Early Stage Innovation:
Matching Opportunities with Inventions

by

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PhD, Physics, Paris VI University, 1999

Submitted to the MIT Sloan School of Management
in Partial Fulfillment of the Requirements for the Degree of

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at the

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1
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ABSTRACT

What makes innovation happen in reality?

The challenges companies have faced in building their competitive advantage have been shifting over the last decade, away from operational excellence and global footprint and towards innovation and learning.

This thesis explores the interactions between new business opportunities and technological inventions during the early stages of breakthrough innovations in technology. Hypothesizing: a technological innovation is primarily a match between a new business opportunity and an invention.

The literature review redacts the recent developments regarding ways of sourcing inventions, new ways to build business opportunities, and best practices for assessing innovation projects.

The core of the thesis is a comparative analysis of the interactions between business opportunities and inventions in four different organizations: The Langer Lab at MIT, IDEO, The MIT innovation ecosystem, and LargeCo (a large multinational company whose name has been disguised). The analysis is conducted by describing each organization, gained through interviews and research, with specific attention to the source of inventions, the way new business opportunities are generated, and the dynamic interactions between inventions and opportunities.

The analysis of the Langer Lab and IDEO suggests a possible blueprint for inventive organizations, it reveals the high level of attention both organizations pay to business opportunities, and it shows the critical role of the interactions between opportunities and inventions during the early stages of the innovation process. Similarly, the study of the MIT ecosystem unveils numerous mechanisms fostering those interactions at every stage of the innovation process. By contrast, the absence of entrepreneurial behaviors and the aversity of the organization to market-related risks seem to be hurdles to those interactions at LargeCo.

Thesis Supervisor: Diane Burton
Title: Fred Kayne (1960) Career Development Professor of Entrepreneurship and Associate Professor of Management
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Introduction

Early Stage Innovation

“Innovation: People creating value through the implementation of new ideas.” IDEO [1]

In 1999, the CEO of IBM got frustrated because he wasn’t able to engage his company to address potential opportunities in biotechnology and life science. He asked three senior executives to assess why IBM was consistently missing the emergence of new industries and to provide recommendations for improvements. The team assessment included the following conclusions[2]:

- “Our management system rewards execution directed at short-term results and does not place enough value on strategic business building.
- We are preoccupied with our current served markets and existing offerings.
- Our approach to gathering and using market insights is inadequate for embryonic markets.
- We lack established disciplines for selecting, experimenting, funding, and terminating new growth businesses.
- Once selected, many IBM ventures fail in execution.”

It is interesting to note that the analysis performed at IBM raised issues related to market analysis and internal process, but it did not mention any issue related to a lack of inventiveness or a lack of technological inventions.

Over the last decade, many practices on innovation have focused on market and business opportunities rather than ideas generation and technology inventions. As an example, one of Clayton Christensen main arguments on disruptive innovation is that companies should listen less to their best customers and focus more on analyzing the needs of new and dissatisfied customers [3]. Similarly, Eric
Von Hippel has developed an innovation framework based on the idea of companies leveraging lead-users in their innovation fields [4]. In addition, new innovation practices related to the invention component of the process tends to recommend that companies source inventions from outside through acquisitions, partnerships, ideas brokering, copying and licensing (see for instance[5], [6], [7]). This evolution from technology-centric innovations to market-centric innovations might be one of the most significant changes to take place in innovation practices recently [8].

In order to better understand this dynamic, I decided to study the interactions between business opportunities and inventions during the early stages of new technological businesses. More precisely, the question I wanted to clarify was the following:

“In early stage of technological innovations, how do inventions and business opportunities interact?”

**My project**

“Innovation simply isn’t as unpredictable as many people think. There isn’t a cookbook yet, but we are getting there”, Clayton Christensen [8].

My project is a comparative study of the interactions between business opportunities and technological inventions in four different organizations:

- ‘LargeCo’, a large multinational company[^1^], involved in the commercialization of products for the construction industry. I selected this company because its management was looking at possible ways to improve early stage innovation outputs (number of new projects, success of the projects). I post-analyzed two recent innovation projects that had been considered strategic in this company.

[^1^]: “LargeCo” is not the real name of the company. LargeCo and the innovation platforms A and B are real, but I will keep them confidential.
- The Langer Lab at MIT [9], which is renowned for its success at commercializing technological innovations by spinning-off new companies. I chose to study the Langer Lab because its scale and resources are comparable to those of the innovation projects at LargeCo. In addition, I expected the Langer Lab to develop innovations mostly driven by technological inventions. Finally, the Langer Lab has been described in the literature in detail [10] and it was accessible.

- IDEO [11], which is a renowned product design company that helps its customers in developing new products and new services. I chose to study IDEO because I expected innovations to be mostly driven by markets and customers in this organization. Similarly to the Langer lab, IDEO has been extensively described in the literature [1, 12] and it was accessible.

- The “MIT innovation ecosystem.” This innovation cluster is also renowned for its success at commercializing technological innovations. I chose to study this ecosystem because I expected I could draw insightful comparisons between the complex organization of LargeCo and the entire institute. I found the fact that innovation is not the main goal of both organizations to be very relevant to my study.

After describing those organizations in detail, I systematically apply the following questions to them:

- Why is this organization innovating?
- What defines a good innovation project in this organization?
- Who build business opportunities in this organization? Why are they good at it?
- Who perform technological inventions in this organization? Why are they good at it?
- How do opportunities interact with inventions in this organization?

Before describing my analysis of the four organizations I studied, I present a literature review describing the different ways companies build business opportunities, source inventions, and select innovation projects.
Literature review

Possible sources of technological inventions

The sources of technological innovations can be internal or external. As mentioned in the introduction, recent literature on inventions sourcing focuses mostly on external source of innovations. Among companies renowned for their performances at innovating, some claim that they have embraced open innovation (P&G, IBM, Boeing, Unilever) and some seem still very focused on internal capabilities (Corning, GE, Toyota, Shell, Whirlpool) [8].

Creativity and inventiveness

“Follow your heart. Do something you are interested in, do something you can get energized about. That is where passion comes from. And, creativity comes from passion.” Lina Echeverria - CORNING

Theresa Amabile has studied the conditions promoting creativity and inventiveness [13], [14]. She identifies three components driving individual creativity:

- Expertise
- Creative-thinking skills
- Motivation, and especially internal motivation

Among those criteria, Theresa Amabile suggests to start by leveraging individuals’ internal motivation, which falls into a few categories: challenge, freedom, resources, work-group features, supervisory encouragement, and organizational support.

In their book on innovation [15], James Andrew and Harold Sirkin from the Boston Consulting Group define six conditions to promote idea generation within an organization:
• Time to think
• Space to explore
• Deep domain knowledge
• Stimulation
• Idea-focused dialogue
• Motivation

Finally, embracing the argument of the founder of IBM, Thomas Watson, Richard Farson, and Ralph Keyes insist on the importance of failure-tolerant leaders in promoting inventiveness in an organization [16]. They characterized failure-tolerant leaders as:

• Engaged: they ask real questions about projects and providing new insights
• Analytical rather than praising
• Fostering team working and collaborations within the organization
• Ready to publicize their own failures

In the figure below, I present my simple analysis of creativity based on those readings:
Invention by internal R&D

“The best way to get a good idea is to get lot of ideas.” Linus Pauling – Nobel Chemistry Prize and Nobel Peace Prize

Despite the recent trend on open innovation, internal inventions are still predominant in many large companies. Some companies as Corning [17] and GE [8] claim that their inventions are still conceived within the company because their researchers are the best in the world, and because their outputs of technological inventions fulfill their needs. Others prefer to rely on internal inventions because they are concerned with confidentiality issues, or because they use unique assets to perform their inventions.

Sourcing inventions

From “Not Invented Here” to “Nothing Invented Here”

“The image of the lone genius inventing ideas from scratch is romantic and engaging, but it’s a dangerous fiction. Innovation and creativity are far less mysterious than that image implies. They are a matter of taking developed ideas and applying them in new situations. If your company has the right connections and the right attitude, it works.” A Hargadon and R Sutton [18].

The literature on “open innovation” or “idea brokering” is rich, and several companies have made those concepts the cornerstone of their innovation process.

In the academic literature, Henry Chesbrough has developed the concept of open innovation extensively [19]. Chesbrough’s initial argument is that the dominant model of integrated innovation capabilities that prevailed before the 80’s in large companies is not the best practice anymore, because broader education and the development of entrepreneurship have multiplied the possible sources of ideas and inventions. As a result, companies should innovate with inventions brought from outside, using different processes: licensing, acquiring, or copying. The principles of open innovations described by Chesbrough are the following:
• Not all smart people work for us
• We don’t have to originate the research in order to profit from it
• External R&D can create significant value; Internal R&D is needed to claim some portion of that value
• If you make the best use of internal and external ideas, you will win

In their recent book [15], James Andrew and Harold Sirkin argue that the innovation model used by a company should be adapted to its innovation goals and to the capabilities of the company. They define 3 different models and describe the best conditions for each as follows (adapted from [20]):

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Best used when...</th>
</tr>
</thead>
</table>
| Integrator | Manage all the steps necessary to generate profits from an idea | • innovation is incremental  
• market position is already strong  
• customer tastes are well understood  
• technology is proven  
• Product life cycle are long |
| Orchestrate | Focus on some steps and link with partners to carry out the rest | • innovation is breakthrough  
• time-to-market is critical  
• competition is intense, substitute possible  
• technology is in early stages  
• partners and suppliers are capable |
| Licenser   | License the innovation to another company to take it to market | • market is new to innovator  
• importance of innovator’s brand is low  
• intellectual property is protected  
• significant infrastructure is needed |

Their analysis shows that when companies look for breakthrough innovations in a competitive environment or in emerging markets, they should reach out and work with partners. However, when looking for innovations in a market where the company already has some leadership and a good understanding of the customers, companies might be better off keeping an integrator model. Although not focused on early stage innovation, Andrew and Sirkin’s argument suggests that when a company ventures outside of its core markets, it should reach out as much as possible to better innovate.
After IBM and Eli Lilly, Procter and Gamble has embraced the concept of open innovation in 2000 when its CEO AG Lafley initiated their Connect & Develop initiative by declaring: “More than 50% of P&G innovations must come from outside. Half new products will come from our labs, the other half through them” [7].

The Connect and Connect initiative has the following characteristics [7]:

- Mandated by CEO, managed by full-time senior executive
- Explicit company-wide strategy: “more than 50% products invented outside!”
- 70 tech entrepreneurs managing networks and scouting the world for ideas and inventions
- Specific process, based on Open Innovation, to find inventions relevant of identified opportunities
- External Business Development group to make deals with partners for open innovation
- Change of all incentives schemes for R&D people (outward focus, ideas, speed)

More precisely, the process to look for solutions to problems identified internally includes two levels of networks:

- **Proprietary networks** = P&G technology entrepreneurs who initiate collaborations with academia, industry, suppliers and a structured network with P&G top 15 suppliers
- **Open network** = InnoCentive, Ninesigma, YourEncore, Yet2.com

The Open networks used by P&G to support their Connect & Develop initiative open new ways of sourcing ideas and inventions. I describe them in more details later in the “Inventions brokering” paragraph.

The number and the quality of external sources of ideas and inventions have sharply increased in the last decade creating both new tools and confusion. In a recent paper [21], Nambisan and Sawhney
segment the different offers in three categories: raw ideas, market-ready ideas, and market-ready products. They also describe the tradeoff that companies need to make between risk and cost when sourcing inventions externally.

**Translating existing inventions**

Translating inventions encompasses different ways of tuning existing inventions in order to solve new problems. Those different ways include:

- Leveraging internal inventions initially developed to solve other problems
- Leveraging outside inventions initially developed to solve other problems
- (Legally) copying inventions developed by others to solve similar problems

Companies that are experts at translating ideas and inventions are consulting companies specialized in product design and innovation. Their ability to translate ideas from one domain to another one, or from one customer to another one, constitute an important competitive advantage for them. One of them, IDEO [11], has developed ways of optimizing this competitive advantage by actively managing inventions’ translation. For instance, each of the eight IDEO offices uses a “Tech Box” displaying large variety of internal and external inventions [1]. IDEO’s Tech Boxes are used by its designers as a potential source of inspiration.

