

Louvain School of Management

Comprehensive approach toward managing innovation with machine learning algorithms

Enhancing the entrepreneurial strategic vision
and ecosystem of innovative projects throughout
large language models

Author: **Fiset ALEXANDRE**
Supervisor: **Gailly BENOÎT**
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Abstract

In this work, we extended research already made in the fields of building a shared strategic vision for innovation and managing an entrepreneurial ecosystem for innovative project with new research conducted after 2021. The results of the research suggested that building solutions should be tailored to the organization, the external environment it is evolving into, and should be flexible. The second part of this work involved developing an AI tool capable of providing guidelines specific to a firm and its environment. Because the field of AI tools is still in development, we proposed a flexible solution not confined to a specific model, allowing further use cases and models can be tested. We finally found that the models we used in this work are still limited, as most of them successfully synthesis the given theory, while only the Mixtral model show enough cognitive capabilities to create links between the proposed PRPL Foundation organization and the given papers. For example, Mixtral model was able to provide specific guidelines to motivate the different stakeholders within the foundation. While this works shows promising results, there are still remaining open questions. The first is to acknowledge the reproducibility across several sectors, and the second is to create a system so that important papers can be directly fed to the system.

Foreword

The field related to this work is the management of innovation. This work is seen as a first step in exploring the capabilities that IA tools can have in the management field to aid in decision-making and strategy creation. The main concern of this work is to address the problems that managers developing innovations are confronted with. As managing innovation is time-consuming, keeping up to date with the literature in that field is non-negotiable. This is why we address this problem by transforming it into a tool to reduce the time for managers willing to adopt a scientific approach in the management of their innovative environment. As both fields, management of innovation and AI tools, are hot research domains, this work and result obtained will tend to fade over time. That is why we also gave advices and created guidelines that will remain constant over time. Since we are working with algorithms using copyright work to learn about a field, only open-access papers were chosen for this work to avoid any copyright problem and respect researchers. Currently, the ruling on using papers in AI tools is not yet well-defined, so we used the principle of parsimony. Finally, because this work is limited, we could not explore and strengthen our research and results about AI tools, leaving some gaps to be addressed in the future, such as cross-sector comparisons and false answers produced by the model.

As a disclaimer, this work utilized generative AI tools to refine the language used. These tools were employed a linguistic assistant by providing part of this work as drafts and then comparing the given output with the draft to produce the final version. In all cases, the output was analyzed and compared with the original to create a mixt resulting in the final version. These tools were never used in this work to conduct research or to create chapters/paragraphes from simple queries.

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Introduction

On the time of writing, people are more and more enthusiasts about AI and chatbot such as ChatGPT developed by OpenAI ¹. This enthusiasm is mainly due to the ease and facility to use such tools and the mass adoption foreseen (Duarte, 2023). Those tools are part of an undergoing development to analyze big set of data and to extract useful information dedicated to particular topic (Elyan, 2011) ². Such tools are presented as decision helpers to highlight important aspects to consider. For example, IBM Watson ³ can detect rare diseases given set of symptoms, although the final diagnostics should always be made by an expert as it need verification. Nevertheless, this reduces the research time and help identifying possible solutions, reducing the range of possibilities.

AI comes with a more general trend inherent to humankind, innovation. Innovation is a word which is very familiar in everyday language, but few really understand the idea behind it. This work, in order to define what is innovation, is based on the research of Benoît Gally, Professor at UCLouvain ⁴, and the materials provided, *Navigation Innovation* (Gailly, 2018) and the linked web platform ⁵. As stated, this work aggregate over 20 years of research on the matter, thus references and ideas bring through this work take time to master. As the field of managing innovation expands over time, managers also need to free up time to continuously update their knowledge in this area.

Such available time cannot be freed for entrepreneurs or managers that need to keep innovating while doing business. Managing innovation, despite the time it takes to master, shows an important factor in successfully achieve goals. If we take a narrowed field which is startup management, growing of such enterprise can be found on figure 1.1 (Baroudy,

¹<https://chat.openai.com/auth/login>

²<https://www.ibm.com/watson>

³<https://www.ibm.com/cloud/healthcare>

⁴<https://uclouvain.be/fr/repertoires/benoit.gailly>

⁵<http://www.ipdigit.eu/ebook/appendix-methodology/>

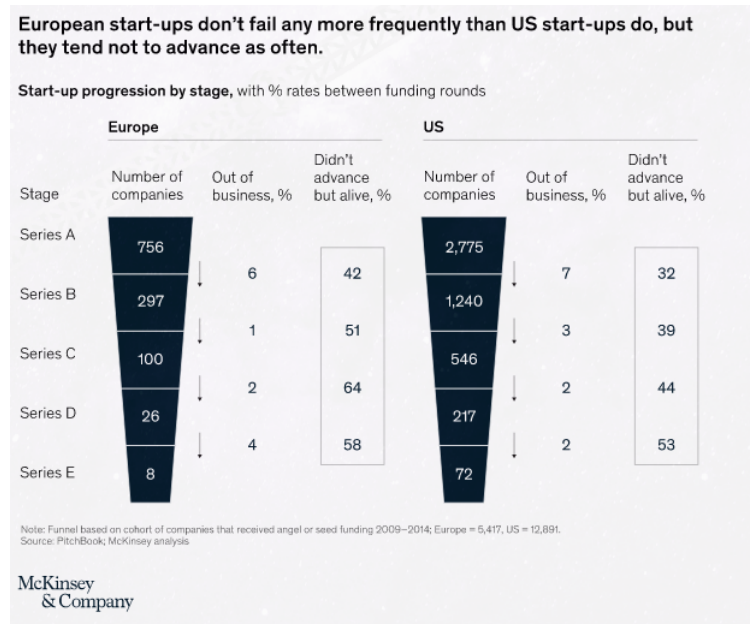


Figure 1.1: Failing rate and stagnation of startup through founding stage

2020). As resources mobilized for innovation is not negligible, reducing failing rate is crucial to increase ROI. With the recent breakthroughs in tools to handle big amount of information and making links between it, an entrepreneur, with limited knowledge in managing innovation, could take advantage of these technologies to enhance his ability to bring his project to a successful story.

AI is for now used in some large corporation or small technological startup (Benbya, Davenport, & Pachidi, 2020). They play a role in reinforcing or discover new methods in terms of process and activities (Gama & Magistretti, 2023).

However, adoption still faces challenges as deployment in production is still not enough mature to strengthen the corporate confidence in investing in it. The most common models tested by these early adopters are BERT (Devlin, Chang, Lee, & Toutanova, 2018) and GPT-3 (Brown et al., 2020). These models are chosen because they offer a better understanding of the context over a given dataset, whereas their predecessors relied on frequency analysis algorithms (Just, 2024).

Despite the challenge of adoption, several applications were developed in the field of managing innovation. They mainly aim at selecting ideas over a pool with low classification error compared to expert (Bell, Pescher, Tellis, & Füller, 2023) or to help at increasing and refining the area of solutions from an initial idea (Bouschery, Blazeovic, & Piller, 2023; Bag, Gupta, Kumar, & Sivarajah, 2021).

What can be observed is that the available AI tools in the market have their action range limited to the initial tasks in the innovative process. However, managing innovation extend far beyond this initial phase, resulting in a gap. This gap is what this work aims to address.

For that, first, a review of the literature over managing innovation will be complete. Then, a comparison over the different AI tools available on the market will be done. Methodology on how the literature review was proceeded will be explained to justify the relevance of the articles found. Then a comparison with the previous theoretical background given by the work of Prof. Gailly will be produced. After that, building and training of the different models will be exposed. Finally, an analysis of the responses given by the models and the pertinence to the given selected project will then be discussed.

Theoretical background

This chapter aims to bring together the in place theory in the field of innovation management. It also brings the fundamentals about models and their limitation. First, the state of the art in managing innovation will be exposed. Then LLMs technologies available on the market will be evaluated with their limitation in the perspective of the tasks they are expected to perform.

2.1 Managing innovation

This section will expose the knowledge given by the work of prof. Gailly (Gailly, 2018). We will explain the different concepts and results given in the chapters *build a shared strategic vision of innovation* and *managing entrepreneurial ecosystem*. This will allow the reader to understand why some papers were chosen in our review and their contribution to the resources given by prof. Gaily.

2.1.1 Build a shared strategic vision of innovation

Agreeing on what and why a firm should engage in innovation is a challenge when multiples parties are involved, as belief and strategies may differ. How to manage the different process involved also need to be defined, resulting in strategic decision to drive the innovative process. We will explore the different challenges and concepts that building a shared strategic vision implies.

Why it matters : Innovation management capabilities Understanding the importance of enabling innovation management in a firm is the first step before building a shared strategic vision. Today's world is defined as VUCA (volatile, uncertain, complex

and ambiguous), describing high frequency of disruption. Those disruptions first comes from megatrends such as international competitiveness and social challenges like ecological awareness. These megatrends imply disruptions through new technologies arriving in the market, change in customer needs, or changes in regulations. All these disruptions affect the firm's sustainability, and not keeping up with them will impact their business by making it outdated. This is why developing innovation management capabilities is crucial for a firm that intends to evolve with the world and not becoming obsolete. This implies to adapts and be flexible to align with environment changes.

Innovation as a business: more than creativity Reasons why a firm should enable innovation management shows that innovation is not only about creation, but also about applying changes in existing ones. Innovation might be seen as new for some, but as a small changes for other ones. Managing innovation involve changing people's perception by guiding them through changes.

Innovation as a process: beyond ideation Managing innovation is not only about ideation, but also about guiding people through changes. As innovation requires end-users and stakeholders, it requires changes in people's routines. Breaking someone's routine requires some effort, as people tend to avoid changes due to fear of the unknown. Therefore, the main task lies in driving the adoption. This can be done by demonstrating the benefits of the innovation while showing the ease and low risk of adopting it.

