the two parties have different interests and the agent has more information, the principal cannot directly ensure that its agent is always acting in its (the principal's) best interests (Jensen & Meckling, 1976). As explained before, costs arise in two forms:

- The principal accepts to bear the costs as inherent to the use of the agent: there is a consumption of resources of the organization for the exclusive benefit of the agent. For example, the corporation or its venture capital assumes that the entrepreneur will not exert its maximum effort under certain conditions and funding strategies.
- The costs incurred by the principal setting up mechanisms to minimize information asymmetry in order to minimize these costs, like techniques to acquire additional information through reporting or compensation plans to align interests.

Agency costs have profound impact in important features of an open innovation program, like contracts, capital structure and project portfolio decisions and will be a key element of analysis in the articulation of the thesis proposal.

We will discuss separately agency costs related with outside-in programs and inside-out programs.

Agency costs in outside-in programs

There is extensive research of agency costs, particularly in the context of venture capital, related to the relationship between entrepreneur and investors, which are directly applicable to outside-in innovation programs (either the corporation directly or through a corporate venture capital fund structure). Complex cash flow and control right provisions in VC contracts reflect the parties' efforts to reduce the moral hazard problems associated with financing entrepreneurs (Fried & Ganor, 2005) like the use of preferred stock as a way to provide the entrepreneurs stronger incentives. We will use a framework for agency costs based on Cumming & Johan (2014) (list and definitions), to which we add our extension to corporate venture funding:

Agency cost	Description
Moral Hazard	An agent not exerting its best effort (against the interest of the principal) in view of his diminished accountability. Effort is potentially observable but not verifiable and therefore unenforceable.

Application to corporate venture funding

Though the effort is unenforceable, it can be incentivized designing appropriate funding mechanisms. When bankruptcy is not expected, the entrepreneur's [VC's] effort into a venture is increasing [decreasing] function of the amount of debt to common equity provided. The corporate-venture programs we are proposing in this thesis imply significant effort from the investing corporation, and therefore suggests that equity or convertible securities are preferable than non-convertible debt as a result of higher quality information access.

This cost also appears in the case of program managers or CVC partners as agents of the corporation and investor (principal), depending on the type of incentives provided by the corporation. Independent VC's incentives are usually strongly aligned with those of their

institutional investor's interest through the carried interest bonus. CVC partners without similar remuneration structure (without actual carry, "shadow carry" or at least variable remuneration linked with the contribution of the fund to the financial performance of the corporation), may lead to suboptimal effort or, worse, high turnover.

Table 6 Moral Hazard

Agency cost	Description
Multitask Moral Hazard (Holmstrom & Milgrom, 1991)	Refers to situations that involve multiple tasks that the agent may undertake, with only a subset of these tasks benefiting the principal

Application to corporate venture funding:

The corporation will typically have many portfolio investments and has to decide how to allocate time. As agent of the entrepreneur in supporting the venture, the program managers of the CVC partners may allocate disproportionate amount of time to companies with higher upside. This situation is similar to independent VC, although a corporate program could be, additionally pressured by sponsors from the business units with special interest in particular ventures.

Independent VC are also subject to multitask hazard related to the fundraising activities. In this case, the institutional investors are principals and the partners are diverting part of their efforts to raise funds from other investors to ensure the continuity of their activity instead of supporting the portfolio companies. Though CVCs are not raising funds from institutional investors, their managers/partners will need to dedicate time to maintain the buy-in of top management. This results in a multitask agency cost between the entrepreneurs as principals and the program managers of CVC.

Table 7 Multitask moral hazard

Agency cost	Description
Adverse selection (Akerlof, 1970; Hellmann & Stiglitz, 2000; Spence, 2002; Stiglitz & Weiss, 1981)	Arising before a contract is signed between the parties. Refers to the fact that different types of contracts attract different types of parties.

Application to corporate venture funding:

In our context, adverse selection agency cost can affect two principal-agent relationships:

- Attraction of different types of program/fund managers skills and risk appetites in connection to the negotiations of carried interest. Mehri, Hassan, and Jouaber-Snoussi (2017) discusses this adverse selection risk in the context of regular venture capital. In the negotiation stage:

The fee structure chosen by the fund manager acts as a signal of the fund manager’s ability to generate profits and perform a risk-sharing function, determining the final distribution of profits between the fund manager and the investor. [...] High-type fund managers [high skills to perform the fund] with lower risk aversion [than the investors] will tend to negotiate the carried interest as high as possible to signal their type, since they have the skills to perform the investment and are sure that the investment will generate high net profit. [...] [W]hen the low-type fund managers [without enough skills to perform the fund] are less risk averse than the investors, they will tend to negotiate the carried interest as high as possible to maximize their profit share from a low investments’ net profit.

Therefore, the bargaining process by itself may not be useful for the manager to assess the fund manager quality. Consistent with this analysis, what is observed in the VC fund ecosystem is stickiness of the carried interest around 20%. In a study by Metrick and Yasuda (2010), of 98 venture capital funds, one fund had a 17.5% carry level, three a 25% level, and one fund with a 30% level, with the remaining 93 remunerating general partners with a 20% carry.

Though the analysis above refers to venture capital in general, we can extract certain insights applicable to corporate venture investment. In theory, the remuneration of CVC is much more flexible, and can include variable bonus linked with either the

performance of the fund with a regular carry rate, a shadow calculation that simulates carry, the global performance of the corporation (for example with stock options) or a mix. But the corporation should nevertheless consider the VC “market” level to gauge the risk appetite of the managers running the program or fund, since it is targeting talent with the same skillset. Though the acceptance by managers of lower variable remuneration (or remuneration less aligned with the performance of the portfolio) do not necessarily signal lower skill, compensation schemes that significantly deviates from standard VC may attract managers with excessively low risk-taking profile that may not bring the entrepreneurial drive that the corporation is trying to nurture.

- Attraction of different types of entrepreneurs depending on the type of financing offered, concretely nonconvertible debt versus convertible securities or equity. The asymmetry of the downside and upside payoffs in debt and equity lead to adverse selection (D. J. Cumming & Johan, 2014). Given two ventures with the same expected returns, the entrepreneur perceiving higher risk will prefer debt: “Debt attracts nuts”. Similarly, when entrepreneurs differ in terms of expected return but not in risk, common equity attracts low performers: “Equity attracts lemons”.

Venture capitalists therefore need to define their financing strategy conscious of the selection bias that results from its funding proposition. This not only refers to its debt-equity composition, but also other contractual clauses like preemptive rights, rights-of-first refusal, co-sell or “piggy-back” rights and lock-in rights, designed to restrict the movement of shares between shareholders, that can further adverse select, reducing the interest of high performance ventures.

In mature business financing, this adverse selection results in the tendency of managers to favor debt over equity (pecking order theory, (Myers & Majluf, 1984)). High quality investments want to signal their confidence by looking for a capital structure that favors upside risk taking (vs. downside protection) for existing shareholders. Low quality investment, despite its theoretical preference for equity financing, also favors debt to avoid signaling low performance. Venture financing is different in the sense that there is investor risk appetite. Proper due diligence should have reduced, in theory, information asymmetry and detected important upside potential. But some researches like Klonowski (2018) are of the opinion current risk

appetite and heavy reliance on “uniform” equity financing (i.e. not adapted to the particular needs of each investment) results in the concentration of low performance-high risk ventures in the VC portfolios:

Financial contracts in the venture capital ecosystem are likely to be incomplete, imperfect, and defective. Most financial contracts aim to “overcompensate” for venture capitalists’ inabilities and lack of expertise rather than address information asymmetry.

This “overcompensation” comes in the form of excessive voting rights or restriction of exit options, which further attracts “lemons”, lowering valuations and adverse-selecting higher performance ventures.

Corporate venture faces the same adverse selection risks, although:

- The corporation may be more tempted than independent CV to introduce preemptive rights and rights-of-first refusal to reserve spin-in optionality. Without this protection, the corporation may be less willing to give access to strategic assets, that can eventually end up in the hands of the competition. This can potentially increase adverse selection costs towards entrepreneurs with lower upward expectations.
- In terms of due diligence, it can be argued that a corporation may be better suited to evaluate the potential of a new technology, based on its market intelligence and technical expertise. This can potentially lower asymmetries, reducing the risk of low performance ventures while maintaining the higher risk profile of the portfolio

Table 8 Adverse selection

Agency Cost	Description
Free riding	Arising in the context of ventures in which the efforts of different agents is substitutable.

Application to corporate venture funding:

Cumming and Johan (2014) gives a particular example of free riding in the context of syndicated venture capital investment, with one VC free riding the efforts of another syndicated investor. This situation can take place in corporate venturing too, in settings when the CVC fund

syndicates with other independent venture capitalists. As we will discuss later, corporation may consider the introduction of other VC firms in later funding rounds as they may be able to enhance investment discipline and proper valuation of ventures, particularly in the context of a spin-in. The flipside of this decision is the introduction of new principal agent relationships, subject to agency costs. In the context of free riding, the IVC firms may free ride on the industry specific technical support provided by the corporations, creating value that may or may not be captured by the CVC branch through higher valuations implicit in late funding rounds.

Another free-riding risk, specific to CVCs, appear with startup and corporate target similar markets. Misplaced or naïve openness may result in the misappropriation of valuable knowledge and resources by an opportunistic partner (Das & Teng, 1998; Katila, Rosenberger, & Eisenhardt, 2008). The overt use of safeguards will not necessarily help as such precautions can send a signal of mistrust which may prompt the withholding of resources and closer social interaction (Ghoshal & Moran, 1996; Lui & Ngo, 2004), leading to other types of agency costs.

Table 9 Free riding

Agency Cost	Description
Hold up	Arising from situation of expropriation in which there is unequal bargaining power between different parties to a contract

Application to corporate venture funding:

Hold up situations can be triggered both by the entrepreneur and the venture capital firm.

Entrepreneur hold up is usually related with the particular knowledge or skills of the entrepreneur, key for the success of the venture. This holdup risk is usually managed through contractual terms that delay incentives (like stock options) until certain milestones are achieved (D. J. Cumming & Johan, 2014). Unlike independent venture capital, corporate venture capital can mitigate this risk by developing and strengthening the interaction between the venture and business units, thereby reducing technical holdup risks.

Investor holdup usually emerges from the staged funding strategy of venture capital. In the corporate venture setting, this is particularly problematic as the entrepreneur may have difficulty of finding alternative sources of funding if the corporate decides to hold up new funds. The refusal by the corporation to provide capital sends a very strong negative signal that may be virtually impossible to overcome, giving the CVC a strong bargaining position. The matter was raised systematically in conversations with CVC funded entrepreneurs. Note that, unless managed properly, this important agency cost may lead to severe adverse selection problems.

Limiting hold up risk is the willingness of the corporation to manage its reputation risk, both with the startup community and with other venture capital investor firms.

Table 10 Holdup

Agency Cost	Description
Window dressing	Arising from falsely improving the performance of the venture to obtain short term benefits

Application to corporate venture funding:

Window dressing can appear both in the flow of information from the entrepreneur to the fund and from the fund to the investors (from the VC fund to the corporation). In the former case, risks are higher with staged financing, that leads to high short-term pressure. In the latter, longer term funding commitments of institutional investors with the venture funds could in theory mitigate this particular agency cost, but short-term pressure still exists as a result of the fundraising efforts (D. Cumming & Johan, 2007; D. Cumming & Walz, 2010). First time VCs, seeking to build reputation may be especially vulnerable and prone to grandstand (P. A. Gompers, 1996)

In CVC, the pressures of entrepreneurs to grandstand are similar to those of independent venture funding settings. But risks on the fund-corporation relationship can be substantially different, as they are greatly dependent on the funding mechanisms. Annual funding allocation (evergreen through periodic commitments) or per project fundraising from the corporation can significantly increase the pressure to obtain short term results (particularly in the early stages of the program), leading to increased window-dressing risk (see Box 1 Repsol).

Table 11 Window dressing

Agency Cost	Description
Underinvestment	Arising from entrepreneurs not having sufficient incentives to provide sufficient effort. The value of the firm is low and the effort will be mostly captured by the debt holder.
Asset stripping	In this context, it refers to the sale of assets by entrepreneur to improve the return to equity holders, lowering the net-worth of the company and damaging position of the debt holders (same debt with lower assets and weaker income)
Risk shifting	In this context, change of the risk profile of the company's activities after receiving debt financing, in order to improve shareholding value at the expense of debt-holders.

Application to corporate venture funding:

These three agency risks are relevant in the case of debt, particularly with small equity valuations, when the downside for the equity is marginal or even zero (as in the case of underinvestment). For venture firms, these agency costs appear in the context of venture debt, a relatively small part of early stage startup funding and out of the scope of the present thesis, that focuses on corporate-startup equity transactions. But it can also be relevant in convertible debt scenarios, a very frequent financing strategy adopted in the venture capital space. In the cases of low performance, when the probability of conversion is small, convertible debt behaves like conventional debt, and underinvestment, asset stripping and risk shifting risks are relevant.

Table 12 Underinvestment, asset stripping and risk shifting

Agency costs in inside-out programs

Agency costs in inside-out programs are relevant in two interactions:

- Between employees (agent) and the firm (principal) before the creation of the startup

- After the creation of the startup, between the new venture and the corporation open innovation program (possibly the CVC), that may involve multiple principal-agent interactions.

Concerning agency costs before the creation of the startup, the main cost relates to adverse selection.

Agency cost	Description
Adverse selection (Akerlof, 1970; Hellmann & Stiglitz, 2000; Spence, 2002; Stiglitz & Weiss, 1981)	Arising before a contract is signed between the parties (in this context the corporation as employer-principal, and the R&D employee as agent). Refers to the fact that different types of employment contracts attract different types of employees.

Application to corporate venture funding:

Before the creation of the firm, we have already argued that information asymmetries in the employee (agent) corporation (principal) interaction is a key element in understanding internal entrepreneurial pressure and the incentives of employees to create spin-outs. Ample research has identified asymmetries between general management and innovation teams (Cheng, Chen, & Shih, 2014; Chow, Cooper, Waller, & Wailer, 1988; Shields & Young, 1993). In general, teams leading innovation in organizations understand the potential of the technology better and are in a favorable position to assess better the impact of external factors. This asymmetry may result in strong incentives for employees to leave, and value can be lost. A formal, well-functioning program to channel internal entrepreneurship can mitigate the risk.

Table 13 Adverse selection, inside-out programs

After the formation of the startup, the new autonomous venture and the corporate venture capital fund face similar agency costs as in the outside-in transitions. Nevertheless, it can be argued that the costs are smaller, as the information asymmetry (at least at the beginning) is lower: corporation has more information about the venture and the performance of the employees forming the startup. The reverse is also true.

Transaction costs

This section continues the analysis of organizational structures from the cost perspective. The previous sections have examined agency costs, arising from the use of agents by principals to act on their behalf. The transaction cost analysis below will focus on the information flow frictions that have to be overcome in order to transact equity.

Corporate startup portfolio management and transaction costs

Corporation and startup incur in the use of resources in the interaction that leads to the transaction of equity for funds. These resources are required in the different phases of the process as agents seek, decide and bargain and monitor. Similarly to the case of agency costs, the level of the transaction costs is consequence of the information availability and flow between corporations and startups, and therefore directly linked with the open innovation program design.

As framework for the analysis of transaction costs, we will rely on the taxonomy offered by Dahlman in his study on externalities (1979). In particular:

[S]earch and information costs owe their existence to imperfect information about the existence and location of trading opportunities or about the quality or other characteristics of items available for trade. The case is the same for bargaining and decision costs: these represent resources spent in finding out the desire of economic agents to participate in trading at certain prices and conditions. What is being revealed in a bargaining situation is information about willingness to trade on certain conditions, and decision costs are resources spent in determining whether the terms of the trade are mutually agreeable. Policing and enforcement costs are incurred because there is lack of knowledge as to whether one (or both) of the parties involved in the agreement will violate his part of the bargain: if there were adequate foreknowledge on his part, these costs could be avoided by contractual stipulations or by declining to trade with agents who would be known to avoid fulfilling their obligations.