David Kelley, founder of IDEO, commented on translating ideas in an interview with Andrew Hargadon [22]: “Working with companies in such dissimilar industries as medical instruments, furniture, toys, and computers has given us a broad view of the latest technologies available.”

Similarly to the Tech Box from IDEO, P&G has developed a “Eureka” online catalog where their 70 Technology Entrepreneurs file the inventions and products they have identified outside the company that could fit one of the strategic areas of the company [7].
Andrew Hargadon and Robert Sutton describe the importance of being able to capture and recycle good ideas from inside or outside the company into new projects [18]. Starting with the premise that the main source of new inventions is old ideas, they define the concept of brokering cycle: capturing good ideas → keeping ideas alive → imagining new use for old ideas and putting promising concepts to test.

A famous example of translation of ideas within a company would be the Corning’s display business [23], which started in the 1980’s when the computer business started growing with a technology invented in the 1960’s. Another example would be the development of micro-replication technologies at 3M.

**Partnering**

Partnering is widely used by most of the companies to boost innovation capacities. A company might partner with different stakeholders to improve its ability to generate ideas and inventions:

- With external laboratories in academia in order to leverage their expertise, inventiveness, resources, existing inventions, but also to benefit from their location in specific innovation ecosystems
- With consultants to benefit from their inventiveness, specific expertise, and ability to translate ideas
- With customers, suppliers, and complementors to develop new offers with them

I found Intel “Lablet” [24] organizations a very interesting partnering model with academia regarding early stage innovation. Lablets are small research labs adjacent to universities allowing Intel employees, academics and graduate students to work collaboratively on exploration projects. Lablets are co-directed by a faculty and an Intel employee. The main idea behind lablets is to transfer
knowledge from the university to Intel, and to integrate Intel within the local innovation ecosystem of the university.

"We concluded that the needs for exploratory research program to cast a wide net for new ideas and to learn from the external research ecosystem greatly outweighed the need to obtain proprietary advantage." David Tennenhouse, INTEL

Lablets are somewhat similar to French collaborative labs between companies and government-funded labs, called “laboratories mixtes,” but their integration in an external innovation ecosystem, centered around the chosen university, creates a significant difference. Our analysis of MIT innovation ecosystem shows how, as put by M. Porter, “Location matters for innovation” [25]. In that regard, partnerships appear as an interesting lever to benefit from existing ecosystems.

**Problems & solutions brokering**

“To invent, you need a good imagination and a pile of junk.” Thomas Edison

P&G uses invention brokering extensively in its Connect and Develop initiative. Some of the tools used by P&G are available online [7]:


- InnoCentive ([http://www.innocentive.com/](http://www.innocentive.com/)): Created by Eli Lilly, Innocentive is similar to NineSigma but more oriented towards scientific problems and solutions.


- Yet2.com ([http://www.yet2.com/app/about/home](http://www.yet2.com/app/about/home)): Online marketplace for intellectual property exchange.
In order to activate those networks, P&G translated the needs of its customers, as expressed by its business and marketing managers, into technological briefs that describe a clear problem to solve. Other companies relying on ideas brokering or ideas scouts include Henkel, Staples, Kraft, Microsoft, and Dupont.

Other sources of inventions brokering include:

- The websites of patents offices such as the European patents website (www.espacenet.com) and the American patents website (www.uspto.com).
- The technology license offices of universities and research institutes.
- Some website of large companies such as IBM and GSK

**Acquiring**

Silicon Valley companies such as Cisco, Amazon, Google, and Pharmaceutical companies such as Eli Lilly have become experts at sourcing inventions and innovations through the acquisitions of startup companies. Eli Lilly has structured its partnership and acquisition process in three steps:

- **Find it** = 20 scientists searching the world for innovative opportunities
- **Get it** = Work together with “Find it” team to seize the opportunities quickly
- **Create value** = Manage relationship between Lilly and its innovation partners. They help manage cultural differences and create win-win
Building business opportunities

“If I had asked my customers what they wanted, they’d have said a faster horse.” Henry Ford [12]

Introduction

Market studies focus on average or good customers who tend to answer, “cheaper, better, more efficient, with more options,” when asked what they need. Because “cheaper, better, more efficient, with more option” seldom allows building any attractive business opportunity, some practitioners have developed theories and tools that help companies better identify attractive business opportunities. They include:

- Disruptive innovation
- Customers ethnography – Empathic design
- Lead users

Disruption

The concept of disruptive innovation has been developed extensively by Clayton Christensen and his colleagues [3, 26]. The main premises of disruptive innovations are the following:

- Offers’ performances generally progress faster than customer needs
- On mature markets, offers’ performances often over-shoot customers needs
- On mature markets, non-consumers might adopt lower-end offers
- Incumbents almost always win when an attacker tries to fight by out-performing them
- Incumbents almost always loose when someone disrupt them by addressing over-shot customers or non-consumers

Given those premises, the authors define four different ways to build disrupting business opportunities:
• Make your customers’ experiences easier and simpler. Examples include Federal Express, Intuit’s QuickBooks

• Develop offers targeted to the low-end of the market: Nucor minimills, discount retailers

• Enable non-consumers: PC, Walkman, Skype (video call and long distance calls)

• Commoditize expertise: make it simple enough to allow less skilled people to use your offer: balloon angioplasty, Minnesota-based MinuteClinic, GE Crotonville training center

As an example, when applied to the photovoltaic industry, the disruption theory would suggest going develop a very cheap photovoltaic module enabling large population not connected to any electrical grid to have access to electricity. In his talks, Pr Christensen refers to very low-tech panels obtained by rough silicon sputtering on glass that can be found for sale in the streets of Ulaanbaatar in Mongolia. His argument is that such cheap resources would scale-up as demand increases and improve with time, allowing the companies selling them to serve more demanding customers and thus disrupt existing suppliers. Today, as the demand of photovoltaic modules in the developed world still exceeds supply, the proposal of Professor Christensen might sound awkward, but only time will tell.

Disruptive technologies are difficult to pursue in established firms for different reasons. The main reason is that they start by addressing markets that are initially not attractive by company standards. It is by getting a foothold in those “unattractive markets” that disruptors can grow by disrupting incumbents in more attractive markets or by developing new markets (serving non-consumers). Companies willing to play the game of disruptive innovation must develop skills and tools allowing them to attack markets that initially seem unattractive and remain flexible at redefining their strategy as uncertainties diminish. Building disrupting business opportunities require specific mindset and management tools.
Some companies have integrated the concepts behind disruptive innovation in their innovation process. For instance, the New Business Initiative group at Intel uses this approach to screen new ventures. Johnson & Johnson also uses it to identify new opportunities that appear when progress made in diagnostic and treatment allows for treatment by less skilled practitioners.

**Customers’ ethnography – Empathic design**

“The real act of discovery consists not in finding new lands, but in seeing with new eyes.” Marcel Proust

The techniques of empathic design are familiar to engineering and design companies [12, 27], but they are not common practice. The main ideas behind customers’ ethnography are the following:

- The ‘voice of the customers’ is limited by their current experience and by their creativity
- Customers ‘hidden needs’ and real ‘pain points’ are difficult to identify
- Careful observations of customers in real situation are the best way to develop interesting insights

Dorothy Leonard and Jeffrey Rayport have described empathic design process in four steps [27]:

1. Observation. Companies want to observe customers, customers of customers, and other types of users such as people in charge maintenance operations.
2. Capturing data. Data is best captured using video and photographs, rather than interviews.
3. Reflection and analysis
4. Developing prototypes of possible solutions

The main users of customers’ ethnography remain design consultancies. They use this process to build business opportunities by better understanding the real (deep, hidden, not yet existing, etc) needs of the customers of their clients. For instance, Design Continuum used this method to invent the Swiffer
sweeper for P&G. The consultants, who had been initially hired to develop a new concept of detergent, started the project by carefully observing 7 people cleaning their kitchen floors. Their observations led them to two interesting insights:

- People don’t clean their floor as often as they would like because it is a cumbersome process

- When observed from far away, it is not clear if people clean the floor or the mop.

Those observations suggested helped them develop a simple, disposable cleaning system that would enable people to clean their floors easier and more often using “consumable mops.” Interestingly, the first electrostatic cloth they developed for the role of “consumable mops” was not their own invention, but borrowed from a technology already used by fire-fighters to clean ashes without using water. Simple as it might sound, the “Swiffer” became a major hit on the market and one of the leading brands of P&G.

The concept of “job segmentation” recently developed by Clayton Christensen [28] and his colleagues extends the notion of empathic design to marketing practices. Interestingly, the authors consider a situation where the customer is a business in their analysis. In that case, they argue that the equivalent of the “observation phase” consists in determining and observing the levers that drive the customer’s own profitability. On the consumer side, one example described by the authors is a car that would be developed to fulfill the function of a “mobile office,” which appears to be a car’s central use for millions of users. Ford has actually developed a version of its F-250 pick-up for this ‘job.’ On the B2B side, the authors describe how Hill-Rom captured a large market share of the hospital beds in the US by developing a bed that optimized the work of the nurses, which then allowed hospitals to lower their operational costs or improve the quality of care. Job segmentation appears as a way to build business opportunities that are customized to better fulfill customers’ real needs.
One company that has embraced customer empathic design is Xerox. PARC (Palo Alto Research Center) [29], the famous centralized R&D center created by the company in 1970, has an integrated research labs staffed with some of the best computer scientists. PARC is well known for its brilliant research but it is conducted in isolation from the company's business. However, as described by its former director Seely Brown [30], PARC has completely changed over the last years to become customer-centric by mixing anthropologists, sociologists and scientists to invent new solutions.

**Lead users**

The concept of lead-users' innovation has been developed extensively by Eric Von Hippel [4]. The main premises of lead-users innovations are the following:

- Information on user needs are sticky and expensive
- Some users might already have innovated in the field you want to explore
- Some users might already have innovated in related, often more demanding, fields

The main idea of lead-users' innovation is to identify lead-users, and use their ideas and prototypes to better build business opportunities and to source ready-made inventions. Lead-users are those who:

- are ahead of a market trend that is interesting to you (∴ business opportunity)
- have strong incentives to solve their needs by innovating (∴ invention)

They are different from early-adopters because they develop their own solutions, whereas early-adopters are simply the first ones to buy solutions developed by companies.

Lead-users' innovation would be best used when companies are looking for functionally-novel innovations:

- Lead-users tend to develop functionally novel innovations
• Manufacturers tend to develop dimension of merit Improvements
• Markets have numerous customers and products are ‘tweak-able’ (not exclusively)

Examples of lead-users innovations include:

• World Wide Web, mountain bike, protein-base shampoo, sport nutrition bars
• Scientific instruments: 100% of first of a kind, 80% of major functional improvements
• Semiconductor process equipment: 100% of first of a kind, 80% of major functional improvements
• Computer industry: 25% of higher performances systems, 30% radical structural innovations

Examples of companies that have encompassed lead-users’ innovation

• 3M: revived its ‘Surgical drapes’ business unit using lead-users’ innovation [31]. It also launched new projects in other business units, e.g. commercial adhesives
• Sharp, Nestle, Norton networks, Grundfos

The process of lead-users innovation has been described in detailed in several papers [31, 32] and on the web [33]. It consists in:

• Defining the area and scope of the study
• Identifying and select relevant market trends
  - Background reading, in team and individual
  - Interviews of experts and some lead-users (=> trends and business opportunities)
• Framing interesting customers needs and possible opportunities for the company
  - Identify and network (referral) lead-users
  - Conduct semi-structured phone interviews with lead-users (=> Business opportunities, inventions, prototypes)
o Conduct sites visits of the most interesting lead-users

- Proposing final concepts
  o Run a lead-users workshop (=> Business opportunities, inventions, prototypes)
  o Evaluate and document final concepts
Assessing and screening innovation projects

Introduction

The criteria that organizations use to assess and screen innovation projects should reveal what those organizations consider important for the commercial success of a project. Selection criteria might also strongly impact the behaviors of people during early-stage innovation because they naturally want their projects to get 'good grades' and be selected to become real businesses. Finally, project selection is a key step in the innovation process because it defines the transition point between early-stage innovation and implementation. For startups, venture capital firms often play this role. Their success is primarily linked to their ability to hand-pick good projects and good teams.

