DEPARTMENT OF
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Master's in management

AI-Powered ideation in Start-ups: a study on ChatGPT's impact on Open Innovation strategy.

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Table of Contents

1 INTRODUCTION 4

2 LITERATURE REVIEW 6

2.1 START-UPS AND THEIR RELEVANCE 7
2.1.1 DEFINITION OF START-UPS AND EMINENT EXAMPLES 7
2.1.2 START-UPS AND THEIR INFLUENCES IN JOB CREATION 8
2.1.3 START-UP AND INNOVATION 10
2.1.4 START-UPS AND INVESTMENTS ATTRACTION 11
2.1.5 START-UPS AND TECHNOLOGY ADVANCEMENTS 11
2.2 OPEN INNOVATION 12
2.2.1 DEFINITION 12
2.2.2 TYPES OF OPEN INNOVATION (OPEN INNOVATION) 14
2.2.3 ADOPTION OF OPEN INNOVATION 15
2.2.4 MOST RELEVANT PRACTICES OF OPEN INNOVATION 17
2.2.5 CROWDSOURCING 19
2.2.6 CROWDSOURCING AND OPEN INNOVATION IN THE START-UP ARENA 19
2.3 ARTIFICIAL INTELLIGENCE 21
2.3.1 DEFINITION 21
2.3.2 ARTIFICIAL INTELLIGENCE IN BUSINESS 22
2.3.3 CHAT-GPT 24
2.3.4 USE CASES OF CHAT-GPT IN DIVERSE SECTORS 25
2.3.5 USE CASES OF CHAT-GPT IN DIVERSE FUNCTIONS 28
2.4 CHATGPT AND OPEN INNOVATION 30
2.5 HYPOTHESES FORMULATION 32

3 METHODOLOGY 32

3.1 RESEARCH DESIGN 32
3.2 MEASUREMENT 33
3.2.1 DEPENDENT VARIABLE 33

3.2.2 INDEPENDENT VARIABLE 34
3.2.3 CONTROL VARIABLES 34

4 RESULTS 36

5 DISCUSSION 38

5.1 THEORETICAL IMPLICATION 38
5.1.1 FOR START-UP LITERATURE 38
5.1.2 FOR OPEN INNOVATION AND CHATGPT 39
5.2 PRACTICAL IMPLICATION 39
5.3 POLICYMAKING IMPLICATIONS 40

6 CONCLUSIONS AND LIMITATIONS OF THE STUDY 40

7 BIBLIOGRAPHY 42

1 Introduction

In light of their role in fostering economic growth (Colombo & Piva, 2008; Davila et al., 2003) and their relevance in promoting radical and disrupting innovation (Richter et al., 2018) Start-ups and running of new business have gained ascending prominence in the evolving economic landscape and has been often at the center of the discussion between scholars, managers, and policymakers (D. Audretsch et al., 2010; Hakovirta et al., 2022; Richter et al., 2018). Given the premises it's no longer surprising that professionals are now questioning the creative process that propels innovation in the start-ups' confines, with a specific focus on idea generation (Curley & Formica, 2013; Ezema et al., 2022). To this end, Open Innovation stands out as a pivotal strategical approach that has been very well documented since early 2000s. Open Innovation refers to the practice of collaborating with subjects that are external to the organization during the ideation and design processes (Chesbrough, 2016; Chesbrough Henry, 2003). These external partners - such as research institution, customers, suppliers and even competitors - share valuable ideas and resources that often help companies to develop innovative solutions at a much faster pace than the regular internal R&D closed innovation approach (Hossain, 2013; Lichtenthaler, 2017; West et al., 2014). Crowdsourcing, a contemporary iteration of Open Innovation, involves collecting ideas, services, content, or resources from a diverse group of individuals known as the "crowd". This is usually done through open requests or calls, often using digital platforms and online communities (Brown & Mawson, 2016; Cricelli et al., 2021; Rougès & Montreuil, 2014.).

Start-ups, intrinsically characterized by their openness, readily embraced Open Innovation paradigms, empowering them to access a vast pool of knowledge and resources, often on par with larger, established companies (Spender et al., 2017). Recent technological advancements have further facilitated this process by eliminating geographical and physical distance with the creation of digital platforms where these external contributors can give deliver their ideas exploiting their diverse social and professional background partaking in the idea generation process (Cappa et al., 2016; Schemmann et al., 2016). In this regard a significant body of literature highlights the beneficial impact that Open Innovation has on new venture's success and survival rate showing that consumers and companies can often co-create value interdependently (Brown & Mawson, 2016; Rougès & Montreuil, 2014). Examples of successful ideation from start-ups and researchers that have adopted the Open Innovation paradigm range from t-shirt and clothing companies that leverage the crowds in the designing

and selection processes, navigation applications firms that leverage crowdsourced user reports for providing service, to a group of researchers that have proved that is possible to create a cost-effective tool for extracting digital evidence from mobile devices during private and public investigations exploiting online collaboration (Amin-Naseri et al., 2018; Cappa et al., 2016).

Conversely, the integration of Artificial Intelligence (AI) and computational methodologies into the innovation strategy of the company - whether the company uses a closed innovation strategy or an Open Innovation approach – remain largely unexplored. The discussion around this topic holds particular interest considering the recent advancements in AI technology field, wherein "ChatGPT", a highly advanced generative pre-trained transformer model, is gaining recognition. The capability of this tool to generate text that closely resembles human language has made it a valuable tool across various domains, including entrepreneurship and creative tasks, offering a unique opportunity to enhance the traditional methods of idea generation by introducing an intelligent and creative AI assistant into the equation (Shaji George et al., 2023; Singh et al., 2022).

ChatGPT could be a useful asset especially for start-ups in the early stage of development with evolving strategies and resource constraints. It could provide guidance, offering start-ups informed suggestions and assistance in the selection of the most promising business ideas, serving as a simple cost-effective consultant for innovation tasks.

Understanding the compatibility of ChatGPT, which can be described as particular form of Open Innovation driven by AI rather than human counterparts, with established Open Innovation practices, and whether it might be more favourably embraced by companies following a closed innovation or an Open Innovation approach, remains a topic requiring further exploration.

Several studies suggest that these two concepts, AI and Open Innovation, can coexist harmoniously (Broekhuizen et al., 2023; Marshall et al., 2021; Strazzullo et al., 2022; Yun et al., 2016). Within this framework, ChatGPT is often regarded as an enabler, facilitating and enhancing the Open Innovation process. However, contrasting viewpoints also exist, acknowledging AI's capacity to substitute tasks traditionally performed by humans, ChatGPT may find greater resonance among organizations not actively pursuing Open Innovation, as it presents a potentially more efficient and time-saving alternative to human-driven processes like Crowdsourcing. This study aims to advance knowledge in this debate by answering the question:

"Do start-ups employing crowdsourcing display a greater inclination towards adopting ChatGPT?"

To respond to the question, I carried out an OLS regression on a dataset of 85 participant who I administered surveys via Qualtrics, the participants were selected among start-ups owner and employees involved in the idea generation process of their company in the European area.

The study's outcomes could provide practical implications for both start-ups and the broader business community seeking to exploit the benefits of AI and Open Innovation effectively, possibly revealing the current trends in technology adoption and entrepreneurial practices.

2 Literature review

The present literature review synthesizes existing research across three interconnected dimensions of importance for this study.

Firstly, the review undertakes an examination of the role that start-ups play in contemporary economies. It delves into the ways in which these entities drive economic growth, disrupt traditional industries, and contribute to fostering a culture of creativity and dynamism within the business landscape.

Secondly, the review will take into consideration the topic of Open Innovation. Through an analysis of scholarly works, this dimension seeks to understand the key theories of Open Innovation, its models, and the various mechanisms through which it is operationalized within the entrepreneurial ecosystem. By investigating the various forms and manifestations of Open Innovation, the review aims to shed light on how start-ups may leverage external knowledge networks to fuel their growth and innovation activities, with a particular focus on Crowdsourcing.

The third dimension focuses on the terrain of AI, with a specific focus on the transformative potential of ChatGPT. This dimension acknowledges the paradigm shift brought about by the integration of AI into the creative process. By examining the existent literature on the deployment of ChatGPT, the review aims to understand the capabilities, limitations, and implications of this innovative AI tool.

Ultimately, this exploration converges on the ongoing discourse surrounding the union of AI, Open Innovation, and start-up enterprises, analyzing previous studies, and considering their findings and their implications while formulating hypotheses.

2.1 Start-ups and their relevance

The first step of the literature review is presenting the state-of-the-art research on what constitutes a start-up, supplemented by notable examples of renowned enterprises that embody the essence of start-ups' innovation. Subsequently, my focus will shift towards a review of start-ups' effects on the economy, underlying their relevance. This part will particularly delve into their significance and impact on macroeconomic metrics, explaining their role in shaping a nation's growth rate and contributing to its economic dynamics, with particular emphasis on the innovation and technological advancements.

2.1.1 Definition of start-ups and eminent examples

Start-ups are newly established businesses, in the early stage of operations that are known for their innovative ideas and potential for rapid growth (Colombo & Piva, 2008). Start-ups are enterprises or initiatives centered around a singular product or service that founders intend to introduce to the market. Generally, these entities lack a fully matured business model and, notably, face a shortage of sufficient capital to progress to the subsequent stages of their operations. The initial funding for most of these enterprises often originates from their founders themselves (Cockayne, 2019). They often focus on new technologies, which attracts the attention of investors and policymakers. Renowned names like Facebook, Uber, Airbnb, and Amazon are prime examples of start-ups that have become incredibly valuable without requiring extensive physical assets. For instance, Airbnb has connected people globally without the need to own hotels, while Uber has revolutionized transportation without owning a fleet of vehicles. What sets these start-ups apart is their ability to leverage the power of the internet to reach a broad audience without incurring substantial initial costs. Successful start-ups usually also employ clever business models that enable individuals to capitalize on their own assets, such as renting out a spare room or utilizing their personal vehicle. Start-ups have the power to transform industries through the introduction of innovative digital products and novel concepts. Considering Facebook's approach, its services are free for users, but the company generates revenue by utilizing user data to deliver targeted advertisements. Other start-ups, like Spotify, have disrupted the music industry by offering subscription-based access to a vast library of music, departing from the traditional practice of purchasing individual songs. Amazon, an eminently successful ex-start-up, has coupled its market influence and efficiency to disrupt

competition, often selling products at prices lower than its acquisition cost. (Neumann, 2020; Richter et al., 2018).