As Dahlman himself points out, all of these transaction costs are fundamentally, resource losses due to imperfect information. In summary, for an open innovation program to be efficient, the design needs to reduce information flow related costs related with:

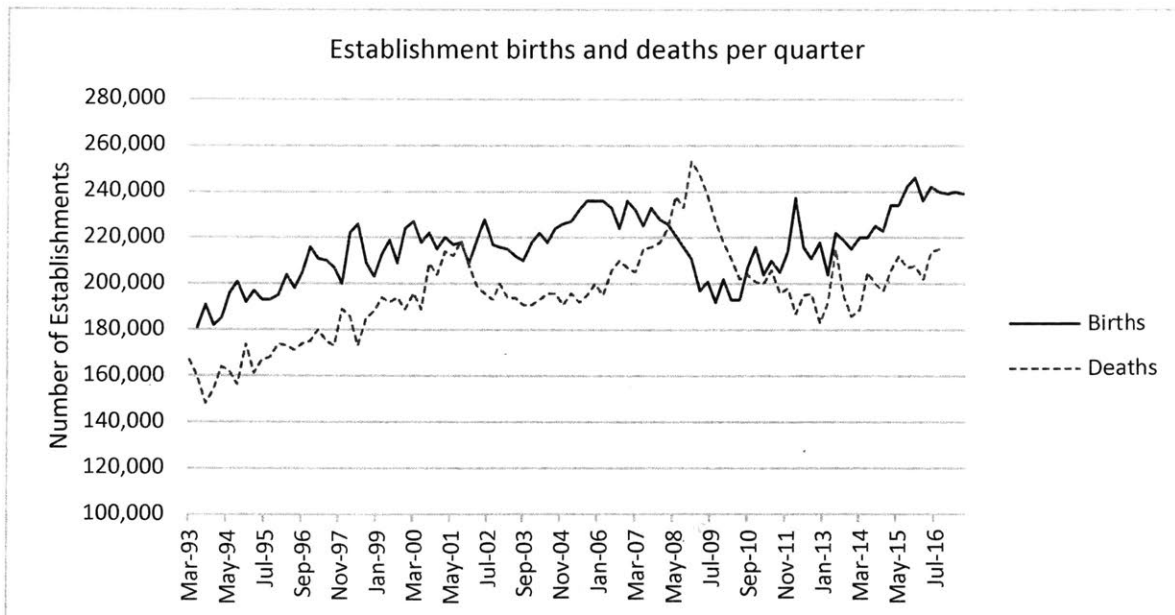
- Gathering information and informing each other of the exchange opportunity;
- Decision making;
- Bargain; and
- Police and monitoring.

We discuss the theoretical foundation of each of these costs.

Information gathering transaction costs

Participants in open innovation programs incur in substantial costs gathering information and informing each other of the exchange opportunity. A former outside-in program from Siemens, Siemens Technology to Business (TTB) was, at its peak, screening about 1,200 potential project pipeline ideas per year, going into detailed evaluation of 80 of them (Weiblen & Chesbrough, 2015).

To give an idea of the scale of the task, we have included below the data on business births and deaths in the US on a quarterly basis from the Bureau of Labor Statistics, the timeliest source of data available on new private sector business establishments in the United States. Mortality has decreased significantly from the peaks of the financial crisis, but the quarterly number of new establishments is now above pre-crisis levels, around 220,000 per quarter, generating approximately 800,000 jobs. Even if corporations narrow the efforts geographically and by sector, their programs are facing a potential source of thousands, if not tens of thousands of new ideas *per quarter*.³⁵



³⁵ Graph prepared using data from the Bureau of Labor Statistics of the United States, Department of Labour, *Table 8. Private sector establishment births and deaths, seasonally adjusted*, last modified date January 26, 2018, retrieved from <https://www.bls.gov/news.release/cewbd.t08.htm> on March 22, 2018.

Figure 4 Establishment births and deaths

Startups, on the other hand, have to gain attention in this competitive landscape of fast venture creation and destruction.

Obviously, corporations will only sometimes be targeting startups in the first year. The high death rate of new ventures during the first years of the new entrepreneurial initiatives reduces significantly the information gathering costs if the corporation decides to increase the maturity of the targets. But the decision to focus only on mature ventures also has its downsides: lower competitive value of the innovation (potential to outperform competition), slower response to disruption and weaker bargaining power of the corporation when negotiating equity.

The US Bureau of labor statistics keeps tract of the survival rate of establishment based on cohort. The data have been compiled and are shown below.³⁶



Figure 5 Establishment survival rates, selected cohorts

³⁶ Graph prepared using data from the Bureau of Labor Statistics of the United States, Department of Labour, *Chart 3. Survival rates of establishments, by year started and number of years since starting, 1994 in percent*, last modified on April 28, 2016 and retrieved from https://www.bls.gov/bdm/entrepreneurship/bdm_chart3.htm on March 22, 2018

Restricting targets to a minimum life of 5 years reduces cohorts by approximately 50%. It is remarkable how stable the survival rates are over the years, despite the changes in the global economy that different cohorts had to transition through.

This extremely high number of very heterogeneous companies force corporations to be very selective in their approach. Indeed, many studies (Martin Andersson & Xiao, 2016) show that the acquisition targets represent a small group of firms with defining characteristics, and are very rare in this first 5 year period. Anderson in particular, could extract the following patterns:

- There is an important focus in new-technology based startups. Corporations perceive tech firms as a quick and less risky way of gaining access to new technology (complementing or expanding their own R&D) or solve the problem of technological exhaustion.
- There seems to be a “hierarchy” in market selection in terms of technology profile. High technology-intensive start-ups are acquired (or sold to) multinational enterprises, medium technology-intensive firms are acquired by domestic enterprises, while lower tech ventures remain independent.
- Spin-offs are more likely to be acquired than other types of new firms. Spin-offs have been shown to have higher post-entry performance in terms of both survival and employment growth (M. Andersson & Klepper, 2013; Eriksson & Moritz Kuhn, 2006). This pattern could be explained by the fact that spin-off inherit capabilities and processes from the incumbent that add value to the business but that are difficult to measure (Agarwal et al., 2004; Klepper, 2001).
- Corporate acquisition probabilities are higher for new firms with weaker internal financial resources. This may suggest that corporate capital may be better suited to evaluate value in high risk early stage innovation than other forms of funding like independent venture capital or public offering, resulting in attractive valuations (for the incumbent).

Decision making transaction costs

Value is created by the venture capital activity by successfully allocating funds to good investment ideas, which, in turn, relies on efficient decision-making. A recent paper published by the National Bureau of Economic Research (P. Gompers, Gornall, Kaplan, & Strebulaev, 2016) includes an extensive survey of 885 respondents from 681 venture capital firms. We will use the results of

this paper with caution because it targets specifically independent corporate venture capital and will make remarks when we suspect that the results may not be directly transferable to a CVC setting.

Decision related activities are grouped in eight areas: deal sourcing; investment selection; valuation; deal structure; post-investment value-add; exits; internal organization of firms, and relationships with limited partners. A median firm considers roughly 100 potential opportunities and closes about 4 deals per year. Managing this deal funnel generates an important demand of internal resources. NBER survey provides a breakdown of the deal funnel process, quoted at length below:

[...] [F]or each deal in which a VC firm eventually invests or closes, the firm considers roughly 100 potential opportunities. At each subsequent stage a substantial number of opportunities are eliminated. One in four opportunities lead to meeting the management; one-third of those are reviewed at a partners meeting. Roughly half of those opportunities reviewed at a partners meeting proceed onward to the due diligence stage. Conditional on reaching the due diligence stage, startups are offered a term sheet in about a third of cases. Offering a term sheet does not always result in a closed deal, as other VC firms can offer competing term sheets at the same time. Similarly, legal documentation and representations/warranties may cause deals to fall apart between agreeing to a term sheet and the deal closing. The fact that VC firms on average offer 1.7 term sheets for each deal that they close, a close rate of roughly 60%, suggests that a meaningful number of opportunities that ultimately receive funding are not proprietary.

The decision-making process involves the evaluation of the business-related factors and the management team. Business factors include the business model itself, the product, the market and the industry. Evaluation of the management team includes analyzing industry and entrepreneurial experience, ability, teamwork and passion.

Curiously, the NBER suggest that the VC's ability to add value was mentioned by the respondents in only about half of replies, and only 3% considered it the most important factor. An interesting further research could look at how this perception changes in the case of CVCs firms.

The median firm processing 100 potential opportunities and closing about 4 deals per year required, to manage this deal flow, 4 investing general partners (25th and 75th percentile being 3 and 5).

As mentioned earlier, this study focuses on institutional venture capital. Corporate venture capital has to face, in addition to the challenges inherent in venture capital, additional complexities in decision-making due to the interaction with the internal business unit. This interaction is not only more challenging in terms of financial return modeling (as it is dealing with the combined returns of corporate and startup equity and their interaction), but also more complex from an organizational structure, political and cultural perspective, as we have seen earlier in this thesis. Even when the opportunity is recognized by the open innovation program, there could be many internal conflicts that can lead to increased decision-making costs, like those resulting from cannibalization of current product market share, shifts in the customer base and margin erosion in current sales.

Bargaining transaction costs

A third source of transaction costs are related to bargaining of deals. Following Dahlman's framework (1979), what is being revealed in a bargaining situation is information about willingness to trade on certain conditions, and decision costs are the resources spent in determining whether the terms of the trade are mutually agreeable.

We will analyze separately inside out and outside in transitions, as the information asymmetries are different and require specific analysis.

Outside-in: corporation startup bargaining power

We begin by focusing on the bargaining costs emerging in a corporate-startup funding negotiation. We are interested in evaluating not only the factors that drive the relative bargaining power of corporation and startup in a specific deal but also the information sourcing and processing costs incurred in determining the balance of power. If there is surplus from the alliance (revealed in earlier stages of the decision process), its split will certainly be the result of their relative bargaining power but will be profitable for both parties. Properly designed open innovation programs need to address information flow inefficiencies.

In order to evaluate its bargaining power, both the entrepreneur and the corporation have to discover:

- The benefits and costs to the other party
- Their own costs of not agreeing

To understand the relative power of the two parties, we will rely on a framework developed by Teece (1986) that analyzes the commercialization of innovation, explaining the engagement of innovators with the external environment based on two concepts: appropriability and ownership of specific complementary assets.

- Appropriability refers to the imitability of the innovation. Hard to imitate innovation enables innovators to monopolize the profits from the innovation. A formal way to enhance appropriability is through intellectual property.
- Complementary assets refer to the firm's assets or capabilities (other than IP) required to successfully commercialize specific technology, which include manufacturing capacity, distribution channels, after-sales services, brands and complementary technologies (D. J. Teece, 1986). Generic assets can be contracted for in the market on competitive terms, while specific assets need to be built over time, are often path dependent and idiosyncratic, and therefore difficult to obtain in the market.

In our corporate-startup setting, the innovation is owned by the venture, but its appropriability can be weak or strong depending on the IP rights and the specific characteristics of the technology. Complementary assets will typically be under the control of the corporation, and result in a stronger or weaker bargaining position depending on their relevance to develop the technology and whether they can be sourced from third parties or not (general or specific). Gans and Stern (2003) map the different commercialization strategy environments in four quadrants. We will rely on this framework to present the different bargaining scenarios, adding our own analysis of uncertainty and information discovery costs:

- **Ideas Factory:** Scenarios where appropriability is strong and assets under the control of the corporation are relevant and specific will lead to a low uncertainty, balanced negotiation, with lower bargaining costs. Innovators will typically approach corporations in order to collaborate through partnerships as product market entry is costly or perhaps impossible. Companies will typically move to secure startup collaboration.
- **Greenfield competition:** Scenarios where appropriability is strong but the relevance of assets is low or are generic (can be accessed by the venture), lead to higher uncertainty. The expected competitive dynamic in this scenario is intense competition for technological priority. Understanding how threatening is the development of the

technology for the incumbent corporation and how easily can the startup can raise funds from alternative sources will be key.

In these situations, it is probably the case that the entrepreneur is in a better position to evaluate the parties impact of the deal (better understanding of the technology, public corporate financial reports vs. private startup data), a situation that can lead to higher bargaining costs.

- **Attacker's advantage:** Scenarios where appropriability is weak and controlling assets not relevant result in even higher levels of uncertainty. Innovators are incentivized to profit through fast and stealthy growth strategies. Entrants will initially target niche markets and will make investments, if they have access to capital, to build complementary assets to growth their competing technologies.

Even if detected by the corporation, bargaining costs will be high because of the high level of uncertainty and the unwillingness of either party to disclose information due to the low appropriability options for the technological proposition.

Weak appropriability and strong control of strategic assets by the corporation (**reputation-based ideas trading**) are spaces where innovators are in a weak bargaining position and will typically result in low competitive pressure for the corporation (technological development will often result from internal corporate R&D investment). Innovators will approach corporations that have built a strong reputation of fair treatment. Bargaining costs in this case are, therefore, path dependent.

Box 8 Raizen

Raizen, leveraging on the control of strategic assets to overcome internal R&D weakness³⁷

As one of the most competitive companies in the energy sector, Raizen has grown to be Brazil's main manufacturer of sugarcane ethanol, its third largest fuel distributor and the leader in sugarcane crushing.

³⁷ Based on interviews with Guilherme Dal Lago, Innovation Management and Networks at Raizen and Fabiana Tarabal Oliveira, Innovation at Pulse Hub de Inovação, São Paulo, Brazil, on February 28, 2018. Information about the company taken from www.pulsehub.com.br and <https://www.raizen.com.br> accessed on May 2, 2018.

The third largest Brazilian energy company by revenue and the fifth largest in Brazil, it is a joint-venture formed in 2010 from the merger of the assets of sugar, fuel and ethanol derived from sugar from Cosan and Royal Dutch Shell in Brazil. The company has a market value of approximately US\$ 20 Billion and a revenue of about R\$79.2 billion, US\$ 22.5 billion (2017).

It operates four very tightly related business: sugar, ethanol (produced via fermentation of sugarcane), cogeneration (power generated in the mill and ethanol refineries using excess steam from sugar milling and ethanol distillation, powered by the combustion of sugarcane bagasse) and fuel distribution (fossil fuel fuels and bio-blends with the ethanol). The company has 26 production plants, producing 2 billion liters of ethanol, milling 73 million tons of sugarcane and selling 2.8 TWh per year. In the fuel business, they distribute 25 billion liters of fuel to their extensive network of more than 6,000 service stations. It has currently 30,000 employees

Pulse, Hub de Inovação, founded in 2016 in one of the largest agribusiness hubs in Brazil, Piracicaba, is a Raizen initiative, run in collaboration with SP Ventures³⁸. Following a relatively standard design for corporate incubators, it is a meeting point for startups, universities, investors, executives, mentors and agribusiness companies. It is non-profit and currently not investing equity. Admitted startups participate the hub at no cost. They can remain in Pulse as long as they remain active in the community and contribute to the circulation of knowledge through the ecosystem.

Mr. Guilherme Dal Lago, Innovation Management and Networks at Raizen and Mrs. Fabiana Tarabal, Innovation at Pulse Hub de Inovação, explained to us that their main objective was to externalize R&D, that was internally weak. Operating in oil, gas and agricultural business sectors, and having traditionally focused their efforts in operational excellence through upstream continuous improvement programs, they haven't developed a culture of innovation. The main challenge they faced when defining the open innovation strategy was to create a program able to handle ventures with long development cycles and very different maturities, as agricultural trials are tied with the natural yearly cycles of crop planting and harvest seasons.

