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AN INTERNATIONAL CENSUS OF GOVTECH STARTUPS

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ABSTRACT

English version

A new generation of technologies is revolutionizing the way governments operate and interact with citizens and stakeholders. Driving the change is the rise of Government Technology (GovTech), grounded on the application of frontier Information & Communication Technologies (ICTs) to the public sector, in order to enhance both effectiveness and efficiency of public services (including eGovernment services) and, at the same time, in order to foster innovation in the multifaceted public environment, where the effect of digital application is extremely promising but need better comprehension. Indeed, GovTech is only in an early stage and much is still unexplored. The adoption of new technologies is a challenging process for public administrations and, to deal with it, startups can play a crucial role given their innovative nature and expertise in digital technology exploitation. Accordingly, the purpose of this research is to conduct a census and analyse the GovTech international ecosystem of startups – where startups and governments meet each other to foster digital innovation for Public Administrations (PAs) – and to outline the structural characteristics that impact on their performances. The ultimate goal is to help future research to deepen the knowledge in GovTech in order to exploit its great potential.

Versione in Italiano

Una nuova generazione di tecnologie sta rivoluzionando il modo in cui i governi operano e interagiscono con i cittadini e gli stakeholders. A guidare il cambiamento è l'ascesa del Government Technology (GovTech), basato sull'applicazione delle Tecnologie dell'Informazione e della Comunicazione (ICTs) di frontiera nel settore pubblico al fine di migliorare sia l'efficacia sia l'efficienza dei servizi pubblici (compresi i servizi di eGovernment) e, allo stesso tempo, promuovere l'innovazione nel poliedrico ambiente pubblico, dove l'effetto dell'applicazione digitale è estremamente promettente ma necessita di una migliore comprensione. In effetti, l'ambito GovTech è solo in una fase iniziale e molto è ancora inesplorato. L'adozione di nuove tecnologie è un processo impegnativo per le pubbliche amministrazioni e, per affrontarlo, le startup possono svolgere un ruolo cruciale data la loro natura innovativa e competenza nell'utilizzo della tecnologia digitale. Di conseguenza, lo scopo di questa ricerca è censire e analizzare l'ecosistema internazionale di startup di GovTech – dove startup e governi si incontrano per favorire l'innovazione digitale per la pubblica amministrazione (PA) – e delineare le caratteristiche strutturali che impattano sulle loro prestazioni. L'obiettivo finale è aiutare la ricerca futura ad approfondire la conoscenza del GovTech al fine di sfruttarne il grande potenziale.

EXECUTIVE SUMMARY

The diffusion of ICT creates unprecedented opportunities for the Public Sector to have a leading role in the digital transformation of our society. To accomplish this mission many governments have put their effort trying to digitalize their process and to offer better services for their citizens and businesses, to facilitate interaction and increase consumption, and, consequently, enhance the economic development. Electronic Government and Open Government initiatives represents some of the most recent attempts to ride the wave of the digital revolution. Results turned out to be controversial since a perfect receipt to make the use of ICTs the backbone of a county has not been found yet. However, the positive results gained by the early adopter countries are undeniable. It is the case of "eEstonia", that has developed a resilient eGovernment system able to empower citizens and businesses with a very efficient information sharing system (despite the country gained the independency from the soviet occupation only in 1991); United States that created the Small Business Administration portal, a government agency to provide support to entrepreneurs and small business; or the untimely eGovernment initiative led by South Korea to encourage citizens participation and to provide universal service for them, reducing digital divides.

These initiatives undertaken by institutions go under the name of Government Technology (GovTech) and is the hot topic of political agenda. GovTech can be defined by some important components: it is a new way to create public value for citizens and businesses, fuelled by ICTs and enabled by entrepreneurs, innovators and startups in which governments can find solid and skilled partners. Since a definition has not been elaborated by the scientific world and neither any academic study has been conducted on GovTech, we structure our thesis work in a way that readers can understand these fundamental components.

eGovernment refers to the use of ICTs in public administrations in order to improve public value services, democratic processes and reinforce public policies (Ardielli & Halásková, 2015) enhancing engagement and enabling easy exchange of information. Several areas of improvements have been recognized by (AL-Shehry et al., 2006) such as economic, social, political, technological and managerial. eGovernment needs a deep understanding of the surrounding environment to be effectively implemented and specific factors that could inhibit its spread must be recognized. In this regard Ebrahim & Irani (2005) report

five possible barriers that can jeopardise the effort: inadequate IT infrastructure, security and privacy issue, shortage of IT staff, organisational barriers and the lack of an adequate financial resource plan.

Leading technologies for the development of smart government have also been investigated. Most of the time these technologies are interoperable and the use of one automatically lead to the use on another. For example, if *Internet of Things* allow the collection of a large amount of data with the use of smart sensors, the analysis of data is carried out by an *Artificial Intelligence* tool to extract some valuable information. At the same time, data is stored on *Cloud* on some remote server since a physical device could not bear it.

A third necessary field of investigation at the basis of GovTech regards the digital entrepreneurial ecosystem, the dynamic environment where startups, the focus of our research, compete. After defining what do we mean by "startup", the critical success factors have been presented as well as its three-stage lifecycle and the new innovative paradigm of the Lean Startup.

To conclude with the GovTech-related literature the existing frontiers of collaboration, namely Public Procurement of Innovation (PPI) and Public Private Partnership (PPP) have been explored. Furthermore, Open Innovation perform an important role as a very promising paradigm to be adopted to foster innovation in the public sector by the smart inclusion of all the possible stakeholders and their know-how and creativity to improve to empower governments.

A further step in the thesis is the attempt to answer the following research questions related to the GovTech startup ecosystem.

- **RQ1. How many GovTech startups are there? What are their features?**
    a) How many startups work in GovTech?
    b) Where, in which countries, is GovTech gaining momentum?
    c) Where, in which countries, is the interest of investors in GovTech gaining momentum?
    d) How big is the interest of investors in GovTech startups?
    e) What organizational structure do GovTech startups have?
    f) Which public domains are mostly approached by startups in GovTech?

g) What are the key technological infrastructures in GovTech?
h) Which business model mainly characterizes the GovTech startup ecosystem?
i) What kind of educational and professional background do GovTech startup founders have?

- **RQ2. What characteristics and factors determine differences in the performance of GovTech startups?**

- **RQ.3 Which strategic variables and context factors may favour the success of a young high-tech GovTech startup?**

To answer these questions a multi-phase process was developed. Starting from the online platform Crunchbase, a dataset of companies was extracted, and many other related qualitative and quantitative data were retrieved through online sources in order to populate a database of international startup operating in the sector. At the end of this process, the final database counts 228 active GovTech startups.

From the analysis, startups result to be concentrated in countries characterized by solid economic conditions and political stability, with *United States* at first place followed by *UK* and *China* respectively.

More than a half of the new technological ventures analysed are still in the first rounds of investments suggesting the newness of GovTech arena.

Nonetheless, some exceptions hint the growing attention that this filed is acquiring. As expected, the large majority of startups belonging to the GovTech domain are not different from any other startup in terms of organizational structure with a limited number of employees and founders.

The most popular domain covered demonstrated to be *data analysis and intelligence*, *communication and transparency*, and *cybersecurity*. This is attributable to the relevance of data analysis in shaping decision making process and, on the other hand the importance of the privacy issue and trust as an enabling factor of the GovTech process of growth.

In regard to the technology adopted, results show that the majority of the startups rely on *Artificial Intelligen*ce and *Cloud Computing* and that a remarkable number of them include the contemporary use of more digital technologies in its value proposition.

Moreover, the vast majority of the population *collaborates with local public entities*. This fact can be interpreted as a strategical choice or even as an evidence of the difficulties that startups find scaling up and enlarging their territorial focus.
In addition, services of more than a half of the startups diversify their business also *targeting* the *private sector*.
Very few ventures disclose information about the way they make money and their pricing strategies. This fits with the definition of startups as entities still looking for the right way to profit from their businesses.
Lastly, the majority of the founders seem *not* to be at their *first experience* in running a startup.

For the structural factors that can influence the ability of GovTech startups in collecting founding, we invite the readers to consult the discussion presented in Chapter 4.

Even though this research work is not free from limitations, it is useful to get readers and future researchers closer to the new phenomenon of GovTech, to aware them of the importance that this theme covers and to provide them with the necessary background of knowledge required to understand its complexity. Furthermore, the methodology adopted can serve as a starting point to base future theoretical and empirical research to with the objective of deeper investigating the factors behind the success of a GovTech startup.

INTRODUCTION

The recent scientific and technological advancements have led to favourable opportunities for the development and diffusion of Information and Communication Technologies (ICTs). By now, ICTs' effects are widespread and influence every contexts of our society, transforming habits of the population and pushing enterprises into a vital research for innovation and to a new receipt to success. Indeed, a new concept of *ambidextrous organization* is spreading, where two different organizations are included in the same firm, one devoted to exploration (innovation) and one devoted to exploitation (effective management of ordinary activities).

If on the one hand the private sector can be considered as the main promoter of the technological and digital development, the public sector instead has found it difficult to innovate and to take advantage of these technologies. In fact, there is an explicit conflict between the stereotyped perception of the public sector as a stable and stagnant environment governed by highly bureaucratic processes, and the nature of innovation depicted as the engine of change and development. Moreover, when innovation practices are introduced in the public domain, institutions have demonstrated their inherent incompetence in replicating them on a larger scale since their efforts result in an insufficient level of innovation (Davidson et al., 2018). However, the need for innovation in the public sector is even more urgent than in other domains, since prolonged global recession and structural changes in demography have increased the need for efficiency and effectiveness of governments' action (Axelson et al., 2017).

Several governments have started experimenting some changes through an appropriate implementation of eGovernment initiatives, thanks to which they achieved positive outcomes. Electronic Government is considered a central element in the process of modernising public administrations (Gascó, 2003) and an essential step to reach the forefront in effectiveness and efficiency of government services.

Nevertheless, PAs cannot play this game alone and some academics suggest public entities to mimic private sector practices since its high performance could be also valuable within the public sphere (Glennon et al., 2018). For this reason, new frontiers of collaboration between the private sector and the public sector should be considered with the final aim of creating new innovative challenges and improving public administration services.

The relation between public and private sector deserves further examination and centrality in the debate. In fact, if on one side the new generation technologies are powerful to increase product/service quality and flexibility, as well as their effectiveness in meeting social needs, on the other ICTs also create a new level of complexity and led to increase uncertainty, unpredictability and nonlinearity of business and entrepreneurial processes.

This environment barely fits the business model of well-established firms, but rather the characteristics of innovative startups. Startups nature of non-linearity and their need to innovate in order to survive in a high-competitive environment, make them the perfect partner for the public sector to effectively implement digital transformation. Conversely, despite their high innovation potential, they lack in financial capital - a condition that limits their capability to scale up.

At the crossroad between eGovernment and Digital Entrepreneurship stands GovTech, namely Government Technology, a new arena full of opportunities for citizens, policy makers, investors, startups, institutions and political leaders that deserve the right attention as it will soon boom and as it represents the highway to economic development.

Thus, the purposes of this thesis work can be identified as follow.

1. *To study the characteristics of GovTech startups ecosystem*
2. *To investigate the possible reasons behind performance differences among GovTech startups*

To achieve these goals the work is structured as follows.

- *Chapter 1* – includes the theoretical background of GovTech that is necessary to get confident with the theme. In particular, the topics presented are eGovernment, digital entrepreneurship ecosystem and startups, and the new frontiers of collaboration between public and private sectors.
- *Chapter 2* – involves the methodology undertaken for the literature review and presents the empirical process adopted to create the GovTech Startups Database.
- *Chapter 3* – presents the results of the work and explains the main features of the GovTech startup ecosystem.

- *Chapter 4* – includes the final discussion with a recap of the findings under an analytical perspective, the answer to the research questions and, finally, limitations of the work and future researches.
- *Chapter 5* – propose a final evaluation of GovTech by highlighting the relevance of the topic and the contributions of thesis.

CHAPTER 1 – LITERATURE REVIEW

This chapter has the objective to illustrate the most important literature studies that contribute to the rise of GovTech as a new area of research. Accordingly, the first section is dedicated to eGovernment and describes its path of development. The second section briefly presents the features of the most impacting technologies for the spread of smart and high-tech public administration. Lastly, the third section give an insight about the topic of startups as powerful partners for the implementation and the integration of these technologies into public government practices.

1.1 eGovernment

The implementation of Information and Communication Technologies (ICTs) has brought a gust of innovation which has revolutionized the way we live and exchange information. The advantages introduced by these new tools, have created a very hyped environment, where citizens and customers are very sensitive to technological implementations and benefits.

Many practitioners have raised the question as to the exact impact of this modernisation on societies, and the implementation of ICT in public organizations has gained momentum on public agendas and for a critical mass of scholars (Gil-García & Pardo, 2005) . Despite a growing importance since the 90s, a universally accepted definition of "eGovernment" was barely reached by the literature (Yildiz, 2007). Its areas of interest are cross-disciplinary and overlaps with many other fields such as information science, digitization, computer science, management science, and e-management (Hu et al., 2009).

In order to fill the variety of meanings beyond this word and the multifaceted nature of eGovernment, several definitions are introduced below.

An early United Nations approach refers to eGovernment as the possible use of Internet and Web to deliver government information and services to citizens (ONU, 2003). In addition to the Internet Web, Jaeger (2003) embeds the use of other technologies, including database, networking, multimedia, automation, tracing and tracking systems, and personal identification technology. The European Union defines eGovernment as "the use of ICTs in public administration, combined with organisational change and new skills in order to improve public value services, democratic processes and reinforce public

policies" (Ardielli & Halásková, 2015). eGovernment leverages on ICT technology to improve relations with citizens, businesses and among government bodies (World Bank, 2015).

In this regard, Brown & Brudney (2004) indicate the multiple stakeholders involved in the process of improved coordination and information flows and sharing as Government-to-Citizen (G2C), Government-to-Business (G2B), and Government-to-Government (G2G). More specifically, following Evans and Yen (2006), G2C relieves the physical dependence of citizens from government offices with an improved online government communication (e.g. posting of forms and registrations online). G2B empowers governments with the possibility to purchase items, pay invoices (while obtaining data to analyse to improve decision making), and businesses increasing electronic tax capabilities and the availability of online regulations, resulting in more cost-effective procedures. G2G refers to the use of ICT in order to improve the efficiency of information sharing among government agencies, eliminating redundancies and communications.

The definition adopted for the purpose of this study, is the one proposed by Hu et al. (2009) defining eGovernment as

> "*the major initiatives of management and delivery of information and public services taken by all levels of governments on behalf of citizens and businesses, involving the use of multi-ways of internet, web site, system integration, and interoperability to enhance the services (information, communication, policy making), quality and security as a new key strategy or approach".*

Despite a broad acceptance has never been reached, experts agree on the motivations to adopt eGovernment. Bearing in mind that technological sophistication is a poor surrogate for under understanding benefit attainment (Brown, 2007), several benefits and areas of improvement have been identified by AL-Shehry et al. (2006):

- ***economical***, as eGovernment fosters cost reduction for both government itself and its counterparts;
- ***political***, pointing out that eGovernment can increase citizen participation in political processes and build trust between citizens and government by improving the government's image and perhaps facilitating democratic processes;

- ***social***, considering a better delivery of governments' services such as learning and education, and the empowerment of citizens through access to information;
- ***technological***, allowing transparency and a better provision of information;
- ***managerial***, since eGovernment can lead to the identification of efficient management strategies and practices for public bodies.

In 2009, at the background of eGovernment, a new movement in government appeared - the so-called *Open Government* movement - with the objective of improving the relationship between government and citizens and promoting a trustworthy and responsive government (Veljković et al., 2014). Open Government is based on three pillars – transparency, participation and collaboration – that create public value (Wirtz & Birkmeyer, 2015). To implement Open Government practices, open data is fundamental. Open data refers to "governmental data of public interest that are available without any restrictions and that can be easily found and accessed" (Veljković et al., 2014). The concepts of eGovernment and Open Government seems to have much in common (see Geiger & Von Lucke, 2012) and despite a growing relevance of the topic, literature still lacks of an integrative definition and a clear understanding of this newly born concept (Wirtz & Birkmeyer, 2015).

Another stream of research which has attracted scholars is the degree of adoption and diffusion of eGovernment in the society, and the factors influencing its successful implementation among governments. On the one hand, researchers follow an already explored path and use models previously tested to explain the diffusion of e-commerce thanks to the information system innovation. These approaches attempt to extend the application of these models from the e-commerce context to the eGovernment one. Technology Application Model (TAM) elaborated by Davis (1989), Roger diffusion of Innovation model (Orr, 2003) contribute to stress the importance of the perception of the eGovernment services to be "easy to use" from the eyes of citizens and businesses as a key driver for the adoption. In the same way, the degree to which a service offered by governments is congruent with the way citizens like to interact with the external environment and the perceived trustworthiness and trust of citizens (towards both internet and governments) are positively related to their intentions to use a eGovernment service (Carter & Bélanger, 2005). Bélanger & Carter (2008), posit that "if government agencies expect citizens to provide sensitive information and complete personal

transactions online, they must acknowledge and enhance citizens' views concerning the credibility of eGovernment services"

Even though the theories above are useful, their application to eGovernment is a bit of a stretch, given its idiosyncratic and complex nature (Dwivedi et al., 2011). The limitations are evident considering the different nature of eBusiness and eGovernment: the former is profit-driven while the latter is service-oriented and citizen-focused. Moreover, they have a different set of stakeholders and user domain. Access, structure, and accountability have been pointed out by (Carter & Bélanger, 2005) as three noteworthy differences between e-commerce and eGovernment. If businesses can freely choose their target customers, governments have to guarantee the access to service and information to the entire population, even protected categories (social inclusion). Secondly, public agencies have a less centralized authority compared to businesses and this dispersion can prevent the creation of government services and blur responsibilities and feedbacks. Lastly, governments are constrained to allocate resources "in the best interest of the public".