Innovation typology: beyond new products Talking about innovation and how to guide people through it is important, but the guidance might differ depending on the innovation itself. Therefore, defining the innovation is crucial, as motivating people to adopt it may vary. There are two major different axes to considered. The first one is about making new things or making new ways of doing similar things. The second one is about the degree of change compared to existing technologies, whether it is an incremental change, or a radical modification. Defining the innovation will determine its added value.

The majority of business are adding value with services, making new products a small part of the total possible innovations. New ways of doing things also allow business to differentiate from competitors while not disrupting customers, thereby reducing the efforts needed in innovation's adoption. The space for creating new products is then small compared to the range of possible innovations. Innovation is much more about designing business than creating new products.

Innovation strategies: beyond new product development Defining the innovation strategy begins with identifying the firm's current core business. Then, the firm can define its innovation strategy in two ways. The First way is to define how the firm want to extend its core buiseness, this means exploring new needs or new solutions to compete for. The second way is to redefine how the firms want to compete on new markets or with new products. The goal of redefining the core buiseness is to challenge the core strategy to achieve potentials benefits while mitigating the risks. For example, the first-mover in a innovation is not always the best solution, as it can lead to an high uncertainty.

Drivers of innovation strategies: beyond hype While adopting an innovative strategy, managing innovation should aim at leveraging its resources and networks. The firm's strategy and surrounding environment might change. The goals of having an innovation strategy is to adjust the available resources and networks to best fit what the firm's prediction of what the future will be made of. This prediction about the future involves various stakeholders who need to acknowledge a shared vision. The firm posture to a particular innovation can then be defined by this shared vision and the strategy adopted, rather than just following trends that are not aligned with the firm's long-term objectives.

2.1.2 Manage entrepreneurial ecosystems

Having an innovation strategy is meaningless if you don't have the resources and people within the firm to drive it. Innovation is prone to risk, creating an entrepreneurial ecosystem means creating an environment that enables experimentation, learning and failure. As different stakeholders can be involved, the entrepreneurial ecosystem can be different depending on the level of collaboration.

Encourage people to innovate: corporate entrepreneurs Entrepreneurs are ordinary people willing to changes things. Entrepreneurs focus on mobilizing the different resources they have to engage new ventures while being flexible with their goals and organization. This behavior can be encouraged by allowing people to test and learn while developing their skill set and offering incentives when tackling uncertainties.

Build and lead effective innovation teams: balancing acts When creating an environment in the firm, multiple stakeholders are involved, one of those are the teams

engaged in the innovation. A crucial factor in the innovative performance is the building and managing of those teams. When building teams, it is important to let some free time to for them to explore and fail. This exploration can be strengthened by having a diversity in terms of character and skills fitted to the innovative initiative.

Build and manage innovation-ready organizations: how some elephants can dance The willingness to innovate is not the whole picture, underlying characteristics must reside inside the firm to innovate. The firm's mindset need to support learning and exchange activities, and people within it need to trust the firm in breaking traditional organization structures. The firm must support those new ventures by allowing them to evolve away from the inertia of the organization. This implies that the firm should be flexible enough to enable the agility of small structures while efficiently sharing resources available in the organization.

Develop innovative networks and collaborations: never walk alone The organization might not have all necessary resources to achieve scale and speed in their development. Sourcing partners can allow the firm to acquire unique resources and capabilities. When building partnerships, an important aspect to consider are barriers of the distance and culture, which the firm need to be capable of trading off as they reduce efficiency. Managing innovation then implies attracting and seeking new collaborators, which requires skills in identifying and selecting the right partners and creating of the right interactions. A particular case of collaboration is open innovation, which is defined as continuously reaching out to outsiders and developing innovation with them.

Create innovation ecosystems: lands of opportunities When developing an innovation, the firm is bound by its regional innovation ecosystem. Available infrastructure and institution in the region allow innovative ventures to source knowledge, human and financial resources. Strong public intervention is needed to maintain this regional innovative ecosystem and support new ventures, as most of them are limited in resources. The region then need to enhance private and public innovation support mechanism to allow the innovative ecosystem to grow and effectively support innovative ventures.

2.2 AI algorithms available on the market

The goal in this work is to find the fitted AI algorithms for processing literature which could be applied afterward to a case study. An AI algorithm capable of understanding our documentation is part of a machine learning algorithm known as NLP (Natural Language Processing) (Bonaccorso, 2017). But that is only one part of the solution, as the model need to also generate an analysis depending on the project and questions submitted. While understanding the query is still part of NLP, generating a reasonable output need first to perform an information retrieval on the given information, such algorithms based on language models are explained in the reference book (Kraaij & Spitters, 2003). Then with that information retrieved, a human-like answer needs to be generated, those kinds of algorithms are part of NLG(Natural Language Generation) (E. Reiter & Dale, 1997). As the goals of this work is not to create a new machine learning architecture for helping entrepreneurs to manage innovation, available tools on the market will be evaluate with their ability to answer the last mentioned capability :

- Generating human-like language.
- Understanding human-like language.
- Retrieving information.

While the first point is important to ease the utilization of the wanted tool, the last two criterions are more important as it is crucial that the tool understand and retrieve the right information.

2.2.1 Tools of interest

While there is a lot of possible application available on the market, the comparison in performances is a key aspect to compare between different algorithms and their use. One of the biggest dataset found online with open source models can be found on Hugging Face ¹. Algorithms solving the 3 mentioned problems are often classified as multimodal algorithms or LLMs (Large Language Models). Hugging Face offer a real-time leaderboard over such algorithms on different benchmarks (Beeching et al., 2023). Available benchmarks differ in terms of task given to the algorithm, HellaSwag (Zellers, Holtzman, Bisk, Farhadi, &

¹<https://huggingface.co/models>

Choi, 2019) and Winogrande (Sakaguchi, Bras, Bhagavatula, & Choi, 2019) are the most promising benchmark in regard to a single task reasoning. Others presented benchmarks, such as MLLU (Hendrycks et al., 2021), are more suited to test multipurpose tasks, but one other interesting benchmark metric to take into account is the ThruthfulQA (Lin, Hilton, & Evans, 2022), which test the robustness of the model against false information. Based on the 3 benchmark chosen, Hellaswag, Winogrande and ThruthfulQA, most promising architecture are MixtralForCausalLM and LlamaForCausalLM².

Mixtral : Mixtral model is the most open source performing model of Mistral AI³, it is referred as Mixtral of Experts (Jiang et al., 2024). Mixtral 8x7B work with the same architecture as the Mistral 7B model, but instead of having only one feedforward block⁴, it randomly chose two feedforward blocks among 8 and combine it. It has the advantage of having access to a high number of parameters (47 B) while only actively using a part of them (13 B), which reduce latency and cost.

Llama 2 : Llama 2 is a new open source family of pretrained and fine-tuned models going from 7B to 70B developed by Meta (Touvron et al., 2023). The main breakthrough developed on the models, is the training of the model. Llama use two different reward system⁵ to judge separately the helpfulness and the safety.

2.2.2 Prompt engineering and context creation

Given that models take as input natural language, multiple prompts can express the same requested information. Managing to create a prompt to ask a generative model to work on the task requested is still a hot topic, with no or a few metrics to judge the quality of research. As the reviewing the literature over the field require a deep understanding of the field, only the source from the biggest LLMs actors will be taken as knowledgeable. In the prompt engineering guide of OpenAI⁶, strategies suited for the test case to get better results while prompting are :

- Avoiding fake answer or hallucinations by providing reference text.

²ForCausalML stand for models that generate output text (next token) by only taking in consideration the left tokens (already generated token)

³<https://mistral.ai/news/mixtral-of-experts/>

⁴A feedforward block is a group of parameters which can be trained and process a token

⁵A reward system, in AI, is a model designed to give a score on the response given by a prompt

⁶<https://platform.openai.com/docs/guides/prompt-engineering>

- Splitting complex task in multiple simple task.
- Asking for the *chain of thought* to correct errors and slow down the *thinking* process.

Once the queries are defined, the models need to have access to the papers. For that, embedding the documents must be done. As different models can be found with different metrics and performances ⁷, we will use a common embedding model for all of our LLMs models. Still different embedding models are available and keep being developed. For the use case, we will define a transformer model with the help of the already present tools and the availability of the ecosystem we are using to build our solution.

For the rest of the work, we will concentrate our self over 2 models, Mixtral and Llama 2 as they outperform the rest of the market. Queries will be created and maintained through different models, as section 2.2.2 suggest.

As the one best practice of the prompt is to provide sources or text of reference to the model, all documentation used in the section 2.1 will be given before any prompt.

Building a shared strategic vision and managing the entrepreneurial ecosystem involve numerous trade-offs and external collaborations that the firm need to be capable to deal with. This underscores the necessity of managers to have vast knowledge and remain constantly aware of the environment in which the firm operate. Available tools such as Llama 2 or Mixtral show strong cognitive capabilities to understand and answer questions based on the given dataset. Therefore, in the following sections, we will construct our dataset and test the cognitive capabilities of these models over a use case.

⁷<https://huggingface.co/spaces/mteb/leaderboard>

Methodology

For the review of the literature we used the same methodology described to build the relevant literature for *Navigation Innovation*, to ensure high quality papers (Gailly, 2018)¹. Because the goal of the review was to refresh the already given literature over the subjects of *Build a shared strategic vision of innovation* and *Managing entrepreneurial ecosystem*, only papers in the 2022 and 2024 time frame were taken. Also, only most cited journals in *general management* and *Innovation & Entrepreneurship* were reviewed. The 2021 ranking (last released guide) in the CABS² and the SJR Scopus³ h-index of the selected journals can be found on table 3.1

Journal name	AJG 2021	AJG 2015	H-index
Strategic Management Journal	4*	4*	318
Research Policy	4*	4	271
Administrative Science Quarterly	4*	4*	201
Journal of product innovation management	4	4	162
Technovation	3	3	150
R&D Management	3	3	112

Table 3.1: Ranking of journal chosen for the literature review.