³⁸ SP ventures is the investment manager of the São Paulo Innovation Fund (FIP). FIP is R\$105 million fund (US\$29.7M, 2018) with Desenvolve SP, FINEP, FAPESP, Sebre-SP, CAF and Jive Investments as limited partners. They target agtech investments, mostly in the Brazilian innovation hub centered in the city of Piracicaba.

They opted for a non-equity flexible corporate incubation model. Mr. Dal Lago and Mrs. Fabiana commented that they had, in their first 1.5 years, analyzed 450 applications, leading to 60 admissions and 13 pitches. In early 2018 they were running 11 proofs of concepts in 10 different farms, that will require 2 to 3 years to mature.

Raizen's strategic strength comes from its vertical integration: agricultural production (sugar cane), processing (sugar milling, ethanol fermentation), distribution and sales (fuel and biofuel wholesale and retail). It owns or controls important asset resources: cultivated land (860,000 hectares), sugar mills with ethanol distillation units and cogeneration (26 plants), fuel terminals (68 terminals able to distribute 5 billion liters of fuel per month) and points of sales (over 6,000 service stations with the Shell brand).

This vertical control results in competitive advantages in both competences and products. For startups, long testing cycles and weak vertical position leads to very costly or even impossible independent entry. Though some of the startups (mostly in the digital and biotech areas) can potentially secure their IP while working in the incubation program, Raizen must build a reputation of fair player to attract external innovation. In this scenario, the corporation can expect reinforcement of their current competences from the startup innovation, even in the case of technological change.

Inside-out: corporation-employee bargaining power

Bargaining is not only relevant in outside-in transactions, but also when establishing programs to develop internal corporate entrepreneurship. Corporations face permanent mobility of key employees that are exposed to high value R&D. A particular case of employee mobility is the creation by the employee of a start-up. The threat of the establishment of a start-up and the relative bargaining power between the corporation and their key employees can have important effects on the innovation strategy, especially in the way the corporation allocates funds to internal R&D and open innovation.

The two relevant factors are: (i) the value of the knowledge stock generated by the R&D activities, based on their potential to produce new products and services and, (ii) the strength of the asymmetry of information (whether employee and corporation share essentially common

knowledge for the valuation that will then be bargained as remuneration premium). Ample literature supports the existence of relevant information asymmetry between general management and the employees in charge of research and development (Cheng et al., 2014; Chow et al., 1988; Shields & Young, 1993), although the magnitude of the asymmetry depends on the industry and the internal processes of each corporation. In particular, Cheng, Chen and Shih (2014) identify specific sources of asymmetry. R&D employees, within their areas of responsibility:

- Have better information regarding the activities
- Have more familiarity with the input-output relations
- Are better able to assess the performance potential of their departments
- Are technically more competent
- Are able to assess better the impact of external factors
- Have better understanding of what can be achieved

High R&D value and strong information asymmetry in assessing it leads to important bargaining costs.

Additionally, as mentioned earlier, parties need to evaluate the costs of a failed agreement. More specifically, the corporation has to assess the loss of R&D that would result if the employee leaves the corporation to fund a start-up, as it is possible that only a fraction of the knowledge generated through R&D remains with the corporation (Colombo & Dawid, 2016). Poor process design and weak internal networks can be the source of information loss. But loss may happen even when appropriate corporate processes have been implemented if innovation relies heavily on tacit knowledge, the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it (Polanyi, 1966), as opposed to formal, codified or explicit knowledge.

Actually, in the event of the loss of a key employee, the firm suffers a double loss: because of its ability to fully appropriate the returns from the R&D investments and because of the emergence of a new competitor. High value of the appropriated R&D outside the firm both increases the incentive of the employee to leave and increases the strength of the competition. As in the case of outside-in technology transfer, the value of the employee's option depends, ultimately, on the appropriability and the control by the corporation of complementary assets. In particular, as

discussed above, specific complementary assets, difficult for the employee to source from the market, will result in lower incentives for the employee to leave.

Policing and monitoring transaction costs

Outside-in policing and monitoring

Important agency costs and the inherent risk profile of new ventures lead to significant time investment of fund managers in supporting portfolio companies, in an effort to support growth and monitor risk. In VC firms analyzed by Gompers *et al.* (2016) post-investment value adding by fund managers was seen as the second most relevant factor contributing to returns (seen as important by 87% of the VC funds, and the most important factor by a quarter of them). In the same research, VCs, when questioned about post-investment time allocation, reported an average of 18 hours per week working with the portfolio companies vs. 22 hours per week spent networking and sourcing deals and, out of a total reported work week of 55 hours. Cumming and Johan (2014) report slightly lower figures, with an average of 15 hours per week per investment, with 2.1 startups per venture capital fund manager.

The reported post-investment time allocation involves advice activities (most notably financial, exit strategy, and networking) besides policing and control. Nevertheless, Cumming and Johan's analysis mentioned earlier found strong correlation between capital fund manager's effort and risk, board participation and veto and control rights, suggesting an important component of policing and monitoring in these activities.

Kaplan and Strömberg (2001) identify three different types of risk measures considered by VC's:

- Internal risk: a consequence of asymmetric information between the parties
- External risk: environment-related uncertainty
- Project complexity: arising from the difficulty and complexity of the project realization

VC's have to balance the tradeoff between assuming the risk and investing time in monitoring activities. This is handled in many ways.

- Early improvement of the management team. A study by Kaplan and Strömberg (2001) confirms that:

[...] VC's play a large role in shaping and recruiting the senior management team. In 14% of investments, the VC plays a role in shaping the management team before investing and in 50% of the investments, the VC explicitly expected to play a role after investment. Sometimes this involves replacing a founding manager, but more often it is an issue of strengthening and broadening the existing management team by hiring experienced executives.

- Forms of financing are designed to mitigate agency costs. Participating preferred stock or convertible debt protect funds on the downside but still incentivizes the entrepreneur in higher valuations. Thresholds and timing of rights are adjusted by the fund managers to balance risk and entrepreneurial effort.
- Typically, cash flows and control rights are made contingent to observable outcomes, explicitly recorded in the financial contracts.

Policing and monitoring strategies of venture funds are well documented in the literature (D. J. Cumming & Johan, 2014; P. Gompers et al., 2016; Kaplan & Strömberg, 2001; Lerner, 1995; Sahlman, 1990) and are directly applicable to corporate venturing settings, leading to financial contracts that inherit most of the provisions of typical of independent venture capital funds.

Arguably, CVC has access to the internal talent pool if the management or the board of the ventures needs reinforcement. Unfortunately, our interviews have showed that top management of corporations are neither interested or well suited to support small, highly volatile ventures with limited resources (see for example Box 7 Mizuho Bank).

Inside-out policy and monitoring

The extraction of people and processes from the organization to create independent companies implies the substitution of part of an internal organization structure with a portfolio of businesses amalgamated through a set of formal contracts. Actually, what is distinctive in firms is that they are domains for organizing activity, precisely, in a non-market-like fashion (D. Teece & Pisano, 2004): internal organization is a domain of unleveraged or low-powered incentives.

The transition of resources to the internally nascent startups implies:

- Change of reward mechanisms, from a system determined at group or organization level (encouraging team behaviour) to high-powered individual incentives.

- From an environment of joint effort to system where individual contributions are highly visible and measurable.

Despite the internal origination or the resources, the impact of this change should not be underestimated, and inside-out programs must implement, in parallel with the market incentives that spur the entrepreneurial drive, monitoring mechanisms similar to external ventures

Transaction cost drivers

We have discussed in the previous sections the theoretical foundation of transaction costs, from the view point of information gathering, decision making, bargaining and police and monitoring activities. We will summarize now key transaction cost drivers from the perspective of the corporation, the startup and the business environment.

Size

Size is a key driver in transaction costs in any economic interaction, due to the setup costs involved in the exchange. In the context of venture capital funding, setup costs are equally relevant. These costs are not proportional to the size of the startup or the amount of equity targeted, but mostly fixed per transaction, like legal fees and due diligence. The nature of these costs introduces strong non-linearities when the size of the units decreases, particularly when the corporation targets very early stage initiatives.

Maturity

Earlier stage companies not only are smaller but also require longer incubation times. This leads to extended time related costs like those associated with monitoring. These costs are non-linear: although there may be a linear time-cost relationship for a single surviving firm, the survival rate of early stage startups is significantly lower (the efficiency is lower), requiring increasingly higher number of targets per surviving firm at the end of the pipeline. Additionally, due to the lower maturity of the venture and the higher variance in terms of results, per firm information related costs may actually increase. These aspects result in a strongly non-linear reciprocal relationship between size, maturity and transaction costs.

Complexity of the business proposition of the target

A single product or a service related firm will involve lower transaction costs than a venture associated with complex business proposition. It is obviously easier for a biopharma company to

acquire a small team working on a single molecule than to target a commercial-stage drug development company, thereby assimilating significant amount of assets, people and processes that create the pipeline producing portfolio of development-stage drugs. This is not only a question of size and maturity, but also the complexity: product portfolio, geographical reach, variety of clients. Internal complexity also leads to more possible friction points between the target firm and the corporation.

Technological proximity

It is tempting to build on the corporate strength and target businesses in very close technological proximity or that interact efficiently with complementary assets already under the control of the corporation. Like in the case of business complexity, there is a tradeoff between the innovation potential and costs, with close technological proximity leading to low risk but low upside potential.

Strategic assets and appropriability

Corporation's control of complementary assets and idea appropriability determines the dynamics of the competitive space and the balance of power when bargaining the deal. We have already discussed different settings. One extreme occurs in scenarios where appropriability is strong and assets under the control of the corporation are relevant and specific. They will lead to less uncertainty, a balanced negotiation, and lower bargaining costs.

The other extreme are scenarios where appropriability is weak and controlling assets not relevant resulting in high levels of uncertainty. Innovators are incentivized to profit through fast and stealthy growth strategies. As discussed in earlier sections, even if detected by the corporation, bargaining costs will be high because of the high level of uncertainty and the unwillingness of either party to disclose information due to low appropriability.

Agency and transaction cost analysis: conclusions

Based on the discussion above, we can derive the following key management insights:

- Corporate managers should pursue practices that mitigate agency costs associated with the asymmetry of information between parties. In the cases of outside-in transitions, agency costs with the entrepreneur as agent can result in moral hazard, adverse selection risk shifting and asset stripping risks. In inside-out transitions, the asymmetry in

information between general management and R&D teams can lead to significant agency costs in the form of retention efforts, loss of knowledge and increased competition. Managing asymmetry of information requires understanding the trade-off between the costs and benefits of using the agent and the costs of the techniques to mitigate these risks.

- In terms of transaction costs, we have discussed the strong non-linearities between information costs and the size and maturity of the ventures targeted by the program. Obviously, there are upsides in investing in early stage startups. The earlier the maturity and the broader the scope of technologies considered by the corporation, the lower the number of opportunities lost and the earlier the response to a disruptive event. Despite the high failure rate, frequent interactions lead to greater and richer information flows. Early interaction can also lead to lower integration costs. During the earlier stages of the ventures, startups take decisions on business processes, fixed asset suppliers, software platforms, data structures, etc., that can later be expensive to merge with the corporation. Early coordination can reduce these non-value-adding activities.
- We have highlighted the impact of the targets' business complexity on transaction costs. Again, there is a tradeoff between these costs and the innovation potential. A startup offering a single, low complexity product or service generates small transaction costs but the corporation should consider if this transaction can be managed with even lower cost strategies like non-equity alliances or direct purchase of the product or service. On the contrary, open innovation is particularly valuable with high business complexity propositions that the corporation may not be able to develop internally, especially when it fits poorly into the R&D pipeline.
- Complementary assets and IP appropriability frame the dynamics of the interaction between startup and corporation. It is therefore key for the management of corporations to have a deep understanding of their control over complementary assets, in particular how easily it is for a new entrant (either a start-up formed by external entrepreneurs or by departing employees) to acquire them independently. Control over assets which are expensive to acquire, time-consuming to develop, path dependent and idiosyncratic (not easily redeployed for other uses) will have important consequences in the dynamics of the competitive space and the relative bargaining power of startup and corporation. Appropriability of the technology, explicit through IP protection or as a result of the

nature of the product or service is also a key factor in understanding startup strategies and competitive strength.

Innovation goals

We have already described how many activities, once developed exclusively within corporations, are now fields of collaboration. R&D, the main source of core competences in so many industries, has resisted change. But as processes and product development became more dynamic and global, corporations have been forced to look beyond its labs and innovate around the innovation process itself and incorporate an increasingly complex network of interfirm collaboration models.

For corporations, a key success factor in open innovation programs is clearly defining its strategic intent. Recognizing its importance, the strategic intent of corporate incubators, accelerators, centers of excellence and corporate venture capital has been an area of recent intensive research (Bauer et al., 2016; Kanbach & Stubner, 2016; Kohler, 2016). We will use here the framework from Kohler based on a high number of interviews with managers of startup accelerators and teams participating in the accelerators (Kohler, 2016) to present the current expectations of the agents. We will then consider their relevance in the context of inside-out and outside-in equity transactions.

Strategic intent of corporations

We summarize below the strategic intents reported by corporations involved in open innovation programs³⁹

Strategic intent	Objectives
Close innovation gap	Search for ideas that fall outside of the scope of existing business units.
Expand new markets	Capabilities and agility to compete in newly emerging sectors
Platform growth	Accelerate the growth of one or both sides of a platform owned by the corporation, for example creating a startup layer developing new products based on the platform
Transform corporate culture	Public, long term commitment to innovation and, specially, creating inside-out options for innovative ideas developed by employees can inspire innovative thinking and new attitudes towards risk taking and failure
Attract and retain talent	Bridges between corporation and startups can help corporations develop entrepreneurial talent, both internally and externally.

Table 14 Strategic Intent Corporations

³⁹ Modified from Kohler (2016, p. 351)

Close innovation gap

Corporate's top management, especially in public companies, are under continuous pressure to produce short term results. As Legrand and Weiss explain (2011):

A decade's worth of executive surveys on innovation highlight that a significant gap exists between what leaders say they want and what their organization delivers. Over 80 percent of leaders surveyed⁴⁰ believe innovation is important for their future success, but less than 30 percent are satisfied with their current level of innovation. This is what we call the "innovation gap."

Corporates invest in open innovation programs to expand their innovation reach, avoiding the pressure of short term results in favor of longer term upside and protection against disruptive events (see Box 7 Mizuho Bank and Box 6 Calidad Pascual).

When designing and selecting ventures, corporations can opt between two types of innovation reach strategies: exploration and exploitation (March, 1991). With exploration alliances, incumbents seek to learn new technologies. Exploitation alliances' intent is to level existing complementary assets.

Rothaermel, when studying 889 strategic alliances in the pharmaceutical industry in 1991 found a split of 317 exploration and 589 exploitation alliances, with only 17 following a mixed strategy (Rothaermel, 2001). The small number of mixed intents supports Mach's view that these two activities are distinct (March, 1991). The split also suggests that both strategies, one rendering short term, low yield, low risk returns and the other longer term, higher yield, high risk return, are required for the sustainability of the business, similar to the balance required in designing the portfolio of an internal research and development unit.

Expand new markets

Besides product innovation reach, a balanced strategy may require expanding the corporation into new markets. This extension to new markets involves:

- Extension of existing products into new geographical areas
- New target audiences

⁴⁰ Globe & Mail and the Schulich Executive Education Centre, survey conducted in 2007

- New channels to offer products in new ways to existing or new clients

When developing new markets, corporations usually faced the decision of growing organically or inorganically. Open innovation strategies open the possibility a new a hybrid approach, with initial alliances that can later lead to equity participation and eventually acquisition.