2.1.2 Start-ups and their influences in job creation

Several studies have been conducted over the years to understand whether start-ups have positive influence on job creation and the employment rate of the country, many of them coming from the United States,

The first evidence that I'll present comes from a study on United States economy from CRS Report for the Congress. This research seeks to understand the role played by start-ups in the overall employment of the country, and their impact on overall job creation.

Year	# of Employer Firm Startups	# of Employer Firm Non-startups	Total # of Employer Firms	Share of Employer Firms that are Startups
2005	644,122	5,339,424	5,983,546	10.8%
2006	670,058	5,352,069	6,022,127	11.1%
2007	668,395	5,381,260	6,049,655	11.0%
2008	597,074	5,333,058	5,930,132	10.1%
2009	518,500	5,248,806	5,767,306	9.0%
2010	533,945	5,200,593	5,734,538	9.3%

Figure 1 table 1 [1]

As presented in **Table 1**, the count of new employer firm start-ups exhibited a relatively consistent trend between 2005 and 2010. The figures hovered around a stable range, starting at 644,122 in 2005, rising to 670,058 in 2006, and then slightly dropping to 668,395 in 2007. A decline was observed in 2008 (597,074) and 2009 (518,500), with a moderate increase noted in 2010 (533,945). In contrast, the number of established employer firms that were not start-ups displayed a relatively steady pattern from 2005 to 2008, with figures holding at approximately 5.33 million in 2005, 5.35 million in 2006, 5.38 million in 2007, and 5.33 million in 2008. A decline was evident in 2009 (5.24 million) and 2010 (5.20 million). The data highlights the relevance of this type of venture in the total employment count of the country, from 2005 to 2010 start-up firms consistently accounted for a notable portion of all employer firms, ranging between 9.0% and 11.1% in any given year. This study also reveals that the influence of smaller start-ups on net job creation varies based on their size. Start-ups with fewer than 20 employees exhibit a limited effect on net job creation over time. In contrast, start-ups

[1] Retrieved from (Dilger, 2013)

encompassing 20-499 employees demonstrate a positive employment effect that continues to strengthen for five years post-formation before tapering off (Dilger, 2013).

Another study from Kauffman foundation based on US data from 1977 to 2005 - while recognizing that businesses, whether large or small, are perpetually engaged in a simultaneous process of job creation and job destruction – found out that exists a distinct dynamism related to the birth of new enterprises that holds crucial implications for comprehending job creation. In essence, the paper underscores the exceptional impact of these entities. To put it briefly, this study demonstrates the proposition that without the contribution of start-ups, net job growth within the U.S. economy would be non-existent. This assertion holds true on an average basis and is remarkably consistent, applying to all but a mere seven years of available data, tracing back to 1977, within the United States as explained in **figure 2.** The data brings to light a notable observation: start-up firms are predominantly responsible for driving net job creation across most years, while established firms (aged one year and older) tend to experience net job losses. It's important to note that start-ups have a built-in advantage in this regard since they can't initially experience job losses, and it's likely that some of the jobs they create will be offset by job losses in the subsequent year's age one firms (Kane et al., 2010).

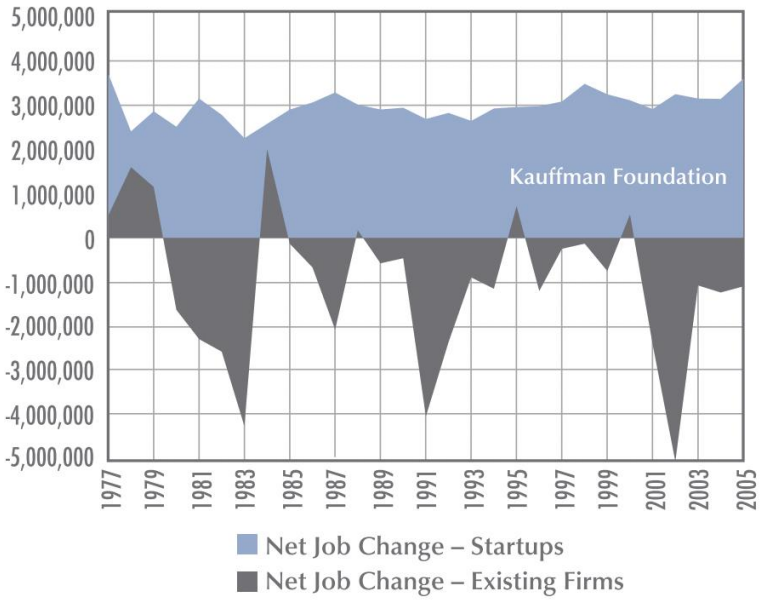

Figure 2 Job creation by Start-ups and Existing firms [2]

[2] Retrieved from (Kane et al., 2010)

The role of Entrepreneurship and Start-ups in the US market has been also analyzed by a 2014 study by Decker et al., the research claims that start-ups and emerging businesses play a crucial role in driving job creation. Over the period analyzed by the researchers between 1980 and 2010, the combined yearly job creation by all establishments averaged around 18 percent of the total workforce, equivalent to an average of 16.3 million jobs annually. Of this total, approximately one-sixth, or an average of 2.9 million jobs each year, can be attributed to new firms, while another one-sixth stems from the establishment of new branches by existing firms. The statistics become even more striking when considering net job creation. For new firms, specifically those designated as having an age of zero in the Business Dynamics Statistics, "net" job creation aligns with "gross" job creation. This is because these new firms do not have any prior jobs to lose, resulting in a net job creation figure of 2.9 million jobs per year. However again as for the previous study taken into consideration, these statistics can be somewhat misleading for a couple of reasons. Firstly, gross job creation significantly surpasses net job creation within any given period. This implies that various groupings of growing firms could potentially contribute to accounting for net job creation. Secondly, it's imperative to delve into the post-entry dynamics of start-ups. For instance, if all start-ups were to fail within a short span of time, their contribution to lasting net job creation would be minimal (Decker et al., 2014)

Start-ups make a considerable impact on job creation, consistently proving themselves as significant drivers of employment growth within economies. As these enterprises set out on their ventures, they actively recruit more and more people to assume diverse roles, consequently augmenting the workforce. This influence is particularly pronounced during the formative stages of a start-up. (Baumol & Strom, 2007)

2.1.3 Start-up and Innovation

Schumpeter's insights from his works in 1934 and 1939 highlights the pivotal role that new firms play as agents of transformative change and catalysts for driving economic progress. These new enterprises emerge as the driving force behind shifts within the economic landscape. Building upon this perspective, the concept of “creative destruction”, which forms the bedrock of the role played by new entrants, claims that these fresh participants within the market landscape inherently possess the ability to displace comparatively less efficient incumbent firms. While disruptive, this displacement clears the way for innovative and more efficient practices to take center stage, ultimately propelling the entire economy toward a trajectory of productivity and prosperity. Within this conceptual framework, the entrepreneurs who establish

these new firms encapsulate the very essence of what Schumpeter termed “energetic types”. Driven by their innate inclination to introduce novel concepts and transformative approaches, these individuals infuse innovation into a multitude of economic domains. Their bold initiatives lay the groundwork for fresh business paradigms, technological breakthroughs, and inventive strategies, all of which collaboratively contribute to the evolution and expansion of economic frontiers. (Colombelli et al., 2016; Rojas & Tuomi, 2022; Song et al., 2010). In the contemporary landscape, start-ups have assumed a key role for driving innovation that is precisely tailored to address intricate issues, ranging from the imperative of sustainability to the unprecedented challenges posed by events like the global COVID-19 pandemic of 2019. It is the remarkable agility typical of this type of venture that allows them to effectively deliver innovative solutions that cater to the evolving demands of the market in times of rapid change and uncertainty. (Bergset & Fichter, 2015; Kuckertz et al., 2020)

2.1.4 Start-ups and investments attraction

Start-ups also play a significant role in of attracting capital and securing funding, contributing a dimension that extends beyond their innovative initiatives. These enterprises have the ability to capture the attention and interest of venture capitalists and a diverse array of investors. This appeal is not solely based on their innovative concepts, but also on the inherent appeal of the risk-reward relationship intrinsic to the start-up landscape. By effectively presenting their pioneering ideas and substantiating their value proposition, start-ups construct a compelling narrative that entices investors. (Veselovsky & Nikonorova, 2017) This narrative encompasses the potential for novel solutions, unexplored market opportunities, and transformative industry shifts. In response, investors are motivated to participate, allocating financial resources crucial for realizing these transformative visions. Thus, start-ups serve as conduits for financial inflow, driving their growth, innovation, and the materialization of their creative ideas into tangible results. The role of start-ups in attracting capital and funding emerges as a significant aspect of their entrepreneurial journey, underlining their importance in contemporary economic ecosystems. (Prohorovs et al., 2019)

2.1.5 Start-ups and Technology advancements

Start-ups, fueled by entrepreneurial drive, possess an inherent capacity for rapid ideation and adaptability, affording them an edge over larger corporations. The entrepreneurial attitude intrinsic to start-ups stimulates a culture of risk-taking and a relentless pursuit of innovative solutions. Their ability to picture novel business models in the face of market disruptions and crises has been underscored as a survival strategy. This agility extends beyond mere

conceptualization, permeating their organizational fabric and allowing them to swiftly act upon new ideas and trends. (Weiblen & Chesbrough, 2015) The literature underscores how start-ups, sustained by the capacity for agile ideation and risk-taking, are pivotal in propelling technological advancements. Their role in generating diverse business model ideas, complemented by the collaborative efforts of diverse divisions within organizations, is instrumental in initiating innovation(D. B. Audretsch & Acs, 1994; Santisteban et al., 2021; Weiblen & Chesbrough, 2015). Their contribution is so obvious that even larger corporation are starting to engage in start-ups to leverage their capacity to generate disruptive innovation. Within the technology sector, the fusion of start-ups and corporations has encouraged the formulation of diverse engagement models, each with distinct characteristics, challenges, and rationales. These models, drawn from empirical analyses and prominent examples, range from equity-based partnerships to shared technology initiatives. While established models rely on corporate equity as a driving mechanism, newer models emphasize the synergy of shared technology to expedite collaboration, reduce organizational costs, and enhance both speed and agility (Weiblen & Chesbrough, 2015). The synergy between start-ups and corporations is not solely confined to technological advancements but extends to the broader sphere of economic development (Santisteban et al., 2021) Studies underscore the significant contributions of technology-based start-ups (TBSs) in generating jobs and fostering economic growth. However, the high failure rate of TBSs highlights the need for critical success factors (CSFs) to ensure their sustainability. (D. B. Audretsch & Acs, 1994; Santisteban et al., 2021)

2.2 Open Innovation

The next phase of the literature review delves into Open Innovation, with an emphasis on the concept of Crowdsourcing. This phase initiates with an examination of research pertaining to the delineation and categorization of this domain. Subsequently, it delves into an exploration of the literature surrounding the uptake of Open Innovation and its contemporary practices. Ultimately, this phase culminates with an exploration of the literature on crowdsourcing and its ramifications within the start-up ecosystem.