Refining the research over the keywords *innovation*, *strategy*, *entrepreneurial* or *ecosystem* on the time frame of 2022 - 2024 gives the number of issue paper referenced in table 3.2.

¹<http://www.ipdigit.eu/ebook/appendix-methodology/>

²<https://charteredabs.org/>

³<https://www.scimagojr.com/>

Journal name	n papers	n open access papers
Strategic Management Journal	231	110
Research Policy	414	206
Administrative Science Quarterly	65	28
Journal of product innovation management	130	77
Technovation	446	168
R&D Management	148	80
Total	1313	595

Table 3.2: Number of paper resulting of the query "innovation OR strategy OR entrepreneurial OR ecosystem" on selected journals.

But by using the query, a paper not related to the subject we are seeking may still appear. As the papers are going to be used to a model and because of copyright, only open-access papers abstract and title were reviewed to found papers related to the subject. Then a more deep analysis was made to narrow down the studied papers, to only include papers that are really related or bring a valuable contribution to the studied topics. The meaning behind valuable contribution, is the removing of paper targeting a too small geographical area such as *Resource allocation and growth strategies in a multi-plant firm: Kanegafuchi Spinners in the early 20th century* (Yamaguchi, Braguinsky, Okazaki, & Yuki, 2023), Resulting in keeping papers studying trends on a national variety of organization. The resulting number of papers can then be found on table 3.3. Only selecting open access papers lead to a limitation and a vulnerability on the review of the literature processed. This limitation of using open-access papers will be discussed at the end of this work.

Journal name	n open access papers	n selected papers
Strategic Management Journal	110	25
Research Policy	206	18
Administrative Science Quarterly	28	1
Journal of product innovation management	77	12
Technovation	168	21
R&D Management	80	10
Total	595	87

Table 3.3: Selected papers for review.

The number of citation of the papers were not taken into account, as most of them were only 1 to 2 years old. We assumed that picking them from high quality journals is a sufficient criterion to include them in the review. Such a limitation will be discussed at

the end of this work.

The selected papers were then classified among the common topics they are referring to. The organisation of those papers and the common topics can be found on table 3.4.

Common topics	n papers
Build a shared strategic vision of innovation	
Innovation as a business: more than creativity	4
Innovation as a process: beyond ideation	6
Innovation typology: beyond new products	3
Innovation strategies: beyond new product development	2
Manage entrepreneurial ecosystems	
Encourage people to innovate: corporate entrepreneurs	4
Build and lead effective innovation teams: balancing acts	4
Build and manage innovation-ready organizations: how some elephants can dance	8
Develop innovative networks and collaborations: never walk alone	35
Create innovation ecosystems: lands of opportunities	21
Total	87

Table 3.4: Topics cover by the literature review.

One can notice the amount of papers varies among the different subsections with a majority being part of *Develop innovative networks and collaborations: never walk alone* and *Create innovation ecosystems: lands of opportunities*. Showing active research in the field of collaboration and ecosystem creation.

With the separation done, we will in the next chapter highlight the added value that each paper brings in its subsection.

Results

This chapter aims to underline the important aspect describe in Chapter 2. As a reminder, the goal of this work is to identify the important aspect to consider when managing an innovative project across the two topics, *Building a shared strategic vision of innovation* and *Managing entrepreneurial ecosystem* and complete the previous literature with more recent one. This will allow evaluating the responses given by our AI tools in regard to a situation. First, the new papers coming from the review will be placed in the subsections presented in the Theoretical background. We will then emphasize the main changes that were found with already in place literature. This will allow us to then evaluate the model build and its reaction to the given case.

4.1 Contribution to existing literature

4.1.1 Build a shared strategic vision of innovation

Innovation as a business: more than creativity Changing people’s perception is crucial, internal stakeholders have their lone vision and bias regarding managerial decision. Those decisions, if not carefully managed, may discard or harm innovative ventures (Chen, Magnusson, & Björk, 2023). For example, CEO narcissism is known to have a beneficial outcome when it comes to increase the innovative performance of a firm. In another hand, this narcissism can lead to reducing collaborations, causing the cancelation of those performances (Kraft, 2022; You, Li, Jia, & Cai, 2023).

It has also been shown that adopting a more scientific approach in developing the innovative project, reduce emotional decision-making and thus possible switch in the development, leading to reduction in development cost and then reducing the failure (Camuffo et al., 2024).

Innovation as a process: beyond ideation When it comes to convincing stakeholders, enabling democratic decision-making among stakeholders and the innovative project (Radaelli & Currie, 2023), shows good results in terms of adoption. However, careful analysis of the stakeholders' values need to be done, as it has been shown that it exists values such as nationalism which can moderate relationship between multinational corporation and limit the international visibility (Wu & Fan, 2024). Organization and individual hubris can also impact positively the innovative performances and organization/team recognition. But can lead to limitation when it comes from external resource seeking as it affects the image of the organization and the innovative project itself, increasing the polarization of stakeholders (Gamache, Pfarrer, & Curran, 2024).

Having the stakeholders adhering and being motivated by the innovative ventures is crucial, as their involvement depends on their commitment. As in high competitive market, organization innovation capability results from the employees' innovation and managers' proactive goal regulation (T.-Y. Kim, Wang, Schuh, & Liu, 2024). A way of increasing motivation is by pitching outcomes in the venture (Harmon, Rhee, & Cho, 2023).

Larger firms that show efficiency in redeploying resources and gathering help from external stakeholders, increase success likelihood for the innovative ventures it conducts and then gain the trust on the market and future shareholders or investors (Dickler, Folta, Giarratana, & Santaló, 2022).

Innovation typology: beyond new products When defining the innovation, the surrounding ecosystem needs to be characterized to offer a complete service and increase adoption likelihood (Borner, Berends, Deken, & Feldberg, 2023). This is even more true for highly specific and radical innovation (Abbasiharofteh, Kogler, & Lengyel, 2023) as most radical innovation tends to be developed by users (Preißner, Raasch, & Schweisfurth, 2024). Such ecosystem helps to facilitate the adoption rate by responding to a need with a complete solution.

Innovation strategies: beyond new product development Commercial viability and technological feasibility are key aspects when selecting innovation to extend the core business (Chatterjee, Chaudhuri, Mariani, & Wamba, 2023). Feasibility and viability allow the firm to evaluate if the business must be extended. Indeed, innovating is not always the best approach, as users can be reluctant to changes, preferring to stick to the old technology (Li, 2024). Another example, of avoiding entering a market is by analyzing

the market trends, a better adoption rate is shown for innovation produced during busts of technology and have a larger effect than those developed during booms of technology. This highlights the importance of the cycle composition in-between research and founding (Li, 2024).

4.1.2 Manage entrepreneurial ecosystems

Encourage people to innovate: corporate entrepreneurs Not every one wants to become entrepreneurs, detecting people willing to can help targeting the different incentives. Entrepreneurs that have higher cognitive empathy and risk propensity, are better to implement an innovation in their institution than the ones having a higher emotional empathy (Vassallo, Banerjee, Zaman, & Prabhu, 2023).

Space of learning and knowledge sharing in important, employees having access and allocating attention to a strong brokers network, increase their participation in idea generation and implementation in the firm's products or processes (Rhee & Leonardi, 2024). Motivating and the ability to capture the employees' attention are keys metrics when making the network available. Creating an entrepreneurial space inside the firm has shown to increase the knowledge management and spillovers. Increasing also the value of the knowledge shared and its impact over international open innovation and engagement within the networks (Ferreira, Fernandes, Veiga, & Dooley, 2023).

Another important point is creating space for failure, it has been shown that early-stage failure is preferable to late-stage failure, as the knowledge gained can be easily used to launch new early-stage innovations (Wang, 2023).

Build and lead effective innovation teams: balancing acts Team diversity is important, incorporating new external members create a space of new perspective, underlying the importance of having a diversified team when building innovative project (Chang, 2023). This even extend to the board management, where having different background and education leads to a different and unique perspective vision of the innovative project, helping to increase the long term value of radical innovation (Genin, Ma, Bhagwat, & Bernile, 2023). Diversity is a key aspect in team composition, but also in the organization of the firm itself, has using tools more fitted to the team for a specific innovative project lead to more novelty in the final outcome of the project (Miric, Ozalp, & Yilmaz, 2023).

Teams can also be seen as pools having specific knowledge. A crucial role of managers is then to spread and enhance cross-pools collaboration to strengthen innovation performances

(Walrave, van de Wal, & Gilsing, 2024).

Build and manage innovation-ready organizations: how some elephants can dance When managing a portfolio, firms tend to hire employee with high transferable competencies, whereas employee with high level specialization are preferred for solo ventures. But when the rigidity of the market is low, this distinction is mitigated (Hietaniemi, Santamaria, Kacperczyk, & Peltonen, 2024). Redeployment also comes with an increase in financial performances for the projects due to knowledge spread-over, especially when the redeployment is for specialist. This has to be mitigated as most of the time specialist are redeployed in the same sectors, whereas generalist can be redeployed in different activities sectors due to their competencies (Sabel & Sasson, 2023). Flexibility in resource allocation and management procedures is key. Firm capable to change their managing way of doing by learning from failure (Love, Roper, & Vahter, 2023) and create learning activities to open reflection space (Harvey, Cromwell, Johnson, & Edmondson, 2023) shows better success in their project.

International organization have another advantage when learning from failure, for example by using trial launch on high competitive markets to learn from failures and experiments. This has a side effect of increasing the preemption on other markets, but reduce the cost of failure when launching is made globally (Klingebiel, Joseph, & Machoba, 2022). Also, when the market of the firm is already global, change on a particular market can lead to a market advantage as unexpected events may have already been experienced on another market. But for that, knowledge communication across-market need to be fluid (Garrido, Giachetti, & Maicas, 2023).

