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Final Report

From Research Project to Innovation: The case of MyTreatment

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This report examines the process of transitioning from academic research to a Deeptech startup, focusing on the essential elements, success factors, and challenges involved. It explores prerequisites such as identifying market opportunities and assessing commercial potential, emphasizes the importance of securing funding, developing a strong business plan and building a support network. The report illustrates these concepts through the analysis of the Deeptech's project MyTreatment. Finally, it discusses strategies to enhance the value of results for researchers who lack entrepreneurial motivation. By providing insights and guidance, this report aims to facilitate the effective transformation of academic projects into tangible innovation.

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Summary

1 Introduction to Deeptech

1.1 Definition of Deepetch

> According to chatgpt, Deeptech refers to a category of technological innovations that are based on scientific advances and breakthroughs. It involves the application of cutting-edge research and development in fields such as artificial intelligence, machine learning, robotics, biotechnology, nanotechnology, quantum computing, and other emerging areas. What sets Deeptech apart from other technologies is its focus on addressing complex challenges and pushing the boundaries of what is currently possible. Deeptech solutions often require significant expertise, substantial investment, and long development cycles due to their reliance on scientific principles and fundamental advancements in scientific disciplines. Deeptech innovations have the potential to disrupt industries, create new markets, and significantly impact society. They can be found in various sectors, including healthcare, agriculture, manufacturing, energy, transportation, finance, and more. Some examples of Deeptech applications include autonomous vehicles, gene editing technologies like CRISPR, advanced robotics systems, precision medicine, and quantum encryption. The development and commercialization of Deeptech solutions often involve collaborations between researchers, scientists, engineers, entrepreneurs, and investors. These partnerships are essential to bridge the gap between scientific discoveries and real-world applications, as well as to overcome the technical, regulatory, and market challenges that arise in the process. Overall, Deeptech represents the forefront of technological advancements, leveraging scientific breakthroughs to create innovative solutions that have the potential to transform industries and improve our lives.

In more conventional terms, the definition proposed by the BpiFrance is as follows. Deeptech strat-ups are defined by tree main criteria [2]:

- They offer a product that brings high added value to its market;
- They use a disruptive technology protected by intellectual property rights;
- They are developed in close collaboration with public or private research teams.

DeepTech start-ups have their own challenge, in particular for their business model, funding, team and intellectual property.

1.2 Challenges of Deeptech startups

DeepTech innovations rely on technological solutions that are based on significant scientific or technical challenges, related to the research field. Deeptech start-ups are characterized by a much longer development time horizon than traditional start-ups. They have development phases during which no revenue can be generated. These phases include the early stages of technology development from prototyping in a research laboratory, to demonstrating the technology in a real-world environment and scaling up to create an impact.

Technical complexity : Deeptech innovations involve advanced and complex technologies, requiring deep scientific expertise and technical knowledge. Startups must overcome challenges related to uncertainty about the effectiveness of the technology developed, legalization and regulation, adoption of new practices and scalability.

Intellectual property (IP) protection : Ensuring the protection of IP is of utmost importance for Deeptech startups, as patents are often a distinguishing feature of these companies. However,

the process of safeguarding innovations through patents, trademarks, and copyrights can be legally intricate, expensive, and challenging to defend. Despite these complexities, patents provide reassurance to investors and offer protection against potential competition. Depending on their IP strategy, some startups opt to rapidly accumulate multiple patents, while others in the Deeptech sector may emerge with few or even no patents. It is worth noting that the time and resources required for patenting a technology or conducting research should not be underestimated, and a delicate balance must be struck to effectively serve the interests of the startup, whose primary focus is not solely on research development.

Talent acquisition : Deeptech startups have a need for exceptionally skilled professionals, including researchers, scientists, engineers, and data scientists. However, these startups often encounter stiff competition from larger corporations and research institutions when it comes to attracting and retaining such specialized talent. While some startups have co-founders who originate from public research laboratories, others opt to integrate researchers into key strategic roles. Nevertheless, persuading highly talented individuals to join a startup can be challenging given their existing secure positions and personal circumstances.

Funding and investment : DeepTech startups encounter the hurdle of acquiring financing in the early stages, often prior to the development of a Minimum Viable Product (MVP). Unlike conventional startups that typically raise funds once they have generated substantial revenue, DeepTech startups require funding over an extended period and grapple with elevated technical risks. This presents a challenge as traditional investors are frequently cautious about offering funding at such an early stage. Consequently, DeepTech startups explore alternative avenues such as seeking support from venture capital firms, government grants, and forging strategic partnerships to secure the necessary funding. Public funding sources such as Bpifrance or regional funds allocate budgets specifically for DeepTech startups, providing grants, recoverable advances, loans, equity investments, and guarantees [6]. Early-stage investments from business angels and angel groups are also possible if the project leaders can convince them of the startup's impact, prioritizing it over quick returns on investment. Investment funds typically come into play at more advanced stages when the technology has been validated in a real-world setting. The investment horizon is typically between 5 and 8 years, depending on the maturity of the fund. Encouragingly, since 2015, there has been a significant surge in DeepTech investments, with an impressive annual growth rate of 60%. Many private equity firms are even planning to allocate funds specifically for DeepTech startups by 2023, indicating a positive trend in the availability of funding for the sector [3].

Market adoption and regulation : Deeptech startups encounter the complex task of maneuvering through intricate regulatory frameworks and surmounting obstacles to achieve market adoption. It is of utmost importance for these startups to adhere to industry-specific regulations, particularly when operating in novel and unregulated domains. Moreover, ethical considerations hold significant weight in the development and implementation of Deeptech solutions. Effectively addressing these regulatory, legal, and ethical dimensions is crucial for ensuring the successful market entry and acceptance of Deeptech innovations.

Business model and commercialization : Unlike the conventional approach where market needs are identified first and then solutions are developed, Deeptech startups often prioritize technological advancement over market research. Since the technology typically originates from research laboratories, the initial emphasis lies on technological development rather than identifying potential customers or their willingness to pay. However, for a startup to thrive, it is crucial to ascertain market demand and customer willingness to pay for the product or service.

While a Deeptech solution may offer significant technical benefits, its success ultimately depends on market acceptance and readiness. Without a market that is ready to adopt the technology and invest in it, the startup may encounter difficulties in achieving prosperity. To transition from research and development to commercialization, Deeptech startups must identify viable market opportunities, validate their solutions, establish strategic partnerships, and devise scalable business

models. Effective go-to-market strategies and clear communication of the value proposition are pivotal in gaining market traction and ensuring the startup's success.

Despite the challenges faced by Deeptech startups, they also possess distinct advantages, including disruptive potential, technological differentiation, and the ability to address societal and industry needs. Overcoming these challenges requires a combination of technical expertise, entrepreneurial skills, strategic partnerships, and access to funding and resources. An illustrative example of these unique characteristics is the MyTreatment project, which seeks to leverage the latest advancements in artificial intelligence to enhance personalized medicine.

1.3 Illustration on MyTreatment

An exemplary case that underscores the academic foundations required to launch a Deeptech startup is MyTreatment, a DeepTech project originating from the computer science laboratory of University Paris Dauphine-PSL. The primary goal of this project is to streamline the personalized prescription of cancer treatments. By leveraging meticulously crafted algorithms, MyTreatment strives to ensure that each patient receives the most suitable treatment. This innovative approach capitalizes on the latest advancements in Artificial Intelligence (AI), with a specific emphasis on research in the field of Causal Inference.