The figure below reports some of the most famous examples of misleading market assessments that can be found in the literature on innovation. Those mistakes, all made by highly-qualified experts with access to the best information available, remind us of the difficulty in assessing the potential of an innovation.

"I think there is a world market for about five computers", Thomas Watson, founder of IBM

"Everything that can be invented has been invented", Charles Duell, Commissioner, US Office of Patents, 1899

"There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will", Albert Einstein

"The phonograph is not of any commercial value", Thomas Edison

"Man will not fly for 50 years", Wilbur Wright, 1903

"640K ought to be enough for anybody", Bill Gates

"With over 50 foreign cars on sale here, the Japanese auto industry isn't likely to carve out a big slice of the U.S. market for itself", Business Week, 1968

Possible screens

Despite the difficulties described above, many managers continue to focus primarily on future revenue and profitability to assess projects even at early stage. Pushing the argument to the extreme,
we could wonder why they don’t focus on what could be considered the ultimate indicator for the company: the impact of a project on the market value of the entire company. As illustrated in the figure below, project ranking could be focused at three different levels of integration: project’s attributes, project’s results at maturity, and impact on the market value of the entire company.

**Possible level of integration when assessing projects**

<table>
<thead>
<tr>
<th>Project’s attributes</th>
<th>Project’s results</th>
<th>Project’s impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market size at maturity</td>
<td>Market shares</td>
<td>Stock price</td>
</tr>
<tr>
<td>Structure of the industry</td>
<td>Revenue</td>
<td></td>
</tr>
<tr>
<td>Uniqueness (IP, assets)</td>
<td>Profitability</td>
<td></td>
</tr>
<tr>
<td>Structural advantages</td>
<td>Product lifetime</td>
<td></td>
</tr>
<tr>
<td>Organizational competences</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The more we integrate the information, from project attributes to project financial results, and from financial results to the impact on the market value of the company, the more relevant it is to the shareholders. However, integrating information increases the probability of mistakes and the possibility for tweaking the numbers. Most importantly, integrating information allows people to bypass most of the strategic questions by emphasizing the question: “How much could we earn?”

As long as a target market is large enough, focusing on the right questions at an early stage seems more important than focusing on potential financial returns. This has been nicely described by Georges Day in a recent article [34]. Day suggests using a RWW screen (Is it Real? can we Win? Is it Worth?) at an early stage. As shown in the figure below, this screen consists of a set of questions with three level of analysis.
Day suggests that definitive "No" answer to one of the six questions of the second column would lead to the termination of the project, and that a "No" to any of the questions of the third column should also be considered as a potential serious threat to the project.
Clayton Christensen and his colleagues [35] have analyzed in details the potential pitfalls of over-emphasizing financial analysis when assessing innovation projects. They describe how cash flow projection, sunk costs analysis, and earnings per share can be misleading when assessing innovation whose purpose is to build new growth business. Then, the authors suggest focusing projects’ analysis on their strategy and on the different ways to tune this strategy when projects mature.

Relying on revenue and profit when assessing innovation projects at early stage presents the advantage of focusing on the end results with simple indicators, but it also presents several drawbacks:

- **Relying on erroneous data.** First future revenue and profitability of emerging business are difficult or impossible to predict at early stage. Second, it is easy for teams willing to make their projects attractive to adjust scenarios and tweak numbers to show good results. Finally, as described by Christensen and al., errors could arise from the financial tools themselves.

- **Sending an incomplete message within the organization.** By focusing on revenue and profit, teams address only the third set of questions proposed by G Day: “Is it worth doing?” and might underestimate the other two “Is it real?” and “Can we win?”

- **Not putting enough emphasis on competitive advantages roadmaps.**

- **Under-valuing projects addressing emerging markets or disruptive innovations.** Relying on revenue and profit forecast might favor new business addressing existing markets and hinder projects dealing with uncertain markets.

- **Launching projects addressing emerging markets too late** by “waiting” for market uncertainties to be reduced.
Examples of screens

Corning

As described in two cases written by Rebecca Henderson and Cate Reavis [17, 23], Corning Inc has a history of more than 100 years of innovation in material science, glass and ceramics. “Corning’s Innovation recipe” reported in those papers is presented in the figure below.

Corning’s Innovation Recipe

This recipe is closely linked to a strategic choice of business plan consisting in providing unique keystone components enabling new solutions responding to specific customers needs in a growing market. It is interesting to note the goal of the process described at the bottom of the process: Developing Business with Strategic Control resulting from: Uniqueness, Intellectual Property, and Specialized Capital Investments. The goal of the innovation projects is clearly articulated around the notion of competitive advantage.

As described in the second case, strategic innovation projects are managed at the corporate level at Corning by two of the four corporate committees:
- Corning Technology Council. CTC is led by the CTO of the company and focuses on early stage innovation, including technologies and keystone components for new and existing business.

- Growth Strategy Council. GSC is led by the CEO of the company and focuses on the development stages of high potential strategic projects.

It is interesting to note that the transition from CTC to GSC is determined after assessing projects against specific questions, including:

1. Is the opportunity large?
2. Is it connected to a "megatrend"?
3. Is the problem significant – requiring a step change in cost or capability?
4. Is the hypothetical (quantified) value proposition compelling?
5. Is Corning’s approach unique? Is there a possibility for significant differentiation?
6. Is there a good fit with Corning skills?
7. Are the required resources available?

We see that the screening questions used at Corning are similar to those used by G Day in the RWW screen.

*IBM*

In 2000, IBM put a new system in place to manage its strategic innovation projects at early stage. This system was called Emerging Business Opportunity (EBO). The organization, process, and culture of EBOs have been described in a case by David Garvin and Lynne Levesque [2].

In its 2004 edition, this case describes the focus of review meetings during the early stages of EBOs:
“Most of early discussions were designed to gain ‘strategic clarity.’ In virtually all EBOs, the strategy was revised three or four times due to changes in markets, customers, and technologies.[...]”

Harreld (SVP-Corporate Strategy) continually asked the same three questions, which he regarded as ‘strategy 101’:

1. What’s the ‘pain point’ for the customers?
2. Who are we going to come up against in the marketplace?
3. How can we deliver more value to our customers than our competitors?”

The screening questions for EBO at early stage focused on customers’ needs, competition, and competitive advantages.
**Langer Lab at MIT**

**Introduction**

The lab of Professor Robert Langer [9] was founded in the mid-'80's and focuses on works at the interface of biotechnology and materials science. Robert S. Langer, who is one of 13 Institute Professors at MIT, has written over 950 articles and has more than 600 issued or pending patents worldwide. He has actively contributed to the commercialization of the inventions made in his lab through more than 200 licensing agreements and the spinoff of thirteen companies in fifteen years. The current cumulated market value of those spin-offs is equal to several billion dollars. The Langer Lab employs about 60 scientists from all over the world and is located at MIT.

I chose to study the Langer Lab because I assumed that innovation in this organization would primarily be driven by technology inventions rather than by business opportunities, and because the size of the Langer Lab scales well with the size of a small collection of innovative projects at LargeCo. In this study, we will see that my initial assumption was quite wrong because innovations in the Langer Lab result from close interactions between market opportunities and technology inventions.

I interviewed Prof. Langer for this study, and complemented my analysis using detailed data available in “The Langer Lab” HBS case [10].

**Description of the Langer Lab**

“What excites me, personally, is that you can use science as a tool to create things that can change the world. Everything we have tried to do is to make discoveries that will affect human life.” Pr.

Robert Langer – MIT.
The Langer lab employs about 60 scientists with an annual budget of about $10M. Most of the funding is provided by government grants. Scientists are mostly PhD and Post-Doc students from all over the world. The turnover of researchers in the Lab is high because students rarely stay more than 5 years.

In order to describe the Langer Lab, I applied the congruence model [36] to it using the data available in the literature. The congruence model simply describes an organization by looking at the characteristics of its Mission, Strategy, Leadership, Culture, Organization & process, People, and Critical tasks. It is useful when assessing alignment within one organization, and when comparing different organizations.

The results of my analysis are presented in the figure below:
We see in this figure that the Langer Lab is organized around Bob Langer with a flat and diverse organization. The vision of the lab is compelling. Its strategy focuses on potential impact and clear differentiation. The culture mixes challenge, diversity, team-working and hard work. Processes are light, emphasizing autonomy, experiments and communication. The leadership description echoes the interview I had with Prof. Bob Langer (c.f. next paragraph).

As described in a recent article from the Wall Street Journal [37], another important aspect of the Langer Lab is the tight relationship between the lab and a prominent Venture Capital firm (Polaris Venture Partners [38]). This relationship started as a friendship between Bob Langer and Terry McGuire, partner at Polaris, resulting from their first collaborations. It has now broadened, with direct links between some researchers of the lab and analysts at Polaris Ventures. The WSJ article focuses on the fact that this relationship gives an edge to Polaris Venture as compared to its competitors. Reversely, this relationship might also give an edge to the lab by bringing valuable insights on possible business opportunities.

**Interview of Pr Robert Langer**

**Focus of the interview**

While reading the literature on IDEO and the Langer Lab, I noticed that the innovation processes seem significantly different in both places. IDEO seems to be all about “democratized ideation,” whereas the Langer lab seems to be a “one man show.” I presented my observations to Bob Langer and asked him to describe his role in his lab.

In a second phase of the interview, I reminded Prof. Langer that IDEO had eight offices spread in different locations over the world and that all of them showed good performances at innovation. I asked him if he thought that his lab could be exported.
**Langer’s roles in the lab**

Langer described his main roles in the lab as follows:

- Hiring good people
- Leading people with a positive vision
- Setting the environment: culture, strategy, organization and partnerships
- De-inhibiting and encouraging people to innovate, mostly through role models

After further discussions on the differences between identifying a problem to solve and having ideas, Langer said that he plays an important role by pointing his team members “where to look,” which he sees as part of what he calls “setting the environment.” However he insisted on the fact that, once the broad problem has been defined, ideation and innovation are shared by all. Prof. Langer concluded: “Once I might point researchers in the right direction, they might do the innovation as well or better than I may ever do it.”

**Transporting the Langer lab**

When discussing the possibility of exporting his lab, Pr Langer said: “The personality, the vision, and the credentials help define the lab. There might be elements you can transport, but to transport in general would be hard. I don’t know that somebody else would have my personality.” It is interesting to note that Langer doesn’t mention expertise, knowledge, or intelligence as key features that cannot be transported. In regards to this topic, the HBS case on the Langer Lab states that the size of this lab is limited by Langer’s ability to engage with all the researchers.
Business opportunities and inventions in the Langer Lab

Why is this organization innovating?

One might argue that the Langer lab innovates because it is its mission. In fact, the missions of the Langer lab can be derived from those of MIT: “The mission of MIT is to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century” MIT website [39]. As described in my study, the Langer lab innovates to have impact on human life. Langer believes that starting companies is one of the most efficient ways to have impact.

What defines a good innovation project in this organization?

Langer has a defined screening tool he applies to innovation projects when assessing their commercialization potential (in the sense of leading to a successful startup). According to Langer, to be attractive from a commercial standpoint, a project must have the following characteristics:

1- A huge idea conceived by recognizing a critical customer need that could be met by inventing a platform product
2- A seminal paper describing the science underlying the product concept and its efficacy
3- A blocking patent
4- Applications studies demonstrating the technological advantage of the product

Who build possible business opportunities in this organization? Why are they good at it?

