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An empirical analysis of EU Framework Programmes financing HTEVs in the drone industry

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Abstract

In this thesis, we focus on the European Framework Programme for Research and Technological Development to finance High Tech Entrepreneurial Ventures to investigates firms characteristics that are associated to the funds' assignment process. The study will focus on the Drones industry, which represents a suitable setting for our investigation, provided that it belongs to the latest generation technologies has a fast-developing environment; it is significant in terms of market value and growth rates. Also, the vast diversity of applications in different fields makes it possible to achieve a greater generalization of the research's outcomes.

The study is developed in two layers, firstly a census of all the drone-related projects that participated in FP of the last two decades and won the tender has been made. All the characteristics of these projects were carefully tabulated and then analyzed, intending to describe the winning projects' population. The second part of our dissertation concerns the development of an econometric model, shifting the focus to the company level instead of the projects level. The model was built to find evidence of the influence of the variables that play a role in the assignment of funds. With our analysis, we can define some guidelines concerning the variables that differentiate the FP's winning companies from all the others. Generally, resulted that quite new organizations and well-established companies are the ones that have succeeded in obtaining the tender. Among the other findings, the other interesting one regards the specialization advantage owned by firms that focus on narrower fields.

Our work offers many possibilities for future research, as to be generalized to other industries, or it could be integrated in the future with data related to the companies that participated in the calls but that has not obtained the grant, on

which we do not have the visibility at this moment. This could bring additional value and confirmation to our results.

Key-words: HTEV, Drones, EU, Framework Programmes, Innovation, Grants.

Estratto

Durante gli ultimi decenni, è emerso come l'intervento dei governi e dei policymakers sia sempre più fondamentale nel finanziare l'innovazione e le High Tech Entrepreneurial Ventures. Tra tutti gli strumenti che i policymakers hanno a disposizione, ci siamo focalizzati sugli European Framework Programme for Research and Tecnological Development. La letteratura esistente non fornisce informazioni che riguardino le variabili che influenzano le dinamiche dell'assegnazione dei fondi. Lo studio si focalizzerà sull' industria dei Droni, che è risultata la più adatta ad essere presa come soggetto di studio dato che concerne una delle tecnologie di ultima generazione, è caratterizzata da un contesto in via di sviluppo, è significativa in termini di market value e growth rates. Inoltre, la vasta eterogeneità di applicazioni in ambiti differenti, rende possibile poter raggiungere una buona generalizzazione dei risultati ottenuti. Abbiamo redatto un censimento di tutti i progetti relativi a Droni che avessero partecipato a un Framework Programme nell'ultimo ventennio e avessero ottenuto un finanziamento. Tutte le caratteristiche relative ai progetti sono state accuratamente tabulate e poi analizzate al fine di descrivere e esplicitare le loro caratteristiche. La seconda parte della nostra dissertation riguarda la costruzione di un modello econometrico, spostando il focus a livello dell'azienda, piuttosto che a livello del progetto in sé. Il modello ha il fine di evidenziare l'influenza che delle variabili hanno nel processo di assegnazione dei fondi. Siamo in grado di definire delle linee guida circa le variabili che differenziano le aziende vincitrici dei bandi. Abbiamo evidenza di come le aziende appena nate e quelle grandi e ben stabilite, siano quelle che hanno ottenuti i finanziamenti. Tra le altre

evidenze ottenute, di particolare interesse troviamo il vantaggio di essere specializzati e operare in pochi campi differenti.

Il nostro lavoro offre molte possibilità per la ricerca futura, potrebbe essere generalizzato ad altre industrie, oppure potranno essere integrati i dati delle aziende che hanno partecipato ai FP, senza però ottenere il bando. Questo potrebbe portare ulteriore validità ai nostri risultati.

Parole chiave: HTEV, Drones, EU, Framework Programmes, Innovation, Grants.

Introduction

Innovation impacted many aspects of our lives, such as the technological developments that improved our lifestyle or solutions that could benefit our planet in the following years.

It could be helpful for firms being aware of how policymakers and governments supported their countries' economic growth and technological advancement. In this thesis, we considered the importance that central governments such as the European Union have nowadays in providing support financing projects and stimulating the advancement of their countries.

Framework Programmes are the instrument available to the EU to regulate the financing of innovative and potentially beneficial projects, where the most recent and the most significant is Horizon2020. H2020 differs from its predecessors on many sides, the fund available, the easiness to access the funds, lower bureaucracy, many inclusive objectives, and other aspects.

We have also seen how innovation often arises, not in large and well-established companies, the so-called incumbents, but in small and technological firms, what we will call High Tech Entrepreneurial Ventures, HTEVs.

Moreover, we decided to analyze the relationship between framework programmes and the emerging drone industry, characterized for the most part by highly technological small and medium-sized companies.

The first part of our dissertation concerns a descriptive analysis considering all the projects that have obtained funding by winning the calls made available in the framework programmes of the last twenty years (2001-2021).

The chosen time horizon began when the drone industry began to develop at the start of the 21st century.

This project-oriented analysis consists of a census that has led us to describe these projects' characteristics, relationships, and differences as exhaustively as possible.

Therefore, we understood how belonging to a specific country characterizes the type of project, the number of participants, the funds requested, and the size of the project itself. We also discovered how the EU funds were distributed by sector, country, type of project coordinator, number of participants, etc. Next, we looked for possible relationships between these variables, obtaining results that we can define as not evident. In the last part of our descriptive analysis, we looked slightly at predictive analysis, representing the relationship between the number of participants and the funds received.

Having seen how the characteristics of the projects and the objectives of the framework programmes evolved and adapted to the needs of that moment, we felt we had to broaden the scope of our analysis, focusing more on companies instead of on the temporary project.

So we decided that the second part of our dissertation should be dedicated to a complete predictive analysis, born with the assumption of giving depth and solidity in the future to our thesis. We have thus expanded our dataset, including information regarding drone companies in Europe. In this way, we were able to build an econometric model, more precisely a Probit regression model, which had as a binary dependent variable the obtaining of funds or not by a given company, and as independent variables the variables whose impact and influence we wanted to test.

The results of this model will answer our first research question, which variables play a distinctive role in the obtainment of funds.

Among the considered variables we had taken into account are the age, size, the type of product or service that characterize the firm's offer, the sector in which the firm operates, the application fields of the firms themselves, and the clients' ones, etc.

We thoroughly believe that our work could open the door to new research to investigate more in-depth the areas around the assignment of funds by the EU Commission through the Framework Programmes and the world of the drones industry, deepening the analysis of the impact of such variables.

The structure

The following chapters will present an overview of the extant literature regarding our starting point: policymakers and their intervention in supporting innovation, with a deepening on the instruments available to them. In this specific context, we decided to develop and focus our efforts towards grants, and more specifically, the EU Framework Programmes that regulate the assignments of grants by the Europen Union.

In the following chapters, the Census and the Econometric Model will be presented. Finally, in the last chapter, we discuss our results, highlighting the implications of our study, and assessing its limitations, which open avenues for future research.

2 Background and Literature review

To comprehend the state of the art of the actual research in the world of new technology-based firms that relates with the European Union when they look for capital to invest in their project.

2.1. Methodology

We need to provide a comprehensive framework of the following phenomena: how new technology-based firms participate in EU-funded projects.

The review of extant knowledge concerning this topic has been firstly grounded on research in the Scopus database.

Keywords identification

We started our systematic research by identifying the necessary keywords to complete a structured and valid search on the Scopus database.

The chosen document from which we started our systematic review was "*The participation of new technology-based firms in EU-funded R&D partnerships: The role of venture capital" by Massimo G. Colombo, Diego D'Adda, Lorenzo H. Pirelli, 2015.*

Why is this research significant?

This paper investigates the participation of new technology-based firms (NTBFs), which we will call High Tech Entrepreneurial Venture in EU-funded R&D partnerships. It examines whether venture capital (VC)-backed firms are

more likely to enter these partnerships than their non-VC-backed peers and the role of the ownership and governance of the VC investors.

The main focus of the research conducted by Professor Colombo regards the same subjects and dynamics as ours, so New Tech Entrepreneurial Venture that fund themselves through European Funding systems.

Given that, we thought that this paper could be the perfect source to draw the concepts needed to search for papers relevant to our analysis.

We used Colombo's paper as the foundation tree, and we branched it out to find connected papers.

To do that, we identified:

- The papers that had been cited by Colombo's paper: 77 papers
- The ones that had cited Colombo's paper: 27 papers

We selected those that concerned our research field, which could be used for keywords selection for queering Scopus database aiming to reach satisfactory papers related to our dissertation. As a result, we found:

- 34 papers from the cited ones
- 6 papers among the citing ones

Starting from these, we counted how many times a keyword had been used and classified them from the highest to lowest used.

Conducting this analysis, we noticed that the geographic focus influenced how the new technology-based firms fund themselves. Knowing that our focus in the EU- funding projects, we found it necessary to add an extra pool of papers specifically targeting entrepreneurial finance in the *EU.*

In this way, we added other 13 papers for a total of 53 pieces.

By this methodology and considerations, we were able to build the following search string for Scopus:

TITLE-ABS-KEY (("High tech entrepreneurial Venture" OR "New Technology based" OR "New tech* Venture" OR "high tech start up") AND ("fund*") AND ("Public Venture Capital" OR "EU framework programme" OR "public venture capital" OR "entrepreneur*" OR "public policy" OR "financing policy" OR "financ*" OR "R&D" OR "financ* innovation" OR "innovation" OR "barrier* to innovation"))

Document selection

This query produced 30 documents on Scopus, on which we have performed the following operation to find and select those papers applicable for our analysis.

1. We exported an Excel sheet from the Scopus platform with all the documents. We created a table containing the following information*: Title, Author(s), Year of publication, Source title, Abstracts, Authors Keywords, Publisher, Document type*.
2. Then, after a preliminary phase of abstract reading, we decided to discard those not in line with the research's scope. In this sense, we discarded 14 papers that were not focused precisely on the financing methods for high-tech entrepreneurial ventures.
3. Afterward, we categorized the papers by relevance to identify reliable and famous sources. To do that, we used the *Scimago Journal Rank* or *SJR indicator*, which measures the degree of scientific influence of academic journals. So, we have identified the quartiles of relevance for all the papers, divided into *Q1: Best Case; Q2: acceptable case; Q3 and Q4 of minor/non-relevance*.
   We eliminated those papers with minor relevance.

4. In the end, we had a pool of valid and solid papers from which to start our analysis. Therefore, in-depth scientific researchers reading round began.

Overview of the selected documents

All the documents were very fragmented; in fact, each regarded a completely different topic.

Thus, to better comprehend what pushes governments, or policymakers, in support of the high-tech entrepreneurial venture, we had to enlarge the focus of our research, including the specific relationship between the public government and the support of firms.

Second selection

Keeping in mind what was stated above, we modified the first research string increasing the focus on policymakers' intervention:

TITLE-ABS-KEY (("High tech entrepreneurial Venture" OR "New Technology based" OR "New tech* Venture" OR "high tech start up") AND ("fund*") AND ("Public Venture Capital" OR "EU framework programme" OR "public venture capital" OR "entrepreneur*" OR "public policy" OR "financing policy" OR "financ*" OR "R&D" OR "financ* innovation" OR "innovation" OR "barrier* to innovation"))

The latter resulted in 29 documents, from which we were able to select nine papers that might be more in line with the analysis' scope.

Finally, we employed all these papers to build a comprehensive framework appropriate for our research.

2.2. Background

2.2.1. Why should the government support innovation?

An overview on innovation

Innovation: the new theology.

INNOVATION has become the industrial religion of the late 20th century. Business sees it as the key to increasing profits and market share. Governments automatically reach for it when trying to fix the economy. Around the world, the rhetoric of innovation has replaced the post-war language of welfare economics. It is the new theology that unites the left and the right of politics.

"The Economist," February 20th, 1999, Innovation in Industry

The focus of our thesis gravitates around policymakers' interventions in fostering innovation. Still, before dipping into this, we have to do a preliminary introduction to deeply understand why governments must support innovation and innovative firms in their country, and most importantly, how they can do that.

Nowadays is taken for granted that, given the crucial importance of innovation in our society and the economy, we can clearly define what innovation is. However, given its kaleidoscopic nature, converging to a unique and single definition on which everyone agrees is also challenging.

Most roughly and synthetically, it can be defined as "the production and commercialization of an invention" (Congress. Office of Technology Assessment,1995). This is a crucial aspect; from an economic perspective,

innovation is defined as the first real commercial transaction of a new product or process (Freeman, 1974).

Above all the definitions, the most used and agreed one is: “Innovation is the practical implementation of ideas that result in introducing new goods or services or improvement in offering goods or services” (Schumpeter, Joseph A.,1983).

Recently a more complete definition of innovation has been reached; it encloses the three fundamental characteristics of innovation. “An innovation is the **implementation** of a **new** or significantly **improved** product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.” (OECD Oslo Manual, 2005). It is fundamental for innovation to have novelty; it is valuable, both for the user and the producer, and commercialized, as Freeman also said.

The producer’s valuable innovation aspect depends on value creation and value capture. The innovator’s profitability depends on the value created by the innovation and the share of such value that the innovator is able to appropriate (Grant, 1996).

As we said, innovation entails a plurality of definitions and **types**, **disciplines**, and **perspectives**.

For a firm, innovation can assume different shapes, such as *product innovation*, the creation, and introduction on the market of a good or service that can be new or an improved version of the existing ones. *Process innovation* concerns the renewal of processes inside an organization as a competitive advantage and *organizational innovation*. Product and process innovation must rely on a solid base. Hence, the organization itself needs to innovate its organizational structure to fully exploit the benefits that come from innovation. (Boer, Harry.,2001).

There are many disciplines that study innovation, such as sociology, psychology, organization science, strategic management, and economics; this last one is our field of research. In this sense, we focus on market mechanisms and optimal level of innovation, the firm's incentives to invest in innovation, and how policymakers can support innovation.

In this landscape, there are two different perspectives, the firms' one where they want to profit from innovation, and the policymakers' one in which they are eager to support innovation for growing their economies.

2.2.2. Why do policymakers want to support innovation?

Innovation is the key to firms' success. Through product innovation, they can enter new markets and gain new customers, while process and organizational innovation help improve internal performance, be more efficient, and external performance answering the needs of the market.

Innovation leads to an industry transformation by disrupting extant segments and creating new ones; this is the case of disruptive innovation. There is a clear distinction between *sustaining* and *disruptive* innovations.

Sustaining innovation is the improvement of a product or service based on the known and actual needs of the current market. Innovation, in this case, is barely an improvement in the performance of something already existing.

Disruptive innovation, instead, refers to a process by which a new product or service creates an entirely new market, eventually displacing established competitors (Bower, Joseph L.; Christensen, Clayton M., 1995). According to Christensen, disruptive innovations are critical to long-term competitive advantage and success in business (Christensen, Clayton M.; Raynor, Michael E.; McDonald, Rory,2015).

Furthermore, disruptive innovation is often enabled by disruptive technology. Marco Iansiti and Karim R. Lakhani define foundational technology as having the potential to create new foundations for global technology systems over the longer term (Iansiti, Marco; Lakhani, Karim R., 2017).

In a nutshell, the key aspect of innovation relates to the actual realization of something new and valuable. Aiming to create something new or improved, technology is fundamental. It enables disruptive innovation that has a long-term competitive advantage potential. The value for an innovating firm depends on the share of the value generated that is able to capture over time. The value generated impacts not only the firm but also the society.

2.2.3. Focus on High-Tech Entrepreneurial Ventures

Therefore, innovation is a fundamental pillar of a bright economic system on which nations should set their foundations for future developments. Despite the consistent amount of knowledge that companies can create, this needs to be expanded and spread all over the industry such that countries or regions (like EU) can achieve satisfactory performance in terms of growth and employment (Bravo-Ortega and García Marín, 2011; O'Mahony and Vecchi, 2009; Pop Silaghi et al., 2014).

Given the fundamental role of technologies in the innovation process, we introduce the *High-Tech Entrepreneurial Ventures* (HTEVs), small young organizations operating in technology-intensive industries (D.J. Storey, B.S. Tether, 1998), meant as connectors between the industry and research world (Colombo, 2010). These latter are the key players in performing the Schumpeterian creative destruction, where their small sizes and lack of experience are offset by innovation sources (Audretsch and Acs, 1994). As a result, HTEVs boost the country's economic growth by exploiting previously

developed knowledge converting them into value-added knowledge (Braunerhjelm et al., 2010).

HTEVs are usually defined as small businesses that rely on products and services primarily endowed by next-generation scientific and technology knowledge (Allen 1992). Indeed, these organizations are often equipped with intangible assets, which characterize their innovation sources, but lack “hard” assets fungible as collaterals (Valérie Revest and Alessandro Sapio, 2010).

A successful example of a flowery HTEVs ecosystem is the United States (US), where there has been a rising movement of such firms with incredible growth in employment, sales, export, assets, and employees’ wellbeing. In addition, US intensive-technology clusters, where most HTEVs reside, have proved a more excellent indirect employment creation in business and consumer service sectors (D.J. Storey and B.S. Tether, 1998).

Once having understood the potentiality of HTEVs and their environment, we needed to shed light on the controversial European Union case. Compared to countries such as the US, the latter presents a consistent delay in establishing a frontier of technological knowledge. Indeed, in the EU, there are many developed countries with a similar culture, distinguished by diverse financial and law systems. It is worth noting that finance and innovation are linked by the features of the financial system (Dosi 1990). Furthermore, the legal and institutional environment influence the contracts’ draw and thus the degree of support towards the HTEVs ecosystem (Levine 1997; La Porta et al. 1998; Rajan and Zingales 2001).

We are interested in investigating which kinds of issues affect these firms, utilizing a multi-dimensional approach to get an overview concerning the European lag described above.

The first element refers to the survival rate of these firms. Multiple studies in various European countries have shown more outstanding performance of HTEVs compared to their corresponding traditional competitors. This essential finding contrasts the common thought of correlation between high-tech and high risk. A possible reason behind this is the ordinary founders' high level of education compared to low-technology firms (D.J. Storey and B.S. Tether, 1998).

The second refers to growth, one of the policymakers' significant interests, which can be enhanced thanks HTEVs based on the empirical evidence led by US experience. Consistent studies brought to the emergence of three facts: (i) HTEVs present a faster average employment growth rate than other startups,(ii) from a generic perspective, the employment growth rate results modest (iii) while Europe misses extremely fast-growing firms widespread in the United States (D.J. Storey and B.S. Tether, 1998).

Then, the HTEVs founders' characteristics have been analyzed to comprehend potential differences. They usually own a higher educational background than the working population and other new business founders. In this respect, the age profile of founders is mainly ranged between 30 to 50 years of age due to educational paths that last at least until 25 years of age. Moreover, some studies depicted the tendency of such entrepreneurs to be employed in large enterprises before starting their own business (D.J. Storey and B.S. Tether, 1998).

The external finance element depicts a crucial point. Entrepreneurs feel the growth of their business "unreasonably" restricted by lack of access to external finance (D.J. Storey and B.S. Tether, 1998). HTEVs show significant default probability compared to well-established organizations. Moreover, firms' values decrease drastically in case of default due to the specialized and intangible nature of the few assets possessed that cannot be redeployed. On the other hand, HTEVs' transaction costs appear higher than large and mature companies

because of the conversely proportional relation between banks' market power and borrower size.

Finally, there are substantial information asymmetries between HTEVs' managers and outside investors, primarily due to short track of records and uncertain innovation processes. Furthermore, this latter is characterized by complex technical projects and difficulties in monitoring the R&D investments, distinguished sometimes by an unwillingness to disclose information because of the rivalry in the R&D race (Valérie Revest and Alessandro Sapio, 2010).

In the end, location effects and the importance of networking have been considered. The US role model has proved HTEVs tendency to organize themselves into clusters (such as Silicon Valley in California). In Europe, there is more significant heterogeneity among countries, but most firms are located around major urban areas. In Germany and UK, there are the most important geographical clusters that are characterized by greater access to knowledge and information. On the other hand, from a collaborative point of view, HTEVs are not conceived as small firms that provide inputs to larger organizations but rather as partners to sustain and develop, seeking to obtain access to their advanced technologies (D.J. Storey and B.S. Tether, 1998).

2.2.4. Innovation and market failure

It is now clear that innovation leads to economic development (Schumpeter Joseph A., 1961), in terms of both *dynamic efficiency*, related to better use and allocation of resources in an economy over time, and *economic growth*, leading to an increase in wealth generated by innovation over time in the economy.

So, innovation brings remarkable benefits to firms that invest in it. Innovation enables firms to:

- boost the prices and thus the revenues by reducing demand elasticity,

- decrease operating costs by enhancing operating efficiency through process and organizational innovation,
- increase employees' competencies, skills, and motivation by establishing a positive and open mindset inside the organization.

Nevertheless, on the other side, innovation implies some costs to the firms that decide to invest in it:

- Innovation can affect the firm's offer portfolio by cannibalizing and reducing the revenues from extant products.
- If you want to innovate, you have to invest in R&D; thus, there is a high risk of failure in the commercialization of an idea. Serendipity can mitigate this risk.
- Difficulties in attracting external finance for innovative projects
- Necessity to have a well-established structure, procedures, and processes organized to capture innovation's value.

The benefits of innovation, so the value generated, are not just limited to the firm itself, but they extend to the stakeholders in society. When a firm innovates, e.g., commercialization of a new product, customers also benefit from it, having a better product than the extant one. Suppliers and providers of complementary goods and services benefit from firm's innovation by having the opportunity to expand and enter new markets. Moreover, also firm's stakeholders such as Universities, allies, and banks can benefit from it.

Lastly, the whole society benefits from innovation. Innovation creates new jobs, improves life conditions (especially in the case of social innovation), generates and fosters economic growth. This is why policymakers need firms to invest in innovation.

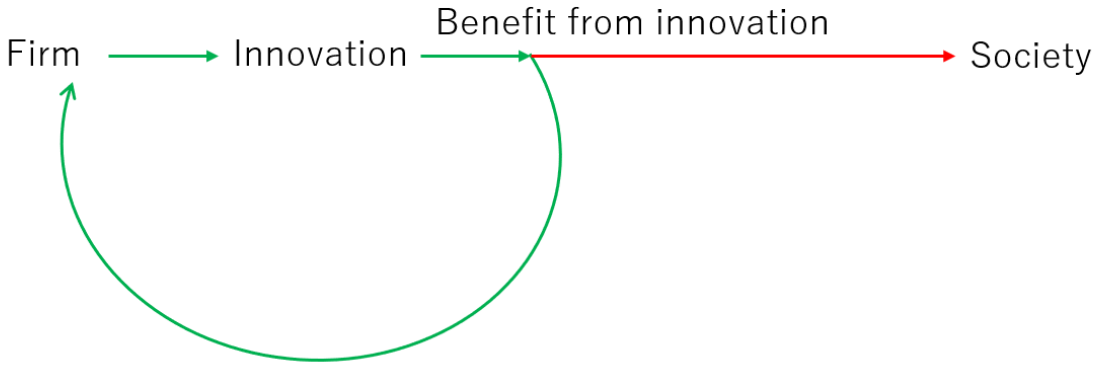


Figure 1:Positive externality

There is a failure in this mechanism; in fact, the loop is not closed since there is another actor, society, that benefits from a firm's investment. This generates a *positive externality*, preventing the investing firm from fully recovering the investment result. The value captured or Schumpeterian profits, those that arise when firms are able to appropriate the returns from innovative activity, are meager compared to the real benefits generated. Nobel laureate William Nordhaus ran the numbers and found out that innovators keep a very tiny fraction of the benefits they generate; most precisely, he estimated that innovators are able to capture about 2.2% of the total social surplus from innovation (Nordhaus, William D., 2004).

Therefore, firms' incentives to invest in innovation are sub-optimal.

In order to close the loop, as society benefits from the effort and investments of firms, policymakers have to increase and support firms that want to innovate. Governments must foster innovation by filling the gap generated by the positive externality.

2.2.5. How Policymakers support innovation:

It is clear now that there is a barrier in financing innovation. Moreover, history agreed on the Schumpeterian view that the source of innovation is entrepreneurs and their entrepreneurial ventures.

As we already saw above, our analysis subjects are high-tech startups or high-tech entrepreneurial ventures.

Startups and generally new and innovative firms are the catalysts of newness; they were born with good ideas, are flexible and agile, all characteristics that boost innovative capabilities that incumbents do not possess. Size, bureaucracy, the organizational structure, agency, and hiring costs make incumbents unreceptive to innovation, even if they can easily leverage ownership and financial advantages. The ownership advantages refer to all the resources that incumbents have and startups do not possess, both tangible and intangible. Startups, instead, are prone to innovate but suffer from the *startup paradox (Aldrich, H., & Auster, 1986)*. This concerns the organizational age and size of the firm. New ventures suffer from the liability of newness, so being new in the market, and liability of smallness, so not having many resources to invest in the entrepreneurial and innovative activity.

Policymakers can intervene in two ways in order to increase firms' incentives to invest in innovation:

1. Increase *intellectual property* (IP) protection.
2. Provide *subsidies* to firms that invest in innovation.

Both actions have advantages and disadvantages. Strengthening IP protection assures a firm's probability of recovering from the investment done. While, for governments, it implies high social costs for the creation and coordination of

dedicated institutions and for all the activities needed to run these programs. Increasing IP protection on one side will worsen competition in the market.

On the other hand, by providing subsidies to firms taking in charge part of the investment, the policymaker will solve the startup paradox, enabling innovative and agile firms to scale the investments in R&D up and boosting innovation.

2.2.6. The instruments

Policymakers can finance innovation through a mix of direct and indirect instruments. Governments can directly support investments in innovation through grants and subsidies, equity financing, and loans. Otherwise, they can provide indirect support through fiscal incentives (Table 1) (OECD, 2014).

Direct funding allows governments to target specific innovation activities driving the efforts towards business areas that are interesting for specific projects, such as the cases of R&D in green technologies, social innovation, or healthcare firms as happened during the pandemic. A high discretionary level characterizes direct funding instruments. In contrast, indirect funding instruments are more neutral in terms of industry, region, and firm characteristics, although this does not exclude some differentiation, most often by firms' size (OECD, 2010b). So, direct subsidies are more suitable for long-term projects, while indirect schemes encourage short-term research and boost incremental innovation rather than radical breakthroughs.

Direct financing concerns competitive grants and debt financing, such as loans for R&D projects. A loan guarantee implies that the credit guarantee scheme will reimburse a pre-defined share of the outstanding loan to the lender in the event of loan default.

Therefore, it is interesting to highlight that governments hold the intellectual property (IP) of research results developed in the framework of public

procurement programs. In contrast, the research results belong to the performing firm under other funding schemes (Guellec and van Pottelsberghe, 2000).

A brief description of the financing instruments:

Direct public funding

- Grants and subsidies are among the most common funding instruments. Used as seed funding for startups and innovative SMEs. Granted on a competitive basis and in some cases based on private co-funding. No repayment is usually required for this type of instrument.
- Debt financing:
  - Credit loans: government-subsidized loans require sorts of collateral or guarantee. The obligation of repayment as debt. The investor or the lender does not receive an equity stake.
  - Repayable grants/advances: repayment required partial or total could be in the form of royalties. It could be granted based on private co-funding.
  - loans guarantees and risk-sharing mechanisms: used widely as an essential tool to ease financial constraints for SMEs and startups. In the case of individual assessment of loans can signal ex-ante creditworthiness of the firm to the bank. Often combined with the provision of complementary services, for example, information assistance or training.
- Debt/Equity financing:
  - Non-bank debt/equity funding: new funding channels. Innovative lending platforms and non-bank debt or equity funds.
  - Mezzanine funding: a combination of several financing instruments of varying degrees of risk and return that incorporate

elements of debt and equity in a single investment vehicle. Used at a later stage of the firm's development. More suitable for SMEs with a strong cash position and a moderate growth profile.

- Equity financing:
  - Venture capital funds and funds of funds: funds provided by institutional investors to be invested in firms at early to expansion stages. Tends to invest at later increasingly -less risky- stage. Referred as patient capital due to long period for exiting (10-12 years). The investor receives an equity stake.
  - Business angels: provide financing expertise, mentoring, and networks facilities. They tend to invest in groups and networks at the early stages.
- Public procurement for R&D and innovation: create a demand for technologies or services that do not exist or target the purchase of R&D service (pre-commercial procurement of R&D). It provides early-stage financial support to high-risk, innovative technology-based firms with commercial promise.
- Technology consulting services, extension programs: expand the diffusion and adoption of already existing technology and contribute to increasing the absorptive capacity of targeted firms (especially SMEs). It provides information, technical assistance, consulting and training, etc., of particular importance in low-income countries.
- Innovative vouchers: small lines of credit provided to SMEs to purchase services from public knowledge providers to introduce innovations in their business operations.

Indirect public funding

- Tax incentives

- Tax incentives on corporate income tax: used in most countries. There is a broad range of tax arrangements on corporate income tax, including tax incentives on R&D expenditure and, less frequently, tax incentives on IP-related gains. They are indirect non-discriminatory.
- Tax incentives on personal income tax and other taxes: Available in many countries. A broad range of tax incentives on R&D and entrepreneurial investments and revenues apply to personal income tax, value-added tax, or other taxes (consumption, land, property, etc.). Indirect, non-discriminatory.

Direct public funding	Grants, Subsidies	
	Debt financing	Credit loans
		Repayable grants/ advances
		Loans guarantees and risk-sharing mechanisms
	Debt/equity financing	Non-bank debt/equity funding
		Mezzanine funding
	Equity financing	Venture capital funds and funds of funds
		Business Angels
	Public procurement for R&D and innovation	
	Technology consulting services, extensions programs	
	Innovation vouchers	
Indirect public funding	Tax incentives	Tax incentives on corporate income tax
		Tax incentives on personal income tax and other taxes

Table 1: Financing instruments, (OECD, 2014)

Focus on three diverse policymakers' initiatives

Once we have understood the available instruments policymakers have to finance innovation, we need to spotlight Europe. Indeed, since the Lisbon conference in 2000, where the European Council set out the goal to become "the most competitive and dynamic knowledge-based economy in the world" (Lisbon Strategy, 2007), European policymakers started identifying the most significant issues that prevent the achievement of that objective (Luca Grilli and Samuele Murtinu, 2014). One of the principal causes identified is the absence of high-tech rapid, growth entrepreneurial firms, that as previously mentioned, bear the country's economic growth.

Their poor financing capabilities often bound the development of these young innovative organizations. We have seen that HTEVs are difficultly the most appropriate candidates for "traditional" bank loans due to their peculiarities such as high information asymmetries and lack of collateralizable assets. As a result, there is the so-called "funding gap" problem, where the credit market is incapacitated to match the demand for financing (Meza and Webb, 1987; Stiglitz and Weiss, 1981).

The academics Gompers and Lerner (2001) and the European policymakers (EU Economic Recovery Plan; European Council, 2008) recognized Venture Capitals (VCs) as the most tailored financing manner for supporting HTEVs. In this respect, we know four main reasons behind the appropriability of such financing mode towards these young innovative firms. First, VC investors typically own better screening capabilities in identifying firms with high-growth potential than other capital operators (Sahlman, 1990). Second, VCs can provide competencies and managerial skills, besides the needed capital, to train baked firms' entrepreneurs. Furthermore, thanks to their technical preparation, VCs can perform a proper monitoring activity of managers' conduct and results on portfolio companies' fields (Hellmann and Puri, 2002; Lerner, 1995). Third, once

one or more VCs endorse a young innovative firm, it represents a “signal” of quality that can be spent to access additional external resources or competencies (Hsu, 2006). In the end, VCs are equipped with a vast business contacts network that baked firms can benefit from (Hochberg et al., 2007).

Although the VC system has been favorable in the US for the development of rapid-growth HTEVs, generating the employment of thousands of people in a few years, among the most known cases Facebook and Google, Europe failed its mission in the creation of such a thriving environment (Massimiliano Guerini and Anita Quas, 2015).

The former President of European Commission Jean-Claude Junker to the European Parliament in Strasburg, on the 26 November 2014, said:

“…Not only are we faced with a serious investment gap; we are caught in an investment trap. […] While investment is taking off in the U.S., Europe lags behind. Why? Because investors lack confidence, credibility and trust.”

Nowadays, the discrepancy between the US and EU VC systems is still significant with a total amount of investments raised, in 2019, by firms of $36 billion in EU compared to the $136,5 billion in the US (Dom Guzman, Crunchbase news, 2020; Pete Settles, KPMG report, 2020).

Specialized early-stage financing modes, such as Crowd founding and Initial Coin Offerings Platforms, provide opportunities to young innovative firms to raise early-stage capital (Belleflamme et al., 2014; Bruton et al., 2015; Chod and Lyandres, 2018; Howell et al., 2018). Nevertheless, these methods are appropriate only in a narrowed cluster of industries favored by the “crowd,” where projects should be easily comprehensible without relying on strategies and technologies that cannot be disclosed (Yan Alperovycha, Alexander Groha, and Anita Quasb, 2020).

Therefore, we will keep a set containing the three main financing alternatives to cope with the above-described founding gap; European policymakers utilize that to encourage the development of HTEVs. The financing methods used are characteristic of the European Union working method. They could focus on debt capital, such as subsidies or Tax incentives, and equity, like Governmental Venture Capital.

1) TAX INCENTIVES

Tax Incentives are indirect instruments that policymakers can utilize to support companies, especially young innovative firms, in developing knowledge.

Fiscal incentives related to R&D expenditures encompass both current and capital expenditure and range from tax credits to enhanced deductions passing by special depreciation allowance terms.

In general, R&D tax incentive schemes are divided into:

- Incremental: firms benefit only on the exceed of R&D expenditures they have formerly performed.
- Volume-based: firms benefit from all their R&D expenditures

Recently, among industrialized countries, there has been a rising trend of adopting volume-based schemes to ease the policy design and enlarge the group of beneficiaries (Irem Guceri, 2017).

We can utilize a valuable business case to comprehend better the impacts of tax incentive policies regarding the UK's measures. Indeed, this country has struggled in boosting the Business Enterprise Expenditure on R&D from 1987 until 2013. UK policymakers conducted three fundamental tax incentive interventions relying on volume-based schemes. In 2000 an SME scheme, those organizations with fewer than 250 employees and a turnover of less

than £50 million, was created based on enhanced deductions and cash credits.

As a result, SMEs gained a deduction of £150 for every £100 of R&D expenditures from their taxable income or got a 24% of R&D expenditures to refund if they did not have taxable profits. On the other hand, in 2002, a large company scheme was established, allowing to deduct £125 for every £100 spent in R&D. Despite the good intentions of policymakers and generosity of measures undertaken, R&D tax credits appeared to have narrowed impact. Therefore, in 2008 UK decided to enlarge the boundaries of SMEs definition up to 500 employees and a turnover of lower than £100 million. In this sense, the medium-sized companies benefiting from the scarce advantages of large company schemes got the opportunity to enter on SMEs' schema. Consequently, these firms obtained a user cost of R&D capital reduction between 15-21%. Thus, firms affected by this policy increased their R&D investments by 15-20%, with an enhancement of R&D headcount rather than a boost in the scientists' salaries. Furthermore, the government roughly recovered the additional costs for the 2008 policy without considering potential spillovers benefits (Irem Guceri, 2017).