Context

According to the information provided by the *World Cancer Observatory*, cancer remains a significant global health concern, impacting approximately one in five men and one in six women worldwide. The number of new cancer cases reported globally reached 19.3 million in 2020, with cancer-related deaths reaching 10 million. These numbers are expected to increase due to the aging global population. A study conducted on the British population indicated that individuals born after 1960 have a 50% risk of developing cancer during their lifetime [1]. Additionally, there has been a consistent average increase of 4% in the number of patients receiving cancer treatment over the past five years, as reported by IQVIA [4].

The continued advancements in patient care, early detection capabilities, and therapeutic innovations have contributed to a decline in mortality rates associated with cancer. In France, for example, mortality rates have shown a decrease of -2% for men and -0.7% for women, as reported by *Intitut National du Cancer* [5]. Cancer patients have access to various treatment options, including surgery, chemotherapy, radiotherapy, immunotherapy, and targeted therapies. The year 2021 witnessed a remarkable milestone, with a record-breaking number of 30 new active substances in oncology being introduced globally, totaling 159 since 2013, according to IQVIA [4].

Despite the significant advancements in cancer treatments, they are not without their drawbacks. These treatments can have varying effects on individuals, often resulting in side effects that can significantly impact patients' quality of life. Studies have indicated that one in five individuals lose their jobs within five years of a cancer diagnosis, and 6.5% experience treatment-related after-effects, as reported by INC [5]. Unlike many other diseases, the development of cancer is unique to each individual. Cancer cells do not exhibit identical behavior in all cases and progress through different stages at varying rates. The stage at which cancer is detected, the speed of cancer cell spread, and an individual's lifestyle are crucial factors in determining the likelihood of remission.

The present challenge revolves around striking the appropriate balance between the benefits and risks of cancer treatments for each patient. For instance, the consequences of a mastectomy will differ for a young girl compared to an older woman. Each patient is unique and must be treated on an individual basis, taking into account their specific circumstances. In situations where cancer cells are spreading rapidly, achieving swift results may come at the expense of strong side effects and significant after-effects. Conversely, for patients with slower-spreading cancer cells, the emphasis is on preserving their quality of life and minimizing side effects.

Problematic

The field of personalized medicine in oncology is intricate and multidisciplinary, requiring the consideration of vast amounts of data. To aid in this decision-making process, doctors convene in multidisciplinary meetings where they consult with specialists from various medical domains. During these meetings, comprehensive medical data for each patient is gathered, presented, analyzed, and compared with relevant clinical studies.

Traditionally, doctors have to gather information from multiple sources, including patient data, test results, and pertinent clinical studies. This manual compilation process can be time-consuming and prone to errors, resulting in delays in decision-making. Additionally, doctors need to stay updated on ongoing clinical studies for potential new treatments and assess patient eligibility for participation.

A significant challenge faced by doctors is the limited understanding of why certain treatments fail to yield the expected outcomes in specific patients. While the response rate to a treatment may be established, accurately predicting which patients will derive greater benefits compared to associated risks remains elusive. Consequently, doctors often make treatment decisions under conditions of uncertainty, sometimes involving patients in the decision-making process by presenting them with the choice of accepting potential risks.

The integration of information technology into the decision-making process has the potential to streamline data compilation, reduce errors, and facilitate faster decision-making. By automating certain tasks and providing access to up-to-date information, technology can significantly enhance the efficiency and effectiveness of the decision-making process in oncology.

Proposed solution

MyTreatment is an innovative decision-support tool that is currently being developed with the goal of enhancing the prescription of cancer treatments. This tool offers several key functionalities:

- Data collection from clinical studies: MyTreatment enables the collection and integration of data from relevant clinical studies. This feature ensures that doctors have access to the latest research findings and treatment outcomes, allowing them to make informed decisions based on comprehensive and up-to-date information.
- Patient data recording: The tool facilitates the recording and management of patient data in a unique and streamlined manner. By avoiding duplication of efforts, MyTreatment ensures that multiple doctors working on the same case can access and update patient information efficiently. This improves collaboration and reduces potential errors in data management.
- Benefit/Risk ratio estimation: One of the core capabilities of MyTreatment is assisting doctors in assessing the benefit-to-risk ratio for each patient. By leveraging patient-specific data, the tool provides estimates of treatment efficacy, toxicity, and potential side effects. This personalized information empowers doctors to make more accurate and tailored treatment decisions, taking into account individual patient characteristics and potential risks.

By incorporating these features, MyTreatment aims to enhance the precision and efficiency of treatment prescription in the field of oncology. This, in turn, can lead to improved patient outcomes and optimize the delivery of cancer care.

1.4 Problematic and outline

While academic research focuses on expanding knowledge and understanding within a particular field, the path towards discovery and innovation involves leveraging that knowledge to develop real-world solutions and bring them to market. This transition often begins when researchers recognize

the practical implications of their work, requiring a shift in mindset from purely academic pursuits to considering the practical applications and potential commercialization of their research findings.

The journey from academic research project to startup creation is a complex process that involves transforming scientific knowledge into practical applications. Startups provide researchers with a means to translate their scientific knowledge into tangible products, technologies, or services that can address market demands. However, this transition often requires additional skills, such as business planning, fundraising, and team building, which researchers may not possess.

Securing funding and support is crucial in the transition from academic research to innovation and startup creation. Funding sources can provide the necessary resources to further develop prototypes, conduct market validation, and scale the business. Moreover, the process of transitioning from academic research to innovation requires a mindset that embraces risk-taking, adaptability, and resilience. Startup creation is inherently challenging, and entrepreneurs must be prepared to navigate uncertainties, overcome obstacles, and iterate on their ideas based on market feedback. Flexibility and a willingness to learn from failures and pivot when necessary are critical components of the innovation journey.

This report aims to examine the process of transitioning from an academic project to the creation of a viable startup, exploring the prerequisites and success factors involved. It seeks to address key questions such as how to navigate this journey effectively and what essential requirements contribute to success.

The first part of this report delves into the essential elements required to transform an academic project into a thriving startup in today's competitive business landscape. It explores key prerequisites that researchers and academics should consider, such as identifying market opportunities, understanding customer needs, and assessing the commercial potential of their research findings.

In the second part, the report investigates the success factors that contribute to the viability and growth of startups originating from academic research. It emphasizes the importance of securing adequate funding and support, developing a robust business plan, and establishing a strong network of mentors, advisors, and industry connections. Additionally, it explores the significance of market validation, scalability, and adaptability in ensuring the long-term sustainability and competitiveness of the startup.

By analyzing the case of the MyTreatment project, this report highlights strategies and approaches that have yielded positive results. Its aim is to provide valuable information on the prerequisites and success factors that can maximize the chances of successfully transforming an academic project into a thriving startup.

Finally, the report addresses the role of the researcher who initiated the research and explores strategies to enhance the value of their work, particularly in cases where the researchers may not possess strong entrepreneurial motivations.

2 Prerequisites for a Deeptech project: The essential trio Technology-Market-Ecosystem

The prerequisites for deeptech projects play a crucial role in their overall success and impact. These prerequisites are essential components that lay the foundation for the project and contribute to its feasibility, viability, and potential for commercialization.

2.1 Technology

The technological prerequisite ensures that the project is built on a solid technological foundation. Having the necessary technical expertise and research and development capabilities is crucial to address technical challenges.