2.2.1 Definition

As defined by the inventor the term Open Innovation refers to:

"A paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology." (Chesbrough, 2016)

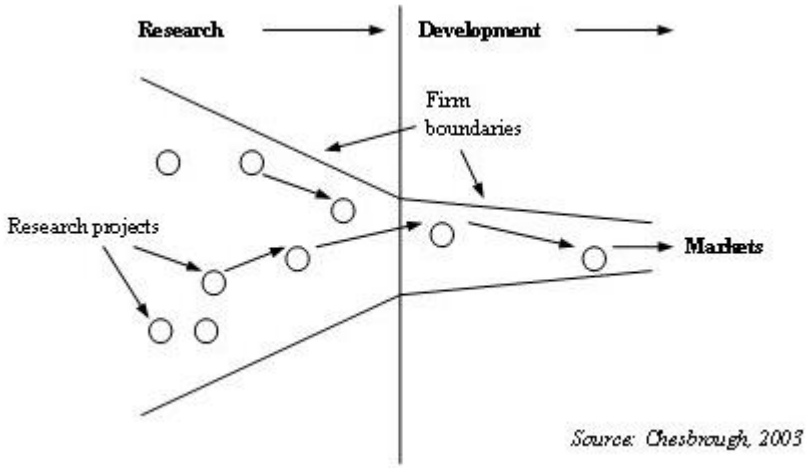

Figure 3 Traditional Pattern of innovation [3]

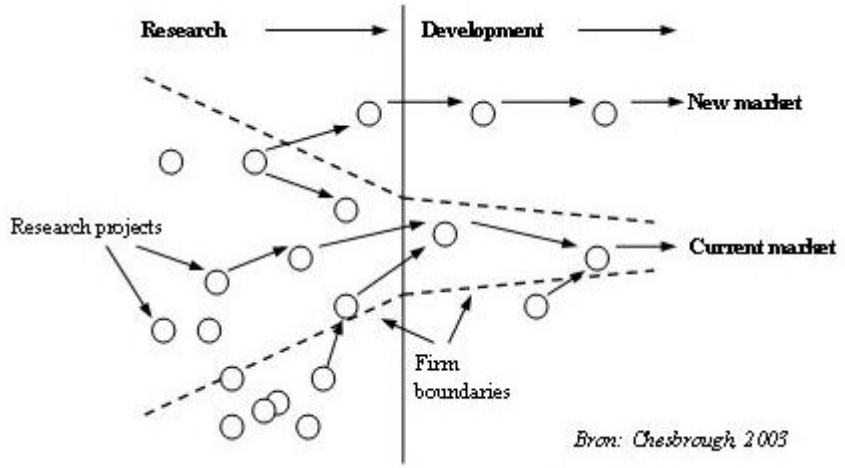

Figure 4 Open Innovation pattern [4]

In modern times the term has become an evolving and complex concept, it basically emerges as a deviation from conventional innovation paradigms. It contrasts closed innovation, typified by vertically integrated models where internal product development and distribution are the norm. Open Innovation is fundamentally based on collaborative relationships among diverse subjects to support work on novel projects, leveraging along with internal resources, ideas and assets external to the organization. Yet, the concept's precise nature remains contested, leading to discrepancies among scholars and practitioners.(Lichtenthaler, 2017) Open Innovation

[3] Retrieved from (Chesbrough Henry, 2003)
[4] Retrieved from (Chesbrough Henry, 2003)

frequently intersects with related paradigms like open source, user innovation, and Crowdsourcing, adding to the complexity and confusion within the academic community. At its core, Open Innovation suggests that corporate innovation operates as an open system, a shift from the traditional vertically integrated model. This innovative perspective, drawn from observations of pioneering large firms, finds historical echoes in the diverse technology markets of the late 19th and early 20th centuries and externally oriented R&D labs. Notably, Open Innovation does not replace traditional R&D but augments it with external technology infusion and strategic internal technology dissemination. This is founded on existing innovation research, recognizing the influence of external sources on novel idea generation. In recent times, Open Innovation's relevance has surged, reflecting the growing necessity for firms to embrace open practices despite management intricacies. (Chesbrough, 2016; Hossain, 2013; Lichtenthaler, 2017; West et al., 2014)

2.2.2 Types of Open Innovation (Open Innovation)

As emerges from the analysis of the literature concerning Open Innovation, the latter can be divided into three main types (Bogers et al., 2013; Chesbrough & Bogers, 2013)

Outside-In Open Innovation:

Outside-In Open Innovation involves a company's deliberate opening of its innovation processes to external sources of knowledge and input. This type encompasses mechanisms such as acquiring, sourcing, and integrating external ideas, technologies, and contributions into the company's innovation process. It involves activities like scouting, in-licensing intellectual property (IP), collaborating with intermediaries, suppliers, customers, and utilizing agreements to manage the inflow of knowledge and ideas from external sources. The objective is to leverage external expertise to enhance internal innovation and market competitiveness.

Inside-Out Open Innovation:

Inside-Out Open Innovation focuses on the outbound flow of knowledge and ideas from an organization to external entities. This type involves allowing unused or under-utilized ideas and assets to be utilized by other businesses or partners. Organizations engage in selling, revealing, and sometimes donating their intellectual property, technologies, and ideas to external parties. The business models for these ideas may differ from the originating company's model, necessitating strategic considerations for taking the ideas to market. This type includes mechanisms such as out-licensing IP, technology transfer, spin-outs, and collaborations with partners for joint development.

Coupled Open Innovation:

Coupled Open Innovation represents a hybrid approach that integrates both Outside-In and Inside-Out Open Innovation processes. In this type, organizations collaborate with external partners to jointly develop and commercialize innovations. This collaboration involves purposeful knowledge exchange and interaction between partners, spanning the organizational boundaries. Mechanisms like strategic alliances, joint ventures, consortia, networks, ecosystems, and platforms are used to facilitate the flow of knowledge between collaborating entities. The aim of coupled Open Innovation is to leverage the complementary strengths of multiple partners to create and capture value from innovation initiatives.

In summary, the concept of Open Innovation sums up a tripartite nomenclature consisting of three, above mentioned, connected categories: Outside-In, characterized by the assimilation of external knowledge; Inside-Out, centering on the dissemination of internal knowledge; and coupled, emblematic of cooperative knowledge interchange and innovation engendered through collaborative endeavors among distinct entities. These categories serve to accentuate the dynamic essence to the Open Innovation paradigm, affording organizations the opportunity to employ external expertise and engage in reciprocal collaboration, thereby fostering concurrent advancement and innovative progression.(Bogers et al., 2013; Chesbrough & Bogers, 2013)

2.2.3 Adoption of Open Innovation

Before talking in specific about the practices of Open Innovation I'll take into consideration the degree to which Open Innovation has permeated the strategic and operational fabric of large enterprises.

The first study that I'll like to preset was undertaken by Henry Chesbrough and Sabine Brunswicker and surveyed 125 large US companies. The research reveals a substantial adoption of Open Innovation with a notable 78 percent of participating executives affirming their firms' engagement in Open Innovation practices.(Chesbrough & Brunswicker, 2014)

The study also found out that the intriguing panorama of Open Innovation transcends the conventional confines of high-tech sectors, expanding its field of influence across low-tech domains as well. This expansive outreach becomes particularly evident when considering sectors such as wholesale, trade, and retail, all of which demonstrate active involvement in diverse facets of Open Innovation initiatives. This observation breaks the notion that Open

Innovation is exclusive to the high-tech enclave, thereby substantiating its wider applicability and significance.(Chesbrough & Brunswicker, 2014)

Nevertheless, distinctions emerge when scrutinizing the adoption intensity across distinct industry sectors. While the data suggests a inclination towards Open Innovation adoption in high-tech manufacturing, trade, and retail, this predilection appears to taper in sectors characterized by low-tech manufacturing and financial services. Although these disparities seem indicative, their statistical significance remains questionable due to the study's inherent limitations, notably the relatively modest sample size. A temporally oriented examination sheds light on the maturation of Open Innovation practices. The median duration of Open Innovation adoption among the surveyed enterprises is approximately five years, denoting a moderate temporal consolidation of this paradigm. Furthermore, a substantial fraction of participants - more than 30 percent - asserts an extensive engagement with Open Innovation, with certain instances tracing back to periods anterior to 2003. This observation underscores the persistence of Open Innovation endeavors and attests to its establishment as a discernible trend within the landscape of contemporary business practices.(Chesbrough & Brunswicker, 2014). Noteworthy trends emerge when evaluating changes in management support and the vigor with which Open Innovation is pursued. A robust 71 percent of respondents indicate an amplification in management backing for Open Innovation, pointing to an increasingly favorable disposition towards its incorporation. Concurrently, a noteworthy 82 percent of participants note a increased intensity in Open Innovation pursuits, reflective of a proactive approach toward leveraging external knowledge and collaborative ideation.(Chesbrough, H. W., and Brunswicker, 2013; Chesbrough & Brunswicker, 2014).