Business opportunities are initially drafted by Langer when he advises a student to an area to pursue research, i.e. when he tells his students “where to look.” The exact way Langer chooses the research topics of his students hasn’t been studied in detail. However, my study suggests that Langer chooses
areas where he feels his lab has the ability to perform “first-of-a-kind experiments” that might solve “big problems.” The notion of a first-of-a-kind experiment will generally lead to a strongly differentiated product that is patentable. The notion of “big problem” indicates a business opportunity characterized by a clear need of a group of currently underserved customers.

My study indicates several factors that might promote the ability of Langer to identify good business opportunities:

- A deep knowledge of the market trends provided by his experience in the field of drug delivery, his interaction with the industry, and his strong relationship with Polaris Venture Partners.
- A deep knowledge of the technology provided by his experience, his students, and his contacts with other labs.
- A sense of where inventions from his students could lead to significant progress.

Who perform technological inventions in this organization? Why are they good at it?

Langer insisted on the fact that inventions are created by his students and not by himself. All students in the lab, which essentially means everyone in the lab, spend most of their time inventing.

My study indicates several factors that might promote the ability of Langer’s students to be good at technological inventions: passion, challenge, talent, curiosity, diversity of skills, teamwork, helping one-another, sharing information, hard-work, flat organization, strong autonomy and freedom.

How do opportunities interact with inventions in this organization?

The initial opportunity brought in the field of innovation when Langer tells his students “where to look” is usually broad. Thus students rely on trial and errors (experimentation) to invent in the
designated area. Langer follows closely the projects of his students, which creates a constant interaction between business opportunities and technological inventions.
**IDEO**

**Introduction**

IDEO [11] is a world leading Innovation and Design firm that uses a human-centered approach to generate new offerings for its customers. IDEO has contributed to the design and development of many standard-setting innovations, including the first computer mouse and notebook computer. Other noted product successes include the Palm V, the Handspring Treo, Zyliss kitchen tools, Bank of America's “Keep the Change” service, and Shimano’s Coasting bikes. Today, IDEO employs more than 500 design thinkers in 8 locations. IDEO’s organization, culture, and process have been extensively described in the literature [1, 12, 40]. My analysis of IDEO is mainly based on those documents. I also had the opportunity to discuss my analysis with Tim Brown, CEO of IDEO, and David Privitera, Head of IDEO office in Boston.

**Description of IDEO**

“IDEO is a zoo. Experts of all flavors co-mingle in offices that look more like a cacophonous kindergarten classrooms... Walk into their offices and you’ll be immediately caught in the energy, buzz, creative disarray and sheer lunacy of it all. Breach the reception area at x corporation and you’ll think you’ve walked into the city morgue.” T Peters in *The Peters principles*.

The figure below presents my analysis of IDEO using the congruence model [36]. The congruence model simply describes an organization by looking at the characteristics of its Mission, Strategy, Leadership, Culture, Organization & process, People, and Critical tasks. It is useful when assessing alignment within one organization, and when comparing different organizations.
I discussed the notion of business opportunity, which in the case of IDEO translates more into “what is the real need of the customers of our client” with several people at IDEO. Tim Brown, the CEO of IDEO, told me that IDEO’s clients do come with some sense of the domain they want to investigate but they are often unsure about the specific questions. Thus, it is IDEO’s role to help them determine that. Tim Brown added that this search for the right question is conducted in the same collaborative and interdisciplinary way as the rest of IDEO’s innovation phases, but with more involvement from experienced IDEO people. Tim Brown’s comment on the role of more experienced people in determining “the direction of the investigation” indicates that this phase is considered as an important task at IDEO, for which past experiences can be effectively leveraged.

On a similar topic the general manager of IDEO, Tom Kelley wrote in one of his book [12]:
“Like most of our client companies, we have a lot of great problem-solvers. But you have to know what problem to solve. And people filling the Anthropologist role can be extremely good at reframing a problem in a new way so that the right solution can spark as a breakthrough.” Tom Kelley, IDEO

By ‘people filling the anthropologist role,’ Tom Kelley refers to people leading empathic design.

People inventing at IDEO are its design thinkers. The invention process of IDEO has been described in the literature. It consists of deep dives, exposure to external stimuli, and well organized brainstorming sessions. In addition, the constant exposure to many different clients’ problems and solutions provide consulting companies like IDEO with an edge at inventing.

Another important aspect of IDEO’s innovation process is prototyping and testing. Concerning prototyping, the founder of IDEO, David Kelley says: “If a picture is worth one thousand words, a prototype is worth ten thousand.” Interestingly, people at IDEO insist on multiplying prototypes in order to enable testers to provide comparative comments on them, which appear much more constructive than feedbacks based on a single offer. As an example, Bank of America has converted some of its retail offices into pilot offices in order to test inventions with real customers. Prototyping and testing appears as a bridge between inventing and defining the good problem to solve.

Comparison between IDEO and Langer Lab

In this paragraph, I use my analysis of IDEO and the Langer Lab, using the congruence model, to compare those organizations. The table below presents this comparison:

<table>
<thead>
<tr>
<th>Mission</th>
<th>IDEO</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excel at human centered design</td>
<td>Make discoveries that will affect human life</td>
<td></td>
</tr>
<tr>
<td>Grow and maximize profit</td>
<td>Grow high potential researchers</td>
<td></td>
</tr>
</tbody>
</table>
**Strategy**

<table>
<thead>
<tr>
<th>IDEO</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 in product &quot;concurrent engineering&quot;</td>
<td>Focus on innovative drug delivery</td>
</tr>
<tr>
<td>Focus on Human-centred design</td>
<td>Research only on &quot;big problems&quot;</td>
</tr>
<tr>
<td>Focus on Design Thinking</td>
<td>Perform &quot;first of a kind&quot; experiments</td>
</tr>
<tr>
<td>Rely heavily on rough prototyping</td>
<td>Communicate results (papers, all media)</td>
</tr>
<tr>
<td>Grow beyond product innovation to services</td>
<td>Develop strong Intellectual Property</td>
</tr>
<tr>
<td>Grow in new geographic areas</td>
<td>License technology when relevant</td>
</tr>
<tr>
<td></td>
<td>Launch startups when relevant</td>
</tr>
</tbody>
</table>

**Leadership**

<table>
<thead>
<tr>
<th>Brown - Kelley</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>The leader is a highly regarded star who:</td>
<td>The leader is a highly regarded star who:</td>
</tr>
<tr>
<td>Makes very &quot;smart kids&quot; work collaboratively</td>
<td>Makes very &quot;smart kids&quot; work collaboratively</td>
</tr>
<tr>
<td>Enforce interdisciplinarity and fearlessness</td>
<td>Enforce interdisciplinarity and fearlessness</td>
</tr>
<tr>
<td>Work on customers' projects</td>
<td>Defines &quot;where to look&quot;</td>
</tr>
<tr>
<td>Manages business scope</td>
<td>Is eclectic and fearless, never in a box</td>
</tr>
<tr>
<td>Balances freedom &amp; control</td>
<td>Has unlimited supplies of ideas &amp; curiosity</td>
</tr>
<tr>
<td>Claim NOT to be the creative center</td>
<td>Is NOT to be the creative center</td>
</tr>
<tr>
<td>Empowers people and teams</td>
<td>Is a role model for teams to dare</td>
</tr>
<tr>
<td></td>
<td>Empowers people and teams</td>
</tr>
<tr>
<td></td>
<td>Is a network node (other lab &amp; industry)</td>
</tr>
<tr>
<td></td>
<td>Provides constructive feedbacks timely</td>
</tr>
<tr>
<td></td>
<td>Manage IP strategy</td>
</tr>
<tr>
<td></td>
<td>Shares information, glory and rewards</td>
</tr>
<tr>
<td></td>
<td>Considers people growth his first priority</td>
</tr>
<tr>
<td>Enthusiastic and encouraging</td>
<td>Enthusiastic and encouraging</td>
</tr>
</tbody>
</table>

**Culture**

<table>
<thead>
<tr>
<th>IDEO</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driven by challenge</td>
<td>Driven by challenges and potential impact</td>
</tr>
<tr>
<td>Creativity and innovation highly regarded</td>
<td>Creativity and innovation highly regarded</td>
</tr>
<tr>
<td>High freedom and autonomy</td>
<td>High freedom and autonomy</td>
</tr>
<tr>
<td>Interdisciplinarity</td>
<td>Interdisciplinarity</td>
</tr>
<tr>
<td>Team working, sharing, helping</td>
<td>Team working, sharing, helping</td>
</tr>
<tr>
<td>It is fun to work with smart people</td>
<td>It is fun to work with smart people</td>
</tr>
<tr>
<td>Truly embrace failure</td>
<td>Hard working and persistence</td>
</tr>
<tr>
<td>High internal motivation</td>
<td>High internal motivation</td>
</tr>
<tr>
<td>Seriously playful and messy</td>
<td></td>
</tr>
</tbody>
</table>

**People**

<table>
<thead>
<tr>
<th>IDEO</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>High IQ and education</td>
<td>Outstanding intellect &amp; credentials</td>
</tr>
<tr>
<td>Driven by passion</td>
<td>Driven by passion</td>
</tr>
<tr>
<td>Strong abilities for team working</td>
<td>Strong abilities for team working</td>
</tr>
<tr>
<td>Diversity of skills</td>
<td>Diversity of skills</td>
</tr>
<tr>
<td>Creative and curious</td>
<td>Creative and curious</td>
</tr>
<tr>
<td>Higher diversity of backgrounds</td>
<td>Willing to work very hard</td>
</tr>
<tr>
<td>Attracted by interdisciplinarity</td>
<td>Attracted by interdisciplinarity</td>
</tr>
<tr>
<td>Very independent</td>
<td>Very independent</td>
</tr>
</tbody>
</table>
Main tasks (of the researchers)

<table>
<thead>
<tr>
<th>IDEO</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figuring out the right problem</td>
<td>Conduct research projects</td>
</tr>
<tr>
<td>Develop focused expertise ('T profiles')</td>
<td>Develop focused scientific expertise</td>
</tr>
<tr>
<td>Share information and ideas</td>
<td>Share information and ideas</td>
</tr>
<tr>
<td>Generate large surplus of ideas</td>
<td>Help other researchers</td>
</tr>
<tr>
<td>Innovate</td>
<td>Innovate</td>
</tr>
<tr>
<td>Manage customers</td>
<td>Communicate results to the outside</td>
</tr>
<tr>
<td></td>
<td>Follow patenting process</td>
</tr>
<tr>
<td></td>
<td>Advocate for external funding</td>
</tr>
</tbody>
</table>

Organization and processes

<table>
<thead>
<tr>
<th>IDEO</th>
<th>Langer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial and errors (experiments)</td>
<td>Trial and errors (experiments)</td>
</tr>
<tr>
<td>Strong autonomy and freedom</td>
<td>Strong autonomy and freedom</td>
</tr>
<tr>
<td>Systematical reporting</td>
<td>No reporting</td>
</tr>
<tr>
<td>No Management Per individual Objectives</td>
<td>No Management Per individual Objectives</td>
</tr>
<tr>
<td>Flat organization</td>
<td>Flat organization</td>
</tr>
<tr>
<td>Open architecture of design spaces</td>
<td>Open architecture of labs</td>
</tr>
<tr>
<td>Rotating team leaders</td>
<td>Weekly meeting for cross-pollination</td>
</tr>
<tr>
<td>Customer ethnography</td>
<td>Active relationship with Patent Office</td>
</tr>
<tr>
<td>Systematical brainstorming</td>
<td>Systematical communications of results</td>
</tr>
<tr>
<td>Fail quickly and often</td>
<td></td>
</tr>
<tr>
<td>Frequent prototyping</td>
<td></td>
</tr>
<tr>
<td>Customers’ feedbacks</td>
<td></td>
</tr>
<tr>
<td>Organized stimuli: displays, tech box</td>
<td></td>
</tr>
</tbody>
</table>

Inventing and Innovating

According to their respective missions, inventing is a core activity at IDEO and in the Langer Lab. However, innovating is not part of the main missions of the Langer Lab even though it is prominent in its culture. In addition, financial performances and rewards don’t appear in the description of the Langer Lab. Some students might join the Langer lab with the dream of becoming part of a successful startup company, but I would think it is not their main motivation.