Even though the relevance of eGovernment in improving its relations with stakeholders and the creation of public value has been widely recognised, poor effort has been shown by researchers towards the identification of a shared architecture which enables an integrated perspective between ICT and business process management in public administration. This lack has been filled by the architecture framework proposed by Ebrahim & Irani (2005), who presented a four-layer structure for the implementation of eGovernment projects:

- ***Access layer*** encompasses all the possible online and offline channels through which users (citizens, businesses, public servants, other government bodies) can access government services. Channels include all the data communication devices such as websites, mobile phones, call centres, kiosks, PCs and all the others government information sources.
- ***eGovernment layer*** represents a first touchpoint and one-stop eGovernment integrated portal for the fruition of government services. The portal provides users to access and manage information needed through a single window only. Data integration is fundamental because it allows users to reduce overhead exchanging information only once

with government; then, it is up to the government to spread and share the information to all the others public administrations layers and bodies who need that information.

- ***eBusiness layer*** includes the different applications and tools to enable a network of trust, knowledge sharing and information processing, integrating front-end eGovernment layer applications (online catalogues and transactions interfaces) and back- end activities (database and data warehouses), resulting in computer systems and applications of different public departments to be connected with each other.
- ***Infrastructure layer*** represents the backbone technology infrastructure with all the agreed standards and protocols among communicating systems (servers, LANs, intranet, internet, extranet).

Many institutions, both in developed and developing countries, at all levels, have experimented the paradigm of eGovernment in the last two decades with multifaceted results. Heeks (2006) refers to *eGovernment Benchmarking* as "undertaking a review of comparative performance of eGovernment between nations or agencies" which can lead to both an internal benefit (achieved by the individual or the organization undertaking the benchmark) and an external benefit (achieved for users of the study).

If in developed countries scientists are concerned with modernization and coordination of e-services, in developing countries eGovernment heads towards the elimination of bureaucratic procedures, fight against corruption and a drastic increase of the efficiency of public administrations, which are very hot and challenging topics (Shkarlet et al., 2020). Academics posit that shared experiences in the implementations of eGovernments' initiatives by the most developed countries could facilitate the effectiveness of the adoption in developing countries (Weerakkody et al., 2009).

Furthermore, the absence of a robust infrastructure (due to limitations in the telecommunications system), the reluctance to change (caused by government officials' fear of power distribution after introducing eGovernment), and the low ICT literacy rate represent huge challenges that need to be overcome. However, according to Schuppan (2009), the simplistic transfer of concepts and practices from developed to developing countries is not a successful practices, and could lead to unintended effects such as more corruption, centralism, and hierarchy, and to a less efficiency in government

service. Thus, when dealing with developing countries, it is necessary to account for many context-specific such as institutional and cultural background, illiteracy, and weak infrastructure, as well as the reaction of citizens to these innovations. All in all, this require a very deep and accurate feasibility analysis, resulting in longer preparations and project time compared to developed countries (Schuppan, 2009) and , in wider terms, there is a distinct need of empirical investigations for the reasons why eGovernment projects do not achieve the desired results in developing countries (Bakon et al., 2020).

On the whole, public sectors organizations face multiple barriers that constrain the adoption of eGovernment to be fruitful (Ebrahim & Irani, 2005) and to achieve the expected outcomes.

According to the authors, these barriers can be summarized into the five categories reported below.

1. ***Inadequate IT infrastructure*** (hardware and software) which prevents eGovernment organisations' capabilities to provide electronic services to its different stakeholders.
2. ***Security and privacy issues***. Government use, collect, process, and share sensitive personal information over such an impersonal medium like Internet. Users' mistrust in the capability of governments managing data undermines a spread eGovernment adoption. In this regards, government agencies should communicate their ability and desire to provide citizens with convenient channels and publicize successful stories and statistics of citizens who are pleased with e-services (Bélanger & Carter, 2008).
3. ***Shortage of IT staff*** which plays a key role in the implementation of eGovernment. High-qualified IT personnel represents a very precious as well as scarce resource for which government directly competes with private sectors and, most of the times, are not as captivating as private enterprises in terms of payments and conditions.
4. ***Organisational barriers*** related to structural issues, such as fragmentation and poor relations and communication between functional departments and acceptance of the strategic benefits of new initiatives by government managers.
5. ***Operational cost of eGovernment*** and inadequate financial resources provided by central governments which prevents to plan a sustainable IT initiative.

After presenting the obstacles to the right implementation of eGovernment, it is worth investigating how this paradigm take root and evolves within government structure. For this purpose, Layne and Lee (2001) theorize a four-stage growth model for eGovernment which has been widely accepted by academics:

1. ***Cataloguing*** – it refers to the establishment of an on-line presence for the government, where government information is catalogued and presented on web site. The web presence increases citizens' convenience and reduce workload of frontline government employees, that is not consumed in answering basic questions about services and procedures;
2. ***Transaction*** – when eGovernment focuses on connecting the internal government system to online interfaces, and on allowing citizens to transact with government electronically. This stage empowers citizens to deal with their governments on-line anytime, saving hours of paperwork, the inconvenience of traveling to a government office and time spent waiting in line. A two - way communication is now possible and citizens transact with government on-line by filling out forms and government responds by providing confirmations, receipts, etc;
3. ***Vertical integration*** – when federal, state, and local counterpart systems are expected to connect or, at least, communicate to each other. While some jurisdictions' websites currently provide links to other governmental agencies at different levels, vertical integration goes beyond this simple interconnection. If a citizen conducts a transaction with a state agency, the transaction information will be propagated to local and federal counterparts;
4. ***Horizontal integration*** – it refers to system integration across different functions in that a transaction in one agency can lead to automatic checks against data in other functional agencies. Databases across different functional areas will communicate with each other and ideally share information, so that information obtained by one agency will propagate throughout all government functions.

All in all, the increase in the number of study about eGovernment in the last decade testify the centrality acquired by this continuously evolving field (Alcaide–Muñoz et al., 2017), which has not yet reached a stage of maturity. What is clear is that, a part from technological knowledge and robust architectures, in order to investigate and implement eGovernment, a deep understanding of the public sector management 's dynamics is

necessary (Twizeyimana & Andersson, 2019). Furthermore, the need of a shared definition among academics is essential since the ambiguity around the topic could inhibit the effectiveness of the studies and the implementation of eGovernment solutions.

1.2 Digital Technologies and eGovernment

The successful adoption of digital technologies and the Internet in the private sector has attracted the curiosity of academics with the objective to assess whether the outcome of a proper and adequate adoption of these tools could benefit the public sector too.

According to Montagna (2005), if initially government has used these potentialities more slowly because of its unpreparedness to change, countries have now undertaken global projects to take advantages of technological innovations. Although the advantages are now clear to many, it is just as much significant to give prominence to the challenges and the risks that these technologies take with and that must be considered.

In this section and in our analysis, we focus on five (of many) digital technologies together with their applications in the Public Sector. These 5 key technologies represent a new generation of ICTs - Big Data, Cloud Computing, Blockchain, Artificial Intelligence, and Internet of Things –, broadly recognized by researchers as the most impacting for change and innovation in the Public Sector (Engin & Treleaven, 2019).

1.2.1 Big Data

The creation of Big Data (BD) has been enabled by the technological advancement and the continuous increase of computational power of the last two decades (Ji et al., 2012). According to the Gartner IT glossary (IT Glossary Gartner, n.d.) , *"Big data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation".* The definition of BD is therefore associated to the 3Vs: its enormous in *Volume* (billions of gigabytes), its huge *Variety* (spectrum of fields), and the immense *Velocity* through which data is collected (Ahmadi et al., 2016). As of late, two more Vs have been considered: *Veracity*, which points out the relevance of the data source's quality in order to make accurate analysis, and *Value*, which indicates the huge potential advantage coming from Big Data (Ishwarappa & Anuradha, 2015).

Data itself is not a valuable asset and value can be created only from data analysis and interpretation. In this regard, Big Data Analytics (BDA) have the objective to extract information from a cross disciplinary sources for further uses, among all decision making and prediction (Chong & Shi, 2015).

The social applications of BDA are vast and ample, from supporting the policy life cycle to performance benchmark opportunities, from the delivery of data driven services to the implementation of clever law enforcement (Barbero, M., 2016). In the sphere of public administration and city management, public servants and managers can exploit BDA to share information at different administration levels and among many different public bodies, supporting decision making process in smart city domain (Khan et al., 2013). Governments have a huge amount of data coming from various departments and offices that, if properly used, could contribute to public value creation. But to make this benefit reality, a new, flexible, and scalable IT technology infrastructure is required, together with analytics tools, visualization approaches, workflows, and interfaces (Roski et al., 2014). In the same breath, with the amount of data managed by governments and public agencies it is just as much essential to develop an exhaustive protection system to guarantee the effective privacy protection of firms, people, and governments (Puri, 2018).

1.2.2 Cloud Computing

The U.S. National Institute of Standards and Technology (Mell & Grance, 2012) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". This definition points out the five distinctive characteristics of cloud computing and promotes the availability of cloud computing in its three delivery models.

The five characteristics mentioned by NIST are as follows:

- ***On-demand self-service***. Users can unilaterally and automatically access computing capabilities without requiring human interaction with service providers.
- ***Broad network access***. Cloud computing services on the Internet are easily accessible through standard mechanisms by thick and thin clients (e.g., laptops, mobile phones, tablets, etc.).
- ***Resource pooling***. Physical and virtual resources are dynamically reassigned according to consumer demand.

- ***Rapid elasticity***. Capabilities can be elastically provisioned and released to scale rapidly outward and inward commensurate with demand.
- ***Measured service***. The usage of services and resources is constantly monitored, controlled, and reported providing transparency for both the provider and consumer.

Cloud computing is empowered by a technology called "virtualization", where a host computer runs an application which creates more virtual machines that simulate physical computers. Those computers can run any software, from operating system to end-user applications (Zissis & Lekkas, 2011).

Cloud services can be categorised on the basis of the following delivery models.

Infrastructure as a Service (IaaS). Consumers are provided with storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, including operating systems and applications. The consumer is not responsible for the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications.

Platform as a Service (PaaS). Consumers are provided with the possibility to deploy onto the cloud infrastructure consumer-created or acquired applications. The consumer is not responsible for the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

Software as a Service (SaaS). Consumers can use provider's applications running on a cloud infrastructure. The applications are accessible from various client devices and consumers do not manage or control the underlying cloud infrastructure nor individual application capabilities.

Researchers recognize that the adoption of cloud computing for of eGovernment brings about a wide range of benefits, which are summed up by (Mohammed & Ibrahim, 2015) as follows.

The *ease of implementation* guarantees PAs can easily adopt cloud computing without necessarily buying hardware, software licenses or implementing applications.

Cost savings accounts for the possibility of replacing ICT fixed and capitalized cost by operational cost, paying only for services used, and reducing ICT staff cost.

Cloud computing enhances *scalability* since organizations can simply add and subtract network load capacity, and *accessibility* enabling access to information and services from anywhere and with multiple devices even for smaller organizations which can access powerful hardware, software, and ICT staff.
Moreover, this technology allows public organizations to *focus on core activities* like policy development and public services design and delivery rather than functionalities like running data centers and developing and managing software applications. Cloud computing provides public services while using fewer resources, *reducing carbon emissions*.

At last, a remarkable advantage from the implementation of cloud solutions relies on the possibility of joining economies of scale. Indeed, despite a high fixed cost of building a cloud computing centre, there is a low marginal cost to include additional government units and to deploy more e-services. Higher the number of government units joining the cloud computing centre, lower is the average cost for each unit (Cellary & Strykowski, 2009).

1.2.3 Artificial Intelligence

The first approach to Artificial Intelligence (AI) dates back to 1955, when a research project authored by McCarthy et al. (1955) was initiated. Their study relies on the conjecture that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it". Up to date definitions show very similar concepts.

Adams (2012) refers to AI as a "system that could learn, replicate, and possibly exceed human level performance in the full breadth of cognitive and intellectual abilities". The peculiarity of artificial intelligent stays in its attempts to replicate human thinking and learning, and problem-solving abilities in order to enhance performance (Wirtz, Weyerer, & Geyer, 2019). Thus, a comparison between human and AI capabilities comes out spontaneously.

Although the applications of AI need further exploration to exploit its full capabilities, there are multiple areas where AI could immediately be beneficial to improve citizen services (Mehr, 2017). Thanks to the implementation of AI solutions within public

management, processing of citizens' cases and request results speeded up and simultaneously the level of quality increased.

AI aims at providing efficient and sustainable allocation of public resources managing citizens' affairs more effectively, accelerating task execution by public servants, who result as more adaptive and agile to a dynamic society (Wirtz & Müller, 2019a) . All in all, AI is able to help agencies alleviate the significant administrative burden on caseworkers, free up time to spend in more critical tasks, relieve public servants from bureaucratic paperwork, improve decision-making process and deliver services more effectively, as well as solving long wait times typical in the public domain (Fishman & Eggers, 2017).

However, several challenges must be addressed for a successful adoption of this technology.

A first question arises from the peculiarity of AI to act autonomously without the intervention of human being, which can lead to unpredictable solution that human may not have considered (Ministero dello Sviluppo Economico Direzione Generale per la Politica Industriale, 2020).

Secondly, AI will have a considerable impact in the substitution and transformation of workforce (Wirtz, Weyerer, & Geyer, 2019), enough to increase the unemployment rate because of the increased level of automation (Mehr, 2017). If unemployment deriving from the adoption of job loss is a valid concern for civil servants, researchers have found that AI works best in collaboration with humans. Any efforts to incorporate AI in governments should be approached in order to empower and augment human work, not to cut headcount (Mehr, 2017).

Another challenge is related, again, to data privacy and security. The huge amount of data for AI application is vulnerable to cybersecurity attacks with the risk to undermine individual privacy and trust (Kankanhalli et al., 2019), which are fundamental factors for the adoption of government e-services by citizens.

As a final point, many academics (Kankanhalli et al., 2019) (Wirtz & Müller, 2019) (Wirtz, Weyerer, & Geyer, 2019) argue that AI applications in public may result in unethical decisions. The risk, in fact, is that artificial intelligence lacks elements that are typical in a human being decision-making process such as emotion and consciousness, resulting in a decisions which are completely rational and could represent a threat for human beings (Wirtz & Müller, 2019).

1.2.4 Internet of Things

Another crucial set of technologies that appeared in this context relates to Internet of Things, also known as IoT.

Still no consensus on a formal definition of IoT has been reached among commenters (Farhat - NTIA, 2017), since definitions vary across stakeholders, industries of application and parts of government. Nonetheless, it may be a source of restriction for this technology and its growth to lock up its definition into specific boarders (Farhat - NTIA 2017). The fuzziness around this term may derive from the fact that it is composed by two terms: the first one pushing towards a network oriented perspective, whereas the second moves the focus on generic "physical objects" to be integrated into a common framework (Atzori et al., 2010). These objects have to be readable, recognizable, locatable, addressable, and controllable. The meaning is that sensors and actuators shall be embedded into physical objects to enable them operating within a digital information system (Atzori et al., 2017), resulting in multisided interaction between human-to-human, human-to-things and things-to-things (Madakam et al., 2015).

Semantically, IoT can be defined as "a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols" (European Technology Platform on Smart Systems Integration, 2008). What is relevant to highlight is the fact that data, as valuable resources, are created by things. Thus, an accurate definition would be: "An open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment" (Madakam et al., 2015)

Experts have focused the attention on the positive outcomes adopting IoT. Chui, Löffler, and Roberts (McKinsey Quarterly, 2010) identify two broad categories of application: (1) Information and analysis, and (2) Automation and control. The first results from the collection and the analysis of data from products, company assets and the operating environment that improve the quality of information coming from the network of physical objects, allowing to track behaviours, increase situational awareness and sensor-driven decision analytics. Overall, this allows a better decision-making process. As for Automation and control, the application of IoT can better monitor processes and automize resource consumption, increasing efficiency and effectiveness.

The public settings appear to be a fertile field of application for IoT (Wirtz, Weyerer, & Schichtel, 2019), which takes an active part in the context of smart government and is one of the key trends that governments need to investigate over the short term (Mellouli et al., 2014).

Many IoT-related improvements provide governments with cross-cutting solutions and enable the improvement of countless government services (Farhat - NTIA, 2017). Another relevant consideration concerns the positive network externalities generated by IoT: the more the number of users of IoT-enabled product/service, the higher the value generated by that product/service (Castro, D., New, J., & McQuinn, 2016) (Chatfield & Reddick, 2019). Thus, fostering a wider the adoption, governments would obtain positive network effects for itself as well as for citizens.

To give an idea of just a few examples of IoT's applications, Chatfield & Reddick (2019) indicate, among all, beneficial effects especially in Smart City domain (supporting smart building applications), Transportation (notifying drivers of dangerous road conditions, controlling traffic and decreasing congestion), Energy (adapting street lights use in accordance to road use thus reducing energy consumption and electricity cost for municipalities and cities) and Defense (bettering public safety through the use of cameras, sensors, drones, etc.).

However, related challenges should not be set aside, as they may inhibit the implementation and use of IoT applications. The emergence of the Internet of Things, as for the others digital technologies, highlights that new regulatory frameworks are necessary to ensure privacy of customers and security of the network (Weber, 2010).