Combining with the innovation reach described above, a map of projects combining innovation reach and market reach can be useful to visualize the balance.

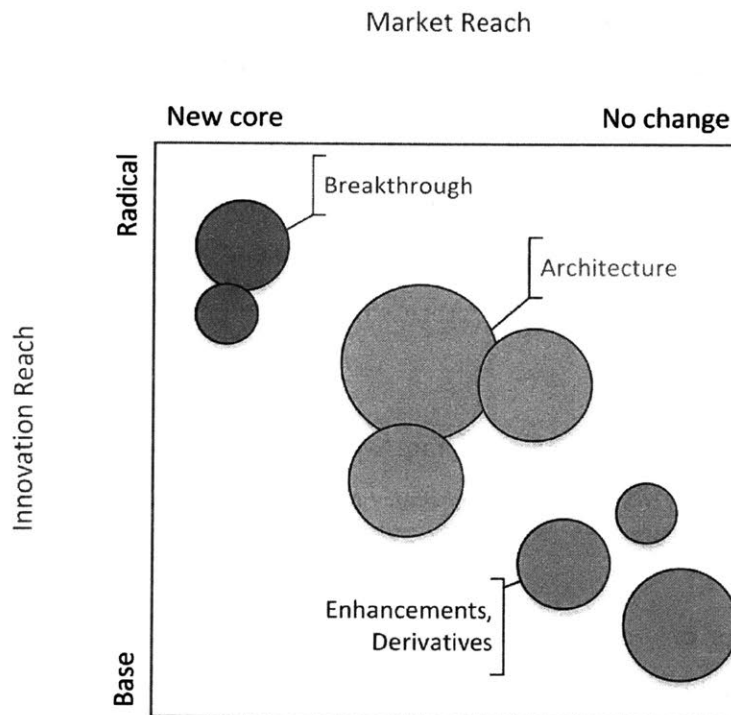


Figure 6 Portfolio of target companies

Projects in the top left quadrant will typically be more exploratory, whereas projects on the bottom right will have an exploitation focus. In theory, due to the high setup cost of open innovation strategies, the number of enhancements and derivatives should be limited. These projects will typically be handled within the business units as there is significant overlap of processes and markets. As we move towards more radical projects with stretched market reach, the trade-off of setup costs vs. internal friction will favor open innovation strategies.

Platform growth

Corporations can use open innovation strategies to stimulate startup activity around a product platform, seeding its adoption with early adopters (Kohler, 2016). Examples of these strategies

are SAP IoT Startup Accelerator⁴¹, or Microsoft Cloud Accelerator Program⁴². These programs are marketing strategies intended to develop an ecosystem of adopters and not an innovation strategy. We will therefore not explore this path.

Transform corporate culture

We have already discussed how entrepreneurs learn to manage very highly unpredictable business environment, with light structures and opportunistic behaviour. Although the implementation is risky, side effects are small and intrinsic motivation high, so it is easy to develop “fail fast” culture based on transparency, early recognition of failure and “pivoting”. Trials, simulations, repeated iterations are clear, identifiable elements in creative process. Employees are more willing to speak up and make suggestions without repercussions.

Corporate management seeks to bring some of this entrepreneurial culture into the corporation. The rigidity inside corporations is the result of higher stakes and stronger brand value, but experimentation is still a core element in the innovative process that has to be nurtured in the teams that are leading products and markets.

Corporate open innovation programs, particularly a program with inside-out and outside-in transitions combined in the same space, create a controlled environment for cultural contagion.

Attract and retain talent

Open programs can be effective not only attracting external entrepreneurial talent, but also retaining entrepreneurial talent within the organization (Kohler, 2016). We have already discussed the costs related to asymmetry of information between management and R&D employees, the latter being able to better understand the potential of technology. Inaction can lead to important agency costs due to moral hazard and adverse selection.

⁴¹ <https://www.sap.com/corporate/en/company/innovation/iot-startup.html>

⁴² <https://enterprise.microsoft.com/en-us/microsoft-cloud-accelerator-program/>

Itaú Unibanco, a broad open innovation strategy⁴³

Itaú Unibanco is a publicly-held bank operating in Brazil and abroad. With total assets of US\$ 452.7 billion (2017) and a net income of US\$ 7.5 billion (2017) it is only second to government-controlled Banco do Brasil in Latin America.

Its portfolio covers all types of banking activities: commercial, investment, real estate loan, finance and investment credit, and lease, including foreign exchange operations and other complementary activities, with emphasis on insurance, private pension plans, capitalization, securities brokerage and administration of credit cards, consortia, investment funds and managed portfolios. As of 2017, the bank has over 46,965 ATMs and 4,910 branches and service centers.

They are present in 18 countries other than Brazil, covering commercial banking and institutional client operations, and investment, wholesale and private banking activities. Eight of these countries are in Latin America, their priority in terms of international expansion, but their operations also comprise North America, Central America, Europe, Asia and Middle East.

Itaú Unibanco employed approximately 99,300 people at the end of 2017, including over 13,800 employees in foreign units.

Cubo Itaú – the largest entrepreneurship hub in Latin America – was founded in 2015 by Itaú Unibanco in partnership with Redpoint e.ventures⁴⁴. It is a non-for-profit initiative with the broad mandate of fostering a digital entrepreneurial ecosystem in Brazil. Following a standard incubation model, it offers coworking space to selected startups connecting entrepreneurs, investors, mentors, corporations, universities and students. It also promotes business events and other activities open to the broader community. They don't invest in the equity of startups.

The scale of the incubator is huge. They have currently more than 250 resident companies, employing roughly 2,000 people, and are now building new office space that will quadruple

⁴³ Based on interviews with Enrique Fragata, Superintendente at Itaú Unibanco, São Paulo, Brazil, on April 13, 2018. Information about the company taken from <https://www.itaubr.com.br/investor-relations/itaunibanco/about>, accessed on May 1, 2018.

⁴⁴ Redpoint e.ventures is an entrepreneurial capital fund with the mission to support entrepreneurs in the Brazilian digital market in the creation of rapid-growth companies.

capacity. They aim to eventually promote the employment of +12,000 people in the near future. They are also developing a virtual incubator platform to be able to attract ventures outside Brazil, expecting to scale x5 the physical Cubo. We were informed that the ecosystem is currently posting more than 2,000 job opportunities. They have engaged with 30 partners, including leading companies like Accenture, Cisco and Coca-Cola.

During our interview with Enrique Fragata, Superintendente at Itaú Unibanco and responsible for Cubo, we explored the strategic intents of the bank when funding the incubator, as our research based on public information showed that they were targeting a very wide range of industries, clearly outside the financial sector. Indeed, Mr. Fragata confirmed that their broad intake filter is the requirement to solve “real world problems” and to have the possibility to scale. He listed for us the list of objectives:

- **Attraction of talent:** Itaú uses Cubo as a platform to enhance its attractiveness as employer. MBA trainees are sent to the incubator to give them exposure to the program and the startups. According to Mr. Fragata, this interaction has proven to be an effective tool for retention.
- **Brand image:** Itaú uses Cubo to project an image of openness and innovation beyond traditional banking. According to the company, it draws important media exposure.
- **Improvement of internal processes:** Internal developments in Itaú pass through long internal vetting procedures that can take up to 3 years. Cubo is used by the bank to test and improve externally, using quick iterations to speed up development, reducing cycles down to 6 months.
- **Transform company culture:** During the last 2.5 years, almost 6,000 employees (~20% of the workforce in São Paulo) have interacted with the incubator through its “Cubo Days” program. It is a learning exercise on agility and productivity.
- **Understand the competitive space:** The bank uses Cubo also to monitor the FinTech space. Though the company is not yet investing in the equity of the startup (according to Mr. Fragata, due to the very high ROI of their core business), the management of the bank participates in the pitching events, resulting in valuable information flows.

Strategic intent of startups

We present below the strategic intents startups engaging with corporation declare when interviewed⁴⁵

Strategic intent	Objectives
Access to resources	Access to complementary assets in control of the corporation
Increase credibility	Increase of visibility and credibility, helping product development
Access to markets	Sponsorship by the corporation helps the startup speed expansion to new markets (geographical expansion, new clients, new channels)
Get funding	Credibility improves startup's access to capital

Table 15 Strategic Intent Startups

Access to resources

We have discussed earlier the importance of complementary assets in defining competitive dynamics (P. Gompers & Lerner, 1998; Lin & Wang, 2015; Rothaermel, 2001; D. J. Teece, 1986). These assets or capabilities (other than IP) include manufacturing capacity, distribution channels, after-sales services, brands and complementary technologies, required to successfully commercialize specific technology.

Complementary assets will typically be under the control of the corporation. If these assets are specific, they usually require time and are often path dependent and idiosyncratic. Startups will therefore have difficulties to build competing assets in parallel to the development of the technology (Gans & Stern, 2003). In these situations, startups can compete by developing new technologies and later seeking alliances with corporations, particularly if the startup has developed excludable technology (intellectual property rights can be enforced).

Increase credibility

CVC can create instant credibility for the startup and potentially serve as a strong industry-related endorsement of the company that can then be leveraged to attract talent and customers (Lishego, 2016).

⁴⁵ Modified from Kohler (2016, p. 351)

Access to markets

Geographic or channel reach can help the startup access new markets much faster. On the other hand, the participation of the corporation in the equity can be a turnoff to potential customers or business partners who view themselves as competitors to the corporate (Lishego, 2016). The entrepreneur must therefore balance the tradeoff.

Get funding

Startups can access funds through independent venture capital, so there needs to be other strategic motivations to address corporate funding. Participation in a corporate open innovation program can be a double-edged sword. Endorsement by the corporation can spur the interest of other independent VC's in future rounds but, at the same time, the refusal of the corporation to participate in later stage funding can send a very adverse signal to other capital market participants.

Additionally, startups should study carefully the how the program is funded by the corporation. For example, tight control in the allocation of capital to the corporate venture capital fund (yearly renewal, ad-hoc individual project approval) can limit the participation of the CVC in future financing rounds. Corporate funds sometimes come with increased control rights like Right of First Refusal, that can limit the upside.

Box 10 Veo Robotics

Veo Robotics, credibility and certification in industrial safety⁴⁶

A cobot (from collaborative robot) is a robot intended to physically interact with humans in a shared workspace. This is in contrast with other robots, designed to operate autonomously or with limited guidance (National Science Foundation, 2017). If cobots design could be improved to make them affordable, highly adaptable, and easy to configure, small and medium-sized enterprises (SMEs) would be eager to adopt, expanding enormously its potential market. This technology is untroubledly a required step towards mass markets (domestic applications). Some analysts forecast massive growth in the near future (Tobe, 2015). In our session with Mr.

⁴⁶ Based on presentation and subsequent Q&A session with Patrick Sobalvarro Co-founder, CEO at Veo Robotics, with the Sloan Fellows 2018 group (innovation week), in Boston, MA, on March 20, 2018. Information about the company taken from <https://www.veobot.com/about.html>, accessed on May 1, 2018.

Patrick Sobalvarro Co-founder, CEO at Veo Robotics, he highlighted the high potential of combining human dexterity with the precision, repeatability and strength of an industrial robot. He expects a compounded annual growth rate (CAGR) of 67% in collaborative robotics vs 13% CAGR of industrial robots. Similarly, TechNavio, a British market research firm, forecasts the global collaborative robots market to grow at CAGR of ~51% to 2019 (Tobe, 2015).

As mentioned, cobots are designed to work alongside human workers, assisting them with a variety of tasks. This involves complying with very strict safety standards. The waist, elbow, hand and wrist of an industrial robot can move at speeds of 480° per second and its shoulder at 300° per second. Fatal accidents happen: researchers from the US National Institute for Occupational Safety and Health (NIOSH) identified 61 robot-related deaths between 1992 and 2015⁴⁷ (NIOSH Division of Safety Research, 2017).

In order to provide a safe environment for collaborative work, systems using computer vision and analytics need to capture images of the work space and generate a semantic interpretation of the current and future position of the robot, the part being moved and the people. Veo Robotics uses a set of depth-sensing cameras that provide complete visual coverage of the work space and software to interpret and take decisions on safety. The robot operates based on its normal program, but now knows the exact location and size of everything (robot, objects and people) in its field of view. Sitting on top of the robot's controller, Veo's software will slow or stop movement of the cobot if the movement of the robot or the part generates a risk for the people in the environment.

Veo Robotics got his initial seed funding from Next47, the investment arm for the German industrial manufacturing giant, Siemens. We asked Mr. Sobalvarro about the rationale behind the decision of using corporate funds. He explained that he could have raised funds from independent venture capital, but that he was aware that a key success factor for the venture was obtaining the required safety certifications. Both in Europe and in the US, the main responsibility for product safety falls on producers. Europe, for example, has adopted Machinery Directive EN safety standards for robots (HRC*) based or adapted on ISO standards (EN ISO 10218, EN ISO 13849-1:2008, etc). According to Mr. Sobalvarro, Siemens credibility and

⁴⁷ Unpublished analyses by NIOSH Division of Safety Research. Through a Memorandum of Understanding with BLS, NIOSH receives CFOI research files with restricted access requirements. Research for this document was conducted by NIOSH using these restricted access files.

know-how navigating the certification process with testing, inspection and certification service providers and authorities was going to shorten significantly time-to-market.

The company is hoping to put into production its first cobot solution soon. Just a few months before our meeting, Veo Robotics had reported raising an additional US\$12 million funding round from Lux Capital and GV (“Veo Robotics raises \$12 million for its vision of a harmonious human-robot workplace | TechCrunch,” 2017).

Premises

This thesis proposes a specific open innovation program that relies on a set of premises, supported by the theoretical and field research presented in earlier sections. We summarize below our main statements:

- **An integral strategy combining inside-out and outside-in transitions lowers costs and enhances the efficiency of the program.** The resources required to accelerate or incubate an internal and an external entrepreneurial venture are identical and a combined program results in economies of scale. Additionally, the interaction of internally and externally sourced entrepreneurs can lead to valuable positive cultural interaction.
- **A sequential, staged design opens the possibility to configure a flexible, modular program with multiple, specifically designed components (accelerator, innovation center, incubator and CVC) enabling the management of a wide range of deal flows.** This flexibility is key as optimal program size and startup maturity depth is context dependent. Multiple environmental, corporation and startup specific characteristics determine the optimal deal flow and, therefore, optimization requires experimentation.
- **Staging the transition through sequential program components also helps to reduce information asymmetries and leads to lower agency costs.** A sequential pipeline design reduces moral hazard risks through frequent information transfer between the entrepreneur, the corporate venture program managers and the corporation. This information sharing happens in a non-coerced, mutual, trust-building way, a key element of the open innovation program success.
- **High technology corporations, with ample opportunities of market and geographical expansion should give priority to inside-out innovation programs.** In these companies, information asymmetry, costs due to loss of talent and additional competition from ventures launched by former employees is maximal. It is therefore essential for leading technological corporations to create avenues to capture at least part of this value, that will be developed as an entrepreneurial venture anyway. Firms holding leading technologies with low appropriability, relying on tacit knowledge and with important growth opportunities, should develop stronger inside-out programs.
- **Established firms in mature markets, relying on general (non-specific) complementary assets or working in sectors where the appropriability of the ideas is low, should**

prioritize outside-in innovation programs. In general, corporations need to develop early response mechanisms to discontinuous innovation events. Except when the innovation appropriability is high and the corporation controls specific complementary assets, corporations should not expect a proactive approach by startups and must design programs to manage the engagement.