Similarities between both organizations

The Langer Lab and IDEO are similar in many regards. The common elements to both organizations are listed below.
The elements of their “People” and “Culture” are almost identical:

- Outstanding intellect and credentials
- Driven by passion and challenges
- Strong internal motivation and creativity
- Praise interdisciplinary diversity
- Consider that team working with smart people is fun
- Active sharing of information
- Helping each other

Most of the elements relative to organizational structure are also shared by both organizations:

- Flat organizations
- High individual freedom and autonomy
- No management per individual objectives
- Open architectures of work space

Both organizations also share some of their main tasks:

- Develop focused expertise
- Share information and ideas internally
- Invent

Finally, both organizations rely on prototyping and testing for invention and innovation. At IDEO, prototyping clearly appears as a bridge between inventions and opportunities.
The similarities between the descriptions of the Langer Lab and IDEO are numerous. Many elements common to both organizations fit well with the description of the parameters enhancing inventiveness described in my literature search [ref to page of manuscript].

As a conclusion, I would argue that the common features of the IDEO and the Langer Lab could define a possible blueprint for organizations willing to foster creativity and inventiveness.

**Main differences between both organizations**

A main difference between IDEO and the Langer Lab seems to be the level of process and organization. When generating new ideas, IDEO designers follow defined processes whereas students in the Langer lab do so in a more ‘chaotic’ manner. In addition, the interactions between people at IDEO seem more organized than it is in the Langer Lab. However, when implementing and testing ideas, students follow the rigorous processes of scientific experimentations and they communicate with their peers in an organized way through meetings in the lab.

Another difference is linked to the fact that IDEO is a for-profit organization that must maximize profit and grow, whereas the Langer lab doesn’t have such constraints. The situation of the Langer Lab allows its researchers to focus on inventions that will differentiate them in the scientific community, and in turn in its entrepreneurial ventures.
Business opportunities and inventions at IDEO

Why is this organization innovating?

IDEO is contracted by clients who want to outsource part of their innovation process.

What defines a good innovation project in this organization?

There is no pre-defined screen to assess innovation projects at IDEO. The criteria of success are defined on a case-by-case basis with IDEO’s clients.

Who build possible business opportunities in this organization? Why are they good at it?

In the case of IDEO, a business opportunity is a ‘real need’ of the customers of its client that could be met by a product or a service invented by IDEO’s designers. Business opportunities are initially drafted by the clients contracting IDEO. Generally, the work of IDEO starts with reframing the initial business opportunity using empathic design techniques. People at IDEO are good at reframing business opportunities because they have developed specific tools and skills to understand the ‘real needs’ of customers (deep, hidden, not existing yet, etc).

Who perform technological inventions in this organization? Why are they good at it?

Everyone at IDEO actively invents.

My study indicates that the factors promoting innovation at IDEO are essentially the same than the ones we found in the Langer Lab: passion, challenge, talent, curiosity, diversity of skills, teamwork, helping one-another, sharing information, hard-work, flat organization, strong autonomy and freedom. In addition, the exposure of IDEO designers to a multiplicity of industries and inventions promote their creativity. IDEO pays attention to leveraging this shared knowledge using ‘Techbox’ displays and other tools.
How do opportunities interact with inventions in this organization?

Technological inventions and business opportunity identification are intertwined at IDEO. The interactions between inventions and needs are dynamic. By prototyping as much as possible, people at IDEO promote those interactions.
MIT innovation ecosystem

“The concept of [innovation] clusters is now well understood [...] But there is still confusion about policy implications. Should clusters be allowed to form spontaneously, which is what has usually occurred, or should there be some sort of policy intervention?” Michael Porter - The Economist 11/17/2007, p.22

Introduction

Today, MIT is one of the leading research institutes in the USA. The MIT research organization praises interdisciplinary diversity. Figures describing the research effort at MIT are available on the internet [41]: About 3,500 researchers work with faculty and students on projects funded by government, foundations, and industry, and approximately 2,900 graduate students are appointed as research assistants. The research budget of MIT is about $600M (fiscal year 2007), 13% of which comes from private industry.

The mission statement of MIT [39] reported below emphasizes the advance of knowledge and the education of students:

MISSION STATEMENT

The mission of MIT is to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century.

The Institute is committed to generating, disseminating, and preserving knowledge, and to working with others to bring this knowledge to bear on the world's great challenges. MIT is dedicated to providing its students with an education that combines rigorous academic study and the excitement of discovery with the support and intellectual stimulation of a diverse campus community. We seek to develop in each member of the MIT community the ability and passion to work wisely, creatively, and effectively for the betterment of humankind.
Even though innovation and commercialization of technologies don’t appear in the mission statement of Institute, the “MIT innovation ecosystem” is renowned for its success in those domains. I chose to study this ecosystem because it is a complex organization and because its primarily goals do not include the creation of new businesses.

Because the MIT ecosystem is fragmented and dispersed, and because entrepreneurship is not the core business of the institute, we had to perform several interviews to gather the data we needed to describe it thoroughly.

**Methodology**

I conducted this study with the help of two of my classmates\(^2\). We performed a literature review and interviewed the following people:

- Ted Acworth, MIT Sloan Fellow student, class of 2007, Involved in several MIT spin-offs
- Luis Perez-Breva, Lecturer at MIT, iTeams
- Prof Charles Cooney, MIT Professor of Chemical Engineering and Faculty Director of the Deshpande Center
- Herve Lebret, Innogrants Manager at EPFL in Switzerland,
- Ken Morse, MIT senior lecturer and Managing Director of the MIT Entrepreneurship Center,
- Jose Pacheco, Program Manager at the MIT Entrepreneurship Center
- Leon Sanders, Executive Director of the Deshpande Center,
- Ken Zolot, MIT Senior lecturer, iTeams

\(^2\) Rohit Kashyap (rnck@mit.edu) and Alfonso Wunschheim (avw@mit.edu)
Descriptions of the MIT Innovation ecosystem

We used the Porter Diamond framework [42] to describe the MIT innovation ecosystem. Porter’s analysis helps to better understand the different elements leading to the competitiveness of the MIT innovation ecosystem.

Porter’s Diamond Analysis has been commonly used to describe innovation clusters [25, 43, 44]. The figure below presents a simplified description of the MIT innovation ecosystem in this framework. It is based on the interviews we conducted and on data available through literature [45-47].

We observe that the MIT innovation ecosystem is complex and fragmented. Interestingly, even supporting organizations are fragmented, with different leaders and sponsors. We also observe that the context of the ecosystem is well defined in different dimensions: mission, examples, culture and rules.

Fragmentation might be the signature of an organic growth that has lasted for several decades and is still evolving. We think fragmentation is instrumental in the success of the ecosystem. It allows the
ecosystem to remain dynamic and to keep growing by experimentation: new initiatives start and grow (or die) constantly. It also induces a multiplication of active networks and a multiplication of possible entry points for external stakeholders or new projects.

The Porter analysis describes an ecosystem along five dimensions: factors, context, rivalry, demand, 

Factors

The main factors driving the innovation ecosystem are talented people, interdisciplinary diversity, and technological dynamism. Open communication across boundaries enables cross-pollination thus further increasing the odds for breakthrough inventions. The inventions fountainhead is rich and diverse.

Outstanding people not only feed the inventions pipeline but they often endorse ownership of innovation projects at early stages. Attracted by the environment, outside champions like serial entrepreneurs and experienced IP\(^3\) hunters can complement the endogenous pool.

Financial resources are also essential to allow to effectively carrying forward projects to a sufficient level of maturity at which venture money can be invested.

MIT provides numerous sounding boards and filters to test both technological inventions and business opportunities in a constructive mode.

Context

\(^3\) IP: Intellectual Property
A strong academic brand with reputation for excellence is a corner stone for such an eco-system. An asset in every student's resume, such a brand helps convincing investors and finding a new job even if a venture fails.

To assure best spread of the "innovation virus," role models are crucial. From the social appreciation they receive to their sponsoring of new initiatives, they are an essential at motivating aspiring entrepreneurs.

In addition, faculty and students incentives must be compatible with academic careers, and clear rules regarding patent rights and revenue sharing are needed. Clear rules allow for ethical and financial freedom of action, and they allow all protagonists to interact safely with each other.

Beyond the work on a specific project, MIT's policy to allow faculty to use 20% of their time during the academic year as well as their summer on non MIT-related activities ensures significant "outside world" exposure.

Last but not least, a culture embracing risk and accepting failures as normal steps toward success, as well as social acceptance for those who reaped the financial benefits of such risks, are fundamental for talents to take this path.

Rivalry

Local rivalry sets performances standards, raises local knowledge and skills, and contributes to the information flow. This rivalry is beneficial among entrepreneurs. While there is no absolute ranking possible in this field, the more living and diverse the entrepreneurial community, the better is the match of resources. Also, in a naturally competitive field driven by the race for capital and clients, it is natural to compete, and it fuels many innovators personal drive.
Demand conditions

Early-adopters play an essential role in ensuring that innovative products are embraced early, providing early feedback and exposure to experimental technologies. Early feedback-loops allow innovators to leverage early on in the S-Curve and thus gain significant competitive advantage in the market entry race.

In addition, demanding clients play an important role in valuation and exit strategies for growing start-ups, offering licensing possibilities and trade sale exits along the road and thus serve as market indicators for the relevance and innovation pursued.

Supporting industries

The Technology Licence Office (TLO) is a key interface between the research institutions and the business world. Ideally, both at the same time, a gate-keeper avoiding plundering of the academic resources and an advisor to the researchers looking to adventure into the business world, they act as a knowledge and network pool for both sides matching and negotiating requests.

Investors should bring much more to the table than just cash. From their pre-selection work to their involvement at board level, their quality and willingness to help significantly contribute to the success of young ventures.

The Deshpande Centre’s mission is to help reduce uncertainty in closing the gap between research and the markets

The Entrepreneurship Centre educates business students in entrepreneurship, an art that differs significantly from preparing students to work in larger corporations.
Last but not least, student run organizations like the 100K competition or numerous industry focused student clubs.

**Leadership for entrepreneurial commercialization at MIT**

During our study of the MIT Innovation ecosystem, we observed that the type of entrepreneurial leadership I had encountered in the Langer Lab was not universal in the ecosystem. We identified three paths of entrepreneurial commercialization, characterized by their respective leadership. The first path is led by students and faculty from the lab where the invention is made; the second one is led by a businessman who has found a technological opportunity; the third path is not led by a strong leader during the early stages. The figure below presents simplified descriptions of the main innovation sequences and leadership of these three paths.

![Innovation Paths Diagram]

*Innovation led by researchers*

*Innovation led by businessmen*

*Innovation without leader*
Most of the entrepreneurial ventures coming from the Langer Lab follow this path. As an example, Advanced Inhalation Research was a spin-off of the Langer Lab and initially led by David Edwards, who had invented the technology when he was a post-doctoral student in the Langer Lab [10].

**Innovation led by businessmen**

Innovations led by businessmen can be initiated by MBA students, entrepreneurs, business angels or Venture Capitalist. As an example, David Lucchino [48] took the opportunity of his Sloan Fellow year to identify an interesting technology and launched Stericoat after graduation. Similarly, A123 Systems was initially led by an aspiring entrepreneur, Ric Fulop, who had been screening MIT labs for opportunities in the area of high performances battery [49]. In that specific case, early-stage leaders are generally driven by a strong motivation to start a business. They don’t necessarily have any strong expertise (market or technology) in the area where they launch their new venture.