1.2.5 Blockchain

The concept of Blockchain was introduced in 2008 by its creator under the pseudonym of Satoshi Nakamoto. Blockchain Technology (BCT) is also identified as a Distributed Ledger Technology based on the idea that every user has access to a shared ledger where all transactions are reported in a chain of blocks (Ølnes et al., 2017). Transaction are confirmed through the use of a digital signature, realized thanks to a pair of private and public keys owned by participants: the private key is used to sign the transaction, while the public for the verification of the transaction by the users on the network (Zheng et al., 2017). Therefore, key futures of blockchain are delineated as follows:

- ***Decentralisation***. There is no need of a trusted third party which validates the transactions, but they are validated by the nodes in the network employing the consensus mechanism: if the nodes agree on its legitimacy, the transaction is confirmed and is laid down in a block;
- ***Persistency***. Since transactions are validated, spread and checked across the network, it is almost impossible to tamper;
- ***Anonymity***. Interaction of each participant with the network occurs through a generated private address which protect users from identity exposure and the disclosure of personal information. The major difference between blockchain and other traceable transactions is that public keys are never tied to a real-world identity (Pilkington, 2015);
- ***Auditability***. Records of transactions can be easily verified by the users of the BC because each transaction is stored on block.

Blockchain technologies are roughly categorized into three typologies (Lin & Liao, 2017).:

1. ***Public blockchain*** refers to the system where everyone can check and verify the transaction. Examples of public blockchain are Bitcoin and Ethereum;
2. In ***private blockchain*** not every node can take part into the process and access are restricted to certain nodes;
3. ***Partially-decentralized blockchain*** represents a hybrid version between public and private blockchain.

These three models differ by the number of nodes allowed in the consensus determination, immutability, efficiency, and centralization (Zheng et al., 2017).

Zheng et al., (2017) argue that BC can be applied to many areas including finance, public and social services, reputation systems and security and privacy. But in its application to government, obtaining the benefits of BC requires deep knowledge of government processes (Ølnes et al., 2017). In this sense, Hou (2017) reports, as the main advantage of applying BC technology to eGovernment in China, the development of individual credit system in such a way that fragmented personal records and information could be stored in the same system providing citizens with a comprehensive digital identity. Government

will then rely on these individual records to provide public services more effectively. Further, BC can be used as an official registry for government-licensed assets owned by citizens such as houses and vehicles, can prevent from voting frauds, and help in back office functions delivering better productivity and demolishing bureaucracy (Shelkovnikov, 2016).

1.2.6 Conclusion

To conclude this chapter, it is noteworthy to underline that soon public and private sector will soon be impacted by the arrival of the new 5G technology, the fifth generation of mobile wireless communication. 5G will boost the connectivity between devices as well as people, will allow the transfer of a huge quantity of data more reliably and faster. Digital technologies will result empowered by this cutting-edge innovation, generating an immense range of opportunities to create, among all, public value. Clearly, the benefits of 5G needs an unprecedented cross sectoral collaboration between local authorities who has got to drive, and telecommunication industry, new business model for the PAs as well as well as prepared legal institutions.

Technology's pace of innovation proved to be unstoppable in the last decade, while legal systems and societies have shown difficulties to keep up with that. The consequences of this can be dramatic, ranging from an inhibition of innovation to more disparities among different countries and communities.

Technology	Definition Considered	Applications in eGov	Requirments and Criticalities
Big Data	"*Big data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation"*	- Support of policy life cycle, - Benchmark opportunites, - Information sharing among different layers of govs, - Support decision making process.	- High potential of application given the big amount of data that govs possess, - Need of a scalable technology infrastructure, analytic tools, expertise, - Need of a robust protection system to secure personal end sensitive data.
Cloud Computing	"a *model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*"	- Possibility to outsource archiving, memory and elaboration of info (pay per use on demand) with consequent reduction of fixed cost, redundances and the possibility to focus on core government activities.	- Internet dependance, - Security issue since data is not managed in house.
Artificial Intelligence	*"a system that could learn, replicate, and possibly exceed human level performance in the full breadth of cognitive and intellectual abilities"*	- Effective management of citizens' practices and affairs, - acceleration of task execution by public servant, - release public servant from bureaucratic paperwork, - improved decision making process.	- Possibility of unpredictable solutions by AI not considered by human, - Ethical issue, - Substitution of workforce.
Internet of Things	*"an open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment"*	- Possibility to have precious data on traffic, pollution, human behaviour, etc. from the network of physical objects in order to improve decision making, monitor services provision, automize resource consumption.	- Cybersecurity issue (risk of hacking), data and privacy protection, - Interoperability with other digital technologies, - 5G impact on IoT adoption.
Blockchain	*"a Distributed Ledger Technology based on the idea that every user has access to a shared ledger where all transactions are reported in a chain of blocks"*	- Secure storage of fragmented record for citizens, businesses and govs, - Can be used as a public registry for any transaction or info exchange where government is with lower transaction cost involved (asset registry) with lower transaction cost.	- Application requires deep knowledge of government processes, - Leak risk for sensitive information and for modifications of data, - Hard to scale because of consensus mechanism, - Implementation cost.

Table 1 - Digital Key Technologies and their application in eGovernment

1.3 Entrepreneurial Ecosystem, Startups and Public-Private collaboration

This chapter is divided in two parts. The first one has the objective to briefly illustrate the literature state of art in the field of entrepreneurial ecosystems as an integrated set of interacting components which can enhance (or inhibit) the success of enterprises (both new ventures and established firms) and, to a greater extent, can contribute to the creation of jobs, societal and economic growth, and wellbeing.

After mentioning the effects of the digital technology on entrepreneurial ecosystems, we present an overview on the concept of startup, with the objective of investigating its definition, critical success factors, and the new lean startup approach as considered critical aspects for the successive development of this work. The second part explores the interactions between public and private sector and provides an overview on how these interactions are fundamental in order to innovate.

1.3.1 Entrepreneurial ecosystem

The environment where businesses navigate (both new ventures and established firms), has been early recognized as a key driver in the enhancement or inhibition for the diffusion of entrepreneurship (Dubini, 1989). The phenomenon of entrepreneurship is difficult to frame because of its multifaceted nature that includes a variety of constructs such as change management, innovation, technological and environmental turbulence, new product development, small business management, individualism and industry evolution (*Low (1988).Pdf*, n.d.).

To overcome the ambiguity created around this term, a widely used definition is the one given by Stevenson (2016), according to which *entrepreneurship is the pursuit of opportunity beyond resources controlled*. This definition is grounded in three key aspects: *pursuit* indicates a urgency in improving and progressing which can rarely be found in large established firms; *opportunity* regard the newness of something (business model, products and/or services, target customers, distribution channels, etc.); *beyond resources controlled* refers to a necessity of creating value which goes beyond the capacity of the venture itself. Accordingly, the figure of the entrepreneur refers to a risk-taker

continuously pursuing economic value through growth, and ambitious as always dissatisfied with the status quo (Isenberg, 2011).

The success of entrepreneurship mainly depends on the ecosystem, which is composed by a virtuous cycle of entrepreneurship (Maroufkhani et al., 2018). The design and the implementation of this virtuous cycle is mainly a responsibility of policy makers.
Spilling (1996) considers the entrepreneurial ecosystem as a set of several actors, roles, and environmental factors that interact together to determine the entrepreneurial performance in a certain regional context. Isenberg (2011) proposes a wide adopted conceptual model where the six domains of entrepreneurial ecosystem have been identified and analysed.

In the *Figure 1* below the six dimensions are summarized.

The first domain, ***policy***, encompasses the two elements of government and leadership. Government authorities should foster a dynamic environment where institutions directly collaborate with entrepreneurs in a private-public dialog, and where public leaders operate with the objective of removing barriers.
The second dimension is ***finance***, that is to say the financial capitals needed by the entrepreneurs and available on behalf of investment funds, private equity funds, private investors and so on.
The third domain refers to the embedded ***culture,*** meaning the set of principles by which societies tolerate righteous mistakes and failures of entrepreneurs, adopt contrarian thinking and risk propensity mentality..
The fourth dimension concerns the ***support*** for the ecosystem, which can be provided by non-government institutions, by support professionals (legal, accountants, investment bankers, expert and advisors in general) and by the right infrastructure (telecommunications, transportations & logistics, energy, incubation centers, etc.).
The fifth dimension pertains ***human capital***, intended as the set of skills, knowledge and competences conducing for the ecosystem.
The last dimension involves the ***market*** intended as customers groups and networks of players who can push for the conducive entrepreneurial ecosystem.

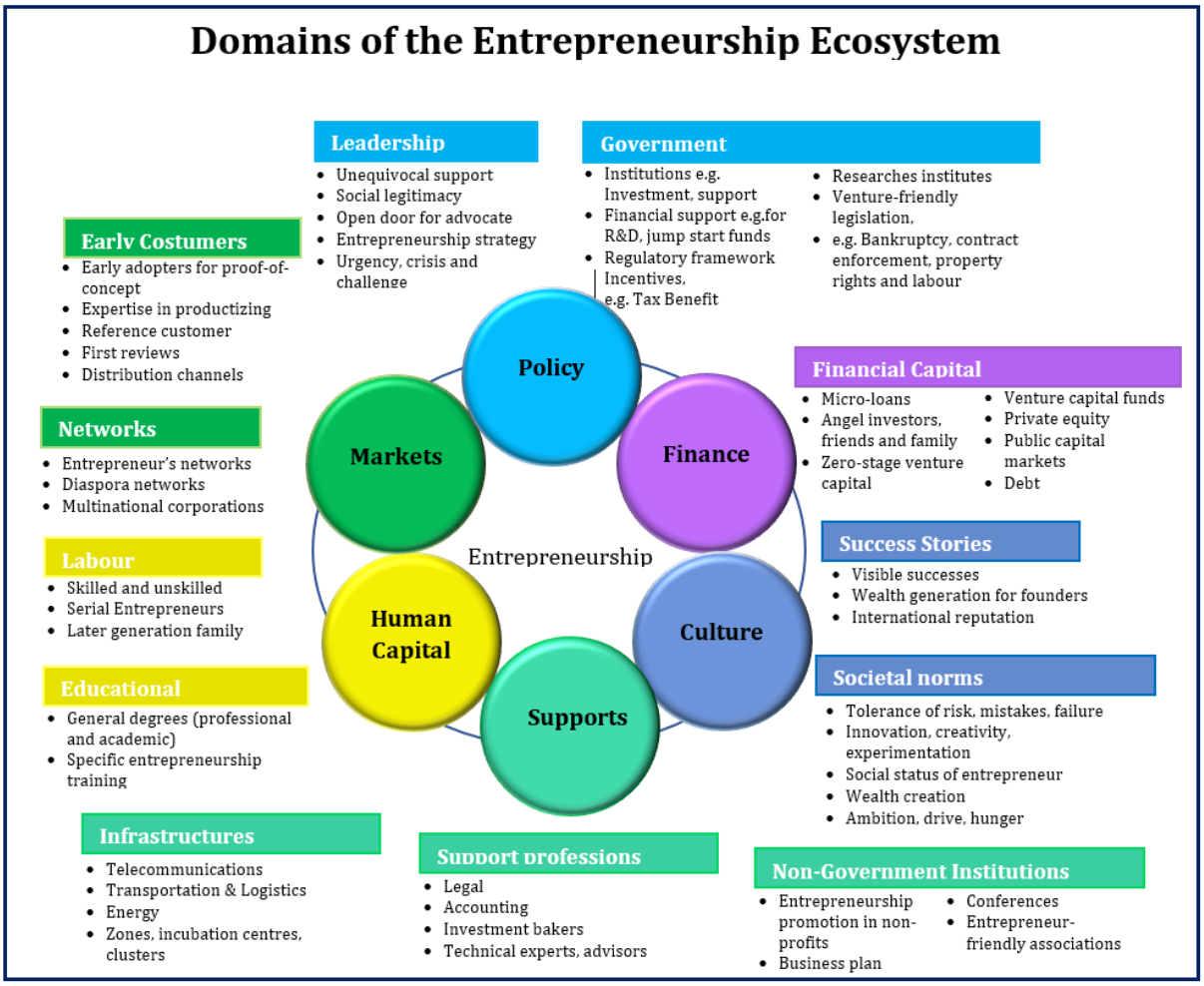


Figure 1 - Domains of Entrepreneurship Ecosystem, Isenberg (2011)

A step further has been done by Mack and Mayer (2016) introducing an evolutionary perspective on entrepreneurial ecosystems which pass through four stages: birth, growth, sustainment and decline. The authors posit that the six domains designed by Isenberg play different roles within the life cycle of an entrepreneurial system. For example, in the birth phase there are few success stories since the ecosystem is newly born, and human capital is not developed due to the few entrepreneurs and their lacking experience, while the supporting infrastructures is pioneering. Similarly, Spigel (2017) states that ecosystems are characterized by the presence of ten multiple overlapping attributes that favour entrepreneurial activity and provide physical resources exploitable by new ventures while expanding and evolving. These attributes can be grouped into three main categories – cultural, social, and material –, based on how benefits are created and managed.

1.3.2 Startup ecosystem

Before introducing this new section, it is important to remark that GovTech startup ecosystem is a very new and unexplored field to the scientific world. No conceptual model, framework or paradigm has been elaborated by academics to facilitate its comprehension has been elaborated in this matter yet. With this poor literature in the background, to become familiar with GovTech, it is of vital importance to investigate the theme of startups and the extreme dynamic environment where they born, grow and compete, namely the Startup ecosystem.

In the context of entrepreneurship, technological advancements have opened to new alternatives of interacting, collaborating, allocating resources, and developing new solutions. These opportunities excited the business world and brought player to reconsider traditional business models and processes, as well as the whole competitive environment (Elia et al., 2020). As a result, new digital technologies have generated a common sense of uncertainty, which gave rise to relevant scientific investigations at the intersection of digital technologies and entrepreneurship, also known as *digital entrepreneurship*, which consider the effects of the adoption of digital technologies in shaping the entrepreneurial ecosystem (Nambisan, 2017). According to the author, digital technologies have affected entrepreneurship making outcomes and processes less bounded, forcing entrepreneurs to adopt a continuously evolving value proposition perspective.

Despite the relevance of the trend, a significant literature gap appears in investigating the conceptualization of entrepreneurship in the digital age. To better assess the integration between the digital ecosystem and the entrepreneurial ecosystem, Sussan and Acs (2017) conceive a new framework named the Digital Entrepreneurial Ecosystem. The framework is composed by four components. The first, *digital user citizenship*, represents the norms that enable users to participate in the digital society. The second, *digital infrastructure governance*, stands for the set of shared technological standards and governance needed for entrepreneurial activities. The third component is the *digital marketplace* and involves value creation as a result of entrepreneurial activities and users' participation. As last, the *digital entrepreneurship* is the set of entrepreneurial activities optimizing the utilization and reconfiguration of digital infrastructure in the form of new systems, platforms, and networks.

As previously seen, an ecosystem is made up by a different categories of actors interacting with each other and contributing to the health of the ecosystem. Among all, a relevant category that is worth mentioning for the purpose of this work is constituted by startups (start-ups). A wide adopted definition of startup is the one proposed by (Blank & Dorf, 2013), reported below.

> *"A startup is not a smaller version of a large company. A startup is a temporary organization in search of a scalable, repeatable, profitable business model"*

This definition highlights the provisional nature of a startup as it remains such until a business model with the afore mentioned characteristics is found. This path is characterized by failures, that are an integral part of the startup learning process. "Startups go from failure to failure" while for existing companies, which have learned what works and doesn't, failure an exception (Blank & Dorf, 2013). Despite the very complete definition by Blank, in order to align the readers to the successive steps of this research, another definition by the Italian Ministry for Economic Development (MISE) has been taken into account. MISE has developed the so called Italian Startup Act (Ministero dello Sviluppo Economico Direzione Generale per la Politica Industriale, 2020), a program that helps innovative startups throughout their whole life cycle in matters of labour market, administrative simplifications, tax relief, failure, and many others. The requirements to access this support and that define an innovative startups are listed below:

- The company is newly born venture or founded no more than 5 years ago
- The yearly turnover is below 5 million €
- Net earnings have never been distributed
- The objective of the company focuses on the development, production, and commercialization of a "high technological value"
- The company is not the result of fusion, mergers, or divesture of other organizations
- It is not listed on the Stock Exchange nor on any other regulated negotiation platform

Bearing in mind these definitions and considering the complicated tasks that startups need to accomplish, it is worth investigating the critical success factors for startups. (Song et al., 2008) identified, among 24 variables widely discussed in the literature, eight significant factors determining the success of new technology ventures (NTV). Unfortunately, the study was not specifically focused on startups but to what the author call, more generally, NTV. In any case, it has been inferred that the two terms (NTVs and startups) are very similar or even assumed as perfectly interchangeable since NTVs explicitly deal with new generation technologies, are newly born and navigate in a really uncertain environment looking for a stable business model, just as startups do. The eight factors and their description are reported in *Table 2* for sake of simplicity.

FACTORS	DEFINITION
1. SUPPLY CHAIN INTEGRATION	A firm's cooperation across different levels of the value-added chain (e.g., suppliers, distribution channel agents, or customers)
2. MARKET SCOPE	Variety in customers and customer segments, their geographic range, and the number of products
3. FIRM AGE	Number of years a firm has been in existence
4. SIZE OF FOUNDING TEAM	Size of the management team of the firm
5. FINANCIAL RESOURCES	Level of financial assets of the firm
6. MARKETING EXPERIENCE	Experience of the firm's management team in marketing
7. INDUSTRY EXPERIENCE	Experience of the firm's management team in related industries and markets
8. PATENT PROTECTION	Availability of firm's patents protecting product or process technology

Table 2 - The eight most impacting success factors for NTV, Song et al., (2008)

The research by Delmar and Shane (2006) show that venture team startup and industry experience enhance new ventures survival. In particular, findings show that new ventures whose founders have prior startup experience are more likely to survive compared to startups created by founders at their first experience. However, founders' experience alone is not sufficient to explain success as it must be shared among team's members and enriched by a high level of passion and a collective vision (Mol, Harvard Business Review, 2019) In this regard, the role of shared leadership, intended as a collaborative process carried out by the team as a whole rather than by a single individual, proved to be particularly relevant in the development and growth of new ventures (Ensley et al., 2006). Salamzadeh (2015) posits that startup companies lifecycle pass through three stages: the *bootstrapping stage*, the *seed stage* and the *creation stage.* In the first stage, the entrepreneurs conduct a set of activities to convert the idea into a profitable business. The objective of this stage is to demonstrate product feasibility, financial capabilities, team building and management, and customer acceptance. In this way, the entrepreneur will be able to collect funds from friends, families and even angel investors. In the seed stage, startups are look for support mechanism by accelerators, incubators in order to develop first prototypes, to sustain teamwork and to develop a strategy to enter the market. This phase is characterized by high uncertainty and most startups fail during this stage, but survivals who got supported have great chance to be profitable in the future. In the final stage, the venture sells its products/services, hires workforce, consolidate its position backed by venture capitals.