A second study from 2016 from the same authors confirms a growth trajectory. More than 60 percent of firms increased financial support for Open Innovation in the previous two years from the survey, with 20 percent reporting a growth exceeding 50 percent. This underscores the recognition of Open Innovation's strategic value and the commitment of resources to support its implementation.(Brunswicker & Chesbrough, 2018)

2.2.4 Most relevant practices of Open Innovation

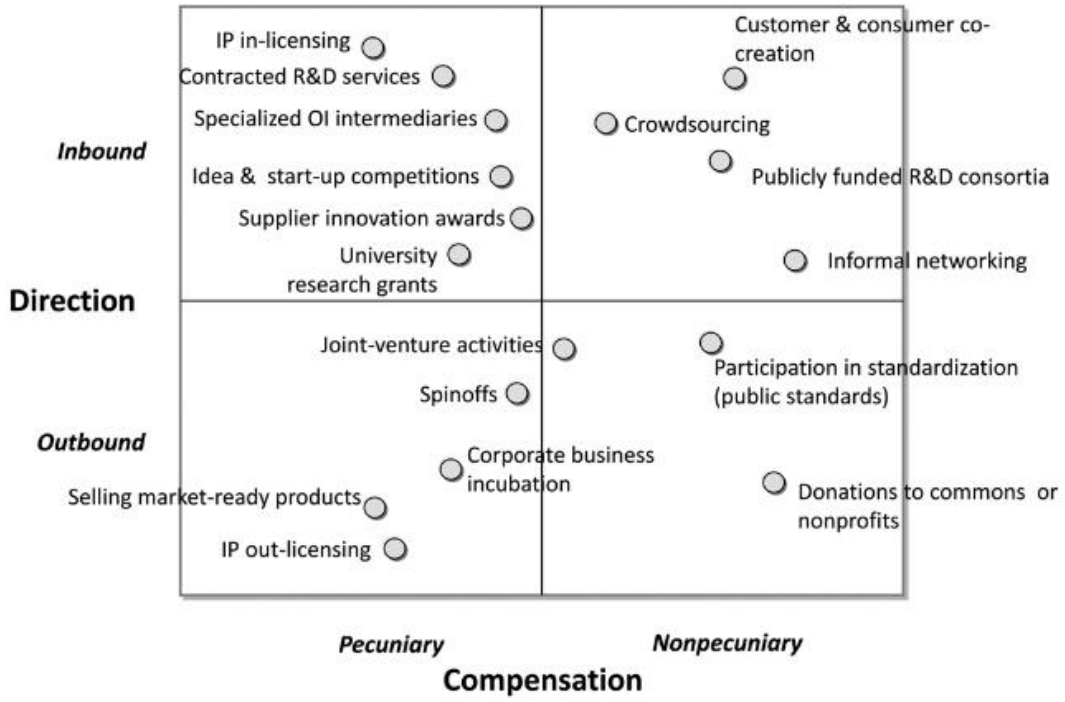

Figure 5 Practices of Open Innovation[5]

The same study from 2014 from Chesbrough & Brunswicker offers us a classification of the Open Innovation practices with a description of each single mode. The first classification made by the authors is Inbound Open Innovation vs Outbound Open Innovation. This highlights their fundamental distinction in knowledge flow direction. This categorization is further refined by classifying practices based on whether they involve compensation for participants, resulting in a four-part matrix that captures the diverse nature of Open Innovation strategies as it can be seen in figure 5. (Chesbrough & Brunswicker, 2014)

The authors also give a description of the practices considered into the study (figure 6).

[5] Retrieved from (Chesbrough, H. W., and Brunswicker, 2013)

Inbound Practices	
Consumer and customer co-creation	Involvement of consumers or customers in the generation, evaluation, and testing of novel ideas for products, services, processes, or even business models
Information networking	Networking with other organizations without a formal contractual relationship, e.g., at conferences or events, to access external knowledge
University research grants	Funding of external research projects by researchers and scientists in universities (faculty, PhD students, or postdoctoral fellows) to access external knowledge
Publicly funded R&D consortia	Participation in R&D consortia with other public or private organizations in which R&D activities are fully or partly funded by governmental organizations (e.g., European Commission or National Science Foundation)
Contracting with external R&D service providers	Contracting with external service providers for specialized R&D services, including technology scouting, virtual prototyping, etc.
Idea and start-up competitions	Invitation to entrepreneurial teams and start-ups to submit business ideas via open competitive calls, with collaboration and venture support to winning teams
IP in-licensing	Licensing of external intellectual property rights (e.g., trademarks, patents, etc.) via formal licensing agreements
Supplier innovation awards	Invitation of existing suppliers to participate in innovation and submit innovative ideas
Crowdsourcing	Outsourcing innovation problem solving (including scientific problems) via an open call to external organizations and individuals to submit ideas
Specialized services from OI intermediaries	Contracting services of intermediary organizations specialized in open innovation to act as intermediary between a "searcher"—an organization with an open innovation problem—and "solvers"—a network of organizations or individuals with potential solutions
Outbound Practices	
Joint venture activities with external partners	Strategic and financial investment in independent joint ventures jointly with external partners
Selling of market-ready products	Sale of a market-ready novel product idea to a third party for sale to its customers
Participation in public standardization	Participation in standardization activities via formal standardization agencies (e.g., ISO) or informal standardization consortia (e.g., OASIS)
Corporate business incubation and venturing	Corporate incubators or accelerators developing potentially profitable ideas and offering supportive environments for entrepreneurs inside the organization to identify novel paths to market
IP out-licensing and patent selling	Licensing of internal IP to external organizations via licensing agreements or selling via single payment
Donations to commons or nonprofits	Donations to commons or nonprofits (e.g., open-source communities) to support external R&D
Spinoffs	Investment in new ventures founded by firm's employees outside organizational boundaries

Figure 6 Practices of Open Innovation[6]

The research underscores a significant prevalence of inbound practices over outbound practices in the surveyed firms. This imbalance suggests that organizations are more inclined to draw external knowledge and ideas into their operations rather than actively disseminating their internal knowledge. Co-creation emerges as a standout inbound practice, underscored by its high rating and incremental increase in importance over the studied period. This underscores the growing recognition of collaborative engagement with customers and consumers as a key driver of innovation. Conversely, outbound practices are generally perceived as less important, with joint venture activities receiving the highest rating in this category. This discrepancy in perceived significance between inbound and outbound practices prompts intriguing questions about firms' knowledge-sharing strategies and the factors that influence their choices.(Chesbrough & Brunswicker, 2014)

[6] Retrieved from Chesbrough & Brunswicker, 2014

2.2.5 Crowdsourcing

Crowdsourcing is a collaborative and decentralized approach to problem-solving and production that utilizes the collective intelligence and input of online communities, referred to as crowds, to achieve specific organizational objectives. This phenomenon involves the organization presenting crowdsourcing activities to the online community, which responds to these initiatives driven by various motivations. (Cricelli et al., 2021) This well-defined concept is used primarily for empirical research purposes, focusing on the distinct aspects of crowdsourcing and related concepts. However, in practice, some individuals may use a more generalized term of “Crowdsourcing” to encompass a range of related activities to suit their needs. A prominent example of crowdsourcing is Threadless, a clothing company highlighted by Jeff Howe's original Wired article. Threadless engages its online community to contribute design ideas for silk-screened graphic T-shirts sold on their website. Members of the community create and share their designs using tools like Photoshop, illustrating the collaborative nature of the crowdsourcing model. crowdsourcing extends beyond graphic design, as demonstrated by InnoCentive, another exemplar. This platform allows companies to post complex scientific research and development challenges online and offer monetary rewards to individuals who provide solutions. In the context of Crowdsourcing, the process of creative production is distributed between the organization and the public. This entails a collaborative approach where the crowd contributes to the creative process from the bottom-up, while organizational management ensures alignment with strategic goals from the top-down. This shared power dynamic sets crowdsourcing apart from other similar creative methods.(Brabham, 2013; Cricelli et al., 2021; *The Rise of crowdsourcing | WIRED*, 2006)

2.2.6 Crowdsourcing and Open Innovation in the Start-up arena

Open Innovation and Crowdsourcing’s ability to facilitate collaborative problem-solving and idea generation has proven valuable to start-ups. This dynamic approach offers a multi-faceted advantage: it empowers start-ups to not only effectively compete in compsetitive markets but also enables them to streamline expenditures, tap into an extensive repository of knowledge and ideas, and swiftly attain insightful feedback from clients. By leveraging Crowdsourcing, start-ups can surmount the challenges of the "valley of death" by leveraging the collective online communities. The integration of crowdsourcing within the context of start-ups has garnered significant attention in contemporary literature, with scholars and researchers delving into its implications and relevance. (Girdauskiene et al., 2015) A foundational factor of the relevance of crowdsourcing to start-ups resides in its capacity to provide access to diverse

expertise and novel ideas. Empirical investigations by various scholars, including Zott, Amit, and Massa (2011), underscore the transformative role that crowdsourcing plays in augmenting the innovative potential of start-ups. The integration of external viewpoints, from disparate disciplines, industries, and geographical regions, facilitates innovations that resonate with the demands of modern markets. (Zott et al., 2011) Furthermore, the significance of crowdsourcing is underscored by its potent role in mitigating cost-related impediments to innovation. The early stages of start-up development are invariably marked by resource constraints, rendering conventional modes of innovation financially onerous. crowdsourcing emerges as an economically prudent alternative, enabling start-ups to seek a diverse array of solutions to specific challenges or tasks from a global crowd. This cost-effective modality not only makes the innovation process quicker but also ensures the allocation of resources to other critical aspects of start-up operations.(Rougès & Montreuil, 2014) In consonance with the imperatives of validating nascent concepts and garnering actionable feedback, crowdsourcing assumes a pivotal role in rendering start-ups resilient in the face of uncertainty. The union of real-world insights and market-driven perspectives, channeled through the crowd's participation, allows start-ups to iteratively refine their offerings and align them with the evolving preferences of their target audience.(Brown & Mawson, 2016; Girdauskiene et al., 2015) Moreover, the integration of crowdsourcing within start-ups generates a pattern of amplified engagement and brand cultivation. By fostering a participatory culture and cultivating a sense of community ownership, start-ups can forge enduring relationships with diverse stakeholders. This engagement not only cultivates brand loyalty but also augments the start-up's visibility and reach, enhancing its capacity to secure a competitive advantage within an expansive digital environment (Gokhale et al., 2014). Start-ups leveraging the Open Innovation strategy to drive innovation span across diverse sectors, including technology, healthcare, manufacturing, engineering, fintech, and extending into the forefront of sustainability and urban mobility. Among the renowned ex-start-ups or start-ups that have used this paradigm to innovate there is Threadless, an online platform, has pioneered the crowedsourced creative process through Open Innovation. The platform invites artists and designers from across the globe to submit their designs for t-shirts. Members then engage in a voting selection process to determine which designs deserves to reach the production phase. This Open Innovation model allows artists to share openly their designs and provides them a platform for their creativity, and at the same moment aligns product offer with demand (Grant et al., 2023; Schemmann et al., 2016).