**Innovation without leader**

Finally, startups can be created without strong leadership during the early stage of innovations. In this case, supporting organizations are generally instrumental in the commercialization process. In addition to helping reducing initial uncertainties, supporting organizations should be instrumental in finding a leader for these ventures. From information available on the web, it seems that Myomo [50] followed this path: In September 2002, a group of MIT researchers received an ignition grant from the Deshpande Center. The grant helped build and test prototypes. One student from MIT Business School who worked on the project with the Deshpande Center, Mira Sahney, seems to have taken leadership for commercialization effort. A company called ‘Myomo’ was then started by the initial team of researchers and Mira in January 2006. Mira is still serves as president of Myomo, and their first product has recently received FDA approval.
Components of the ecosystem and the different entrepreneurial paths

We think that technological innovations, money, clear rules, role models, Technology License Office, ‘free time’ for faculty, and liquid labor market are instrumental in fostering all entrepreneurial paths. An entrepreneurship center and the proximity (geographically and culturally) of business and engineering schools are essential to increase the amount of projects led by ‘businessmen.’ Finally, the Deshpande Center is especially important to support projects with weak leadership at early stages.
**Business opportunities and inventions in the MIT innovation ecosystem**

**Why is this organization innovating?**

It is not clear why an innovation ecosystem has developed around MIT. Several universities in the world invent with a similar intensity as MIT does, but they are not the center of an innovation ecosystem with so many successful entrepreneurial ventures. Today, people start new ventures in the MIT ecosystem because this ecosystem is efficient. Its success depends on many factors that fall into five categories: factor, context, rivalry, demand, and supporting industries.

**What defines a good innovation project in this organization?**

When focusing on the entrepreneurial part of technological commercialization, we can say that innovation projects are selected by the champions who lead them or by investors (angles or venture capital firms). The stakeholders apply their own screening filter when assessing innovation projects. However, most of the filters probably have strong similarities with the filter used by Langer: a strong potential for differentiation, an identified need on the market, some kind of proof of concept, and Intellectual Property rights.

**Who build possible business opportunities in this organization? Why are they good at it?**

When studying the Langer Lab, we have shown that Laboratories’ directors could play a crucial role in defining business opportunities for innovations led by researchers.

In this study, we have identified two other paths leading to entrepreneurial commercialization. For ‘innovations led by businessmen’ businessmen usually start scouting MIT for relevant inventions with a business opportunities in mind. Sometimes, they scout research groups they know or who have good reputations in order to build business opportunities after having seen “available inventions.”


“innovations without leaders,” which correspond to “orphans inventions,” supporting organizations like the Deshpande center organize the process of building potential business opportunities.

**Who perform technological inventions in this organization?, Why are they good at it?**

Inventions are developed by students in the different labs of the institute. The motivations and factor of success that I have described in the study of the Langer Lab applies to most of the labs at MIT.

**How do opportunities interact with inventions in this organization?**

A first type of interaction between inventions and business opportunities occurs very early on in the form of networking events, cocktail parties and conferences. Numerous networking events allow developing ideas to be shared, actively discussed, transformed and filtered.

Angel investors, professors, coaches in entrepreneurships, and venture capital firms also play an active role in fomenting interactions between inventions and opportunities. In addition, they contribute very early in the process by signaling where research in labs should focus.

After inventions and opportunities have gone through initial filters successfully, interactions continue. Clayton Christensen says that more than 2/3 of successful startup companies change their strategy very significantly between initial funding and product commercialization. This observation implies strong interactions between inventions and business opportunities in entrepreneurial ventures at early stages. Most of the MIT spin-offs I have cited in this study have changed their strategy several times before commercialization, and the changes have only been possible because of interactions between inventions and opportunities. The changes of strategy of A123 have been described in a recent issue of MIT Tech Review [51].
Finally, similarly to the interactions I described in the IDEO study, the presence of demanding customers in the ecosystem allows for rapidly testing new innovations in order to change and adapt them iteratively.

We see that innovation clusters allow for dynamic and intense interactions between inventions and business opportunities.
Innovation in a Large Company

Introduction

LargeCo\(^4\) is a good example of a mature multinational company struggling to improve internal growth by fostering innovation. LargeCo aims at developing internally new businesses that would eventually generate several hundreds of millions dollars each in annual sales per year.

At LargeCo, I selected two innovation platforms that have strong similarities: both were considered as strategic by the Head of R&D of the company when they started, both started less than ten years ago and addressed emerging markets, and both have current revenues higher than $50M/year. However, Platform A differs significantly from Platform B because the initial stretch that was required to develop and launch the first product was significantly greater for Platform A.

I conducted numerous interviews and had good access to the relevant documentation when studying Platforms A and B at LargeCo.

Description of LargeCo

History

LargeCo can be considered an outstandingly successful company because of its endurance, its resilience, and its ability to adapt continuously and its growth. LargeCo was founded in Europe in 1665 to develop and manufacture mirrors. LargeCo has started venturing outside the glass markets and outside Europe in the 1970’s. Over the last 40 years, LargeCo grew tremendously by acquisitions, became a conglomerate of leading products, and then developed synergies to become a solution provider in strategic markets. Today, glass products represent a minority of LargeCo revenues (less than

\(^4\) For confidentiality reasons, the name of the real company I studied has been removed.
20% of revenue), the company is global and it keeps changing with the vision of becoming the leading supplier of the construction market.

**Current structure and results**

Today, LargeCo has organized its activities in three main groups: Building Distribution, Construction Products, and Innovative Materials. Building distribution regroups retailing chains aiming at construction professionals and consumers. Construction Products started with glass wool for building insulation and pipes. It then expanded to a broader range of products.

In terms of growth and results, LargeCo entered last year the group of the 100th largest companies in the world (by annual revenue). Its revenue in 2007 was €43B, with net income of €2.1B and more than 200,000 employees worldwide. It has shown constant growth and steady returns on investment in recent history.

**Markets’ structures**

The structures of the main business of LargeCo are presented in the figure below:

<table>
<thead>
<tr>
<th>Size of the market</th>
<th>Innovative Materials</th>
<th>Construction Products</th>
<th>Building distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power of supplier</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Power of customers</td>
<td>It depends</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Intensity of rivalry</td>
<td>Strong</td>
<td>Strong</td>
<td>Medium</td>
</tr>
<tr>
<td>Possible substitutes</td>
<td>Plastic for glass, metal for ceramics, etc</td>
<td>None</td>
<td>Internet</td>
</tr>
</tbody>
</table>

We see that LargeCo industries are generally characterized by low power of suppliers and customers. LargeCo businesses also face strong rivalry. In addition innovative materials often have different possible substitutes.

**Structural competitive advantages**
The main competitive advantages of LargeCo are its scale and its scope. In most markets, LargeCo also demonstrates operational excellence, and it benefits from a strong brand and market leadership. The competitive advantages of LargeCo are described below in more detail:

Scale:

- Low cost through learning (high volume of widgets sold), assets optimization (for instance loading schedule of the different ‘floats’ for glass manufacturing) and supply chain management.
- Centralization of purchasing providing power over suppliers
- Leadership in some markets providing power over customers

Scope (geography, products, position in supply chain):

- Synergies between business
- Balance of cycles provided by variety of businesses and geographical scope

Operational excellence:

- Efficient financial reporting and control
- Excellence in manufacturing
- Organizational structure balancing global and local aspects of the different businesses
- Brand and market leadership

Extended portfolio of ‘local’ business, which has been carefully designed and is constantly adapted:

- Many businesses are intrinsically local, meaning that they cannot be delocalized in low cost countries
• Equilibrated portfolio of business
• Portfolio built to allow developing synergies and economy of scale across businesses
• Portfolio allowing to damp industries cycles

Finally, in many markets and technology areas, LargeCo has established strong leadership providing:

• Strong technical platforms (technology and manufacturing)
• Good knowledge of specific markets
• Unique access to customers

Organizational competencies

In addition to structural competitive advantages, LargeCo has developed relational contracts with its employees and stakeholders:

Lean operations:

• Frugality is widespread
• In many industries, operational excellence has been achieved
• Executives, managers and most employees have a drive for short term "bottom line" results

Hard work and compliance:

• Executives, managers and most employees are industrious
• Managers are usually high achievers
• The organization is very hierarchical, with a high level of compliance

Loyalty:

• Employees tend to be loyal to the company
Employees turnover is low, especially among managers

Strategic capabilities:

- Managers are very analytical
- Good capabilities at defining and implementing strategies
- LargeCo’s portfolio of businesses is constantly being tuned and adapted

‘Local versus Global’ balance:

- The level of central control is very high, but local managers are responsible for their P&L
- R&D is centralized, but largely controlled and financed by local business
Innovation Platform A

Introduction

In its early years, project A was considered one of the most important innovation projects of LargeCo. Directly supported by the CEO, it was an icon of the strategy of LargeCo promoting internal growth through the implementation of strategic projects addressing new markets with new products. Started effectively in 1999, it was considered highly successful in the summer 2004 when customers committed to long-term purchase agreements worth hundreds of millions of dollars.

Context

Using the Porter “Five Forces” model [52], I describe the main characteristics of the industry at maturity as people involved in the project could have described them in 2000 (5-10 years before maturity): strong power of the customers (few customers, potential hold-up linked to long term capital investment, potential spill-over on other business important to LargeCo), high rivalry between players, low power of the suppliers, high barriers of entry, and medium threat of disruption.

The main characteristics of platform A relative to strategic analysis are described in the table below:
Main observations

Opportunity identification and project launch: The opportunity of project A had been identified by marketing champions in the 90s. It took them several years to get an internal buy-in and have a project effectively launched. When platform A started in 1999, a major customer was about to launch its first product line equipped with a product similar to the target product of platform A. The main competitors of LargeCo in that field had already been working on similar projects for more than 10 years and two of them were already well established in the industry for slightly different applications.
**Initial stretch:** LargeCo had knowledge and industrial experience on the materials used in platform A. However, LargeCo had to develop a new product and a new process for this rapidly emerging market. In addition, LargeCo had no previous experience on applications similar to platform A.

**The initial strategy** was to develop and launch as quickly as possible a product only slightly differentiated to take advantage of significant market opportunities timely (Project A-I), and to invent strongly differentiated products for later market releases in parallel (Project A-II). At early stage, the scale of project A-I and its character of urgency didn’t leave much room to discuss competitive advantage roadmap and long-term strategy. As a “short-term must win,” project A-I absorbed most of the attention and resources.

**Risk taking:** Regarding project A-I, innovations have not been limited by an adversity against technical risks. The organization has always been prone to taking risks and persistent when trying to make things work. Examples of significant technical risks taken during project A-I are numerous.

**Motivation of teams:** At early stage, platform A was run as an internal venture. All Team members were very motivated and dedicated. Internal motivation, fueled by a great challenge and careful attention from LargeCo executives, was the main reason for this high level of engagement.

**Ideation:** platform A did not start with a technological invention. In fact, the first significant innovations on the product appeared 18 months after project A-I kick-off, and the first inventions on the process appeared after an additional 18 months. By analyzing the generation process of two of the most significant inventions of the project, common features can be identified: ideas appeared when a researcher had a problem in mind that hadn’t been solved in the lab, when he was out of his office, and subject to external stimuli. Another significant source of ideas for the project has been patents review meetings, where R&D and marketing people discussed competitors’ patents together.
Reaching out: Early successes of project A-I appears to be closely linked to relationships outside the project team: the first prototypes were manufactured in record times thanks to a strong networking with different plants in LargeCo, the testing procedure was setup in close collaboration with a potential customer, the first commercial product was developed in close collaboration with another customer and a preferred complementor, and the first customers were convinced largely thanks to a strong support from this preferred complementor.

Commitment and resources of LargeCo for this project were high by company standards. However, an analysis of patents suggests that competitor companies have dedicated significantly more resources in R&D and industrialization for those projects than LargeCo did.

Prototyping and testing: Prototyping and testing was instrumental in developing the first product line. Reliable testing took more than two years to setup, which was significantly longer than anticipated. The first tests quickly revealed that initial prototypes were not robust enough. Products needed to be significantly reviewed, which took an additional 18 months and many additional cycles of prototypes testing. Overall, the development time of the first product had been closely related to prototype turnover.