Since startups are different from incumbents, they also need different tools. A great contribute has been given by Ries (2011) and Blank (2013) in their attempt to combine the lean philosophy and its principle to the startups development field, by elaborating respectively the "Lean Startup" and "Customer Development Model" methodologies – grouped under the name of Lean Startup Approaches (Ghezzi & Cavallo, 2018). Inspired by the concept of lean, LSAs actualize as the startups' attempt to cut its own waste, conceived as all the activities and processes useless for target customers who do not ask for them (Ries, 2011) (Blank, 2013). The starting point is that usual business plans are not suitable for startups as they rarely survive first contact with customers and try to forecast what is completely unknown for startups (Blank, 2013). Planning and forecasting are well-aimed only when they are backed on a long and stable operating history and a relatively stable environment (Rasmussen & Tanev, 2016).

On the contrary, an LS implements a hypothesis-driven approach to evaluate business opportunity and to develop products/services for specific markets. The hypothesis, which represent ideas about the new products/services development are tested through the use of prototypes in order to validate its features (Eisenmann et al., 2018) (Rasmussen & Tanev, 2016). The features are then revised and remodelled according to customers advises in an iterative process. The differences between traditional approaches and the lean approach are synthetically reported from Blank (2013) in *Table 3*.

	LEAN Approach	**TRADITIONAL Approach**
Strategy	Business Model Hypothesis-driven	Business Plan Implementation-driven
New-Product Process	Customer Development Test hypothesis	Product Management: linear, step by step plan
Engineering	Agile Development; build the product iteratively and incrementally.	Agile or Waterfall Development; build the product iteratively or fully specify the product before building it
Organization	Customer and Agile Development Teams	Departments by Function
Financial Reporting	Metrics that matter (customer acquisition cost, viralness, etc.)	Accounting (financial statements)
Failure	Expected	Exception
Speed	Rapid – operate on good-enough data	Measured – operate on complete data

Table 3 - The Lean approach vs The Traditional approach, Blank (2013)

1.4 Collaboration between public sector and private sector

1.4.1 Open Innovation - A new frontier of collaboration

Now and then public sector has been mocked as unable to deeply innovate (Axelson et al., 2017). In fact, there is an evident inconsistency between the traditional view that describes the public sector as a stable and stagnant environment governed by heavy bureaucratic processes and the nature of innovation, which instead is considered the engine of change and development. Moreover, when innovation practices are introduced in the public domain, institutions have demonstrated their inherent incompetence in replicating them on a larger scale since their efforts towards efficiency and accountability result in an insufficient level of innovation (Davidson et al., 2018). In addition, if innovation pushes organizations into domains for which employees are not equipped with an adequate level of knowledge, on the other, organizations' inertia forces them to remain in the previous boundary where they feel well trained and psychologically safe, generating a knowledge vacuum (Choi & Chandler, 2020). Although this misalignment between the public sector and innovation is still very pronounced, representatives of the New Public Management (NPM) approach argue that the private sector's ability of continuous improvement and of achieving high performances is also valuable and useful within the public sphere and, accordingly, public entities can take advantage by mimicking private sector practices (Glennon et al., 2018).

Furthermore, innovators around the world have been tackled by the fact that "traditional" innovation is no more feasible for two main reasons. The first reason involves the rising cost of innovation development: since technologies are getting more and more complicated, huge investments are required but rarely pay off. The second reason deals with the shorter life cycle of innovations and products which lead to the necessity of innovating very quickly.

In this scenario the new paradigm of Open Innovation has taken roots. This new concept has been introduced by Chesbrough (2003)

> *"Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology"*

The idea behind Open Innovation is to make firms' boundaries blinder and blinder and to look for innovative, valuable and low cost solutions also outside these boarders, including all the possible stakeholders (customers, suppliers, startups, employees, crowds, communities, etc.) in the innovation process (Chesbrough et al., 2006).

Many initiatives have been undertaken in order to develop the open innovation paradigm both in the private and public sectors. However, public sector organizations are only in the early phase of implementation of open innovation and a clear methodology to involve citizens in public sector innovation and the right formulation of a strategy of open public innovation are far from being set up (Kankanhalli et al., 2017). As mentioned in the chapter dedicated to eGovernment, public and private sectors are different under many points of view and this suggest that a direct application of open innovation in the public sector through the use of practices typical from the private one would probably fail (Kankanhalli et al., 2017).

Despite these considerations, many PAs around the world have started implementing open innovation practices and these applications have shown positive result, creating a favourable innovation climate (Lee et al., 2012). A research study conducted by (Feller et al., 2011) points out the following transformations in the public administration context after the implementation of open innovation:

1. ***Aggregation***: transforming identity. This effect describes a shift in the way the authority perceives itself, from being a competitor of other authorities, to a member of a cooperative network. This new perspective results in a joint identity among public bodies with the possibility to enhance short- and long-term alliances.
2. ***Syndication***: transforming competencies. This outcome refers to the authorities' change in the management of core competencies resulting in a shared mechanism to foster innovation and provide value creating processes and services.
3. ***Consumption***: transforming knowledge. Reflects the innovation in the authority's development process which is characterized by the inflow of external knowledge, competence and components which are used for the in-house development of services and processes
4. ***Co-creation***: transformation development represents the innovation in how the authority manages the development process through the inclusion of external partners not only in the short run, but also, and more effectively in the long one.

Some tangible examples of open innovation applications in the public sectors are *open innovation platforms*, used to post public sector problem to collect and evaluate the idea submitted by citizens (see Mergel, 2018)), *living labs* defined as "a design research methodology aimed at co-creating innovation through the involvement of aware users in a real-life setting" (Dell'Era & Landoni, 2014) and *social media monitoring* as a tool providing government agencies with external knowledge and opinions about their services (Loukis et al., 2017).

All in all, collaborative and open innovation seems to be feasible for public administrations to pursue innovation, improving idea generation, selection implementation, and diffusion. Nonetheless, some challenges need to be overcome such as the transfer of authority which raises issue of accountability, organizational and cultural barriers as well as the understanding how to properly evaluate public sector innovations (Bommert, 2010).

1.4.2 Public Procurement of Innovation & Public Private Partnership

Public Procurement of Innovation (PPI) and Public Private Partnership (PPP) are two thriving and consolidated paths that have already been investigated to stimulate the innovative capability of private firms in fostering innovative solutions for the public sector.

Public Procurement of Innovation (PPI)

Public Procurement is generally referred to the set of processes through which public administration purchase goods and services. This phenomenon deeply affects the economy and thereby it is considered as a tool to shape industrial activity in order to accomplish policy goals such as contributing to the economic growth, creating jobs and favour fair competition among enterprises (Spallone et al., 2019).

Nonetheless, public procurement can also be seen as a means to stimulate innovation (Rolfstam, 2012). This form of public procurement fostering innovation is defined by the European commission (see Rolfstam, 2012) as "the purchase of goods and services that do not exist, or need to be improved and hence require research and innovation to meet specified user needs".

Rolfstam (2012) simply defines PPI as a purchasing activities carried out by public agencies that lead to innovation. Georghiou et al. (2014) posits that the innovation-related

activity takes place when a public purchaser, while making its choice of what to buy, either triggers innovation by demanding products and/or services that already exist, or responds to innovation with the request of goods with innovative characteristics. By demanding and purchasing innovative solutions to address public needs and social challenges, for which a real implementation lacks, public sector is able to stimulate and inspire private businesses to exploit the creativity and resources required to co-develop new products. Public demand can thus be targeted and public procurement designed to encourage innovation by influencing markets for new products, technologies, and services (Edler & Georghiou, 2007).

Since the importance of public organisations to reduce costs given a certain level of service, the activity of PPI should improve the cost benefit of public organisation (Georghiou et al., 2014), but this practice is not that simple given the trade-off among the numerous objectives that PPI incorporates.

Georghiou et al. (2014) identifies the main deficiencies that inhibit public procurement for innovation to diffuse and be effective and establishes a "policy taxonomies" in order to intervene and face these deficiencies. The taxonomy is presented as follows.

1) ***Improve the framework condition to make innovation more conducive***. This policy accounts for the fact that procurement regulations are driven by a competition logic rather than an innovation logic.

2) ***Organisation and capabilities***. The second problem identified refers to the lack of awareness towards innovation potentialities and the poor expertise of public employees in handling procurement of innovation and in the execution of strategies oriented to an innovative public procurement, resulting in higher cost.

3) ***Identification, specification & signalling of needs****.* This area of improvement is related to the right communication of the needs and the requirements for a specific good/service that is often too narrowed that does not leave space to innovation and articulated into characteristics which aims at reducing price rather than fostering innovation.

4) ***Incentivising innovation solutions****.* This realm identifies on the one hand the high-risk perception that public buyers feel during the process. This problem is due to the fact that benefits take too much time to be realised into the political

cycle. On the other hand, suppliers perceive the risk about their innovative solution to be identified as such.

An institutional approach has been the research field of Rolfstam (2009) who highlights the role of the institutions and laws to enable innovation and to act as "innovation-friendly", meaning that they should foster innovation through a clear set of rules to allow actors cooperating, facilitate procurement effort and improve coordination. Amann and Essig (2015) finds out complexity and time consumption as the main hindrances preventing the development of effective PPI practices. On the one hand complexity refers to the huge number of stakeholders involved in the procurement process that makes decision-making complicated. On the other it is due to the multitude of expectation towards PPI such as cost savings, social targets and environmental-friendly solutions which rarely can be matched at the same time. Time consumption, instead, reflects the long time that a PPI process requires with the effect of discouraging PPI practices.
To assess all these challenges, (Edler & Yeow, 2016), recognizes the need of an "intermediation structure" that can work as a support to public bodies across the numerous steps in the procurement process. These supporting structures would better adhere to a set of principles accounting for *impartiality* and *neutrality* in the marketplace, *accessibility* and *trustworthiness*.

Public Private Partnership (PPP)

The idea of partnership relations is based on the concept of collaborative market, which can be positioned halfway between a competitive market and the possibility to vertical integrate. The two parts involved (buyer and seller) share risks and benefits from this collaboration, with the objective of maximizing the benefits of both parts and creating competitive advantage (Spina, 2016)

With the term Public – Private Partnership (PPP), literature refers to these innovative and flexible collaborations initiatives between government and business where partners are bound by shared objective and mutual trust, allowing government to harness the competitive forces of the private marketplace (Bloomfield, 2006). A definition by Bovaird (2004) refers to PPP as "working arrangements based on a mutual commitment between a public sector organization with any organization outside of the public sector".

It must be highlighted that PPP is different from "conventional procurement" because it is characterized by the unique feature that is the allocation of risk between the parties, hence a proper mechanism is needed to help in allocating risk effectively and efficiently (Osei-Kyei & Chan, 2015).

The practices of PPP start in the 90s under the form of Private Financed Initiatives (PFI), used to procure public infrastructures and urban development by getting the private sector to finance under long lasting contracts. Afterwards, thanks to a linguistic revision, private financed initiatives was reborn both as PPP and as policy (Hodge et al., 2018).

In recent years PPP has been well adopted in many developed countries with varied results so that critical success factors and the advantages of these initiatives are under the lens of many academics (Cheung et al., 2009). Bovaird (2004) posits that one of the reason behind the diffusion of PPPs is partially due to the centrality that eGovernment has gained driving governments to work closely with private companies in the ICT sector, incentivized by massive investment programmes and, more importantly to access the expertise of these companies.

Findings from a study conducted by Osei-Kyei and Chan (2015) indicate that among several critical success factors contributing to a successful adoption of PPP, the most relevant resulted to be the ones reported here:

1. ***Appropriate risk allocation and sharing*** that involves identification of the risks coming from the contract and an appropriate sharing among parties after a process of negotiation hat should assign more responsibility to the part which could better mitigate those risks.
2. ***Strong private consortium*** which must be equipped with robust technical operational and managerial capacity in order to undertake PPP projects.
3. ***Political support*** is fundamental to the partnership to take place giving the green light to public expenditures and plays a key role in attracting more investors. Environment where political support lacks, are considered to be very risky and, consequently, not appealing with the result of a poor competition in the tendering process.

4. ***Public/community support*** consists in the identification by the public community of the project to be valuable and ensures the progress of PPPs projects especially in the early stage.
5. ***Transparency*** of the whole PPP process depends on the relation between buyer and supplier which must be direct, constant and open to external stakeholders and users.

These aspects need to be framed to harness the potential of PPPs as well as to avoid different insidious positions to be taken against these practices such as staff fear of losing their jobs, politicians fear of losing control, users and citizens fear of becoming objects of a profit-making calculous and fear of losing independence by private companies (Bovaird, 2004). Flinders (2005) reports severely that PPPs sometimes lead to vaunted efficiency of cost savings and risk transfer and highlights disputes such as the increased fragmentation, complexity and opaque accountability resulting in political and democratic costs.

Despite these aspects need to be correctly addressed and investigated, it is undeniable that PPP is a consolidated practices in the Public Private collaboration scenario with high innovation potential (Roumboutsos & Saussier, 2014) but a constant and objective evaluation of its performance is essential to get to the desired benefits as well as investments in expertise by governments in order to analyse options and make informed decisions through independent and unbiased specialist protecting the public interest as intensely as their counterparts in the private sectors.

1.5 INDEXES

This section briefly presents two important indicators that measures the readiness of the countries in order to provide the society with digital services. If EGDI is more specific for e government, DESI considers more dimension and, thus a wider scope in matters of digitization. It is important to remark that these indexes have no significance in Entrepreneurship and Startups concerns.

1.5.1 eGovernment Development Index (EGDI)

The eGovernment Development Index (EGDI) is a comparative ranking among the 193 countries members of the United Nations and monitors the state of eGovernment implementation worldwide. The insights are part of wider work, the UN eGovernment Survey, which has published every two years by the division of Public Administration and Development Management (DPAPM). The indicator is a weighted average of normalised scores on the three most important dimensions of eGovernment and varies from 0 to 1 and is calculated considering three main parameters (*eGOVERNMENT IN SUPPORT OF SUSTAINABLE DEVELOPMENT*, 2020). *Figure 2* shows the results of EGDI for the current year for the EU Member States.

The parameters are the following

1. **OSI** – ***Online Service Index*** that measures the online presence of the government in terms of availability, quality, usability, connectivity and diversity of channels of the services delivered.
2. **TII** – ***Telecommunication Infrastructure Index*** that measures the readiness of the telecommunication infrastructure of countries to exploit the opportunities offered by Information and Communication Technology to enhance their competitiveness. The index considers (i) the estimated internet users per 100 inhabitants; (ii) number of main fixed telephone lines per 100 inhabitants; (iii) number of mobile subscribers per 100 inhabitants; (iv) number of wireless broadband subscriptions per 100 inhabitants; and (v) number of fixed broadband.
3. **HCI** – ***Human Capital Index*** that measures knowledge and skills, that people reach over their lives, enabling them to realize their potential as productive members of society. The HCI consists of four components,

namely: (i) adult literacy rate; (ii) the combined primary, secondary and tertiary gross enrolment ratio; (iii) expected years of schooling; and (iv) average years of schooling.

1.5.2 Digital Economy and Society Index (DESI)

The Digital Economy and Society Index (DESI) is a composite index includes 5 relevant indicators on Europe's digital performance and tracks the evolution of the 28 EU Member States in digital competitiveness with the aim of identifying areas requiring priority actions and investments. The 5 indicators group together 37 parameters in the DESI 2020 calculation and account for interconnected policy areas concerning digital economy and society since developments cannot be reached thanks to isolated improvements (European Commission, 2020).

It is important to highlight how parameters accounting for the 5 areas can change from one year to another, testifying the dynamicity of the digital environment.

1. ***Connectivity*** measures the deployment of broadband infrastructure and its quality. As enabling factors condition for competitiveness.
2. ***Human Capital*** measures the skills needed to take advantage of the possibilities offered by digital.
3. ***Use of Internet Services*** accounts for a variety of online activities carried out by the population.
4. ***Integration of Digital Technology*** measures the digitisation of businesses and e-commerce.
5. ***Digital Public Services*** measures the digitisation of public services, related to both eGovernment and eHealth, as modernisation and digitisation of public services can lead to efficiency gains for the public administration, citizens and businesses alike.

It is worth noticing that DESI 2020 is based on 2019 data and that the United Kingdom is still included in the calculation. *Figure 3* reports the result of DESI for the current year. If from the one hand some countries are fostering innovation and lead the ranking, some others still have a long way to go, and the EU as a whole needs improvement to be able to compete on a global scale. Frontrunners are not the best EU economies in terms of GDP.