Distance is also a key aspect in giving agility to the ventures, having a certain distance to a headquarters balance the freedom and promotion to an innovative venture (Kumar & Operti, 2023). Big organization also tends to decentralize their R&D center, but it comes with a balance between quality and intra-knowledge spillover in the whole firm (Eklund, 2022) as distance may reduce the quality and reduce the knowledge sharing from the R&D center to the headquarters.

Develop innovative networks and collaborations: never walk alone Collaboration can have different aspect and nature depending on the firm size. First alliance that are independent of the size will be exposed, then the difference between small and larger firms will be introduced. As a last comment, some points about open innovation will be exposed.

Alliance between organization doesn't depend on the size, but need some leader to drive it, which generally are market leader in their domain. Joining an alliance give access to a network, but still trust need to be gained. Trust is important when there is uncertainty on the market, contract and bigger control between organization is then concluded (A. Reiter, Stonig, & Frankenberger, 2024). But when the transaction is less reliable, a more simple contract is concluded, as it require more flexibility from the buyer and the supplier (Mayer, Xing, & Mondal, 2022).

Alliance also offer different type of cooperation, horizontal and vertical. While horizontal cooperation is possible and show some advantages depending on the region and presence of clusters for knowledge spillover (Becker, Roper, & Vanino, 2023), too much interaction should be avoided as following an inverted U-shape curve in efficiency (Pindado, Sánchez, & Martínez, 2023). Vertical collaboration with the suppliers seems to be more beneficial, but show limits on high level of innovation novelty where institutional collaboration are better (Lafuente, Vaillant, & Rabetino, 2023). The interaction between the managers in a vertical collaboration is important for the outcomes of the project (Prokop & Hajek, 2023).

Alliance also comes with some drawbacks, as change in environment might cause talents departure. Managers need to control the new knowledge arriving with the change in its infrastructure (Pushpanathan & Elmquist, 2022; Toroslu, Herrmann, Chappin, Schemmann, & Castaldi, 2023). Especially, when it comes to knowledge recombination of the shared resources (Llopis & d'Este, 2022).

Acquisition might be preferred over the alliance, but the organization will face the challenge even more. Keeping the motivation of the acquired talents as they are key drivers in the innovative venture and detain the tacit knowledge. This drawback can be mitigated by reducing the change in the acquired firm and enabling knowledge-transfer between the two entities (J. D. Kim, 2022). As if the alliance is done through acquisition, the acquired firm will compete with the value of the firm. The complementarity between the firm and the acquired one was a key resource before the acquisition. Reducing the commitment of the firm over the acquired business is then a key characteristic to leverage the benefice it had while being in alliance (Lavie, Lunnan, & Truong, 2022). Failing at doing so, can lead to internal leaves as it is shown that most talents leaving a firm to become entrepreneur have failed to be intra-preneur in their previous employer (Lee, Shah, & Agarwal, 2024). Allowing flexibility in the acquisition or the alliance is then a key aspect, this will allow flexibility to the underlying organizations to allow them to have a better exploratory role.

Seeking external collaboration have some benefits for small business. It has been shown that seeking external knowledge help firm to pursue their innovation, especially during firm growth (Asimakopoulous, Revilla, & Rodríguez, 2023). When small, firm also have the opportunity to move toward shareholders to gain financial capabilities (Shi, Sorenson, & Waguespack, 2022). A small firm, when moving closer to its alliances, presents strategic choices between competitiveness and substitution, revealing an inverted U-shape curve in innovative project outcomes (Sheng & Ding, 2024). Failure is also an important aspect when resources are limited, external knowledge seems to have a beneficial outcome when it comes to learning from failure strategies, with higher return on intense market (Ponta, Puliga, Manzini, & Cincotti, 2024).

Larger firms, can benefit from collaboration as becoming leader in the market. But it comes with some skills that the firm needs to master. First, controlling and detecting point of failure in its network is an important part of managing the innovation ventures (Moerchel, Tietze, & Urmetzer, 2023). To prevent those point of failure, firm and manager must be flexible to anticipate and prevent failure on those networks. Alliances shows a beneficial outcome when the leaders in the domain create and manage the ecosystem, revealing a link between the alliance and the capability of the in place leaders to implements the ecosystem and their flexibility and ability to go beyond their domain of expertise (Sahasranamam, Soundararajan, & Chatterjee, 2024).

But collaborating with other firms add complexity as building with other isn't always beneficial depending on the firm's capabilities (Lopes-Bento & Simeth, 2023). Collaboration also comes with multiple limitation.

First, collaboration can slow down the innovative venture with inherent characteristics, such as the not-invented-here syndrome (Ismail, Bello-Pintado, García-Marco, & Lazzarotti, 2023). Or in the other way, bringing external expert to strengthen the workforce show an inverter U-shape curve in innovation performance, resulting of the balance between the implication of the expert and the sentiment of involvement (Schepers, de Vries, Raassens, & Langerak, 2022).

Second, funding is also not always available, cycle of technological innovation affect the probability of funding. Low-reputation venture capital tends to fund a limited project to take advantages of limited projects while other venture capitals tend to widen their portfolio not seeking for short-term profit, but in hot-market, the relation seems to be inverted (DeSantola, Zhelyazkov, & Hallen, 2024).

Finally, an important point of failure when elaborating a cooperation network, is

the protection of knowledge. Knowledge, whether explicit or tacit, is a critical factor of differentiation. Developing strategies to control and protect this knowledge during collaboration is essential. Medium to large firm tend to protect by publicly disclose their innovation through patents (Kang & Lee, 2022). This has a main disadvantage as the efficacy depends on the local politics protecting the patents. When it comes to smaller firms, resources are limited and patenting might not be an option. Because of that, smaller firms tends to create R&D alliances or accept acquisition (Polidoro Jr & Jacobs, 2024).

When collaborating with other firms, the question of open collaboration arise and the participation in wider networks such as hubs or institution. It has been shown that such intermediaries have some benefice (Howells & Thomas, 2022), especially for young firms or startups (Assenova & Amit, 2024; Gimenez-Fernandez, Stefan, Beukel, & Sandulli, 2023). The drawback of such a collaboration is that publicly releasing innovation comes with new risks and different throughput depending on the sector/project, type of partnership and how the incoming knowledge is handle (Lu & Chesbrough, 2022; Madanaguli et al., 2023; Belitski, Delgado-Márquez, & Pedauga, 2024; Conroy, Jacobs, & Liu, 2023). Requiring the managers to improve and optimize the process on how and what is released, showing effort in realizing institutional changes (Selviaridis, Hughes, & Spring, 2023) but also to carefully think about the use of license which can lead to negative impact while too restrictive (de Rassenfosse & Palangkaraya, 2023). Because of that, incorporating open innovation in the process might put ventures in risks (Toroslu et al., 2023). Finally, a different level of openness doesn't lead to a linear increment in financial performances as it has a cost, but is following an S-shaped curve (Schäper et al., 2023).

Create innovation ecosystems: lands of opportunities Localization is important for small structure, as politics often promote and trust regional innovation if it serves nearby habitants (such as local employees) (Bischoff, Hipp, & Runst, 2023). But limitations still exist depending on the project complexity and uncertainty requiring for the firm to have access to rare and unique resources and infrastructure (Ayamga, Annosi, Kassahun, Dolfsma, & Tekinerdogan, 2024; Balzano & Marzi, 2023). It is also shown that if failure arise, venture that were granted R&D subsidies are better at overcoming it (Ning, Guo, & Chen, 2022).

A first incentive that local politics have in hand to support local innovation, is developing hubs (Haukipuro, Väinämö, Virta, & Perälä-Heape, 2024). Such hubs are proven to increase the likely-hoods of the innovative project outcome by increasing the cross-

sector partnership giving visibility and networks, impacting the development (Dzhengiz & Patala, 2023; Ollila & Yström, 2022). Other business is then the tools to translate the individual innovative work behavior in innovative venture output, especially on low level of innovation environment, where an organizational support for innovation is needed (Hock-Doepgen, Montasser, Klein, Clauss, & Maalaoui, 2024). Hubs of innovation may not look like as what is commonly seen, some community can form hubs, such as hacker clubs. Entrepreneur ship and innovation is seen to increase in the regions the communities are created (Cuntz & Peuckert, 2023). Such tendencies will have a snowball effect as firms tends to develop where the ideological trends match the firm's value and operation (Barber IV & Blake, 2023).

Physical proximity to hubs is a robust driver of innovation. However, virtual hubs have also a positive impact if the digitalization habit is in the culture (Obschonka, Tavassoli, Rentfrow, Potter, & Gosling, 2023). To decrease the problem of distance, young firm use remote team and digitalization to counter-act the problem of distance when seeking knowledge from geographically distant areas (Cuvero, Granados, Pilkington, & Evans, 2023; Audretsch & Belitski, 2023). Virtualization has also shown positive impact over quality and global impact of innovation, but can also increase the regional performances at a regional level (Wright, Nagle, & Greenstein, 2023).

Another incentive regional sector can deploy is to help the organization to participate in the research by releasing scientific papers. Firm capable of managing research world are able to share and attract and retain talents and build a firm reputation (Rotolo, Camerani, Grassano, & Martin, 2022).

In the other hand, having a strong manufacturing sector in the region of activity also positively impacts the success rate and recover from failure of the innovation ventures while increasing the manufacturing firms' growth (Vaillant, Lafuente, & Vendrell-Herrero, 2023).

As a drawback, scoop of the collaboration cannot be fixed through the lifetime of the project, as local incentives are proven to have a short-time effect on the growth of SME (Kleine, Heite, & Huber, 2022). More radical innovation needs more resource and tends to acquire distant collaboration quicker, but as distant collaboration increase, the possible competitor as so, impacting incremental innovation and commercial outcomes. As innovative strategies might change overtime, flexibility in the range of collaboration is key (Kesidou, Love, Ozusaglam, & Wong, 2023).