Hedging critical bets taken during fast development phases: Most of the risks taken during project A-I could have been mitigated at reasonable cost by doing parallel developments. In most cases, attempts in this direction have been made, but teams were very rarely successful with parallel projects aiming at hedging technical bets.

Innovation out of the scope of the main project (project A-II): The business has always invested resources to invent highly differentiated products. Despite significant resources allocation, only few prototypes resulting from exploration work have been delivered to partners or customers for evaluation.
from 1999 to 2007. Even though the absence of prototype delivery cannot be considered as a proof of bad performance, I personally think that the outcome of project A-II would have been greater, with the same dedicated resources, if project A-I wouldn’t have existed. The possible reasons that could explain this situation are the following:

1. **Lack of focus**: it is hard to kill options when dealing with “next generation” products. The lack of focus concerns both business opportunities to target and invention paths to pursue.

2. **Absence of threat**: the necessity of project A-II success doesn’t always clearly appear as people struggle to launch project A-I and have good feedbacks with this product.

3. **A “B team syndrome”**: executives and managers have always closely followed project A-I (short term source of revenue and success), but they have paid much less attention to project A-II.

4. **Not enough prototyping**: manufacturing and testing equipments have often been busy with tasks for project A-I, which usually benefited from a higher priority.

5. **Fear of cannibalization**: Products resulting from a success of project A-II would possibly cannibalize sales of products A-I. In addition, most the manufacturing equipment used for project A-I would be useless for project A-II.

**Roadmap of competitive advantage**: LargeCo was able to enter the market of platform A by developing the ability to supply a suitable product to a market where demand was significantly higher than the supply. As this market mature, LargeCo needs to reach competetiveness in project A-I, especially on cost, and to broaden its scope by developing new products. Improving competitiveness on project A-I requires traveling along the learning curve, developing operational excellence and operating at competitive scale. This roadmap is presented in the figure below:
Evolution of desired structural competitive advantages for SG platform A

<table>
<thead>
<tr>
<th>PROJECT A</th>
<th>First years on the market</th>
<th>Maturing market</th>
<th>At maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market characteristics</td>
<td>Demand &gt; Supply</td>
<td>Slower growth</td>
<td>Slower growth</td>
</tr>
<tr>
<td></td>
<td>High growth</td>
<td>Markets shared between 3</td>
<td>Possible disruption of high-end</td>
</tr>
<tr>
<td></td>
<td>Dominant design not fixed</td>
<td>dominant designs</td>
<td>products</td>
</tr>
<tr>
<td>Distinctive advantages</td>
<td>Location: proximity with</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best in class advantages</td>
<td>Ability to supply volumes</td>
<td>Cost</td>
<td>Scope (new products)</td>
</tr>
<tr>
<td></td>
<td>Brand of the company</td>
<td>Scale</td>
<td>Scale</td>
</tr>
<tr>
<td></td>
<td>Access to capital</td>
<td>Operational excellence</td>
<td>Operational excellence</td>
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<tr>
<td></td>
<td></td>
<td>R&amp;D</td>
<td>Cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to capital</td>
<td>Brand in this business</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>R&amp;D</td>
</tr>
<tr>
<td>Possible challenges</td>
<td>Cost</td>
<td>Scope (new products)</td>
<td>Need to dismantle high-end</td>
</tr>
<tr>
<td></td>
<td>Late on the market</td>
<td>Low market share</td>
<td>products' operations</td>
</tr>
<tr>
<td></td>
<td>Late on learning curve</td>
<td>Cost, scale</td>
<td></td>
</tr>
</tbody>
</table>
Innovation Platform B

Introduction

Platform B at LargeCo has generated both profitable businesses (Project B-I) and innovative projects (project B-II). From the beginning, this platform has benefited from the strong presence of LargeCo close to the fastest growing market, champions from the R&D community, and sustained market growth with strong perspectives (demand exceeding supply for about a decade). In addition, because platform B could benefit from some of LargeCo core technologies and from the availability of mature industrial capabilities, it had been able to leverage LargeCo natural competitive advantages early on.

Platform B consists in several projects that are presented in the table below:

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<thead>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Ia</td>
<td>B-0</td>
<td>Failed project: developing integrated systems. Discontinued due to poor results.</td>
<td></td>
<td></td>
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<tr>
<td>B-Ib</td>
<td>B-Ic</td>
<td>Possible improvement of B-I</td>
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<tr>
<td>B-Ia</td>
<td>B-Ib</td>
<td>Possible improvement of B-I</td>
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</tr>
<tr>
<td>B-Ib</td>
<td>B-Ic</td>
<td>Possible improvement of BI-a</td>
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<td></td>
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<tr>
<td>B-Ia</td>
<td>B-Ib</td>
<td>Integration of B-IIa technology in a system, in strong partnership</td>
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<tr>
<td>B-IIa</td>
<td>B-IIc</td>
<td>New product resulting from additional functionalization of B-la</td>
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<td></td>
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</tr>
<tr>
<td>B-Ia</td>
<td>Other route to obtain B-IIc product family</td>
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</tbody>
</table>

- B-0 was an early project aiming at providing complex integrated system in a market that was not growing significantly at that time. B-0 was discontinued in 1995. Although B-0 was not a commercial success, it served as an efficient exploratory platform for the following projects (B-I and B-II). In addition, the development of B-0 allowed for the hiring of experts in platform B technologies.
- B-I was less ambitious than B-O because it was focused on delivering simpler products to OEMs which were integrating systems. The different products of the B-I platform are leveraging LargeCo existing knowledge, industrial capacities, and scale.

- With projects B-II, LargeCo intends to capture more value by integrating more of the value chain and following technological changes.

**Context**

The strategic analysis of the B-I platform is presented below. It is interesting to compare it to the analysis of the A-I platform we have already presented in this chapter.

<table>
<thead>
<tr>
<th>STRATEGIC ANALYSIS</th>
<th>PLATFORM B-I – Analysis performed in 2007 with the intent to describe the situation and decision arguments as they existed in 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic fit</td>
<td>Opportunity of internal growth in strategic domains</td>
</tr>
<tr>
<td>Initial LargeCo strategy</td>
<td>Leverage core competencies and competitive advantage to supply a growing market</td>
</tr>
<tr>
<td>Initial structure</td>
<td>R&amp;D Project, as a sub-project of BO</td>
</tr>
<tr>
<td>Partners / Customers</td>
<td>Different potential customers and complementors.</td>
</tr>
<tr>
<td>Innovation level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>SWOT (Initial)</td>
<td></td>
</tr>
<tr>
<td>Strength</td>
<td>Short term: Brand, Existing product, available industrial capacity, Proximity to market</td>
</tr>
<tr>
<td></td>
<td>Longer term: Industrial capacity, scale, operational excellence, continuous improvements</td>
</tr>
<tr>
<td>Weakness</td>
<td>Short term: Late on market, Longer term: scope if B-I is not successful</td>
</tr>
<tr>
<td>Opportunities</td>
<td>Emerging market with good potential</td>
</tr>
<tr>
<td>Risks</td>
<td>Market future growth is not clear, sustainability of a market based on local subsidies, commoditization</td>
</tr>
<tr>
<td>Porter (Initial)</td>
<td></td>
</tr>
<tr>
<td>Customers power</td>
<td>Medium</td>
</tr>
<tr>
<td>Suppliers power</td>
<td>Very low</td>
</tr>
<tr>
<td>Barrier to entry</td>
<td>Medium: capital expenditure, scale, industrial knowledge, high prototyping cost</td>
</tr>
<tr>
<td>Potential substitution</td>
<td>Small</td>
</tr>
<tr>
<td>Potential disruption</td>
<td>High: next generation technologies, low cost solutions,</td>
</tr>
<tr>
<td>Rivalry</td>
<td>Short term: low</td>
</tr>
<tr>
<td></td>
<td>Longer term: medium</td>
</tr>
</tbody>
</table>

We observe that the platform B-I appears less a stretch than project A-I did because products and processes are part of LargeCo core knowledge, and because projects B-I present strong synergies with other business (assets, knowledge, customers). In addition, for similar reasons, it is expected that
LargeCo should be able to efficiently leverage operational excellence, brand, manufacturing equipments and knowledge in order to build a sustainable competitive advantage on platform B.

**Main observations**

**Opportunity identification and project launch:** The opportunity of platform B has been on LargeCo radar screen for several years before it started effectively because leading markets were located close to relevant LargeCo operations, and required technologies were close to LargeCo core competencies. In addition, LargeCo had taken part to R&D projects sponsored by the European community many years before the platform was launched. LargeCo started platform B as a follower in order to limit marketing risks as much as possible. A potential customer looking for a second suppliers, backed by promising marketing analysis, pulled LargeCo on platform B in 2002.

<table>
<thead>
<tr>
<th>OPPORTUNITY IDENTIFICATION</th>
<th>PLATFORM B-I – Analysis performed in 2007 with the intent to describe the situation and decision arguments as they existed in 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of identification</td>
<td>Started around 1975, B0 served as exploration between 1995 and 2002</td>
</tr>
<tr>
<td>Sources</td>
<td>R&amp;D champions and potential customers looking for additional supplies</td>
</tr>
<tr>
<td>Leader/Follower</td>
<td>Follower</td>
</tr>
<tr>
<td>Push/Pull</td>
<td>Pull</td>
</tr>
<tr>
<td>Innovation at start</td>
<td>The project didn't start with a technological invention</td>
</tr>
<tr>
<td>Partners/customers</td>
<td>One customer for B-la and another customer for B-Ic</td>
</tr>
<tr>
<td>Start of exploration</td>
<td>2000</td>
</tr>
</tbody>
</table>

**Initial stretch:** The initial stretch for project B-I was quite limited: products similar to what was required for project B-I were already sold by LargeCo for other applications, processes were mostly known, industrial equipment was available, and LargeCo brand had significant impact in this industry.

**Initial strategy:** The first product commercialized by LargeCo on platform B, product B-la, was only slightly differentiated from competition and similar to products already existing at LargeCo for other applications. LargeCo quickly launched product B-la after having performed some technical developments to fine tune the initial product and produce it with existing industrial equipments. The
strategy was essentially to leverage LargeCo knowledge, industrial capacity, operational excellence and brand to become a leader in platform B markets. The strategy has remained centered on the product: offering the best products at a competitive price, and trying to differentiate the offers by adding technical features to the products.

**Ideation:** Platform B did not start with a technological invention and the first products launched on the market were not highly innovative. At early stages, ideas were proposed and championed by R&D teams. The portfolio of projects of the platform was mostly established around 2000, soon after technically experienced researchers joined the project. At that time, it appears as a ‘natural portfolio’ based on an analytical assessment of the different ways to improve the product and better suit customers’ foreseen needs by providing functionalized products. During invention phases, core technologies have been efficiently leveraged, revealing good interactions within the technical community. Today, most of the people involved with the project are satisfied by the amount and quality of ideas and there is no tool to collect ideas across platform B.

**Organization structure:** The different projects of platform B are fully integrated within the standard R&D and business organizations of the relevant businesses. The platform consists in a group of projects managed individually. Steering committees allows for coordinating the different projects. However, by interviewing numerous people involved in platform B, I had the impression that the strategy and the vision of the platform were not completely clear in the field. Silos and tensions between organizations were also palpable.

**Prototyping:** New products are developed using existing pilot and industrial equipments to minimize investments and risks. This raises two difficulties:
1. Non-core technologies tend to be rejected by the organization because it is difficult to develop products that don’t fit on existing equipments and existing industrial know-how.

2. Prototyping of new ideas is cumbersome because project leaders often rely on equipment capacity arbitrages that can only be made by top management, which introduce delays and strong control.

Roadmap of competitive advantage: LargeCo was able to enter the market of platform B by developing the ability to supply a suitable product to a market where demand was significantly higher than supply. LargeCo was then able to quickly leverage some of its ‘natural competitive advantages:’ operational excellence, cost and scale. The challenge facing LargeCo in 2007 seems to be increasing scale quicker than its competitors and to developing scope by betting on the good technologies. This roadmap is presented in the figure below.