Tax incentives schemes overall lead to an increase in the private R&D intensity, but the results achieved are dependent on tax relief design (Bloom et al., 2002). For instance, tax incentives addressed to large firms in the Netherlands have partially crowded out private R&D investments. Norwegian tax credits strengthened the introduction of products and processes new to firms, but not major innovations new to the market. Finally, the UK tax reform proved significant effects on private R&D and especially on patenting activities (Lokshin and Mohnen, 2012; Cappelen et al. 2012; Dechezlepretre et al., 2016).

In contrast to tax incentives, GVC and Subsidies are direct funding instruments. The OECD Science, Technology, and Innovation Policy portal, a repository of innovation support schemes (EC-OECD, 2020), shows that direct funding schemes are the most often reported financial support instruments for R&D and innovation in terms of count of initiatives.

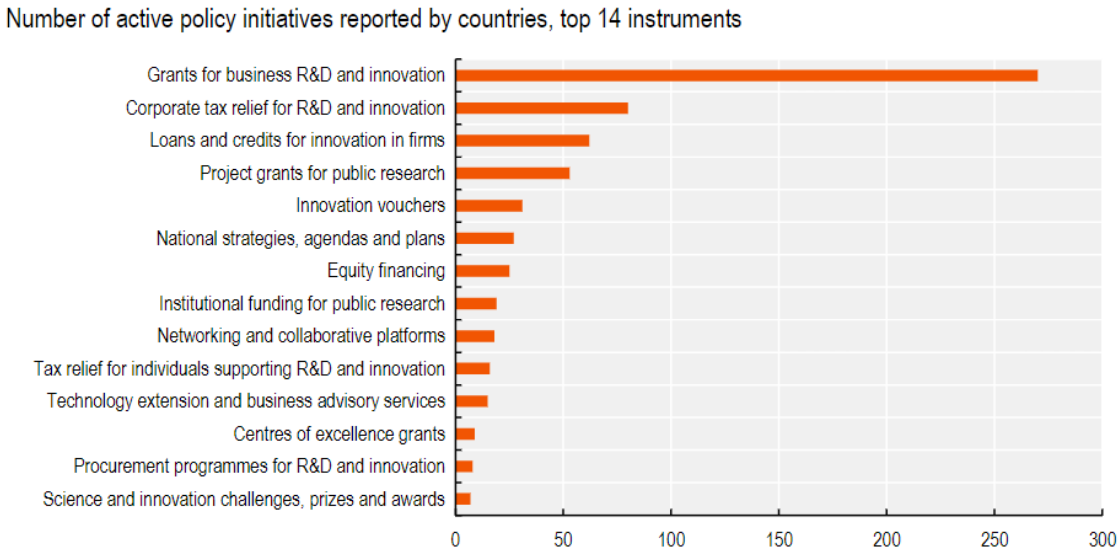


Figure 2:Policy instruments providing financial support for business R&D and innovation

2) EQUITY FINANCE - GOVERNMENTAL VENTURE CAPITAL (GVC)

We know that exist four different types of VC investors: Independent VC, Corporate VC, Bank VC, and Governmental VC. The first manages closed-end funds with a limited lifetime, where at the termination date, general partners must raise a new fund to assure the continuity of operations. Thus, a rapid exit is the main objective of such VC to ensure the investor's appropriate returns (Gompers, 1996). Then, Corporate VCs (CVCs) are VC embedded into large firms with the purpose, besides the financial one, of "technology windowing" such as screening of technological trends and visionary investments (see e.g., Siegel et al., 1988; Ernst et al., 2005; Dushnitsky and

Lenox, 2006; Benson and Ziedonis, 2009). Meanwhile, Bank VCs (BVCs) are subsidiaries of a parent bank created to generate future demand of investment banking operations and build lending relationships with baked companies (Massimo G. Colombo, Diego D'Adda, and Lorenzo H. Pirelli, 2015).

If the supply of private capital towards HTEVs, via IVCs is insufficient to provide the necessary funding, policymakers can intervene through direct or indirect approaches. GVCs are the example of a direct intervention aimed at injecting the needed capital into selected ventures (Brown, 2011; Cumming and Macintosh, 2006; Shane, 2009). Indeed, GVCs are funds managed by a company that is entirely possessed by governmental bodies, with the goal of solving shortages of VC markets. Interesting are the different objectives of GVCs, widespread in entire Europe, and IVCs popular in the US.

GVCs:

- Growth of HTEVs
- They adopt fewer contract mechanisms and voting rights
- Very few contributions to a business idea, managerial professionalization, and exit orientation
- They are less risk-averse, and target firms also value the social benefits such investments could generate

IVCs:

- Boost the growth of baked firms to increase the probability of an IPO or acquisition
- Actively monitor portfolio firms by adopting financial instruments and contractual clauses, creating entrepreneurs' incentives to pursue the growth

- Contribute to the business idea, managerial professionalization, and exit orientation
- They target entrepreneurial firms with developed business ideas

(Luca Grilli and Samuele Murtinu, 2014)

In general, GVCs have a broadly desired outcome of solving market failures by supplying the necessary capital to promising innovative companies. Then, if these firms need other funding later in their lifecycle, it is possible to attract IVCs thanks to the lower uncertainty and investment risk (Yan Alperovych, Alexander Groh, Anita Quas, 2020).

Therefore, GVCs contribute by signaling to private VCs the quality of baked companies that have become "investment ready," easing their investments into them (Mason and Harrison, 2001; Guerini and Quas, 2016; Lerner, 2002; Mueller et al., 2012). On the other hand, GVCs are not the critical elements of baked companies' success because they might not abandon unsuccessful investments to avoid bad media. Indeed, GVCs follow-on investments may feed "living deads" without supporting the development of an innovative ecosystem (Manigart et al., 2002).

We can talk about the GVCs features three essential pillars: *Location/Colocation*, *Syndication*, and *Industry Focus*.

The literature shows that policymakers often deploy local GVC programs in underdeveloped regions to compensate for severe financing gaps due to the lack of private VC in those areas. On the other hand, colocation, namely the geographic proximity between the provider of public resources and beneficiary, brings a greater likelihood of collusion leading to less effective policies (Yan Alperovych, Alexander Groh, Anita Quas, 2020).

Then, regarding Syndication, it can lower the investment risk, thanks to the "second opinion" brought by a professional entity, leading to a boost in the likelihood of successful compared to solo GVC deals (Casamatta and Haritchabalet, 2007; Manigart et al., 2006; Brander et al., 2015; Cumming et al., 2017).

Finally, GVCs that focus on a specific industry field induce industry-specific expertise development. As a result, this positively affects their ability to bridge the financing gap supporting the most promising HTEVs (Yan Alperovych, Alexander Groh, Anita Quas, 2020).

3) SUBSIDIES

This last policy intervention refers to a direct funding measure to provide financial resources to companies, particularly HTEVs, overcoming the financial constraints that prevent innovation development.

If we focus on the most suitable target of such policy, HTEVs, we can clearly see that those firms suffer from "liabilities of newness." Indeed, they lack legitimacy in the eyes of potential resources providers (employees, financers, customers…), leading them to terrible multi-nature limitations. However, HTEVs can tie relationships with essential organizations or institutions to certify their legitimacy (Stinchcombe, 1965; Baum, 1996; Aldrich, 1999; Hannan and Freeman, 1977; Baum and Oliver, 1991; Venkataraman and Van de Ven, 1998).

Government can deliver subsidies to support companies in developing their innovative projects and signal the firm's quality. We can distinguish three main reasons why subsidies could be beneficial besides the economic perspectives concerning the subsidy itself.

First, firms cannot fully capture the value of R&D investments due to unavoidable knowledge spillovers, bringing them to invest less than what is socially optimal. Moreover, this problem is particularly pronounced when HTEVs lack resources to defend their intellectual property in court. Therefore, subsidies can stimulate companies leading their investments closer to a more social optimal levels (Baumol, 1993; Meuleman and De Maeseneire, 2012; Anna Söderbloma, Mikael Samuelsson, Johan Wiklund and Rickard Sandberg, 2015).

Second, new ventures suffer from information asymmetries caused by the scarcity of trust and critical information they cannot provide, unlike large firms. Hence, it is complex to collect information about HTEVs, and finances cannot correctly recognize high-risk and low-risk targets. As a result, entrepreneurs could act opportunistically by exploiting the information gap leading to adverse selection problems. So, subsidies can solve this market failure by providing capital to start the project, and, more importantly, signal the legitimacy of firms to future investors (Carney, 2005; Stiglitz and Weiss, 1981; Anna Söderbloma, Mikael Samuelsson, Johan Wiklund, and Rickard Sandberg, 2015).

Third, new technological ventures suffer from liabilities of newness, as described above, which cause greater difficulty in gaining resources from third parties required to grow and survive. Governmental agencies are seen as knowledgeable due diligence experts who convey a valuable legitimizing endorsement. HTEVs, particularly in the early stages, are highly dependent on external resources, and a valuable certification could profoundly change its development path. Furthermore, the way policymakers design such subsidies, how competitive and prestigious they are, primarily affects the quality of certification provided (Stuart et al., 1999; Rindova et al., 2005; Anna Söderbloma, Mikael Samuelsson, Johan Wiklund, and Rickard Sandberg, 2015).

HTEVs operate in a knowledge-intensive environment where there is the necessity to hire highly qualified and educated employees to run the business. Therefore, recruitment activity is a real challenge that could determine the future of such companies. Colombo et al. (2012) emphasized the indirect effect of signaling for startups as a fundamental driver to boost employment growth. Anna Söderbloma, Mikael Samuelsson, Johan Wiklund, and Rickard Sandberg (2015) explored the role of subsidies on newly-established firms, finding out the consistent importance of influencing the recruiting process success. Indeed, subsidized firms are more attractive employers capable of hiring people with the desired quality and thereby with the ability to make substantial contributions.

Finally, neither subsidies' founding nor qualified employees can be considered the ultimate goals of firms. Indeed, the obtaining and proper utilization of such resources will have a major influence than subsidy itself, which financial effect quickly vanish. Thus, the initial found serves young innovative firms as protection, avoiding “running out of fuel.” While all the concatenated effects explained above enable firms to enhance their performance over time (Anna Söderbloma, Mikael Samuelsson, Johan Wiklund, and Rickard Sandberg, 2015).

2.2.7. Focus on government grants and how they work.

A government grant is a financial award given by a federal, state or local government authority for a specific project from which the society can benefit. Through their scale and ubiquity, grants significantly shape the progress of science and innovation. Grants help determine which areas of science are studied and how, make or break the careers of academic and non-academic scientists alike, and guide the creation of new institutes and discipline-spanning resources. (Nicholson, 2018)

Grants are important for funding basic research (Stiglitz, 2008). Basic research has potential innovation benefits across a wide range of outputs and is often highly risky (Nelson, 1959).

It is a transfer payment. Unlike VC, a grant does not include technical assistance or other financial assistance, such as a loan or loan guarantee, an interest rate subsidy, direct appropriation, or revenue sharing.

The grantee is not expected to repay the money but is expected to use the funds from the grant for their stated purpose, which typically serves some larger good. In certain cases, there may also be revenue-sharing agreements with the government—for instance, in the case of a discovery that leads to a profit-generating patent.

Grants are particularly useful at funding basic research—that is, early-stage research without immediate commercial applications—because firms tend to undervalue basic research, which has substantial positive knowledge externalities.

For instance, Daniel Hemel and Lisa Ouellette compare the innovation incentives of patents, prizes, grants, and tax R&D incentives. They conclude that each motivation is helpful at different times. Grants, they suggest, are most effective when the government is especially good at identifying costs and benefits and when social benefits exceed market signals of value. They also note an important timing feature of grants: ex-ante funding can enable otherwise capital-constrained entities to innovate. (Hemel, Ouellette, 2013).

How grants work

Government grants are not just bestowed: they must be applied for. Getting a government grant is a highly competitive process. The paperwork is complex,

and applicants must describe how the awarded funds will benefit the local community or the public at large. Crafting a convincing proposal is so challenging that applicants often hire professional help. Some freelance writers specialize in writing grant proposals.

Grants can also target the processes or institutions of innovation by providing resources specifically for interdisciplinary research (to build collaborations and boundary-crossing networks) or institutions (to provide physical or other resources for collections of individuals). Finally, they can support infrastructure, including datasets that enable future innovation (Nicholson, 2018)

Receiving government grants

Government grants have no hidden costs or fees: they are outright gifts, not loans. However, tax dollars fund government grants, which include stringent compliance and reporting measures to ensure the money is well-spent.

After receiving a check, the grantee must submit detailed reports of how the money is employed. If the funds are received in stages, these reports must continue during the grant period. Any accomplishments or failures also must be documented and submitted to the sponsoring agency according to various deadlines.

It can be said that receiving a government grant is a prestigious event, a sign an individual or a profit or nonprofit organization has a significant, positive impact on a community or in a field of study or industrial sector. Often, it puts a project on the donor map, attracting other funding providers, both nonprofit and profit. It also might lend the grantee some influence with, or attention from, the sponsoring agency.

Framework Programme

We are interested in analyzing how the European policymakers distribute subsidies, particularly grants, towards the most deserving innovative projects. Therefore, we will consider an EU framework program since it is a vehicle used to deliver grants based on a tender competition where companies challenge each other.

The EU framework programs are one of the main instruments available to policymakers for awarding grants to the best innovative companies that present worthy projects aimed at sustaining the knowledge-based economy.

Collaborative research with EU and extra European partners is at the heart of such policies since they enable generating and internalizing knowledge spillovers. Indeed, large collaboration networks help in the economic growth of locations and regions (Asheim, Boschma, & Cooke, 2011; Tödtling & Trippl, 2005; Daniel Nepelski and Giuseppe Piroli, 2016)

On the other hand, firms have incentives to perform certain R&D activities if the outcomes are difficult to be appropriated, boosting the personal benefits of investing firms. Organizations tend to join in R&D investments when they can access complementary resources. Furthermore, there could be other motifs to participate in an R&D consortium such as reduced transaction costs, split the risks, and strategic management (Caloghirou, Tsakanikas, & Vonortas, 2001; Kogut, 1988; Sakakibara, 1997; Hagedoorn, Link, & Vonortas, 2000).

Policymakers are endowed with the appropriate instruments for overcoming the issues of coordination and risk-sharing in knowledge production. In this sense, the R&D consortia programs should be designed to encourage collaboration among public and private organizations. Moreover, HTEVs need to be placed at the center of these programs to transfer technologies and knowledge collected

to the market thanks to their role as vehicles (Daniel Nepelski and Giuseppe Piroli, 2016).

2.3. Literature weaknesses

As reported above, the literature on innovation and how policymakers can support it through multiple financing and equity methods have been widely studied in several aspects.

On the other hand, despite the long history of European Framework programs, where the first was adopted in 1982, the grants' policies concerning innovation did not receive significant attention from the scientific community.

Broekel T., Fornahl D., and Morrison A. (2015) investigated firms' potentialities in specific clusters to get access with a greater likelihood to grants than others, finding positive evidence.

Aguiar L. and Gagnepain P. (2017), after having identified that these programs are targeted to firms with specific social and economic concerns, clarified their impact on founded firms in terms of performance improvement which turned out to be mainly in labor productivity (at least +44,4%) rather than on profit margin.

The significant contribution brought by Massimo G. Colombo, Diego D'Adda and Lorenzo H. Pirelli (2015) led us to understand the positive impact of VC backing, differentiated based on VC types, over the participation of young innovative firms in EU framework programs.

Finally, Børing P., Fevolden A.M., Mark M.S. and Piro F.N. (2020), by considering the recent Framework programme, Horizon 2020, analyzed three dimensions of Scandinavian organizations: firm's size, industrial sector, and strong connection

with research institutions in order to find correlations with participating and winning companies of such programme. As a result, the firm's size has some positive effects in terms of participation rather than grants' size. Little support has been found related to research-intensive industries and connection with research institutes with programme participation and grant size.

This last research paper opens up the horizon of giving a direct contribute to European companies, that aim at approaching such kind of program, and policymakers that are supposed to design the framework programme. In this sense, the purpose is to identify the relevant characteristics of firms that participate and win a certain amount from the tender.

However, despite the good intentions of the authors, the research takes into consideration firms coming from Scandinavian countries, leading to an unbalanced analysis due to the greater maturity level of certain industries instead of others in such countries. Furthermore, the cluster of factors considered as main winning drivers are too narrowed, do not allowing firms to understand what really affects their success. Indeed, for instance, the size and industrial sector elements enable to collocate the companies in an environment, but they do not provide suggestions on the project category or the most suitable founding schema to utilize. On the other hand, the connection with a strong research institution could give an insight into a potential partnership type. Still, it does not explain the best type of activity coordinator or the more appropriate number of project participants.

Furthermore, this paper does not consider the role of HTEVs in Horizon 2020 and the features that with a more significant likelihood match FP's expectations. Indeed, as formerly mentioned in the literature review, policymakers should pay particular attention to such innovative firms easing their growth by sustaining them financially in the critical steps of their existence.

Therefore, Børing P. et al. (2020) started real work to assess the firms' performance in framework programs. Nevertheless, this paper favors policymakers' point of view, giving them insights on how to involve and coordinate organizations, rather than help firms to familiarize themselves with the success factors of such programs. Moreover, the paper suggests that an ad hoc analysis of SMEs could boost their participation. In this sense, an overall analysis of different traditional industries, like the one of Børing P. research, could result too scattered. While concentrating on new rising industries could be an exciting research topic since it would guarantee to keep an eye open on SMEs while involving broader advanced technology topics (such as AI, blockchain, autonomous driving….) that are gradually catching on in almost all industries.

3 Drones Industry and Framework Programmes

3.1. Research demand

What are the factors that play a decisive role in order to obtain a call?

We will answer this question by initially assessing the potentially available industries to focus on for the framework programme analysis. Once the industry is chosen, an in-depth study of such a market might be necessary to grasp all the peculiarities affecting that context. Subsequently, we can map and describe the results gained by chosen industry firms in Horizon 2020 framework programme. Finally, an econometric model will guarantee us the chance to catch a proper answer to our research question, namely the firms' features that influence FP's tenders' outcomes.

3.2. Drones' industry

The previous chapter investigated the importance of high-tech entrepreneurial ventures for the development of a sound economy, looking at the multitude of ad-hoc financing instruments that can be adopted to sustain such kinds of organizations. Furthermore, the last section detected the literature's gap concerning EU framework programs' grants research topic.

Børing P. et al. (2020) conducted a study that focuses more on the policymakers' side, rather than the firms' one. In addition, this research finds limited applicability, from a practical point of view, due to the not-so-diversified geographical companies' origins and the small set of characteristics considered.

Therefore, we decided to carry on the above authors' work by placing at the core of our analysis the HTEVs, in the hope to achieve satisfactory results that can be made as companies' guidelines before entering in an EU Framework Programme.

In this sense, to overcome the Børing P. et al. (2020) constraints and open the doors to a wider interpretation concept, we must consider the substantial majority of European countries. Indeed, it prevents the emergence of findings anchored to specificities of sub-regions. While regarding the centralization of HTEVs, a proper industry assessment and selection should be made based on specific features. Thus, it is easier to find a larger portion of such firms in new rising industries predominantly grounded on latest-generation technologies, where there is still plenty of room for innovating before reaching the maturity level. Finally, since we are doing a research study on a program institutionalized by the European Commission, it is advantageous to consider a typical field of activities that characterizes the European Union's economic system. Thus, the industry we will pick as the unit of analysis should be comprised within the manufacturing sphere since it represents the sector, in terms of GDP generated, in which the EU ranks first among all the developed nations.

Technological disruptions are shaping business and social environments faster and in a larger volume than ever, with economic returns that often turn out to favor innovators. Thus, technological breakthroughs can be regarded as proper megatrends that will reach a greater maturity level, characterized by more extensive accessibility, changing the way of doing business permanently. (https://internationalfinance.com/the-eight-essential-technologies/)

In this respect, PwC consulting corporation has developed a crucial framework, called The Essential Eight technologies, to help companies focus their efforts on the technologies with the most significant business impact. The consulting firm evaluated more than 250 emerging technologies to individuate those most

pertinent to individual companies and whole industries. After an in-depth analysis, PwC has filtered technologies based on commercial viability and business impact with many criteria ranging from technology's relevance to market size and growth potential. As a result, eight technologies, depicted in the chart below, have been identified as the most influential on business.

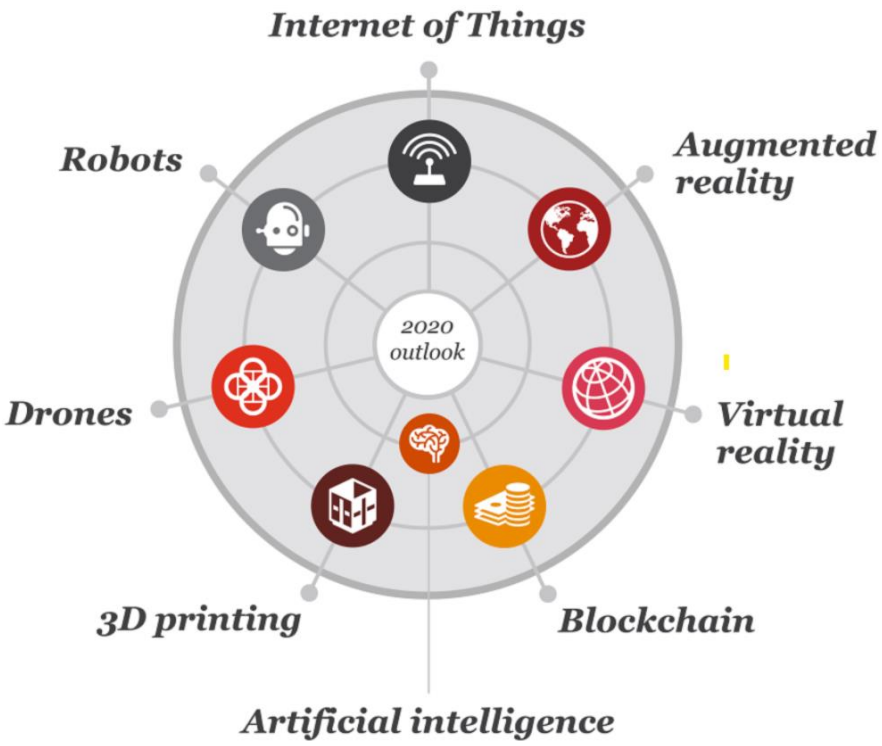


Figure 3:The eight essential emerging technologies

Despite the wide applicability of all these eight technologies, only the left side of the chart, namely Robots, Drones, and 3D Printing, can be reconducted to the manufacturing sector. Indeed, all the aforementioned technologies find their applications in manufacturing industries, but not all the producers of such technologies come mainly from the manufacturing sphere.

Therefore, our industry assessment process begins with studying the three manufacturing technology producers' industries mentioned above.

Starting our analysis, from a global overview of the three industries, we see Robotics as the most promising market. It was valued at USD 27.73 billion, in 2020, with expectations of reaching USD 74.1 billion by 2026, registering a CAGR of 17.45%. COVID-19 has led companies delivering food and other primary goods to a consistent boost in demand. As a result, food and medication delivery robots are expected to consolidate as new niches for service robots. On the other hand, industrial robots have witnessed a concrete development thanks to the car markets competition over the upgrade of energy drive systems and the willingness of labor-capital reduction driven by warehouses automatization.

Afterward, the second most valued industry is Drones one, wherein 2020 was valued at USD 22.5 billion with growth expectations around a CAGR of 13.8% until 2026. Drones' industry was born as a military product that has reached a large application due to the multitude of projects for drones' deployment in military operations. Subsequently, thanks to simplified regulations and advancements of the technologies, vendors started offering drones with numerous commercial applications. The latter range from media services like aerial photography to logistics ones, such as last-mile delivery, passing by agriculture applications.

Finally, 3D Printing (or additive manufacturing) industry is least valued nowadays, USD 13.7 billion, but it is expected to reach a value of USD 63.46 billion by 2026, at a CAGR of 29.48%. This new manufacturing technology is an innovative, fast, and more agile production process. Additive manufacturing evolved from prototyping to a functional subprocess of fabrication, ensuring shorter productions, new materials utilization, and a new approach to adhere to the standards. The recent decrease of additive manufacturing costs and greater

expertise brought this technology to a significant integration into the manufacturing processes.

GLOBAL MARKET	**ROBOTICS**	**DRONES**	**3D PRINTING**
VALUED IN 2020 (USD)	27.73 billion	USD 22.5 billion	13.7 billion
EXPECTED CAGR	17.45%	13.8%	29.48%

Table 2: Industries' value

The first step of our analysis, from an analytical viewpoint, brings us to three promising industries. The first two can be conceived as similar in economic evaluation and future expected growth. While 3D Printing is under-sized nowadays compared with the other two but exhibits superior growth rates. So, further assessments should be pursued to make a safer choice.

The geographic expansion and regions' growth rates represent critical points in our study. Indeed, despite keeping the focus on the EU region, it could be interesting to choose an industry that guarantees similarities worldwide. Further research would be given a chance to verify and align themselves with our discoveries.

The temporal horizon, to assess the two mentioned aspects, is about five years and ranges from 2021 until 2026, as follows:

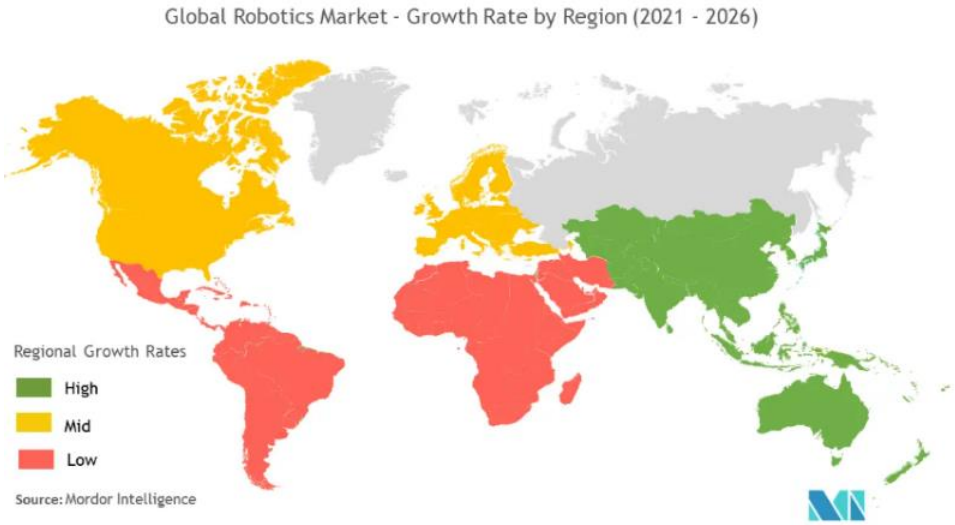


Figure 4:Growth rate by region, robotics market

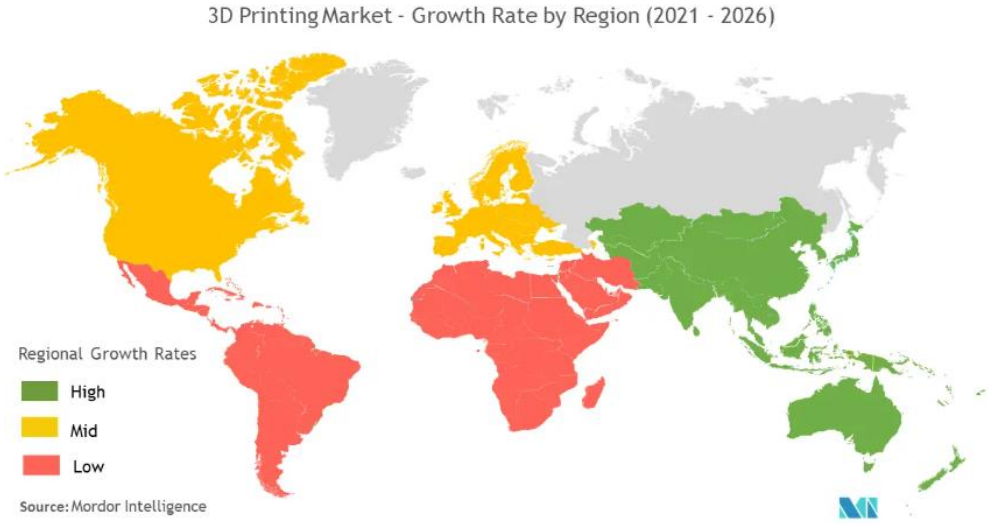


Figure 5: Growth rate by region, 3D printing market

Figure 6: Growth rate by region, Drones market

Two industries, Robotics and 3D Printing share the same geographic expansion and growth rates per area. The latter are characterized by almost complete coverage of the globe, except for Russia, with expected growth rates at their best in South-East Asia, medium level in developed regions such as Europe and North America, and low level in those less developed areas like Africa and South America.

On the other hand, Drones industry presents an utterly different scenario with full geographic coverage and more remarkable similarities in terms of growth rates. In this sense, both less developed and developed regions have almost the same growth rates. The only exception is made for Southeast Asia, which still shows the highest performance.

This second assessment returns a clearer overall picture, with the drones' industry taking a step further towards being selected. Despite the absence of huge differences among the three industries, the drones market better respects the principle of parallelism in the geographical expansion and growth rates

among the diverse areas in the globe. Nonetheless, we cannot set up our decision only on the two examined factors.

Aiming to find an industry with a fair degree of HTEVs, our assessment needs to analyze the concentration levels among diverse industries. So, a low level of concentration means superior fragmentation within the market. Thus, proportionally to the fragmentation level, we find a higher number of small players that more likely fall in the HTEVs category.

Starting the market concentration analysis from a general overview, we can see the following situations:

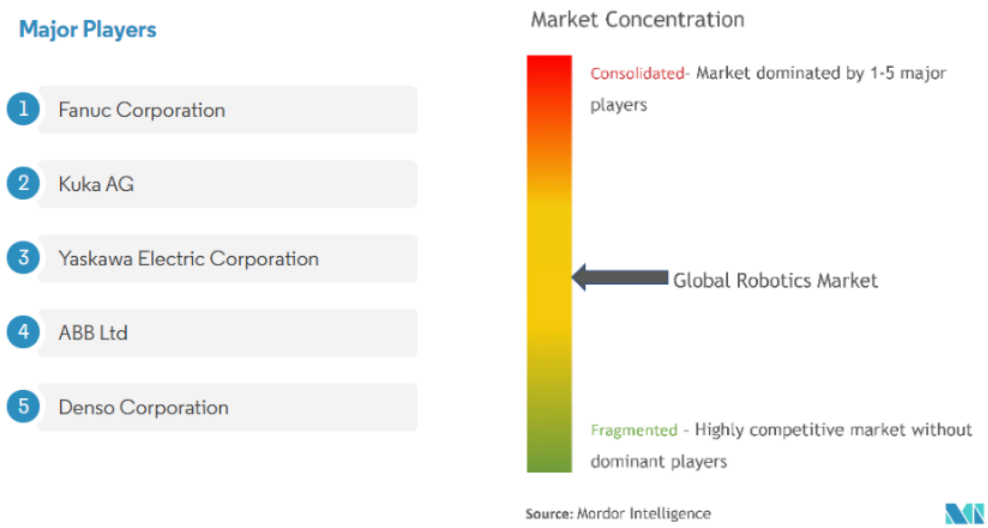


Figure 7: Robotics market concentration

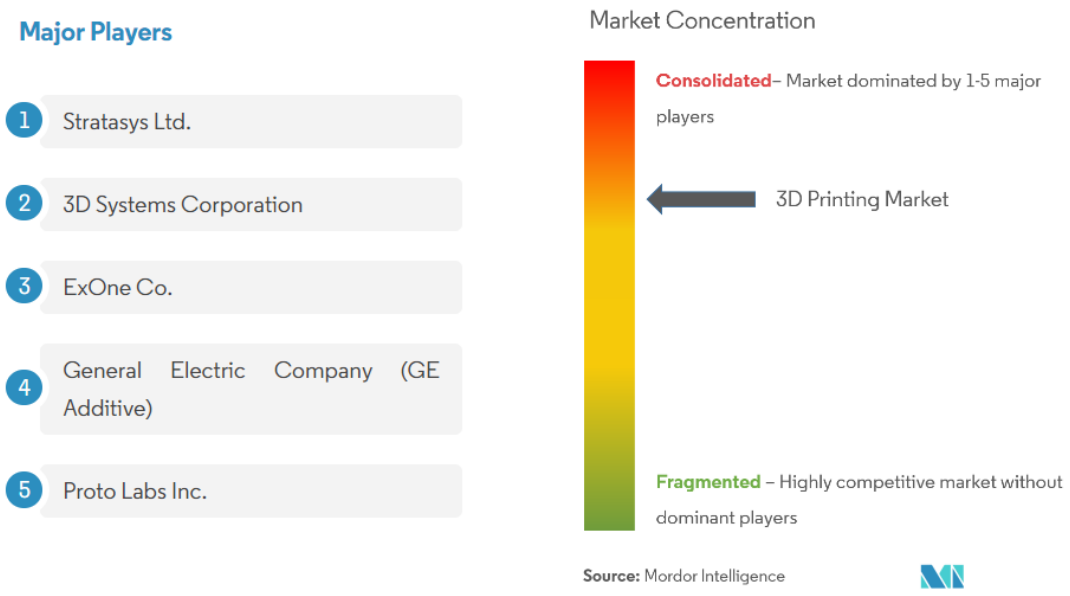


Figure 8: 3D printing market concentration

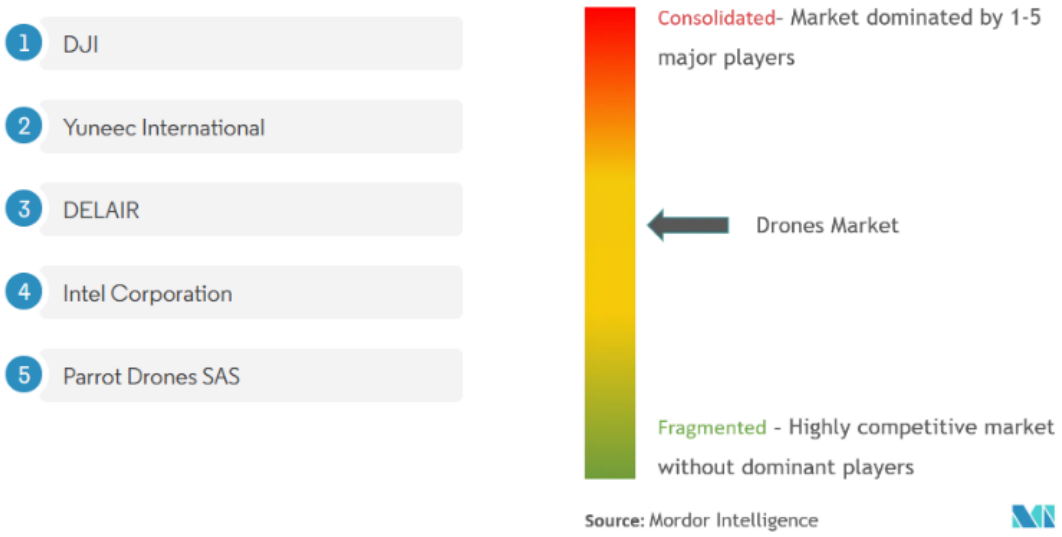


Figure 9: Drones market concentration

Robotics and Drones industries collocate themselves in the medium range of concentration in the worldwide market. The first tends to the lower part of the bar, while the second to the upper one. Instead, the third industry, 3D Printing, is considered a highly concentrated market where fewer players dominate it.