Finally, firms and the region need to create a strong bond. Governments are shown

to have an influence on corporate activities (Gill & Gill, 2024). Firm being capable of taking advantage and aligning with or join regulations show a better likelihood of success (Cozzolino & Geiger, 2024). Government can also be impacted by social movements, thus firms need to create bound with these groups, especially if the implication and activities might be difficult to understand (Odziemkowska & McDonnell, 2024). Maintaining this social control will enforce the innovative performances of the firm as it will be better understood (Rauter, Globocnik, & Baumgartner, 2023).

Recent research over the topics of *Building a shared strategic vision of innovation* and *Managing entrepreneurial ecosystem* shows that managers in innovation should constantly evaluate their environment as tradeoff need to be made. Distance and collaboration shows active research, as they both introduce some constraint and cost while allowing more flexibility. For example, being distant from centers of innovation will allow more freedom in development while reducing possible financial resources and collaboration with the same sector. In certain cases, distant collaboration can be mitigated by digitalization and financial resources can be obtained through local incentives. But still these mitigations doesn't offer and does not have the same efficiency as their counterpart. For that careful management need to be done through the lifecycle of the firm, we identify two major challenges that managers and firms should be capable to engage in. This will ensure that the firm gain access to the needed resources through its life.

4.2 Concepts worth highlighting

In the existing literature, the importance of collaboration, flexibility and vision coherence were well-underlined. However, by reviewing the recent literature, the importance in addressing the VUCA (volatile, uncertainty, complexity and ambiguity) aspects of our current world was present, but adaptation following the grow of the innovation venture was not explained enough. Indeed, short and medium term strategies of the innovative project need to be adapted throughout their lifecycle to mitigate the uncertainty and volatility effectively. There are two major shifts that a company engaged in an innovative project venture should be capable of endorsing.

4.2.1 Shift in the nature of collaboration

The shift in the nature of collaboration is needed to maintain the amount of new knowledge constant and effectively shared in the firm. This approach also allows the project to access sufficient access to new resources.

In the early stage of a project, innovations are often provided by individuals with few resources. Increasing the amount of new knowledge can be achieved by participating in open innovation process or receiving subsidies from political incentives. At this early stage, binding the innovation to larger external companies could be harmful to the innovative project, as it may impose an administrative burden that slow down the development.

Because open innovation and government incentives also have their disadvantages as the project grows, a first shift in the nature of collaboration is needed. Open innovation incurs financial costs to maintain collaboration, which may not be justified at that stage of the project. On the other hand, government incentives have short-term effects and are limited on the long-term in the disponibility of resources that it can allow. Therefore, in the middle lifecycle of the project, forming alliances with other firms becomes crucial. At this point, it is important to note that even if horizontal alliance can be done, the most advantageous type of alliances are the vertical one. These alliances allow the innovative project to consolidate its structure and process by leveraging managerial and process resources available in other larger firms, while maintaining independence.

In the final stage of the project, if the innovation still needs to grow to be a financial success, as opening to the international market, the firm itself might be too large and handling new innovative ventures without significant risk to enter new markets. To mitigate this, the firm should begin supporting other initiatives in the market and position itself as a market leader. This can be achieved by creating an environment that supports industry-wide innovation, for example by participating in open innovation and helping political effort in the regulation of the sector. Concurrently, the main business should aim at creating alliances with multinational or geographically distant leaders to lunch the innovation on new markets.

Those shifts in collaboration are sum up in the below figure 4.1

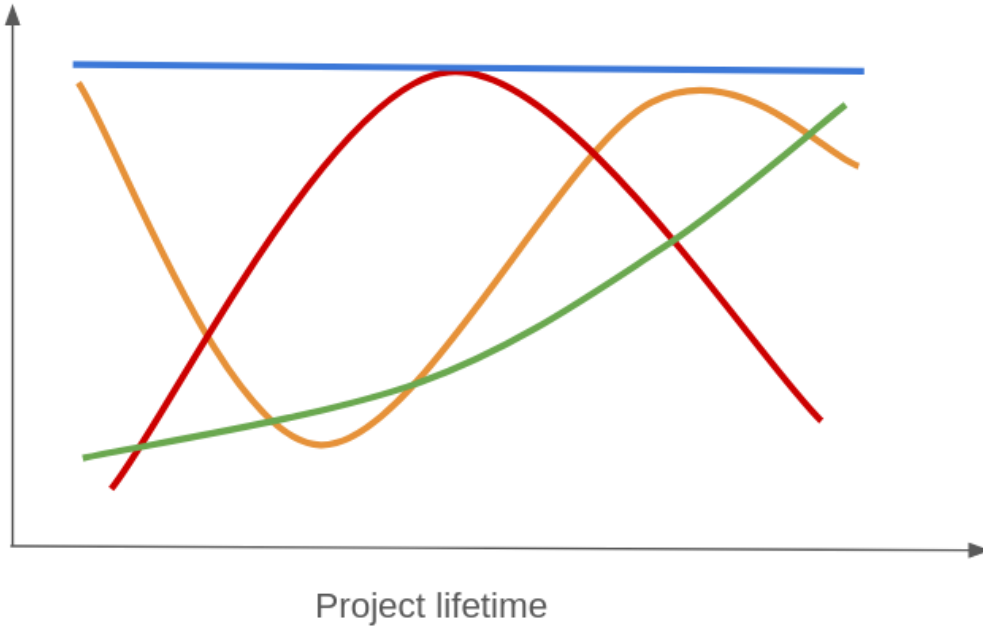


Figure 4.1: Evolution of the nature of collaboration and the knowledge through the lifetime of the project.

The figure represent in red the S curved of the efficiency in participating in open innovation initiative. The red inverted U curve show the the efficiency to collaborate with lagger firm when the project grow. The green curve show the financials needs to maintain the collaboration when the team and thus the project grow. Finally, the blue line show the expected level of knowledge sharing that a firm following the shifts might undergo. This is an hypothesis based on the litterature reviewed and thus will be discussed latter on in the work.

These shifts need to be mitigated, as it is not possible in every sector to construct such alliances, depending on local policies and maturation in the market. But as a matter, the essential idea should be respected to fully benefit from the balance between being constrained by larger players and leveraging the financial and/or human resources that those large players can provide.

4.2.2 Shifts in management and freedom of developpement

The shift in management and freedom of individuals in development of the project need to be adapted along the lifecycle of the project. This adaptation is necessary to explore new opportunities and enable knowledge sharing among the firm while maintaining an

acceptable level of risk to avoid failures in the later stages of the project.

In the early stage of the project, the team is quite small, making knowledge sharing much easier. Allowing individuals to explore and fail is more feasible at this stage, as it is less harmful to the innovative project as a whole. Indeed, failures in the early stage are less harmful since a small team is more flexible and the cost of such failures is lower. Providing significant freedom to test new ideas and processes is crucial for establishing the foundation for the next incoming stages.

As the project grows, the teams as well might expand, necessitating creation of dedicated teams based on their fields of operation. At this stage, knowledge management become crucial and cross-team knowledge management need to be enabled to ensure cohesion among different stakeholders. Failures at this stage are still permitted, but have greater financial impacts and thus need to be controlled by specific activities to avoid the total failure of the project or the withdrawal of partners and shareholders. Such a shift requires the management to control resources to mitigate not calculated risk.

In the latter stages of the innovative project, internal knowledge control becomes a critical aspect, as a more restrictive managerial approach will increase with the multiplication of partnership. To avoid knowledge leaks, forming alliances with more innovative solutions is crucial. First to maintain control over the market and keep leadership, and second to allow entrepreneurial individuals to express them self in a less restrained environment. This is why deploying resources to create an environment apart from the headquarters is crucial.

This evolution still needs to be mitigated, as this assume growth in the number of people involved and increased collaboration between the firm and larger players. If the growth or market expectation in the long-term strategies do not align with what has been proposed, then the lifecycle of the project need to be adapted, and the firm can remain at the corresponding stage of the project.

Model build and asked tasks

The process of confronting and acquiring the necessary information to adapt the strategy to follow in an innovative project requires competencies in managing innovation and a constant awareness of the field to apply the best strategy.

At this point, comes the help of IA tools, as they can possess knowledge across multiple fields and align it with the firm's needs. In this section, we will describe how we build our IA tool and the tasks we will assign to it. First, we will use two translators (Mixtral, Llama 2) to interpret our queries and documents. Mixtral and Llama 2 are chosen to represent higher cognitive capabilities compared to the one proposed by GPT-3 and BERT. Because we want our model to have knowledge over managing innovation, we need to use a text embedding models. When it has been shown on the section 1, most of existing research use embedding model such as GPT-3 or BERT, the flexibility of our solution allow us to use an embedding model different from the translator model itself for vectorizing our documentation.

Another important point noticed during the literature review, was the perpetual innovation and new models emerging in the market. As putting in place the pipelines for the solution with the specific mentioned models might become outdated. Therefore, we will use LangChain ¹ and Ollama ² frameworks to build the pipelines, as they are described as framework to build application powered by any language models.

To build the use case, the Prpl Foundation will be chosen ³. This organization is a regrouping of telecom giants such as Verizon, Orange, Broadcom, and Nokia. Its goal is to regroup the whole vertical chain of development for telecom devices and make it open source. The Prpl Foundation differentiates itself in the market with two major

¹https://python.langchain.com/docs/get_started/introduction

²<https://ollama.com/>

³<https://prplfoundation.org/>

factors. First, it is open source, so all the work of the foundation and its working process can be analyzed by external entities, which can then decide to join the venture. Second, creating a common way of working between these entities will ease the development process and facilitate modifications between certain parts of the product development, allowing flexibility in both the process and design choices.