Comparing LargeCo projects (A and B-I)

“The companies that are enduringly successfully will be those that begin as early as possible to define and embody in their activities a unique competitive position. A period of imitation may be
inevitable in emerging industries, but that period reflects the level of uncertainty rather than a desired state of affairs.” M Porter [53]

The table below presents a synthetic comparison between the two LargeCo projects I studied: project A and project B-I. The table presents the degree of similarities between those projects with comments.

<table>
<thead>
<tr>
<th>Level of similarity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunity identification</strong> and project launch</td>
<td>High</td>
</tr>
<tr>
<td><strong>Initial stretch</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Initial strategy</strong></td>
<td>High</td>
</tr>
<tr>
<td><strong>Ideation</strong></td>
<td>High</td>
</tr>
<tr>
<td><strong>Structural organization of the project</strong></td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Innovating in parallel to the main project</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Prototyping and testing</strong></td>
<td>High</td>
</tr>
<tr>
<td><strong>Reaching-out</strong></td>
<td>High</td>
</tr>
</tbody>
</table>
When they were started, platform A and platform B presented strong similarities:

- Targeted markets were emerging and growing quickly. They were expected to exceed several hundred M$ in less than 10 years.
- Markets locations were close to LargeCo relevant businesses and R&D centers.
- Projects were based on materials that were well known to LargeCo.

However, at the end of 2007, LargeCo competitive positions on both projects were significantly different:

- Project B-I had captured more than 50% of the market. Project B-II was in its industrialization phase. LargeCo was confident in the sustainability of platform B thanks to a strong market position in project B-I, good perspectives with project B-II and other potential projects.
- Project A had captured less than 20% or the market. Project A-II hadn’t been launched industrially. With rather low market share, the competitiveness of project A as pressure on price was increasing appeared as a potential threat to the sustainability of the project, and project A-II hadn’t generated successful alternative yet.

Despite those differences, both projects had sales exceeding $50M. In addition, with markets still in under-capacity, demanded prices were still high.
Business opportunities and inventions in LargeCo

Why is this organization innovating?

LargeCo is innovates to maintain its leadership in its existing business and to grow new businesses.

What defines a good innovation project in this organization?

At LargeCo, innovation projects are ranked and controlled across the company using a centralized management tool. In short, this tool ranks project according to their Attractiveness and Risks.

Attractiveness depends on four factors that are usually pondered as follows:

- 35% ⇒ Sales at maturity
- 35% ⇒ Profitability at Maturity
- 20% ⇒ Strategic leverage (does the project fit with the strategy of the company?)
- 10% ⇒ Differentiation (product differentiation, IP, technological edge, etc)

Risks include technical, commercial and legal risks assessed using a three level scale (low, medium, high).

Who build possible business opportunities in this organization? Why are they good at it?

The development of business opportunities in LargeCo is not a clear process. Platform A and B have been started following strong pushes from potential customers when the markets where already quite well developed. In both cases, the corresponding business opportunities had been identified by marketing and R&D people in the organization years before the platforms effectively started. The long delay observed in both cases between the first identification of a potential business opportunity and the launch of the platform could be accounted for by strong adversity to market-related risks, long process of building buy-ins within the organization, and long decision processes at management level. The lack
of entrepreneurial behavior at LargeCo seems to be another hurdle to the process of building business opportunities.

Who perform technological inventions in this organization? Why are they good at it?

Technological inventions are performed by researchers within LargeCo. My study shows that partnering with potential customers or complementors seems to significantly improve the invention process.

How do opportunities interact with inventions in this organization?

Business opportunities are not prone to change and adaptation in LargeCo because they are brought by customers when markets are already well developed. As a result, interactions between opportunities and inventions are limited.
Conclusion and perspectives

I order to better understand the processes leading to breakthrough innovations in technology, I analyzed the interactions between business opportunities and technological inventions in four different organizations. I purposively chose organizations that were significantly different one from the other in order to draw cumulative insights that could be used to better understand the different dynamics of those interactions.

First, I studied two organizations that were relatively small and homogeneous: the Langer Lab at MIT and IDEO. I assumed that the Langer lab would be a great example of innovations factory-driven by technology inventions, and that IDEO would be a good comparable driven by customers’ needs. Then I moved to larger and more complex organizations: The MIT Innovation ecosystem and LargeCo (a large multinational company whose name has been disguised). The MIT ecosystem is complex and driven by technological inventions, and a LargeCo has strong interest and knowledge in customers’ needs.

I started this project by performing a literature search focused on the recent developments regarding ways of sourcing inventions, new ways to build business opportunities, and best practices for assessing innovation projects. Surprisingly, the four organizations I studied did not use many of the theories and practices described in the literature to source ideas and generate new business opportunities. The Langer Lab, IDEO, all the laboratories at MIT, and LargeCo all rely primarily on their own internal resources to generate inventions. Similarly, their approaches regarding customers’ needs and business opportunities don’t seem to leverage newly developed tools such as disruptive innovation, lead-users innovation, or empathic design (with the exception of IDEO for empathic design). Some exceptions have been observed, but it is fair to say that none of the four organizations I studied have embraced the new approaches of innovation described in recent literature. It is a surprising finding to
me, and I have yet to develop insights into possible reasons to explain this observation. In the future, it might be interesting to determine if this situation is related to either the dynamic of change in those organizations, or if it is structural.

After analyzing each of the four organizations, I systematically applied the following set of questions to them:

1. Why is this organization innovating? (Why)
2. What defines a good innovation project in this organization? (Filter)
3. Who build possible business opportunities in this organization? Why are they good at it? (Opportunities)
4. Who perform technological inventions in this organization? Why are they good at it? (Inventions)
5. How do opportunities interact with inventions in this organization? (interactions)

A summary of the corresponding answers is presented in the table below:
<table>
<thead>
<tr>
<th>Langer Lab</th>
<th>IDEO</th>
<th>MIT ecosystem</th>
<th>LargeCo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Why</strong></td>
<td>To Impact Human Life</td>
<td>To serve its clients</td>
<td>A spill over from MIT missions: knowledge &amp; education</td>
</tr>
</tbody>
</table>
| **Filter** | - Clear market need  
- New Product platform  
- Strong patents  
- Proof of concept | Depending on client | Depending on champions | - Expected sales (5 years)  
- Expected returns (5 years)  
- Strategic fit  
- Differentiation (10% weight) |
| **Opportunities** | Pr Robert Langer  
Polaris Venture Partners | Client  
Anthropologist designer | Lab director,  
Or  
Entrepreneur, MBA students, investors | Customers  
(for both platforms studied) |
|             | - Knowledge of market trends  
- Knowledge of technology  
- Capability to guess what inventions would enable. | - Empathic design  
- Knowledge of market trends | For aspiring entrepreneurs:  
- Knowledge of market trends  
- Business acumen | Adversity to market-related risks prevent leveraging identified business opportunities  
The lack of significant entrepreneurial behavior creates a hurdle to opportunities building |
| **Inventions** | Internal, by students | Internal, by designers | Internal, by students and researchers | Internal, by researchers |
|             | Passion, challenge, talent, curiosity, diversity of skills, teamwork, helping one-another, sharing information, hard-work, flat organization, strong autonomy and freedom | Same as Langer Lab  
Exposure to many different innovations in many different industries. | Same as Langer Lab | |
| **Interactions** | Strong | Strong | Strong | Weak - Moderate |
|             | The constant interactions between Pr Langer and his student, with timely feedbacks, leads to strong interactions between inventions and opportunities. | Inventions and opportunities are intertwined.  
Prototyping as much as possible promotes those interactions. | Numerous networking events allow inventions and opportunities to collide, to be discussed, transformed and filtered.  
Angel investors, professors, coaches in entrepreneurship, and venture capital firms play an active role in activating those interactions.  
The strategy of startups changes significantly before product commercialization.  
Demanding customers allow for rapid testing and adaptation. | Business opportunities are not flexible in the case of LargeCo.  
As a result, interactions between opportunities and inventions are limited. |
By comparing IDEO and the Langer Lab, I show that both organizations present strong similarities. Because both companies are very successful at inventing, I argue that the common features between IDEO and the Langer Lab might define the blueprint of an inventive organization. Such an organization has intellectually outstanding employees driven by passion and challenges, with strong internal motivation and creativity. Those people praise interdisciplinary diversity and are team-oriented. They help each other, and they share both information and ideas actively. The organization is flat, promoting individual freedom and autonomy in open workspace. It doesn’t use any system of management per objectives. The main tasks of the employees in those organizations are to invent, share information and develop their expertise. The Langer Lab and IDEO produce enough inventions for their needs. They don’t rely on external sources of inventions.

My analysis of the identification and generation of business opportunities in the Langer Lab and in IDEO lead to insights that surprised me. By analyzing the Langer Lab, I realized that the main competitive advantage of this lab as compared to other labs is the ability of Prof. Langer to build business opportunities. It came as a surprise because I initially picked the Langer Lab as an example of one innovation factory driven by technological inventions. I have identified three factors that could explain Langer’s successes at building business opportunities: his good knowledge of market trends supported by his strong relationship with Polaris Venture Partners (venture capital firm), his broad knowledge of applicable technologies, and the ability to guess the possible impacts of inventions that could be made in his lab in future market places. At IDEO, defining the most relevant business opportunity, which translates into ‘identifying the deep needs of the customers of their clients’, is considered as one of the most important tasks. Their systematic use of empathic design in this phase demonstrates the potential interest of this approach.
The study of the MIT innovation ecosystem reveals an interesting entrepreneurial path characterized by the leadership of potential entrepreneurs who are not initially related to the inventions they want to commercialize. Those aspiring entrepreneurs scout MIT for inventions relevant of the business opportunities they have detected, or they generate new business opportunities after having been exposed to new inventions. The fact that this path is well developed in the MIT ecosystem indicates strong incentives to start new companies in this environment. Our analysis of the MIT ecosystem shows that those incentives are personal, financial, and social. In addition to strong incentives, the high tolerance of the ecosystem regarding failure reduces possible downsides.

My analysis of LargeCo reveals two things regarding business opportunities management. First, it seems that a strong aversity to market-related risks prevents LargeCo from leveraging new business opportunities identified by its employees. In the two innovation platforms I studied, business opportunities were brought by potential customers when markets were mature enough and presented low risks. Second, business opportunities that allow leveraging quickly its ‘natural competitive advantages’ are best suited for LargeCo because developing other competitive advantages timely appears to be difficult in this organization.

Interactions between business opportunities and technological inventions are intense and clear at both the Langer Lab and IDEO.

The structure of MIT’s innovation ecosystem also enables frequent and intense interactions between technological inventions and business opportunities. Interactions start very early on in the form of networking events, cocktail parties and conferences that allow inventions and opportunities to collide, to be actively discussed, transformed and filtered. In addition, Angel investors, professors, coaches in entrepreneurship, and venture capital firms also intervene very early in the process by signaling where in which area labs should focus their research efforts. After inventions and
opportunities have initially matched, interactions continue because startup companies usually change their strategy between initial funding and product commercialization. Finally, the presence of demanding customers in the ecosystem allows for rapidly testing new innovations. We see that the MIT innovation cluster allows for dynamic and intense interactions between inventions and business opportunities. Further work could be done in order to better assess the relative importance of those interactions in success of innovation ecosystems.

As compared to what we observe in the MIT ecosystem, interactions between business opportunities and inventions are quite weak at LargeCo. For one thing, interactions between business oriented people and R&D people are limited and usually focused on short term challenges. In addition, the reluctance of LargeCo to take market-related risk limits the flexibility in possible business opportunities and thus makes the innovation system more rigid and less adaptable. Finally, the lack of entrepreneurial behavior seems to be another hurdle to the interactions between inventions and opportunities at LargeCo.
List of References


8. The_Economist, Something new under the sun: A special report on innovation, in The Economist. 2007, October 11th.