Waze is another a community-driven navigation company, it operates on a real-time user-generated data model, Waze sources users who contribute information on road conditions, traffic incidents, and accidents. The collaboration enables the company to deliver highly accurate traffic information and navigation services. The fundamental principle of the success of the company which – while improving the quality of the service – forges in the users a sense of community (Amin-Naseri et al., 2018; Trabucchi et al., 2021).

Plaid is a company active in the open banking sector, the company's primary aim is to enable the secure exchange of financial data and transactions between various financial applications and users' bank accounts. This facilitates the development of innovative fintech solutions and services while maintaining the security and privacy of users' financial information. Plaid offers to the developer complete free access to its APIs and allows them to create new financial applications and services; other than that the company also collaborates with a vast array of stakeholders such as financial institution, developers, other fintech start-ups and technology company. (*Open Banking's next Wave: Perspectives from Three Fintech CEOs*, 2018.)

2.3 Artificial Intelligence

2.3.1 Definition

Artificial Intelligence (AI) refers to a transformative and multidisciplinary field that holds the capacity to reshape various aspects of business, economy, and society by revolutionizing interactions and relationships among stakeholders and citizens. At its essence, AI revolves around the conception, design, and operationalization of computer systems and algorithms that possess the ability to engage in tasks that traditionally necessitate human-like intelligence. These tasks encompass a wide gamut of cognitive functions that include, but are not limited to, complex problem-solving, dynamic learning from data, logical reasoning, sophisticated decision-making, nuanced language comprehension, perceptive interpretation of visual or auditory stimuli, and even the generation of novel and innovative concepts. The origins of AI trace back to ancient cultures, including Greek and Chinese mythologies, wherein the concept of sentient automata was postulated, imbued with cognitive capabilities akin to human intelligence. The term "artificial intelligence" was formally coined during a seminal workshop at Dartmouth College in 1956, marking a pivotal moment in its inception.(Loureiro et al., 2021) The evolution of AI has been driven by contributions from diverse academic disciplines. Scholars across domains have explored its implications, spanning ethical and legal dimensions,

deep learning algorithm development, and the profound impacts of AI on customer engagement, organizational operations, and broader stakeholder interactions. However, despite significant advancements, AI research has often occurred within isolated compartments, leading to a lack of a universally accepted definition. Notably, Russell and Norvig (2016) present a framework categorizing AI systems into four distinct types based on their reasoning and behavior dimensions, including those that simulate human-like thinking and action, as well as those that operate rationally. These AI systems exhibit key capabilities such as natural language processing, knowledge representation, automated reasoning, and machine learning. These attributes are the ones that collectively empower AI to engage in tasks ranging from communication in natural languages to extracting patterns from data and adapting to dynamic circumstances. (Dirican, 2015; Rajendra, 2019)

2.3.2 Artificial Intelligence in business

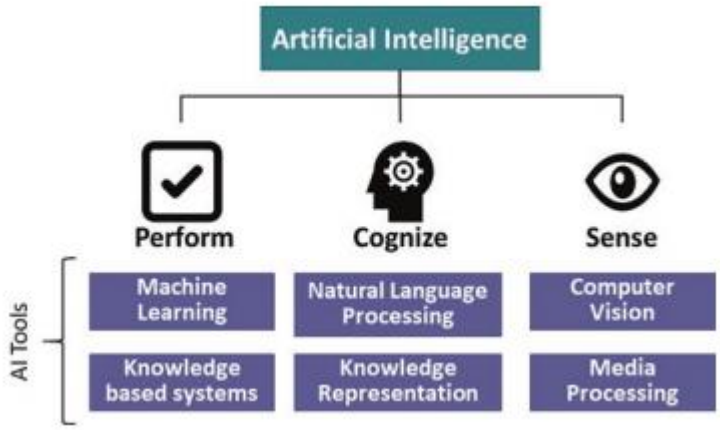

Figure 7 What is AI?[7]

Artificial Intelligence (AI) has a longstanding presence in the technological landscape, but its potential for advancement remains a subject of ongoing discourse. As technology continues to evolve, there is a notable increase in demand for AI systems capable of immersive human-like learning in computational fields. Such systems should possess the ability to autonomously recalibrate their behavioral beliefs, make informed decisions, learn from experiences, and adapt their responses based on past events. AI encompasses a diverse array of tools and technologies that can be creatively combined to perceive, understand, and execute tasks, all while accumulating knowledge from real-world encounters and refining their performance over time. Intelligence, when considered in a broad context, involves an individual's capacity to

[7] Retrieved from (Rajendra, 2019)

comprehend and wield knowledge for solving challenges. This intellectual faculty encompasses a wide spectrum of capabilities, ranging from perceiving and comprehending the external environment and one's own self, to acquiring knowledge through learning, applying knowledge and experience to analyze and unravel problems, engaging in reasoning, exercising judgment, making decisions, abstracting and generalizing linguistic patterns, fostering discovery, invention, creativity, and innovation, effectively navigating complex scenarios, and foreseeing and interpreting developments and changes in various domains.(Rajendra, 2019)

A retrospective examination reveals substantial advancements across domains that were initially integral to the field of AI. Noteworthy among these is the emergence of knowledge-based systems, which have found practical application in numerous global organizations. These systems have been realized through the development of expert system shells, signifying a field robust enough to warrant its own academic courses. Beyond practical accomplishments, knowledge-based systems have contributed significantly to AI's theoretical and methodological expansion, delving into areas such as rule-based knowledge representation, reasoning with uncertainty, domain knowledge verification, and automatic knowledge acquisition via machine learning. Natural language processing is another notable domain where AI has made remarkable strides. The availability of reasonable translation systems, although predominantly effective in controlled contexts, demonstrates AI's prowess in deciphering language. The advent of the World Wide Web has elevated the significance of information retrieval, catalyzed by the unprecedented abundance of data that challenges human processing capabilities. Semantic Web development, content and link analysis of web pages, text mining, targeted information extraction, automated classification, and personalized agents seeking specific data points represent active frontiers in this field. Speech processing, meanwhile, has culminated in practical tools capable of transforming spoken language into machine-readable text, particularly beneficial for individuals with varying typing abilities and disabilities.(Kumar Barman et al., 2014; Rajendra, 2019) The domain of robotics has witnessed considerable push, exemplified by initiatives like the development of humanoid robots aimed at assisting the elderly in daily activities. Innovations by companies such as Honda and Sony have led to the creation of robots capable of imitating human actions to varying extents, from walking and waving to rudimentary dance steps(Rajendra, 2019; Van Roy et al., 2020). Recent breakthroughs in deep learning, facilitated by access to vast datasets and enhanced computing power, have unlocked new horizons for AI's transformative potential. Deep learning connects neural networks capable of unsupervised learning from unstructured or unlabeled data. The

efficacy of these networks has been amplified by technological advancements, resulting in increased efficiency and accuracy. Machine learning (ML), a captivating facet of AI, involves the development of computational approaches that autonomously make sense of data. ML's foundation lies in the dynamic process of learning from examples and experiences, rather than relying on predefined rules. This mechanism empowers machines to progressively accumulate knowledge, akin to the way humans learn and adapt. Unlike human counterparts, machines are not susceptible to sleep deprivation, distractions, information overload, or short-term memory loss. This inherent advantage fuels the excitement surrounding AI, particularly as it finds applications across diverse industries. (Bell, 2022; Rajendra, 2019; Zhou, 2021).

For instance, the financial services sector stands to benefit significantly from AI-optimized fraud-detection systems, projected to prosper into a $3 billion market by 2020. The attributes that set AI apart from human intelligence, including scalability, longevity, and continuous improvement capabilities, are expected to galvanize productivity, curtail costs, and diminish human error. As AI technology matures, it is anticipated to launch a novel paradigm for corporate productivity, competitive edge, and, ultimately, economic growth.(Rajendra, 2019)

Moreover, AI's contributions to data technology are substantial, particularly in the field of data mining. The colossal pool of data within present-day databases, while valuable, remains underutilized if conventional retrieval mechanisms are employed. AI has offered a diverse toolkit, including data warehouses, classical statistical methodologies, neural networks, and machine learning algorithms, to unleash the potential of data through effective analysis, connection, and interpretation. In conclusion, AI's journey from its inception to the present day has been marked by remarkable achievements and persistent growth across various domains. The advent of deep learning and the resurgence of AI's significance in the face of mounting data have positioned it as a transformative force. Its ability to process data, learn from experiences, and adapt portends significant change across industries. As AI advances, it carries the potential to redefine established business models and catalyze economic progress (Dirican, 2015; Loureiro et al., 2021; Rajendra, 2019).