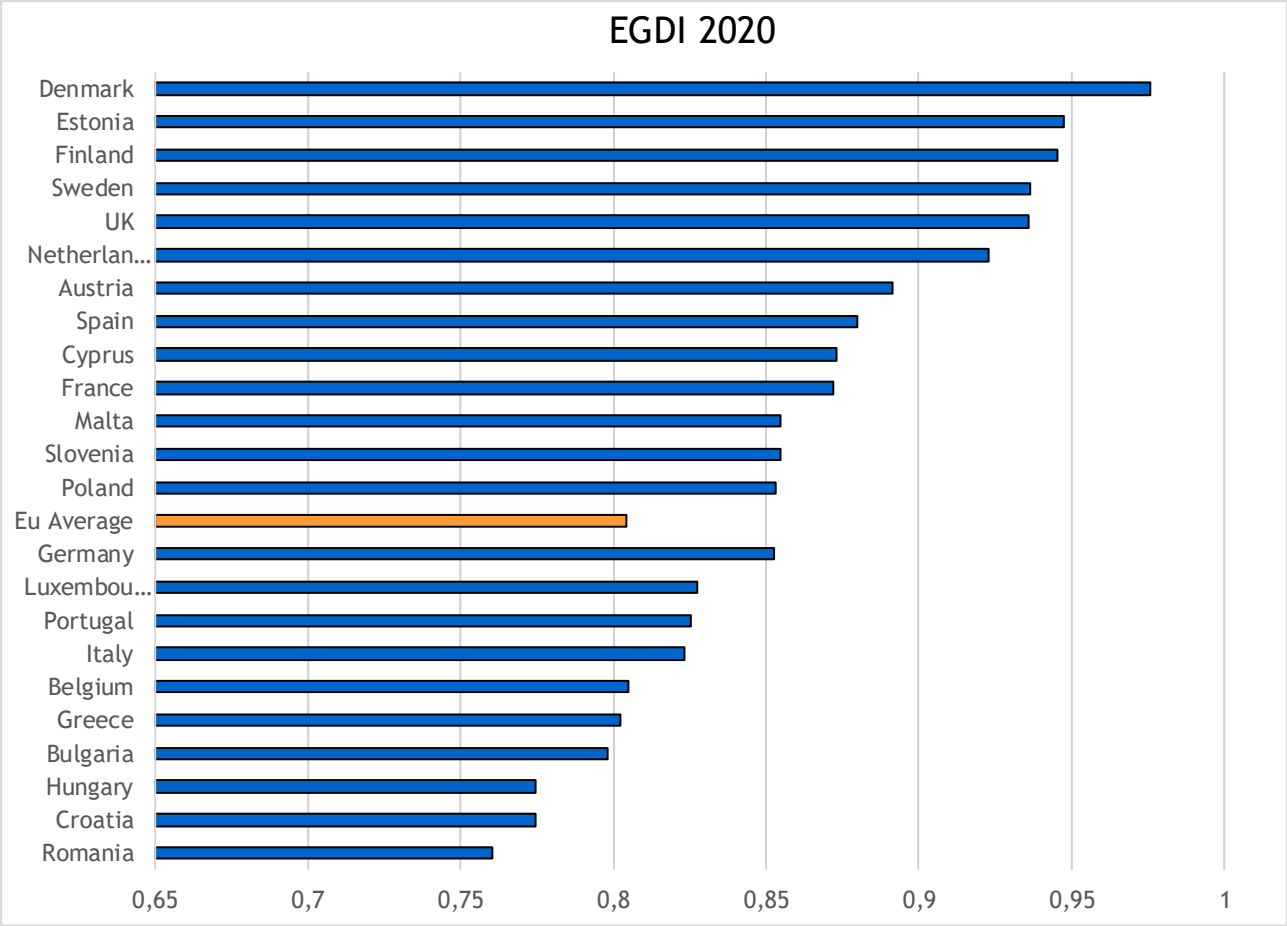


Figure 2 - EGDI 2020

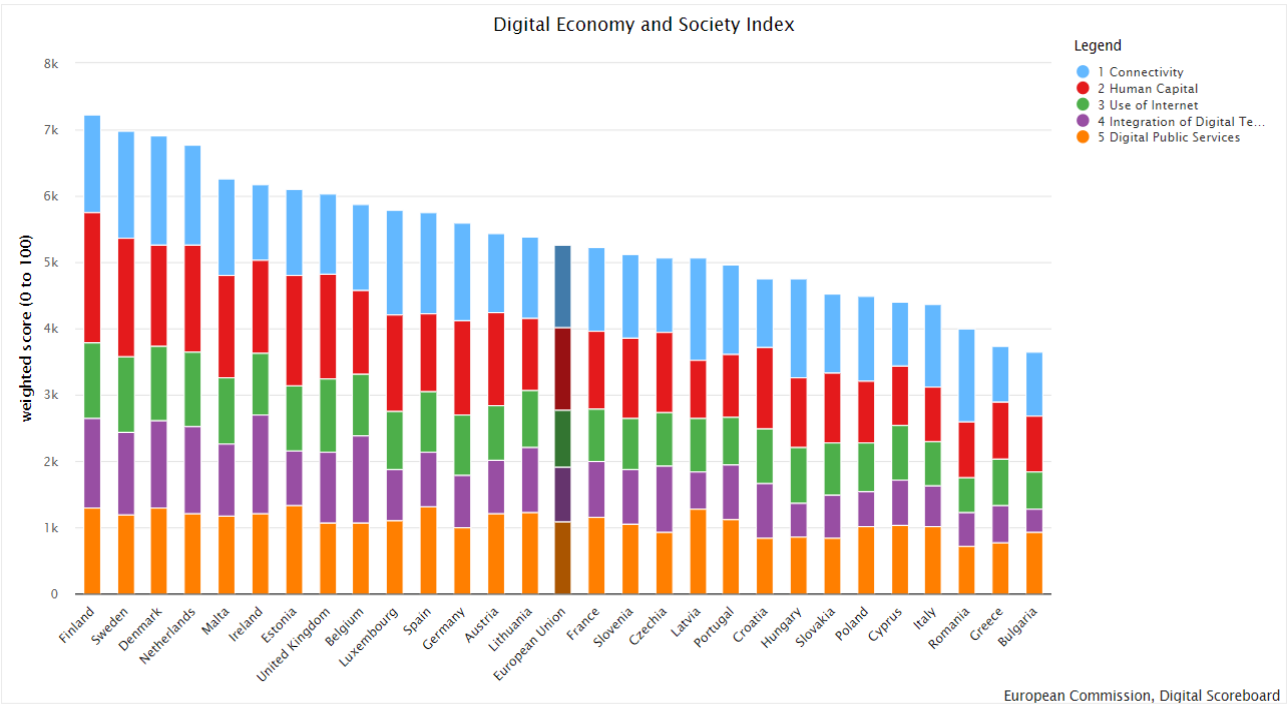


Figure 3 - DESI 2020

CHAPTER 2 - METHODOLOGY

This chapter introduces the research questions and describes the whole process followed to address them. After having made different hypotheses on possible potential areas of research in the GovTech field, we systematically reviewed the literature to identify and qualify the research gaps. Then we formulated the research questions, collected and integrated the data, and performed a thorough a descriptive analysis.

2.1 Research Questions

As accurately described in the Literature review, public sector is considered a stable and stagnant environment characterized by highly bureaucratic process systems, complex procurement procedures, discontinuous strategic views and above all, low innovation pace. This context risks making GovTech a niche industry for big and well-established players, but at the same time, very unattractive for young companies which are always looking for new business opportunities. The result is that public administrations miss the chance to exploit and ride the innovative wave of startups. Therefore, this research rises from the belief that a digital breakthrough in public sector is necessary and can be strongly encouraged by collaboration with startups, which are usually able to anticipate market dynamics and provide disruptive solutions. In the thesis, the issue is addressed by answering to three main research questions related to the GovTech startup ecosystem.

- **RQ1. How many GovTech startups are there? What are their features?**

  Although GovTech is gaining more and more importance considering its potential impacts and benefits on society, the theme is still nearly unexplored and neglected by academic literature. At the same time, GovTech, being an emerging industry, needs further research that can help decision makers, entrepreneurs and scholars to build an ecosystem identikit to visualise disruptive opportunities for public institutions, valuate the attractiveness of the sector and develop solid models through which fostering innovation. Moreover, as it is happening in other industries, startups may bring strong innovative rate and complement what is being done by well-established players.

For all these purposes, it is essential to build a reliable data source from which to extrapolate all key information that allow to delineate and define a clear vision of the GovTech startup international ecosystem and its main characteristics.

a) How many startups work in GovTech?
b) Where, in which countries, is GovTech gaining momentum?
c) Where, in which countries, is the interest of investors in GovTech gaining momentum?
d) How big is the interest of investors in GovTech startups?
e) What organizational structure do GovTech startups have?
f) Which public domains are mostly approached by startups in GovTech?
g) What are the key technological infrastructures in GovTech?
h) Which business model mainly characterizes the GovTech startup ecosystem?
i) What kind of educational and professional background do GovTech startup founders have?

- **RQ2. What characteristics and factors determine differences in the performance of GovTech startups?**

  The population of international startups in GovTech sector is highly heterogeneous. Startups mainly differ for their location, domains covered, technological infrastructures, business model settings. Therefore, this question opens a window for a descriptive analysis investigating if and how each of these differences in structural dimensions, individually analysed, impacts on the performance of startups in receiving funding.

- **RQ.3 Which strategic variables and context factors may favour the success of a young high-tech GovTech startup?**

  If on one hand there are several and considerable business opportunities for newcomers in emerging sectors, such as GovTech industry, on the other side there can be several risk factors when establishing new ventures, since navigating in unexplored business areas means facing also unexpected threats. Even more so in a field with complex dynamics such as the public sector, entrepreneurial initiatives

need a roadmap that can lead new players both to mitigate failure risks and both to achieve success.

To answer these questions a multi-phase process was developed. Starting from the online platform Crunchbase, we extracted a dataset of companies, retrieving many other related qualitative and quantitative data through online sources in order to build a database of international startups operating in the sector. Then we undertook a thorough descriptive analysis, to answer the RQ above. Each step is detailed in the following paragraphs.

2.2 Theoretical review

As mentioned above, GovTech theme lacks accurate academic literature that allows readers to interface with an exhaustive knowledge about the argument. Therefore, from a theoretical point of view, 'GovTech' field was considered the meeting point between two separate domains: the field of 'eGovernment' and the 'digital entrepreneurship' field, with specific focus on startups. With this premise, an extensive research of existent literature allowed to retrieve appropriate academical publications. The systematic process to complete the literature review is described in the following.

During a first phase, 22 articles on general eGovernment topics were consulted to get familiar with the topic from a scientific viewpoint. At the very beginning, the supervisor suggested some articles that investigates several themes such as eGovernment, Entrepreneurial Ecosystem, Open Government, Change management in PAs. Immediately after, these articles were enriched by adding new topic-tailored papers that were extracted from the online database *Scopus*. This platform provides advanced tools thanks to which it is possible to filter contents according to research criteria. So, through the application of 10 keywords an initial set of articles was defined in order to outline a general overview on the topic. Keywords are the following: *digital entrepreneurship, digital technologies, eGovernment, GovTech, New Public Management, open innovation, public administration, public private partnership, public procurement of innovation, startups*.

In a second stage, the research focus moved to the analysis of articles published on Government Information Quarterly (GIQ), a renowned international journal that examines the intersection of policy, information technology, government and the public. Each of the 51 issues, published from January 2009 to September 2020, was carefully

inspected. Since each issue contains on average 19 different articles, the selection process consisted of reading all abstracts of articles and, only when articles were considered pertinent with research topics, they were closely read. Thanks to GIQ review process, a pool of 33 articles was deeply examined.

Once most of relevant topics were covered, the academical perimeter of research was better defined and the following specific topics emerged as research pillars: *eGovernment, Digital Technologies, Entrepreneurial Ecosystem, Digital Entrepreneurial Ecosystem, Open Innovation, Public Procurement of Innovation, Public-Private Partnership*, At this point of the process, each specific argument was deepened through available literature on *Google Scholar, Science Direct, Scopus* and *Research Gate*.

Overall, a total number of 116 articles has been used to write the thesis.

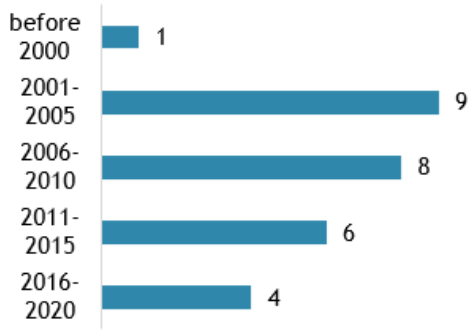
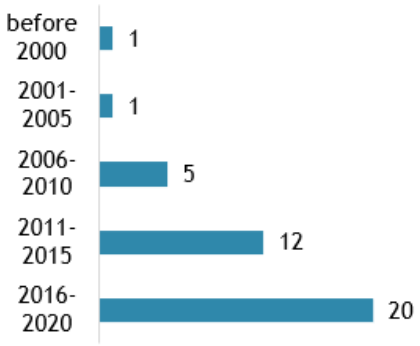
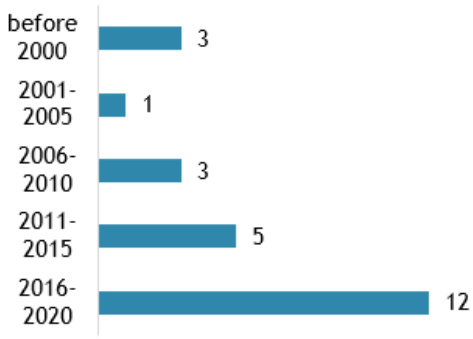
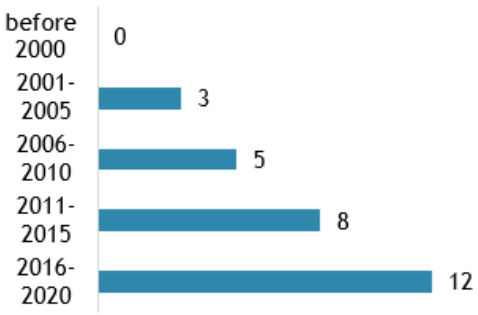
Main Topic	*#Articles*	*Reference Period*
eGovernment	**28**	
Digital Technologies	**39**	
Entrepreneurial Ecosystem & Startups	**24**	
Collaboration (Open Innovation, PPI, PPP)	**28**	

Figure 4 - Articles analysed for the thesis

2.3 Empirical process

The description of the GovTech entrepreneurial ecosystem, along with the study of its structural dynamics and of the factors that drive the success of startups in this context, is the output of an empirical research starting from a census of firms that fall into the perimeter of our study. The final database results from a two-step process designed to gather, process, and study relevant data and information on startups.

The starting point was the data extraction of **2895 startups** from the online platform *Crunchbase*[1]. Subsequently, startups were evaluated one by one to define whether each startup was relevant or not, so that the final database resulted in **228 startups**. Once integrated new data with already available information, the descriptive analysis was undertaken. In the next paragraphs, each stage is discussed in detail.

The entire empirical process on the GovTech entrepreneurial ecosystem was performed in parallel with the study of the Smart City entrepreneurial ecosystem, since the two research fields are highly correlated and both of them belong to the macro theme 'Digitalization of Public Administration'. Although this implied coordination costs, the team research favoured synergies and knowledge exchange, and gave us the opportunity to evaluate more proposals and alternatives from different perspective. That is why, on the whole, we believe that this teamwork enhanced the effectiveness and the level of accuracy in studying and describing the ecosystem.

[1] https://www.crunchbase.com/

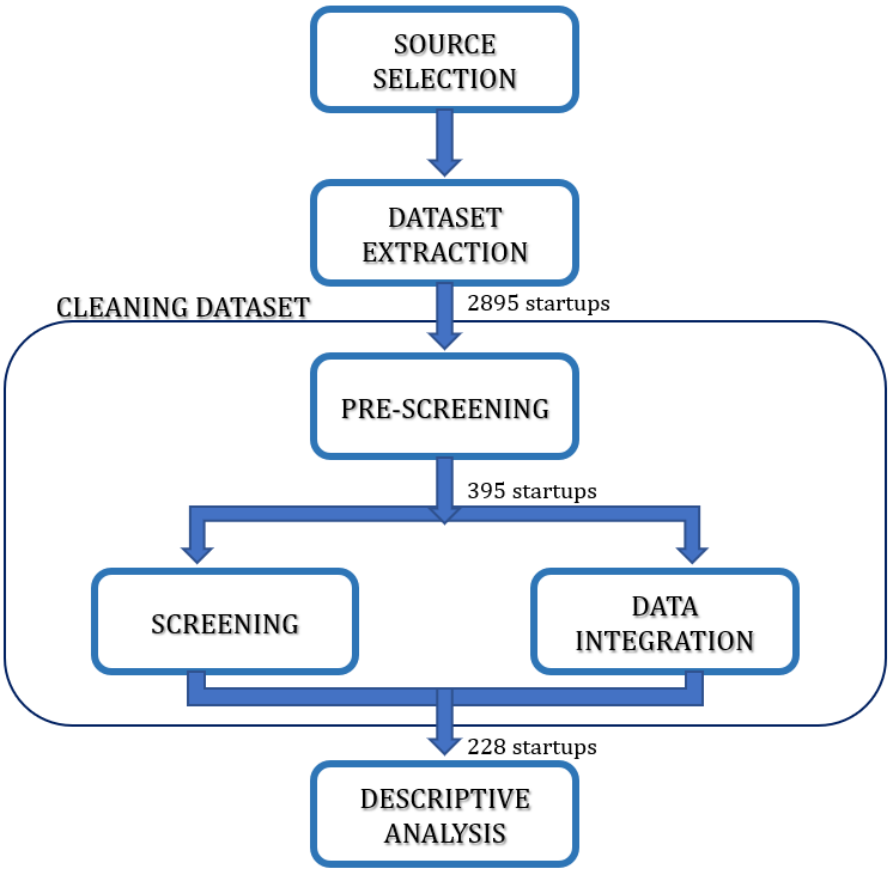


Figure 5 - Empirical process

2.3.1 Source selection

The main source to collect data on the GovTech entrepreneurial ecosystem was Crunchbase, an online *Data-as-a-service* platform which contains relevant business information about private and public companies worldwide. Crunchbase provides the main information concerning investments and funding, as well as information on founding members and individuals in leadership positions, mergers and acquisitions, news, and industry trends. Its data derived from four different sources:

- Crunchbase community composed by entrepreneurs, investors, and board members that update company profile pages;
- In-house data team that develops algorithm and make manual data validation through specific inspections;
- AI and machine learning algorithms that validate data accuracy, detect anomalies, and inform data science team about data conflicts;

- Venture program, more than 3,500 global investment firms that submit monthly portfolio updates to the platform.