However, our primary target remains the European area, where the industry we choose needs to present the characteristics described at the beginning of the chapter. Thus, the concentration levels should be analyzed from a European perspective.

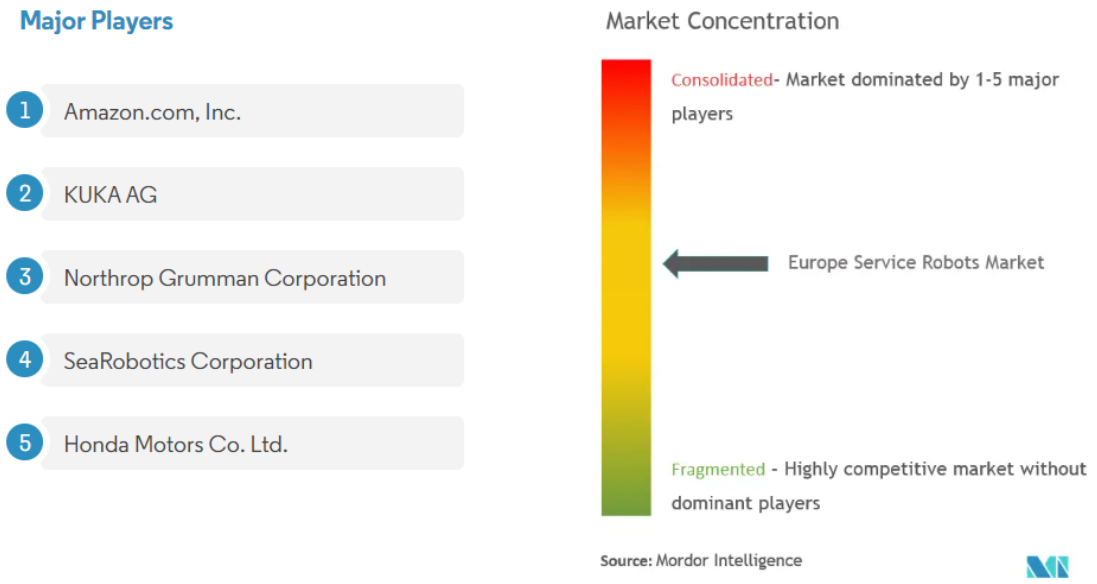


Figure 10: Europe Robots market concentration

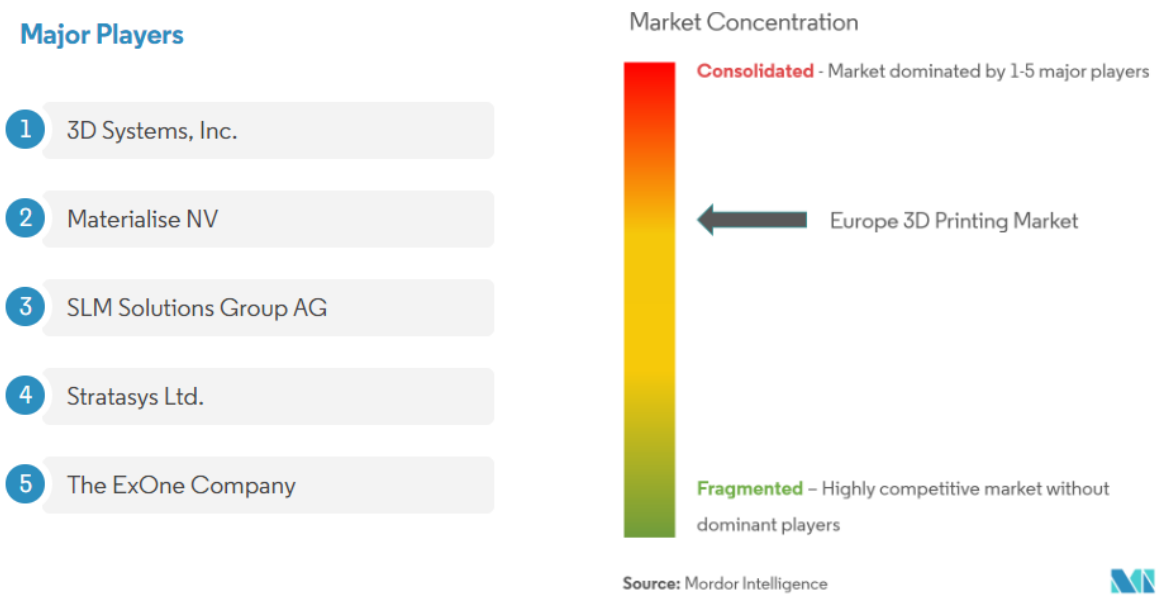


Figure 11: Europe 3D printing market concentration

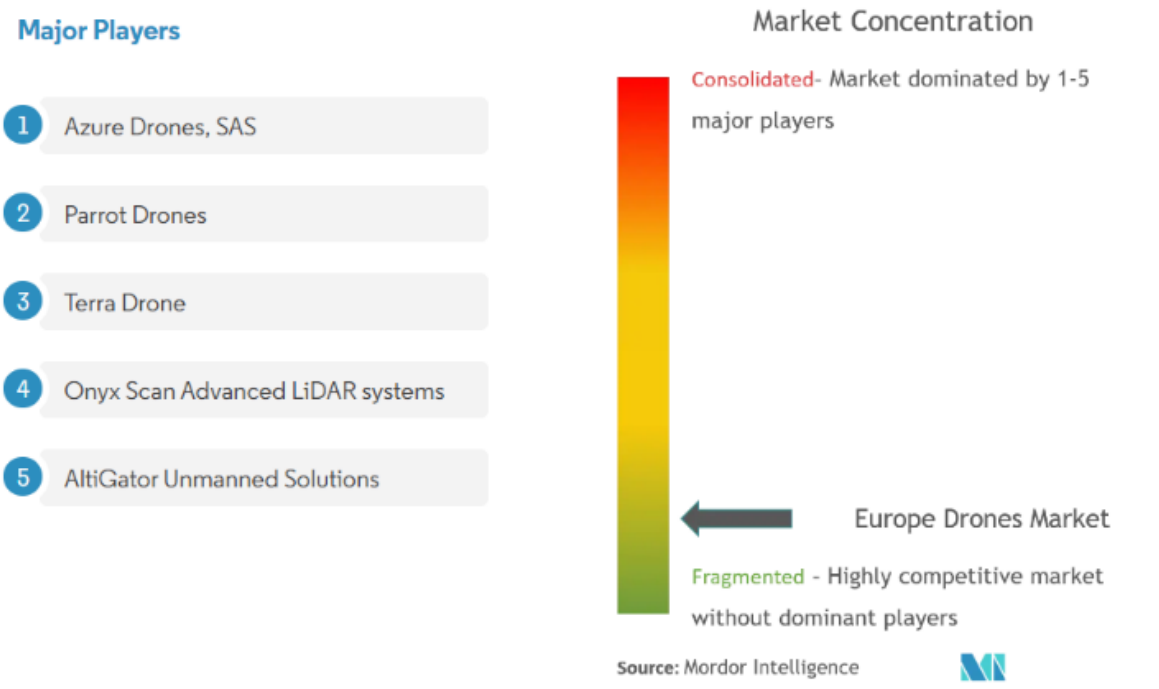


Figure 12: Europe Drones Market concentration

The European markets exhibit similar performance to the global ones, in terms of concentration, in two cases out of three: 3D Printing and Robotics.

The EU 3D Printing represents one of the significant hubs worldwide, with an estimated value of USD 4.61 billion in 2020 (about one-third of the full value). Nevertheless, the expected growth is significantly redoubt, at a CAGR of 14%, probably due to the already advanced level of firms' development described by the high market concentration. Nowadays, the greatest demand centers on prototype fabrication, which needs to be produced quickly, reliable and low-cost. The EU outlook leaves space for additive manufacturing as a disruptive force that could replace traditional manufacturing thanks to greater customization, increased efficiency, and improved products features.

The European Service Robots Market is taken into consideration, in terms of concentration performance, since it shows structural similarities with the industrial one. Europe has the 32%, resulting in 8.87 billion in 2020, of the current robotics world market share, with 14% in the domestic segment and 63% non-military service robots at a CAGR that fluctuate between 11% and 14% based on the robotic branches considered. On one hand, industrial robotics is a key driver for the European manufacturing success in the world, underpinning both the manufacturing and employment capacity. While, on the other hand, service robotics will more than ever sustain the disruptive digitalization of non-manufacturing industries such as agriculture, healthcare and transport turning the EU into the largest area for global service robot sales.

The European drones' market shows a wide fragmentation, in terms of concentration, compared to the worldwide level seen before. Indeed, issues like competition and especially regulations represent fundamental factors in determining the market size. Before the end of 2020, European countries were used to follow national rules concerning the drones industry. Thanks to a comprehensive view introduced by European Union Aviation Safety Agency

(EASA), from 2021 all people and firms intentioned to fly drones over European skies need to follow a common regulation. Experts underlined that this harmonization is: “absolutely critical for the development of the European industry”. In this sense, the regulation helped the deployment of drones in different sectors such as infrastructure, agriculture, transport, entertainment, and security. The European drones’ market is valued at 3 billion USD recording an expected growth rate greater than a CAGR of 11%. Furthermore, this market represents a potentially interesting target for our studies because of the environment crawling with new technological enterprises that aim to take over a significant market share on the global chessboard.

EU MARKET	**ROBOTICS**	**DRONES**	**3D PRINTING**
VALUED IN 2020 (USD)	8.87 billion	3 billion	4.61 billion
EXPECTED CAGR	12.5%	11%	14%

Table 3: EU market values

This industry concentration analysis gives insights regarding the European situation of the three markets. Robotics and 3D Printing are much more in line with the overall global industry in terms of concentration and prospects of development. On the other side, the drones industry presents a challenging condition that stands apart from the worldwide situation. Indeed, European drones organizations have been subjected to a higher level of instability caused by uncertainty over the regulations. In 2021, EASA released the policy all individuals and companies need to respect, bringing back the order and more trustable predictions for investors. However, the business environment still reflects the precedent situation with great fragmentation and probably many small innovative firms.

Finally, our analysis needs to shift its focus towards a more practical point of view, looking at the applicability of these technologies in various fields. Indeed, the larger is the set of industries in which the technology finds a useful implementation, the better our study will be. We decide to take a unique industry for our following study because this helps us in saving time during the data-gathering phase. However, a great variety of projects and applications would, with a high likelihood, determine or not the interchangeability of our research outcomes.

Therefore, we analyze the sectors in which the technologies are applied with a deeper examination of main different industries.

	MANUFACTURING	**SERVICE**	**PRIMARY SECTOR**
3D PRINTING	Automotive	Healthcare	Energy
	Aerospace & Defense		
	Food		
	Construction & Architecture		
ROBOTICS	Automotive	Logistics	
	Food & Beverage	Military & Defense	
	Electronics	Medical & Healthcare	
DRONES	Construction	Logistics	Mining
	Aerospace	Military & Defense	Agriculture
	Industrial Operations	Law Enforcement	Energy
		Entertainment	

Table 4: Application sectors for each technology

The table above describes the major applications of industries' products in different fields. 3D Printing realizes mainly products meant for a manufacturing environment, with some narrow exemptions for the healthcare and energy industry. Nevertheless, the application spectrum appears too narrowed and confined to the sector the technology comes from. On the other hand, Robotics owns a well-balanced range of applications that are almost equally split between the manufacturing and service sectors. Besides the slight improvement gained, the Drones industry gives the most diversified fields application portfolio with a massive presence in all three primary sectors.

Summing up, the Drones industry represents the most suitable candidate to perform further analysis regarding the potentialities of HTEVs in EU framework program tenders. Indeed, this industry belongs to the latest generation technologies, so it is plunged into a fast-developing environment. Furthermore, the Drones market is significant in terms of market value and growth rates worldwide with a homogeneous geographical expansion. In the European area, the significant fragmentation enables us to benefit with a higher likelihood from a pool of innovative small enterprises. Last but not least, the vast diversity of applications in different fields makes it possible to achieve a greater generalization of the research's outcomes.

Drones' industry description

The global Drones' industry settles itself at USD 22.5 billion with estimated growth perspectives that would bring it to almost double its value in 2025 (USD 42.8 billion). Indeed, the market has gone through diverse development phases, from explosive in the first years of commercialization until almost steady returns nowadays. Nevertheless, the reasonably stable growth along time reflects the consistent investments and an approach towards the commercial drone market's consolidation.

Regarding the market segments, military drones have been the driving segment for the entire industry since it represents the field of first applications. Despite the controversies generated by drones' military usage, nowadays, people started to change their perception thanks to the utilization of such products in sensitive fields such as health, humanitarian actions, shipping products to customers, and ecological applications. According to the María de Miguel Molina Virginia Santamarina Campos 2018, five significant market segments differ in terms of price, features, customer targets, and providers.

The first segment refers to Toys, where children are the aimed customers with around €100 and very basic features. European manufacturers mainly compete against Chinese firms, while almost all players take advantage of external sales channels (such as Amazon).

Hobby constitutes the second segment where the customer target comprises amateurs, with remarkable financial availability (€500 - €1500) who want to film themselves during leisure activities. Compared to the previous segment, the drone offers is wider, with greater quality and more technical features (camera, Micro-SD…). This is a more profitable group, given the large number of firms involved that have to compete with the giant Chinese DJI.

The third group, the Professional, includes drones manufacturers for professional filming and photography. The prices are set below €10,000, with a business environment composed of various organizations that propose drone platforms with or without cameras. Even in this segment, DJI is the leading player because of strategic partnerships with hardware and software producers.

The fourth segment is named Commercial, and solutions providers for specific industries constitute it. In this case, the value generated is mainly based on the software and application rather than the drone itself. Therefore, companies are used to partnering with hardware, software, and camera makers aiming to

achieve encouraging results. The business environment is highly variegated with products, software, and service providers that participate along the whole product's life cycle leading to a higher total cost of ownership. Few firms own an online shop, while the vast majority sell directly to the customers or use specialized dealers.

The last segment refers to the Military, where manufacturers, with a military purpose, focus on fulfilling armies, governments, and defense organizations' requirements. On the contrary to the other segments, this group's firms are equipped with skilled resources and technologies that could also be adopted for diverse purposes. Furthermore, some companies populating this segment started doing business in the commercial segment, diversifying their revenue streams (thanks to monitoring and surveillance applications).

After this brief description, which is aimed at categorizing drones' manufacturers, we can dig deeper into the drones' applications census, giving a distinction of the sectors in which the products are utilized and fields of applications. The geographical distribution of such application projects that have been registered is the following:

Figure 13: Geographical distribution of projects

Europe is the leading region, with 48% of the projects, followed by North America (36%) while far more distant are Asia, Africa, and Oceania. These projects are classified with four different statuses:

- Announcement: when organizations or governmental entities are willing to test and turn operational technology into the future.

- Experimentation: organizations are testing a technology to make it safe and compliant with the regulations.

- Operative: projects that have already been through the previous two steps and are ready solutions to be adopted.

- One-off utilization: a single application adopted to solve a specific issue arising.

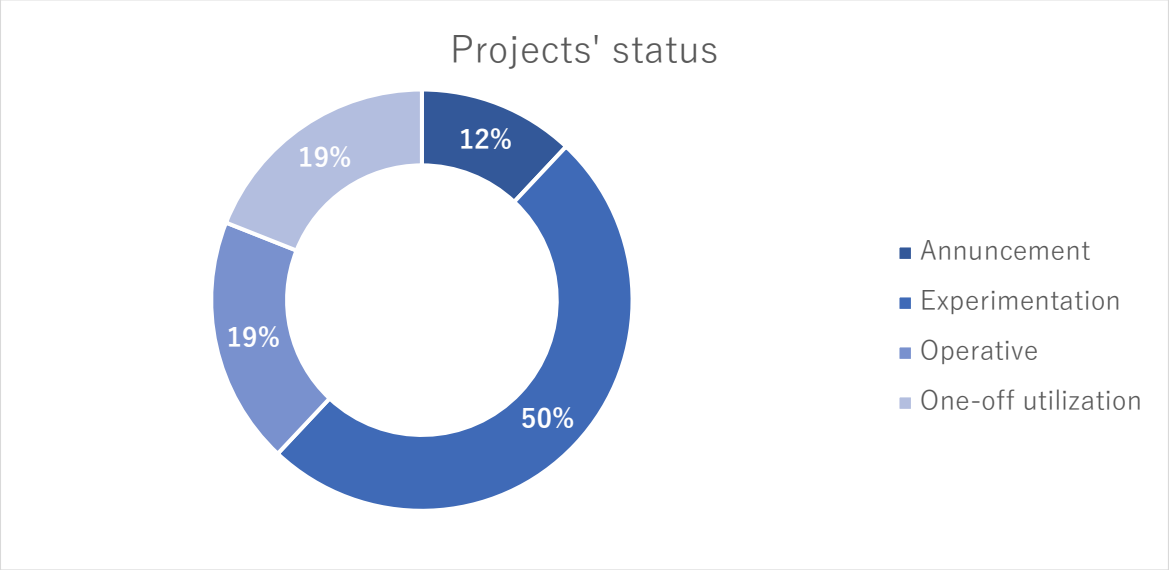


Figure 14: Projects' status

Being drones a fresh technology, it is quite evident that the majority of application projects are located in the experimentation category in the commercial environment. Whilst a remarkable result, which is a predicting sign for establishing potential market segments, is the one-off category. The latter concerns those applications usually undertaken by public administration and carried out in case of dire need, such as during a pandemic crisis.

The projects mapped above cover a distinguished number of different sectors and are distributed as reported below:

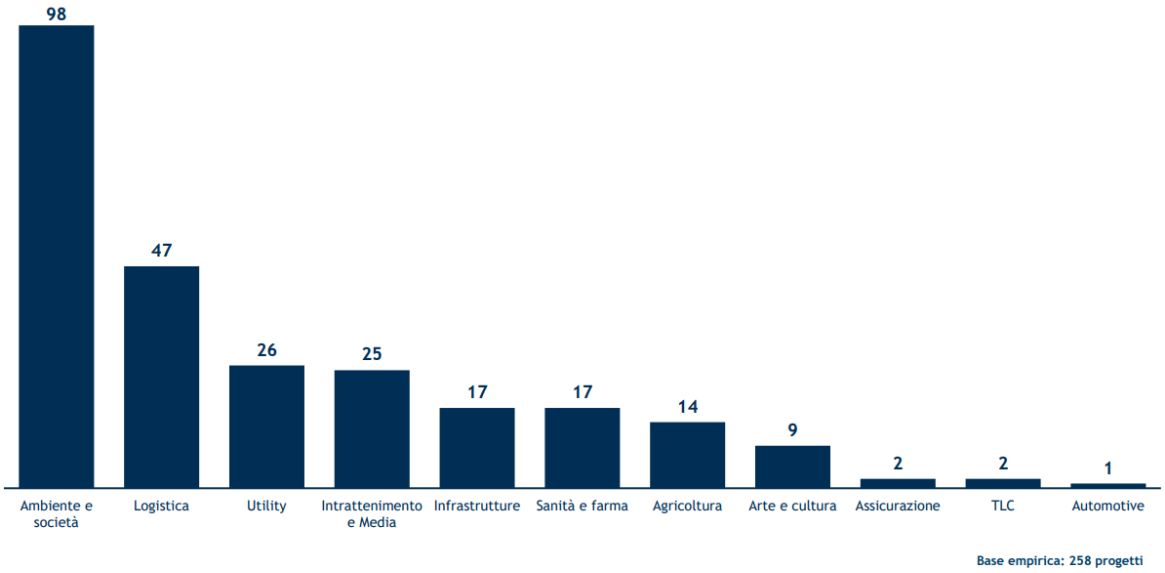


Figure 15: Projects by sector

Green and Society bring together the highest number of projects that range from public interventions (such as law-enforcement missions) to measures to fight pollution. Logistics is the second largest group, 18% of the total, and the fastest growing one, with most open projects classified as experiments or announcements. This latter includes applications within the goods transportation field and inventory management one. Finally, two other relevant groups are Utility and Media & Entertainment; they are equally sized, at 10%, with positive outlook growth.

On the other hand, the application fields, namely where organizations and institutional bodies employ the drones, find the following distribution.

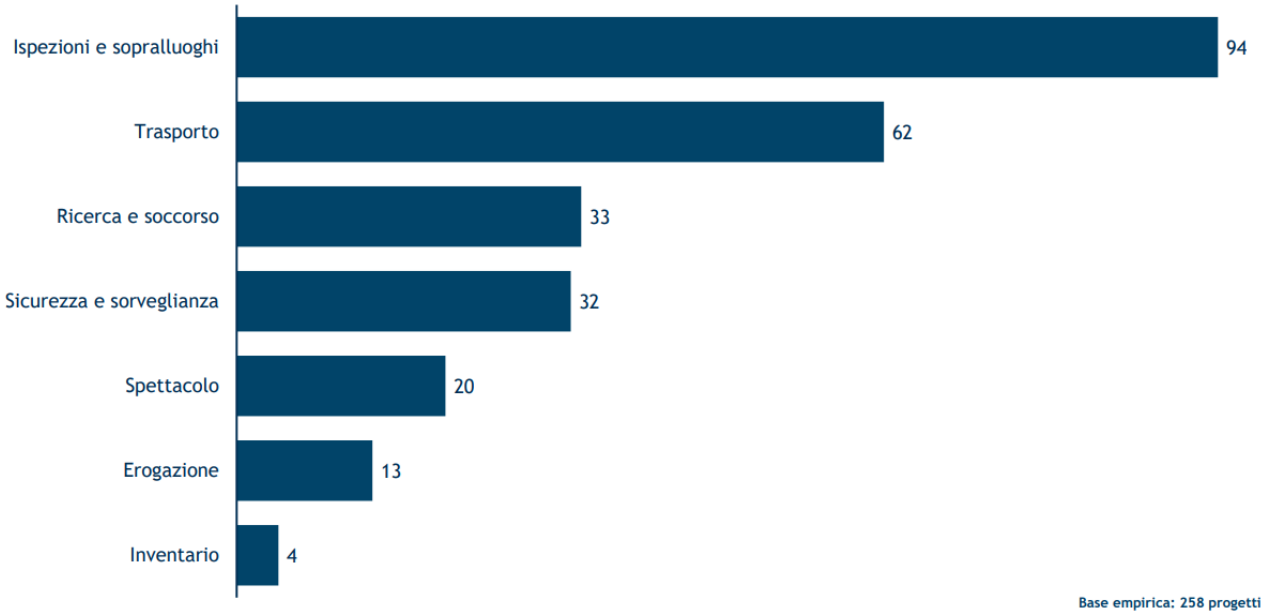


Figure 16: Projects by application field

More than half of the projects belong to the Inspection category, where all the interventions aimed at detecting infrastructures' flaws, inspecting areas post-disasters, reliefs, and monitoring are included. Transport, the fastest-growing application field, comprises two main streams transport of goods and individuals. The first has been introduced to boost the delivery flexibility, the speed of delivery, or carry goods in dangerous locations. Individuals' transportation represents the future of mobility, but it still needs to go through many tests and governmental regulations. Concerning the applications fields related to public administration, we find Search and Rescue and Safety and Surveillance. If the first category refers to spot operations, carried out in case of emergencies, such as search of lost animals or people. Safety and Surveillance regard daily operations like traffic monitoring, cultural heritage protection, and waste management. Finally, the least essential applications fields follow in order: Entertainment, Release, and Inventory Management.

Afterward, an interesting analysis was performed by crossing the sectors in which drones are utilized and the applications fields of most significant concern.

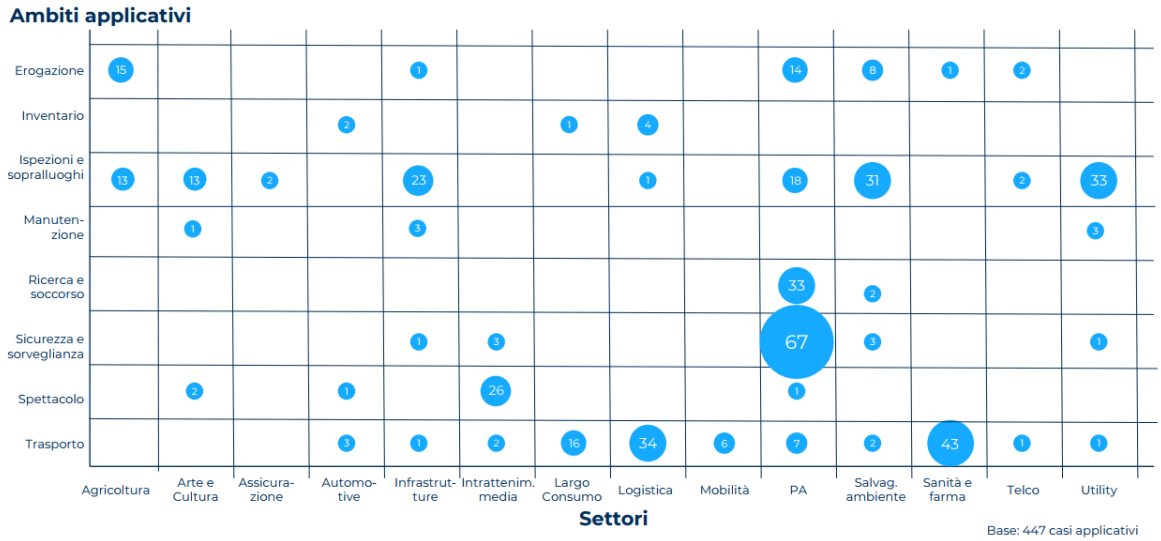


Figure 17: Application fields and sectors

This analysis enables us to identify those clusters of primary interest where the highest investments are committed nowadays. Five are the clusters that deserve greater attention.

Public Safety and Surveillance is the cluster with the highest number of open projects (15% of the total registered). It includes various applications conducted by law enforcement aimed at traffic monitoring, patrolling, and actions to defeat Covid-19.

The second most exciting cluster is goods transportation along the healthcare supply chain. This group contains 9,6% of the projects, which mainly refer to deliveries in case of emergence.

Within the Transportation application field, we find another significant cluster that accounts for 7,6% of total projects. In this case, we have a wide range of

transportations such as home deliveries, postal deliveries, deliveries in complicated areas to reach and spare parts transportation.

Then, Utility inspections and Search & Rescue define the last two clusters of equal importance (both 7,4% of all projects). The first embodies all those projects under the Public Administration jurisdictions, such as territory reliefs, infrastructure inspections, and inspections after environmental disasters. While Search & Rescue regards both first-aid operations and search of individuals or animals.

Startups worldwide

After describing the sectors affected by drone technology and its projects' applications overview, it is relevant to understand the level of innovativeness within this industry. In this sense, a deeper investigation about startups at the international level allows us to figure out how impactful this industry would be toward regional economies.
The Drones' Observatory of Politecnico of Milan has assessed, through a tailor-made analysis, those startups that mainly focus on products innovation. The organization identified small innovative companies founded over a time horizon between 2015 and 2020. The research outcome, gained by crossing two international databases, Crunchbase and Orbis, revealed the presence of 334 censused startups worldwide. These are distributed among the regions as follows:

- North America 45,5%
- Europe 30%
- Asia 21%

The organizations' innovation scopes vary, a most significant portion (64%) covering product innovation such as platform, payload, componentry, and software. On the other hand, the remaining startups are split into service providers (22%) and product & service integrators (14%). Despite the narrowed

number of these latter players, they have received the most significant amount of investments which could probably lead to ulterior developments in the future. The overall funds raised by the recorded startups contribute a bit more than USD 1 billion. This value is far less than the amounts collected by the corresponding startups in the Blockchain and Internet of Things business environments, respectively USD 6 and 15 billion.

There are Infrastructure, Utility, and Public Administration regarding the pioneering sectors where these startups are present. These last account for 91% of the startups. The most common application field is inspection, which is mainly demanded by buildings, infrastructures, and energy plants.
Finally, the Observatory carried out a cluster analysis to map the critical business models adopted by the assessed startups. According to the study, six are the approaches utilized:

- Focused: develop and produce a single specific hardware product, with a single-family application, and usually turned towards one single sector (30% of the startups).

- Adaptable: generalist startups that offer a multitude of products, hardware, and software, with different applications for a wide range of sectors (25% of the startups).

- Developer: specialized software developers for diverse applications fields that can be used by several sectors (17% of the startups).

- Selective: service providers focused on the drones' industry with solutions aimed at various sectors (15% of the startups).

- Concrete: startups that offer products, hardware, and software, with a relatively small set of applications suitable for a few sectors (9% of the startups).

- Open generalist startups that provide a service to a multitude of sectors or few ones.

European environment

This brief dive into the drones' startups world enabled us to achieve a comprehensive view of these small innovative organizations. However, our research focuses on European Union programs, and thus this needs to be the reference market. Although it is convenient to think of Europe as a single homogeneous marketplace, we know that there are very diversified countries inside that do not share the same characteristics and economies. We use an analysis performed in tandem by the Drones' Observatory of Politecnico of Milan and Baker McKenzie to understand the peculiarities of central EU drones' markets.

The countries that have been considered are six and represent the major or more innovative markets in Europe. It is significant to underline that the Italian market received greater attention because of its purposes (confined within the Italian borders) and the more extensive data availability.

Most countries, namely Italy, Spain, Germany, France, and the UK, own common socio-economic characteristics and are the most solid drones' markets. Switzerland has been taken into account since it represents an innovation hub thanks to its advanced universities and its well-known liberal regulations.

The vast majority of the countries exhibit a market characterized by high fragmentation, where SMEs and startups make their masters. In this sense, the French market is the most singular, with 7000 operators, a vast number compared with an average market like the Italian one (700 players). This latter, considered a benchmark, shows that 95% of the firms employ less than ten people.

Despite the slight drop in the drones industry in different countries, the pandemic crisis has not left long-term damages. In Italy, for instance, during the first two waves, only 10% of the firms have been forced to complete inactivity, and only 7% performed a workforce reduction. Nevertheless, countries like Spain and Germany claimed that the pandemic had not flattened the market value but instead sped up specific applications projects.

In Italy, France, and Spain, law-enforcement units have led to a boost in demand for drones' applications, which adopted such technology to manage the pandemic by monitoring the crowd. The United Kingdom has allocated € 7 million for three delivery projects concerning medical materials or delivery of basic necessities in areas complex to reach.

France has benefited from private and governmental investment in research and development headed to startups spread on the territory. In this sense, the UK also enjoyed the strong commitment of the central government to better integrate drones both in the air space and companies' activities.

Germany appears as the most advanced country in manufacturing ecosystem readiness, developing and producing technologies. Furthermore, this last country seems reasonably in line with the smart cities' roadmap, where drones will be fully integrated into everyday life.

Regulation

European Union Aviation Safety Agency (ESEA), on the 31st of December 2020 has approved the new common regulation concerning the Drones industry. This latter assists all the organizations are operating in the industry, leading to higher business stability. Indeed, thanks to the regulation, all the national rules are lifted, except for very few clauses, originating a big Drones market that follows the same guidelines.

The new EU regulation distinguishes drones into four classes based on their weight. Each drone that weighs more than 250 grams must be equipped with an Electronic Identification that allows transmitting data, during the mission, about the drone, position, and route. Then, ESEA developed the proportionality principle, where specific rules and training apply based on the weight class and the level of risk. The risk is assessed through an ad-hoc methodology defined by ESEA, called Specific Operations Risks Assessment (SORA). The second principle introduced concerns adopting the CE trademark with associated drone class on each drone. Finally, each member state is obliged to register all the drones over 250 grams on its online portal (for instance, in Italy, there is D-Flight).

The Observatory conducted a survey on the Italian drones companies' perception of the new EU regulation. The result shows consistent satisfaction among the players, with 60% of them that retain the regulation as a potential driver for the B2B and B2C market. Furthermore, 65% of the responders value Electronic Identification as the first step towards safer air space.Almost half of the players claim that the CE trademark will guarantee higher safety and control over the operating aircraft.

Advanced air mobility – outlook into the future

The concept of Advanced Air Mobility (AAM) has been defined by NASA for all those services, carried out with drones, to deliver goods or transport people in urban areas. Following the forecasts of BIS Research, AAM is supposed to reach a market value of USD 5,3 billion in 2023 and USD 86 billion within 2035, with an average annual growth of around 26%.

Despite the non-distinguished concept utilized for people and goods transport, it is necessary to consider them as separate challenges. On the one hand, the Urban Air Mobility (UAM) represents one of the most appealing alternatives to

offset, in the first place, and then overcome pollution and traffic congestion issues. On the other hand, the Urban Air Delivery (UAD), close to becoming a reality, seeks to increase the flexibility and alternatives for goods delivery in populated areas.

Urban air mobility

Thanks to the Federal Aviation Administration, the American continent represents the greatest investor in UAM, which firmly supports tests and experiments in such fields. United States classifies as first with two leading corporations, Aurora Flight Sciences, a Boeing subsidiary, and Joby Aviation, the first UAM unicorn, that have already developed drones to carry passengers. While other two active countries in the continent are Canada with Canadian Advanced Air Mobility Consortium and Brazil supported by Embraer (third aircraft producer worldwide).

The Asian market is predominantly dominated by the Chinese Ehang, the first one at realizing a prototype and performing an authorized flight dating back to 2016. The South Korean Hyundai and the Japanese SkyDrive, seeking to chase the example of the giant Chinese drones' company, have developed and tested some prototypes of UAM. Singapore constitutes the liveliest scene of UAM worldwide, with several foreign companies that moved there to perform many experiments.

In Europe, the European Innovation Partnerships for Smart Cities and Communities have been established to tackle all the issues and set up new regulations towards Smart Cities. The UAM is a fundamental part and EASA, after the involvement of major EU cities in 2018, opened a public consultation to build up the Air Taxi service standards.

Looking at the single EU countries, Germany is the most proactive country with two of the leading capital collected and tests performed startups worldwide:

Lilium and Volocopter. The UK's aviation authority has constituted an innovation hub to support experimentations in a safe environment, while France benefits from Airbus's effort. Different is the position of smaller countries, like the Netherland and Switzerland, mainly based on the projects activated by the most prestigious universities of the territory (in particular ETH and Lausanne University). Italy is a bit late, compared to the others, with only one startup named Walle, which is supposed, thanks to a partnership with the US-based Jaunt Air Mobility, to create a UAM service for the 2026 winter Olympics games.

Urban air delivery

This field, considered the closest to commercialization, has recently found many applications in the following three areas:

- Last-mile delivery of small packages
- Urgent deliveries of medical materials
- Heavy freights transport

The American companies still find themselves in a dominant position on the world stage. The leading players that have already received the authorization to conduct deliveries from FAA are the Alphabet subsidiary Wing, Amazon Prime Air, and UPS. Other outstanding examples, on the territory, such as Metternet and Volansi have taken advantage of the lockdown period to boost the delivery of small packages and medical materials. While Bell Textron, Elroy Air, and Drone Delivery Canada are seeking to develop platforms for heavy freights.

Asian countries, in particular China and Japan, have heavily invested in UAD solutions. The Chinese Ehang designed two drone models for small packages deliveries and one for freight up to 200 kg. The e-commerce giant JD.com realized ad-hoc solutions able to carry freights between 5 and 60 kg with the

purpose of serving the nation's rural areas. On the other hand, the Japanese SkyDrive has conceived a cargo drone that can unload the freight without landing.