This organization faces different challenges in terms of innovation. The first challenge is to change the mindset of the industry. The telecommunications industry mostly works with proprietary products, as they don't want to share knowledge that could be used in other end-user products. Second, in terms of governance, decisions are made democratically between members, making decision-making much harder than in common organizations.

To build up the tasks, the guidelines given in subsection 2.2.2 will be used. The template of each of the prompt can be found in the listing 5.1.

```
1 template = """ You are asked to answer the following task :
2     - provide guidelines to develop the innovative project
3     The response should mainly respond to the two questions :
4     - How to build a shared strategic vision of innovation for the
    innovative project ?
5     - How to manage the entrepreneurial ecosystem for the innovative
    project ?
6     If you cannot elaborate a task, ask for the information that are
    missing or say that you cannot do the task, don't try to make up the
    task.
7     If you are missing information about the firm, ask precisely
    those informations before answering the main task by highlighting the
    general question the user should address.
8     When providing an answer to a task, explain what is your chain
    of thought to resolve the task.
9     {pres}
10    {context}
11    Question : {question}
12    Answer: """
```

Listing 5.1: Elaborated prompt

The small scripts running the vectorization of the documents and the interaction with the model can be found in annex B.

Before executing any runs, we need to address the information for the specific project chosen. The small text that can be input to the model in order to respond to the interrogations can be found in annex A.

This presentation address some aspect of the what, who and why of the foundation. The detected lack of information are the tools and process used, the capabilities of the foundation through its partners and what local incentives they benefit from. These kinds of resources are available when becoming a member of the foundation and having access to the internal organization. However, this gathering of information is only meaningful when internal contributors can create this information to transform tacit knowledge about the company into explicit knowledge.

5.1 Result obtained by the model

This section will show how the model interacts with our use case and what are the possibilities. For clarity, the interaction with the model can be found in annex C. As a limitation, other models than Mixtral for chat and Mistral for vectorization are not presented in this work, as their results were not good enough to be analyzed or the computational power available was insufficient to run certain models.

We have asked two questions to our model to produce the available data. The two questions were build to help the model explaining its guidelines, those questions can be found in the annex C.

From the first part of the answer, we can see that the model suggest using some guidelines to build a shared vision throughout the project. The guidelines proposed consist mainly in defining the vision and share it through the foundation, encouraging vertical collaboration, being transparent in the organization and monitor goals and achievements. The second part of the answer includes guidelines to promote the project itself. This consist of highlighting the differentiation criteria of the project such as being open source, cost-effectively scaling up for members, being part of a knowledgeable community and having a flexibility system for the partners to drive some aspects of the project's development.

In the second response, when asked to be more precise about the guidelines. The model responded by adding the aspect of managing the entrepreneurial ecosystem. The first part of the answer was quite similar to the topic of building a shared strategic vision, but by being less explicit than in its first answer. Then on the second part of the answer, where it introduces the topic about managing the entrepreneurial ecosystem, it gives insights on the identifying partners outside the industry sector, creating experimental environments for employees and the flexibility of that the firm must show to leverage new opportunities and challenges.

In general, we found that with assistance, the model was capable of grasping key points such as the need for flexibility, collaboration and how these two should be managed and balanced. The guidelines given were good, and in the first answer, it even explained how the firm can promote itself considering the desired shared strategic vision. One point that might be mitigated is the response in the second answer, which was much more generic and concise. We observed that to provide good guidelines, one should not underestimate the environment and industry in which the firm is evolving. On this point, the model was good to make the link between the theory and the given firm.

A final comment to mitigate the output of the models is the fact that questions and answers were run several times among various models. For the exercise, we chose the model that best fit with the task and even then, only one of the runs was selected. Therefore, there is still a prerequisite that only someone with some knowledge of the industry and innovative project management could have chosen the best responses from all the options provided.

Discussion

This chapter balances the important aspects introduced in chapter 4 and 5 while acknowledging some mitigation and limitation. This work shows that building a shared strategic vision for innovation and managing an entrepreneurial ecosystem within the firm are still relevant research fields. However, as these fields evolve, it becomes increasingly complex for managers to follow the research and apply it to their specific fields.

Some general guidelines can be followed across the industry, such as maintaining good flexibility in terms of resources and structure, creating democratic approach to collaboration to include stakeholder, and facilitating the knowledge transfer among stakeholders. However, when it comes to providing guidelines for a specific innovative project, these guidelines can differ depending on the industry and the type of innovation developed. Another important aspect is the lifecycle of the project itself. Indeed, given the need for flexibility that a firm must have when developing an innovative project, constant readjustment of the firm's strategy is required, revealing the need for the firm to continually evaluate the project's progress and external opportunities to react accordingly.

Constant reorientation needs to be mitigated, as this implies changes in the firm's behavior and organization. Changes might not be welcomed and could be slowed down by the stakeholders. The firm can avoid such behavior by carefully selecting stakeholders, but this comes with another drawback, selecting stakeholders will reduce diversity in the project, increasing the risk of limiting the knowledge sharing and path exploration.

Therefore, there is a balance to maintain, specific to the project and the industry, when choosing among the different strategies. For this, we introduced the use of AI tools to help compile this large amounts of information and suggest guideline to follow.

Using AI for this task has shown good results in terms of key aspects that firms must consider. Furthermore, the AI tool is capable of linking the firm's given information with the theoretical background. One surprising outcome was the guideline given to promote

the innovative project to stakeholders and increase their motivation, which was not initially expected but indeed needed to be addressed to create a cohesion and attract interesting stakeholder for the project.

Nevertheless, the use of AI need to be mitigated, as for this work several models were tested but not showed to simplify the presentation. Thus, the only result showed in this work was based on a run of a model that was good enough to be analyzed. This mean that most of the other run not shown in this work were not usable or did not provide guidelines to the firm's information. Therefore, using the model needs to have knowledge in innovative management and the industry itself as gaps was noticed. Indeed, a user still needs to have some theoretical background, as using AI tools should always be used as aids that provide guidelines rather than absolute truths or exact solution. The decision remains in the hands of the user, who must be capable of analyzing and judging the given advice. However, we saw that the minimum required knowledge was significant.

Because we used an AI tool, some limitations needed to be taken into account for this work. A first limitation is the limited use of open access papers. This has both advantages and drawbacks.

In terms of drawbacks, one is the limitation of papers. Seeking only open access papers adds a constraint to the research, considerably reducing the number of available sources. However, as open access is growing and most of the scientific journals offer open access solutions, this limitation was mitigated by allowing more scientific journals with lower reliability in our research. Still, allowing lower-quality journals in our review impacts the overall quality of the research, which we mitigated by only including high quality journals in the research.

On the other hand, using only open access papers allow use to put them in a database to allow algorithms to work with them. Papers are subject to IP rulings, especially if they are not in open access. Using them in AI tool, a field in expansion with IP ruling not yet fully aligned with how AI is using them, can lead to intellectual theft. This needs to be mitigated, as for this work we used a local database, so no papers were shared with other entities. However, as it might be used by entities not managing locally their database and training model, we applied the parsimony rule in this work by projecting our self in an environment that is not necessarily local.

This was the main limitation to this work. Another limitation was the scoop of AI accorded to the work. As this is a limited work in time and IA is a hot topic, research in the domain is still hard to follow. For example, Llama 3 was released while writing the

conclusion ¹.

This cause limitation to the project as the field is in constant evolution, this work fills the gap with the existing tools available, but still, research need to be address. This work provide a general way of working that can be used with new version of the tools but still miss a gap in terms of global infrastructure as both fields cover by this work are in constant evolution. As a result, this work lays some foundation principles that need to be strengthened and highlight the needs to have for functional environment for industry application. These needs are highlighted in figure 6.1.

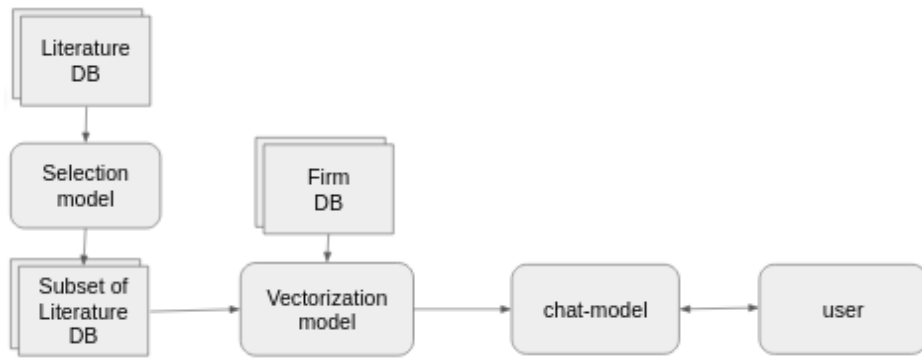


Figure 6.1: Final infrastructure goal to be achieved.

Finally, following the last limitation, the chosen use case also reveal some concerns in this work. We only use one particular firm, Prpl foundation. This cause two problems in the work. First, the information taken online was limited as external to the firm. This limited the amount of information given to the model. To mitigate this, the use of an open organization was chosen, this allowed us to have access to structural information that is not normally publicly announced in other types of organization. The second problem was that the model was not tested over other industries or firms, resulting in a limited amount of results and preventing cross-sector analysis to verify whether the model would have provided the same results for other firms.