2.1.1 High-tech expertise

The technological lock plays a pivotal role in the success of Deeptech projects by providing a unique differentiating factor and facilitating market establishment. Deeptech projects often involve the development of advanced technologies that are not widely understood or mastered, making them exclusive to a limited number of research centers worldwide. The technological lock gives a distinct competitive advantage. By possessing proprietary knowledge and expertise in cutting-edge technologies, the project can offer solutions that are superior to existing alternatives. The involvement of a dedicated research team that has been working on the subject matter for an extended period is critical for the success of Deeptech projects. Their accumulated knowledge, experience, and deep understanding of the technology ensures that the technology is developed and refined with the highest level of competence. Moreover, the involvement of a research team with a long-standing commitment to the subject matter instills trust and credibility in the project. Their recognized expertise and track record in the field lend credibility to the technology being developed. The involvement of a dedicated research team opens also opportunities for collaboration and networking with other experts and institutions in the field. By being part of the wider research community, the team can exchange ideas, leverage external expertise, and access additional resources. Collaborative efforts can accelerate progress, foster innovation, and expand the project's potential impact.

MyTreatment was born in the Computer Science Laboratory (LAMSADE) of Université Paris Dauphine - PSL, which has advanced expertise in the field of machine learning. The MILES project-team is the result of collaborative efforts among distinguished researchers specializing in theoretical computer science, applied mathematics, and game theory. By synergistically combining their expertise, the MILES researchers are deeply committed to achieving significant advancements in the domains of machine learning and data science. Their endeavors encompass a dual focus on enhancing theoretical foundations and developing practical applications. The team has successfully established collaborations with leading industrial partners such as Meta AI and Google AI, as well as academic partnerships with prestigious institutions including Critet, CEA Saclay, and INRIA.

The project is being carried out in collaboration with the personalized medicine team at CRESS (Inserm), affiliated to Paris Cité. The METHODS team aims to remodel the therapeutic evaluation of chronic diseases by exploring innovative concepts and developing novel methodological approaches. The research interests of the METHODS team revolve around statistical and machine learning methods for personalized medicine, as well as methodologies for causal inference on treatment effects, with a particular focus on leveraging clinical trials or observational studies. They actively participate in international projects such as NECESSITY (an Interventional Trial based on Stratifying Patients) and MORE-Europa (More Effectively Using Registries to Support Patient-centered Regulatory and HTA Decision-making). In addition, they previously led the Work Package on Clinical Trials Designs for Personalized Medicine in the H2020-funded PERMIT (PERsonalised MedicIne Trials) project.

In addition, collaborations have been established with medical researchers specializing in oncology

at France's leading cancer centers, such as Institut Curie, Institut Gustave Roussy and Toulouse's Oncopole. These partnerships enable researchers to leverage their expertise and cutting-edge resources to further the research project.

2.1.2 Intellectual property protection

For a Deeptech startup, intellectual property (IP) strategies play a crucial role in protecting and maximizing the value of the project. Filing for patents is a primary strategy for Deeptech startups. Patents provide exclusive rights to the startup, preventing others from using, making, or selling the patented technology without permission. Deeptech startups may opt to protect valuable proprietary information, such as algorithms or datasets, as trade secrets. Trade secrets provide protection as long as the information remains confidential. This strategy requires implementing rigorous security measures to maintain secrecy. Copyright protection can be applied to various aspects of Deeptech, such as software code, databases, or written materials. Copyrights grant exclusive rights to reproduce, distribute, or display the protected works. Startups can leverage copyrights to protect their software implementations and related documentation. Trademarks are used to protect the brand identity of a Deeptech startup. Registering a trademark provides exclusive rights to use a specific name, logo, or slogan associated with the startup's products or services. Trademarks help establish brand recognition and prevent others from using similar marks that could cause confusion among consumers.

The protection of IP is typically handled by the technology transfer center associated with the laboratory. The technological lock often involves the creation of IP which safeguard the uniqueness of the developed technology. IP protection is crucial as it provides legal barriers against competitors, ensuring that the innovative aspects of the Deeptech project remain exclusive to the research team. This protection enhances market positioning and creates barriers to entry for potential competitors. Nonetheless, the initial costs incurred by the research center for protecting IP eventually shift to the responsibility of the startup for ongoing maintenance and expansion, especially when seeking international coverage. Defending IP rights, such as demonstrating infringement by other companies utilizing the patented technology, can impose substantial financial burdens that may be insurmountable for a startup. It is therefore essential to strike a delicate balance between the various protection strategies. This balance aims to optimize competitive positioning while preserving confidentiality and the rights associated with the technology.

Additionally, it is important to acknowledge that the transfer of IP rights from the research center to the startup can be a complex and time-consuming process. Typically, these rights are transferred through licensing agreements, which may not always be favorable to the startup, particularly during the scaling phase. This is because the startup may not have complete ownership of the IP asset, which can create limitations and restrictions on its ability to fully exploit and commercialize the technology. During the scaling process, startups often require the flexibility to make strategic decisions and pivot their business models as needed. However, when IP rights are not fully owned by the startup, it can face challenges in terms of negotiating partnerships, securing investments, or entering new markets. The limitations imposed by licensing arrangements can hinder the startup's agility and potential for growth. To mitigate these challenges, startups must carefully negotiate the terms and conditions of the licensing agreements with the research center. It is crucial to ensure that the startup retains sufficient rights and controls over the IP to support its future expansion and competitive positioning. Seeking legal counsel and engaging in open communication with the research center can help strike a fair balance that benefits both parties while enabling the startup to fully leverage the IP for its success. Moreover, startups should also explore alternative strategies, such as acquiring additional IP rights or investing in research and development to generate their own proprietary technologies. By diversifying their IP portfolio and reducing reliance on licensed assets, startups can enhance their autonomy and strengthen their position in the market.

It is important for Deeptech project to consult with IP attorneys or experts to develop a comprehensive IP strategy tailored to their specific needs. A well-executed IP strategy can strengthen a Deeptech startup's market position, attract investors, and provide a competitive advantage in the rapidly evolving technology landscape.

MyTreatment project has reached an important milestone, known as TLR 4, which signifies that the algorithms have undergone testing in a laboratory setting using synthetic data. The generation of synthetic data was carefully designed to identify any potential limitations. These tests have yielded highly promising results, prompting the project to proceed with further testing in a real-life environment. Simultaneously, the development of a user interface has taken place, ensuring that the tool is user-friendly for medical professionals. Due to the limited protection offered by patentability of algorithms and methods, no patent has been filed at this stage to maintain secrecy. However, the databases created and the corresponding pre-processing activities will soon benefit from copyright protection. This is because, in addition to the algorithm itself, the data utilized significantly contributes to the efficiency of the algorithms and the relevance of the outcomes. Furthermore, the early phase of the project serves the purpose of demonstrating the coherence and alignment of the algorithm and the indicators with the decisions of medical experts. These results will be documented and later used for a patent application at the conclusion of the initial phase. The patent will cover the functionality of the algorithm as well as the validation method employed. Throughout this process, the transfer structure at PSL (Paris Sciences et Lettres) provides support and guidance, ensuring the project's advancement and success.

2.2 Market

The market prerequisite focuses on assessing the commercial potential of the Deeptech project. Conducting thorough market research, understanding customer needs, and validating the demand for the technology are vital steps in ensuring that the project aligns with market realities. This prerequisite helps identify target markets, evaluate competition, and develop strategies to position the project for success in the marketplace.

2.2.1 Market validation and customer needs

Conducting comprehensive market research and validation is a fundamental step in understanding the commercial potential of a Deeptech project. This process entails various activities aimed at gaining insights into target markets and assessing customer needs.