The European UAD situation similarly confirms itself to the UAM seen above. Germany is the leading country with Wingcopter and Volocopter that designed a cargo drone capable of carrying a freight of 200 kg for 40 km. In this sense, a more interesting case is the English Dronamics which conceived a cargo drone that can fly for over 2500 km with freights up to 350 kg saving almost half of the cost sustained with an average aircraft. Other countries like Netherland, UK, and Ireland are working on developing similar technologies.

3.3. Research demand

Before entering into the core research question of our thesis, we need to describe the framework program environment in which firms compete. In this sense, an ad-hoc mapping and assessment of firms' and projects' features is required to feed the fundamental knowledge adequate for answering the main thesis research question. Thus, another research question comes up:

Which are the drone industry firms participating in Horizon 2020 landscape?

4 The framework programs

It is now clear that central governments' support towards firms that invest in research and innovation is of fundamental importance.

Our analysis concerns the European Union and the drone industry, as is stated above. There is the necessity to understand the dynamics that gravitate around the European firms that operate in the drone industry and that applied and obtained funds for their drone-related projects.

This is not a new topic, but the involvement of the European Union in research activities began in the 1970s with the adoption by the Council of the first Community research program.

4.1. History

Community research in the first treaties

Economic and political objectives linked to the control of energy sources – coal and nuclear energy – were at the root of establishing the European Coal and Steel Community (ECSC) in 1951 and the European Atomic Energy Community (**Euratom**) in 1958. The treaties establishing these communities included the development of the first research and technology programs at the Community level (European Parliament, 2016). Article 55 of the ECSC Treaty tasked the High Authority with encouraging technical and economic research with funds provided by the treaty (Trattato istitutivo della Comunità Europea del carbone e dell'acciaio, 1951). Pursuant to Article 4 of the Euratom Treaty, the Commission is to implement a Community research and training program in nuclear research. The Joint Nuclear Research Centre (JRC) was also established under the

Euratom Treaty as an internal Community research center managed by the Commission. During that period, community research was limited to those specific energy fields. The 1958 Treaty of Rome establishing the European Economic Community (EEC) did not include research as an area of competence.

From intergovernmental to Community initiatives

As a result of this situation, research cooperation between European countries was progressively established outside the Community framework under intergovernmental initiatives: the European Organisation for Nuclear Research (CERN) was established in 1953; the European Southern Observatory (ESO) in 1962; and the European Molecular Biology Organisation (EMBO) in 1963. In the 1960s, the widening technological gap between Europe and the United States of America fueled discussion on increased European cooperation in research. Tensions arose between the proponents of Community research policies and those favoring an intergovernmental approach. European Cooperation in Science and Technology (COST) was founded in 1971 as an intergovernmental framework. COST launched concerted actions where various states opted à la carte to collaborate and exchange information on selected research fields (information science, telecommunications, metallurgy, materials, and environment). The intergovernmental setting offered the possibility for non-Community countries to take part.

In June 1972, Altiero Spinelli, a strong promoter of the Community approach, presented a communication developing a Community policy in research and development. In October 1972, a Community summit of Heads of State or Government decided that the Community should adopt new industrial, energy, technology, and education policies. As the EEC Treaty did not provide a legal basis for conducting and funding research programs, it was agreed that a broad application of Article 235 of the EEC Treaty would be used. In parallel, the JRC

was reformed, resulting in the center losing its focus on nuclear energy and becoming a part of the broader Community research policy.

Establishing the first Community research programs

Formulated by the new Commissioner for research, Ralf Dahrendorf, in May 1973, Community research policy was geared towards the creation of 'an effective single area for European science to be based on two dimensions: the coordination of national policies to avoid duplication and cooperation and competition between European entities (universities, research centers, researchers).

In May 1973, the first non-nuclear direct actions were adopted by the Council in the field of standards, environment, and earth observation. These were, then, complemented by the first indirect Community research program adopted in June 1973. The January 1974 Council resolution on an outline program of the European Communities in science and technology mentioned that Community civil research programs would aim to support the sectoral policies of the Community. They should be integrated and contribute to the development of a standard policy science and technology policy. The selection of research programs relevant to the Community was established on the basis of the first set of criteria which are based on the choices already made for the first program launched. Community research programs should demonstrate greater efficiency and rationalization of efforts, be transnational, cover areas requiring large markets, and address everyday needs.

Over the following ten years, more than 25 research programs were approved by the Council in energy, materials, resources, environment, health and living conditions, or industrial research (Figure). The Council also adopted consecutive programs to disseminate information related to the Community research

programs. Meanwhile, additional intergovernmental structures supporting research were also established in Europe outside the Community framework: the European Science Foundation (ESF) in 1974, the European Space Agency (ESA) in 1975, and the European Molecular Biology Laboratory (EMBL) in 1977.

A strategic tool for Community research: introducing the framework programme

The Community research programmes back then were low- budget ones adopted individually by unanimity in the Council incoherently. The commissioner decided that more should be done to streamline the situation. A Commission communication adopted in October 1981 recognized that Europe was 'falling behind its main competitors' and urgently needed 'to make the best use of its financial resource.' The Commission was proposing to establish a 'true Community strategy' for research to contribute in the implementation of other sectoral policies.

This strategy would has taken the form of an **'overall framework program embracing all Community research,'** aimed at:

- bringing together national policies and avoiding duplication and dissipation of efforts;
- defining the common priorities; and
- defining the criteria for selecting joint actions and initiatives.

The framework programme (FP) would has acted as a concertation mechanism which should be revised regularly. Indeed, it was supposed to define thematic priority areas that needed support and required the implementation of horizontal actions stimulating the efficacy of Community research. The Commission would has also established an evaluation process for the FP and a policy to disseminate the results obtained. It also planned on strengthening its capacity to define the scientific needs of the Community.

4.1.1. The framework programmes: from FP1 to FP to Horizon 2020

With the final objective of defining and implementing an overall development, research, and demonstration strategy at the Community level, the European Commission established **the First Framework Programme** covering three years from **1984 to 1987**. The total budget dedicated to the Programme was € 3.75 billion that was split according to 7 scientific and technical objectives:

- 47.2% improvement of the management of energy resources;
- 28.2% promotion of industrial competitiveness;
- 10.3% improvement of living and working conditions;

the remaining financial resources were dedicated to the promotion of agricultural competitiveness (3.5%), the improvement of raw materials management (2.1%), stepping up development aid (4.0%), and improving the effectiveness of the Community's scientific and technical potential (2.3%).

In 1986 the Single European Act (SEA) was approved with the objective of "strengthening the scientific and technological basis of European industry and encouraging it to become more competitive at international level". The SEA introduced a new criterion to the **Second Framework Programme** (from **1987 to 1991**): the Community's social and economic cohesion. The total budget was € 5.4 billion to be dedicated to the following objectives:

- A larger market and information and communication society (42.2%);
- Energy (21%);
- Modernization of the industrial sectors (15.7%);

And other such as, among others, the quality of life and the improvement of the European S&T cooperation (5.3 %).

The **Third Framework Programme** (from **1990 to 1994**), with a total budget of € 6.6 billion, had the main objective of strengthening the scientific and

technological basis of the European industry. Moreover, the Third FP aimed at encouraging European industries' competitiveness on a global scale by supporting enterprises, research centers and universities in their research and development activities. The most innovative feature of the FP3 was CRAFT- a new scheme for SMEs with limited or no research resources.

The following **Fourth Framework Programme**, run from **1994 to 1998** with a doubled budget compared to the previous FP3 (€13.100 billion). Some significant changes have been introduced, in addition to the existing research fields (Information and Communication Technologies, Industrial technologies, Environment, Life Sciences and Technologies, Energy, Transport and Targeted Socio-Economic Research).
In addition, three horizontal programmes had been implemented: the promotion of RTD cooperation with third countries and international organizations – INCO; dissemination, optimization of results and training and mobility of researchers. By encouraging the researchers' mobility and the creation of European research networks, Europe intended to provide specialists with knowledge-sharing opportunities across disciplines and across countries, preparing them to tackle future challenges. Additionally, these activities represented a tool to extend the excellence of European research on a global scale and maximize the potential of the research system.

With a total budget of €14.960 billion, the **Fifth Framework Programme (1998 – 2002)** represented a breakthrough from the past as it was conceived to respond to significant socio-economic challenges in a way that previous programmes have not. It focused on three main criteria:

1. Social objectives;
2. Economic development and
3. S&T prospects and European added value.

To maximize its impact, the FP5 only concentrated on four thematic programmes (Quality of life and management of living resources, User friendly information society, Competitive and sustainable growth; Energy, Environment and sustainable development) and three horizontal programmes (Confirming the international role of Community research; Promotion of innovation and encouragement of participation of SMEs; Improving human research potential and the socio-economic knowledge base). The most innovative feature of the 5th Framework Programme was the concept of "Key actions," defined as a cluster of projects ranging from scientific to technological disciplines addressing a specific problem.

The **Sixth Framework Programme** (**2002 - 2006**), with a total budget of €17.5 billion, had the main objective to the creation of a European Research Area (ERA) by improving, integrating , and coordinating research in Europe, which was highly fragmented at that time.

FP6 was divided into three main blocks of activities:

1. Focusing and Integrating European Research;
2. Structuring the ERA and
3. Strengthening the Foundations of ERA.

The 6th Framework Programme has been characterized by the introduction of two new instruments: integrated projects and networks of excellence. The first instrument was composed of projects aimed at bringing together a critical mass of resources focused on specific objectives to increase Europe's competitiveness and address primary societal needs. The second one aimed at integrating the critical mass of help and expertise at a European level by connecting partners around a joint program of activities.

The **Seventh Framework Programme (2007 – 2013)** with a total budget of over € 50 billion represents a substantial increase compared to the previous Framework Programme. FP7 has been implemented to meet Europe's needs in terms of jobs and competitiveness, while maintaining leadership in the global knowledge economy. FP7 has been structured into 5 main blocks:

1. Cooperation;
2. Ideas;
3. People;
4. Capacities and
5. Nuclear Research.

The Ideas programme was particularly innovative as its main objective was to reinforce excellence, dynamism and creativity across all fields of European research by supporting blue sky research and attracting the most talented scientists. One key aspect of FP7 was the transnationality of many actions: consortia's activities had to be carried out, including participants from different Member States or Associated Countries.

Since the 1st of January 2014, a new Framework Programme has been introduced: **Horizon 2020**. It will run until the end of 2020 and is the most extensive EU Research and Innovation program with a total budget of nearly 80 billion euros of funding available.

4.2. Horizon 2020

A definition

Horizon 2020 (H2020) is the European Union (EU) Framework Programme for Research and Innovation covering the years from 2014 to 2020.

Horizon 2020 unifies in an unique program the three predecessors (2007-2013) with the aim of supporting research, innovation, and technological development: the Seventh Framework Programme (7FP), Competitiveness and Innovation Framework Programme (CIP), and the European Institute of Innovation and Technology (EIT). Horizon 2020 started in 2011, when the EU heads of State and Government invited the European Commission, running from 2014 to 2020, to integrate the different tools to support research and innovation into a single shared strategic framework. The Commission started a broad consultation process involving all the leading research players, which resulted in Horizon 2020.

Purpose and context

The purpose of Horizon 2020 is to support research and innovation: which is one of the five main objectives of Europe 2020, namely the European Union growth strategy for 2010-2020. In line with this strategy, Horizon 2020 aims to develop a society based on knowledge and innovation and address the important priorities suggested by the European Agency for 2020: *smart*, *sustainable,* and *inclusive growth.*

Seen as a means to drive economic growth and create new jobs, Horizon 2020 is the primary financing tool to strengthen the European Research Area, an open space where researchers, scientific knowledge, and technologies can freely circulate. Moreover, it is meant for implementing the Innovation Union, the flagship initiative with the purpose of ensuring Europe's competitiveness, by encouraging the setting up of partnerships for innovation, enhancing research initiatives as well as simplifying administrative procedures to access financing funds.

Five objectives: Employment, research and innovation, climate chance and energy, education, fighting poverty		
Smart Growth Developing an economy based on knowledge and innovation **INNOVATION** Flagship initiative "Innovation Union" **EDUCATION** Flagship initiative "Youth on the move" **DIGITAL SOCIETY** Flagship initiative "A digital agenda for Europe"	**Sustainable Growth** Promoting a more resource efficient, greener, and more competitive economy **CLIMATE, ENERGY, MOBILITY** Flagship initiative "Resource efficient Europe" **COMPETITIVNESS** Flagship initiative "An industrial policy for the globalization era"	**Inclusive Growth** Fostering a high-employment economy delivering social and territorial cohesion **EMPLOYMENT AND SKILLS** Flagship initiative "An agenda for new skills and jobs" **FIGHTING POVERTY** Flagship initiative "European platform against poverty"

Table 5: Horizon2020 objectives and priorities

Priorities and objectives

Horizon 2020 is built around three priorities, or "pillars, " including specific objectives: Excellent Science, Industrial Leadership, and Societal Challenges.

- Excellent Science
- Industrial Leadership
- Societal challenges
- Additional actions

Excellent science

This priority is intended to reinforce and extend the European excellence in the basic science of the European Union. It is built around four specific objectives:

- European Research Council (ERC), to encourage frontier research in Europe by supporting talented individual researchers and their teams;
- Future and Emerging Technologies (FETs), to support collaborative research on radically new advanced technologies and innovative high-risk ideas that can revolutionize the productive system;
- Marie Skłodowska-Curie actions to strengthen skills, training, and career development of researchers by encouraging cross-border and cross-sector mobility;
- Research infrastructres strengthen European research infrastructures, including e-infrastructures, by providing value to their innovative potential and human capital.

Industrial leadership

This proposal seeks to accelerate technological development and help innovative small- and medium-sized enterprises (SMEs) grow internationally. It is designed around three specific objectives:

- Leadership in enabling and industrial technologies to boost Europe's industrial leadership through research, technological development, demonstration, and innovation in helping technologies, including information and communication technologies (ITC), nanotechnologies, advanced materials, biotechnology, advanced manufacturing and processing, and space.

- Access to risk finance, supporting enterprises in the enhancement, through specific financing tools, research and innovation investments.
- Innovation in SMEs, to encourage different types of innovation in small- and medium-sized enterprises, particularly those with high growth and internationalization potentials, by sponsoring the creation of an ecosystem favorable for SMEs' growth.

Societal challenges

Societal challenges targets to address future social issues and lies on seven principal subjects:

- Health, demographic change and wellbeing, geared at the improvement of population lifelong health and well-being;
- Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy, to secure sufficient supplies of safe, healthy and high-quality food by developing sustainable and efficient production systems;
- Secure, clean and efficient energy necessary to make the transition towards a more reliable, affordable, publicly accepted, sustainable, and competitive energy system;
- Smart, green and integrated transport, to achieve a European transport system that is resource-efficient, climate- and environmentally friendly while being safe;
- Climate action, environment, resource efficiency, and raw materials, to achieve a resource - water efficient - and climate change resilient economy and society;

- Europe in a changing world–inclusive, innovative and reflective societies, to foster a greater understanding of ongoing changes and to provide solutions for sustainable growth at the social and economic levels;
- Secure societies by protecting the freedom and security of Europe and its citizens, addressing global threats while strengthening the European culture of freedom and justice.

Additional actions

Moreover, H2020 provides funds for the following actions:

- Spreading excellence and widening participation to ensure that the benefits of an innovation-led economy are maximized and widely distributed across the European Union;
- Science with and for the society, to build practical cooperation between science and society, recruiting new talent for science, and pairing scientific excellence with social awareness and responsibility;
- Cross activities, concerning the circular economy, Internet of Things, smart and sustainable cities;
- Fast-track for innovation, a pilot initiative focused on the promotion of innovation activities that are near the market;
- European Institute for innovation and technology, to support the EU organization with the same name to promote Europe's competitiveness;
- Euratom, within the complementary programme for research and education in the field of nuclear energy;
- Cyber-physical systems, to enhance information technology systems that interact with the physical content where they operate.

Main features

Horizon 2020 presents a value nearly 80 billion euros spread over seven years. The overall amount is higher than 30% compared with the previous programmes. Among the main novelties of Horizon 2020, there are simplified rules for participation of universities, companies, and bodies, as well as a greater focus on the challenges that society will have to address in the next few years, including healthcare, green energy, and sustainable transport.

Special attention is drawn to several cross issues concerning all the priorities, including, for example gender equality in careers and research activity; contribution to cooperation between the European Union and its international partners; innovation valorization; the role of social sciences and humanities in addressing several societal challenges; support in the implementation of the European Research Area and the Innovation Union.

Figure 18: Horizon2020' objectives budget

Beneficiaries

Participation in the program is open to different organizations and individuals from the European Union Member States or countries associated with the program. For example, universities or research institutes, individual researchers at early-stage or mid-stage career, research teams, national, regional or local public or state bodies, non-profit organizations and associations, industries, small- and medium-sized enterprises (SMEs), or groups of enterprises.

Management

The funding opportunities, available under Horizon 2020, are defined through multiannual work programmes prepared by the European Commission based within the legislative framework of Horizon 2020 for the strategic programming aimed at integrating EU policies and established priorities. The funds, centrally

managed by the European Commission or executive agencies, are assigned through calls for proposals where organizations or individuals working in research and innovation can compete. Project proposals are evaluated by a panel of independent experts who select the projects to receive funding.

The selected projects are co-funded by the European Union and by applicants. For research and development projects, the UE share can be as high as 100% of the total admissible costs; for innovation projects, 70% of the expenses, except for non-profit organizations that can receive up to 100% of the total eligible costs. Reimbursement of indirect eligible costs is a flat rate of 25% of direct costs.

Participation

Applications for a call for proposals shall be submitted on the Participant Portal no later than the deadline specified in the calls. Each call can request the participation of several partners: by the participant portal, it is possible to look for and identify potential partners with specific skills and experience.

After the deadline is expired, all proposals are evaluated by a panel of independent experts based on specific criteria, including excellence, impact, and implementation.

The evaluation phase, which usually lasts five months, ends with the ranking of the proposals selected to receive funding, information of the selection outcome to applicants, and the signature of a grant agreement between the European Commission and subjects chosen to receive funding. Besides the rights and obligations, the agreement specifies the research and innovation activities to be implemented, the project duration, the costs, and the European Commission contribution.

4.2.1. Horizon statistics

Horizon 2020, as the name also said, was concluded in 2020. Now, two years apart, we have a full overview of the resources implied, the countries that participated and their performances, the grants obtained.

Few statistics from the official H2020 dashboard are presented below, in order to have an idea of the resources involved in this programme.

- 35381 signed grants, over the 25809 signed grants of FP7;
- 176071 participations, over the 134000 of the FP7;
- Net EU contribution: 67,62 B€, over the 49 B€ of FP7;

In the graph below is shown the distribution of the H2020 contribution by firms' field. There can be noticed the great importance of the field of *natural science* and *engineering and technology* over other fields like agricultural science and humanities.
Having Horizon2020 the objective to transform the European Union into an Innovation Union by fueling market commercialization of good ideas, greater resources have been dedicated to those projects that could have a greater impact in boost the economy, create jobs, and improve lives.
There can be also seen that the *natural science* field obtained a very high percentage of signed grants.

Horizon2020 is more in tune with science's role in society, so it focuses on challenges we urgently need to address, like clean energy and recycling, caring the elderly, healthcare, food safety, and environmental issues to solve.

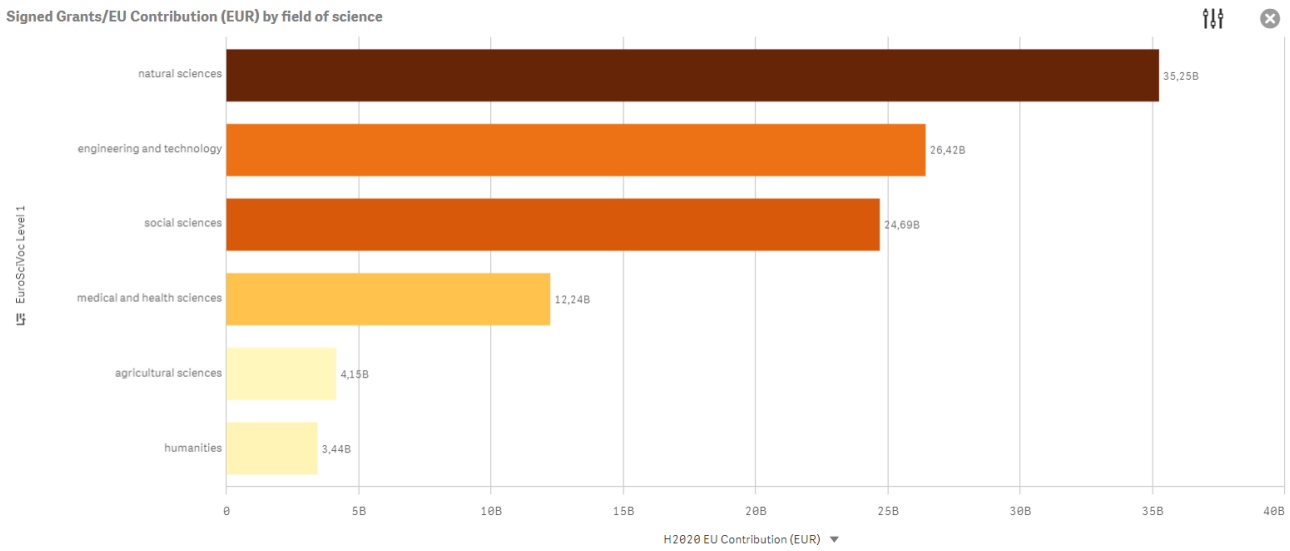


Figure 19: EU contribution by field of science

Here below we have the same representation, of signed grants by field of science.

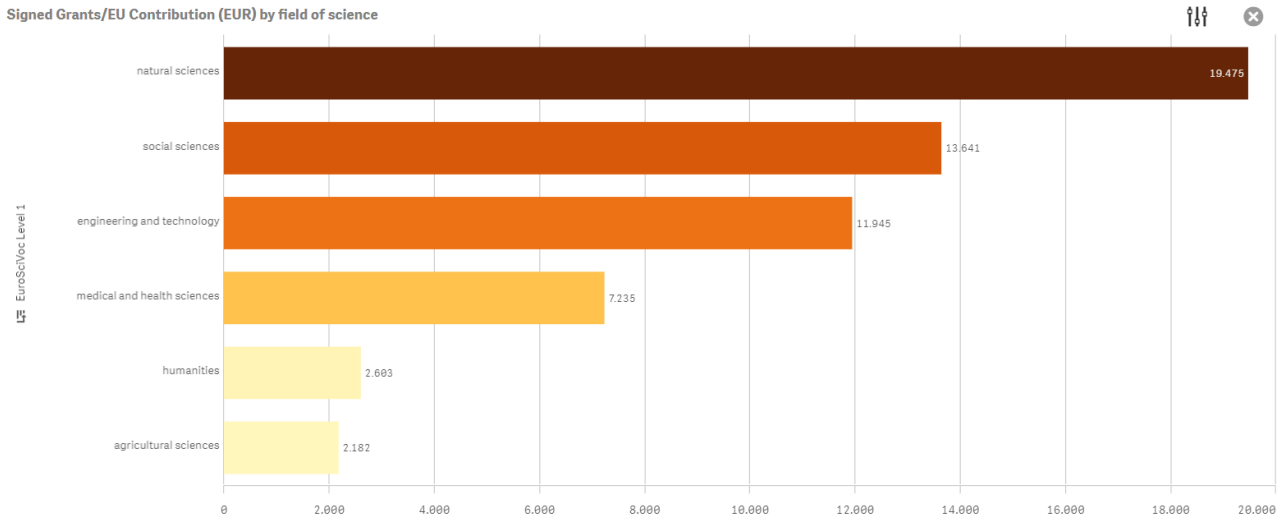


Figure 20: Signed grants by field of science

All the different European countries participated in Horizon2020, and in the table above, we can see Germany, Spain, and Italy compared by the EU contribution obtained and the number of participations.
Germany outstands the other countries both by EU contribution and number of participants.

Participations and Net EU Contribution/EU Contribution by country - region

Country	H2020 EU Contribution (EUR)	H2020 Net EU Contribution	H2020 Participations
Totaux	**€ 29.307.226.920**	**€ 29.265.043.954**	**73.452**
Germany	€ 9.950.166.081	€ 9.967.298.993	20.592
France	€ 7.421.258.653	€ 7.341.926.604	17.018
Spain	€ 6.340.315.417	€ 6.336.853.996	18.811
Italy	€ 5.595.486.769	€ 5.618.964.361	17.031

Figure 2: Participation and EU contributions by region

Horizon 2020 is specifically built to be easier to access for institutions,

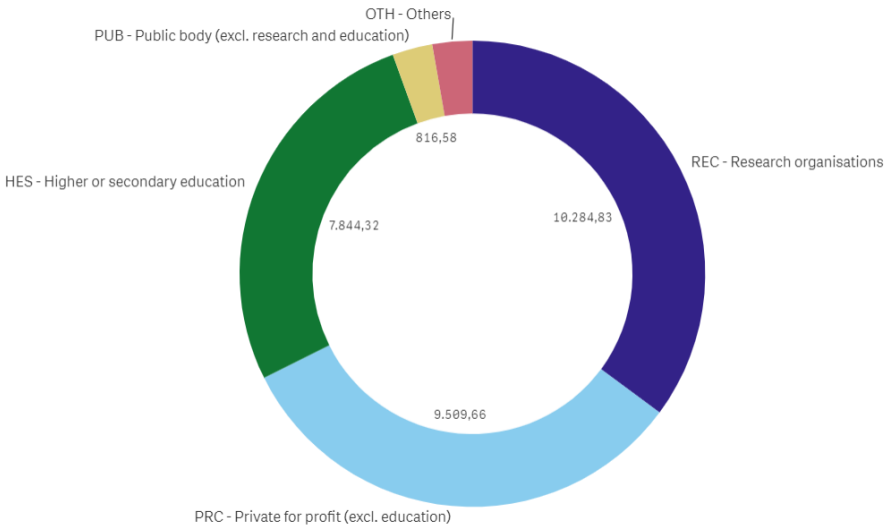


Figure 23: Contribution by type of organization

universities, companies and especially more open to small businesses and international partners. So, it is interesting to consider the contribution by type of organization.

Here below is presented a very interesting instrument that represents the topics of the signed grants by the EuroSicVoc concept. In this cloud of words, we can find all the topics related to the grants that have been assigned to the participants. In particular, the topic 'drone', has a value of 150.

EuroSciVoc is a multilingual taxonomy that represents all the main science fields discovered from CORDIS content and organized through a semi-automatic process based on NLP techniques. It contains more than 1000 categories in 6 languages (English, French, German, Italian, Polish, and Spanish), and each category is enriched with relevant keywords extracted from the textual description of CORDIS projects. EuroSciVoc is managed by the Publications Office of the EU and is currently used by the CORDIS website. It is specifically developed as a reference vocabulary for the Open Science community and is aligned with Linked Open Data standards.)

Figure 24: Topics of the signed grants

4.2.2. FP7 statistics

Given the fact that our analysis covers Horizon2020 and the antecedent programmes, we decided to give space also to the Seventh Framework Programme.

As it is also presented before, FP7 was the Framework Programme that run from 2007 till 2013.

Some numbers to present the resources committed to this programme:

- 25809 signed grants
- 46,09 EU contribution

The average number of participants per project is 5,4, and the average contribution per project is 1,79M€ while the average cost per project is about 2,55M€.

In the graph below we can see the Signed grants in FP7 by thematic priority.

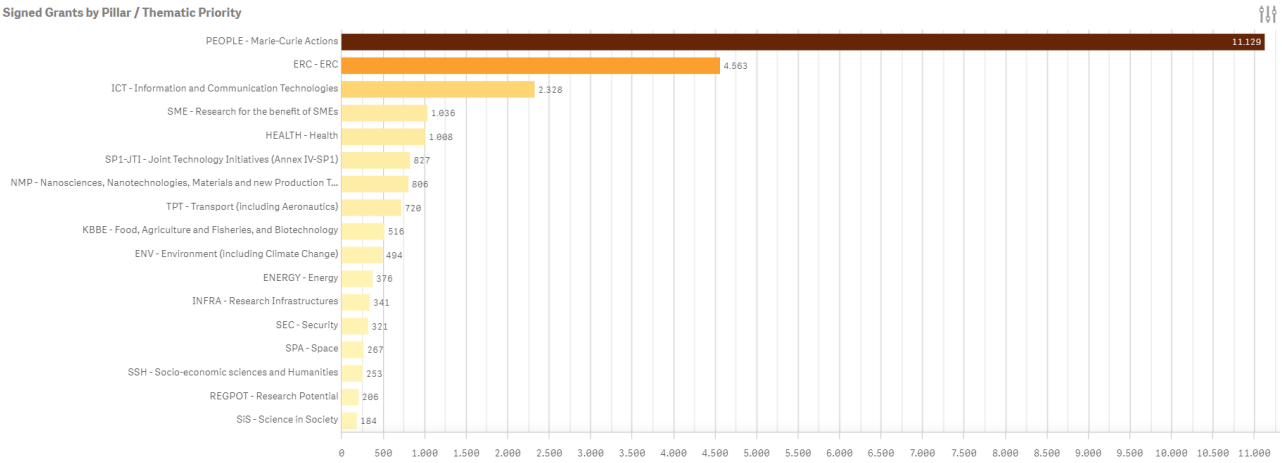


Figure 25: Signed grants by thematic priority

The highest number of grants were assigned to project related to the pillar: PEOPLE- MarieCurie Actions, that outstand the others, covering half of the project by itself.

In the graph below there are represented the signed grants by funding schemes.

Coerently with the previous data, the majority relates to the MSCA founding

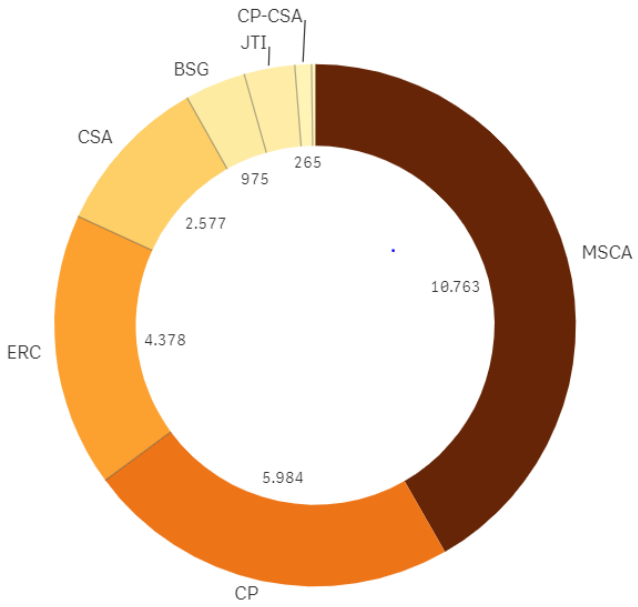


Figure 21: Signed grants by funding scheme

scheme, so the Marie Skłodowska-Curie Actions one.

These are only some of the statistics that can represent the results of these two framework programmes.

It is easy to understand how framework programmes have evolved over the years, trying to answer to the needs of our society, employing more and more resources, simplifying processes, and making it easier for entities to obtain

funds, to progress, and to transform good ideas into innovations that support our countries and the advancement of humanity.

5 Census

Our analysis will evaluate and define the dynamics and the variables that have a role in obtaining grants by SMEs and startups investing in projects related to drones in the B2B market.

In the first part of our analysis, a census of all the projects that won a grant will be conducted. This census will have two main objectives:

1. Classify the projects: geographically, the amount of resources, the scope of the projects, etc. to characterize them.
2. Prepare the data set for the second part of our analysis, the econometric model.

5.1. Methodology

Our objective is to create a census of all the EU grants drones-related world. These projects can be classified as:

- direct, so related to the product itself, as the drone's software or hardware.
- Indirect, so connected to the world of drones, as services in which drones are employed.

5.1.1. The first step: projects' searching

Our source of information is CORDIS, namely the Community Research and Development Information Service (CORDIS). This is the European Commission's

primary source of results from the projects funded by the EU's framework programmes for research and innovation (from FP1 to Horizon 2020).

CORDIS is managed by the Publications Office of the European Union on behalf of the European Commission's research and innovation Directorates-General, Executive Agencies, and Joint Undertakings, supported by specialized contractors for editorial, data, and technical services.

CORDIS has a rich and structured public repository with all project information held by the European Commission, such as project factsheets, participants, reports, deliverables, and links to open-access publications.

Every project that the European commission funded, is classified and reported accurately. Each one has a fact sheet that contains:

- The project description;
- Fields of science: in which the projects is involved
- Programmes: under which the project was funded;
- Topics
- Call for proposal
- Funding Scheme
- Coordinator
- Participants: list and number of participants
- Projects information:
  - Start and end date
  - Overall budget
  - EU contribution
  - Name and origin country of the coordinator

Furthermore, each of it has some keywords that identify it in the search process.

Thus, from Cordis we can download an excel file containing all the projects with the keyword "*drone*."

This represents the starting point of our census.

5.1.2. Second step: screening

This raw extraction contains all the projects registered in Cordis from 2001 till January 2022 under the keyword "drone." This was about 478 projects.

From this list, we first remove all the voices that are not related to the drone industry or where drones are very marginal. In this way, the list gets reduced to 320 projects, which can now pass to the next phase.

5.1.3. Third step: censing

We computed a very detailed classification for each project left looking at the Cordis' page. The census is built around three main pillars:

- Descriptive introductive part that is automatically extracted from the platform;
- Characteristics of budget and coordinator;
- Classification of the project type.

Descriptive information

- *Record Number*: a number that is associated with the project in the Cordis library;
- *Acronym*: a single word that can be representative of the scope of the project or the acronym of the title of the project;

- Title of the project;
- *ID*: a number that identifies the specific grant agreement signed for that project. The grant agreement is the document signed by the European Commission, the project coordinator, and the beneficiaries when the grant is obtained and finalized.
- *Teaser Programme*: it contains a few initial lines of the project description that is reported on the Cordis' website page;
- *Programme* is the specific program inside the whole framework in which the project has competed and won, i.e. "H2020-EU.1.3.2."
- *Programme category,* is the macro framework programme, taking the previous example, "H2020".
- *EuroSciVoc*: are the fields of science related to the project. They are reported from the macro category, to the specific object of the project. An example could be: "information engineering > electronic engineering > robotics >autonomous robots > drones".
- *State*: it is a binary variable and could be "ongoing" if the project's end date is not yet com, and "closed" if the end date is already gone.
- *Start date and End date* of the project.
- *Language*: all our projects are described and reported in English.
- *URL*: it contains the Cordis' website page link for each project.
- *Overall budget*: it is the budget that has been estimated to carry out the project.
- *EU contribution:* it is the portion of the overall budget that the European Union subsidies.