The combination of these four sources led the platform to have always updated data and constantly improve the quality of information. To select the initial sample of startups a set of queries was executed considering the following criteria:

- **Only companies founded from 2013 onward**
  Although a company is defined as startup when it is old no more than 5 years, this research also investigates previously born companies. In fact, due to the complexity of the public sector, it is reasonable to include and analyse the nature of older companies too by considering a wider time frame, in this case a seven-year period.
- **Only companies that received at least an investment from 2018 onward**
  Since startups during the first years of life are constantly on the lookout for financial funding in order to effectively develop their business, this constraint is essential to identify which startups are able to attract financial investors and exclude startups that are nor active on the market nor interesting for investors.
- **All companies in the macro-category *Government & Military***
  Focusing only on those which respected the previous criteria too.
- All companies containing in their description at least one of the following **keywords** (and respected the first two criteria too): *archives, citizen engagement, digital entrepreneurship, digital identity, eGovernment, e-procurement, eID, gov, government, governments, GovTech, ID, justice, ministry, ministries, municipality, municipalities, open data, open government, open innovation, participatory democracy, public, public administration, public sector, tax, taxes*.[2]
  This set of keywords was defined through a team brainstorming session, according to past researches (and the supervision) of the Digital Agenda Observatory of Politecnico di Milano.

[2] The keywords for the Smart City domain were the following: *car park, energy monitoring, museum, parking, public transportation, recycling, smart building, smart city/smart cities, smart culture, smart economy, smart education, smart environment, smart governance, smart infrastructure, smart mobility, smart resources, smart social service, smart traffic, waste management, water management, wellbeing*.

2.3.2 Dataset extraction

Through the application of these criteria, different CSV files were downloaded and then converted and aggregated in a single Excel file. Since queries were not excludable each other, some companies overlapped so, after having cleaned up duplicates, the final dataset converged in a file of 2895 startups, each of which contained 27 variables related to the subsequent dimensions:

- Basic information: description, location, founded date, operating status, website, contact info (phone number, e-mail), social media profiles (Facebook, LinkedIn, Twitter) and category tags.
- Investors details: type and number of investors, type, and stage of investment.
- Team composition: number of founders and employees.
- Funding: status, type, date, amount, and total investments.
- Acquisition and M&A.
- Web traffic, apps, trademarks, and patents.

2.3.3 Cleaning the dataset

In order to accurately evaluate the pertinence to GovTech, the entire dataset was deeply explored through a two-step analysis. During the first step (pre-screening phase), the Crunchbase company profile was examined and startups were classified as 'core', 'peripheral' or 'discarded'. Subsequently, all companies belonging to the categories 'core' and 'peripheral' were further investigated through semantic analysis of their websites and other online sources (screening phase and data integration).

As previously disclosed, the GovTech analysis was carried out in conjunction with the Smart City analysis. In particular, the 2895 data on startups constituted the initial sample for both the two researches, but since the start of cleaning operations (pre-screening phase, screening phase and data integration) the two analyses started following different paths.

Pre-screening

The main goal of the pre-screening process was to skim the entire dataset and detect the most promising startup to be investigated, instead of wasting time in studying in detail all the ones. In fact, in this phase no more than 2 or 3 minutes were spent on Crunchbase to evaluate each startup; only few startups required more accurate reviews of their websites when their profile on Crunchbase was not enough to attribute them to one of the three categories. A subsample composed by the first 600 startups was initially examined to refine the analysis methodology and converge to a *modus operandi* for the whole research.

To shed light on the taxonomy, the GovTech entrepreneurial ecosystem refers to the private business that offers digital public services to public administrations, citizens and enterprises, and whose products or services boost the achievement of eGovernment maturity. In other words, it is the ecosystem of startups that offers digital services to public administration. Based on this concept, the concrete objective was to eliminate all startups that certainly do not respect the boundaries of analysis ('discarded') and simultaneously, promote to the next step both companies that undoubtedly meet the criteria ('core') and both companies that might be relevant ('peripheral'). Hence, the following classification was defined:

- '*Core*' – Companies that surely sell their products or services to public administration.
- '*Peripheral*' – Companies that surely provide services which relevance is public, but they do not respect the conditions to be classified as core. To be more accurate, companies for which it was not clear at this stage of analysis whether or not they offer products or services to the public administration, but they certainly have a product or service that could potentially be offered to the public administration and therefore an in-depth screening was required.
- '*Discarded*' – Companies that did not belong to any of the previous categories. Further, even if it matched the previous rules, the company was discarded when:
    - Its website did not work, LinkedIn profile did not exist, and no other online information could be retrieved. Therefore, information was considered not enough to proper evaluate the company.

- It belonged to a parent company or was recently acquired by another company. Therefore, conditions to be consistent with the nature of a startup were missing.

In addition, the following considerations were considered:

- Since the empirical research included both the GovTech field and the Smart City field, companies that refer to the categories of Smart Building, Waste Management, Recycling, Environment, Renewable Energy, Car Sharing, Parking were considered specific for the Smart City domain and for this reason, categorised as 'discarded' for what concerns the study of the GovTech entrepreneurial ecosystem.
- Some other sectors such as Smart Mobility and Smart Transportation, Water Management were accurately examined. The critical point was to understand whether companies referring to those sectors have a direct business relation with public administration or otherwise, they work primarily with the private sector.
    - Companies that deal with Smart Mobility and Smart Transportation were included in the next phase if and only if their core business concerns the development of intelligent analysis and monitoring systems with the aim of optimizing traffic management.

      In this case, companies were classified as 'core' or 'peripheral' (according to the previous criteria), while in the opposite case they were categorized as 'discarded'.
    - Companies that deal with Water Management were included in the next phase if and only if their core business concerns a public service responsible for ensuring an effective and efficient water supply to citizens (i.e. leak detection, water quality analysis etc.).

      In this case, companies were classified as 'core' or 'peripheral' (according to the previous criteria), while in the opposite case they were categorized as 'discarded'.
- Companies that work exclusively in the Military Security or Safety were classified as 'discarded', since this sector follow proper dynamics that are unrelated with other public domains.
- Companies that work exclusively in the Education or Health Care were classified as 'discarded' because these sectors are heterogeneously managed around the

world. Therefore, since it is country specific whether these sectors belong to the public or private sphere, it would have been inappropriate to maintain startups of these categories.

In addition to this, whenever the only screening of Crunchbase profile was not enough to classify the companies in the three categories, the website was rapidly reviewed. At the end of the pre-screening process the initial sample of 2895 startups converged in a sub-sample of 395 startups (14% of the initial dataset). 194 of them were classified as 'core' and 201 as 'peripheral'. All other startups, categorized as 'discarded', were excluded from further investigations. During the entire pre-screening phase just some descriptive notes on the core business were gathered for each startup, so that in the next phase it would have been easier and more immediate to frame the working context of the company.

Screening and data integration

The main goal of this phase was twofold: on one hand defining the selection of those startups that would have constituted the final sample to carry out the study of the GovTech ecosystem; on the other side integrating the original spreadsheet with a set of new variables that could better describe each startup.

For this reason, the website of each company was meticulously investigated starting with 'core' startups, as they were suspected to be the most pertinent ones and could support and improve the confidence with the research methodology. In the screening execution companies were analysed in a greater detail than in the pre-screening in order to obtain a conclusive single collection of highly pertinent startups. Companies were discarded when:

- It was not possible to confirm that they sold their products or services to Public Administrations, so 'core conditions' were clearly not verified once more detailed information was retrieved. More precisely, all the companies for which the website did not explicitly indicate the working relationship with public administration were discarded;
- It was possible to verify that they closed or they had been acquired (although Crunchbase did not trace this information);
- It was not possible to retrieve enough information to undertake an unbiased evaluation.

At the end of the screening process, 228 startups (corresponding to 58% of the ones survived at the pre-screening phase, and the 8% of the initial sample) were marked as 'approved', thus forming the final database.

Along with the screening, we added further data and variables for those startup that passed this second analysis, with the aim of describing as deeply as possible the GovTech ecosystem. For each startup 37 variables were detected (27 coming directly from Crunchbase, plus 10 collected through online semantic analysis). It is important to stress that the data collection has been a long and meticulous process, based on what is stated by companies, founders and their available online sources or what is deducible from the same resources. Of course, different companies have different online sources as well as founders' background details are not always accessible, so information are heterogeneously presented.

Further details are presented in the following paragraph.

2.3.4 Data

Having clarified the empirical process, it is important to detail those specific variables that are analysed in the next chapter in order to define both the origin and the value of data for each perspective.

Geographical perspective

This perspective considers the headquarter location of startups to frame the geographical distribution and subdivision of the GovTech players. Moreover, the geographical analysis offers interesting considerations that might partially explain context variables which determine and influence the entrepreneurial success.
Data were downloaded from Crunchbase tracing information about country, continent and city of each company.
Data was detected for all 228 startups.

Funding

As previously discussed, data about investments and funding were extracted from the online platform Crunchbase, therefore *financial data was detected only for 183 startups* (80% of the entire population) – when considering last funding amounts *data were available for 159 startups*, about 70% of the population.

Organizational structure

This perspective takes into consideration three different information, all detected on Crunchbase:

- **Year of foundation** – from 2013 to 2020, *data was detected for all 228 startups.*
- **Number of founders** – this variable assumes values from 1 to 6, and *data was detected for 196 startups*.
- **Number employees** – it is clustered into 5 group (1-10, 11-50, 51-100, 101-250), and *information was detected for 226 startups*.

Domains of activity

Taking into consideration both the process and the specific public affairs its value proposition is built for, each startup can work on one or more domains, so that startups were classified into 23 non-excludable clusters.
Data was detected for all 228 startups.

Key technologies

One or more technological paradigms may be leveraged to build a startup value proposition. Therefore, this perspective aims to detect the type of technological solution used by each startup, focusing on the 5 key technologies in GovTech sector according to the literature (see Chapter 1.2).

- Artificial Intelligence
- Big Data
- Blockchain
- Cloud Computing
- Internet of Things

Data was detected for all 228 startups. 114 companies use at least one of the technologies listed above, while the other 114 startups do not implement any of them in their business.

Business model

Business model perspective takes into consideration 4 different information:

- **Territorial focus** – a public entity is sovereign and influences an area which is legally defined and limited within a certain geographical sphere. It is generally possible to recognize local public entities (e.g. municipalities or cities), regional public entities (e.g. regions, provinces, counties, sometimes states), national bodies (states or confederations) and international institutions (as European Union). Consequently, startup services can be addressed and applied to one or more of these administrative levels. Given that institutional and political systems around the world have a heterogeneous level of administrative granularity, no distinction was made between local and regional impact.
  Data was detected for all 228 startups.

- **Business focus** – some startups collaborate exclusively with public sector, while others work with private sector too and so, public sector is just one of the business in which they operate.
  Data was detected for all 228 startups.
- **Stakeholder focus** – it registers to whom the value proposition of each startup is addressed (PA, Enterprise, Citizen, or a combination of them).
  Data was detected for all 228 startups.
- **Pricing** – it describes the way in which a startup capture value, so its pricing method. Each startup was classified according to the listed pricing methods:
  - Asset sale
  - Usage fee (volume)
  - Subscription fee (proportional)
  - Lending, Renting, Leasing
  - Licensing
  - Brokerage fees

  Data was detected for only 47 companies.
- **Mission statement** – according to research methodologies explained in the article of (Bartkus et al., 2006) Mission Statement Quality and Financial Performance", *the entire population of startups was analysed and classified* into three clusters – Stakeholders, Components and Goals – if for each of them at least one of the words listed below in *Table 4* - Mission statement, Bartkus (2006) were detected.

Founders

This perspective takes into consideration two different background type, education and professional experience.

- **Educational background** – for each startup for which information on founders LinkedIn profile was available, data regarding the highest level of university specialization were reported. In other words, PhD studies were first investigated, otherwise research focus shifted to Master qualifications and as a last option, Bachelor degrees were examined; when there were no information for any of the above mentioned university certifications, startups were excluded from further investigations.

Overall, database converged in a sub-population of 163 startups (71% of the entire population). Once, all different academic specializations were identified, each specific subject was then gathered into one of the following macro-categories:

- '**Accounting, Finance & Control**' – *including* 'Accounting', 'Finance', 'Finance and Investments', 'Financial Economics'.
- '**Architecture**' – *including* 'Architecture', Urban/City Planning'.
- '**Communication, Media & Marketing**' – *including* 'Communication', Communication Arts and Sciences', 'Marketing', 'Semantic Web and Multimedia'.
- '**Computer & Informatics**' – *including* 'Computer Application', 'Computer Informatics', 'Computer Law and Network Sciences', 'Computer Linguistics', 'Computer Network', 'Computer Science', 'Computer Systems Security', 'Informatics', 'Information and Communication Technologies', 'Information Systems', 'Signal Processing'.
- '**Design**' – *including* 'Communication Design', Design', 'Entrepreneurship and Business Design'.
- '**Economics & Management**' – *including* all specific academic courses referring to the field of 'Business Administration, Management and Economics'.
- '**Engineering**' – *including* all different engineering specialization such as 'Biomedical Engineering', 'Business Engineering', 'Computer Engineering', 'Electrical Engineering', 'Electronics Engineering', 'Management and Industrial Engineering', 'Mechanical Engineering', etc.
- '**Humanistic studies**' – *including* 'Business Psychology', Culture and Literature', 'Human Geography', 'Philosophy', 'Political Philosophy', 'Psychology', 'Sociology'.
- '**International Business & Entrepreneurship**' – *including* 'Enterprise and Entrepreneurship', 'International Business', 'International and Global Affairs', 'International Relations', 'Leadership, Entrepreneurship and Innovation'.
- '**Law**'
- '**Management of specific fields**' – *including* very specific management fields such as 'Financial Management', 'Human Resources Management', 'Management of Information Systems', 'Operations Management', 'Security Risk Management', 'Telecommunications Management', etc.
- '**Political Sciences, Government & Public Administration**' – *including* 'Business and Government Relations', 'Comparative Social Policy', 'Government and Politics',

'Government Procurement Law', 'International Politics', 'Political Sciences', 'Political Sciences and Government', 'Public Administration', 'Public and International Affairs', 'Public Policy'.

- '**Scientific studies**' – including 'Aeronautics and Astronautics', 'Biochemistry', 'Chemestry, 'Mathematics', 'Physics', 'Science', 'Statistics'.
- '**Others**' – *including* all specific subjects for which it was not possible to identify one of the previous macro categories, such as 'Agribusiness', 'Digital Currencies', 'Digital Ethics', 'Emergency Medicine', 'Healthcare Economics', 'Medical Informatics', 'Product Development', 'Transportation and Logistics', etc.

In this way, at least one of the listed educational macro-categories was contained for each of the 163 startups.

- **Professional background** - once again founders LinkedIn profiles were evaluated, but this time focusing on founders professional career.

  First of all, any past work experiences in public administration sector were checked; although public sector field includes several kinds of job, for the purpose of analysis all works that did not concern the managerial-administrative sphere were excluded (i.e. military, law enforcement, medical-health works, etc).

  Secondly, it was inspected whether founders had previously founded other startups; in addition, when the condition was verified, the operational status of those previously founded companies was tracked, defining them 'active', 'closed', or 'merged & acquired'.

  On the whole, data were available for 193 startups (85% of the population).

MISSION STATEMENT	
STAKEHOLDERS	
Customer	"customers", "clients"or "consumers"
Employee	"employees", "our people"or "workforce"
Investor	"shareholders"or "investors"
Supplier	"pertners"or "suppliers"
Society	"society", "community", "world", "global", "social goals", "environment", "national economies"or "quality of life"
COMPOMENTS	
Industry	standard industry descriptive terms such as finance, banking, oil or automotive
Geographic Scope	it includes an operating or marketing region i.e., worldwide, Asia, Europe
Values/Philosophy	"fair", "integrity", "well-being", "harmony", "honesty"or "responsibly"
Motivation: Excellence	"leading", "best" or "outstanding"
Motivation: Social Benefit	"society", "community", "nation" or "giving back"
Competency	"innovation", "low cost", "high quality" or "efficient"
Future Orientation	"to be", "will be", "future", "create", "dedicate", "dedicated", "anticipated" or a specific future year
Financial Objective	create value, growth, profit, returns, financial strenght, financial performance
GOALS	
Sense of Direction	mission statements that disclosed a future orientation had a sense of direction
Control Mechanism	it included at least two of the following components: industry, customer, geographic scope, and distinctive competence
Non-Routine Decisions	it includes company values or philosophy
Motivation	it is based on excellence or societal benefit

Table 4 - Mission statement, Bartkus (2006)

CHAPTER 3 - RESULTS

This chapter aims at investigating and describing the GovTech startup ecosystem by presenting the results of the analysis of the international database of startups that offer digital products or services to public administration.

3.1 Geographical perspective

Overall, the 228 startups are spread among 34 countries, grouped in 7 sub-continents.