The study can be divided into the following steps:

- Identifying target markets: To define the scope of the Deeptech project, it is necessary to identify the specific industries, sectors, or customer segments it aims to target. This requires a thorough analysis of market trends, growth opportunities, and potential niches where the technology can offer substantial value. Factors such as market size, growth rate, competitive landscape, regulatory environment, and other relevant market dynamics should be taken into consideration during this process. By carefully assessing these factors, the project can determine the most promising areas to focus on and align its efforts with the specific needs and demands of the chosen industries or customer segments.
- Assessing customer needs: To develop a comprehensive understanding of the target markets, it is crucial to gain deep insights into customer needs, pain points, and challenges. This can be achieved through various methods such as market surveys, interviews, and focus groups, which allow direct engagement with potential customers. By collecting feedback and opinions from these sources, the project can identify specific requirements, preferences, and expectations related to the technology. This customer-centric approach enables the project to customize the Deeptech solution effectively, ensuring it aligns with the identified market needs and delivers maximum value to the customers.

MyTreatment has developed algorithms with versatile applications in fields such as marketing, education, economics, and medicine, enabling personalization in each domain. The decision to focus on the medical sector stems from its profound impact on health and life-saving potential, making it a compelling area to pursue. This choice also enhances the project's ability to attract talented individuals who are motivated by the opportunity to contribute to such a meaningful

cause. To identify the needs within the medical sector, extensive efforts were made, including engaging in discussions with numerous doctors, researching current advancements, participating in conferences, and consulting various stakeholders within the healthcare system, including patients. These activities provided valuable insights into the challenges and requirements of the sector.

However, the medical sector presents significant challenges that need to be overcome. One of these challenges is the limited access to sensitive data, which requires careful consideration of data privacy and security measures. Additionally, the regulatory landscape in this field may not be fully established, necessitating the project to adapt to evolving regulations and compliance requirements. Furthermore, the adoption and trust of doctors and patients pose additional hurdles. The technological tools developed by the project may be perceived as complex or unfamiliar, requiring efforts to bridge the gap between advanced technology and end-user comprehension. Establishing trust among doctors and patients is essential for the successful adoption and acceptance of the project's tools and methodologies. By recognizing and addressing these challenges, the MyTreatment project can effectively navigate the complexities of the medical sector. This will enable them to personalize healthcare interventions and ultimately improve patient outcomes.

The project is built upon an extensive examination of various factors. These factors encompass a thorough study of different diseases, an evaluation of treatment costs, the emergence of new medical conditions, and the identified needs of doctors. One notable aspect of this medical condition is the lack of understanding among doctors regarding why two patients with similar characteristics may respond differently to the same treatment. Currently, crucial data that could contribute to a comprehensive understanding of this condition are not integrated into clinical studies, which makes it challenging to accurately categorize patients. As a result, the available information primarily focuses on response rates and general recommendations rather than delving into the intricacies of individual patient characteristics.

2.2.2 Assessing the commercial potential and competitive landscape

To assess the commercial potential and competitive landscape of a Deeptech project, several requirements need to be considered.

The study can be divided into the following steps:

- Evaluating market viability within the target markets: To evaluate the viability of the project, it is important to assess several factors including market demand, barriers to entry, and potential market acceptance. This involves analyzing the level of demand for the proposed solution, understanding the obstacles that could hinder entry into the market, and gauging the likelihood of the market accepting the project. Furthermore, it is crucial to analyze existing solutions in the market and identify their limitations. This assessment helps to determine the unique value proposition that the project brings to the table.
- Market segmentation: To effectively target the markets for the project, it is necessary to segment them based on relevant criteria such as industry, geography, organization size, or customer profiles. This segmentation enables the development of focused marketing and sales strategies that cater to the specific needs and characteristics of each segment.
- Competitive analysis: This analysis of the competitive landscape involves examining existing solutions, technologies, and competitors operating within the same markets. By identifying their strengths, weaknesses, market positioning, pricing strategies, and customer feedback, the project can gain insights that will help differentiate itself and position effectively against competitors.
- IP considerations: This involves conducting a comprehensive assessment of existing patents, trademarks, and copyrights that are relevant to the project. By examining the IP landscape, the project can determine if there are any potential conflicts or infringements. Furthermore, this evaluation helps to ensure that the project's innovations are distinct and have the necessary IP protection.

- Proof of Concept (POC) and pilot testing: This serves as a tangible demonstration of the project's capabilities. Additionally, conducting pilot tests in real-world scenarios, in collaboration with early adopters or partners within the target markets, allows for practical validation. These tests provide an opportunity to gather feedback, measure performance, and assess the project's effectiveness

The ongoing phase of the MyTreatment project is focused on comprehensive validation. Initial research has been conducted, involving interviews with various stakeholders such as doctors, hospital procurement professionals, and startups operating in the field. What sets MyTreatment apart from competitors is its utilization of cutting-edge technology that is currently unknown or not fully mastered by its rivals. Additionally, the project benefits from strong connections with the academic community, allowing for collaborations with hospitals, database construction, and the exploration of new research projects to address challenges.

2.2.3 Scalability, sustainability and impact

Fulfilling prerequisites is an essential foundation for achieving scalability and making a significant impact. In Deeptech projects, satisfying key technology, market and ecosystem requirements significantly enhances the potential for growth, expansion and real-world application. By meeting these prerequisites, the project is better positioned to tackle complex challenges, improve existing systems or introduce disruptive innovations, thus increasing the likelihood of having a substantial societal impact.

MyTreatment aims to simultaneously reduce cancer-related morbidity and mortality. This project aligns with the United Nations Sustainable Development Goal (SDG) of "Good health and well-being" [7]. Cancer is a significant global public health concern, ranking among the leading causes of death worldwide. To achieve the SDG of "ensuring healthy lives and promoting well-being for all at all ages", it is imperative to ensure accessible and affordable high-quality cancer treatment.

Moreover, the rising costs of new drugs present a challenge to the universal availability of innovative cancer treatments. MyTreatment offers a solution by addressing potential ethical dilemmas and prioritizing patients who can benefit the most from these innovative treatments. By doing so, the project facilitates access to affordable and sustainable healthcare, ultimately enhancing the quality of treatment for patients. This approach also reduces the need for expensive and potentially ineffective treatments, alleviating the financial burden associated with cancer care.

2.3 Ecosystem

To generate innovation, it is essential to have the right ecosystem involving a number of key players, including:

- Institutional entities: These organizations play a vital role in shaping public health policies, implementing action plans for health research and innovation, and providing funding for innovative projects. Examples include the French Ministry of Health and Solidarity, Haute Autorité de Santé (HAS), and Institut National de la Santé et de la Recherche Médicale (INSERM).
- Researchers: Research laboratories and institutes contribute to fundamental and applied research, often collaborating with companies and institutions to advance scientific knowledge and develop innovative solutions.
- Industry experts: These professionals provide access to specialized facilities, equipment, and infrastructure that are crucial for the development of the Deeptech project. This access can save costs, expedite experiments, and enable the utilization of advanced tools and techniques.
- Incubators and accelerators: Incubators and accelerators offer valuable support to startups by providing coaching, mentoring, and funding opportunities. They help nurture and develop young companies, enabling them to thrive.