Coordinator characteristics

- *Coordinator's name*: the firm's name that has the role of coordinator.
  The initiator of the project proposal is usually, and almost automatically, the project's coordinator.
  Once the Horizon Europe project is retained for funding, the coordinator must initiate and manage the processes of signing the grant agreement with the European Commission. The coordinator is also expected to manage the process of drafting and signing the consortium agreement (CA) with the partners. After these are settled, it is time for the coordinator to lead and launch the project execution with the other beneficiaries.
  Coordinator's responsibilities:
  - Act as the intermediary for all communications between the beneficiaries and the EC
  - Monitor and control the project's work plan and ensure the action is implemented properly
  - Arrange consortium meetings and subsequent reporting
  - Implement quality procedures for the project
  - Gather, monitor, and consolidate scientific and technical content for periodical reports
  - Prepare, manage and coordinate the project's financial checks
  - Administer project resources, including budget-related issues
  - Handle financial management, including distribution of payments to the beneficiaries
  - Facilitate communication within the consortium on administrative matters

  - Handle outstanding administrative issues like contract amendments
  - Consolidate the project's deliverables and reports, and maintain quality assurance, including submission to the EC
  - Oversee the provision of a project management electronic platform and more.
- Coordinator's state: is the state in which the legal site of the coordinator is based.
- Activity type: it is the type of activity carried on by the coordinator.

  In our census, we found:
  - Higher or Secondary Education Establishments (104)
  - Private for-profit entities (164)
  - Research Organisations (50)
  - Public body (1)
- *Funding scheme*: it is the mechanism governing the administrative and financial management of a COST Action grant.

  In our census, we found these types of funding schemes:
  - RIA - Research and Innovation action
  - IA - Innovation action
  - CSA - Coordination and support action
  - SME-1 - SME instrument phase 1
  - SME-2 - SME instrument phase 2
  - CP - Collaborative project
  - MSCA - Marie Skłodowska-Curie Actions
  - Other

- *Number of participants* to the projects, including the coordinator.

- *Nationality of the participants*: this is “single” if all participants belong to the same nation, and “multiple” if participants are of different nationalities.

Projects mapping

The projects are classified into macro-categories that are *Product, Service,* and *Others.*

These macro-categories are branched into the *Proposal category*, *macro project field*, *micro-project field*, and *project field details*.

Product

The macro category: *product* includes both *hardware* and *software*. The hardware refers to the physical object and it can be both the *drone platform* itself as a whole, as well as a specific *component* of the drone, and an accessory component. As the last macro category, we have all those projects that fall into the counter-drone solutions category.

The second category, on the other hand, covers projects based on software for *flight planning, fleet management and operations, data analysis and navigation.*

Macrocategory	Proposal category	Macro project field
Product	Hardware	Drone platform
		Payload
		Components
		Counter-drone solutions
	Software	Flights Planning & Fleet Operations Management
		Data analysis
		Navigation

Table 6: Macrocategory product, proposal categories, and macro project field

Service

The services category is very broad and includes several subdivisions within it; the macro project fields are shown in the table below.

Most of the projects surveyed belong to this category, with a total of 104 projects related to services.

The macro category that contains the highest number of projects is "*inspections*," with 56 projects. We can also add that most of these fall into the micro-project field "*monitoring*" and *"mapping*."

The macro-category Service is also the one that has received more attention in branching each type of activity, so for every Micro-project field, we have about three or four other project field details. These will bring additional information to our analysis.

An example of these project field details can be shown for the first micro-project field: first aid operations. This is branched in:

- First aid in sea
- First aid in the ocean
- First aid in mountains
- First aid in areas affected by environmental disasters

Macro-category	**Macro-project field**	**Micro-project field**
Service	Search and rescue	First aid operations
		Animal search
		People search
	Inspections	Infrastructure Inspections
		Post-environmental disaster inspections
		Monitoring
		Mapping
	Security and surveillance	Anti-Covid actions
		Public oversight actions
		Protection of the environment, property, and people
		Security of territory and people
		Protection of territory and infrastructure
	Inventory	Warehouse inventory

	Transport	Last-mile delivery
		Middle-mile delivery
		Deliveries to dangerous or hard-to-reach places
		Deliveries to another means of transport
		Deliveries on buildings
		Deliveries in healthcare facilities
		Illegal deliveries
		Transport of persons
	Distribution	Signal emission
		Material release
	Media, arts, and entertainment	Recording photos and videos
		Show
		Creation or conservation of works of art
	Maintenance	Infrastructure maintenance
		Building maintenance
		Monument Maintenance

Table 7:Macrocategory service, macro project field, and micro project field

Other

The last macro category contains all the projects that are not specifically related to the previous classes, so, Collaborative Platforms, Unmanned Traffic Management, Advanced Air Mobility (AAM), Research Activity & Training.

Sector characteristics

To understand whether the project is focused on only a single sector or not, there are other two classifications:

- Single of Multiple sectors addressed by the project
- Sector-specific details: if the project addresses only one sector, it is specified in this column.

Artificial Intelligence

There is an "x," in this column if the project involves any type of artificial intelligence applications. This is because it is considered a hot topic on which the European Commission pays particular attention to allocating a significant amount of funds.

Problem description

The last variables that we consider are related to the specific issues that the project in case of success could solve.

- *Problem addressed by the project*: some examples are *Safety unmanned and manned environment integration*, reduced *operative and maintenance costs, or Performances limits of commercial solutions,* etc.
- *Problem details:* this column is a more detailed summary of the problem addressed, typically the first lines of the project description on the Cordis' page.

Each project related to the drone industry in the B2B sector, which obtained a grant from the EU commission, is described with all the variables presented above in our census.

6 The Census Analysis

Horizon 2020 Framework Programme – Drones

After going through the specificities of EU framework programmes, especially Horizon 2020, and assessing the drones' industry in all its characteristics, it is time to conduct a cross-analysis of the two topics by studying how drones' organizations and projects performed in the EU Framework programme.

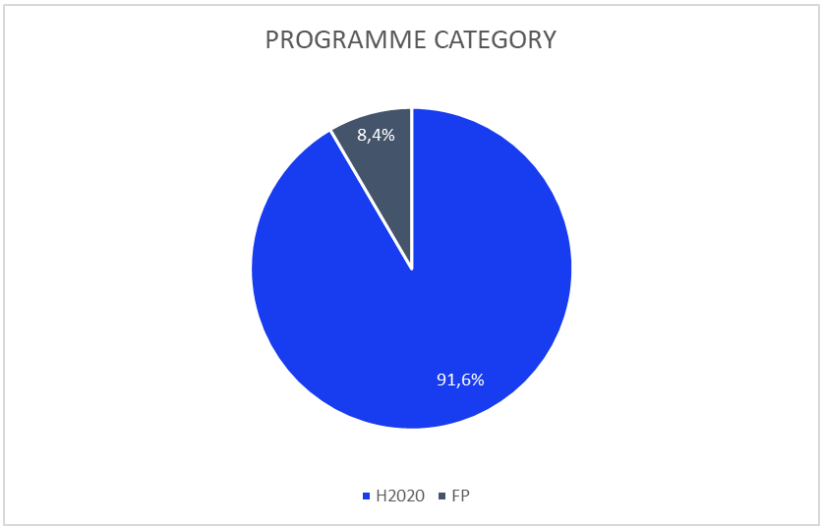


Figure 22: Percentage of projects by Framework Programme

Although we have predominantly focused on H2020, a few projects (around 9% of the total, as shown above) are coming from other Framework Programs. Indeed, the platform Orbis does not present a specific section dedicated to drones, but it only allows to extract data working through keywords. Nevertheless, this does not imply a mistake because the performance of such a limited group of projects have been obtained through FPs, which is our prior

interest.

Closed	Ongoing
67,39%	31,99%

Table 8: Percentage of projects closed and ongoing

The projects recorded are spread over more than two decades, due to the presence of multiple Framework Programs, ranging from 2001 until 2026 (thus comprising the last 4 FPs). Then, according to the Orbis database, more than half of flying drones' projects have already reached their due date, while a consistent part, almost 32%, will end in years ahead.

Concerning the time distribution of projects, and so of funds, we can notice that the large majority of them start after 2014. This is additional proof confirms that H2020 is the primary source for projects about the drones' field. At the same time, projects' initiations peak is in 2017 with a progressive decrease probably caused by the diverse factors among which pandemic crisis could have played its minor even if significant role. Finally, since projects are different in terms of timing, the end dates distribution differs from the starting one, achieving a more balanced scatter.

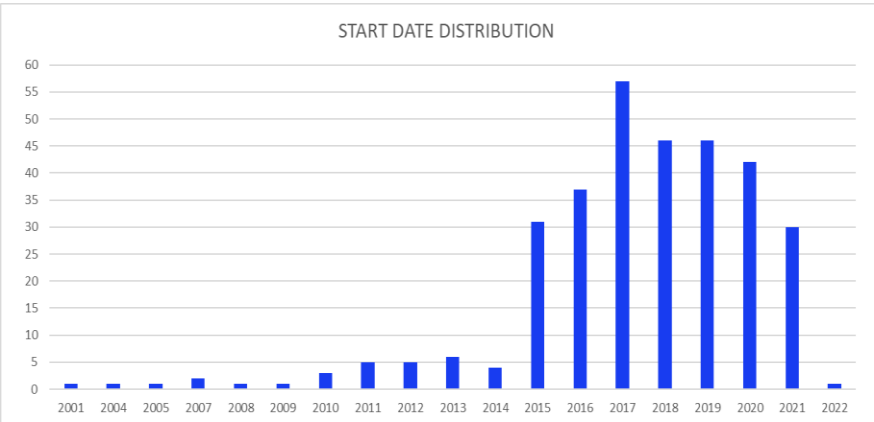


Figure 23: Distribution of projects start date

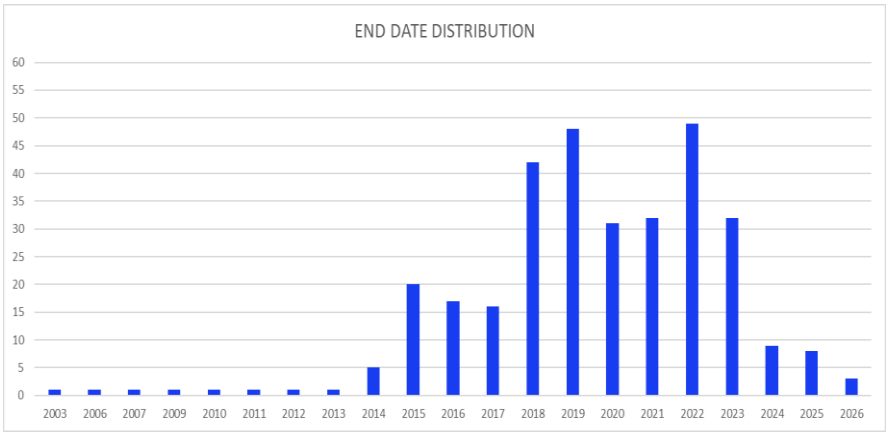


Figure 24: Distribution of projects end date

Then, if we determine the average duration of drones' projects we find 876 days, which is quite similar to the median figure and so probably this sample has a tendency of being normally distributed. Nevertheless, not all the projects are similar in duration, in fact, the standard deviation is very high and gives an idea about the differences encountered.

AVERAGE DAYS	STANDARD DEVIATION	MEDIAN
876	+/- 520	881

Table 9: Percentage of projects closed and ongoing

Afterwards, looking at the drones projects' size, the overall budget is around 1 billion euro with an EU contribution that settles at more than 700 million euro, covering 77% of expenses. In this sense, the European aid does not seem so substantial, being the 1% over the total H2020 FP budget. However, it appears a sound result if accounted over the total budget assigned for the industrial leadership H2020 programme, where most of the drones' projects take part, where it represents 4,4% of the field's budget.

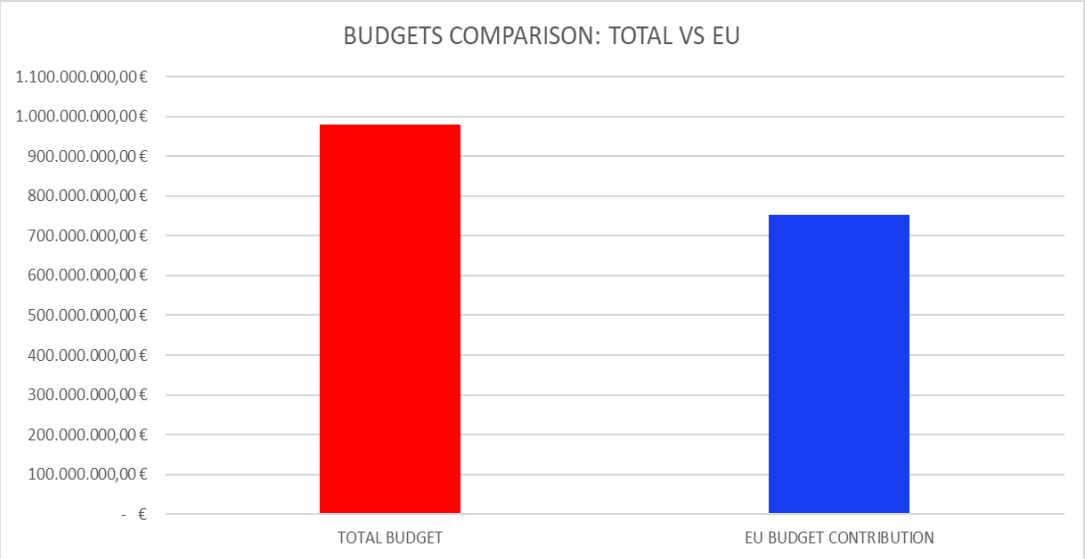


Figure 25: Projects' total budget vs EU budget

The projects' coordinator are considered as a unit of analysis. Indeed, for a sake of simplicity, we have decided to record the main projects' coordinators' data and, except when we do talk specifically about projects' participants, we will always refer to projects' coordinators' characteristics.

Thus, focusing on the organization's types that can participate in this kind of programme, we identify four clusters:

- Higher or Secondary Education Establishments
- Private for-profit entities
- Public Bodies
- Research Organizations

Once visualized the diverse typologies, a pie chart of the number of projects per category gives a snapshot of their perceived importance.

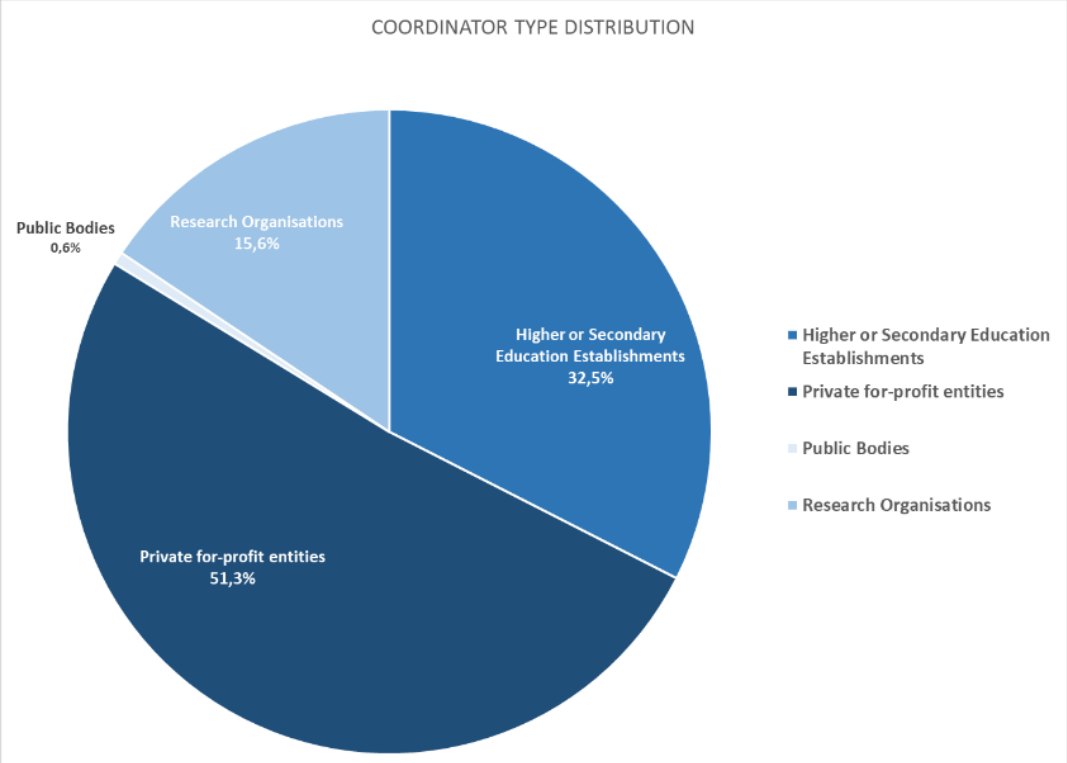


Figure 26: Coordinators' type distribution

Private corporations alone weigh as all the other three classes together, in terms of the number of projects. Indeed, this is quite reasonable considering that drones' industry is an emerging one and most of the projects refer to applicative solutions rather than basic knowledge to develop. Despite the significance brought by the number of projects, we need to verify how the funds are shared among the categories to define the most meaningful classes.

Category	Average EU contribution per project
Public Bodies	5.999.700,32 €
Research Organizations	4.255.578,46 €
Higher or Secondary Education Establishments	2.286.023,00 €
Private For-Profit Entities	1.774.978,05 €

Table 10: Average EU contribution per project by coordinator's category

From a merely numerical point of view, Public Bodies could seem the most remunerative projects, but this is not true. This distortion is caused by the few projects available in that category (two projects). Regarding the other three categories, the last two categories exhibit similar performances that are ensured by the high diversity in the data, thanks to many projects in both classes. Whilst Research Organizations presents an average contribution that is quite greater than the other categories, even if the average might have been doped by narrowed projects observations (less than half of the last two classes).

Therefore, after a preliminary analysis on the average contribution granted by the EU and scrutiny of their truthfulness, we can look at the overall budget contributions raised by the clusters.

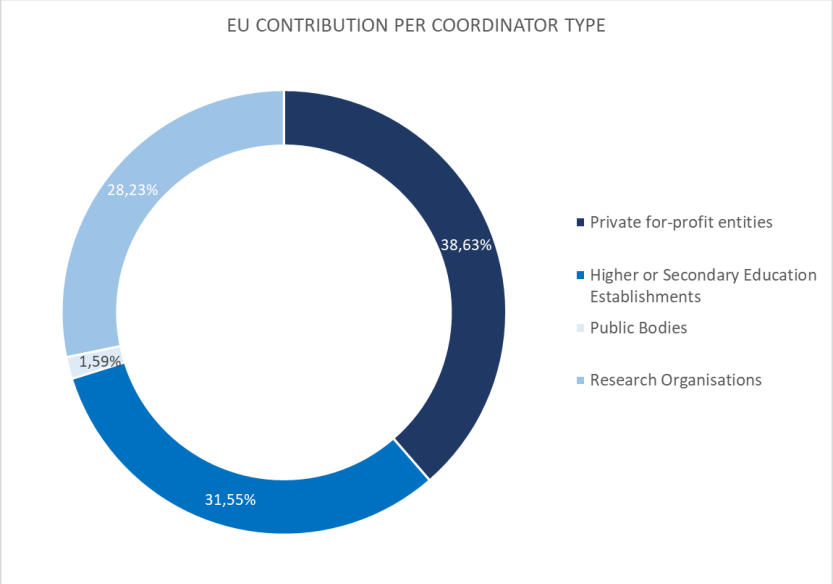


Figure 27: EU contribution per coordinator type

Private corporations are still at the lead of the different categories, even if the percentage compared to the number of projects is diminished by more than 10 percentage points. On the other hand, the positions of Higher or Secondary Education Establishments and Research Organizations are almost equal, with the latter ones that, regardless of the lower number of projects, have raised a similar portion of funds.

Being the European market highly heterogeneous, due to the structural differences of countries of which it is composed, it is advisable to carry out a segmentation analysis by considering as a unit of analysis the different nations.

Three are the main perspectives we retain worthy to pursue:

1) ABC analysis over the volumes of projects per nation

2) Fragmentation analysis of the project's types per nation

3) ABC analysis over the amount of funds collected by nations

Starting from the analysis of the number of projects per nation, we can support it by performing the ABC analysis over the volume of projects. Therefore, we consider three clusters of projects:

- Class A: we find nations that own a greater number of projects than the European average, which is 12 projects per nation.
- Class B: nations have a number of projects which is higher than the average of the remaining countries (4 projects per nation), having excluded class A.
- Class C: all the remaining are endowed of an insignificant number of projects (less than 4 projects per nation).

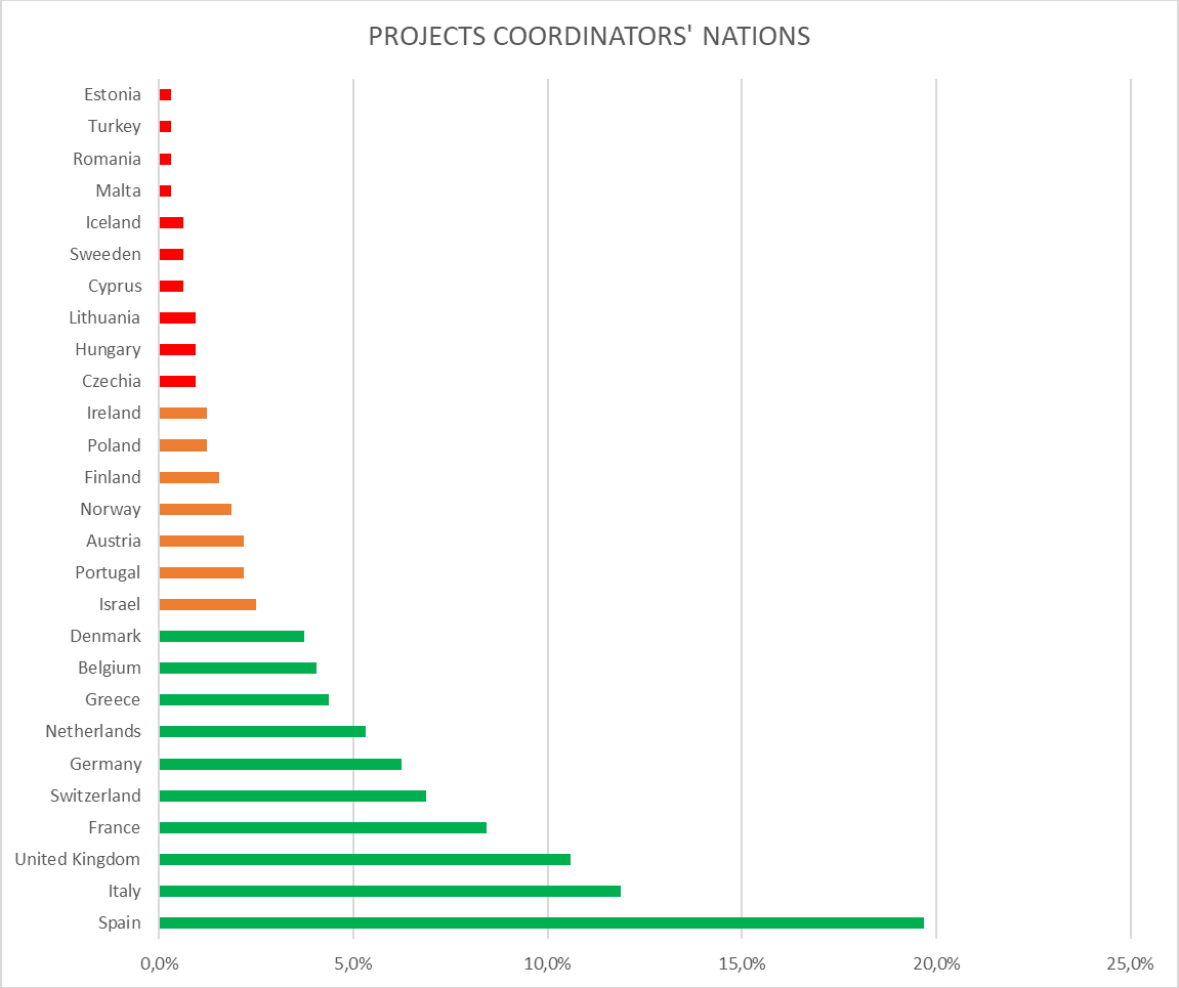


Figure 28: Projects' coordinators nations

From the chart above, we can easily realize that Class A countries are those considered as most developed and typically originating from western Europe. However, it is possible to find highly developed nations, such as Scandinavian countries or Austria, in class B or even C. This is primarily attributable to the small dimensions of such countries that are unlikely provided with the same amount of drones' companies compared to bigger states. In contrast to this thesis, we have countries like Switzerland or Denmark, regarded as small nations, that exhibit a great number of projects probably because of their

characteristics as innovation hubs or the liberal regulations present in those countries.

The results gained thanks to ABC analysis show that countries in class A, which is 37% of the total, account for more than 80% of the overall number of projects. Whilst the remaining 63% of nations are responsible for a mere 18,7% of drones' projects. Thus, the EU should focus its efforts on these countries, especially the ones in class C, in order to pursue a path based on equality and development within the union.

Countries	**% ABC analysis**
37%	81,2%
26%	12,8%
37%	5,9%

Table 11: ABC analysis per countries and number of projects

Before entering into another ABC analysis, a better comprehension of the fragmentation of projects' types could give an overview of the strengths and weaknesses of the diverse nations.

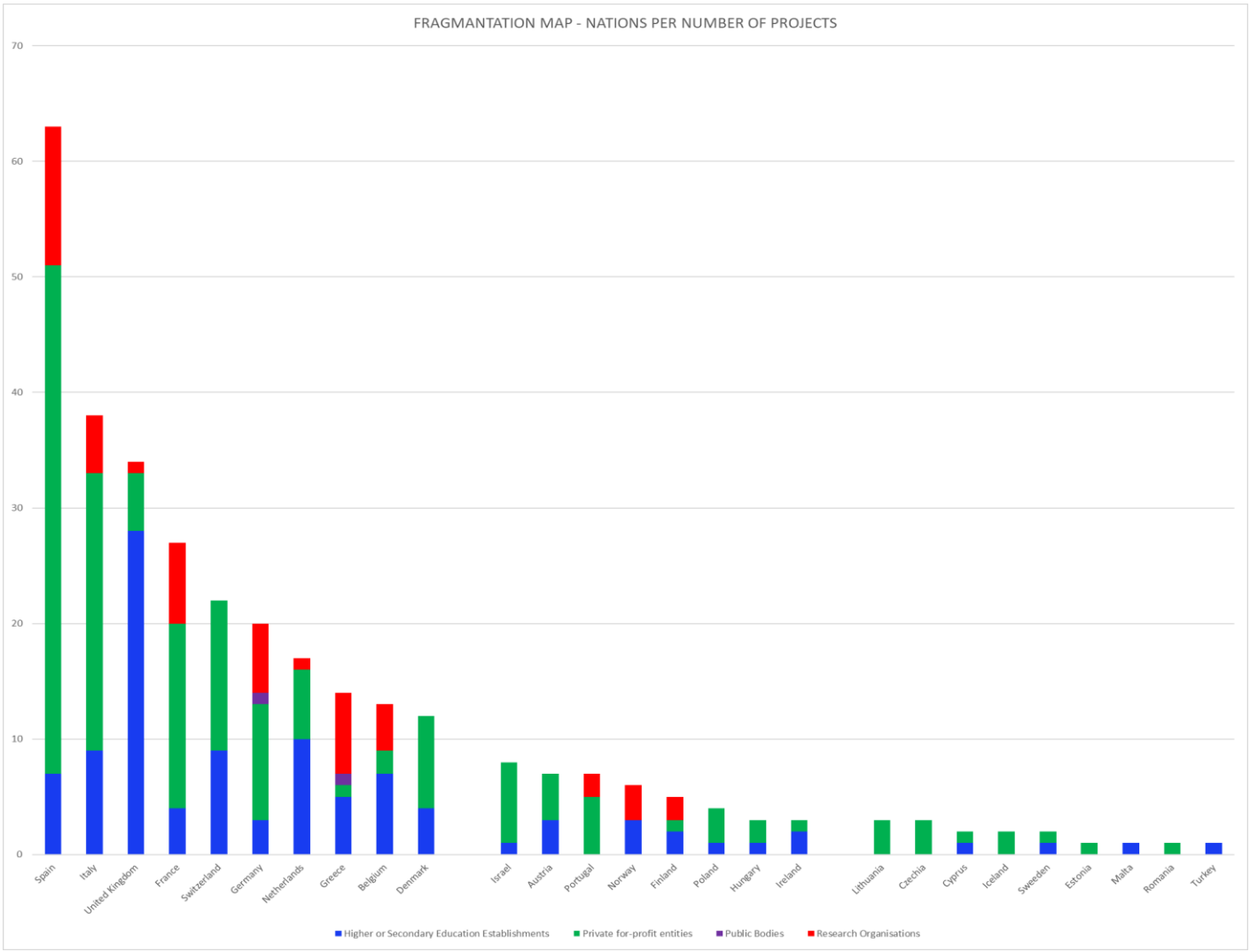


Figure 29: Fragmentation map- nations per number of projects

The chart still considers the number of projects as a unit of analysis and depicts structural differences among countries, even of the same class, that mainly result from countries' characteristics themselves. Indeed, countries with more evolved manufacturing systems, such as Italy, France, Spain and Germany, find a larger portion of Private corporations' projects compared to the other types. On the other hand, nations with superior education systems, like the UK,

Switzerland and Netherlands, present a major portion of coordinator projects' type Higher or Secondary Education Establishments [report oss. Droni]. Whilst concerning Research Organizations and Public Bodies, there is not a visible correlation between countries' specificities and coordinator projects' types. In this regard, the distribution of both coordinators' types might be connected to the presence or not of entities that deal with drones and are active in European programmes.

Afterwards, we can carry out another ABC analysis grounded on the European contribution that each state has been able to cash through drones' projects.

Despite the productive insights achieved by looking at the number of projects, the amount of funds raised gives a more powerful message since it indicates the quality and size of projects that have been conducted. Therefore, we perform an ABC analysis regarding the funds assigned to projects making a distinction of the different types of coordinators. Indeed, thanks to the fragmentation analysis we have already broken-down nations in terms of projects coordinators' types. Thus, it is reasonable to follow this level of granularity in order to distinguish case by case based on the scenario faced.

Starting from the most important category of coordinators, in terms of funds raised, namely the Private corporations, we have the following situation:

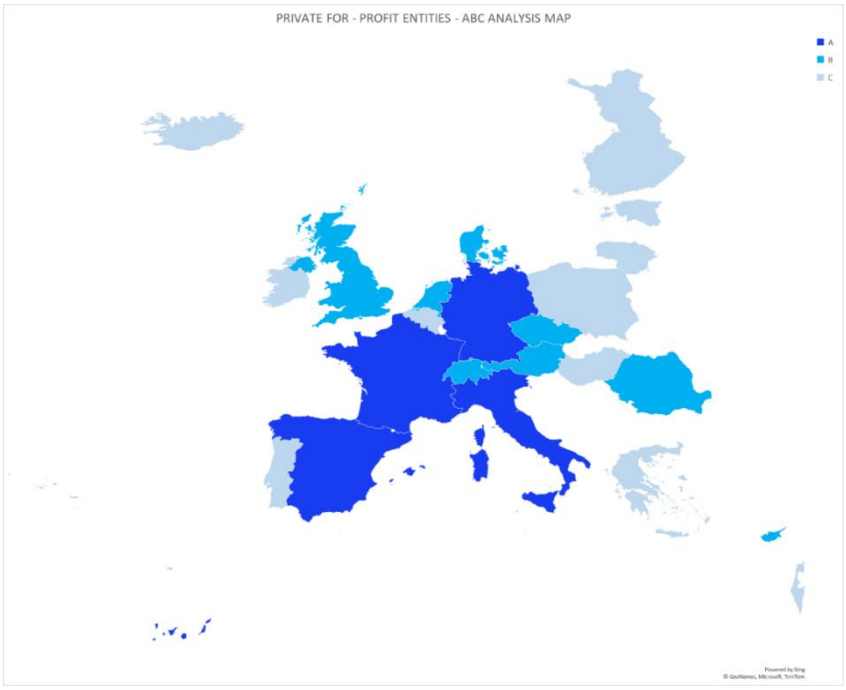


Figure 30: Private for-profit entities- ABC analysis

ABC analysis	Private for-profit entities
Germany	A
Italy	A
France	A
Spain	A
Switzerland	B
Netherlands	B
UK	B
Austria	B
Cyprus	B
Romania	B
Czechia	B
Denmark	B
Belgium	C
Estonia	C
Israel	C
Ireland	C
Portugal	C
Hungary	C
Finland	C
Greece	C
Poland	C
Lithuania	C
Iceland	C
Sweden	C

In contrast with the ABC analysis over the number of projects, but in line with the fragmentation assessment above, making an exception for the United Kingdom, we find that those countries considered the most developed from a manufacturing point of view are classified in the cluster A. Then, in class B countries are those that are perceived as innovative, especially thanks to the connection with bright universities, or those nations with a growing drones' market. Whilst in class C, there are smaller countries or underdeveloped ones from a technological point of view.

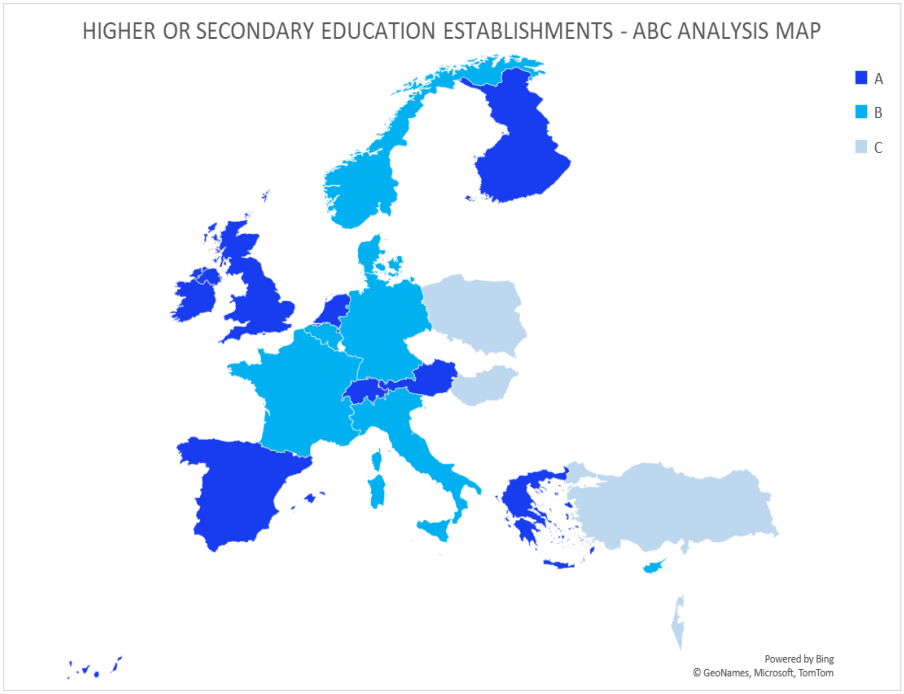
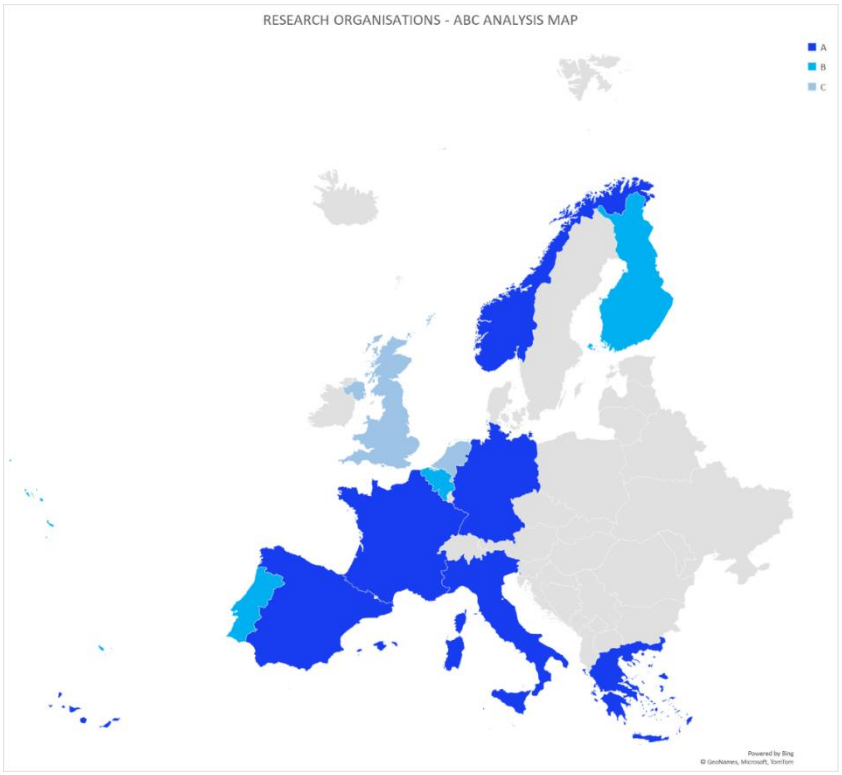


Figure 31: Higher or Secondary Education Establishments - ABC analysis

ABC ANALYSIS	Higher or Secondary Education Establishments
UK	A
Netherlands	A
Switzerland	A
Spain	A
Greece	A
Finland	A
Austria	A
Ireland	A
Denmark	B
Belgium	B
Cyprus	B
Italy	B
Germany	B
Norway	B
France	B
Sweden	C
Israel	C
Hungary	C
Poland	C
Malta	C
Turkey	C

Concerning the Higher or Secondary Education Establishments coordinators' type, we have an importance overturning, except for Spain which is still in the first cluster, with countries previously in class B or C that are now classified as A. This is because certain nations such as Netherlands, Switzerland or UK have very advanced universities, which in accordance with what we have previously verified does not automatically imply strong private corporations likewise (even if it could be an aid thanks to intra-fields connections). On the other hand,

countries with well-developed manufacturing systems, that previously were classified in the top class, do not show a so strong university ecosystem.