World Map

Starting from the world map, the high concentration of startups in *North America* is immediately evident. In fact, more than half startups come from US (119 companies out of 228) proving how US is a pioneer in fostering digital innovation and entrepreneurship[3]. Canada also shows excellent results contributing with 9 startups to the North America leading supremacy (56% of the entire population of startups is located in North America); this mainly because Canada benefits from its economic and commercial relations with US thanks to which many Canadian companies also operate in the neighbouring US.

Europe ranks second in terms of number of startups (24% of the entire population).

Asian countries are in third position (12% of the population) and companies are mainly concentrated in China (12 startups), India (7) and Singapore (5).

Middle East companies represent just the 4%, where 6 startups out of 8 are located in Israel, which ranks 10th in the world ranking of countries according to the Global Innovation Index[4].

South America companies (3%) are mainly represented by Brazil (4 startups out of 7).

Finally, the smallest portions of the population relate to *African* and *Australian* companies.

[3] Nevertheless, Crunchbase is a US database so data about non-US startups may have some disparities or delays respect to data about US startups.

[4] Global Innovation Index includes two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index. The first sub-index is based on five pillars: ***Institutions***, ***Human capital and research***, ***Infrastructure***, ***Market sophistication***, and **Business sophistication**. The second sub-index is based on two pillars: ***Knowledge and technology outputs*** and ***Creative outputs***.

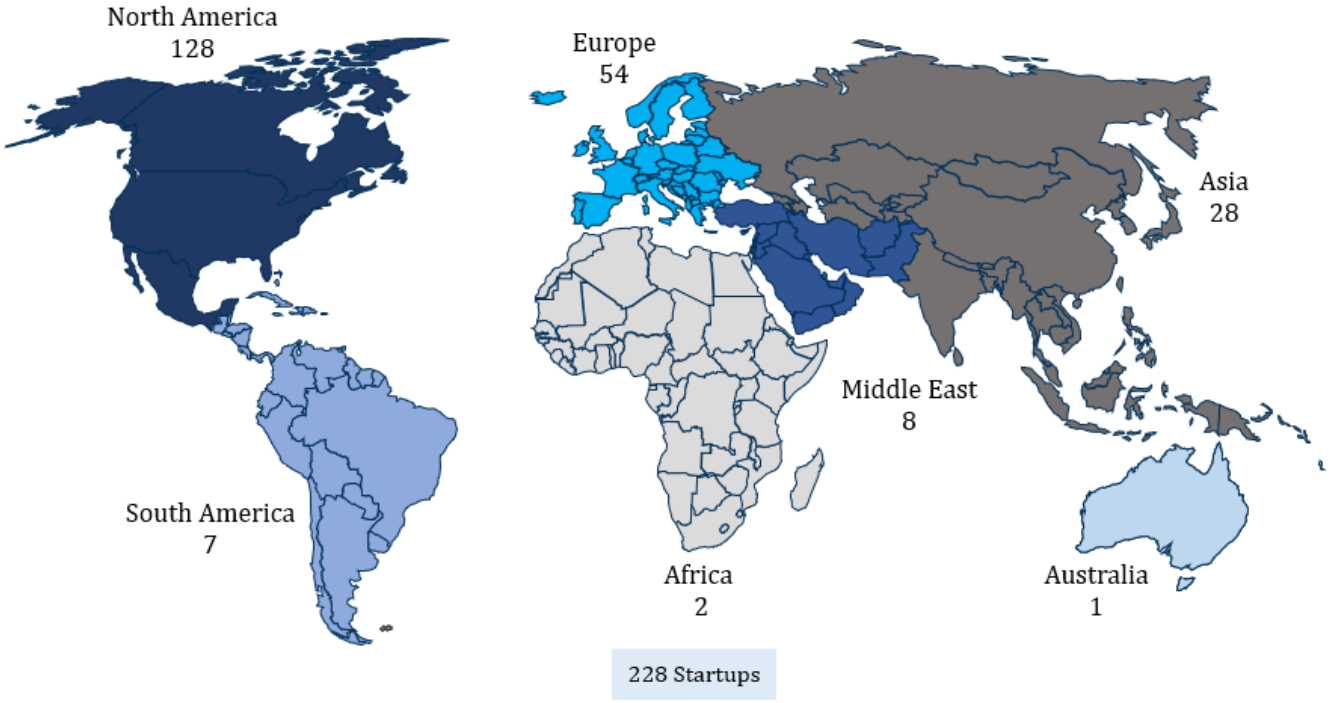


Figure 6 - GovTech startups global distribution

USA

Focusing on the US, it is important to point out how startups are concentrated in highly entrepreneurial ecosystems such as those active in *California* (32% of the entire US) and New York (11%), areas where top ranked educational and research institutions are located. California and in particular the *Silicon Valley*, which is considered one of the most prosperous and advanced technological regions in the world, offer favourable conditions for the development of highly technological startup (San Francisco Bay Area hosts 29 startups out of 38 from California and specifically, 11 of these were born in Silicon Valley).

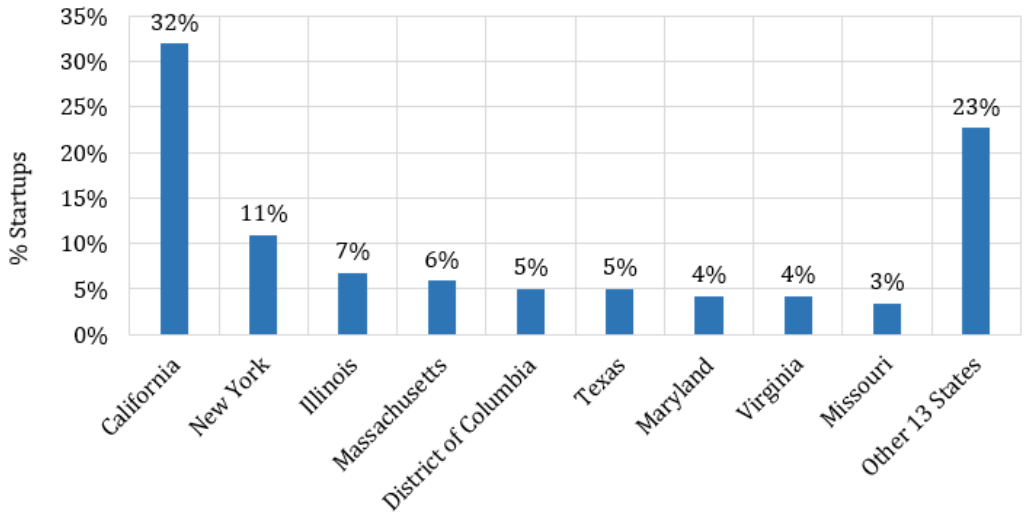


Figure 7 - Distribution of GovTech startups in U.S.A.

Europe

The distribution of European companies sees the *United Kingdom* in a leading position, with 15 startups, followed by *Germany* (8 startups), *Spain* (6 startups), and a group of five countries that are *France*, *Ireland*, *Netherlands*, *Norway* and *Switzerland* with 3 startups each.

In particular, a fundamental role for the GovTech startup ecosystem of United Kingdom is played by the London region, where 2/3 of UK startups are located.

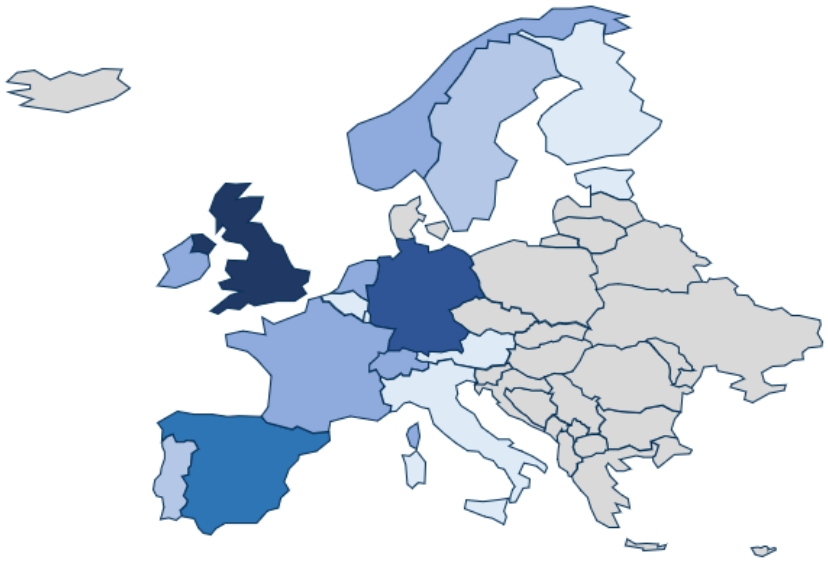


Figure 8 - Distribution of GovTech startups in Europe

EUROPEAN COUNTRIES	# STARTUPS
UNITED KINGDOM	15
GERMANY	8
SPAIN	6
FRANCE	3
IRELAND	3
NORWAY	3
SWITZERLAND	3
NETHERLANDS	3
PORTUGAL	2
SWEDEN	2
AUSTRIA	1
BELGIUM	1
ESTONIA	1
FINLAND	1
ITALY	1
LUXEMBOURG	1
TOT	**54**

Table 5 - European countries by number of GovTech startups

When aggregating European countries considering the United Nations geo-scheme, we see that *Northern Europe* is at the top of the ranking (46% of European startups), followed by *Western Europe* (37%) and *Southern Europe* (17%), while no relevant startups belonging to *Eastern Europe* countries met the criteria of our screening.

Despite the results are influenced by the individual impact that few countries have, the results of Northern Europe are confirmed also by the DESI (2020): Finland, Estonia and Denmark got on the podium as European countries with the highest value of eGovernment users – more than 90% of internet users (aged 16-74) who needed to submit filled forms to the public administration choosing governmental portals.

EUROPE					
NORTHERN	# STARTUPS	**WESTERN**	# STARTUPS	**SOUTHERN**	# STARTUPS
United Kingdom	15	Germany	8	Spain	6
Ireland	3	France	3	Portugal	2
Norway	3	Netherlands	3	Italy	1
Sweden	2	Switzerland	3		
Estonia	1	Austria	1		
Finland	1	Belgium	1		
		Luxembourg	1		
TOT STARTUPS	25	TOT STARTUPS	20	TOT STARTUPS	9
% STARTUPS	46%	% STARTUPS	37%	% STARTUPS	17%

Table 6 - European regional division, by number of startups

Top 10 Countries by number of startups

On the whole, although results are far from being homogeneous around the world, the top 10 countries by number of startups are spread in 5 out of 7 sub-continents considered, only Africa and Australia are excluded. Thus, even if the polarization of startups in *North America* is remarkable, it seems that the digitalization of public administration is getting more attention in the startup ecosystem globally.

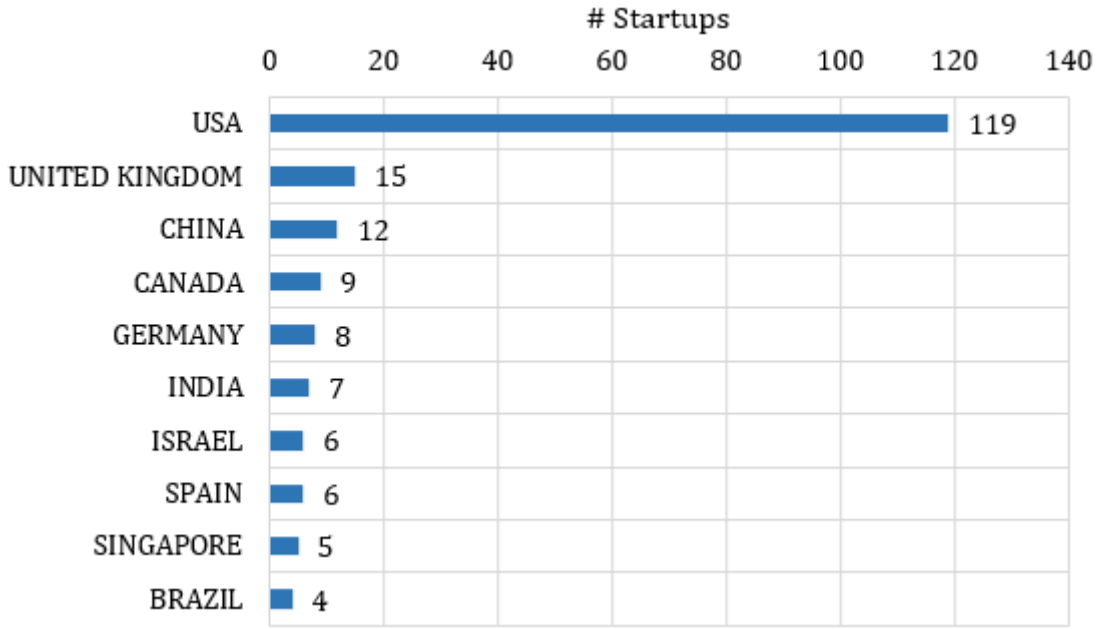


Figure 9 - Top 10 countries, by number of startups

3.2 Funding

Overall, this sub-population of startups received almost 3,7 billion dollars.

Funding by region

Table 7 shows how investments are not homogeneously distributed among sub-continents; in fact, North America accounts for 80% of the entire funding in the GovTech ecosystem. According to the number of startups located in different regions, average funding in North America and Asia is clearly bigger than elsewhere. If, on one hand, this result was predictable for North America, on the other hand it was not taken for granted that Asia, despite having a lower concentration of startups than Europe, has an average funding more than five times bigger than Europe and more than twice the total investments.

As for the regions with a lower number of startups, Middle East stands out with respect to South America, Africa and Australia both in terms of total funding and of average funding. Furthermore, although European total investments are more than twice the investments in the Middle East, the average funding in Europe is significantly lower.

REGION	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
North America	108	80%	$ 2.954.847.807	$ 27.359.702
Europe	41	5%	$ 197.018.507	$ 4.805.329
Asia	18	12%	$ 448.103.687	$ 24.894.649
South America	7	0,4%	$ 14.987.528	$ 2.141.075
Middle East	7	2%	$ 74.251.868	$ 10.607.410
Africa	1	0,04%	$ 1.359.968	$ 1.359.968
Australia	1	0,02%	$ 785.100	$ 785.100
TOT	183		$ 3.691.354.465	$ 20.171.336

Table 7 - Total and Average funding distribution, by region

Funding by startup

To better understand how investments are distributed among startups, we plot the total funding amount against the amount of the last funding round. In this case, 159 companies have data available on the amount of the last funding round – about 70% of the population.

Figure 10 presents an analysis of the investments received by startups under two dimensions: the last funding received and the total amount of funding received. It is evident that investments are very skewed: 5 startups collected more than 100 million of dollars of total funding each, and more than 50 million of dollars of last funding amount each; together they account for 41% of the entire total funding. Therefore, the overall amount of total investments in GovTech ecosystem is definitively influenced by a very limited number of startups. 4 of these companies are located in USA, while only Dt Dream is in China. It is not surprising that best performing startups in terms of funding received were born in USA and China, since these two countries are the economic powers of world economy.

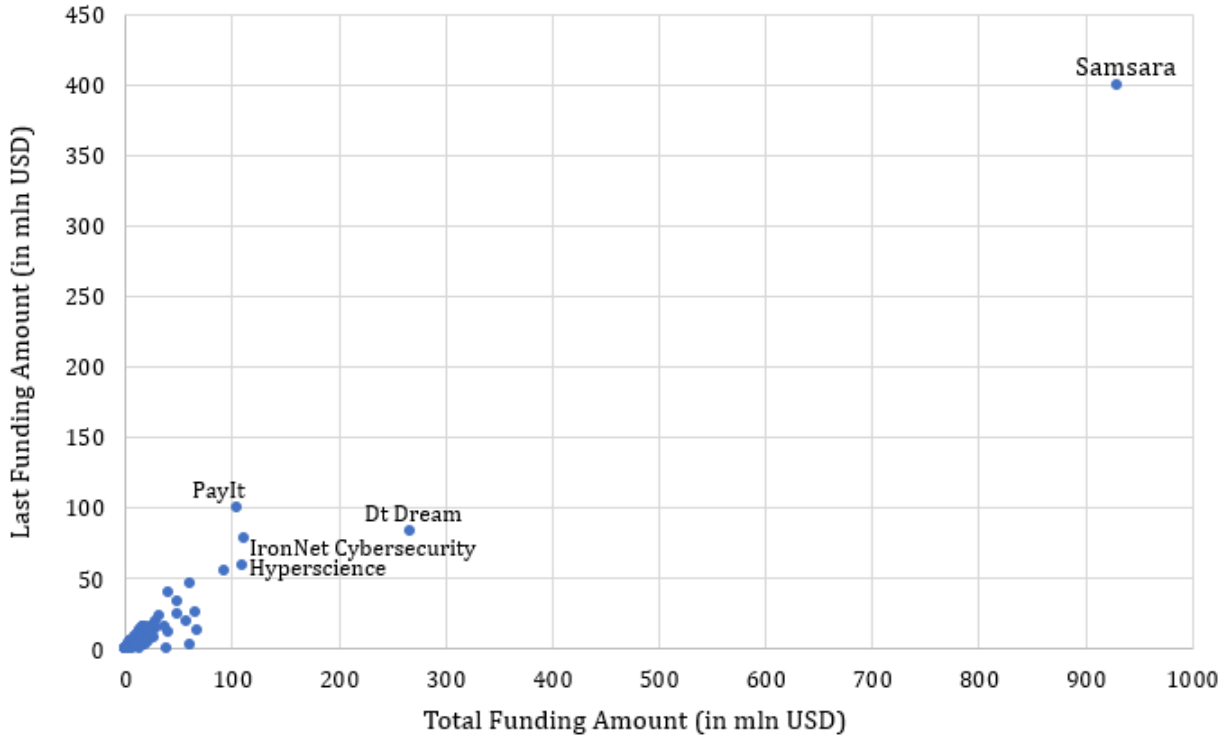


Figure 10 - Startups plot, by Total and Last funding amount

We replicate the graph using the logarithmic scale in order to reduce the distance among funding with different orders of magnitude. This allowed us to have a closer look into the group of startups that have not collected a huge amount of funding yet. In addition, using the logarithm scale, the points located far away from the axis of the graph (both x and y)

have exponentially higher value than points located in the central part, and differences along the axis are no more simple variations in absolute terms of x and y, but percent variations.