- **The dynamism of today's business environment, its increased complexity and the high internal efficiency of large multinationals justify early engagement with both the internal and the external entrepreneurial initiatives.** There is a fundamental opportunity cost in delaying startup engagement. A decision to target only mature ventures leads to less capacity to capture innovative ideas, delays the corporation's response to disruptive events and increases costs of integration, thereby reducing the efficiency of the innovation channel. Consequently, successful programs need to engage with a wide range of venture maturities, which is another argument in favor of a staged, modular design.
- **Corporates should deploy the program sequentially, starting with the early stage (acceleration, innovation center) components.** Late stage interaction with startups, particularly those involving equity, are very resource consuming for the corporations, limiting options rapidly. In order to maintain maximum optionality, corporations should focus, during the first years of the program, on the early stage startup interaction, delaying corporate venture capital programs until the pipeline is already delivering ventures well aligned with corporate strategy and of value for the business units.

We proceed to develop further these premises, as they will serve as foundation for the design presented in the final section of the thesis.

Efficiency gains from integral strategy

As discussed above, research and business communities are gradually refining open innovation strategies, with targeted programs for matching particular industries and intents. Nevertheless, we believe there are currently **no research has fully explored the benefits of an integral strategy combining efficiently outside-in and inside-out open innovation processes in the same program.** **We believe that the combination of these two flows is a key element for the program's success.** The efficiency gains result from the symmetry in the transitions, enabling efficient use of teams and business processes:

- A well set up corporate venture capital team is efficient both sourcing and exiting startups. Whether the venture was sourced with the ultimate goal of integrating it as a business unit or for further exit is not relevant in terms of skills and processes. Similarly, exiting a startup involves the same business processes irrespectively of whether the company had been initially acquired from the startup ecosystem or was a nurtured internal entrepreneurial initiative. Complexity, for this unit, comes from the external startup environment, and CVC skills, business processes and network reach are specifically designed to manage this end.
- In a similar manner, an internal program dealing with the transition of incubatees and the corporation (both inside-out and outside-in) requires a team that has deep understanding of the business units and the startup in the incubation stage portfolio. Complexity for the internal program is generated by the corporate environment. A team experienced with startup nurturing and strong internal network ties with the business units would be ideally suited to detect and spin-out internally generated ventures and, simultaneously, integrate mature incubatees into the corporation.

We will propose a model that leverages on the specialization and the economies of scale that result from this combined operation.

Deal flow management requires a flexible design

We have already argued the need of corporations to constantly monitor the environment and consider alliances to enhance its position in the market. This is especially relevant in times of technological discontinuities, when incumbent's technological value-chain are depreciated by new technologies, generally pioneered by new entrants (Tushman & Anderson, 1986).

Interfirm cooperation results in mutual access to assets and information, driving intensive learning and, consequently, performance. However, the higher the number of alliances a corporate explores and executes, the higher the probability that management will be less effective in managing those alliances due to bounded rationality (Simon, 1961). This combination of increased technological development capabilities and increased information gathering costs leads to a curvilinear relationship between size and returns, a trade-off that the corporation has to consider when dimensioning the program. The optimum is context dependent, but the fact that this optimum exists has been established by research. Concretely Rothaermel studied the

effect of the number of strategic alliances with providers of new technology and incumbent's new product development in the context of the pharmaceutical industry, and, in a second stage, the relationship between new product development and performance of the firm (Rothaermel, 2001). This study was made in the context of a technological discontinuity: drug development based on chemical synthesis developed by traditional pharmaceutical industries had been rendered obsolete by new biotech from new entrants. The quantitative analysis controlled for multiple factors like firm size, age of the alliances, type (equity/non-equity), economies of scope and other institutional differences. The conclusions were clear:

The relationship between an incumbent's strategic alliances with providers of the new technology and the incumbent's new product development [associated with its performance] is curvilinear, i.e., the relationship exhibits diminishing marginal returns and, past some point, diminishing total returns.

Multiple environmental, corporation and startup specific characteristics will determine the optimal deal flow. We will discuss this in later sections. But we conclude from our research that programs have to be very flexible to allow experimentation. A modular design, with components able to handle a wide range of deal flows, is an essential feature.

Sequential, staged interaction reduces agency costs

It is currently standard practice in venture capital to stage *financing* to reduce agency costs. Staging *organizationally* the flow through sequential program components, each with its own gated transitions equally reduces information asymmetries and limits agency costs. As opposed to the pure financial approach, a strategy that combines staged financing and staged organizational design can lead to increased information sharing in a non-coerced, mutual, trust-building way.

The gates between the different modules defines the deal flow "funnel" and is an essential part of the design, particularly the entry point for the early stage startups, since this will define the scope of innovation space targeted and its necessary coherence with corporate strategy. We have seen successful implementations of corporate accelerator programs that issue briefs for the startups to target. These briefs, generated in coordination with the business units, describe challenges but are, as much as possible, technology/solution agnostic. Inhouse participation preparing the briefs ensures not only coherence but also program buy-in from middle and senior management.

Defining the technological or market stretch of these briefs is complex: there is a tension between the risk and the reward potential of high and low innovative projects. Companies can map ventures in the market-innovation reach space, emulating R&D portfolio management practices, to visualize the balance. Projects handled in open innovation programs will fundamentally be exploratory in nature, involving radical innovation and ambitious market reach developing new cores, but there can still be differences that the company must understand and manage. For example, early implementations of open innovation programs may need to sacrifice breakthrough projects in favor of shorter return ventures, in order to gain internal legitimacy.

Inside-out priority in high tech-high growth corporations

High tech firms, with ample opportunities of expansion have in common:

- High information asymmetry between R&D employees and management. These employees are able to better understand the technologies in the portfolio of the company and evaluate its potential.
- The market value of the technology is higher, with untapped opportunities in terms of new customer segments and geographies.
- The emergence of the former employee as new competitor can be particularly damaging in growth stages before “lock-in”, with growth trajectories very uncertain and path dependent.

These characteristics make inside-out programs particularly valuable. A well-designed program enables the corporation to capture at least part of the value, channeling the internal entrepreneurial drive corporate accelerators, innovation centers or incubators. This channel is particularly relevant when the appropriability of the technology is low, as employees have higher incentives. Another relevant factor is the reliance of the technology on tacit knowledge (complex social skills, ascetic sense, physical coordination), as this information difficult to encode and will erode rapidly.

We have discovered that many companies neglect or are completely unaware of the potential of inside-out innovation programs, despite the huge value creating potential.

Outside-in priority in mature consolidated corporations

Outside-in innovation programs have the highest potential for established firms in mature markets, relying on general (non-specific) complementary assets **OR** working with intellectual property with low appropriability.

We have explored the different corporate-startup competitive spaces using Gans and Stern's framework (2003). Except when the innovation appropriability is high **AND** the corporation controls specific complementary assets, the company should not, in general, expect proactivity from the startups, that may explore other more attractive strategies. It will therefore require varying but notable degrees of effort to gather information, select and engage new ventures. Particularly when appropriability is low, alliances will only be possible if the corporation has built for itself a reputation of fairness. This earned trustworthiness can result in a very valuable and difficult to replicate competitive advantage, due to its path-dependency. We believe there is significant value creation potential in these cases for first movers.

Staged design leads to capacity to deal with higher complexity

In the context of innovation, current trends of increased business complexity requirements to create value and high internal efficiency in corporations leads to a much more challenging environment for innovation, increasing the difficulty to identify new ideas and to profit from them in corporations:

- **High internal efficiency in corporations:** increased scale of production and operations, extensive use of advanced analytics and automatization are creating extremely efficient international corporations. In this environment, weak signals from new internal or external ideas are more difficult to detect as a result of the inertia of successful, hard to replicate competitive advantages.
- **Increased business complexity to create value:** The sophistication of societies is leading to much more complex value propositions to create value. Clients increasingly demand "solutions" that require the combination of multiple products or services. The development, acquisition or sale of units producing single products may not justify complex business processes. But corporations **spinning in or out highly integrated and complex business propositions** face **high transaction costs** as more elements of the

existing operation (already optimized for other specific processes) are affected by the change.

We believe that, currently, opportunities are lost as a result of high transaction costs at either side of the pipeline (corporation and startup ecosystem) bringing inside innovation out and outside innovation in. An efficient program needs to address these transaction costs, retaining effectiveness (in terms of high number of successful, value creating ventures across the pipeline), while reducing overall cost for the corporation.

This challenge justifies the need to design:

- Dedicated programs (inward looking and outward looking), focused and able to detect internal and external weak signals.
- A staged transition through sequential corporate units to reduce information asymmetries and leads to lower transaction costs

Modular design enables sequential deployment of the program

The open innovation model presented in this thesis is complex and resource consuming. This is especially true in late stage interaction, in particular those involving equity. Even the largest corporations with mature venture capital programs can only handle a handful of new investees per year (we are excluding here purely financial investment through limited partnerships in independent venture capital funds). Monitoring, supporting and eventually integrating ventures is an extremely complex change management problem, involving organizational design, power and cultural dimensions. Brand reputation is gradually more at stake as the interaction progresses.

In order to maintain maximum optionality, corporation should focus, during the first years of the program deployment, on early stage startups, delaying corporate venture capital programs until the pipeline is already delivering ventures that are well aligned with the corporate strategy and are of value for the business units.

Model for integrated open innovation

We have studied both through research of published data and interviews of startups and corporates the current state of open innovation models, analyzing strategic intents, operational choices, metrics and outcomes to present best practices. We have focused, specifically, on corporate, for-profit, interactions immediately involving or targeting startup equity (investment or exit). Recognizing that there are other forms of open innovation (contests, hackathons, institutional or academic accelerator and incubators), we have made this choice because it is, in our view, the most complex, resource consuming corporate open innovation program. It also leads to longer time frames and requires the management of higher amount of risk and return potential.

In the earlier section we presented the key insights that will be assumed here as premises to support the model we present below. Summarizing, the proposed model will involve:

- An integral strategy that combines outside-in and inside-out equity open innovation transactions
- A structured design with specific modules adapted to the deal flow and maturity of the ventures.
- A staged transition with well-defined transition gates.

On the basis of the assumptions above, this thesis proposes a model composed by the following modules:

- **A corporate accelerator:** fixed-term, cohort-based early startup (pre-seed) support program funded by the corporation, providing mentorship and other services like office space and IT services. The fix term starts with a selective intake process and culminates in a demo day, that involves pitching to corporate units. The program is open to both external and internal ventures proposals. The scope of the business propositions is guided by briefs produced by the program in combination with the business units. Accelerator initial screening is based on ideas. Successful pitches, including basic business plans developed during the acceleration process, enter the next program module (lab).
- **Corporate pilot lab/innovation center:** corporate facility supporting startups with the early stages of conception, design, and production of products and services. The center would provide lab and production equipment. Its aim would be to develop prototypes or

minimum viable products (MVPs). Successful MVP's are tested and screened by corporate program and business units and enter into the next module (incubator).

- **Corporate incubator:** flexible term startup support organization funded by the corporation, aimed to develop feasible business ideas with workable business plans. Like in regular incubators, startups receive business development support like legal, accounting, intellectual property, information services, etc. May include two stages:
 - o An initial stage of non-equity incubation
 - o A second stage of further incubation after the equity participation as portfolio company of the corporate venture capital fund.

The objective during the incubation period would be to develop revenues and confirm scalability.

The management of these modules requires a three-tier organizational design that handles simultaneously inside-out and outside-in technology transfer:

- **An internal venturing program unit:** links business units with corporate incubator. The objectives of this inside looking corporate program office would be to:
 - o Spin out: Transition internal ideas into the corporate accelerator/lab/incubator program
 - o Spin-in: Transition incubated models into the business units
- **Corporate venture capital unit:** link between external start up environment and corporate incubator. Objectives:
 - o Sourcing: Handle the identification and incorporation of start-ups into the incubator program
 - o Exit of incubatees
- **Program managing team for the accelerator, pilot and incubator modules:** Responsible for managing the pipeline modules (with companies moving in both directions) with progressive stages towards either environments.

The diagram below represents graphically the proposed design, which can be read as a decision tree. Individual venture flows are represented with lines. Tree symbols like decision mode node, chance event node, endpoints, branches of alternatives and rejected alternatives follow the conventional notation:

Symbol	Definition ⁴⁸	Application
△	End point: A node that terminates a branch (and also a branch path). The endpoint is the location where a payoff value is identified.	Corresponds to folding, exiting, spinning events. The venture leaves the program
○	Chance event node: A node that identifies an event in a decision tree where a degree of uncertainty exists. A chance node represents at least two possible outcomes.	Linked with the successful/unsuccessful outcome of a venture in a module in the program
□	Decision node: A location on a decision tree where a decision between at least two possible alternatives can be made.	Correspond to screening decisions of the corporate program
└	Branches: A particular decision alternative or chance outcome. A branch representing a decision alternative emanates from a decision node. A chance branch (chance outcome) emanates from a chance node.	Alternatives after screening or change events

Table 16 Symbols in decision tries

Outside-in and inside-out flows are represented top to bottom and vice versa.

Different maturities of the ventures are recorded left to right, with younger ventures on the left and mature startups to the right. Left-right progression is also aligned with the typical engagement type, stating with general terms and conditions for accelerator programs, standard agreements for pilot labs, staged equity venture capital financing documents for incubators, and IPOs, mergers and acquisitions for mature ventures. A correspondence can be established between the left-right horizontal progression of the venture and the typical time scale of the engagement, with accelerator programs in the range of 3 months, lab projects in the range of 3-12 months, non-equity and equity incubators involving periods of 1 to 3-4 years respectively, and M&A operations active throughout the lifetime of the corporation and planned within its strategic horizon.

The vertical axis represents a deal typical flow and target outcome of the program stages:

⁴⁸ Definitions taken from Rafael Olivas glossary in <http://www.stylusandslate.com/>, accessed on April 7, 2018 (Olivas, 2007)

- Deal flow:
 - For accelerators, cohorts of 25-100 idea stage proposals can be processed 4 times a year for a deal flow of 100-400 idea-stage ventures/year. Larger programs with automated pre-screening protocols could reach higher numbers (+1000/year). Screening of the accelerator would reduce the 100 venture/year to approximately 10-20 ventures/year, that would enter lab stage.
 - Labs would admit 10-20 ventures/year, and mature 5-10 minimum viable products per year, entering the incubation stage
 - Early stage incubation, for ~1 year, will further reduce the flow to 1-5 ventures every 3-4 years, that will be considered for equity participation by the CVC.
- Outcome of the program stage:
 - Accelerator: Business proposition
 - Pilot lab: Minimum viable product
 - Incubation: Revenue from sales
 - Late stage incubation: Growth and profit

Staged bidirectional open innovation model

©2018 Roberto Jose Vazquez Lucerga. All rights reserved.