ABC ANALYSIS	Research Organisations
Norway	A
Greece	A
Italy	A
Germany	A
Spain	A
France	A
Finland	B
Portugal	B
Belgium	B
United Kingdom	C
Netherlands	C

Figure 32: Research Organisations - ABC analysis

Finally, research organization coordinators' type is less diffuse, compared to the previous two, probably due to the low number of research centers dealing with drones' thematic or caused by their scarce participation in EU programmes. Anyway, some of the biggest nations are also the ones able to collect the greatest amount of funds.

Talking about Public Bodies there is no meaning to analyze them in detail with a tailored ABC analysis since there are only two projects related to the drones world.

In the end, since we have performed two ABC analyses, on the volumes of projects and funds raised, it is valuable to cross them aiming to understand whether the countries perform similarly under the two perspectives. Thus, it is necessary to aggregate all the ABC analyses conducted on funds raised for the different coordinator's types to get a unified classification suitable for the multicriteria assessment explained above.

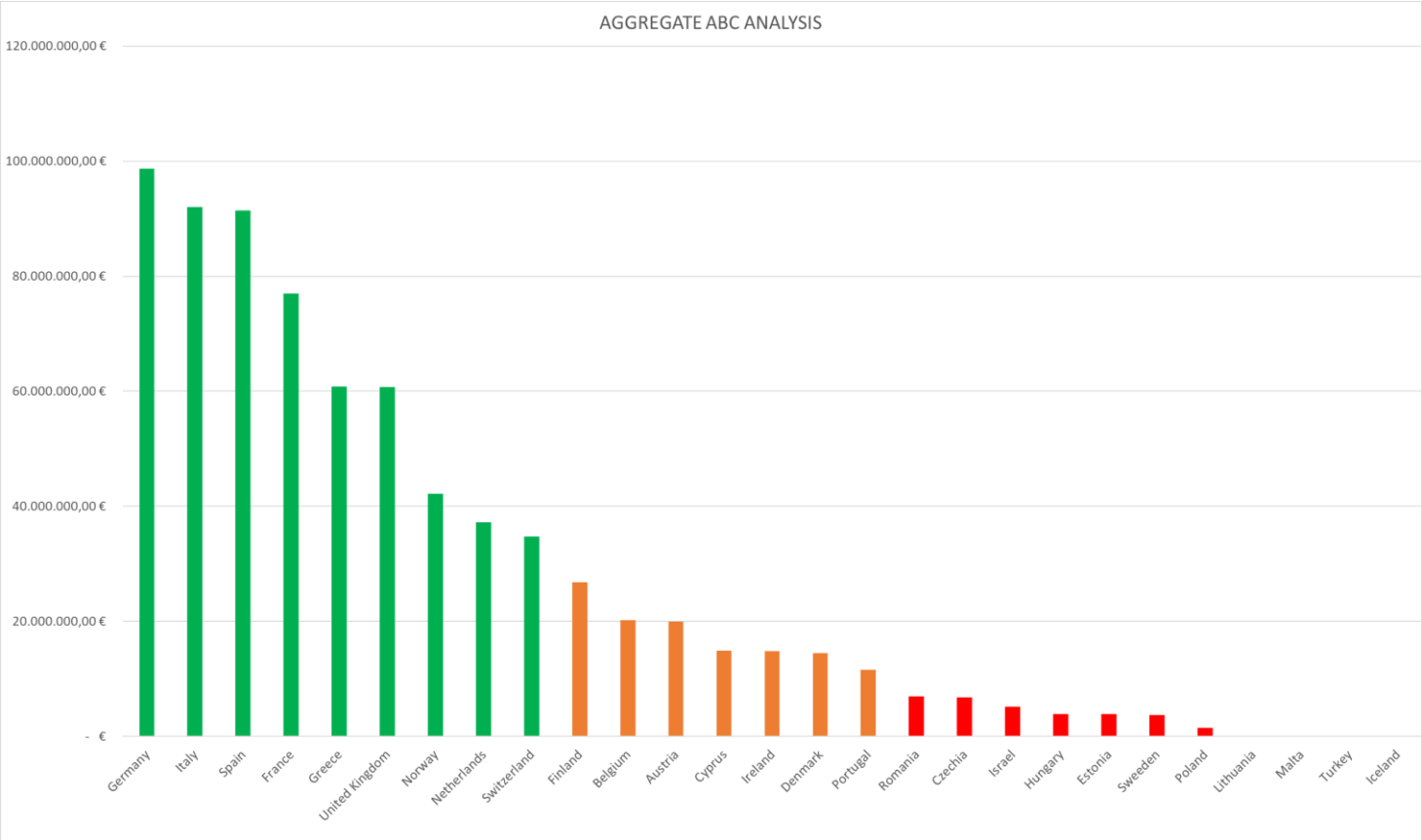


Figure 33: Aggregate ABC analysis by country

This bars chart depicts the distribution of projects' funds among the different nations, classified in decreasing order. However, it is not properly clarifying whether countries' organizations have outperformed the European competition

by getting higher funds in individual projects. Indeed, the weakness of such aggregate analysis stands in the impossibility of getting how projects performed on average. Thus, we decide to carry out the aggregate ABC assessment, performed above, on the average funds per project gained by nations.

Despite the greater comprehensibility brought by average measures, the analysis could be distorted by a small number of projects on which the average of certain countries is computed. Therefore, it is advisable to clean up from nations with a number of projects that fall below a defined threshold. In this respect, we take a minimum limit of projects that is equal to half of the overall average. Countries with a minor frequency in such framework programmes, such countries like Sweden and Ireland or underdeveloped nations such as Romania and Hungary, are not so valuable to be considered in the analysis.

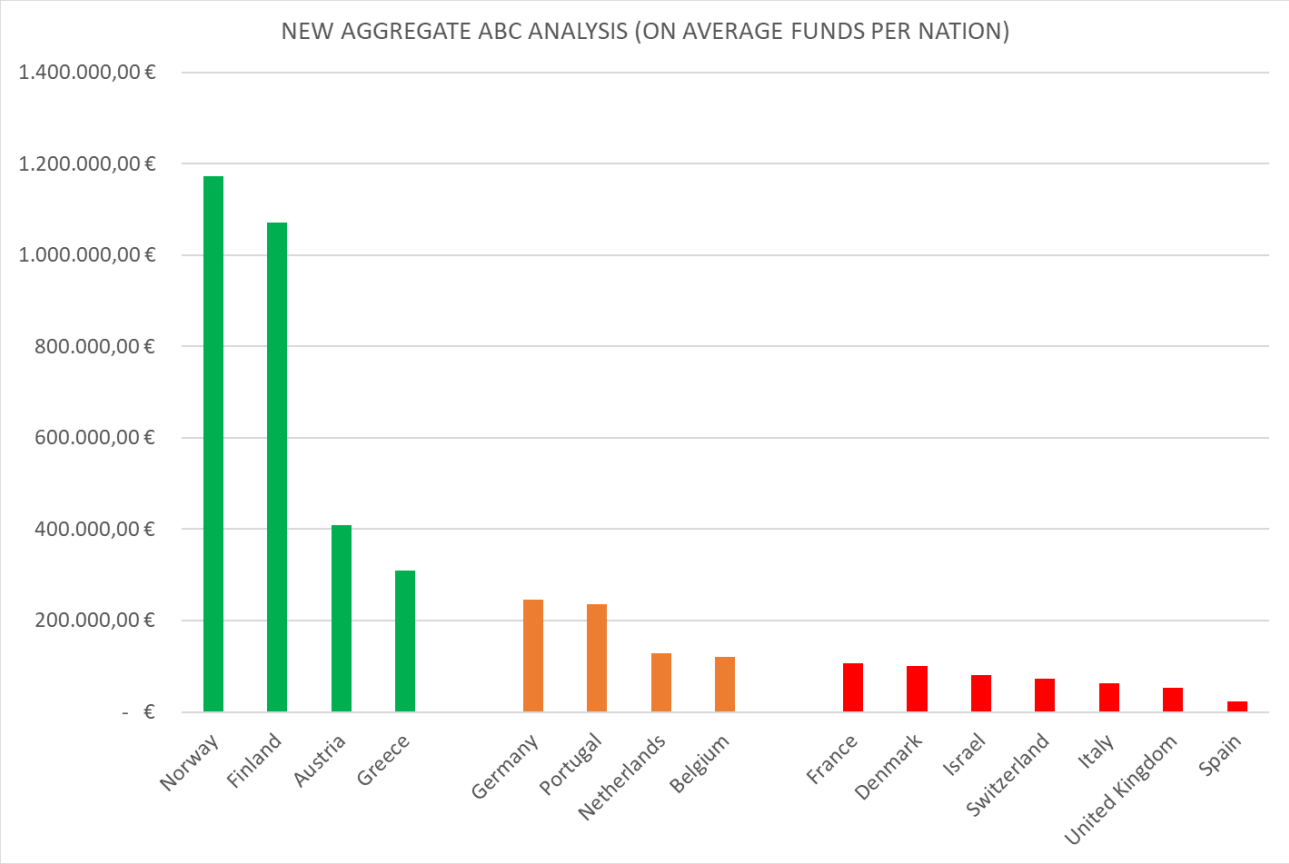


Figure 34: ABC analysis on average funds per nation

The new framework shows a completely different situation compared to the previous aggregate study. Indeed, countries, like Spain, UK and Italy, able to collect an overall amount of funds classifiable as A cluster, here they are the least performing nations. Whilst companies with a significant presence of research organizations and universities, such as Norway and Finland, find themselves at the top of the rank. In between, we find class B, which mainly consists of countries with a thriving educational system, made up of strong research centers and well-known universities, such as Netherlands and Belgium. Furthermore, a country like Germany which is predominantly manufacturing-based but compared to Italy and Spain it presents more structured companies.

Once finalized the new aggregated ABC for funds raised, we can build up the ABC multicriteria which is based on the number of projects per nation and average funds raised per nation, as follows:

# of Projects/ Funds Raised	A (€)	B (€)	C (€)
A (#)	Greece	Belgium Netherlands Germany	Denmark France Switzerland Italy Spain UK
B (#)	Norway Austria Finland	Portugal	Israel
C (#)			Czechia Sweden

Table 12: Number of projects and average funds raised per nation

This analysis tells us that countries on the diagonal such as Greece and Portugal have similar performance in term of number of projects and amount of money coming from them. Therefore, this means that Greece in the AA cluster can be though as the best, with companies able to win many calls that are usually significant in terms of EU contribution. Whilst BB cluster, with Portugal, represents a cluster with medium number of projects and narrowed budget's contributions.

Concerning nations outside the diagonal, those above it are characterized by a greater number of projects, but with more restricted budget contributions. This

implies that these financed projects are likely perceived less strategic by the European commission (especially for those in class BC). On the other hand, clusters below the diagonal are featured by a narrowed number of projects but with high contribution. In this case, it could be due to the lower number of companies nationwide, which are then able to propose and pursue project's conceived as vital by the commission.

The nations assessment gave us an understanding of how organizations from different states perform. However, calls in such kind of framework programmes are won thanks to inspiring project's proposals retained in line with programme's objectives. Thus, an attentive analysis of winning projects typologies would help in the knowledge consolidation of the most rewarded projects, building up solid foundations for entities that are willing to participate in the future.

The projects are divided into three different macro-categories: Product, Service and Other. The first one refers to a physical product that could be in the form of hardware or software. Service macro-category, instead, embeds all those services that can be carried out through the usage of drones ranging from inspections and maintenance to media and art entertainment services. Last but not least, we have Other macro-category which is a miscellaneous one containing platforms for data exchange, solutions related to Advanced Air Mobility (AAM) and Unmanned Traffic Management (UTM) and projects classified as research activities & training.

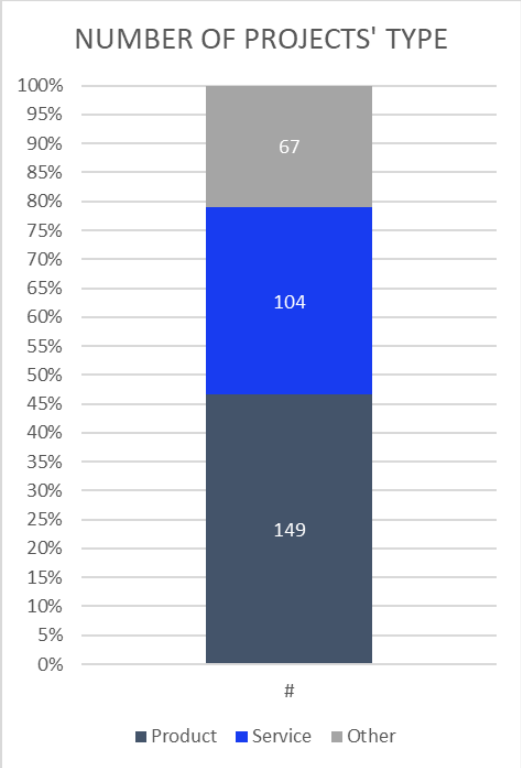


Figure 36: Number of project per macro category

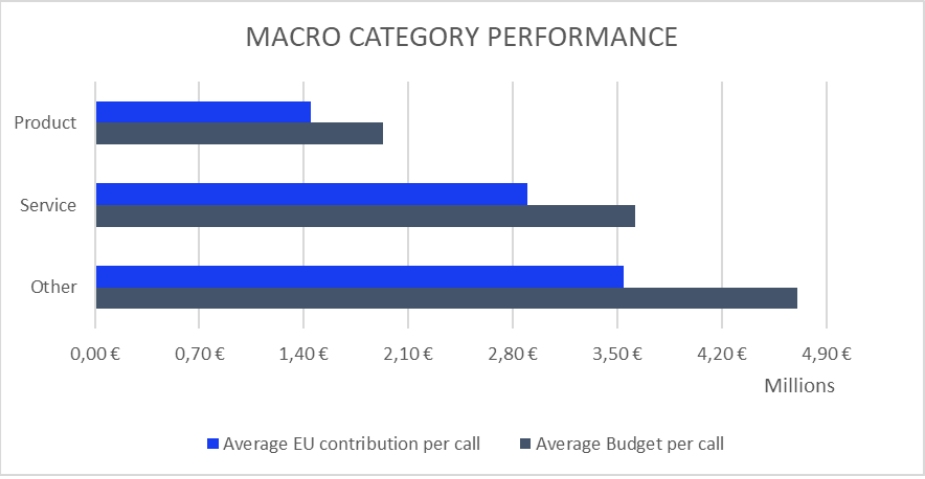


Figure 35: Average EU contribution and budget per macro category

The chart on the top shows the recurrency of projects types, underling the massive presence of products and service solutions compared to the other ones. Nevertheless, the performance diagram tells us that projects pertaining to the Other macro-category reach on average greater total budget and contribution from the EU. Despite the smaller statistical significance of such category's data, due to the significantly lower number of samples, it is reasonable to think they are provided with larger support. This is because most of the topics treated in Other refer to the establishment of rules and simulations of the future air traffic, where drones will be the masters, which is at the center of EU Smart Cities initiatives. Furthermore, Other macro-category also contains Research activity initiatives, which is placed at the heart of EU framework programmes pillars in order to sustain basic knowledge generation. Whilst Product and Service macro-categories, especially the first one, exhibit a downgrade both in terms of the total budget and EU contribution. In all the three categories seen above, we find an almost equal proportionality between the total budget and the amount covered by contributions.

Despite a first distinction brought by macro-categories, it is necessary to go into detail by breaking them down towards a more in-depth level. Thus, we analyze separately each macro-categories to better comprehend what organizations are really proposing within their projects.

Starting from the Product macro-category, we find two levels of detail structure, where it is firstly split into hardware and software. Then, a greater distinction is reached at the second level, in which for each branch there are specific kinds of hardware or software proposed.

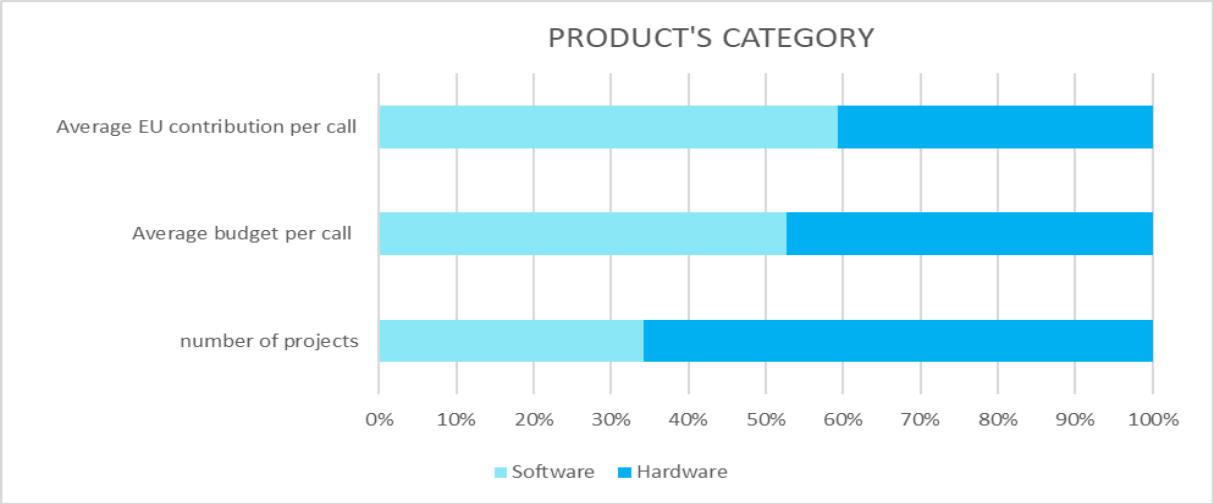


Figure 37: Number of projects and contributions by software and hardware

Looking at the performance achieved by the two branches of the product's macro-category, we notice a higher number of projects involving hardware, more than 65%, compared to software's ones. However, despite these two sub-categories share a similar average total budget per project, there is a sharp distinction between how much projects' coordinators can raise in terms of EU contribution on average. Indeed, software proposals have been able to reach contributions that are around 60% of the total macro-category contribution, while hardware ones barely overcome 40%.

The Hardware micro-category is then composed by four types of hardware. Drone platforms, namely drone devices, which is the most recurrent project field when we talk about hardware and thus also for the product. Then, the Payload is the second most frequent type of hardware, which represents all the

independent types of equipment a drone can be featured with (such as cameras, sensors….). The third type of item is Components that find less than half of the projects of the previous kind and comprises all those components needed to run a drone (such as engine, propeller…). Finally, one of the most innovative and growing fields in the hardware sphere is Counter Drone solutions, even if the least frequent, where we can find all those products aimed at taking down other drones.

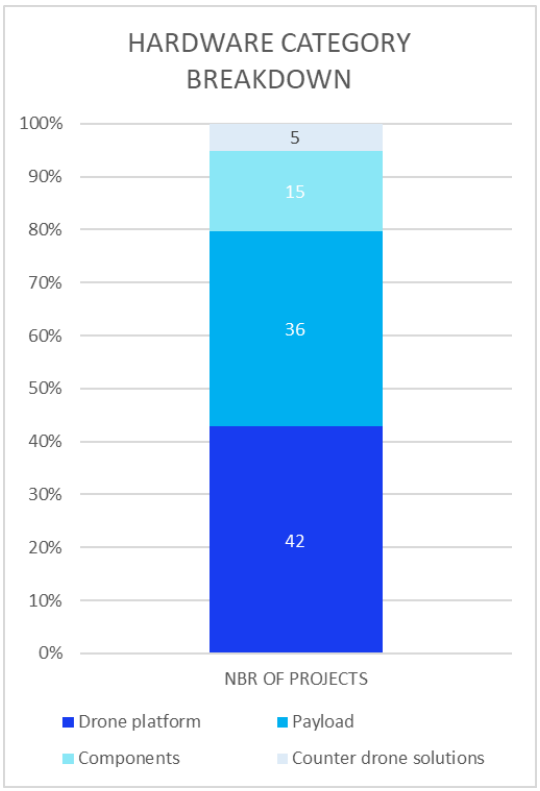


Figure 38: Number of project per micro category

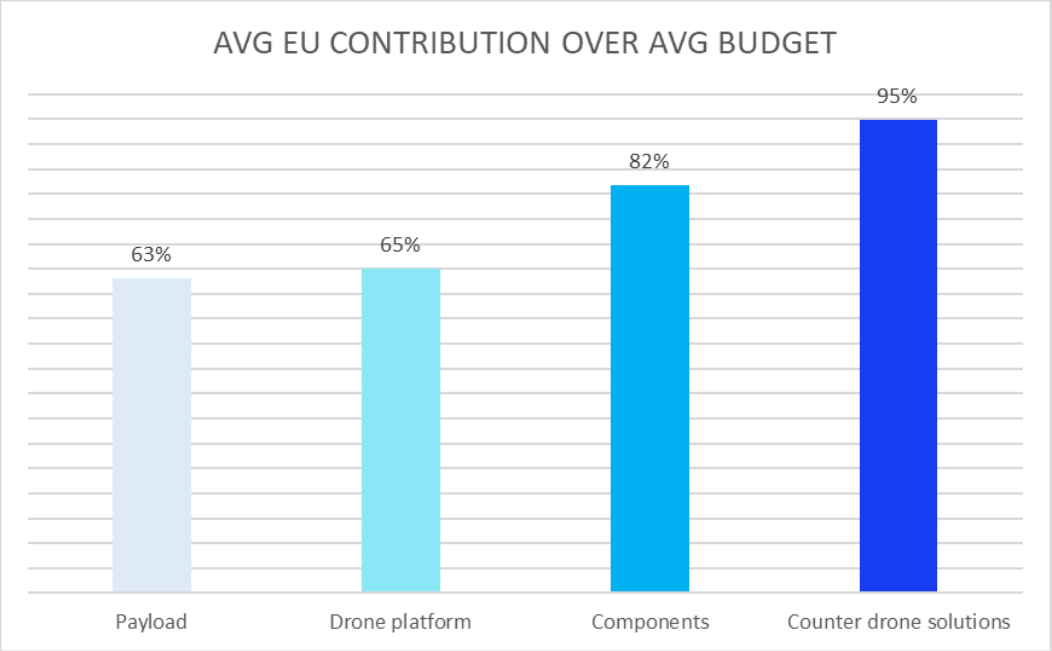


Figure 39: Average EU contribution over average budget

Assessing the four hardware types from an economical point of view, particularly considering the rates between average contribution and average total budget, we understand how strategic these kinds of products are. Indeed, despite Counter drone solutions and Components types being less recurrent, but probably also less statistically significant, they are better perceived and sustained by the EU compared to payloads and Drone platforms.

Then shifting towards the software micro-category, we break it down into all its three subcategories. These latter are similarly distributed in terms of a number of projects, with Data analysis software as most recurrent followed by Navigation and Flights Planning & Fleet Operations Management.

Secondly, it is not superfluous to emphasize that as the numbers of projects are very similar across the subcategories, it is the same with EU contributions. Indeed, if we take the same performance ratio considered before, average contribution over average budget, it is readily identifiable that the three software types are perceived almost in the same way. The importance scale also from an economic perspective is kept equal to the number of projects one, with Data analysis software at the lead followed by Navigation and Flights Planning.

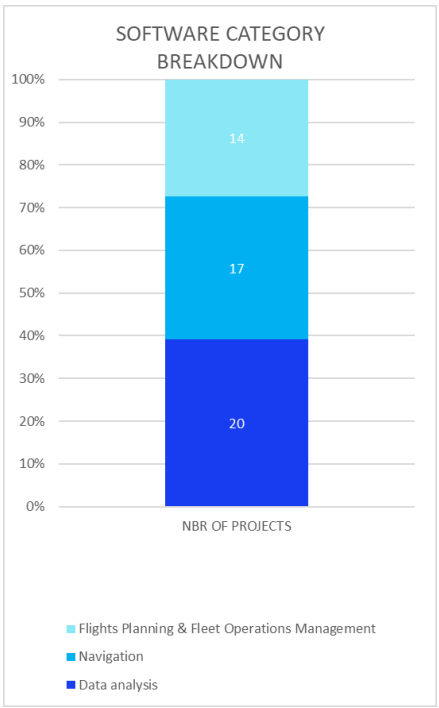


Figure 40: Software category breakdown

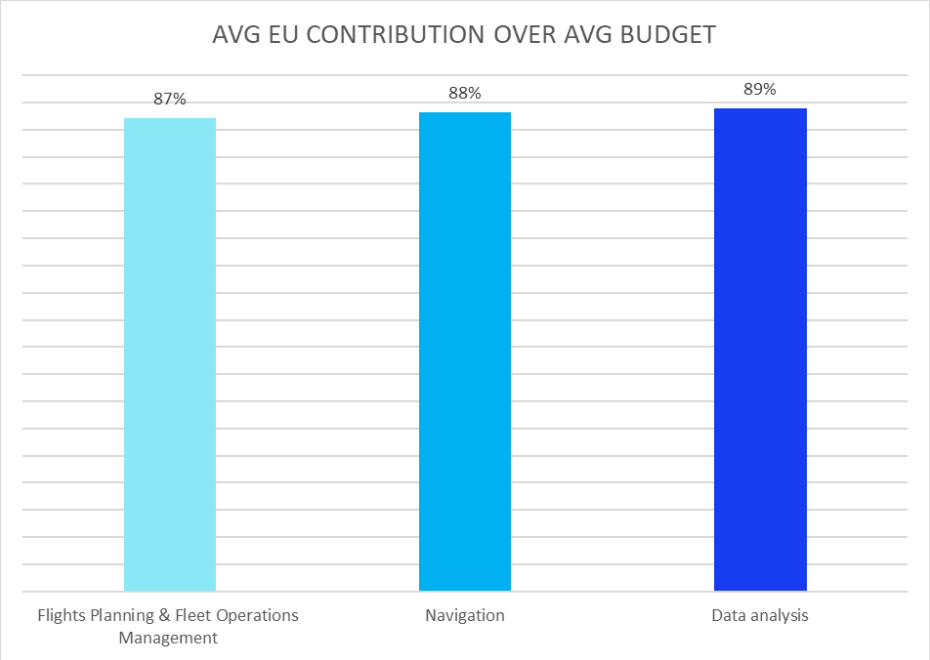


Figure 41: Average EU contribution over average budget

The second macro-category in terms of the number of projects regards Service one, which is almost 35% of drones' projects. On the contrary to the previous macro-category, this owns only one level of detail, where all the kinds of services are specified. Therefore, we can proceed with the macro-category breakdown such that we can recognize the most strategic services.

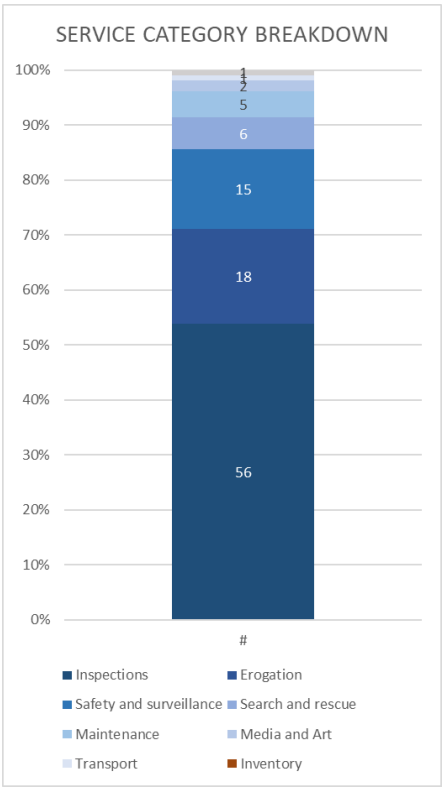


Figure 42: Service category breakdown

Despite the level of detail is only one, the total subcategories are more than the Products' ones. These latter are quite different from each other, with some like Inspections and Safety & Surveillance that are more mature and present in terms of the number of projects, while others such as Inventory and Transport exhibit great potentials to become the most important services but are still underdeveloped. Inspections' service represents the subcategory with the highest number of projects by far and probably the most widespread in the business environment thanks to the large applications in public and private sectors (such as gas pipeline, energy infrastructure and railway). Erogation and Safety & Surveillance follow in terms of significance, even if with a dimension that is more than three times smaller compared to Inspections. Subsequently,

all the other subcategories are of minor relevance, always in terms of the number of projects financed, with Search & Rescue and Maintenance that stand out among the others.

Afterwards, bearing in mind the ascertainments made above, we assess the economic perspective as with the previous categories looking at the average contribution and average projects' budget ratio per service type. Some of them, such as Transport, Inventory and Media & Art, are not really statistically significant since they present just one or two projects. However, this could be connected to an EU carelessness regarding these topics or a shortage of such kinds of proposals. Whilst the other subcategories, which can be considered some more and some less statistically significant, show interesting results.

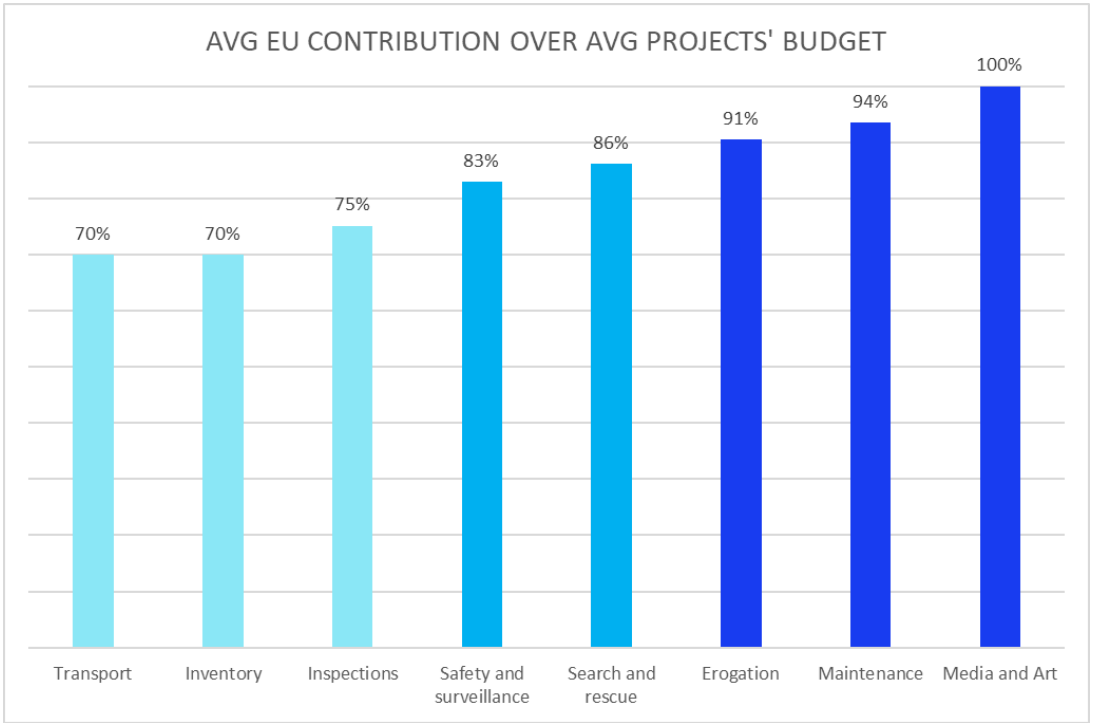


Figure 43: Average contribution over average projects budget

Erogation and Safety & Surveillance have received greater European funds compared to the most diffused service type Inspections. Indeed, regarding the first, there is a multitude of experimentations and studies that range from the utilization of drones for the transmission of signals such as 5G until agriculture applications aimed at releasing various substances among which insecticides. On the other hand, Safety & Surveillance has reached a special interest during the pandemic crisis given the need from law enforcement to monitor gatherings and respect the rules.

Finally, we have the miscellaneous macro-category, Other, which involves subcategories widely differing and that need to be taken separately or in groups for a detailed analysis. This macro-category owns, as the previous one, only one level of detail where subcategories are explained. In this sense, we can break it down in order to understand the relevance of each of them with regard to the number of projects.

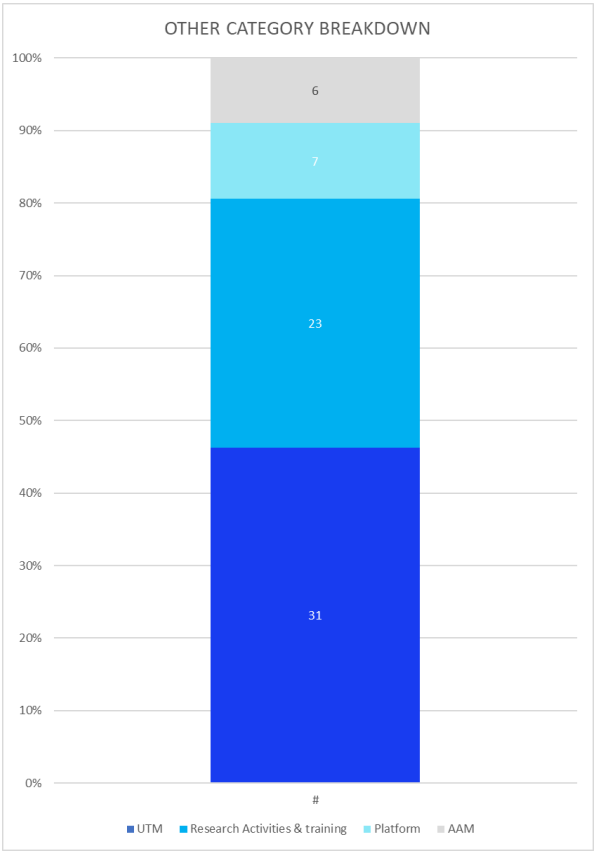


Figure 44: Other category breakdown

UTM and AAM are the only subcategories that can be analyzed together since they make reference to similar topics. Unmanned Traffic Management results more important, given the much bigger number of projects, because of the more rooted aerospace issues treated that go also beyond the drones' industry itself. Whilst Advanced Air Mobility is a fresh theme, introduced by NASA, which specifically faces those services, regarding drones' delivery and people transportation, that will be established in the next future.