- Public and private funders: Financing is essential for innovative companies, and both public and private funders fulfill this role. Institutions like BPIFrance and Elaia offer financial support to help innovative ventures bring their ideas to fruition.
- Major corporations: Collaboration with established corporations is vital for startups to gain market access, deploy their technologies, and drive the adoption of new innovations. These partnerships facilitate knowledge transfer, commercialization, and scalability.
- Potential customers: Engaging with potential customers helps validate the project's market fit and gather valuable feedback.

By bringing together these diverse players, an environment conducive to innovation is fostered. This ecosystem encourages collaboration, resource sharing, and the development and adoption of new technologies. These partnerships provide valuable insights, resources, and networks that greatly contribute to the success of the project.

Forming strategic partnerships can accelerate the development of the project by leveraging the expertise, experience, and resources of collaborators. Engaging with industry experts and research institutions expands the project's network, creating opportunities for mentorship, knowledge sharing, and potential future collaborations. This collaboration allows the project team to tap into existing knowledge and accelerate progress through joint efforts, ultimately reducing time to market. Collaborations also unlock new opportunities, such as joint ventures, licensing agreements, or access to new markets. Furthermore, deep technology projects often require significant financial resources to support research, development, and scaling efforts. Identifying potential funding sources, such as venture capital firms, government grants, or strategic partnerships, is crucial to ensure the project's sustainability. Additionally, ethical implications, privacy concerns, and the handling of sensitive data are common aspects of Deeptech projects. Navigating the regulatory landscape and ensuring compliance with relevant laws and regulations governing data protection, security, and ethical guidelines is of utmost importance.

The MyTreatment project benefits from a diverse academic network that includes prestigious institutions such as Dauphine-PSL, Mines Paris-PSL, Paris Cité, PRAIRIE, as well as collaborations with other key players like Unicancer, Filière Cancer & AI, and Ethik-IA. The project is further supported by the PSL incubator, which provides valuable resources and guidance. Additionally, connections have been established with startups that share similar goals, fostering a collaborative ecosystem. The project also enjoys the support of individuals who generously grant access to their networks in both the private and public sectors. These partnerships and expanded networks are integral to the project's success, enabling the exchange of knowledge, resources, and expertise that propel its advancement.

It is worth highlighting that the French healthcare ecosystem provides a highly conducive environment for digital innovation. The presence of various public policies encourages funding and supports the growth of innovative startups. At every stage of startup development, there are dedicated support structures available, along with specialized deeptech investment funds. This favorable environment surrounding MyTreatment encompasses academic excellence, ambitious political initiatives, numerous funding schemes for innovative companies, early-stage financing options, technology transfer support structures, and an evolving regulatory framework that aims to foster rather than restrict innovation. These factors create an environment that is highly supportive of the MyTreatment project's goals and aspirations.

3 From concept to implementation: Success factors

Understanding the success factors is crucial for a Deeptech startup to transition from a concept to a successful implementation. The identification of these factors provides entrepreneurs and stakeholders with valuable insights to make informed decisions throughout the startup's journey. This helps in prioritizing resources, allocating funds, and concentrating efforts on areas that have the most significant impact on the company's success. Startups encounter various risks, such as technological uncertainties, financial challenges, market adoption, regulatory compliance, scaling, and resource management. By comprehending these success factors, entrepreneurs can address potential challenges and mitigate risks associated with scaling, resource management, market adoption, and regulatory compliance.

MyTreatment is currently in the design phase, and the venture has not been created. While we cannot delve into specific details at this point, it is important to note that all relevant aspects are already being carefully considered and addressed.

3.1 Strong team

Having a skilled and capable workforce that can effectively navigate the journey from project conception to implementation is crucial for achieving success.

3.1.1 Co-founders team

Forming a co-founder team is a critical decision that significantly impacts the success of a Deeptech startup. Thoroughly evaluating potential co-founders, conducting due diligence, and ensuring alignment with the startup's vision, skills and culture are essential.

A diverse co-founder team with complementary expertise and skill sets is beneficial for covering all areas of the startup's operations. Shared vision and passion among co-founders foster commitment and dedication, particularly during challenging times. Building trust and cultivating a compatible working relationship are crucial, emphasizing effective communication, collaboration, and constructive conflict resolution.

Entrepreneurial mindset and resilience are vital traits for Deeptech startup co-founders, as they navigate ambiguity, embrace change, and take calculated risks. Co-founders with a strong network in the Deeptech industry offer valuable resources, mentorship, access to investors, customers, and partnership opportunities, accelerating growth and overcoming obstacles.

Full commitment, investment of time and effort, and a track record of accomplishments demonstrate co-founders' dedication and increase the startup's chances of success. Embracing diversity in the team, including gender, ethnicity, background, and experiences, contributes to varied perspectives, creativity, problem-solving, innovation, and reaching a broader customer base.

Once the co-founder team is formed, it is essential to establish clear agreements that define their roles, responsibilities, share distribution, and mechanisms for resolving disputes. These arrangements are typically formalized through legal agreements, such as a shareholder pact. When allocating shares, it is important to carefully consider each individual's current and potential future contributions to the project. This ensures a fair and equitable distribution that aligns with the co-founders' commitment and anticipated value to the startup.

Currently, the project is supported by the researcher behind the technology development. She has a background in AI and a strong expertise in Deeptech entrepreneurship. She would like to assume the position of Chief Executive Officer (CEO). Efforts are underway to put together a team of three co-founders, with two specific profiles. One is a highly technical person capable of fulfilling the role of Chief Technology Officer (CTO), while the other is a healthcare specialist with extensive experience in this field, ready to take on the role of Chief Operating Officer (COO).

3.1.2 Board

The board plays a vital role in guiding the startup's overall direction, decision-making processes, and long-term success. One key element is the composition of experienced and knowledgeable individuals, with diverse backgrounds and expertise. This diversity helps in making well-informed decisions, identifying opportunities, and mitigating risks. Having board members with deep industry knowledge and understanding of emerging technologies can be particularly advantageous. Through regular meetings and discussions, board members can provide valuable advice, challenge assumptions, and offer guidance based on their collective experience. Moreover, the board can provide access to valuable networks and resources. Board members often have extensive networks of industry contacts, potential investors, and other key stakeholders. They can open doors to partnerships, funding opportunities, and strategic alliances that can significantly benefit the Deeptech startup.

One common challenge faced by certain startups is the tendency for the board to serve merely as a symbol, representing the investors' interests, rather than actively engaging in the startup's operations. In such cases, the board may function more as an investor rather than a genuine advisor. By actively involving the board, startups can tap into a wealth of expertise, insights, and guidance. Involving the board in the startup's activities fosters a sense of ownership and shared responsibility. When board members have a genuine stake in the startup's success, they are more likely to actively contribute their expertise, connections, and resources. This level of involvement can strengthen the startup's overall performance and enhance its credibility with stakeholders, including potential investors, partners, and customers.

MyTreatment benefits from the support and guidance of several mentors who are actively involved in the project. These mentors will assume positions on the board once it has been established. The board composition includes a diverse range of profiles, each bringing unique expertise and insights to the table.

In the business board:

- A tiger investor profile who has made investments in numerous startups both in France and abroad. This individual's experience in the startup ecosystem and understanding of investment strategies will provide valuable guidance and resources.
- An institutional profile with a strong background in public research institutions will contribute a wealth of knowledge regarding navigating research landscapes.
- A healthcare profile with extensive experience in the sector will ensure compliance with regulations, navigate legal complexities, and provide insights into healthcare-specific challenges and opportunities.