¹<https://llama.meta.com/llama3/>

Conclusion

In this work, we based our research on previous studies and extended the results with new literature in the fields of building a shared strategic vision and managing entrepreneurial ecosystem for innovative project. We then confronted that theory with the use of an AI tool for Prpl foundation to extract recommendations based on the literature and apply them to a specific firm. Building a shared strategic vision and managing entrepreneurial ecosystems are key drivers when developing an innovative project. For the project to be a financial and technological success, firms must adopt several guidelines that can be shared across sectors. Firms must, for example, be flexible enough to react to change in their internal and external environment, as well as have the capacity to leverage opportunities offered to them. This flexibility allows the firm to strengthen crucial characteristics, such as collaboration and spread of the knowledge with their stakeholders. Collaboration and knowledge management are key metrics in an innovative project, as leveraging them allows the firm to navigate through the different phases of the innovative project and reduce risk in the VUCA world we live in. Nevertheless, though its lifecycle, the project is not static, nor the environment it evolves in, and thus adaptation need to be constantly engaged. This need of constant reevaluation requires the firm to monitor the progress of the project alongside its environment and to confront it with the literature to adopt strategic decision guided by scientific research. Such constant evaluation and theoretical background knowledge are time- and cost-consuming. This is why in this work we proposed the use of AI tools to handle this task. We found that with the available AI tools on the market, it was possible to have guidelines propositions specific to the project, even with limited information about the firm. Nevertheless, obtaining those guidelines is not feasible with all the studied models and still requires a careful filtering of responses. As AI tools are still a hot topic, this work provides a general framework to easily switch between models without altering the user experience. This will allow further research to test more

powerful models that require larger amounts of resources or that are still in developed. In conclusion, we proposed a flexible system that can be utilized in industry, with an important second part to be addressed in the future on the filtering of research made on the fields of innovation.

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Appendices

Presentation of the firm passed as input

Below is the text passed to the model to do the analysis

1 Do the analysis for Prpl foundation with the following informations We are a diverse community of Service Providers OEMs Silicon Vendors ISVs and opensource developers committed to opensource software and open APIs to build standardized carriergrade CPE We are a large ecosystem of likeminded companies and individuals working to defragment the plethora of proprietary software platforms developed and deployed today We collaborate with industry organizations such as the Broadband Forum and WiFi Alliance to help accelerate our goals Prpls Mission is to enable highvelocity servicedriven innovation on CPE by harmonizing interfaces in open APIs and delivering opensource reference implementations of common infrastructure Prpl is all about open APIs and opensource to drive scalability prpl Foundation promotes Velocity by decomplexifying the process of integrating a Gateway GW stack onto multiple platforms Servicedriven innovation by enabling proprietary differentiation from a 3rdparty services ecosystem Harmonized APIs through collaboration convergence among member companies and other industry organizations to help companies scale up their businesses An opensource community needed to jointly coalesce the largest possible ecosystem to avoid duplication and wasted efforts Cultivating a community of knowledgeable developers to help speed deployments prpl Foundation is the place for Service Providers SPs to specify carriergrade features for open gateways How We Work prpl Working Groups are established and meet to develop projects such prplOS prplMesh and more Our governance comes from our Steering Committees and Board of Directors Our members contribute to or sponsor our work through several channels Members gain visibility as leaders in the industry and are first to market with the latest developments The Intellectual Property Policy IP Policy for the Foundation is as follows The prpl Foundation strives to be a royaltyfree organization Distinction is made between Code and NonCode documents Code refers to sourcecode and its binary forms NonCode refers to all other prpl documents including but not limited to Requirements Analyses Specifications Recommendations API application programming interfaces and Test Plans Participants in Foundation activities and discussions agree to use their true name and corporate affiliation if any and be bound by the policies of the Foundation Outbound Code Distributions The Foundation will release code which is developed for any prpl projects Project Code under the BSDPatent License <https://opensource.org/licenses/BSDplusPatent> unless the Board of Directors votes to change the license as provided in the Bylaws Except as otherwise expressly stated in the BSDPatent License the Foundation does not grant any licenses under copyrights patents or other intellectual property for Project Code The Foundation acknowledges that thirdparty code may be included in prpl projects and that such thirdparty code may be under other licenses The Foundation will maintain on its site a list of all Project Code Any other code developed and contributed will fall under the Inbound Contributions category Inbound Code Contributions All inbound contributions of code to the Foundation will include a sign off by the developercontributor of a Developers Certificate of Origin DCO and must comply with the inbound code review policy adopted by the Foundation as may be updated by the Foundation from time to time The DCO is the same as used by kernelorg for Linux and is set forth below The contributor must declare under which OSIapproved open source license the contribution is made Contributions are preferred under the BSDPatent License The Maintainer and Chair of a project will decide if a contributions license is acceptable Modifications to already contributed code will be contributed under the same license as the code being modified The Foundation will not accept contributions of code under the GPLv3 License In addition all contributions of original code specifically developed for the prpl project and submitted by developercontributor to the Foundation will be submitted under the BSDPatent License unless the Board of Directors votes to change the license as provided in the Bylaws The Foundation

acknowledges that thirdparty code may be included in the prpl project and that such thirdparty code may be under other licenses Note The BSDPatent license is not to be confused with a license from Facebook with a similar name BSDPatents The BSDPatent license used by prpl is approved by the Open Source Initiativesee <https://opensource.org/licenses/BSDplusPatent> prpl Foundations Working Groups are established and meet to develop specific projects Governance of Working Groups comes from the Steering Committees and Board of Directors There are a variety of ways that member companies and others can contribute to or sponsor the work Most member companies have particular interests and expertise in progressing specific projects Resources can mean Volunteer or allocate some of your SW developer resources to help progress prpl opensource projects Sponsor contract developer resources eg from the prpl community to progress projects in a favorable direction or Donate funding into particular prpl projects

Scripts used for this work

B.1 Vector creation script

```
1 from langchain_community.document_loaders import PyPDFDirectoryLoader
2 from langchain_community.document_loaders import WebBaseLoader
3 from langchain_community.vectorstores import Chroma
4 from langchain_community.embeddings import OllamaEmbeddings
5 import sys
6 import os
7 import inquirer
8
9 questions = [
10     inquirer.List('models',
11                   message="What model to use for embedding ?",
12                   choices=['mistral:text', 'llama2:70b-text', 'llama2:13b-
13                        text', 'llama2:7b-text'],
14                   ),
15     inquirer.List('vectore_database',
16                   message="What vectore data base to store ?",
17                   choices=['./mistral_db', './llama_70b_db', './
18                        llama_13b_db', './llama_7b_db'],
19                   ),
20 ]
21 answers = inquirer.prompt(questions)
22
23 # handle stdout
24 class SuppressStdout:
25     def __enter__(self):
26         self._original_stdout = sys.stdout
27         self._original_stderr = sys.stderr
```

```

26     sys.stdout = open(os.devnull, 'w')
27     sys.stderr = open(os.devnull, 'w')
28
29     def __exit__(self, exc_type, exc_val, exc_tb):
30         sys.stdout.close()
31         sys.stdout = self._original_stdout
32         sys.stderr = self._original_stderr
33
34 # load the pdf and split it into chunks
35 loader = PyPDFDirectoryLoader("/home/fiset/Documents/Cours/tfe-lsm/
papers", silent_errors=True)
36 data = loader.load()
37 print("PDFs loaded")
38 # load navigating innovation
39 #intro
40 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/
introduction/")
41 data.extend(loader.load())
42 #chap 1
43 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
-1-build-a-shared-strategic-vision-of-innovation/")
44 data.extend(loader.load())
45 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
-1-build-a-shared-strategic-vision-of-innovation/why-it-matters-
innovation-management-capabilities/")
46 data.extend(loader.load())
47 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
-1-build-a-shared-strategic-vision-of-innovation/innovation-as-a-
business-more-than-creativity/")
48 data.extend(loader.load())
49 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
-1-build-a-shared-strategic-vision-of-innovation/innovation-as-a-
process-beyond-ideation/")
50 data.extend(loader.load())
51 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
-1-build-a-shared-strategic-vision-of-innovation/innovation-typology-
beyond-new-products/")
52 data.extend(loader.load())
53 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
-1-build-a-shared-strategic-vision-of-innovation/innovation-
strategies-beyond-new-product-development/")

```

```

54 data.extend(loader.load())
55 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -1-build-a-shared-strategic-vision-of-innovation/drivers-of-
    innovation-strategies-beyond-hype/")
56 data.extend(loader.load())
57 #chap 2
58 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -2-manage-entrepreneurial-ecosystems/")
59 data.extend(loader.load())
60 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -2-manage-entrepreneurial-ecosystems/encourage-people-to-innovate-
    corporate-entrepreneurs/")
61 data.extend(loader.load())
62 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -2-manage-entrepreneurial-ecosystems/build-and-lead-effective-
    innovation-teams-balancing-acts/")
63 data.extend(loader.load())
64 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -2-manage-entrepreneurial-ecosystems/build-and-manage-innovation-
    ready-organizations-how-some-elephants-can-dance/")
65 data.extend(loader.load())
66 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -2-manage-entrepreneurial-ecosystems/develop-innovative-networks-and-
    collaborations-never-walk-alone/")
67 data.extend(loader.load())
68 loader = loader = WebBaseLoader("https://www.ipdigit.eu/ebook/challenge
    -2-manage-entrepreneurial-ecosystems/create-innovation-ecosystems-
    lands-of-opportunities/")
69 data.extend(loader.load())
70 print("Web pages loaded")
71
72 from langchain.text_splitter import RecursiveCharacterTextSplitter
73 text_splitter = RecursiveCharacterTextSplitter(chunk_size=500,
    chunk_overlap=100)
74 all_splits = text_splitter.split_documents(data)
75 print("Data splitted")
76
77 with SuppressStdout():
78     embedding_mistral = OllamaEmbeddings(model=answers["models"])
79     vectorstore = Chroma.from_documents(documents=all_splits, embedding=
    embedding_mistral, persist_directory=answers["vectore_database"])

```



```

80     vectorstore.persist()
81 print("Vectores stored")