2.3.3 Chat-GPT

Chat-GPT has been launched by Open AI in the year 2022. Publicly accessible and built upon the GPT technology (Generative Pre-trained Transformer), the tool exemplifies the powerful language processing capabilities. At its core, the GPT technology exploits the potential of a Generative Pre-trained Transformer, a statistical model that calculates the probability distribution over a sequence of words. This enables Chat-GPT to predict the most probable text

to follow when generating input text. (Tingiris, 2021). The foundation of Chat-GPT's ability lies in the domain of Natural Language Processing (NLP), a sophisticated technique that allows computers to not only interpret but also understand the context and meaning of the input provided by users or the contents of documents. By incorporating NLP principles, Chat-GPT can analyze and comprehend human language, thereby facilitating interactive and contextually relevant conversations with users (Singh et al., 2022). Furthermore, the GPT technology is built upon the concept of transformer architecture, an innovative neural network design known for its ability to efficiently process sequential data. The transformer architecture has revolutionized NLP by enhancing the model's capability to capture long-range dependencies and contextual information, resulting in more accurate and coherent language generation (Han et al., 2021). During the pretraining phase, GPT learns from vast amounts of unlabeled text data in an unsupervised manner. This process mirrors the way a person might learn in a new environment, absorbing the nuances, patterns, and intricacies of language from the data it is exposed to. Through this unsupervised learning, GPT becomes able to recognize grammar, semantics, and context, forming a deep understanding of natural language and its structures. The pretraining phase lays the foundation for GPT's language generation abilities, enabling it to fluently generate coherent and contextually appropriate responses to input text. It can simulate human-like conversations and even create imaginative and creative text, thanks to the knowledge and patterns it has internalized during pretraining (Lund & Wang, 2023). Following pretraining, the fine-tuning phase refines GPT's performance on specific tasks by employing supervised learning techniques. During this guided process, the developers of GPT provide structured feedback and additional data tailored to the target task. This allows the model to specialize in particular applications, such as question-answering, text completion, or summarization, achieving even higher levels of accuracy and task-specific proficiency (Zhou et al., 2023). The two-step refinement process is crucial to GPT's versatility. By combining the unsupervised learning of pretraining with the targeted optimization of fine-tuning, GPT becomes a language model that can be employed in a wide range of language-related tasks. Its success has led to numerous advancements in natural language processing and artificial intelligence research, propelling the development of even more sophisticated language models with broader real-world applications.

2.3.4 Use cases of Chat-GPT in diverse sectors

The AI-powered chatbot, with its advanced capabilities, has been extensively explored and implemented across a wide range of domains, including sectors such as research, healthcare, education and even agriculture (Singh et al., 2022)

2.3.4.1 Healthcare

In the landscape of the healthcare sector, ChatGPT has emerged as a powerful tool with several applications. ChatGPT has shown especially potential in automating patient triage, delivering valuable health advice and enhancing patient education (George et al., 2023). Automating patient triage is a critical aspect of healthcare operations, particularly in busy clinical settings. The AI enabled tool can efficiently assist in this process by engaging in interactive conversations with patients, comprehensively evaluating their symptoms, and providing initial assessments. By categorizing patients based on the severity of their conditions, ChatGPT can prioritize urgent cases, enabling healthcare professionals to focus their attention on patients with critical needs. This automation streamlines the triage process, leading to quicker response times and improved patient outcomes a study of the Turkish journal of medicine has concluded (Sarbay et al., 2023). Furthermore, ChatGPT's ability to offer health advice has proven to be invaluable for patients' seeking information on common medical conditions, preventive measures, and general health-related queries. By providing evidence-based responses sourced from vast medical databases and research literature, it allows patients to make informed decisions about their health. It acts as a reliable virtual health advisor, providing accurate information and potentially reducing unnecessary visits to hospitals and other healthcare facilities (Kung et al., 2023). Talking about patient education, ChatGPT may play a significant role in promoting health literacy and facilitating self-management of chronic conditions. The tool can help to tailor health information to the specific needs and preferences of individual patients. It can explain complex medical concepts in simple terms, answer questions about treatment plans and promote the adherence to prescription plans. This allows patients to take an active role in managing their health (Javaid et al., 2023). Another clear advantage that shows the versatility of the tool is the possibility to be integrated into healthcare websites and mobile applications, providing users with seamless access to health information and resources 24/7. This accessibility can help patients to be more engaged and may even promote healthy behaviors (Wang et al., 2023).

2.3.4.2 Education

In the field of education, the implementation of chatbots has proven to be an emerging force, facilitating personalized learning experiences for students while addressing their specific inquiries and offering additional educational resources. Particularly, these AI-powered tools have shown capabilities in supporting students with writing essays, generating ideas, and providing information across various subject matters (George et al., 2023). Notably, the chatbot's proficiency in interpreting inputs and delivering responses that closely resemble human-like interactions has gained widespread recognition within the educational community (Bommarito & Katz, 2022). The incorporation of chatbots in education has promoted the idea of personalized learning, tailoring educational experiences to suit individual students' unique needs and learning styles. By engaging in interactive conversations, chatbots can identify students' strengths and weaknesses, assess their comprehension levels, and provide learning content accordingly (Lo, 2023). Moreover, chatbots have exhibited proficiency in supporting students with their writing endeavors, particularly in crafting English essays. With their knowledge of language conventions, grammar rules, and writing structures, chatbots can provide feedback on students' writing, offering suggestions for improvement and guiding them towards producing more polished and coherent compositions. This real-time assistance empowers students to refine their writing skills but also helps to boost their confidence and motivation in tackling writing assignment (Alafnan et al., 2023). Additionally, the chatbot's ability in idea generation has proven to be relevant in this landscape. In brainstorming sessions with students, chatbots may prompt critical thinking, explore diverse perspectives and inspire insights. The generation of fresh ideas may cultivate their innovation and problem-solving abilities (Rahman et al., 2023).

2.3.4.3 Agriculture

Moreover, the influence of chatbots extends beyond traditional domains, making significant contributions to agricultural practices. In the agricultural sector, chatbots have demonstrated remarkable efficacy in various areas, including crop forecasting, soil analysis, crop disease and pest identification, precision farming, and irrigation scheduling. Chatbots have emerged as tools in agricultural operations (Biswas, 2023). In crop forecasting, by analyzing historical data, weather patterns, and other relevant factors, chatbots can accurately predict crop yields and harvest timelines. This valuable information allows farmers to make informed choices about crop selection, resource allocation, and market planning, thereby optimizing their agricultural productivity and profitability (Kumar et al., n.d.) In soil analysis chatbots equipped with advanced algorithms can assess soil health, nutrient content, and pH levels based on soil

samples collected from different regions of a farm. Providing real-time analysis and personalized recommendations for soil management, these tools can enable farmers to implement precise and targeted fertilization and irrigation strategies, ensuring optimal crop growth and minimal resource wastage (Mostaço et al., 2018). Chatbots integrated with image recognition and machine learning capabilities can even identify and classify crop diseases and pests based on images captured from farm fields, detecting potential threats at an early stage (Sarkar et al., 2018).

2.3.4.4 Research

Researchers are starting to adopt ChatGPT at different stages of research, including idea generation, summarizing literature, and manuscript preparation. Particularly, several research articles have even attributed authorship to the tool, sparking a new debate on the role of AI in authorship. With the increasing capabilities of language models some researchers have begun to explore the possibility of using AI-generated content as a valuable contribution to academic work. In idea generation, it's starting to be employed as a tool to assist researchers in brainstorming and exploring new concepts. During the literature review process, the AI tool can be used to summarize and synthesize relevant research papers and articles. This automation can significantly speed up the process of gathering information, enabling researchers to identify key findings and build a stronger foundation for their work. Moreover, as researchers draft their manuscripts it may serve as a writing assistant, suggesting language improvements, enhancing clarity and coherence. The AI model can help refine the language to meet academic standards and communicate complex ideas effectively. However, the most controversial aspect arises when researchers attribute authorship to ChatGPT itself. Some have started to credit the language model as a co-author due to its substantial contributions to the research process. This practice has given rise discussions on the ethics and implications of AI-generated content in academic publishing. The debate revolves around questions of intellectual ownership, the nature of creativity, and the definition of authorship in the context of AI. Critics argue that authorship should be reserved for human individuals who actively contribute intellectual creativity and critical thinking to the research process. On the other hand, proponents of AI co-authorship contend that ChatGPT's involvement can be likened to that of any other tool used in research, such as statistical software or data analysis tools (Bocken et al., 2015; Rahman et al., 2023; Xames & Shefa, 2023).

2.3.5 Use cases of Chat-gpt in diverse functions

2.3.5.1 Digital Marketing

Digital marketing has undergone significant transformations in recent years, with an increasing focus on providing personalized experiences to customers. Chatbots play a crucial role in this personalized approach by leveraging AI and natural language processing to deliver tailored interactions with customers (Mogaji et al., 2021). Through sophisticated algorithms, chatbots can understand customer preferences, previous interactions, and purchasing behavior, enabling them to provide targeted recommendations, personalized offers, and relevant content (Mogaji et al., 2020). In addition to lead generation, chatbots excel in enhancing overall customer engagement. They provide real-time assistance, answer customer queries, and offer support around the clock. This availability and responsiveness contribute to improved customer satisfaction, as customers can receive immediate assistance without being restricted by traditional business hours. Furthermore, chatbots can handle multiple customer interactions simultaneously, providing scalable and efficient customer service (Ho, 1 C.E.). Chatbots in digital marketing can also provide proactive and personalized recommendations. By analyzing customer data, browsing patterns, and purchase history, chatbots can suggest relevant products, cross-sell or upsell items, and create a tailored shopping experience. This personalized approach not only enhances customer satisfaction but may also increases the likelihood of repeat purchases and brand loyalty (Thompson, 2018). The effectiveness of chatbots in digital marketing has been demonstrated through numerous case studies and practical implementations. Companies across various industries have successfully utilized chatbots to streamline their marketing efforts, improve customer experiences, and drive business growth (BARIŞ, 2020).