In the scientific board:

- An AI researcher. His knowledge and experience in AI research will enable him to shed valuable light on the technical aspects of the project, and to stay at the cutting edge of innovation in the AI field.
- A researcher in healthcare, bringing expertise in the intersection of healthcare and technology. His contribution will help align the project with the specific needs and challenges of the healthcare industry.
- A practicing oncology researcher, with direct experience of cancer research and treatment, will provide valuable insight into the requirements and complexities specific to oncology, ensuring that the project addresses relevant issues.

3.1.3 Management team

One key factor in the success of a management team is their collective skill set and expertise. A diverse team with complementary skills and experiences can effectively tackle the various challenges

that arise in a startup's journey. Strong leadership, strategic thinking, and the ability to adapt to changing circumstances are essential traits for the management team to navigate the complexities of running a startup.

However, attracting and convincing talented individuals to join a startup can be a significant challenge. Startups often compete with established companies that may offer more stability, resources, or established brand recognition. To overcome this challenge, startups need to showcase their unique value proposition, potential for growth, and the opportunity for employees to make a meaningful impact. This involves effectively communicating the startup's vision, mission, and the exciting possibilities it offers for personal and professional growth. A compelling and inspiring vision can attract individuals who are passionate about the startup's mission and believe in its potential to make a positive difference. The vision provides a sense of purpose and direction, aligning the efforts of the management team and employees towards a common goal.

In order to drive the progress and success of the MyTreatment project, it is crucial to promptly assemble a substantial team of researchers. This will enable the startup to not only develop its own IP but also maintain a competitive edge by conducting continuous research. Furthermore, the establishment of a dedicated technical team is essential to ensure the effective deployment of the technology. Additionally, allocating resources towards the development of regulatory and commercial aspects is of utmost importance. This will involve navigating the complex regulatory landscape and securing necessary approvals, as well as strategically planning and executing commercialization strategies to maximize the project's market potential.

3.2 Being close to the market

3.2.1 Improving market positioning

Improving market positioning is a crucial task for startups aiming to succeed in a competitive landscape. Startups may face challenges in gaining a deep understanding of their target market, including customer needs, preferences, and industry dynamics. The solution is to conduct thorough market research to gather insights about the target market. Engage in customer discovery interviews, surveys, and data analysis to gain a comprehensive understanding of customer pain points, desires, and market trends. Leverage market research tools, industry reports, and expert advice to develop a clear picture of the market landscape. In crowded markets, startups struggle to differentiate themselves from competitors and grab the attention of potential customers. Effectively communicating these differentiators to potential customers through branding efforts and value proposition messaging is essential.

MyTreatment operates in a highly competitive market where numerous startups are pursuing similar objectives. However, MyTreatment distinguishes itself by being at the forefront of AI advancements and leveraging technologies that are not yet mastered by its competitors. This unique positioning gives MyTreatment a significant advantage. One crucial asset for the project is its strong connections with research laboratories. Collaborating with research laboratories allows MyTreatment to tap into the latest scientific advancements, access specialized expertise, and gain insights into emerging technologies. This partnership facilitates the development of cutting-edge algorithms and ensures that MyTreatment remains at the forefront of innovation in the field of AI.

3.2.2 Market entry strategy

Developing a comprehensive market entry strategy for a Deeptech project involves various challenges and requires careful consideration of distribution channels, pricing models, marketing campaigns, and potential strategic partnerships.

Choosing the most effective distribution channels to reach the target audience is another challenge. Different markets may require different distribution approaches, and selecting the wrong channels can lead to limited market reach or inefficient resource allocation. To determine the most suitable distribution channels, it is important to analyze the target markets and customer behaviors.

Factors such as online platforms, retail partnerships, direct sales, or industry-specific channels should be considered.

Setting the price too high may hinder market adoption, while setting it too low may undervalue the technology or hinder profitability. To determine the appropriate pricing, it is essential to conduct a pricing analysis considering factors like production costs, value provided to customers, competitive landscape, and customer willingness to pay. Depending on the nature of the Deeptech project and customer preferences, innovative pricing models such as subscription-based, usage-based, or value-based pricing can be considered. Regular reassessment and adjustment of pricing strategies based on market feedback and competitive dynamics are also important.

Developing and executing effective marketing campaigns to create awareness, generate interest, and drive adoption is a significant challenge. Limited resources, targeting the right audience, and creating compelling messaging are common obstacles. To effectively promote the Deeptech project, it is necessary to develop a targeted marketing strategy aligned with the identified customer segments and their preferred communication channels. Utilizing digital marketing techniques, content marketing, social media platforms, and participating in industry-specific events can help reach the target audience effectively.

Identifying potential partners who can offer complementary resources, market access, or expertise is essential. Building relationships with industry leaders, investors, or research institutions can help leverage their networks and knowledge. Developing a clear value proposition for potential partners and crafting partnership agreements that align with the goals and objectives of both parties are important steps in fostering successful collaborations.

The entry of MyTreatment as a decision-support tool for practitioners relies heavily on gaining acceptance and adoption within the healthcare industry. Recognizing this, the development of the tool is being carried out in close collaboration with influential doctors who will play a crucial role in championing and endorsing the technology to the wider medical community. By involving influential doctors in the development process, MyTreatment benefits from their expertise, insights, and firsthand experience in clinical practice. These doctors contribute to refining the tool's functionalities, ensuring its alignment with real-world medical needs, and enhancing its user-friendliness. Their involvement also helps to instill trust and credibility among their peers, as their endorsement carries significant weight within the medical community. The influential doctors who collaborate with MyTreatment serve as ambassadors for the technology. They play a vital role in promoting the tool's benefits, showcasing its effectiveness, and highlighting the positive impact it can have on patient care and outcomes.

3.2.3 Iterative optimization

Gaining access to comprehensive market insights can be challenging, especially in emerging and rapidly evolving industries. Collecting and managing customer feedback is a valuable asset. To effectively manage customer feedback, it is important to implement a feedback management system, which enable systematic collection, categorization, and analysis of customer feedback. Tools such as customer surveys, feedback forms, and social media monitoring can be leveraged to gather feedback from various channels. Clear criteria should be established to prioritize and address feedback, considering its impact on the technology's performance, usability, and value proposition.

Implementing agile methodologies can help manage the iterative development process effectively. Breaking down the project into smaller, manageable components or sprints allows for better control and progress tracking. Realistic timelines should be set, and tasks should be prioritized based on their impact on technology performance and market requirements.

In the context of MyTreatment, it is crucial to collect feedback not just from practitioners but also from patients who are showing growing interest in comprehending and actively managing their own health. The development of the tool will follow an iterative process, encompassing design, development, and testing phases. Starting with initial versions that have limited specifications and a smaller dataset, the goal is to gradually enhance the tool's effectiveness by addressing prescription-related issues on an individual basis. The iterative approach allows for continuous

improvement and refinement of the tool. Each iteration builds upon the insights gained from previous versions, incorporating new features and enhancements to address identified challenges and optimize the tool's performance. This iterative development process enables MyTreatment to adapt and evolve in response to emerging healthcare trends and evolving patient needs. At the current stage, three proof-of-concept (POC) projects are underway, each focusing on addressing specific challenges related to the prescription process. These POC serve as targeted experiments, allowing the MyTreatment team to validate and fine-tune different aspects of the tool's functionality and usability. The insights gained from these POC will inform further development and contribute to the overall refinement of MyTreatment.