Then, Research Activities & Training finds a consistent number of projects, even when compared with subcategories of other macro-categories, mainly due to the need for Horizon 2020 to bridge the gap of basic knowledge that is not privately developed since the low or null financial returns.

Platform subcategory embeds software concerning the drones' sphere for the exchange of data and it is one of the least supported. This latter owns the potential to grow larger once the drones' industry will stabilize and a higher necessity of drones' data comes true.

Shifting our focus towards a more economic perspective, we encounter an almost similar contribution for UTM and AAM projects on average, even if the latter does not possess a large range of samples to be considered reliable. Then, Research Activities & Training projects are largely supported and financed by the EU commission recording a rate that almost reaches 100%. Finally, platforms are highly backed by the EU, even if there is no statistical evidence that confirms it due to the narrowed set of data.

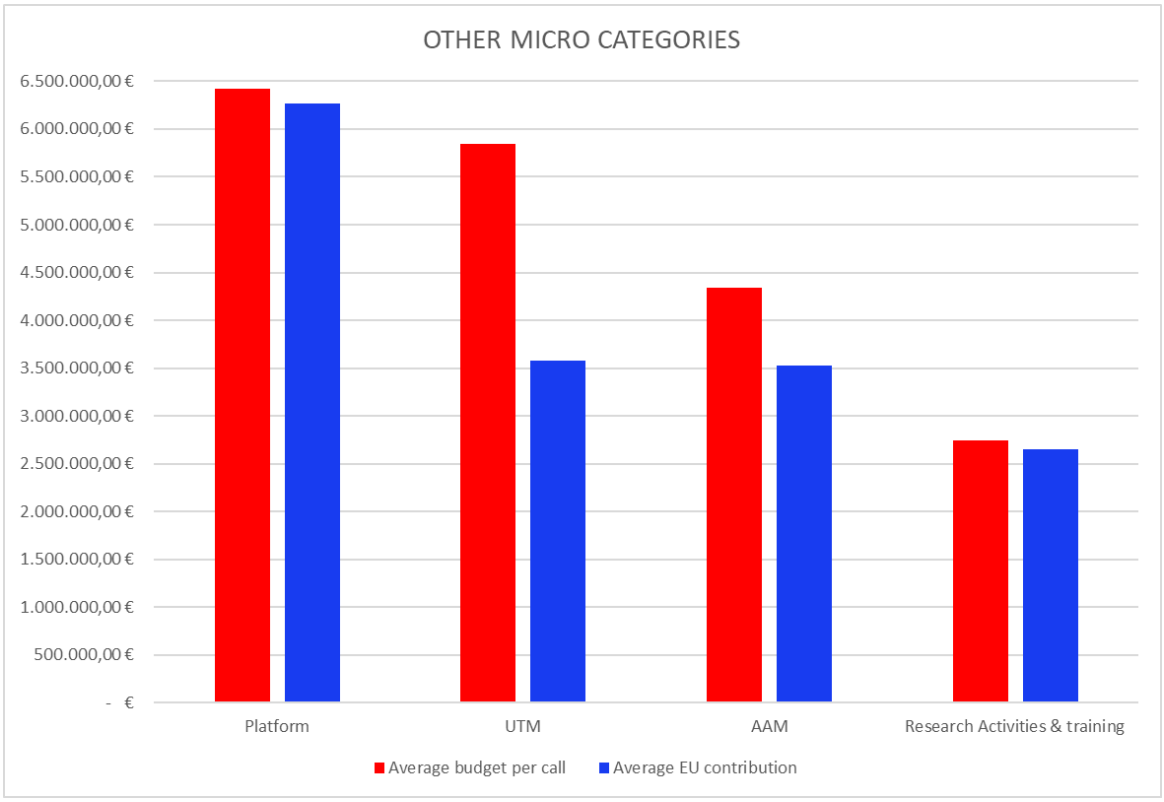


Figure 45: Other micro categories

At the end of our analysis, we consider those remaining factors that had an influence on the accomplishments of the calls' victory, namely funding schema chosen and projects' participants.

Talking about funding schemas, we assess the typology of schemas by looking at the macro-category of them, as follows:

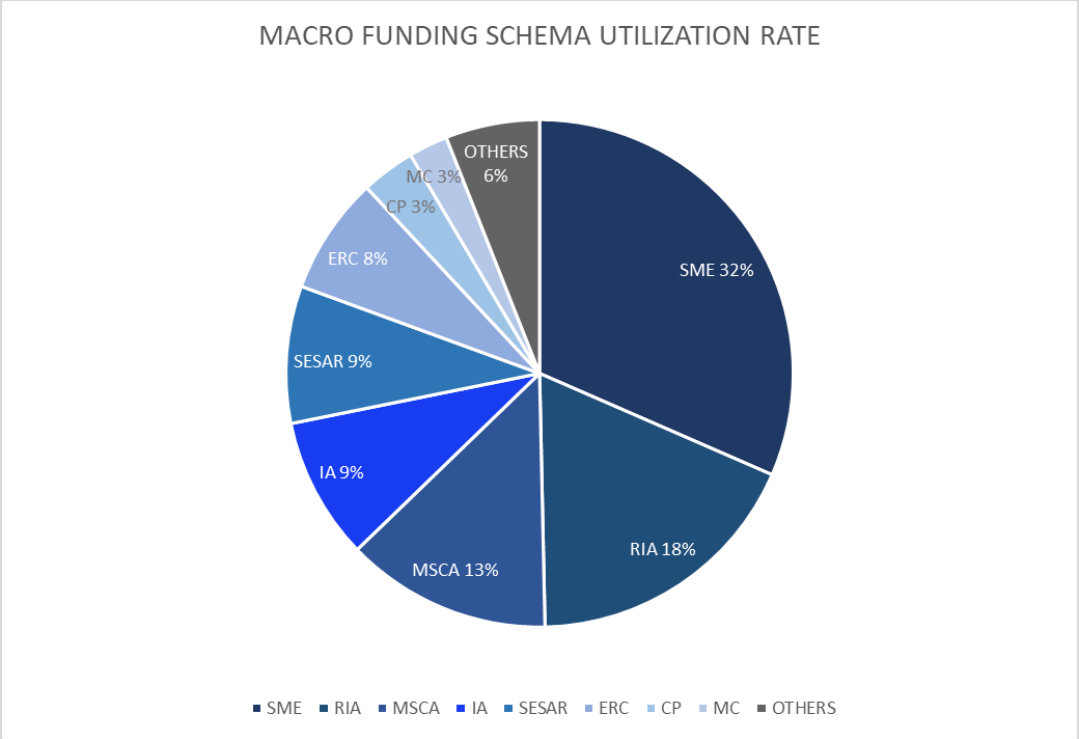


Figure 46: Macro funding schema utilization rate

The most adopted macro-category of the scheme is SME, which is aimed at supporting both individual SMEs and groups of SMEs with international ambition that are determined to turn their innovative business ideas into reality. Then Research & Innovation Actions is the second most utilized, with 18%, and enables to carry out basic or applied researches towards the exploration of new knowledge or the viability assessment of new or improved technological solutions. On the contrary to the previous two, Marie Sklodowska-Curie Actions (MSCA) refers to research funding given personal funds that scientists can use to gain experience abroad and cross-sectoral training. In line with this latter, we find the European Research Council (ERC) which is supposed to back frontier researches made by researchers and teams. Whilst the other macro schemes are less utilized and relate to various methodologies of innovation, for instance

Innovation Actions (IA) directly finances the production of plans and arrangements of new or improved solutions; while SESAR is specifically aimed at modernizing the Air Traffic Management working towards the implementation of a unique European sky.

The last factor to consider is projects' participants, how they are distributed and their influence over the EU contribution.

Starting from a general overview, we can see that most of the projects, almost half of them, have only the coordinator. However, if we run the average counting all the projects it will return us 6,4 which is a doped value caused by very few projects with a large number of participants. Indeed, if we analyze the median,

it is possible to get a more reasonable result which is around 2. Then looking at the projects' participants distribution map, you can say that from the 16th participant on the number of projects is a meaningless part, identified as the 10% of the total. Therefore, in absolute value, a narrowed number of participants would signify the largest portion of contribution deployed by the EU.

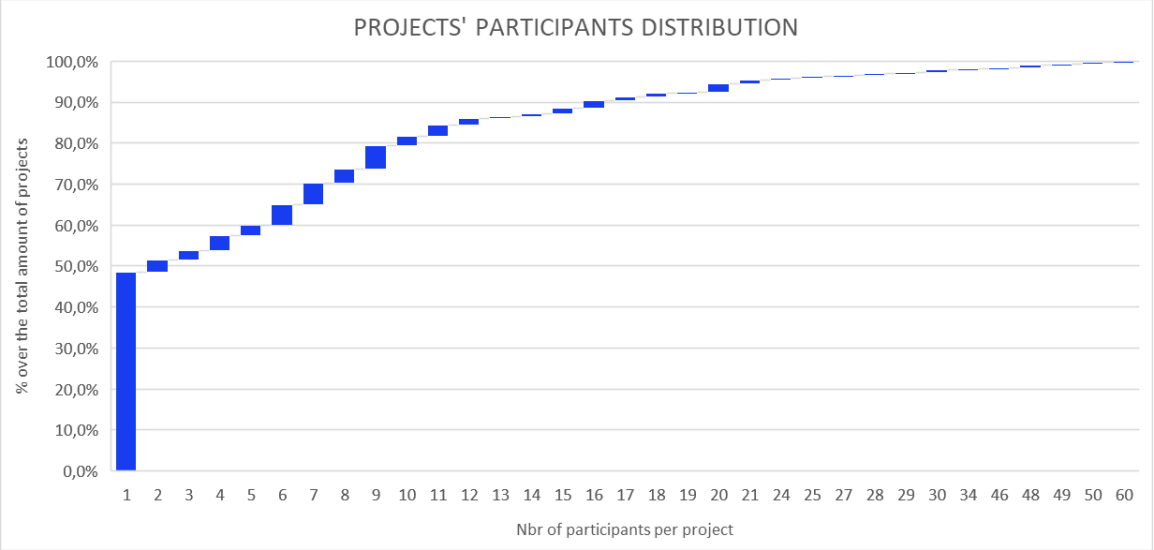


Figure 48: Projects' participants distribution

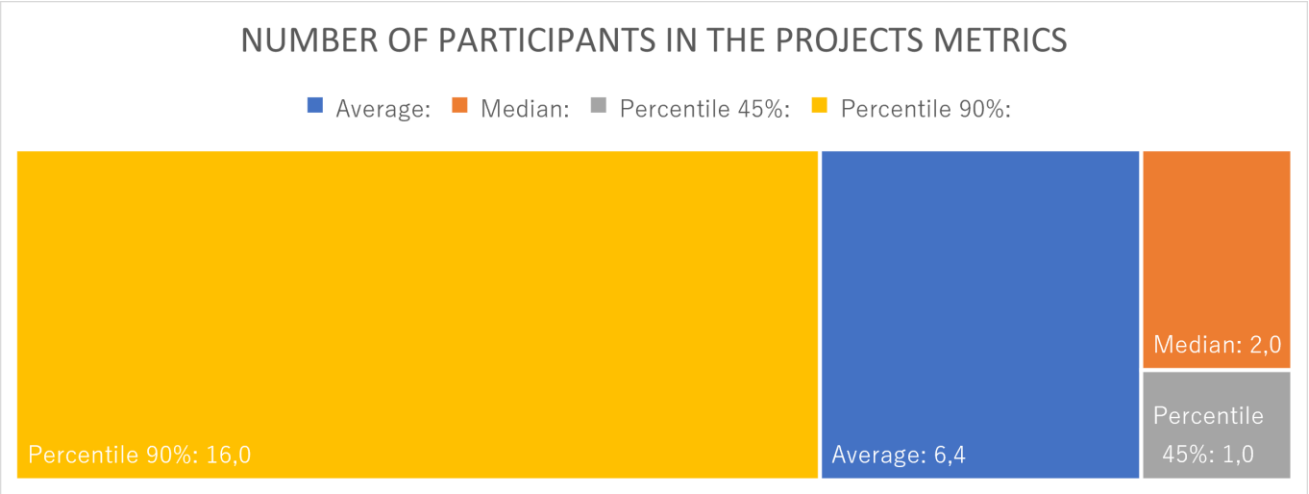


Figure 47: Number of participants in the projects metrics

Subsequently, we need to think about the participants and their support to the projects. They are undoubtedly vital to the projects' completion thanks to their technical knowledge and experience in the field. However, we are eager to understand whether their aids find space even in the financial contribution provided by the European Union. Therefore, we assess the financial intake given by participants to each project by dividing projects into different clusters

identified through the number of participants. In this sense, it is substantial to take into account the average value achieved by each cluster. Indeed, despite the fact that each project is different, this streamlining lead us towards a better comprehension of the data.

The first chart below shows us the distribution of EU contributions along the diverse clusters. Focusing on the chart's development, at a first sight, it seems that the EU contribution grows with the raise of participants. This is, in fact, partially true since once overcome the 26th participants' group the growth becomes unstable and more unpredictable.

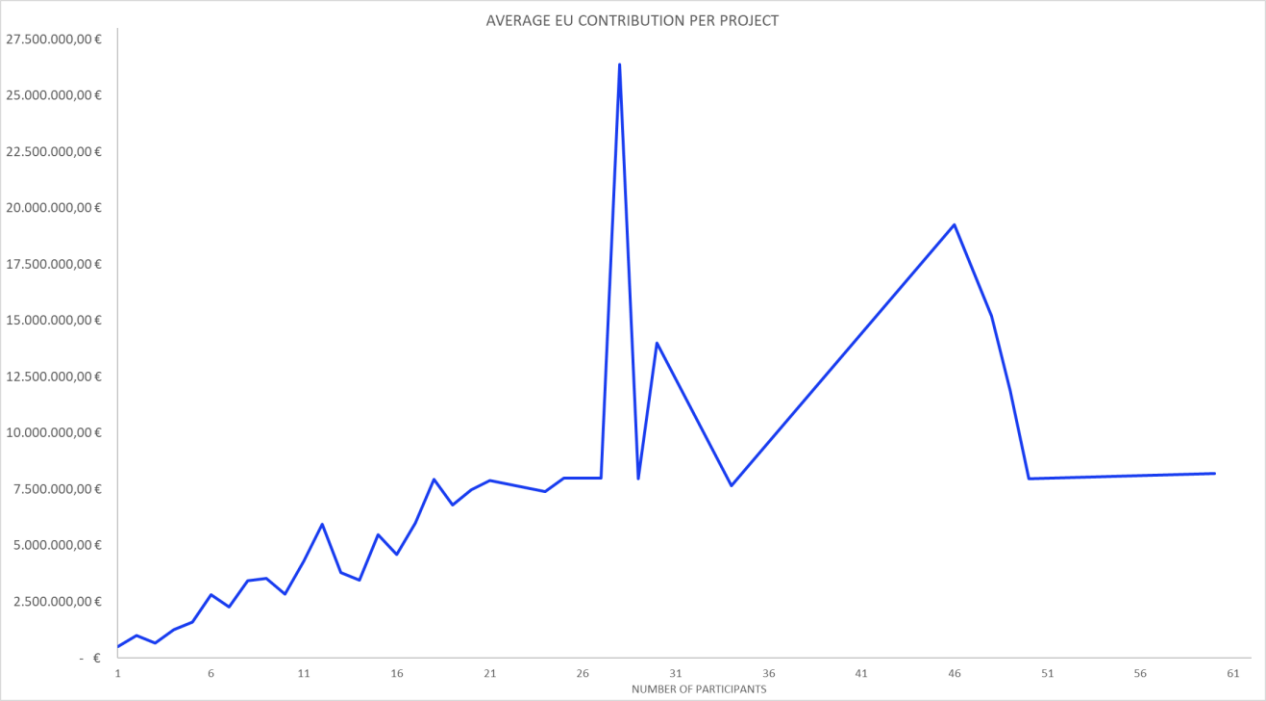


Figure 49: Average EU contribution per project

Despite the long-tail dispersion, we could better understand data and potential correlation if we switch from a unit scale to a logarithmic one. Indeed, a logarithmic scale chart enables us to shrink the volatility and gain a more intelligible graph where it is easier to find correlations.

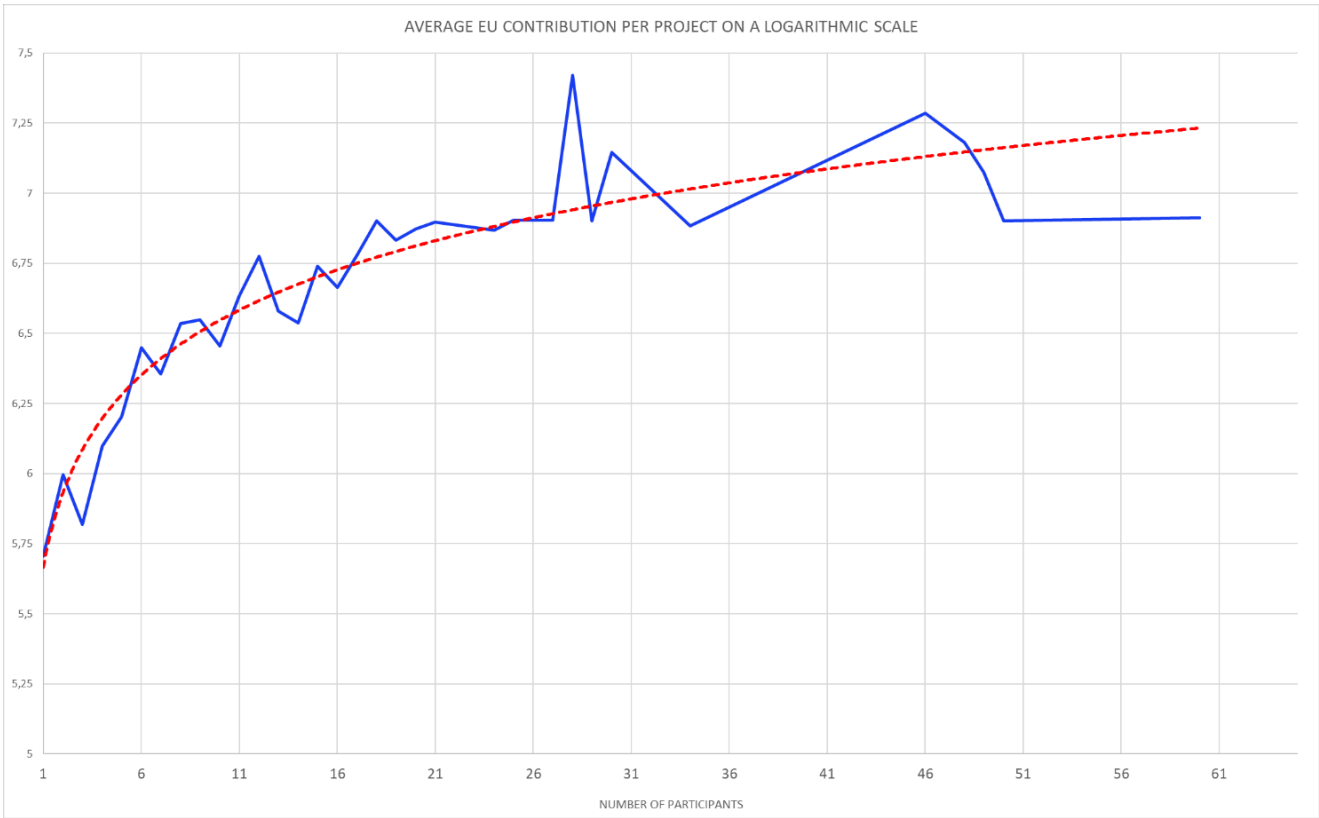


Figure 50: Average Eu contribution per project on a logarithmic scale

This new scale allows a better interpretation of the relationship between the number of participants in each project and the contribution obtained. If we apply logistic regression to this new scaled data, we find that the initial growth slows down its growth rate until it reaches a limit that in absolute terms is set around 8.000.000 € and 10.000.000€ on average.

This was just a brief descriptive introductive analysis that precedes an in-depth study based on econometric models to figure out whether sounder correlations can be learned. Indeed, we are going to build up a series of econometric models that take into consideration a larger set of variables over a wide sample of drones companies, where High Tech Entrepreneurial Ventures are the vast majority, among which there are also Horizon 2020 winners. The next chapter is, thus, considered the brain trust of our work, where drones' private organizations that have participated and not to FPs will be taken under review with a set of more sophisticated econometric models to figure out potential features that might be developed when firms want to win EU framework programme tenders.

7 Econometric model

The last chapter has permitted us to obtain a comprehensive understanding of firms, within the drones' environment, competing in European Framework programmes. In this sense, most of the analysis and charts performed are mainly descriptive, aimed at outlining what happened so far from several perspectives. Despite the vast majority of descriptive assessments, at the end of the former chapter, we touched another sphere of statistical analysis: the prescriptive one. The latter has been utilized to grasp a potential relationship between the number of participants and the funds raised. However, regardless the usefulness of such kind of study, the topic on which the analysis has been carried out appears narrowed in terms of expected results both due to the confined availability of data and potential research contributions.

Therefore, we want to keep going with prescriptive statistical analysis, but shifting the focus on more interesting issues that could truly support the development of existing literature while assisting firms in the achievements of public funds.

7.1. Methodology

This chapter constitutes the backbone of our thesis, where we would like to reach an evolved knowledge regarding the most impactful features that companies competing into EU FP should develop. Indeed, this represents the final answer to the primary research question we have set. Thus, aiming at fulfilling such a goal we need to enlarge the data available which cannot be restricted to the project information we have previously described. Another dataset, containing the core characteristics of drones' companies has to be adopted. This is because, despite the details stated by FP's projects, there is no

guarantee that projects coordinators or participants find their core businesses within such themes. On the other hand, basic features such as the types of solutions provided, multi-channel presence, and environment in which these firms operate would provide a wider spectrum of analysis that with greater likelihood can lead us to sounder and meaningful results.

Which is the most appropriate dataset usable?

Thanks to the Drones' Observatory of Politecnico of Milan and its network, we had the opportunity to rely on a specific dataset that shares some of the peculiarities we were looking for. This latter, to be more precise, goes beyond our actual necessities because it depicts in-depth the specificities of almost all worldwide innovative small firms for drones, which account for 5283, founded over a temporal horizon that spans from 2011 to 2021. Furthermore, some of these startups that have been founded at the beginning of such period had the opportunity to grow and consolidate themselves, while others suffered the competition and fell into decline. So, firms' data might also be not up to date whether they fall into this last scenario.

The dataset has been designed based on two main platforms' data extractions: Crunchbase and Orbis. Nevertheless, not all the firms can be found on both platforms, so the resulting dataset exhibits missing parts.

Drones' startups' dataset is structured as follows:

a. *Statutory information*: the name, description, founding date, geographical scope, and main contacts of each organization.

b. *Website & Social Media*: the communication channels utilized or not by the companies are reported under a few dedicated columns.

c. *Equity*: here the companies are described looking at whether it is baked or not, where in the first case much more details on founders and lead investors are provided.

d. *Market's details*: the market of reference is given along with the NACE code. Furthermore, specificities concerning the solutions' offered is explained in detail based on several alternatives.

e. *Environment*: the companies operate in certain application fields, which are more specific than the sector associated with the NACE code. Moreover, the client's business environments are specified to spot a light on the downstream part of the supply chain.

f. *Annual Report*: information and KPIs that are extracted from companies' balance sheets and income statements to fully outline their financial and non-financial performances.

Here below there are some examples of the 6 different areas.

Statutory Information

Company Name	Description	BvdID	Founded Date	Headquarter City	Headquarter State	Headquarter Geographical area	Contact email	Phone contact
FlyingBasket	FlyingBasket is a design, production, operation and maintenance of Remotely Piloted Aircraft Systems	IT02868860210	01/01/2015	Ortisei	Italy	Europe	applications@flyingbasket.com	+39 471172669

Table 13: Statutory Information

Website & Social Media

Company Name	Website	Twitter	Facebook	Linkedin	Social media channels counter
FlyingBasket	www.flyingbasket.com	twitter.com/fb_aviation	facebook.com/flyingbasketaviation/	linkedin.com/company/flyingbasket/	4

Table 14: Website and Social Media information

Equity

Company Name	Baked company	For-Profit?	Founder 1	Founder 2	Last Founding date	Lead Investor 1	Lead Investor 2
FlyingBasket	1	1	n.a.		21/10/2020	MassChallenge	

Table 15: Equity information

Market's Details

Company Name	B2B (1)	B2C (2)	B2B2C (5)	Target Market (B2B + B2C + B2B2C)	NACE code	Product	Service	Combination	Activity Typology
FlyingBasket	1	2		3	7112	1	2	3	Specialized

Table 16: Market Details

Environment

Company Name	Platform	Hardware	Software	Combination (H + S)	Value Proposition (P + H + S)	Hardware Type	Softwa re Type	Platform Type
FlyingBasket		1			1	Drone Platform, Payload, Components		

Table 17: Environment Information

Application Fields

Company Name	Unmanned Traffic Management	Search & Rescue	Site Inspections	Security & Surveillance	Transport	Inventory	Maintenance	Release	Entertainment & Media	Total Count
FlyingBasket					1					1

Table 18: Application Fields

Client Fields

Company Name	Agriculture	Utility	Entertainment & Media	Infrastructures & Buildings	Environment	Public Sector	Telco	Logistics & Transport	Healthcare & Pharmaceutical	Art & Culture	Total Counter
FlyingBasket								1			1

Table 19: Client Fields information

Annual Report

Company Name	Number of Employees	Revenues	Equity	Liability	Equity/Tot Assets	Fixed Assets	Cash & Cash Equivalents	Loans	Long-Term Debt	.....	.....
FlyingBasket	21										

Table 20: Annual Report

This dataset, as it is noticeable from the tables above, presents many empty cells for multiple reasons. First of all, not all companies are big enough to be required to issue their annual reports. Then, other data could be missed because of the lack of a certain firm in one of the two platforms, Orbis or Crunchbase, which implies the consequential lack of data in all the fields of such platform. Finally, since it involves companies also from outside Europe, we know there are some nations that do not oblige companies to draw a financial report.

After having understood the weaknesses of such dataset, we are ready to assess the correspondence with the one we have censused about Drones' FP. Indeed, thanks to this analysis we can gain the connection between those firms that won a tender and their features. However, there is no certainty that there will be enough matchings to create a well-functioning econometric model based on them. Thus, firstly a threshold of 8% matchings was set, between the two datasets, over the total amount of sample. In this regard, the whole number of firms in the dataset is established based on a series of filtering analyses and supplement activities, that will be presented below, needed to fulfill the columns of the dataset. As a result, the total number of rows, and so of firms, that respect the criteria in the selected columns is 552. Now, it is fundamental to set up a reliable method to figure out the matched companies.

So, which is the most suitable method assuming excel as working tool?

After an initial attempt with the implementation of nested Vlookup functions between the two different excels files, we found out that this approach was not trustworthy. Hence, a particular extension of excel, named Fuzzy Lookup, has been installed to carry out with greater reliability the matching process.

Fuzzy Lookup:

This method allows selecting two datasets, where pairs reside, with a certain range of columns. Then, we need to specify the ID column which is shared by both datasets and enables the link between them. In our case, the ID columns are the company name, even if they are not the most correct ones because there could be differences in the way they are written (for instance with or without the national legal form). However, a proper unique ID for each company was not present and Fuzzy Lookup advanced algorithms enable, differently from Vlookup functions, to find matches even when the ID is not 100% correct. Before getting the matches another step is needed, in fact, we have to set a similarity threshold which defines the level of similarity between the two ID columns. For instance, we set initially the highest threshold possible, 100%, where no deviations are accepted between the two IDs. In this way, we can get all those matches that are undoubtedly true. Thus, after this first skimming, we can gradually decrease the threshold level, verifying case by case if the matched proposed by the system makes any sense.

So, as a result of the Fuzzy Lookup process, we gained 54 matches that widely satisfy the prerequisite defined. Therefore, after having obtained the matches, we can proceed cleaning up the Drones' startups dataset which would bring us towards the ultimate achievement of 552 companies.

More in detail, the column fields selection relies on multi-variate criteria. Firstly, information availability predominantly imposes the exclusion of all those fields that do not allow a substantial number of rows (and so companies). This turns out to be the strictest criteria, which leads to drop a high number of fields such as most of the columns within the annual report area or the specific typologies of hardware and software. Afterward, fields that are not deemed of strategic importance are excluded from the selection, such as contact information and the national legal forms. Finally, columns based on words strings, such as description, cannot be considered due to econometric model requirements.

Then, after the application of the criteria above, before shifting to the econometric model definition and all the corresponding assumptions, we need to convert and modify certain columns' domains. Indeed, the dataset exhibits some typologies of data that cannot be accepted by any kind of econometric model, while others need to be clustered favoring an easier interpretation. The main notable changes that deserve better explanations are reported below:

1) Web & Social Media needs a massive conversion of most of its domains, in fact, it is not fundamental to specify in which social media channels companies operate, but rather whether they have it or not. Thus, instead of different types of social media and website columns, binary fields are created to state whether a company owns a website and at least one social media channel or none of those.
2) Geographical Scope is replaced by 5 different binary variables, where 4 out of 5 determines in which European group the company resides (South, North, West and East Europe). Whilst the 5th is specific for organizations based outside Europe. Furthermore, an additional field dedicated to whether a firm has its headquarter in a financial center, based Global Financial Center Index, is introduced to verify the potential impact on EU FP.
3) NACE code of each organization is shortened to two digits code with the purpose of producing common macro sectorial groups.
4) In the Environment area, for both application and client fields some macro-categories are created. The first new categories are grouped based on the level of maturity and innovation. *Filming, Inspections, and Release* constitute the most mature and operative cluster, which involves release, inspections, maintenance, and media & entertainment application fields. *Safety and Rescue* is the second macro category which is considered innovative within the niches of safety & surveillance,

counter drones, and search & rescue. Finally, *Logistics and Mobility* regards the least developed, but with greatest outlook, category group involving transport and inventory. On the other hand, client's fields are gathered into 4 main groups. In this sense, the first group which includes agriculture, environment, public administration, and utility went under the name of *Environment, Energy, and Society*. The second one includes all those *infrastructure and transportation* fields. Then, a *Leisure* group is created based on Consumer, Entertainment, and Art. Whilst automotive, insurance, and other fields can be grouped under the *Growing Niche* where their potentials have not been expressed yet.

5) A *H2020* column is defined in order to signalize which are the winners of the calls (necessary as the dependent variable in the econometric model).
6) Finally, based on cross-filtering analysis each company is valued in terms of size and assigned to Micro company, Small company, and Medium & Large company classes. In particular, the criteria utilized to carry out such assignment process is founded on: Number of Employees, Total Revenues or Total Asset following the European Union classes' guidelines.

Proceeding towards the econometric model selection, it is of fundamental importance to clearly state the assumptions, based on our dataset structural characteristics, necessary for the goal of gaining the aimed results.

What are the assumptions we have deemed necessary for our analysis?

Academic problems, and thus also their resolutive methodologies, are often grounded on a perfect scenario. This one is often almost impossible to realize in real life, which instead require multiple adjustments and hypotheses.

In the same way, our dataset and econometric model demand some fundamental assumptions without that a proper solution could not be found. There are several assumptions referring to diverse issues our data present.

For a start, as already mentioned above we set a minimum number of winners threshold to 8% based on some empirical observations. In particular, we focused on M. G. Colombo et al. (2015) work, which has carried out a similar econometric analysis, even if with a diverse research topic. Colombo and colleagues studied the effect of baked Venture Capital firms over the likelihood of being selected into EU-funded R&D partnerships. In their research, they accepted a percentage of EU-funded R&D partnerships which accounted for 7,7% of the total sample.

The second, and most important assumption, concerns the structure of our dataset. Indeed, with the actual data availability, even exploiting the Drones Observatory's network, we are not able to retrieve the list of firms participating in the different calls. Furthermore, even in the case of available calls' participants' data, we might not be capable of accessing organizations' characteristics. Thus, we decide to keep a tight focus on high-tech entrepreneurial ventures, adopting the dataset shown above, and looking for matchings with the one censused by us. In this way, we will compare startups that won, at least one, FP call against others that could or not have participated without winning. This facilitation might appear huge, but it is the only way to answer the main research questions, given the available data sources.

Once again, Colombo at al. (2015) helps us to understand that there are no significant differences between projects' coordinators and participants in the obtainment of FP funds. Thus, our matching process has been employed over the winner of both projects' coordinators and participants.

Last, but not least, assumption regards the validity of Colombo and colleagues' work and we decided to consider only baked companies in our sample. Indeed,

these researchers proved the importance of being baked by Venture Capital when firms compete in European Framework programmes. Therefore, being impossible to retrieve all calls' participants, by selecting only baked firms we presume to compare the winning organizations against startups that own the same competitive advantage.

Approaching the econometric model construction phase, we need to ask ourselves:

Which is the most appropriate econometric model to apply, given the stated research topic?

Before entering the details of the most appropriate model, we need to clarify what is regression analysis. This latter is intended as a statistical method useful to estimate the relationship between a dependent and one or more independent variables. In general, there are 3 kinds of regression analysis:

- Linear Regression
- Multilinear Regression
- Nonlinear Regression

In statistics, the most common analyses are carried out with linear regression models, where different variables are related to the dependent one via a link function which guarantees that the magnitude of the variance of each measurement determines the predicted value. In particular, we focus on the binary classification model, in fact, our research needs to provide, based on certain features, if a firm would reach a greater or lower likelihood of winning a tender. The most suitable regression model for our study is the *probit* one. This model is a type of regression where the dependent variable can take only two values, in our case victory or loss of the tender. More in detail, a probit, which comes from probability plus unit, regression is aimed at estimating the likelihood under which a specific observation, affected by a set of characteristics, will fall

into one category rather than the opposite one. Then, if linear regression models are endowed with a link function, the probit one, being a subcategory of the linear regression, is equipped with a probit link function.

Variables operationalization

The last step before beginning the result's analysis concerns the explanation of variables operationalization, that will be utilized in the models, and the process needed to reach the definitive econometric models.

As depicted in the dataset's domains changes above, almost all the variables within our econometric models are binary stating the affiliation to a certain group or not. In this sense, we seek to segment firms' possible characteristics in different clusters that might affect the final dependent variable, namely the victory of FP's tender (variable named H2020). The adjusted dataset shows 134 variables, where only 99 could be potentially useful to the regression analysis, over 552 valid observations. Indeed, the remaining 27% of variables found applications during the descriptive analysis or matching process but resulted to be meaningless for the regression one.