2.3.5.2 Idea Generation

While there is still a substantial lack of a large quantity of studies to date exploring the extent of ChatGPT's specific potential in enhancing creativity, it is worth noting that various other forms of AI have unequivocally exhibited their capacity to significantly augment creativity and provide substantial support to the process of idea generation in the firm. Recent research has proved the capacity of ChatGPT to amplify creative process within the Japanese writers, showcasing its potential to provoke innovative thought processes (Osone et al., 2021). Other studies have shown proficiency in aiding designers in sketching, further proving its versatile utility in creative works (Tholander & Jonsson, 2023). Some researchers even claim that artificial intelligence has come to almost the same level of human’s (Haase & Hanel, 2023). While the last statement is certainly provocative and exaggerated, is clear that this tool can help augment or at least speed up the process of idea generation.

2.4 ChatGPT and Open Innovation

I'll now proceed in a review of the works that studied the relationships between the two already introduced concepts of ChatGPT, and more in general AI, and Open Innovation. It's worth noting that while ChatGPT is relatively new and lacks an abundance of research, being a form of artificial intelligence - an extensively studied field - we can leverage insights from AI to provide an overview of the progress made in exploring the interactions between these two concepts.

The first study that I'll like to take into consideration is by Marshall (2021). The study revolves around the topic of Open Innovation analyzing the survey administered to a pool of large US firms about their innovation strategies. The study claims that after years of limited success within large companies, Open Innovation has now emerged as the driving force behind superior business outcomes, surpassing all other forms of innovation, the survey revealed that a substantial 83 percent of companies consider Open Innovation crucial to their future growth strategies. The point in interest for my study the survey also showed that Artificial intelligence (AI) functions as a transformative presence within this Open Innovation ecosystem, filling it with intelligence that uncovers fresh perspectives and expedites the process of discovery. By enhancing and broadening the capabilities of all participants in the ecosystem, AI becomes a catalyst for tapping into the potential of diverse and abundant data, facilitated through hybrid cloud infrastructure, and translating it into actionable insights. Consequently, AI has taken on a central role in shaping the landscape of next-generation innovation endeavors and initiatives.(Marshall et al., 2021).Compelling data from IBM highlights that a notable 58 percent of companies now anticipate AI to be the driving force behind their imminent innovation pursuits. A compelling illustration of this is demonstrated by Yara, a Norwegian enterprise. Yara has introduced a global digital farming platform that seamlessly integrates artificial intelligence, machine learning, real-time field data, and weather information. This amalgamation of technologies unlocks novel insights for farmers, empowering them to enhance crop yields in an ecologically sustainable manner. Moreover, the platform's capabilities extend to linking individual farms with the broader food supply chain, fostering the development of a holistic approach to food production that spans from farm to plate.(Marshall et al., 2021).

Another significant portion of the literature, asserting the interconnectedness and potential complementarity of the two concepts, maintains that a full understanding of the dynamics of their interaction is still lacking.(Strazzullo et al., 2022; Yun et al., 2016)

Broekhuizen in 2023 undertook a combined effort to explore the intersection of Open Innovation and Artificial Intelligence. Their work asserts that AI offers ample opportunities to facilitate efficient knowledge exchange among organizations striving to foster Open Innovation. Additionally, the study highlights that while prior investigations often concentrate on AI's ability to replicate "human" tasks within structured domains, a significant gap exists in the literature regarding a methodical examination of when and how much AI can be leveraged for the intricate and unstructured aspects of Open Innovation (Open Innovation). The researchers also devised a 3x3 matrix (refer to Figure 8), in which they align the three distinct phases of Open Innovation (initiation, development, realization) with the three core managerial functions of AI (mapping, coordinating, controlling). This matrix serves as a strategic tool for identifying potential avenues through which different AI applications can enhance or even automate human cognitive capabilities. (Broekhuizen et al., 2023)

		AI functions		
		Mapping	*Coordinating*	*Controlling*
OI stages	*Initiation*	**I – AI as scout** Exploratory search: partner and innovation opportunity identification	**II – AI as matchmaker** Reconnaissance of partners	**III – AI as forecaster** Foreseeing problems, opportunities, and aids
	Development	**IV– AI as cartographer** Mapping potential recombination of partners' diverse knowledge	**V – AI as conductor** Knowledge integration for innovation development	**VI – AI as whistleblower** Early warning and detection of opportunistic behavior
	Realization	**VII – AI as vanguard** Evaluation of new business opportunities	**VIII – AI as broker** Deploying joint resources for commercialization	**IX – AI as custodian** Guarding intellectual property and (re)allocation of value capture

Figure 8 Open Innovation and Artificial Intelligence 3x3 matrix[8]

[8] Retrieved from (Broekhuizen et al., 2023)

2.5 Hypotheses formulation

In the introductory section, I have identified a research void concerning the intricate interplay between Open Innovation practices and the integration of AI technologies. This research gap signals a need for an exploration of these dynamic intersections. With this in mind, this study aims to shed light on the relationship between start-ups that are involved Open Innovation and the adoption of innovative AI solutions, with a specific focus on ChatGPT. The central inquiry revolves around the question of whether companies deeply committed to Open Innovation as a strategy are more predisposed to embracing novel AI advancements like ChatGPT, or conversely, if organizations with less Open Innovation engagement demonstrate greater propensity for adopting such cutting-edge AI solutions.

The formulation of the hypothesis is grounded in a body of literature that states the interconnectedness of these two concepts, highlighting their potential for complementarity (Strazzullo et al., 2022; Yun et al., 2016). This part of the literature posits that AI provides substantial opportunities for enhancing the efficiency of knowledge exchange among organizations that foster Open Innovation. Moreover, within the existing body of research, there is a notable emphasis on AI's ability to replicate "human" tasks in structured domains, which is exactly what ChatGPT does (Broekhuizen et al., 2023). Based on the analysis thus far, it is reasonable to infer that start-ups already actively engaging in crowdsourcing are likely to view AI as an additional Open Innovation collaborator. Consequently, these start-ups may exhibit a greater propensity to embrace and integrate AI into their ideation processes. On this basis the hypothesis of the study is as it follows:

H1: Start-ups with a strong commitment to Crowdsourcing, will exhibit a significantly higher tendency to adopt ChatGPT into their business.

3 Methodology

3.1 Research Design

To conduct the study, I have chosen an empirical approach and I administered surveys to a series or relevant individuals in the start-up arena. These subjects are both owner of start-ups and employees involved in the creative process of the company. The platform chosen for the survey was Qualtrics – a reliable platform to administer and manage questionnaires - and the participant were contacted by the researcher via direct WhatsApp messages, social media and

in person, where via anonymous link they were able to complete the survey. The participants were primarily chosen from the researcher's personal network, specifically individuals who the researcher knew met the requirements to be included in the study. However, in order to expand the sample size, the survey link was also shared online and through social media platforms. Nevertheless, throughout the recruitment process, it was consistently emphasized that the survey was intended just and only for members of the target population. A reminder to disregard the survey was prominently displayed on the first page for those who did not work in a start-up or were not involved in the idea generation process. Among the 101 individuals who received and initiated the survey, only 85 successfully completed all the questions, constituting the study's final sample. The survey structure is as it follows: the first block is composed by an introduction that explains the participants the purpose of the research and the target population while restating the anonymous nature of the research. Then the survey unfolds with question related to idea generation, AI and Crowdsourcing, concluding with a demographic section. All the questions except for the dependent and independent variable – which are measured to Likert scale 1-7 – are multiple choices with the possibility for the users to make text entries in case the options didn't satisfy them.

3.2 Measurement

3.2.1 Dependent Variable

The variable of interest for this study is predisposition for the individuals working in start-ups - start-ups' owners and start-ups' employee involved in the idea generation process – to embrace AI technology, in the case of my study defined as ChatGPT. This variable is measured in the survey in the question 17. The question asks the participant how much they think ChatGPT could be useful for gathering successful business ideas, the participant has the chance to express its choice moving the slider from the position one (not useful) to the position seven (very useful). The scale used is a Likert 1-7

Survey question	**Type of scale**
From 1 (not useful) to 7 (very useful), please indicate how much do you think AI and ChatGPT could be	*Likert from 1 to 7 (Not useful – Very useful)*

useful to gather successful business ideas	

Figure 9

3.2.2 Independent variable

The independent variable in my model is the level of usage of crowdsourcing within the start-up company that the participants own, or in which it works. The variable is measured in the survey in the question 12. The question asks the participants how much they use crowdsourcing within their firm, the participant has the chance to express its choice moving the slider from the position 1 (do not use) to the position 7 (extensive use). The scale used is a Likert 1-7

Survey question	**Type of scale**
From 1 (do not use) to 7 (extensive use), please indicate how much do you use crowdsourcing within your start-up company	*Likert from 1 to 7 (do not use – extensive use)*

Figure 10

3.2.3 Control Variables

In the exploration of the dynamics between ChatGPT utilization and Crowdsourcing, I took into consideration control variables (categorized as explained in figure 11 below). These variables summarize diverse dimensions that could potentially influence the observed relationships and outcomes each in their own ways.

- Age: participants' age might infuse distinctive perspectives and inclinations, potentially impacting their attitudes and approaches toward AI-adoption.

- Gender: gender demographics provide a lens through which we can assess potential variations in responses, shedding light on gender-related factors that may shape perceptions and decisions.

- Annual Revenues: the financial stature of start-ups, as reflected in their annual revenues, serves as a crucial factor influencing resource allocation and capabilities for AI - adoption.

- Number of Employees: the size of a start-up's workforce contributes to the organizational dynamics, potentially affecting its technology strategies and ability to implement them effectively.

- Education Level: participants' educational backgrounds offer insights into the breadth of knowledge and expertise, which could influence their viewpoints and choices concerning AI.

Survey question	**Multiple choice answers**
Age	o *18-24 years old* o *25-34 years old* o *35-44 years old* o *45-54 years old* o *55+ years old*
Gender	o *Male* o *Female* o *Prefer not to say*
Education	o *Middle school Diploma* o *High School Diploma or Equivalent* o *Bachelor's Degree* o *Master's Degree* o *Doctoral Degree*
Number of employees	o *Sole Founder* o *Small Team (2-10 employees)* o *Growing Team (11-50 employees)* o *Expanding Team (51-200 employees)* o *Scaling Team (201+ employees)*
Annual Revenue	o *Very Low (Up to $50,000)*

	○ *Low ($50,001 - $200,000)* ○ *Moderate ($200,001 - $1 million)* ○ *High ($1,000,001 - $5 million)* ○ *Very High (Above $5 million)*

Figure 11

4 Results

The results of the Ordinary Least Squares (OLS) regression analysis conducted using RStudio are shown in the Figures below. The descriptive statistics for each relevant variable are also presented, along with the Variance Inflation Factor (VIF) analysis for multicollinearity.