3.2.4 Shifting market dynamics

The ever-changing nature of markets presents challenges in maintaining a strong market position for Deeptech startups. Shifts in customer preferences, emerging technologies, and regulatory landscapes can disrupt their positioning efforts. To address these challenges, it is important to establish mechanisms for continuous market monitoring. This involves staying updated with industry trends, customer feedback, and regulatory changes that may impact market positioning. By actively monitoring the market, startups can identify emerging trends and potential threats, allowing them to make informed decisions. Adapting strategies and product offerings is crucial to align with shifting market dynamics. By being responsive to changes in customer preferences and industry advancements, startups can stay relevant and competitive. This may involve making adjustments to the value proposition, features, or pricing of their offerings.

For MyTreatment, conducting competitive and market intelligence is crucial. This involves conducting studies and collaborating with key stakeholders in the industry.

3.3 Securing funding and resources

Securing funding and resources is a critical aspect of success for DeepTech startups, as these ventures often require significant financial support to develop and commercialize their innovative technologies.

Strong business plan A Deeptech startup can enhance its chances of securing funding and resources by developing a thorough business plan that effectively communicates the value proposition, market potential, and scalability of the venture. It is important to emphasize the distinctive technological advantages and the potential impact on the target market. A compelling business plan not only attracts investors but also showcases the potential return on investment.

Accelerators and incubators Joining a reputable startup accelerator or incubator program can provide valuable resources, mentorship, and networking opportunities. These programs often offer funding, access to industry experts, and connections to potential investors. Engaging with such programs can enhance credibility and increase the chances of securing further funding.

Government grants and funding programs Government-sponsored initiatives in numerous countries and regions provide grants, subsidies, and funding programs tailored to support Deeptech startups. It is worthwhile to conduct research and apply for these opportunities that align with the objectives of the startup. These programs can offer financial assistance, access to valuable resources, and guidance in navigating regulatory requirements.

Partnerships Establishing strategic partnerships enables to leverage the resources and expertise of established companies, research institutions, or industry leaders. These collaborations can bring both financial and tecnical resources benefits. Strategic partnerships offer access to specialized knowledge, technology infrastructure, distribution channels, and potential funding opportunities.

It is crucial to seek out partnerships that align with the goals of the startup and have the potential to accelerate growth.

Crowdfunding Crowdfunding platforms can be a valuable way for Deeptech startups to raise funds from a wide audience. By presenting their vision and value proposition to potential backers, and offering incentives or pre-sales of products/services, startups can attract financial support. In addition, crowdfunding serves as a marketing tool, creating awareness and capturing the interest of early adopters.

Business angels Business angels play a significant role in financing Deeptech startups in early-stage investment. Business angels are willing to take higher risks compared to traditional institutional investors. They often have extensive experience and expertise in specific industries or domains. Beyond financial investment, business angels can offer strategic support to Deeptech startups. They may contribute their experience in business development, technology commercialization or regulation. They can bring valuable insight, mentoring and advice to Deeptech startups. Business angels may also provide networking opportunities and connections within their industry networks. Their involvement can lend credibility to the startup and attract further investment. While business angels are often focused on generating financial returns on their investments, they tend to have a longer-term perspective compared to traditional venture capital firms.

Venture capital Venture capital firms specialize in providing funding to Deeptech startups, including ventures during their early stages. They invest capital in exchange for equity ownership in the company. Venture capital firms often have extensive industry expertise and domain knowledge. They understand the unique challenges and potential of Deeptech startups, enabling them to evaluate investment opportunities effectively. Venture capitalists can provide valuable insights, mentorship, and guidance based on their experience in supporting similar companies, helping Deeptech startups navigate technical, market, and operational hurdles. Venture capital firms have extensive networks comprising entrepreneurs, industry leaders, potential partners, and other investors. By partnering with a venture capital firm, Deeptech startups gain access to these networks, which can open doors to new business opportunities, strategic partnerships, and further funding rounds. As Deeptech startups progress beyond the early stages, they require additional capital to scale their operations, expand their teams, and enter new markets. Venture capital firms are well-positioned to provide follow-on funding rounds to fuel the growth of Deeptech startups. Venture capital firms aim to generate returns on their investments by exiting their positions in portfolio companies. They typically seek exit opportunities through means such as initial public offerings (IPOs), acquisitions, or secondary market sales. It's important to note that venture capital investments often come with certain expectations, such as a focus on high growth, potential for large-scale market disruption, and a path to profitability. Deeptech startups seeking venture capital funding should be prepared to demonstrate the scalability of their technology, market potential, and a clear path to commercialization.

Revenue generation In situations where external funding sources are limited, Deeptech startups can concentrate on generating revenue from early customers or clients. This approach allows the startup to bootstrap its operations, validate market demand, and increase attractiveness to potential investors. By reinvesting generated revenues into product development and scaling operations, the startup can fuel further growth.

MyTreatment is committed to exploring diverse funding sources to support its development. As an academic project, it will initially seek public funding for the preliminary and maturation phases. Public funding has the advantage to provide the necessary financial support to advance the project from its early stages to a more mature and refined state. This funding can fuel research, development, and testing activities, enabling MyTreatment to reach key milestones and demonstrate the viability of its approach. Moreover, securing public funding can also help establish credibility and legitimacy for MyTreatment. It demonstrates recognition and support from respected institutions, which can attract further attention and interest from potential investors, partners, and

stakeholders. While public funding is crucial during the early stages, it is also essential to consider additional funding sources to sustain and scale the project. Hence, a subsequent round of funding from business angels will be pursued. Their involvement can contribute to the strategic growth of MyTreatment and open doors to future funding opportunities. By planning a first fundraising round within 18 to 24 months, MyTreatment demonstrates a clear timeline for securing the necessary financial resources. This timeline provides transparency and reassurance to potential investors, showcasing the project's commitment to progress and achieve key milestones within a specified timeframe.

3.4 Legal and regulatoty requierments

Deeptech startups often operate in emerging and rapidly evolving technological domains where legal and regulatory frameworks may be lagging behind. This can create uncertainty and compliance challenges for startups as they navigate through complex legal landscapes. Deeptech startups need also to address ethical considerations and biases embedded in their technology.

Startups should adopt a proactive approach to legal compliance. Engaging legal experts early on can help navigate regulatory landscapes, anticipate potential legal challenges, and ensure compliance with relevant laws and regulations. Establishing open lines of communication and collaboration with regulatory authorities can help to stay informed about evolving regulations and provide input on policy development. Engaging in discussions and industry collaborations can contribute to shaping regulatory frameworks that are conducive to Deeptech innovation. Finnaly, instilling a compliance culture within the organization is crucial. Educating employees about legal and regulatory requirements, conducting regular compliance training, and establishing internal controls and processes can help embed compliance as a core value within the Deeptech startup.

Medical software and AI-based tools in healthcare are subject to regulatory frameworks, including medical device regulations and data protection laws. It is crucial to have a thorough understanding of and adhere to these regulations to ensure patient safety and legal compliance. In light of this, MyTreatment is actively undertaking a project with "Ethik-IA" to proactively establish the necessary regulatory framework. This initiative highlights their commitment to meeting regulatory requirements and ensuring the responsible and ethical use of their tool in healthcare settings. Moreover, rigorous clinical validation is crucial for ensuring the safety and effectiveness of the tool. Clinical trials, real-world evidence, and comparative studies can help establish the tool's clinical utility and validity. Patient data privacy and security are paramount. Adhering to data protection laws and implementing robust security measures are necessary to safeguard patient information. Anonymization and encryption techniques can be employed to protect sensitive data. Transparency in data handling practices and obtaining informed consent from patients are critical for maintaining trust and compliance with ethical standards. The transparency and explainability of AI algorithms used in the tool are important ethical considerations. Healthcare professionals and patients should have a clear understanding of how the tool arrives at its recommendations or predictions. AI tools need to be developed and validated to mitigate bias and ensure fairness. Bias can arise from skewed training data or algorithmic biases. It is crucial to evaluate and address biases to avoid perpetuating health disparities and promoting equitable treatment recommendations. Regularly monitor the tool's performance, efficacy, and safety to identify and address any potential issues. Incorporate user feedback, engage in post-market surveillance, and actively contribute to ongoing research and learning in the field to improve the tool's capabilities and address emerging challenges.