Collinearity

Subsequently, being our econometric models made up of a set of multiple regression variables, it is necessary to understand if there is collinearity among them. This latter is present when those independent variables that form the model show linear relationships, or correlations, between one or more causing issues for models' inputs. Indeed, in the case of multicollinearity, inputs influence each other, and it is difficult to test whether and how the combination of independent variables affects the dependent one. To cope with this potential issue, we operate the *Variance Inflation Factor* (VIF) tool to identify the degrees of collinearity for each variable. The first assessment with all the 99 independent variables is reported below:

Variable	VIF	1/VIF
Logisticsa~y	117.92	0.008481
transport	105.02	0.009522
M7	43.18	0.023159
J6	27.46	0.036415
C3	24.89	0.040175
over_3_cf	21.70	0.046083
growingniche	20.40	0.049026
C2	20.30	0.049270
Insurance	16.52	0.060524
inv	15.20	0.065803
up_3_cf	14.05	0.071189
J5	9.66	0.103481
Infrastruc~t	8.79	0.113787
Filmingins~n	8.20	0.122021
Infrastruc~s	8.19	0.122032
inspection	7.83	0.127787
LeisureB2C	7.72	0.129551
G4	7.70	0.129849
Seucrityan~e	7.46	0.134115
Entertainm~a	7.07	0.141521
over_4_af	6.57	0.152239
Environmen~y	5.91	0.169078
Automotive	5.61	0.178124
H5	5.20	0.192480
age_y	5.12	0.195493
N8	4.99	0.200483
_4_af	4.98	0.200648
security_s~e	4.05	0.247091
M6	3.93	0.254218
LogisticsT~t	3.78	0.264391
from_2016	3.57	0.280248

Variable	VIF	1/VIF
Multisector	3.38	0.295553
A1	3.36	0.297258
from_2019	3.27	0.306256
Utility	3.24	0.309034
MICROCOMPA~S	3.14	0.318389
serv	3.14	0.318586
N7	3.13	0.319259
ArtCulture	3.00	0.333583
media	2.96	0.338208
SMALLCOMPA~S	2.92	0.342159
F4	2.90	0.344775
Other	2.77	0.361608
prod	2.76	0.362331
search_resc	2.66	0.376193
Agriculture	2.64	0.378372
M2	2.56	0.390209
C7	2.56	0.390444
PublicSector	2.55	0.392370
P8	2.52	0.396568
a_monitori~e	2.51	0.397902
K6	2.50	0.400506
countersoc~a	2.30	0.434400
Healthcare~l	2.27	0.440052
SocialMedia	2.21	0.452579
Q8	2.19	0.457235
Hardware1	2.18	0.458997
Environment	2.17	0.459787
Telco	2.15	0.464735
I7	2.15	0.464821
M5	2.15	0.464827
software	2.14	0.467467
J7	2.12	0.472374
S9	1.96	0.509260

Table 21: Variance Inflation Factor- Collinearity test

Variable	VIF	1/VIF
C8	**1.82**	**0.548087**
C5	**1.82**	**0.549303**
b2b	**1.82**	**0.550493**
H7	**1.82**	**0.550689**
J3	**1.81**	**0.552713**
A2	**1.80**	**0.555343**
I6	**1.78**	**0.562169**
J8	**1.76**	**0.567122**
M4	**1.76**	**0.569062**
b2c	**1.69**	**0.593189**
H8	**1.66**	**0.602389**
erog	**1.58**	**0.631972**
I4	**1.54**	**0.647973**
J4	**1.53**	**0.653777**
C6	**1.52**	**0.659002**
M3	**1.48**	**0.673513**
M1	**1.46**	**0.683610**
Consumer	**1.45**	**0.689585**
H6	**1.45**	**0.691675**
C1	**1.44**	**0.692488**
I5	**1.43**	**0.698077**
S2	**1.43**	**0.699848**
spec	**1.43**	**0.701201**
R9	**1.41**	**0.708492**
J2	**1.41**	**0.709744**
I8	**1.39**	**0.718478**
NorthernEu~e	**1.37**	**0.732157**
WesternEur~e	**1.33**	**0.750587**
b2b2c	**1.33**	**0.753550**
maint	**1.29**	**0.776520**
SouthernEu~e	**1.28**	**0.782610**
FinancialC~r	**1.26**	**0.795750**
EasternEur~e	**1.15**	**0.869328**
Website	**1.15**	**0.869454**

Mean VIF	**7.00**

Table 22: Mean Variance Inflation Factor

A critical threshold that states the presence of collinearity is set to values greater or equal than 10. (Vittinghoff E, et al,2011.)

Thus, from the study above we can prove that the first 12 independent variables are affected by multicollinearity and cannot be considered in our models. Whilst the vast majority exhibit VIF lower than 5, claiming low or non-existent collinearity.

Robustness

After this first selection, we proceed with the variables operationalization testing introducing robustness factors. In this sense, the robust factor enables to gain of robust variance estimations by solving some misspecifications. Along with this robust factor introduction, we perform the Probit regression to estimate the P-Value significance of the variables selected keeping a maximum alpha value of 0,1.

Clusterization

Finally, the last reinforcement of our analysis regards the clusterization under the Financial Center independent variable. In standard OLS regression models, there is the hypothesis that the errors' variance is constant along with the whole data sample. Nevertheless, in the reality, we know that this is impossible, but we can group observations in different clusters where the variance is similar. In order to cope with the heteroscedasticity issue, our observations are grouped by the Financial Center variable, in this way the firms are splitted in two diverse clusters, where within the same cluster errors share the same variance. Indeed, firms with headquarters in cities classified as financial centers can guarantee themselves a greater likelihood to access funds. This ensures a lowering in the P-Value of several independent variables, boosting their significance. Following

the previous operationalization testing, we keep performing the variables selection preserving an alpha-value equal to 0,1.

7.2. Econometric results

The econometric analysis has been executed in two different levels. Firstly, there is the description of the regression results coming from the main model. Secondly, has been examined how the main model reacts to different independent variables' group exclusions. This step is aimed at verifying the goodness of the main model questioning whether changes could be done towards the achievement of better results.

Main model results

Running the Probit model, we defined the statistical relationship between the binary dependent variable, obtainment or not of the grant, and the independent variables that characterize the firms. The output follows:

```
.  probit H2020 Website SocialMedia countersocialmedia from_2011 from_2016  FinancialCenter EasternEurope WesternEurope NorthernEurope SouthernEurope b2b b2c G4 I7 J7 K6 M6 prod serv spec Hardware1 software F
> ilminginspectionsandreleasin Seucrityandrescue Environmentenergyandsociety Infrastructureandtransport LeisureB2C MICROCOMPANIES MEDIUMLARGECOMPANIES a_monitoringandc_drone search_resc inspection security_su
> rveillance maint media _4_af over_4_af Agriculture Utility EntertainmentMedia InfrastructuresBuildings Environment PublicSector Telco LogisticsTransport HealthcarePharmaceutical Automotive Insurance Consume
> r Multisector up_3_cf, rob cluster(FinancialCenter)

Iteration 0:   log pseudolikelihood =  -172.3098
Iteration 1:   log pseudolikelihood = -103.60925
Iteration 2:   log pseudolikelihood = -88.628535
Iteration 3:   log pseudolikelihood = -86.446024
Iteration 4:   log pseudolikelihood = -86.309342
Iteration 5:   log pseudolikelihood = -86.308788
Iteration 6:   log pseudolikelihood = -86.308788

Probit regression                                 Number of obs =    552
                                                  Wald chi2(0)  =      .
                                                  Prob > chi2   =      .
Log pseudolikelihood = -86.308788                 Pseudo R2     = 0.4991

                                  (Std. err. adjusted for 2 clusters in FinancialCenter)
```

H2020	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
Website	-2.431827	.3130266	-7.77	0.000	-3.045348	-1.818306
SocialMedia	-1.584432	.3271964	-4.84	0.000	-2.225726	-.9431391
countersocialmedia	.4811406	.2022868	2.38	0.017	.0846659	.8776154
from_2011	.3803906	.5791144	0.66	0.511	-.7546528	1.515434
from_2016	.0502698	.7473391	0.07	0.946	-1.414488	1.515027
FinancialCenter	.2185799	.0808992	2.70	0.007	.0600204	.3771393
EasternEurope	2.928451	.2643734	11.08	0.000	2.410289	3.446614
WesternEurope	1.969384	.1188297	16.57	0.000	1.736482	2.202285
NorthernEurope	1.236097	.0802991	15.39	0.000	1.078714	1.393481
SouthernEurope	3.107141	.5957679	5.22	0.000	1.939457	4.274824
b2b	.0185378	.2338027	0.08	0.937	-.4397071	.4767826
b2c	1.508695	.3411677	4.42	0.000	.8400188	2.177372
G4	.5189669	.2259377	2.30	0.022	.0761371	.9617967
I7	1.36137	.3175504	4.29	0.000	.7389824	1.983757
J7	2.98072	1.702697	1.75	0.080	-.3565047	6.317945
K6	1.542576	.0299509	51.50	0.000	1.483873	1.601278
M6	1.993981	1.093323	1.82	0.068	-.1488928	4.136854
prod	.3905269	.4672125	0.84	0.403	-.5251927	1.306247
serv	-.2008969	.3463506	-0.58	0.562	-.8797315	.4779377
spec	.1014396	.0219129	4.63	0.000	.0584912	.1443881
Hardware1	.2769936	.027648	10.02	0.000	.2228044	.3311827
software	.3439774	.2167485	1.59	0.113	-.0808417	.7687966
Filminginspectionsandreleasin	.4524421	.6985241	0.65	0.517	-.9166399	1.821524
Seucrityandrescue	.0528524	.5911427	0.09	0.929	-1.105766	1.211471
Environmentenergyandsociety	-.4338032	.3038275	-1.43	0.153	-1.029294	.1616877
Infrastructureandtransport	.6103751	.1116665	5.47	0.000	.3915129	.8292373
LeisureB2C	1.938808	.2922158	6.63	0.000	1.366076	2.511541
MICROCOMPANIES	-.5108012	.1793179	-2.85	0.004	-.8622579	-.1593446
MEDIUMLARGECOMPANIES	.1779271	.072442	2.46	0.014	.0359435	.3199108
a_monitoringandc_drone	.9951939	.2337314	4.26	0.000	.5370887	1.453299
search_resc	.6021584	.2524316	2.39	0.017	.1074015	1.096915
inspection	-.060493	.3705146	-0.16	0.870	-.7866883	.6657022
security_surveillance	-.4402993	.1401481	-3.14	0.002	-.7149845	-.165614
maint	1.122862	.1992177	5.64	0.000	.7324022	1.513321
media	-.6965755	.6211633	-1.12	0.262	-1.914033	.5208822
_4_af	1.220216	.2031067	6.01	0.000	.822134	1.618298
over_4_af	.9412088	.2402392	3.92	0.000	.4703487	1.412069
Agriculture	.8002838	.0812943	9.84	0.000	.6409499	.9596177
Utility	.2517289	.0709451	3.55	0.000	.112679	.3907787
EntertainmentMedia	-2.293397	.3951307	-5.80	0.000	-3.067839	-1.518955
InfrastructuresBuildings	-.2810864	.0220357	-12.76	0.000	-.3242755	-.2378972
Environment	-.2318427	.0683749	-3.39	0.001	-.365855	-.0978304
PublicSector	.1190762	.232059	0.51	0.608	-.3357511	.5739036
Telco	.8282846	.148853	5.56	0.000	.536538	1.120031
LogisticsTransport	-.6971306	.2126972	-3.28	0.001	-1.114009	-.2802517
HealthcarePharmaceutical	-.82154	.0139041	-59.09	0.000	-.8487915	-.7942885
Automotive	1.780111	.5734624	3.10	0.002	.656145	2.904076
Insurance	.573191	.3015712	1.90	0.057	-.0178777	1.16426
Consumer	-3.147435	.5975741	-5.27	0.000	-4.318659	-1.976211
Multisector	.3884688	.178763	2.17	0.030	.0380999	.7388378
up_3_cf	.0902314	.3785086	0.24	0.812	-.6516317	.8320946
_cons	-2.408376	.5926451	-4.06	0.000	-3.569939	-1.246813

Starting from the anagraphical features, companies' age has been partitioned into three groups and all of them seem not to be impactful due to the high P-values. The size of the company is positively related to the possibility of obtaining the grant. So, Medium&Large (0,17) companies have a greater probability to win the tender than Small-companies, and even greater than Micro-companies (-0,51).

The company's location claims the favored position held by EU firms compared to extra EU ones, which is quite reasonable being the FPs European. Furthermore, the analysis allows us to see that not all European areas have the same chances to win tenders. Indeed, companies based in Southern, above all, and Eastern European clusters show a higher likelihood than Western and Northern European clusters (in order). This outcome is in line with the European Union desire of helping more poorer areas. Furthermore, it is highly valuable for our study, being Børing P. et all (2020) focused only on Scandinavian countries.

Staying on the geographic location, the proximity to financial centers, as supposed by us in the reinforcement process of our models, finds a slightly positive influence on startups.

Looking at the communication channels of firms, we adopt three variables of which two are binary *Website* and *Social Media* and one is integer *Counter Social Media*. The first two support that having a website and at least one social media lead to a lower winning likelihood in the tenders. However, this should not be interpreted as a rule as it is, because almost all firms analyzed own a website and one social media channel. Instead, this is a signal that the EU commission sends to newly born innovative startups that, whether in possession of good ideas, even without an online representation of their brands should participate to FPs. On the other hand, we can see thanks to the third variable, *Counter Social Media*, that firms with a higher number of social media channels own greater possibilities of winning an FP's tender.

Afterward, regarding the industry of origin and types of products provided, we can say that being in a business-to-business market is less appealing than a business-to-consumer, but in the previous cases are better than being present in both markets at the same time.

From a NACE code point of view, the industries that appear correlated with FPs' calls victory are:

- Information and Communication (J7), with 2,98;
- Professional, Scientific and Technical activities (M6), with 1,99;
- Accommodation and Food Service activities (I7), with 1,5;
- Financial and Insurance activities (K6), with 1,36;
- Wholesale and Retail trade (G4), 0,51;

Instead, looking at the solutions offered, specialized solutions providers are more preferred than generalist ones, while product and service are not significant in terms of P-values. Nevertheless, if we consider the products' providers, we can see how the two categories *hardware* and *software* are better perceived individually than combined, where software one is somewhat better than the hardware.

Shifting our focus on application fields, we grouped all the application fields into three big clusters: *Filming inspection & releasing, Security & rescue,* and *Logistics & mobility*. The latter one has been unselected due to high collinearity in the initial VIF assessment, while the other two do not exhibit significant P-value. Digging deeper into the individual application fields, there are three meaningful variables, in terms of P-value, *aerial monitoring & counter-drone*, *security & surveillance,* and *maintenance*. Where the first and last ones are the most innovative and undeveloped, as reported by the Observatory of Drones by Politecnico di Milano. These bring positive chances to firms participating in FPs'

tenders, while *security & surveillance* which is a mature application field leads to a negative likelihood of victory.

On the other hand, singular results are achieved with two variables stating the number of application fields where a company is present. Indeed, operating in less than 4 application fields *(_4_af)* is better perceived than being in more than 4. Although, these two groups constitute a better alternative than not having application fields.

This insight is particularly precious for us because the European Commission is asking to focus our resources on precise business areas, which should be at least greater than 0 but better if lower than 4. Thus, HTEVs need to narrow their horizon of innovation committing their scarce resources over a few promising subjects.

The last topic covered by our econometric model refers to the fields in which firms' clients operate. Contrary to the former study, the macro-categories that summarize the client fields are in part significant. Despite the collinearity of the *growing niche* and the too-high P-value of *Environment Energy & Society*, *Leisure B2C* and *Infrastructure* and *Transport* have low P-value. The latter made up of *Infrastructure & Buildings*, *Telecommunication*, *Logistics & Transport,* and *Healthcare & Pharmaceutical* exhibits a low negative contribution towards the tender's victory. On the other hand, with a more significant intake, we find *Leisure B2C,* which contains solutions for those clients labelable within the Fun and Cultural spheres, such as Entertainment & Media, Art & Culture, and Consumer players.

Interesting is now to assess the contribution, whether significant, of individual client fields. Despite the positive contribution brought by *Infrastructure & Transport*, if we analyze separately the single variables comprised in it, we find that all the four independent variables, except for *Telecommunication*, lead to a

lowering in the likelihood of winning with a range of coefficients that goes from values tending to 0 to 1. This great suggestion came up from regression analysis led firms to diversify the streams of clients when operating in such contexts. Even more unusual is the second group considered: Leisure B2C. Indeed, the two significant variables *Entertainment & Media* and *Consumer,* have heavily negative coefficients, around 2, if taken alone. Again, when firms are operating in these areas with such client fields, they should diversify their offers covering the zones mentioned above. Regarding the two macro-categories, these considerations are even supported by the substantial independent variable *Multisector*, which claims the positive effect of being present in more than one client field simultaneously.

Looking at the remaining significant client fields, it is worthy of underlining the positive impact of growing, even if not so developed, fields such as *Public Sector*, *Automotive,* and *Insurance* on which European Commission is willing to bet. While the results of *Agriculture* and *Utility* lead us to confirm some of the already well-established businesses that will probably consolidate even more in the next future.

Finally, we find a remarkable outcome, which supports the thesis about newly born innovative startups gained through communication channels analysis, concerning the number of application fields on which operate. Indeed, the regression analysis tells us that is preferred to have a low number of client fields, where zero is the best. This final claim might appear tricky, but what the model wants to communicate is that the EU commission is extremely focused on new innovative players. This latter can be recently created with no client field specified, but with one or more targeted application fields on which to innovate. Nevertheless, the former statements regarding multiple client fields are still valid but refer to other firms' targets (probably the medium-large companies).

Model comparison

The objective of this analysis was to understand the variation of the main model's variables, excluding the seven groups of variables one by one.

The first independent variables excluded are Website & social media, which results in a minor reduction of the pseudo-R-squared (0,447). The main change, which affects also our assumptions, is the shift of the Financial Center variable from significant towards not significant. This, indeed, would undermine the hypothesis made by us about the importance of financial centers for HTEVs to gain funds. Another meaningful change regards the turnaround, from positive to negative, of the b2b variable. This latter, even if not significant, implies, thanks to the significance of the b2c variable, that being only in the b2b business environment is not preferred to being in both anymore. Then additional changes, of a lower relevance, concern the exceeding of 0,1 p-value threshold for certain variables, such as software product type, utility as client field, and medium & large companies' size.

The second variables' group exclusion regards companies' locations, which leads us to a huge impact in terms of econometric model robustness. Indeed, along the variables' operationalization process, we strengthened the model by adding a variables' clusterization. As a result of location variables exclusion, we witness a drop pseudo-r-squared from almost 0,5 to 0,28. Furthermore, it has a massive shock on industry type and product's features. Most of the industries that were significant in terms of p-value, such as G4, I7, and M6, are now not compliant anymore with the threshold set. Furthermore, software product type becomes again not significant and there is no preference between a specialized and a focused solutions provider. Other large impacts are registered in the different client and application fields, where most of the variables significant for our main model get tipped over. In the end, no significance is encountered also in the company size's group of variables.

The exclusion of industry specificities variables can be interpreted as the least impactful among all the steps we are going through. The main variables touched, by such exclusion, consist in the specialization needed by HTEVs, the software product types, and a few applications and client fields. All the mentioned variables experienced an increase of p-values over the predefined threshold.

Afterward, stepping into solutions' variables opt-out, we can notice two interesting results. First of all, the Financial Center variable is once again not significant and accordingly the clusterization performed results meaninglessly. On the other hand, the combination of missing company's specialization and client fields grouping variables do not allow to identify how HTEVs should strategically behave. Indeed, we have no certainty on whether a startup should be focused and how much narrowing their client fields. Other minor variables, especially among application and client fields, witness a boost in the p-value turning not significant.

Then, it is worthwhile to analyze the independent variables' groups of application and client fields both at the same time. In this sense, we can grasp the main differences detected when the groups excluded referring to similar concepts. So, both exclusions bring to a non-significance of Financial Centers variables. Whilst, despite the significance of variable b2b for the no application fields model, this latter experiences a greater impact in terms of non-significant variables among the industry types compared to the no client fields model. Looking at the product type and specialization, we find conflicting results since the no application fields model keeps specialization variable as relevant, while no client fields model has product types of variables in line with the main model. Then talking about of company's size, the two groups exclusions react similarly, with the only difference that no application fields does not have medium & large companies significant.

Finally, the company's size variables exclusion leads to almost the same results as the main model, with the main exception for the company's specialization and product types details that are now non-significant. In addition, other application and client fields variables, among the most important the number of client fields, result not significant anymore. However, the amount of variables and their importance is fairly reduced compared to the previous groups' exclusions analyzed above.

	MAIN MODEL		NO WEBSITE & SOCIAL MEDIA		NO LOCATION		NO INDUSTRY FEATURES		NO SOLUTIONS' FEATURES		NO APPLICATION FIELDS		NO CLIENT FIELDS		NO COMPANY SIZE	
INDEPENDEDNT VARIABLES	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE
WEBSITE	-2,43	*	/	/	-1,89	*	-1,99	*	-2,34	*	-2,03	*	-1,79	*	-2.20	*
SOCIAL MEDIA	-1,58	*	/	/	-1,49	*	-1,47	*	-1,41	*	-1,68	*	-1,69	*	-1,69	*
COUNTER SOCIAL MEDIA	0,48	*	/	/	0,415	*	0,39	*	0,38		0,46	*	0,53	*	0,51	*
10 YEARS OLD	0,38		0,5		0,22		0,5		0,33		0,45		0,41		/	/
5 YEARS OLD	0,05		0,24		-0,26		0,4		0,05		0,08		0,10		/	/
FINANCIAL CENTER	0,21	*	0,04		/	/	0,28	*	0,12		0,05		0,12		0,13	*
EASTERN EU	2,92	*	2,48	*	/	/	2,77	*	2,70	*	2,48	*	2,45	*	2,81	*
WESTERN EU	1,96	*	1,84	*	/	/	1,74	*	1,92	*	1,66	*	1,54	*	1,91	*
NORTHERN EU	1,23	*	1,16	*	/	/	1,07	*	1,01	*	1,02	*	0,83	*	1,25	*
SOUTHERN EU	3,1	*	2,94	*	/	/	2,69	*	2,94	*	2,44	*	2,46	*	3,13	*
B2B	0,01		-0,04		0,25		/	/	0,06		0,33	*	0,02		-0,12	
B2C	1,5	*	1,22	*	0,68	*	/	/	1,31	*	1,21	*	0,88	*	1,39	*
G4	0,51	*	0,41	*	0,03		/	/	0,73	*	0,16		0,44		0,57	*

I7	1,36	*	1,35	*	1,17		/	/	1,11	*	1,29	*	1,24	*	1,05	*
J7	2,98	*	2,87	*	1,81	*	/	/	2,60	*	2,05		2,23	*	3,39	*
K6	1,54	*	1,17	*	1,23		/	/	1,24	*	1,06	*	1,74	*	1,40	*
M6	1,99	*	1,62		2,18	*	/	/	1,87	*	1,88		1,74	*	1,90	*
PRODUCT	0,39		0,31		-0,05		0.04		/	/	0,28		0,22		0,38	
SERVICE	-0,2		-0,01		-0,61		-1,28		/	/	-0,37		-1,21		-0,35	
SPECIALIZED	0,1	*	0,15	*	0,16		0,018		/	/	0,19	*	-0,05		0,00	
HARDWARE	0,27	*	0,28	*	0,4	*	0,37	*	/	/	0,02		0,34	*	0,16	
SOFTWARE	0,34	*	0,36		-0,15		0,4		/	/	-0,00		0,34	*	0,29	
FILM, INSPECTIONS & RELEASING	0,45		0,28		-0,14		0,31		0,30		/	/	0,11		0,52	
SECURITY & RESCUE	0,05		0,22		0,23		-0,4		0,24		/	/	0,34		-0,10	
AERIAL MONITORING	/	/	1,09	*	0,7	*		*	0,95	*	/	/	0,78	*	1,01	*
SEARCH & RESCUE	/	/	0,53	*	0,19		0,64	*	0,72	*	/	/	0,22	*	0,79	*
INSPECTION	-0,06		0,15		0,6		-0,10		0,01		/	/	0,50		-1,39	
SECURITY & SURVEILLANCE	-0,44	*	-0,49	*	-0,44		0,133		-0,40		/	/	-0,47	*	-0,32	
MAINTENANCE	1,12	*	1,17	*	0,59		0,88	*	1,06	*	/	/	0,95	*	1,10	*
MEDIA	-0,69		-0,52		-0,28		-0,41		-0,62		/	/	-0,55		-0,60	
LESS THAN 4 APPLICATION FIELDS	1,22	*	0,82	*	1,26	*	1,31	*	0,77	*	/	/	1.07	*	/	/
MORE THAN 4 APPLICATION FIELDS	0,94	*	0,45	*	0,66		1,05	*	0,30	*	/	/	0,45	*	/	/
ENVIRONMENT, ENERGY & SOCIETY	-0,43		-0,29		-0,82	*	-0,22		-0,42		0,01		/	/	-0,37	
INFRASTRUCTURE & TRANSPORT	0,61	*	0,74	*	-0,31		0,30	*	0,67	*	0,64	*	/	/	0,43	*
LEISURE B2C	1,93	*	1,88	*	1,6	*	1,81	*	1,88	*	1,63	*	/	/	1,78	*
AGRICULTURE	0,8	*	0,65	*	0,58	*	0,65	*	0,74	*	0,50	*	/	/	0,75	*
UTILITY	0,25	*	0,08		0,28		0,27	*	0,30	*	0,03		/	/	0,24	*

MEDIA AND ENTERTAINMENT	-2,29	*	-2,42	*	-1,8	*	-2,23	*	-2,4	*	-1,97	*	/	/	-2,25	*
INFRASTRUCTURE	-0,28	*	-0,25	*	0,39		0.15	*	-0.34	*	-0,18	*	/	/	-0,09	
ENVIRONMENT	-0,23	*	-0,25		-0,35		-0,79		-0,13		-0,35	*	/	/	-0,10	
PUBLIC SECTOR	0,22		0,1		-0,13		0,00		0,08		0,08		/	/	0,13	
TELECOMMUNICATION	0,82	*	0,74	*	0,38		0,68	*	0,72	*	0,42	*	/	/	0,98	*
LOGISTCS & TRANSPORT	-0,69	*	-0,7	*	-0,05		-0,42		-0,55	*	-0,82	*	/	/	-0,62	*
HEALTH & PHARMACEUTICAL	-0,82	*	-0,89	*	-1,19	*	-0,77	*	-1,04	*	-0,51		/	/	-0,84	*
AUTOMOTIVE	1,78	*	2,05	*	1,46	*	1,77	*	1,93	*	1,78		/	/	1,64	*
INSURANCE	0,57	*	0,43		0,38		0,51	*	0,54	*	0,08		/	/	0,60	*
CONSUMER	-3,1	*	-2,46	*	-1,9	*	-2,53	*	-3,20	*	-2,74	*	/	/	-3,06	*
MULTI SECTOR	0,38	*	0,45	*	-0,58		0,34	*	0,21	*	0,44	*	/	/	0,47	*
UP TO 3 CLIENT FIELDS	0,09	*	-0,76	*	-0,22		0,14		0,15		-0,01		/	/	0,10	
MICRO-COMPANIES	-0,51	*	-0,5	*	-0,3		-0,55	*	-0,52	*	-0,61	*	-0,47	*	/	/
MEDIUM & LARGE COMPANIES	0,17	*	0,07		0,43		0,11	*	0,26	*	-0,08		0,23	*	/	/

Table 23: Comparing the econometric models

8 Results and conclusion

In this last chapter, we will recap by **presenting and analyzing the results** that have emerged in the course of our thesis. In particular, we will **answer** the research questions raised along the path followed as we proceeded with our reasoning, thus giving a general and comprehensive overview. Secondly, we will evaluate and present the **limitations** of our analysis, thus exploring the **subsequent development** that future researchers may carry out. Finally, we point out the **precis conclusions** of the research.

8.1. Comprehensive results and overview of the thesis

At the beginning of the research, we asked ourselves which kind of dynamisms characterized the obtainment of tenders by HTEVs. We focused on the manufacturing sector and we found the drone industry as a representative industry matching our research demand. Therefore, first of all, we tried to understand and analyze all actors involved. The context of observation was the European one; in particular, we focused on the government programmes set up by the European Union. The first part of our thesis concerned carrying out a census of the winning projects related to the drone industry of Horizon2020 programs and the Framework Programmes that preceded it (2001-2021).

The census allowed us to gather enough information to describe the characteristics of those projects that received demanded funds. In particular, it gave us the possibility to run a dual analysis with different levels of detail. On one hand, a country-oriented analysis has been executed looking at the common

features of winning nations. As a result, most developed countries from manufacturing and educational points of view, such as Germany, Italy, France, or Spain, turned out to be the most active and successful in terms of the number of projects and funds raised. Furthermore, an in-depth focus allowed us to become aware of the presence, in such countries, of a large number of projects with small budgets, probably deriving from an HTEVs environment.

On the other hand, the product-oriented study led us to experience the major rewarded topics of winning projects. The most recurrent macro-categories refer to products and services, where in the first case the two sub-categories, Hardware and Software, show differences. Hardware products are mainly dominated by Drone Platforms and Payload in terms of projects, even if promising products such as Counter Drone Solutions exhibit higher EU contributions. Whilst Software products: Flights Planning, Navigation, and Data Analysis share similarities both in terms of projects' volumes and funds raised. The second most recurrent product is Service which finds few well-established fields, such as Inspections that is widespread in various business environments ranging from public, with public infrastructure inspections, to private with energy infrastructure ones. Nevertheless, the vast majority of service types, such as Erogation and Maintenance, are considered innovative with few current applications in businesses nowadays, but with good growth prospects. The third macro-category, Other, is not so evolved but it has been able to gain, in relative terms, greater contributions thanks to the presence of Advanced Air Mobility (AAM) and Unmanned Traffic Management (UTM) that represent the future of drones' industry.

However, the census analysis is limited to a descriptive focus and it can not grasp the full dynamism that characterizes this context and so even our research demand. A project-oriented analysis can display a situation that is characterized by great volatility, projects' themes, change very frequently accordingly to society, our needs, innovations, and technologies. Indeed, if we want to

understand the dynamism that characterizes the obtainment of grants, we cannot rely on descriptive statistics of the census, but we need to focus on structural and strategic elements of the firms, which on the contrary of projects' topics will survive over time.

Thus, in the second part of our thesis, we decided to run a company-oriented analysis by developing an econometric model. The aim was to find out the possible statistical relationships that are believed to hold between the variables chosen.

This is the backbone of our research work and enables us to foster knowledge development even further than a simple FPs drones' projects overview. Indeed, we are willing to support the knowledge evolution keeping a companies' perspective. On the contrary of most of the research drawn up so far, which is mainly focused on giving suggestions to policy makers, we operate in the same industrial economics environment, but with the purpose of backing firms in EU FPs. In this sense, we provide high-level guidelines useful for firms to understand which are the structural features that have been rewarded over the different programs. Thus, this dissertation results are not meant at pointing out the topics on which firms need to focus on for future FPs, but conversely, define the most suitable company's and project's frame.

Expanding our database, we have dedicated ourselves to studying and comparing the winning companies' characteristics with all the drone companies present at Europe, Middle East, and Africa level (EMEA).

Our analysis starts from the limitations of the research carried out by Børing P. et al. (2020), who were able to state that, in the Scandinavian regions, the company's size is positively related to the participation in the EU FP and slightly to the obtainment of more significant funds. In contrast, other variables such as

the country of origin and the relevant industry were not detected as impactful, if not in part.

We have expanded the pool of companies, considering only one industry, the drones' one, but throughout a broader area, making an equal comparison between all the companies and countries participating in the framework programs of the last twenty years.

The model permitted us to identify the statistical relationship between the binary dependent variable, obtainment or not of the grant, and the independent variables that characterize the firms, such as firm's age and size or the firm's strategic setting (like the application fields or the communication channels).

Among all the independent variables considered, few resulted related to the obtainment of grants. We found that the geographical area is an impactful variable; southern and eastern European countries are advantaged. In addition, we have seen how residing in a financial center can lead to a higher likelihood of receiving FP funds.

The variables related to the communication channels allowed us to understand a fundamental point for our thesis. Nowadays social media are becoming an important instrument of corporate communication strategy (Carim, Warwick, 2013). On the contrary, the model shows that the EU Commission had also privileged those newborn companies that probably just came up with a great idea, but that is still not structured enough to have a website and a social media account.

The other very interesting part regards the level of specialization. We looked at the typology of clients and the application fields of firms. The model affirmed that applying only in the b2b or b2c sector is better perceived than operating in both of them. Also, looking at the application fields, we can state that specializing in one or at least less than four application fields is positively related

to the winning of the tender. Another point favoring this thesis is made if we consider the type of product, so focusing only on hardware or software is better perceived than doing both.

So, concluding, we can say that, considering, the development and size of the companies, the newborn companies, the HTEVs with small innovative projects, and large and well-established companies are the ones that were advantaged in the funds' assignment. In addition, being specialized and focused is better perceived than being differentiated. This last concept is specifically related to the world of HTEVs, especially for startups that approach the market with innovative ideas that can be easily sustained by a small and new organization, so being initially specialized and focused.

8.2. Limitations and future developments

Our thesis presents some very interesting guidelines that could be helpful for firms that need to apply strategic decisions in order to obtain funds participating in EU framework programmes.

Being drones an emerging technology means that this is a moment of initial market development, which is characterized by many high-tech small ventures, as is shown in the drone industry chapter. These ventures are riding the wave of unexpressed possibilities that may emerge in the near future. To build a complete model, there should be a full insight into the financial information of these small and medium-sized companies, which unfortunately are not legally required to provide this information.

All this leads to a limitation of our model, which suffers from the lack of data caused by low transparency regarding the financial documents of startups and small and medium-sized enterprises.

Another important limitation of our model relies on the fact that we do not have visibility on the firms that participate in the calls but that do not obtain the grant at the end. This could bring additional and valuable information to understand the dynamics behind the assignment of tenders in the EU FP.

So, our model can be limited to providing general guidelines and quantitative indications regarding the observable variables of these times.

These limitations open up great possibilities in the next future for additional developments and research. There is space for future research considering other industries in the same area, to understand if our results can still be generally valid. Another possible evolution regards enlarging the geographical boundaries, expanding the interest area outside the Euro-zone. There can also be interesting to consider the B2C market of drones and their applications in our daily lives. Drones have already been used by the industrial sector, by governments, etc., but the applications for the consumers' use of drones are still growing, and we can only imagine what the future will bring.

With this thesis, we had only scratched the surface of a possible branch of analysis, to fully grasp and understand the dynamics that evolve around the grants assignment. This work could be beneficial for those young companies that were born with a great idea and that were able to make it valuable and profitable, that need to be financed. That is why EU Framework Programmes exist, to foster and support innovation and development, and so, firms, startups, and HTEVs with innovative projects. Having guidelines and being aware of how they could exploit their strategic assets, could lead and favor them to outperform

Framework Programme’s calls obtaining funds, and at the end bring value to the whole society.

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(Regression Analysis - Formulas, Explanation, Examples and Definitions (corporatefinanceinstitute.com))

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