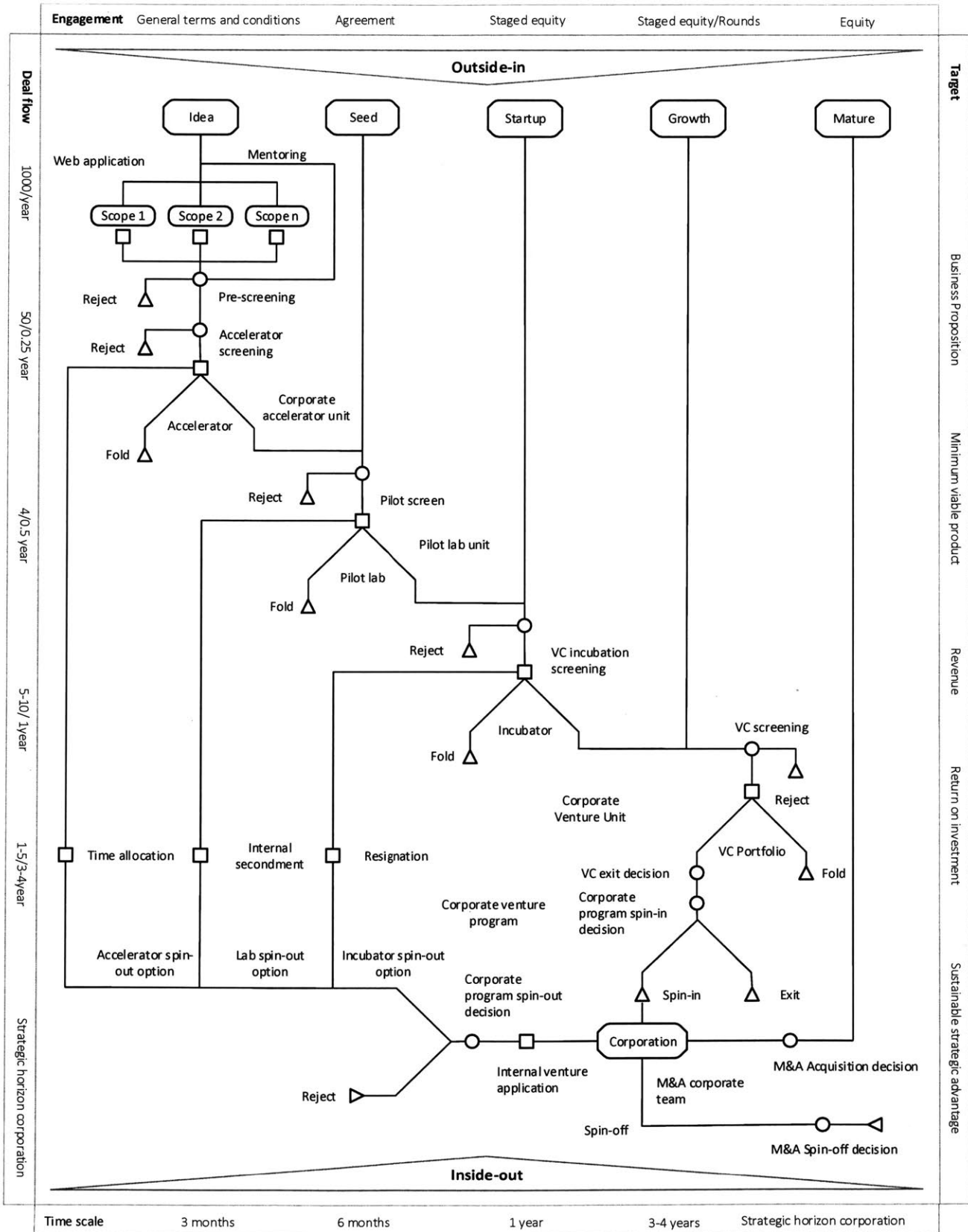


Figure 7 Model for corporate open innovation program

Implementation strategies

In the section presenting the model, we have already mentioned that some aspects of the strategy are context dependent. The model itself has built-in flexibility, so we will present now a framework to guide the decision-making process during implementation.

We will focus on two important aspects:

- **Timing:** we will analyze what is relevant in order to decide incubation period and the timing of the equity participation
- **Size of the program:** we will discuss what context parameters are relevant to decide on the size of the programs, i.e. the number of ventures in each stage.

Incubation period and timing of the equity participation

In the program design stage, companies must decide on the incubation period (how long startups will need to mature to transition to the next stage) and when to consider equity participation.

Regarding the timing of the equity, the possibility to stage transactions through progressive degrees of integration is, in our opinion, one of the most relevant advantages of corporate versus conventional venture capital. The option to lever on this continuum of forms of collaboration seems particularly attractive to improve integration success and reduce risks resulting from asymmetric information. This business integration, like staged funding used regularly in VC, leads the reduction of moral hazard risks through frequent information transfer from the entrepreneur to the corporation, as mentioned earlier, in a non-coerced, mutual, trust-building way.

Within the program, corporations have the option to choose from a continuum of interfirm strategic collaboration types. On one extreme is the simple arm's length contractual relationship to interchange services or products. The existence of previous supplier-client deals has proven to be a key factor in the success of future equity transactions in the context of CVC.

Transitioning to a closer relationship, corporations can consider a number of non-equity corporate alliances, both contractual (for example licensing) and collaborative (share of resources and competences). Further partner commitment could be developed in the form of joint ventures.

Companies should be flexible and consider, dynamically, equity transactions and non-equity alliances as valid alternatives and may discover that, eventually, some form of alliance with an

initially acquisition targeted start-up results in a better strategy, and vice versa. Actually, successful companies like Cisco run very strong M&A programs in parallel to strategic alliances and internal technology incubation programs, with very close management interaction to align interests (Dyer, Kale, & Singh, 2004).

Typically, literature has considered these two strategies different, with acquisitions being competitive, market based and high risk, and alliances cooperative and lower risk. While large M&A operations between major players in competitive industries may require confidentiality to prevent negative impact on customer, employee, supplier relationships or to avoid attracting competitive bids, we believe that these aspects are less relevant when companies are dealing with early ventures. Corporate programs will typically be engaging with multiple, small size ventures, with varying degrees of equity and non-equity relationships, and competitors will have a weaker position presenting competitive biddings due to poorer information and bonds of trust between corporate and startup teams.

Though the arguments above have been presented from the perspective of an outside-in transaction, a spin-out process can also benefit from a staged transition and flexible decisions on equity participation. A new venture born inside the corporation will necessarily have a distinct value proposition that justifies its nurture in a separate company, but will typically be initiated starved in resources, imbalanced in team skills and with a limited network outside the corporation. A staged transition could increase the success rate.

In either case, timing on the transition is an important consideration in the management of the transition: quicker transitions reduce time related costs and increase deal flow but increases risk of failure.

We have adapted (modified and extended) a factor decomposition from Dyer *et al.*, (2004)⁴⁹ to analyze the how corporates should evaluate the timing requirements of the integration and the decision on equity participation. We will define two types of transitions: hard and soft. Hard transitions are short in duration and high in intensity and resources. We consider these hard

⁴⁹ Though we use their factor decomposition, our views on the effect of this factors differ (and sometimes reach opposite conclusions) to Dyer, Kale and Sighs'.

transactions optimal when the reduction of time related costs outweighs the increased risk of integration failure, and soft transitions were longer, staged integration is possible.

Type of business process interaction

We will begin analyzing how the synergy of resources determine the optimal speed of the transition. We will consider three types of synergy: modular, sequential and reciprocal.

Business process interaction	Description
Modular	Companies manage resources independently and pool only the results for greater profits (synergies are modular because modularly independent resources generate them).
Sequential	One company completes tasks and passes on the results to a partner. The resources are sequentially independent. Moderate customization is required at the interphase.
Reciprocal	Companies perform tasks through an interactive knowledge-sharing process. High customization is needed to make them reciprocally independent.

Table 17 Business process interaction types

It is clear from the definitions above that collaboration in terms of coordination of resources (assets and people) and information sharing is increasingly more complex as we move from modular to reciprocal synergies. As the complexity of the interaction increases, companies need to dedicate more resources that compromise flexibility and, consequently, optionality. This is true from the perspective both of the corporation and the startup. In general, a corporation will be able to handle multiple modular intercompany relationships but only a limited number of reciprocal ones. But complex integrations also consume the limited resources of the startup and, additionally, can impose constraints on its ability to source competitive funding alternatives, both as a result of management time constrains and the adaptation of processes to the particular needs of the interfirm interaction. Based on this, companies should design hard (high intensity, short time) transitions for the reciprocal synergies, and softer for sequential and modular collaborations.

In the case of inside-out transitions, highly dependent synergies should be less frequent. If the intention is to eventually spin-out, the venture will need to gradually build independent business processes, either creating new ones or developing in-house capacity for valid corporate processes.

Nature of the assets

The type of resources involved in the transaction is also key in managing the timing of the transition.

Nature of the assets	Description
Soft assets	Transaction involving mostly soft assets: tangible (such as human resources) or intangible (such a brand, knowledge, skills) assets, not normally included in a firm's financial statements ⁵⁰ .
Hard asset	Transaction involving mostly hard assets: tangible assets, whether physical (such as land, buildings, inventory, machines) or financial (cash, credit, financial instruments) ⁵¹ .

Table 18 Nature of assets

Faster transition can be planned when the startup transaction involves a high percentage of hard assets. These assets are generally easier to value and generate synergies rapidly (Dyer et al., 2004). Areas like purchasing, operations, maintenance, can immediately benefit from economies of scale. Startups involving mostly tangible (human resources) and intangible (knowledge) assets, if fact the great majority, are much more difficult to transition. This calls for a slower integration plan that builds mutual trust and enables sufficient information flow to allow an accurate valuation. Open innovation, particularly staged models one proposed in this thesis, are well suited to operationalize this gradual integration and can prove to me much more effective that regular M&A. Organizational design, power and cultural aspects can be gradually tackled, avoiding the loss of talent that typically plagues direct acquisitions.

⁵⁰ <http://www.businessdictionary.com/definition/soft-asset.html>

⁵¹ <http://www.businessdictionary.com/definition/hard-asset.html>

Extent of redundant resources

There are two questions here. First is how much overlap, in terms of operations and people, is there between the corporation and the startup. A second aspect is what is the cost reduction potential from economies of scale.

Extent of redundant resources	Description
Low	Low cost savings potential associated with reducing redundant operations and people or by leveraging on economies of scale
High	High cost savings potential associated with reducing redundant operations and people or by leveraging on economies of scale

Table 19 Extent of redundant resources

General M&A literature offers two arguments that support hard transitions when the extent of redundant resources is high. The first obvious reason is savings: the higher the size of the synergies, the greater the potential savings. The second no less important reason refers to the anxiety of the employees as they become aware of the redundancy of their units, that can lead to lower performance and higher churn.

In the context of corporate-startup interaction the cost reduction potential from redundancy and economies of scale is negligible from the perspective of the corporation due to the difference of scale. Nevertheless, programs should not underestimate the importance of removing work load from the entrepreneurs so that they can focus on the value creating activities. In our interviews, we have very often heard them saying that their most important “cost” is time. Integrating support activities like IT, human resources, accounting, financing, can be very rewarding for the ventures, and can also reduce subsequent integration costs. There should not be, in general, significant overlap in core startup activities. After all, the purpose of the collaboration is to bring innovative ideas into the corporation. Still, shared industry scope may lead to common suppliers and clients, potentially leading to efficiencies in the supply chain.

Degree of industry risk

By industry risk we are referring not to the risks associated to the particular venture but rather uncertainty from far more wide-ranging issues involving the entire industry to which the venture belongs to. We assume that the ventures will work in the same broad industry as the corporation due to the strategic alignment of the investments.

Degree of industry risk	Description
Low	Low variability in the probability distribution of industry aggregate future cash flows, due to factors that affect industries overall performance.
High	High variability in the probability distribution of industry aggregate future cash flows, due to factors that affect industries overall performance.

Table 20 Degree of industry risk

In theory, this risk is taken into account in the valuation if the corporation decides for a hard transition. But what is relevant here are the differences in the perception industry risk by the entrepreneur, the corporation and, more broadly, the venture capital markets. Arguably, we would expect the corporation to have a better view on the industry-specific uncertainty. On the other hand, the corporation has less diversification options since it imposes itself strategic alignment with the portfolio startups, and therefore assumes diversifiable risk that the capital market is not rewarding.

Should the better market intelligence outweigh the lower diversification potential, it would provide the corporation and edge valuing startups that can be exploited through fast, hard acquisitions in favorable terms. We have not seen this issue settled in recent research, so it will be a matter for each corporation to individually benchmark itself against other VCs.

Degree of company specific uncertainty

We are referring here to startup specific risk.

Degree of company specific uncertainty	Description
Low	High variability in the probability distribution of the startup specific future cash flows
High	Low variability in the probability distribution of the startup future cash flows

Table 21 Degree of company specific uncertainty

Again, the key aspect here is whether the corporation and its corporate venture capital fund has an edge evaluating specific business propositions. Otherwise, the rate of return required to assume the risk would be no different from what the venture can obtain from the broader venture capital fund market.

Firstly, we should recognize that the risk will be very dynamic. As information becomes available, valuations will be adapted. Should the corporation be able to evaluate better and earlier the startup's specific risk, it will, in theory, hold an option that can be better exploited through hard transitions. The higher the uncertainty, the greater the value of this option.

We have argued that a well-designed open innovation program can, indeed, offer an edge in risk evaluation by reducing information asymmetries due to the continuous flow of information from repetitive interaction. This leads to opportunities that outweigh to the cost of these programs.

This insight is counterintuitive. Dyer (2004), in the context of interfirm alliances and M&A, reasons that corporations should favor hard acquisitions when targeting low risk business propositions and plan softer transitions through alliances in high company specific risk scenarios.

When a company estimates that a collaboration's outcome is highly or moderately uncertain, it should enter into a nonequity or equity alliance rather than acquire the would-be partner. An alliance will limit the firm's exposure since it has to invest less money and time than it would in an acquisition. Besides, the company can sink more into the partnership if it starts showing results, and, if necessary, buy the firm eventually. If the collaboration doesn't yield results, the company can withdraw from the alliance. It may lose money and prestige, but that will be nowhere near the costs of a failed acquisition.

We believe, on the contrary, that risk is (or should have been) already considered in the valuation, so the corporation will face changing, but marked-to-market (“fair”), valuations (in relation to the residual risk) as new information becomes available. What is relevant is whether the corporation is able to make better estimations of the true value with less delay. We should expect information to diffuse to the capital market, so a slow, conservative strategy doesn’t necessarily help.

The conclusion of the above is that corporations with mature open innovation programs, in industries with fast knowledge diffusion dynamics and high return variability should favor harder paced transitions.

Corporate-startup competitive dynamics.

We have already discussed appropriability and the role of complementary assets as key driver of dynamics (Gans & Stern, 2003). We believe that this framework is much more relevant to decide the pace of the transition of startups in the program than the absolute level of competition, which is probably already factored in the valuation of the ventures.

Corporate-startup

competitive dynamics	Description
Fast competitive dynamics	Markets where leadership is determined by technological leadership and incumbents face high competitive pressure from startups in “niche” markets. Typically, in scenarios where appropriability is low and complementary assets are generic (or incumbent’s complementary assets do not contribute to the value proposition of the new technology)
Slow competitive dynamics	Markets where changes in technological leadership do not result in market leadership due to the control by incumbents of specific complementary assets and appropriability is high, encouraging startups to seek alliance and reinforce existing platforms.

Table 22 Corporate-startup competitive dynamics

Faster dynamics will require not only technologically broader and deeper (earlier startup stage) programs, but also faster transitions in order to build in fast response to discontinuous innovation events.

Sizing of the program

We have discussed factors that determine the timing. We will now proceed to provide a framework to analyze the optimal size of the programs. We have summarized in a table below the factors that we believe are relevant for sizing decision.

Variable	Evaluation
Equity vs. non-equity	<p>Quantitative analyses (Rothaermel, 2001) suggest that equity interactions are more effective in terms of new product development than non-equity (in terms of number of developments per alliance). But, as discussed, equity transactions have significantly more decision, bargaining and, especially, policing and monitoring costs. We have also discussed in earlier sections the limited throughput that can be effectively managed through highly interactive venture capital, even in large corporations.</p> <p>Management will therefore need to balance the intensity of equity participation in startups (efficiency in terms of the development of new products and services and size) and program size (that leads to optionality).</p>
Maturity of the open innovation program	<p>The ability to manage open innovation programs is a skill (involving not only the development of integration tools, methods, and processes, but also changes in power structure and corporate culture, as we have discussed in earlier sections) that requires time to develop. Companies like Cisco, with extensive experience in the management of outside-in processes, have made of this skill (specifically the companywide expertise for integrating acquired companies) a key competitive advantage (Rifkin, 1997).</p>

We have presented earlier a progressive implementation strategy, starting with early stage-non-equity programs to build a pipeline before introducing mature startup equity programs. Reputation of offering fair deals and valuations will also take time, and new programs will not be able to develop open innovation strategies in areas where IP appropriability is low.