```

Listing B.1: Vectorisation script

B.2 Model dialog script

```

1 from langchain_community.vectorstores import Chroma
2 from langchain_core.prompts import PromptTemplate
3 from langchain_core._api.deprecation import
   suppress_langchain_deprecation_warning
4 from langchain_community.llms import Ollama
5 from langchain.callbacks.manager import CallbackManager
6 from langchain.callbacks.streaming_stdout import
   StreamingStdOutCallbackHandler
7 from langchain.chains import RetrievalQA
8 from langchain_community.embeddings import OllamaEmbeddings
9 import inquirer
10
11 questions = [
12     inquirer.List('models',
13                   message="What model to use for llm ?",
14                   choices=['mistral:instruct', 'mistral:instruct', 'llama2
   :70b-chat', 'llama2:13b-chat', 'llama2:7b-chat'],
15                   ),
16     inquirer.List('vector_database',
17                   message="What vectore data base to use ?",
18                   choices=['./mistral_db', './llama_70b_db', './
   llama_13b_db', './llama_7b_db'],
19                   ),
20 ]
21 answers = inquirer.prompt(questions)
22
23 embedding_mistral = OllamaEmbeddings(model=answers["models"])
24 vectorstore = Chroma(persist_directory=answers["vector_database"],
   embedding_function=embedding_mistral)
25
26 print("Vectors loaded")
27
28 with suppress_langchain_deprecation_warning():

```

```

29 while True:
30     query = input("\nQuery: ")
31     if query == "exit":
32         break
33     if query.strip() == "":
34         continue
35
36     # Prompt
37     template = """ You are asked to answer the following task :
38     - provide guidelines to developpe the innovative project
39     The response should mainly respond to the two questions :
40     - How to build a shared strategic vision of innovation for the
innovative project ?
41     - How to manage the entrepreneurial ecosystem for the innovative
project ?
42     If you cannot elaborate a task, ask for the information that are
missing or say that you cannot do the task, don't try to make up the
task.
43     If you are missing information about the firm, ask precisely
those informations before answering the main task by highlighting the
general question the user should address.
44     When providing an answer to a task, explain what is your chain
of thought to resolve the task.
45     {context}
46     Question : {question}
47     Answer: """
48
49     QA_CHAIN_PROMPT = PromptTemplate.from_template(template)
50
51     llm = Ollama(model=answers["models"], callback_manager=
CallbackManager([StreamingStdOutCallbackHandler()]))
52     qa_chain = RetrievalQA.from_chain_type(
53         llm,
54         retriever=vectorstore.as_retriever(),
55         chain_type_kwargs={"prompt": QA_CHAIN_PROMPT},
56     )
57
58     result = qa_chain({"query": query})

```

Listing B.2: Vectorisation script

Models dialogues

Below is the dialog with the model mixtral using vectorisation from the mistral model.

```
1  [?] What model to use for llm ?:  
2  > mixtral:instruct  
3  mistral:instruct  
4  llama2:70b-chat  
5  llama2:13b-chat  
6  llama2:7b-chat  
7  
8  [?] What vectore data base to use ?:  
9  > ./mistral_db  
10 ./llama_70b_db  
11 ./llama_13b_db  
12 ./llama_7b_db  
13  
14 Vectors loaded  
15  
16 Query: Do the analysis for Prpl foundation  
17 To build a shared strategic vision of innovation for the Prpl  
18 Foundation, I would recommend following these guidelines:  
19 1. Define the vision and mission: The first step is to clearly define  
the vision and mission of the foundation. This should be done in  
consultation with key stakeholders, including members, industry  
organizations, and open-source developers. The vision should be  
ambitious and inspiring, while the mission should be clear and  
actionable.  
20 2. Identify key trends and drivers: The next step is to identify the key  
trends and drivers that are shaping the industry. This could include  
technological advancements, regulatory changes, and shifts in  
consumer behavior. By understanding these trends, the foundation can
```

better position itself to anticipate and respond to changing market conditions.

21 3. Develop a shared understanding of innovation: It is important to develop a shared understanding of what innovation means for the foundation. This could involve defining different types of innovation (e.g., product, process, organizational), as well as the stages of the innovation process (e.g., ideation, development, commercialization).

22 4. Establish goals and objectives: Based on the vision, mission, and shared understanding of innovation, the foundation should establish specific goals and objectives for its innovative projects. These should be SMART (Specific, Measurable, Achievable, Relevant, Time-bound) and aligned with the overall strategy of the foundation.

23 5. Foster a culture of innovation: To create a truly innovative organization, it is important to foster a culture of innovation. This means creating an environment where ideas are encouraged and valued, risk-taking is supported, and failure is seen as a learning opportunity.

24 6. Measure and evaluate progress: Finally, it is important to measure and evaluate progress towards the foundation's innovation goals. This could involve tracking metrics such as the number of innovative projects launched, the impact of these projects on the industry, and the level of engagement from members and other stakeholders.

25

26 To contribute to the Prpl Foundation's innovative projects, member companies and others can consider the following options:

27

28 1. Volunteer resources: Members can volunteer their time and expertise to progress prpl opensource projects. This could involve contributing code, providing technical guidance, or participating in working groups and other collaborative efforts.

29 2. Sponsor contract developer resources: Member companies can sponsor contract developer resources from the prpl community to progress projects in a favorable direction. This could involve hiring developers with specific expertise or funding development efforts that align with the company's strategic goals.

30 3. Donate funding: Members and other organizations can donate funding to support particular prpl projects. This could involve providing grants for specific initiatives, sponsoring events or workshops, or contributing to the foundation's general fund.

31

32 In terms of resources, the Prpl Foundation should consider a range of
 options beyond just volunteer and contract developer resources. This
 could include partnerships with universities and research
 institutions, grants from government agencies or other organizations,
 and revenue-generating activities such as training and certification
 programs.

33

34 To ensure the success of its innovative projects, the Prpl Foundation
 should also consider the following best practices:

35

- 36 1. Involve users and stakeholders in the innovation process: By
 involving users and stakeholders in the innovation process, the
 foundation can ensure that its projects meet real-world needs and
 have a greater impact on the industry.
- 37 2. Foster cross-functional collaboration: Innovation often requires
 collaboration between different functions and departments within an
 organization. The Prpl Foundation should encourage cross-functional
 collaboration to ensure that all perspectives are considered and that
 synergies are leveraged.
- 38 3. Embrace experimentation and iteration: Innovation is a process of
 trial and error. The Prpl Foundation should embrace experimentation
 and iteration, learning from failures and continuously improving its
 projects based on feedback from users and stakeholders.
- 39 4. Leverage open innovation: The Prpl Foundation is an open-source
 community, and as such, it should leverage the power of open
 innovation to tap into a broader pool of ideas and expertise. This
 could involve engaging with external partners, sponsoring hackathons
 or other collaborative events, or using crowdsourcing platforms to
 solicit input from the wider community.
- 40 5. Communicate and celebrate successes: Finally, it is important for the
 Prpl Foundation to communicate and celebrate its successes. By
 sharing stories of innovation and impact, the foundation can inspire
 others to get involved and contribute to its mission.

41 Query: Be more precise on the guidelines for Prpl foundation

42 To develop an innovative project within the prpl foundation, I would
 suggest the following guidelines:

43

- 44 1. Building a shared strategic vision of innovation:
- 45 * Understand the mission and goals of prpl foundation and how your
 project aligns with them.

- 46 * Identify the key stakeholders in the project, including internal teams
 , external partners, and end-users.
- 47 * Conduct a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats
) to understand the internal and external factors that will impact
 the success of your project.
- 48 * Define clear objectives and key results (OKRs) for the project,
 including measurable outcomes that align with prpl foundation's
 mission and goals.
- 49 * Foster open communication and collaboration among stakeholders to
 ensure alignment and buy-in on the strategic vision.
- 50 * Regularly review progress against OKRs and adjust the strategy as
 needed based on feedback and changing circumstances.
- 51 2. Managing the entrepreneurial ecosystem:
- 52 * Identify the key resources, capabilities, and competencies required
 for your project's success.
- 53 * Engage with external partners, including suppliers, customers, and
 complementary technologies, to leverage their expertise and resources
 .
- 54 * Foster a culture of experimentation and risk-taking, encouraging teams
 to test new ideas and learn from failures.
- 55 * Establish clear processes and governance structures for decision-
 making, resource allocation, and performance management.
- 56 * Provide support for entrepreneurial activities within the organization
 , including training, mentoring, and access to funding.
- 57 * Regularly review the ecosystem's performance and adjust the strategy
 as needed based on feedback and changing circumstances.

Dans ce travail, nous abordons le dilemme que les gestionnaires d'innovation sont confrontés dans le domaine de la construction d'une idée commune au projet d'innovation tout en maintenant un environnement dynamique et de développement au sein de cette même entreprise. Pour répondre à ce défi, nous avons mis en place les premiers pas d'un outil basé sur l'IA qui a pour but de joindre la distance entre les recherches académiques et les besoins particuliers d'une organisation qui voudrait appliquer ces théories. Ce travail s'attaque à deux problématiques, d'une part, les nouvelles recherches menées dans le domaine de la gestion d'innovation et d'autre part la réduction de coût que cette démarche d'alignement peut engendrer.

In this work, we address challenges that managers in the innovative sector must handle in the field of building a shared strategic vision and managing an entrepreneurial ecosystem. To tackle these issues, we build the first steps of an AI-based tool which aims to bridge the gap between research and the practical adaptation that the firm needs to elaborate so it can be implemented. This work aims to solve two problems: first, embedding new researches done in the field of managing innovation and extract valuable insights, and second, the cost reduction for firms to adopt theoretical research within their organization.

UNIVERSITÉ CATHOLIQUE DE LOUVAIN
Louvain School of Management

Place des Doyens, 1 bte L2.01.01, 1348 Louvain-la-Neuve
Boulevard Emile Devreux 6, 6000 Charleroi, Belgique
Chaussée de Binche 151, 7000 Mons, Belgique
www.uclouvain.be/lsm