Figure 13 shows two models. The second model (Model 2) includes the independent variable “Crowdsourcing”, while the first model (Model 1) does not. The R-squared value of 0.192 for Model 1 indicates that the model explains a significant portion of the variance in the dependent variable, "ChatGPT usefulness". The independent variable “Crowdsourcing” is the only variable that is significant at the $p < 0.01$ level in both models; it has a positive coefficient, meaning that higher levels of crowdsourcing are associated with higher levels of perceived ChatGPT usefulness. The variable "Revenue" is also significant at the $p < 0.05$ level in Model 2, but it is not significant in Model 1, which suggests that revenue may be a proxy for the financial resources the organization, and that richer organizations may be more likely to perceive ChatGPT as useful. The Fisher F statistic of 3.06 for Model 2 indicates that the models fit the data well. Our analysis reveals VIF values around 1 for all independent variables, indicating minimal multicollinearity. Multicollinearity arises when independent variables exhibit strong correlations, which can result in less stable coefficient estimates and make it difficult to interpret the model effectively, this index ensures reliable coefficient estimates and enhances the model's interpretability, strengthening the validity of our results. The descriptive statistics in Figure 12 show that the sample is composed of predominantly male (64%) and young (92% are under 34 years old) individuals who work in start-ups with less than 10 employees (77%) and annual revenues of less than $200,000. Of the 85 respondents, 10 do not use crowdsourcing at all, and 53% use it to a limited extent. However, the majority of respondents (67%) believe that ChatGPT could be useful for gathering successful business ideas assigning values from 4 to 7.

Overall, the results indicate a positive influence of the independent variable "Crowdsourcing" on the dependent variable, meaning that those who utilize crowdsourcing in their start-ups tend to express themselves more favorably towards the usefulness of ChatGPT in the process of gathering ideas. Thus, organizations with stronger commitment to crowdsourcing – according to our data – could have the tendency to incorporate more AI and, in particular, ChatGPT in their idea generation process, seeing the AI as another possible external collaborator to perform Open Innovation. Conversely, according to our model, individuals who work in organizations that are less committed to crowdsourcing are more inclined to think that ChatGPT is less useful.

The sample, although limited, respects the 10 observation per variable prescribed by the relevant literature. (Acciarini et al., 2023; Cao et al., 2015; Fasano & Deloof, 2021)

Figure 12. Descriptive statistic for the variables

Statistic	N	Mean	St.Dev.	Min	Max
Crowdsourcing	85	3,565	1,735	1	7
Chat GPT	85	4,435	1,829	1	7
Size	85	2,282	0,717	1	4
Revenue	85	2,012	0,824	1	4
Age	85	1,918	0,561	1	4
Sex	85	1,376	0,511	1	3
Education	85	3,541	0,716	1	4

*Figure 13: OLS regression with crowdsourcing as independent variable. Model 1 includes only the control variables, while Model 2 includes the independent variable (Crowdsourcing), both with 85 observations. Note: *p<0.1; **p<0.05, ***p<0.01*

	Dependent Variable:	ChatGPT
	(1)	(2)
Crowdsourcing	-	0,450***
Size	-0,096	-0,277
Revenue	0,283	0,510**
Age	-0,168	-0,121

Sex	0,181	0,175
Education	0,152	0,251
Constant	3,621**	1,441
Observation	85	85
R-squared	0,023	0,192
F Statistic	0,369	3,096

Figure 14. VIF test for collinearity for each variable

Statistic	**VIF Score**
Crowdsourcing	1,074
Size	1,167
Revenue	1,170
Age	1,025
Sex	1,053
Education	1,052

5 Discussion

The findings of this study contribute to the understanding of how new AI tools are adopted and received by business start-ups. Specifically, the results suggest that ChatGPT is seen more positively and therefore is more likely to be adopted by start-ups that already have a high level of crowdsourcing. This finding has implications for theory, practice, and policy.

5.1 Theoretical implication

5.1.1 For Start-up literature

This study could contribute to the literature on start-ups in several ways. First, it suggests that start-ups that have already implemented crowdsourcing to access a wide range of perspectives to gather successful business ideas are more likely to do the same using AI tools like ChatGPT.

After all, start-ups that have already leveraged the collective intelligence of "crowds" should be more prone to utilize in the same way the AI-driven intelligence in their idea generation process. The results of the study suggest that ChatGPT and AI are not necessarily a substitute for "crowds" intelligence but – conversely – they could act in the framework of Open Innovation practices to ultimately drive innovation in a more efficient way. This study could lay the foundation for future research on the effectiveness of AI tools in driving innovation in start-ups.

The research is a valuable contribution to the literature on start-ups and it could help to push research in this area forward.

5.1.2 For Open Innovation and ChatGPT

This research confirms the view that open innovation and AI are interrelated concepts that have the potential to complement each other. The study supports the view of Strazzullo et al. (2022), Yun et al. (2016), and Broekhuizen et al. (2023) that AI can offer significant opportunities to facilitate knowledge sharing and collaboration among companies that already use open innovation in their idea generation process. However, the result of the study also suggests that more research is needed to understand exactly how and when AI can be used to enable open innovation. For instance, it is not yet clear whether AI can significantly contribute to open innovation practices, or if there are potential limitations to its use in certain tasks.

This study helps also to expand the state-of-the-art literature on ChatGPT offering new insights into the relevance and potential use of this tool in open innovation and start-up environments. It could pose the basis for future research that will further explore the capability and possible limitation of this all-new type of Artificial Intelligence.

5.2 Practical Implication

This research could be relevant for a variety of stakeholders in the business world, including managers, start-up founders, and employees who are involved in the idea generation process. Many companies and start-ups are already using AI capabilities to automate tasks, generate insights, and improve decision-making (Haase & Hanel, 2023.; Osone et al., 2021; Tholander & Jonsson, 2023). Additionally, open innovation also is a popular approach that allows companies to collaborate with external partners to bring new ideas to market (Spender et al., 2017). The ideas and conclusions obtained here could reveal the trend in which the industry is going and provide insights into how AI and open innovation can be used together to drive innovation. It could also help managers, start-up founders, and employees to understand the

potential benefits and challenges of this approach with new test and trials that could be done to better assess the overall effectiveness of the Open Innovation-AI methodology. The study's outcomes could be useful also for AI developers who, if the trend of this research is confirmed, could develop AI tools and Chatbots specifically to enable and facilitate specific steps of the Open Innovation process that can be automated, therefore improving the efficiency of the Open Innovation approach overall.

5.3 Policymaking implications

While the potential benefits of chatbots and AI for the broader business community are undeniable, there are also some potential risks and challenges that policymakers must consider related to the trends that this study underlines. Perhaps one of the most concrete risks is the fact that chatbots and AI could be used to collect and store personal data, allowing the possibility to track citizen's activities or to discriminate against them. It is important to ensure that such data is properly protected by adequate and up to date legislation. Other risks include the likelihood of chatbots and AI algorithms to be biased, which could lead to the spread of misinformation or fake news. Policymakers must ensure that these algorithms are tested and evaluated to identify and mitigate bias.

Ultimately – and this is an inherent risk for AI technology - policymakers must consider that the accelerated adoption of AI could render many jobs obsolete in the next decades, and perhaps decide to limit this adoption to some extent.

6 Conclusions and limitations of the study

The primary objective of this research is to delve into the intricate relationship between startups and the utilization of Open Innovation, with a specific focus on how these innovative ventures can effectively integrate emerging AI tools like ChatGPT. This investigation emerges from the recognition of a significant gap in the existing body of literature, which has yet to comprehensively explore the intersection of startups, Open Innovation, and AI, despite the undeniable prominence of ChatGPT and artificial intelligence across virtually every industry in today's economy. By investigating this, we aim to shed light on the evolving landscape of the industry, offering valuable insights into the potential synergies between open innovation strategies and the integration of AI tools. Our research is poised to serve as an initial steppingstone for future inquiries, paving the way for a deeper understanding of how and when these cutting-edge AI tools can be effectively employed to enhance the quality of the idea

generation process within startups. Nonetheless, it is crucial to acknowledge the inherent limitations of this study. Firstly, my examination primarily focuses on the predisposition of startup personnel, including employees and founders, to embrace ChatGPT and AI technologies within the framework of open innovation. While this is a vital initial step, it doesn't provide a definitive answer regarding the ultimate success of this synergy in bringing innovative ideas to market, both in the short term and the long term. Further research would be required to explore the concrete outcomes of this integration. For example, future research could address the following research questions:

- Does the use of AI tools affect the rate of success of start-ups that use Open Innovation?
- Can AI tools be used to automate tasks that are currently carried out by humans within the framework of Open Innovation, freeing up time and resources (inherently lacking in start-ups) for other activities?
- How can AI tools be used to improve the efficiency of open innovation practices in start-ups?

Secondly, it's worth noting that the sample size in this study is relatively small, although meeting the minimum requirements for statistical significance. A larger and more diverse sample would undoubtedly enhance the reliability of our findings and allow for a more robust analysis of the data.

Thirdly, this study lacks control over a multitude of potentially influential variables, including geographical, institutional, and cultural factors. These variables could potentially confound the results and limit the generalizability of our findings. To address this limitation, future research could benefit from a more comprehensive set of control variables, thereby strengthening the validity of the outcomes. In conclusion, while this study offers a crucial initial exploration of the interplay between startups, Open Innovation, and AI tools like ChatGPT, it is essential to recognize its limitations and view it as a steppingstone towards a more comprehensive understanding of this complex relationship. By addressing these limitations and further expanding on this research, we can unlock deeper insights into how startups can effectively utilize AI for innovation and growth.

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