Exploration vs. exploitation scope

As discussed corporations can enter in two types of strategic alliances from the viewpoint of motivation: exploration and exploitation (March, 1991) depending on whether they are seeking to learn new technologies or to level existing complementary assets. In both cases there is risk, but as exploitation alliances bring mostly tested technologies in the last stages of development cycle, the failure rate is lower, leading to higher effectiveness and lower requirements on management. Of course, this strategy attracts ventures with less innovation potential.

During the first years of the program implementation, the corporation may need to target lower risk projects both to limit management load and to ensure buy-in from the corporation.

Target size

Controlling for revenue generated, smaller target companies lead to higher transaction costs as a result of the setup resources consumption.

Additionally, a high number of projects require management and technical teams to switch frequently between them. This constant switch can significantly reduce productivity. An IBM Development Efficiency Study recorded by the MIT⁵² showed that the average value-added time on engineering tasks increased from 60% to 85% when switching from 1 to 2 projects, but then decreased gradually to only 20% for 6 projects or more.

⁵² IBM Development Efficiency Study, https://ocw.mit.edu/courses/sloan-school-of-management/15-351-managing-innovation-and-entrepreneurship-spring-2008/lecture-notes/18_lec.pdf

Geographical extension of the program	These programs should expect country-specific differences. Standard integration processes and methods will need adaptation in each country in order to meet differences in local laws and business practices (“Business Management Case Study - Cisco,” 2007). Geographically wider programs consequently lead to more complexity, limiting the size for a given volume of resources.
Nature/Complexity of the targets	Some targets require the integration of complete business models as opposed to individual products. Consider the development of personal computing in the late 1970’s. Incumbent companies were focused on the exploitation of the business segment. PC’s required not only new hardware, but a new portfolio of software (games, intuitive and user-friendly work processing and spreadsheet programs, easy to use file management tools...) and a whole new marketing plan, including the development of new distribution channels. Higher complexity implies more friction points with the internal organization, and therefore more challenging acquisition process.

Table 23 Program sizing variables

As optimum size for the program is very context dependent and is influenced by a high number of parameters, it will necessarily require experimentation, as mentioned earlier. A flexible program design, as the one presented here, is therefore required to manage a wide range of deal flows.

Conclusions

Summary

Recent years have seen important changes in the way corporates compete and the dynamism of this competition. Companies are facing increasing pressure to innovate and generate value for customers in over-satisfied societies, demanding more complex business propositions and faster response. These changes lead to greater horizontal and vertical uncertainty that corporations have to manage while sustaining investment in core assets to ensure short term performance.

Open innovation strategies, leveraging on the internal and external entrepreneurial drive, have been proposed to increase the resilience of corporates while opening the opportunity for nascent ventures to grow in new markets. The design of these programs is an area of active research.

This thesis proposes a specific open innovation program. The design implements an integral strategy combining inside-out and outside-in transitions to lower costs and enhance efficiency. The design is sequential and staged, resulting in a flexible, modular program architecture with multiple, specifically designed components (accelerator, innovation center, incubator and CVC) enabling the management of a wide range of deal flows.

More specifically, the thesis proposes a model composed by the following modules:

- **A corporate accelerator:** fixed-term, cohort-based early startup (pre-seed) support program funded by the corporation, providing mentorship and other services like office space and IT services. The fix term starts with a selective intake process and culminates in a demo day, that involves pitching to corporate units. The program is open to both external and internal ventures proposals. The scope of the business propositions is guided by briefs produced by the program in combination with the business units. Accelerator initial screening is based on ideas. Successful pitches, including basic business plans developed during the acceleration process, enter the next program module (lab).
- **Corporate pilot lab/innovation center:** corporate facility supporting startups with the early stages of conception, design, and production of products and services. The center would provide lab and production equipment. Its aim would be to develop prototypes or minimum viable products (MVPs). Successful MVP's are tested and screened by corporate program and business units and enter into the next module (incubator).

- **Corporate incubator:** flexible term startup support organization funded by the corporation, aimed to develop feasible business ideas with workable business plans. Like in regular incubators, startups receive business development support like legal, accounting, intellectual property, information services, etc. May include two stages:
 - o An initial stage of non-equity incubation
 - o A second stage of further incubation after the equity participation as portfolio company of the corporate venture capital fund.

The objective during the incubation period would be to develop revenues and confirm scalability.

The management of these modules requires a three-tier organizational design that handles simultaneously inside-out and outside-in technology transfer:

- **An internal venturing program unit:** links business units with corporate incubator. The objectives of this inside looking corporate program office would be to:
 - o Spin out: Transition internal ideas into the corporate accelerator/lab/incubator program
 - o Spin-in: Transition incubated models into the business units
- **Corporate venture capital unit:** link between external start up environment and corporate incubator. Objectives:
 - o Sourcing: Handle the identification and incorporation of start-ups into the incubator program
 - o Exit of incubatees
- **Program managing team for the accelerator, pilot and incubator modules:** Responsible for managing the pipeline modules (with companies moving in both directions) with progressive stages towards either environments.

Our aim has been to contribute in three distinctive areas:

- The further development of corporate venturing, the entrepreneurial behavior inside firms that leads to the discovery and exploitation of new business opportunities, through a more organized and mature organizational design.
- Expansion of the innovation space currently targeted by startups. Until very recently, startups have rarely aimed areas where corporations hold strong strategic assets.

Industries like pharma, oil and gas, chemicals and construction, had to research and development internally. Recent developments in open innovation have proven that alliances with startups can be very beneficial to both parties. In these cases, a more sophisticated design, implementing a gradual, trust-building process, is needed.

- Most of the research is focused on outside-in innovation (flow of from the startup space to corporations). Through our interviews with open innovation pioneers, we have also reached the conclusion that there is ample potential to develop inside-out innovation. Companies recognize that there are high-performing employees with great ideas that are willing to take entrepreneurial risk, but that no programs exist to channel these opportunities. This is leading to the loss of valuable talent. Our aim has been to provide a design that can capture this flow, efficiently, and through a mutually beneficial interaction with outside-in innovation initiatives.

Critique of the model proposed

We have decided to focus on corporate open innovation strategies and have therefore excluded from our study incubators and accelerators sponsored by academic institutions and nonprofit development organizations (private or public). The reason has been that these programs usually focus on the promotion of general business innovation in a specific region or sector. Despite the general mandate guiding these organizations, corporations can, nevertheless, collaborate with these institutional programs replicating, partly, some of the strategies proposed in this model, which considers the units completely under the control of the corporation.

We have also excluded from our study of corporate participation in independent venture capital funds as limited partners. This allocation of capital usually is not connected with any particular corporate strategic intents other than by the general mandate of these partnerships to target sectors of interest for the corporation. Some corporations do take relatively active roles in funds despite their limited partnership positions, and engage with investees, resulting in some information flow, but certainly not with the intensity of corporate lead CVC's.

Our focus on equity transactions has excluded programs that target solely business development. There are a number of successful startup programs that are aimed to spur complementary innovation and push new corporate products (particularly in the form of platforms). An example of this strategy is Microsoft BizTalk, an offer to automate business process through enterprise

wide application integration (www.microsoft.com/biztalk, 2009). These initiatives aim to grow business opportunities between organizations, as opposed to implementing inorganic growth, and therefore face a different set of strategic challenges.

Suggestions for further research

Open innovation investment gives corporations optionality and early response capabilities, resulting in a more robust model against technological discontinuities: This is achieved reducing time to perceive changes and creating optionality through seed investment. On the other hand, capital allocation to venture equity reduces investment in core assets and consumes managerial time. Additionally, high volatility of venture returns introduces higher variance in corporate returns. As most corporate venture capital units are funded through the balance sheet, corporates are required to mark to market, resulting in significant write-downs in periods of bearish equity markets. As an example, corporations were forced to write-down \$9.5B of venture related losses in the second quarter of 2001 alone: Microsoft was hit with \$5.7B, Wells Fargo with \$1.2B and Intel with \$632M (CBInsights, 2017).

The management of this volatility could potentially lead to higher investment in short term efforts (“making the numbers”) at the expense of long term capability building in the core business (Rahmandad, Henderson, & Repenning, 2016). Time delays in capability building can, in turn, lead to weaker response general market deterioration. This opens a dilemma between robustness to technological shocks and to general market shocks. Future research could develop system dynamic models and provide guidelines for the management of this tradeoff.

Another possible area of research is inside-inside models, in which corporations establish corporate innovation centers to nurture internally lead innovations, but without constituting separate legal entities. This model is similar to the Alpha Teams currently used in Cisco (see Box 5: Cisco), or the “Skunk works” model used by Kronos (Box 2: Kronos) and may be effective when focus and isolation, but not entrepreneurial drive, is needed.

Glossary

Contest (open innovation): Targeted intense effort to solve a corporate challenge within a limited amount of time

Corporate accelerator: fixed-term, cohort-based early startup (seed, pre-seed) support program funded by a corporation, providing mentorship and often other services like office space and IT services. The fix term starts with a selective intake process and culminates in a demo day, that involves pitching to corporate investors.

Corporate incubator: continuous intake startup support organization funded by a corporation, aimed to develop feasible business ideas with workable business plans. Like in regular incubators, startups receive business development support like legal, accounting, intellectual property, information services, etc.

Corporate pilot lab/innovation center: corporate facility supporting startups with the early stages of conception, design, and production of products and services. Provides lab and production equipment. Aimed to develop prototypes or minimum viable products

Spin-in: Spin-ins are corporate acquisition of companies started up with money from the corporation

Spin-off: Corporate realignment involving the separation of a unit to form a new independent firm. The spin out company takes with it the operations of the segment and associated assets and liabilities.

Spin-out: The creation of an independent company, by which the equity owners of the parent company receive an equity stake in the newly spun-off company (United States Securities and Exchange Commission)

is a firm formed

Venture capital: form of financing involving the creation of a financial intermediary between sources of funds (typically institutional investors) and entrepreneurial firms. Venture capital funds invest in these early-stage firms in exchange for equity or preferred equity. Funds are typically structured as limited partnerships.

Corporate venture capital: form of financing involving the creation of a financial intermediary between corporate funds directly in external startup companies. It is therefore a specific form of venture capital in which the funds are provided by the corporation. Like conventional venture capital funds, CVC invest in early-stage firms in exchange for equity or preferred equity.

Indirect corporate venture capital: The corporation is a limited partner in a venture capital fund, which is externally managed by general partners. The fund can be multi-investor or a captive fund (client based, with the corporate as a unique or majority investor). Typically has a mandate to invest in targeted industries.

Direct corporate venture capital: The corporation manages directly the venture capital fund through autonomous unit with operational independence.

Corporate venturing: general term referring to the development of strategic components of an organization, such as corporate culture, firm resources and capabilities, that spur entrepreneurial behavior inside corporations

Bibliography

- Agarwal, R., Echambadi, R., Franco, A. M., & Sarkar, M. B. (2004). Knowledge transfer through inheritance: Spin-out generation, development, and survival. *Academy of Management Journal*, 47(4), 501–522. <https://doi.org/10.2307/20159599>
- Akerlof, G. A. (1970). The market for lemons: qualitative uncertainty and the market mechanism. *Quarterly Journal of Economics*. <https://doi.org/10.2307/1879431>
- Andersson, M., & Klepper, S. (2013). Characteristics and performance of new firms and spinoffs in Sweden. *Industrial and Corporate Change*, 22(1), 245–280. <https://doi.org/10.1093/icc/dts046>
- Andersson, M., & Xiao, J. (2016). Acquisitions of start-ups by incumbent businesses: A market selection process of “high-quality” entrants? *Research Policy*, 45(1), 272–290. <https://doi.org/10.1016/j.respol.2015.10.002>
- Bauer, S., Obwegeser, N., & Avdagic, Z. (2016). Corporate Accelerators: Transferring Technology Innovation to Incumbent Companies. *Technovation*, 50–51, 13–24. Retrieved from <http://aisel.aisnet.org/mcis2016>
- Bengtsson, M., Kock, S., Lundgren-Henriksson, E. L., & NÅrsholm, M. H. (2016). Coopetition research in theory and practice: Growing new theoretical, empirical, and methodological domains. *Industrial Marketing Management*, 57, 4–11. <https://doi.org/10.1016/j.indmarman.2016.05.002>
- Bergemann, D., & Hege, U. (1998). Venture capital financing, moral hazard, and learning. *Journal of Banking and Finance*, 22(6–8), 703–735. [https://doi.org/10.1016/S0378-4266\(98\)00017-X](https://doi.org/10.1016/S0378-4266(98)00017-X)
- Botkin, J. W., & Matthews, J. B. (1992). *Winning combinations: the coming wave of entrepreneurial partnerships between large and small companies*. Wiley & Sons, Incorporated, John.
- Bouncken, R. B., Gast, J., Kraus, S., & Bogers, M. (2015). Coopetition: a systematic review, synthesis, and future research directions. *Review of Managerial Science*. <https://doi.org/10.1007/s11846-015-0168-6>
- Burgelman, R. (1983). A Process Model of Internal Corporate Venturing in the Diversified Major Firm. *Administrative Science Quarterly*, 28(2), 223–244. <https://doi.org/10.2307/2392619>
- Burt, R. S. (1992). *Structural Holes: The Social Structure of Competition*. *Structure* (Vol. 58). <https://doi.org/10.1177/0265407512465997>
- Burt, R. S. (2000). The Network Structure Of Social Capital. *Research in Organizational Behavior*, 22, 345–423. [https://doi.org/10.1016/S0191-3085\(00\)22009-1](https://doi.org/10.1016/S0191-3085(00)22009-1)
- Business Management Case Study: How Cisco Applies Companywide Expertise for Integrating Acquired Companies - Cisco on Cisco. (2007). Retrieved January 3, 2018, from <https://www.cisco.com/c/en/us/about/cisco-on-cisco/business-it/acquistion-integration-web.html>

- CBInsights. (2017). The history of Corporate Venture Capital.
- Cheng, K. C., Chen, T. C., & Shih, N. S. (2014). The influence of budgetary participation by R&D managers on product innovation performances: The effect of trust, job satisfaction and information asymmetry. *Asia Pacific Management Review*, 19(2), 133–150. <https://doi.org/10.6126/APMR.2014.19.2.02>
- Chow, C. W., Cooper, J. C., Waller, W. S., & Wailer, W. S. (1988). Participative Budgeting: Effects of a Truth-Inducing Pay Scheme and Information Asymmetry on Slack and Performance. *Source: The Accounting Review*, 63(1), 111–122. <https://doi.org/10.2307/247682>
- Christensen, C. M., & Bower, J. L. (1996). Customer Power, Strategic Investment, and the Failure of Leading Firms. *Strategic Management Journal*, 17(3), 197–218. [https://doi.org/10.1002/\(SICI\)1097-0266\(199603\)17:3<197::AID-SMJ804>3.3.CO;2-L](https://doi.org/10.1002/(SICI)1097-0266(199603)17:3<197::AID-SMJ804>3.3.CO;2-L)
- Colombo, L., & Dawid, H. (2016). Complementary assets, start-ups and incentives to innovate. *International Journal of Industrial Organization*, 44, 177–190. <https://doi.org/10.1016/j.ijindorg.2015.11.003>
- Cortese, A. (2002, February). Business; Losses Sour Companies On Venture Investments - The New York Times. Retrieved April 21, 2018, from <https://www.nytimes.com/2002/02/03/business/business-losses-sour-companies-on-venture-investments.html>
- Cumming, D. J., & Johan, S. A. (2014). *Venture Capital and Private Equity Contracting*. *Venture Capital and Private Equity Contracting*. <https://doi.org/10.1016/B978-0-12-409537-3.00023-2>
- Cumming, D., & Johan, S. (2007). Regulatory harmonization and the development of private equity markets. *Journal of Banking and Finance*, 31(10), 3218–3250. <https://doi.org/10.1016/j.jbankfin.2007.01.010>
- Cumming, D., & Walz, U. (2010). Private equity returns and disclosure around the world. *Journal of International Business Studies*, 41(4), 727–754. <https://doi.org/10.1057/jibs.2009.62>
- Dahlman, C. J. (1979). The Problem of Externality. *The Journal of Law and Economics*, 22(1), 141–162. <https://doi.org/10.1086/466936>
- Das, T. K., & Teng, B. (1998). Das, T. K. and Teng, B.-S. (1998). 'Between Trust and Control: Developing Confidence in Partner Cooperation in Alliances. *Academy of Management Review*, 23(3), 491–512.
- Dushnitsky, G. (2006). Corporate Venture Capital: Past Evidence and Future Directions. *The Oxford Handbook of Entrepreneurship*, (April 2016), 387–429. <https://doi.org/10.1093/oxfordhb/9780199546992.003.0015>
- Dyer, J. H., Kale, P., & Singh, H. (2004). When to Ally and When to Acquire. *Harvard Business Review*, July-August(Spring 2014), 1–2. <https://doi.org/Article>
- Eisenhardt, K. (1989). Making Fast Strategic Decisions in High Velocity Environments. *Academy of Management Journal*. <https://doi.org/10.2307/256434>