3.5 Scalability

Successful implementation requires startups to achieve rapid growth and scalability. Deeptech startups face the challenge of scaling intricate cutting-edge technologies while ensuring optimal performance and efficiency. Additionally, there is a difficulty in sourcing and retaining skilled professionals with the required expertise in deep technologies. Furthermore, scaling a Deeptech startup necessitates significant financial resources.

To overcome scalability challenges, Deeptech startups can collaborate with established companies and research institutions, attracting and retaining top talent, allocating resources to research and development (R&D), planning strategically, and building investor confidence. Collaborations enable the leveraging of resources and expertise, while attracting skilled professionals addresses talent scarcity. Investment in R&D enhances technology capabilities, and strategic planning ensures scalability from the outset. Building investor confidence involves showcasing technical capabilities, market traction, and a clear path to scalability, increasing the likelihood of securing necessary funding.

Some key factor related to scalability of the project MyTreatment are crutial:

- Data availability: In order for the tool to be applicable to all institutions, it is important to consider the diversity of databases available in different cancer centers worldwide. This means ensuring that the tool can effectively accommodate and utilize data from various cancer centers, allowing it to be relevant and valuable on a global scale. This entails developing models and algorithms that can efficiently process and analyze data from different sources while maintaining a high level of accuracy in the personalized treatment recommendations.
- Computational resources: Deep learning models used for personalized treatment recommendations may require intensive computing infrastructure to process and analyze large datasets efficiently. Ensuring access to robust computational resources and optimizing algorithms for scalability is crucial.
- Algorithm optimization: To scale effectively, the project should focus on optimizing algorithms for efficiency and speed. This includes exploring methods such as parallel computing, distributed systems, and model compression techniques to reduce computational requirements while maintaining accuracy.
- Automation and integration: Scalability can be enhanced through automation and integration with existing healthcare systems. Developing interfaces and APIs that integrate seamlessly with electronic health records and other clinical systems can streamline data collection, analysis, and prescription generation.
- Collaboration and partnerships: Collaborating with healthcare institutions, research organizations, and industry partners can bolster the scalability of the project. Partnering with hospitals, oncology centers, and cancer research networks can provide.

4 Discussion

Transitioning from an academic project to a viable startup is a challenging yet rewarding journey. This report has explored the prerequisites and success factors involved in this process, shedding light on key considerations for researchers and academics aspiring to embark on the entrepreneurial path. By identifying market opportunities, researchers can align their projects with real-world demands, ensuring that their solutions have a potential market. Understanding customer needs enables researchers to develop products or services that effectively address those needs, increasing the chances of market acceptance and success. Assessing the commercial potential of research findings is crucial in determining the viability of a startup. Researchers should evaluate factors such as IP protection, competitive landscape, and market size estimation. This assessment helps researchers assess the feasibility of commercialization and make informed decisions regarding the path forward. Market validation and adaptability are crucial for startup viability and long-term success. By obtaining customer feedback, iterating on the product or service, and staying attuned to market trends, startups can refine their offerings, enhance the product-market fit, and stay ahead of competition. Securing funding and support is a fundamental aspect of startup creation. Adequate resources are necessary to further develop prototypes, conduct market validation, and scale the business. Researchers should explore various funding options and leverage government programs, grants, or venture capital to fuel their entrepreneurial journey. Developing a robust business plan is vital for attracting investors and providing a road-map for the startup's growth. By articulating the value proposition, identifying the target market, analyzing competitors, and outlining marketing and sales strategies, researchers can demonstrate their vision and potential to stakeholders. Finally, establishing a strong network of mentors, advisors, and industry connections can greatly enhance the startup's prospects. The guidance, expertise, and industry insights provided by these individuals can be invaluable in navigating challenges, making strategic decisions, and seizing growth opportunities.

It is important to acknowledge that this report aims to discuss the challenges and concepts involved in the transition from an academic project to a startup. However, it provides a high-level overview and there is potential for further exploration. Some areas that could benefit from more in-depth analysis include research funding programs, team recruitment strategies, various stages of fundraising, business plan, road-map and other relevant aspects.

Previously, the responsibility of finding a market and viable ecosystem for commercializing research work has been placed on researchers themselves. However, this task can be challenging as it requires studying different markets, assessing technology viability, and developing a suitable business model. This additional burden of entrepreneurship falls outside the expertise of most researchers. While training courses are available to raise awareness and provide essential entrepreneurial skills, expecting researchers to excel in both research and entrepreneurship is unrealistic. It is important to acknowledge that being a skilled researcher does not automatically translate into success as an entrepreneur. Transforming research into a startup requires additional skills, resources, and a deep understanding of the startup ecosystem. Consequently, some high-impact research may not be fully exploited if the research team lacks familiarity with startups or entrepreneurial capabilities.

To address this issue, a potential solution would involve identifying research work with high market potential and assigning a person with the necessary expertise to further develop the technology. This person could be a researcher/entrepreneur with a related background, but not necessarily the original researcher behind the work. A platform dedicated to connecting promising technologies with potential project leaders could facilitate this interaction. The researcher/entrepreneur leading the project could temporarily join a research laboratory to advance both existing and future research projects, with the goal of transforming the research work into a valuable market innovation. Although the concept of financing postdocs through pre-maturation funding aligns with this approach, there is a fundamental distinction. In the proposed approach, the project leader has the vision of creating a startup and temporarily shifts focus from research. In the current approach, researchers often view this funding as a supplement to their research work, and the project continues to be driven primarily as a research endeavor rather than an entrepreneurial one. Embracing an entrepreneurial mindset maximizes the potential for success by infusing the project with an entrepreneurial dynamic, distinct from purely academic pursuits.

Bibliography

[1] Amar S Ahmad, Nick Ormiston-Smith and Peter D Sasieni. 'Trends in the lifetime risk of developing cancer in Great Britain: comparison of risk for those born from 1930 to 1960'. In: *British journal of cancer* 112.5 (2015), pp. 943–947.

[2] Bpifrance. *Bilan du Plan Deeptech à 3 ans : 2021, une année record pour les créations et le financement des deeptech françaises, toujours plus actives dans le tissu industriel*. 16th Mar. 2022.

[3] Direction générale des Entreprises (DGE). *Panorama des fonds de capital-risque deep tech*. 17th Feb. 2021.

[4] *Global Oncology Trends 2022*. IQVIA, 2022.

[5] *Panorama des cancers en France, edition 2022*. (Institut National du Cancer (french republic), 2022.

[6] *Récapitulatif des principales aides spécifiques aux projets innovants*. URL: https://bpifrance-creation.fr/encyclopedie/aides-a-creation-a-reprise-dentreprise/aides-a-linnovation/recapitulatif-principales (visited on 11/11/2022).

[7] Nations Unies. 'Objectifs de développement durable'. In: *New York: Nations Unies* (2020).