- Eriksson, T., & Moritz Kuhn, J. (2006). Firm spin-offs in Denmark 1981-2000 - patterns of entry and exit. *International Journal of Industrial Organization*, 24(5), 1021–1040. <https://doi.org/10.1016/j.ijindorg.2005.11.008>
- Evald, M. R., & Bager, T. (2008). Managing venture team relationships in corporate incubators: A case study of network dynamics and political rivalry in a high-tech incubator. *International Entrepreneurship and Management Journal*, 4(3), 349–364. <https://doi.org/10.1007/s11365-006-0024-x>
- Farrell, C., & Doutriaux, J. (1996). COLLABORATIVE STRATEGIES OR INTERNAL DEVELOPMENT: WHEN ARE THEY MOST APPROPRIATE FOR CANADIAN ENTREPRENEURIAL HIGH-TECH FIRMS AND WHY? *Journal of Small Business & Entrepreneurship*, 13(1), 25–44. <https://doi.org/10.1080/08276331.1996.10600511>
- Fried, J., & Ganor, M. (2005). Agency Costs of Venture Capitalist Control in Startups. *New York University Law Review*, 81, 967–1025. <https://doi.org/10.1525/sp.2007.54.1.23>
- Gans, J. S., & Stern, S. (2003). The product market and the market for “ideas”: Commercialization strategies for technology entrepreneurs. *Research Policy*, 32(2 SPEC.), 333–350. [https://doi.org/10.1016/S0048-7333\(02\)00103-8](https://doi.org/10.1016/S0048-7333(02)00103-8)
- Ghoshal, S., & Moran, P. (1996). Bad for practice: A critique of the transaction cost theory. *Academy of Management Review*, 21(1), 13–47. <https://doi.org/10.5465/AMR.1996.9602161563>
- Gimmy, G., Kanbach, D., Stubner, S., Konig, A., & Enders, A. (2017). What BMW’s Corporate VC Offers That Regular Investors Can’t. *Harvard Business Review*, July, online. Retrieved from <https://hbr.org/2017/07/what-bmws-corporate-vc-offers-that-regular-investors-cant>
- Gompers, P. A. (1996). Grandstanding in the venture capital industry. *Journal of Financial Economics*, 42(1), 133–156. [https://doi.org/10.1016/0304-405X\(96\)00874-4](https://doi.org/10.1016/0304-405X(96)00874-4)
- Gompers, P., Gornall, W., Kaplan, S. N., & Strebulaev, I. A. (2016). How do Venture Capitalists make Decisions? *National Bureau of Economic Research*. <https://doi.org/10.3386/w22587>
- Gompers, P., & Lerner, J. (1998). *The Determinants of Corporate Venture Capital Successes: Organizational Structure, Incentives, and Complementarities*. *Venture Capital*. <https://doi.org/10.3386/w6725>
- Gompers, P., & Lerner, J. (2001). The Venture Capital Revolution. *Journal of Economic Perspectives*, 15(2), 145–168. <https://doi.org/10.1257/jep.15.2.145>
- Guo, B., Lou, Y., & Pérez-Castrillo, D. (2015). Investment, Duration, and Exit Strategies for Corporate and Independent Venture Capital-Backed Start-Ups. *Journal of Economics and Management Strategy*, 24(2), 415–455. <https://doi.org/10.1111/jems.12097>
- Hakansson, H., & Johanson, J. (1988). Formal and informal cooperation strategies in international industrial networks. In *Cooperative strategies in international business* (pp. 369–380).
- Hamm, Sophia J.W., Jung, M. J. (2018). How Transparent are Firms about their Corporate Venture Capital Investments? *Harvard Law School Forum on Corporate Governance and Financial*

Regulation.

- Hellmann, T., & Stiglitz, J. (2000). Credit and equity rationing in markets with adverse selection. *European Economic Review*, 44(2), 281–304. [https://doi.org/10.1016/S0014-2921\(98\)00076-2](https://doi.org/10.1016/S0014-2921(98)00076-2)
- Henderson, R. M., & Clark, K. B. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly*, 35(1), 9. <https://doi.org/10.2307/2393549>
- Hofisi, C., Hofisi, M., & Mago, S. (2014). Critiquing Interviewing as a Data Collection Method. *Mediterranean Journal of Social Sciences*. <https://doi.org/10.5901/mjss.2014.v5n16p60>
- Holmstrom, B., & Milgrom, P. (1991). Multitask principal-agent analyses: Incentive contracts, asset ownership, and job design. In *Journal of Law, Economics & Organization* (pp. 7, 24–52).
- J. Thelander Consulting. (2016). *Thelander - CVI² 2015 CVC Compensation Report*. Retrieved from <http://jthelander.com>
- Jensen, M., & Meckling, W. (1976). Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics*, 3, 305–60. [https://doi.org/http://dx.doi.org/10.1016/0304-405X\(76\)90026-X](https://doi.org/http://dx.doi.org/10.1016/0304-405X(76)90026-X)
- Kanbach, D. K., & Stubner, S. (2016). Corporate accelerators as recent form of startup engagement: The what, the why, and the how. *Journal of Applied Business Research*, 32(6), 1761–1776. <https://doi.org/10.19030/jabr.v32i6.9822>
- Kaplan, S. N., & Strömberg, P. (2001). Venture Capitalists as Principals: Contracting, Screening, and Monitoring. *American Economic Review*, 91(2), 426–430. <https://doi.org/10.1257/aer.91.2.426>
- Katila, R., Rosenberger, J. D., & Eisenhardt, K. M. (2008). Swimming with Sharks: Technology Ventures, Defense Mechanisms and Corporate Relationships. *Administrative Science Quarterly*, 53(2), 295–332. <https://doi.org/10.2189/asqu.53.2.295>
- Klepper, S. (2001). Employee Startups in High-Tech Industries. *Industrial and Corporate Change*, 10(3), 639–674. <https://doi.org/10.1093/icc/10.3.639>
- Klonowski, D. (2018). The Venture Capital Deformation. In *Venture Capital: Investment Strategies, Structures, and Policies*.
- Kohler, T. (2016). Corporate accelerators: Building bridges between corporations and startups. *Business Horizons*, 59(3), 347–357. <https://doi.org/10.1016/j.bushor.2016.01.008>
- Ku, M. S. (2015). Recent trends in specialty pharma business model. *Journal of Food and Drug Analysis*. <https://doi.org/10.1016/j.jfda.2015.04.008>
- Legrand, C., & Weiss, D. S. (2011). How Leaders Can Close the Innovation Gap. *Ivey Business Journal Online*. Retrieved from <http://libra.naz.edu/docview/912503052?accountid=28167%5Cnhttp://linksource.ebsco.c>

om/linking.aspx?sid=ProQ:abiglobal&fmt=journal&genre=article&issn=&volume=&issue=&date=2011-07-01&spage=N_A&title=Ivey+Business+Journal+Online&atitle=HOW+LEADERS+CAN+CLOSE+

- Lerner, J. (1995). Venture Capitalists and the Oversight of Private Firms. *The Journal of Finance*, 50(1), 301–318. <https://doi.org/10.1111/j.1540-6261.1995.tb05175.x>
- Lerner, J., & Stern, S. (2016). Innovation Policy and the Economy: Introduction to Volume 16. *NBER Innovation Policy & the Economy*, 16.
- Lin, J. H., & Wang, M. Y. (2015). Complementary assets, appropriability, and patent commercialization: Market sensing capability as a moderator. *Asia Pacific Management Review*, 20(3), 141–147. <https://doi.org/10.1016/j.apmr.2014.12.013>
- Lishego, D. (2016, May). The Pros and Cons of Taking Investment from Corporate VCs. Retrieved March 24, 2018, from <https://medium.com/startups-and-investment/the-pros-and-cons-of-taking-investment-from-corporate-vcs-b8164023a938>
- Lui, S. S., & Ngo, H. yue. (2004). The role of trust and contractual safeguards on cooperation in non-equity alliances. *Journal of Management*, 30(4), 471–485. <https://doi.org/10.1016/j.jm.2004.02.002>
- March, J. G. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, 2(1), 71–87. <https://doi.org/Doi 10.1287/Orsc.2.1.71>
- McNally, K. (1997). Corporate venture capital, bridging the equity gap in the small business sector. *International Small Business Journal*, 16(4), 116–119. <https://doi.org/0803973233>
- Mehri, M., Hassan, M. K., & Jouaber-Snoussi, K. (2017). Optimal Carried Interest: Adverse Selection in Islamic and Conventional Venture Capital and Private-Equity Funds. *Emerging Markets Finance and Trade*, 53(7), 1458–1476. <https://doi.org/10.1080/1540496X.2016.1166424>
- Metrick, A., & Yasuda, A. (2010). *The VC Industry. Venture capital and the finance of innovation*. <https://doi.org/10.2139/ssrn.1242693>
- Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2), 187–221. [https://doi.org/10.1016/0304-405X\(84\)90023-0](https://doi.org/10.1016/0304-405X(84)90023-0)
- National Science Foundation. (2017). National Robotics Initiative 2.0: Ubiquitous Collaborative Robots. Retrieved May 1, 2018, from https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503641
- NIOSH Division of Safety Research. (2017, September). CDC - Robotics: About the Center - NIOSH. Retrieved May 2, 2018, from <https://www.cdc.gov/niosh/topics/robotics/aboutthecenter.html>
- Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation Ikujiro Nonaka. *Organization Science*, 5(1), 14–37. <https://doi.org/10.1287/orsc.5.1.14>

- Olivas, R. (2007). Decision Trees Primer - Introduction. Retrieved April 7, 2018, from http://www.stylusandslate.com/decision_trees/index.html
- Pink, D. H. (2005). *A whole new mind : why right-brainers will rule the future* . tcrecordorg (Vol. <http://www>). <https://doi.org/10.3200/TCHS.81.3.141-142>
- Polanyi, M. (1966). Tacit Knowing. In *The Tacit Dimension*. <https://doi.org/10.1353/ppp.2002.0018>
- Quarterly Global Active Corporate VC Investors. (2017). Retrieved January 9, 2018, from <https://cbi-blog.s3.amazonaws.com/blog/wp-content/uploads/2017/01/upload.png>
- Rahmandad, H., Henderson, R., & Repenning, N. P. (2016). Making the Numbers? “Short Termism” and the Puzzle of Only Occasional Disaster. *Management Science*, mns.2016.2670. <https://doi.org/10.1287/mnsc.2016.2670>
- Rifkin, G. (1997). Growth by Acquisition : The Case of Cisco Systems. *Strategy and Business (Booz, Allen and Hamilton)*, 1–14. Retrieved from <https://www.strategy-business.com/article/15617?gko=3ec0c>
- Rothaermel, F. T. (2001). Incumbent’s advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22(6–7), 687–699. <https://doi.org/10.1002/smj.180>
- Sahlman, W. A. (1990). The structure and governance of venture-capital organizations. *Journal of Financial Economics*, 27(2), 473–521. [https://doi.org/10.1016/0304-405X\(90\)90065-8](https://doi.org/10.1016/0304-405X(90)90065-8)
- Schein, E. H. (2010). *Organizational Culture and Leadership*. Jossey-Bass (Vol. 4). Retrieved from <http://www.loc.gov/catdir/bios/wiley047/2004002764.html%5Cnhttp://books.google.com/books?id=xhmezdokfnYC&pgis=1>
- Shields, M. D., & Young, S. M. (1993). Antecedents and Consequences of Participative Budgeting: Evidence on the Effects of Asymmetrical Information. *Journal of Management Accounting Research*, 5, 265–280. Retrieved from <http://ezaccess.library.uitm.edu.my/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=9701211563&site=ehost-live&scope=site>
- Simon, H. A. (1961). The New Science of Management Decision. *Harvard Business Review*.
- Spence, M. (2002). Signaling in retrospect and the informational structure of markets. *American Economic Review*. <https://doi.org/10.1257/00028280260136200>
- Stiglitz, J. E., & Weiss, A. (1981). Credit Rationing in Markets with Information Imperfect. *The American Economic Review*, 71(3), 393–410.
- Teece, D. J. (1986). Profiting from technological innovation. *Research Policy*. [https://doi.org/10.1016/0048-7333\(93\)90063-N](https://doi.org/10.1016/0048-7333(93)90063-N)
- Teece, D., & Pisano, G. (2004). Chapter 42: The Dynamic Capabilities of Firms. In *Handbook on Knowledge Management 2: Knowledge Directions* (pp. 195–213). Springer Science & Business Media B.V. / Books. Retrieved from

<https://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=19432918&site=eds-live&scope=site>

- Tidström, A. (2014). Managing tensions in coopetition. *Industrial Marketing Management*, 43(2), 261–271. <https://doi.org/10.1016/j.indmarman.2013.12.001>
- Tobe, F. (2015). Why Co-Bots Will Be a Huge Innovation and Growth Driver for Robotics Industry. *IEEE Spectrum*, 1–8. Retrieved from <https://spectrum.ieee.org/autoton/robotics/industrial-robots/collaborative-robots-innovation-growth-driver>
- Tushman, M. L., & Anderson, P. (1986). Technological Discontinuities and Organizational Environments. *Administrative Science Quarterly*, 31(3), 439. <https://doi.org/10.2307/2392832>
- Tversky, A., & Kahneman, D. (1982). Judgment under uncertainty. Heuristics and biases. In *Judgment under uncertainty. Heuristics and biases* (pp. 3–20). <https://doi.org/10.1017/CBO9780511809477.002>
- Veo Robotics raises \$12 million for its vision of a harmonious human-robot workplace | TechCrunch. (2017, October). Retrieved May 1, 2018, from <http://social.techcrunch.com/2017/10/18/veo-robotics-raises-12-million-for-its-vision-of-a-harmonious-human-robot-workplace/>
- Viki, T. (2016). Five Reasons Your Boss Was Right To Shut Down Your Innovation Lab. Retrieved December 30, 2017, from <https://www.forbes.com/sites/tendayiviki/2016/09/04/five-reasons-your-boss-was-right-to-close-your-innovation-lab/>
- Weiblen, T., & Chesbrough, H. W. (2015). Engaging with Startups to Enhance Corporate Innovation. *California Management Review*, 57(2), 66–90. <https://doi.org/10.1525/cmr.2015.57.2.66>
- www.microsoft.com/biztalk. (2009). Microsoft BizTalk Server. Retrieved December 29, 2017, from <https://www.microsoft.com/en-us/cloud-platform/biztalk>