By definition, of course, all the startups are located below the first diagonal since it is obvious that the last funding amount cannot exceed the total amount collected.
In general, the further they are from the diagonal, the more they have been successful in terms of investments received in previous rounds of funding.
To dig deeper, we outline at least three clusters of startups according to the two dimensions:

1. For the startups situated **on the diagonal** the total amount of capital received has been collected in the last funding round. This leads to the consideration that this cluster needs to be monitored in time, with particular attention to startups in the upper right part of the diagonal, that were able to convince the market to invest immediately big amounts of capital.

2. The second cluster includes all those startups that are **slightly below the diagonal**. The possible interpretation here is that they keep growing and have a considerable potential, since they were able to go further in the funding rounds after the first one and collected a larger amount of capital if compared to the previous rounds.

3. The third cluster comprises the startups positioned **significantly below the diagonal**. In this case the last amount of funding received is at least comparable to the previous. The explanation can be twofold: either they are beginning a declining phase or there is a possible reinforcement effect and a stabilization on the market.

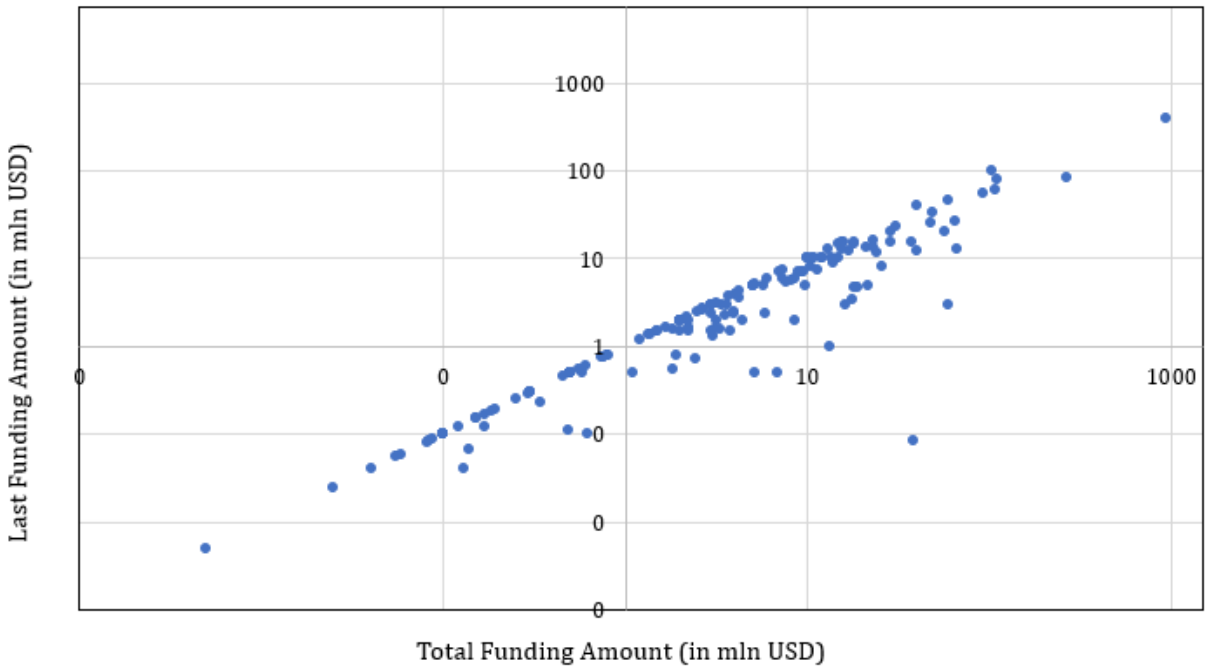


Figure 11 - Startups plot using logarithmic scale, by Total and Last funding amount

After having understood the impact of these high-potential startups, further considerations excluding these companies are needed. Another startup, Rubrik, for which data about last funding amount is not available, was not included in the previous plots because it collected more than 100 million of total funding amount. In particular, Rubrik ranks second for total investments received, so its influence on the overall funding amount is huge; when aggregating Rubrik to the other high-potential startups, together they account for 56% of the overall investment in GovTech startup sector.
Further information on these startups will be presented in the next paragraphs.

HIGH-POTENTIAL STARTUPS	TOTAL FUNDING		LAST FUNDING		YEAR
Samsara	930	mln USD	400	mln USD	2020
Rubrik	553	mln USD	-	mln USD	2019
Dt Dream	267	mln USD	84	mln USD	2019
IronNet Cybersecurity	111	mln USD	78	mln USD	2018
Hyperscience	109	mln USD	60	mln USD	2020
PayIt	105	mln USD	100	mln USD	2019

Table 8 - Total and Last funding amount of high-potential startups

Funding by region – excluding high-potential startups

First of all, the average funding per startup drops from about $ 20 million to about $ 9 million. At the same time, average funding for North America and Asia reduced by more than half, but still the value of North America remains slightly higher than both the average funding per startups in Asia and in the Middle East. Moreover, North America maintains its leading position for total investments (71% of overall funding).
Europe surpasses Asia regarding both the percentage and the value of total funding, while average funding remains lower. The latter result underlines once again how the Asian ecosystem is relatively more fertile; in fact, even if European total amount is higher than the Asian one, these values are affected by the remarkable difference in the number of startups per region.

REGION	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
North America	103	71%	$ 1.147.968.132	$ 11.145.322
Europe	41	12%	$ 197.018.507	$ 4.805.329
Asia	17	11%	$ 181.514.361	$ 10.677.315
South America	7	1%	$ 14.987.528	$ 2.141.075
Middle East	7	5%	$ 74.251.868	$ 10.607.410
Africa	1	0,08%	$ 1.359.968	$ 1.359.968
Australia	1	0,05%	$ 785.100	$ 785.100
TOT	176		$ 1.617.885.464	$ 9.192.531

Table 9 - Total and Average funding distribution, by region (excluding high-potential startups)

Last equity funding type

Along its lifecycle, a startup goes through many funding stages, each of which usually differ for requirements, typology of investors and amount of investments. *Figure 12* shows last equity funding round type of startups in the population. The sector appears to be still immature since most companies are in first stages (47%) – Pre-Seed (14 startups), Seed (92), Angel (2). A quarter of the population is in initial rounds of venture capital financing – Series A (38 startups), Series B (18); while 15% of companies is in the next steps of venture capitals – Series Unknown (31 startups), Series C and beyond (3). Lastly, a minority is in other funding rounds (6%) – Corporate Round (6 startups), Initial Coin Offering (4), Private Equity (3).

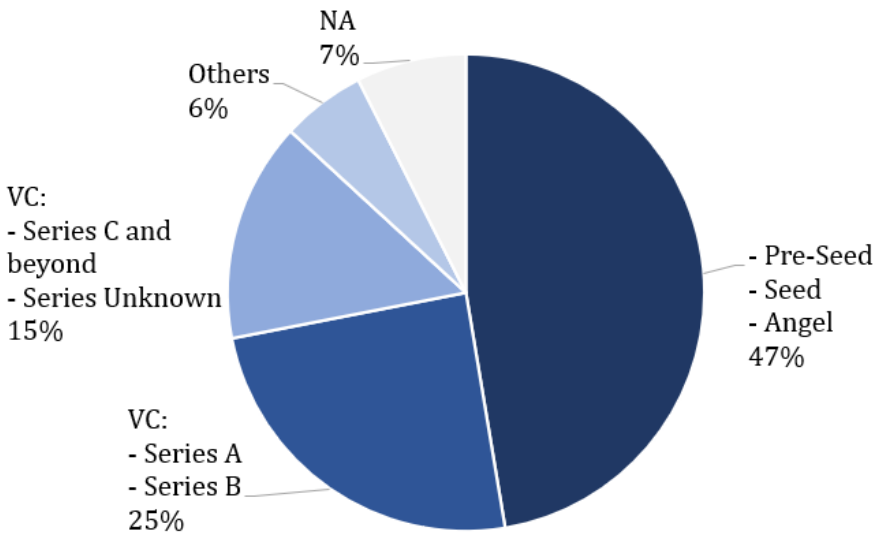


Figure 12 - Typology of last funding round

3.3 Organizational Structure

Startups are newly-born companies and inherently rely on basic and still blurry organizational structures, this paragraph examines few variables that can make up an organizational identikit of the companies under exam: year of foundation, number of founders, number of employees.

Following our research criterion, all companies in the population are founded from 2013 onwards, following the distribution illustrated in *Figure 13.* During the first three years an increasing trend that culminated in 51 new startups in 2015 is registered, while in recent years, despite a climb back up in 2017, there was a constant decrease of entrepreneurial initiatives. Nevertheless, this trend should be read through the lens of research bias introduced by data collection on Crunchbase, as the platform is empirically affected by delays in data updating.

Figure 14 illustrates that more than half startups (58%) were founded by 1 or 2 entrepreneurs, 19% of startups have 3 founders, and in about 8% of times number of founders overcome 3 people.

Lastly, *Figure 16* confirms that startups are very small entities, in fact in 82% of cases companies have a maximum of 50 employees. It is not surprising that top two startups in terms of funding received are exactly the two companies with the highest number of employees (251+ in the chart) – Rubrik and Samsara with an estimated range of employees between 1001 and 5000 people each.

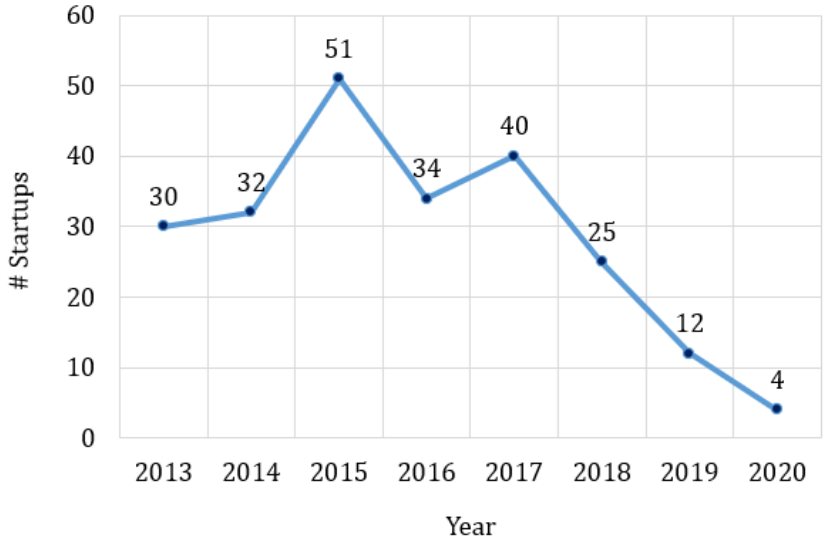


Figure 13 – Startups year of foundation

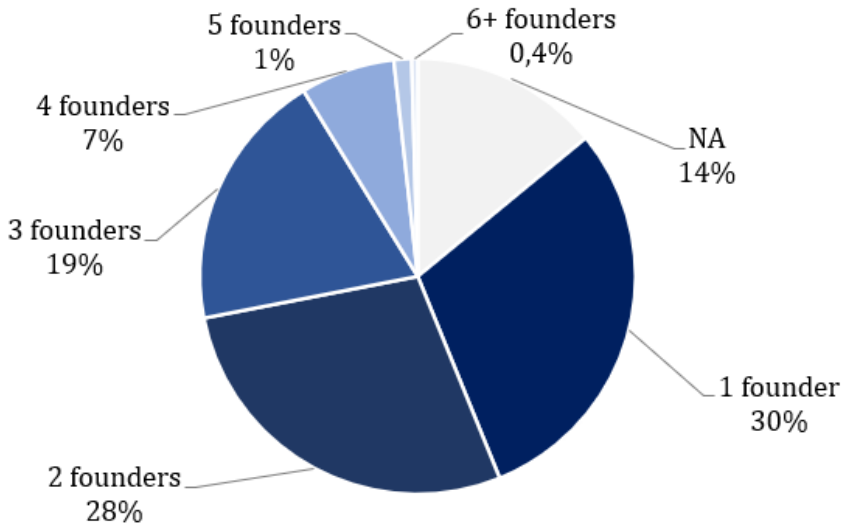


Figure 14 - Startups distribution, by number of founders

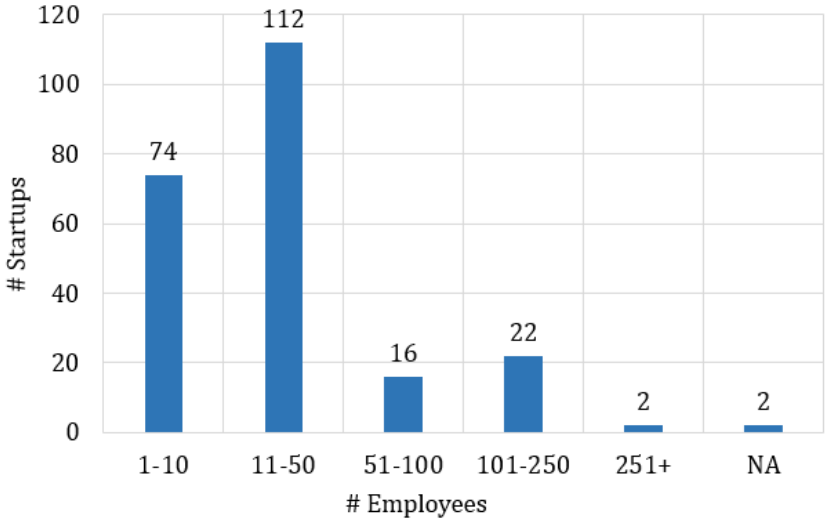


Figure 15 – Startups number of employees

3.4 Domains of activity

Startup distribution by domain

Depending on the type of services offered, the 228 startups were assigned from 1 to 7 of the 23 application domains (*Figure 17*). Data Analysis & Intelligence is definitely the most widespread domain (66 times – 29% of startups), followed by Communication & Transparency (49), Cybersecurity (45), Data Storage (41), Community Engagement (40) and so on.

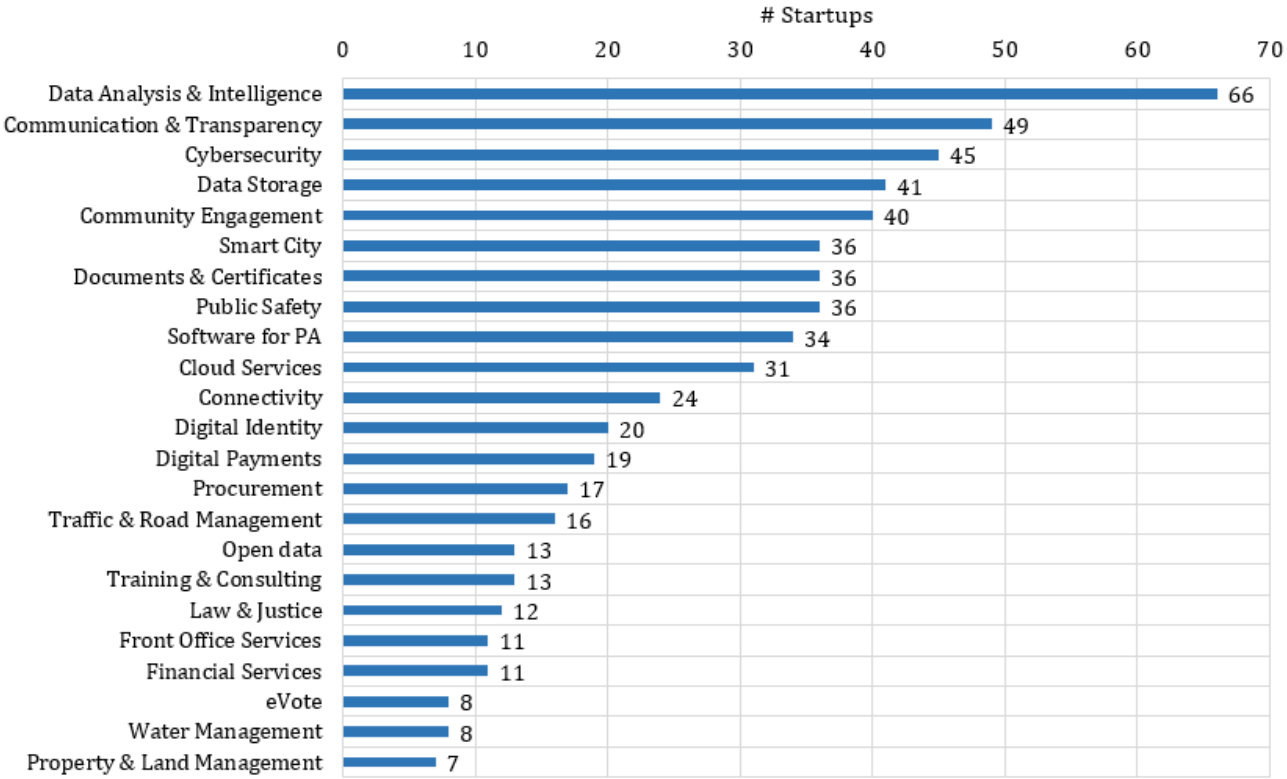


Figure 16 - Startups number of domains

Startup distribution by number of domains

The *Figure 18* shows that there is not a clear evidence on which number of domains is more common among startups. In fact, aggregating categories 4, 5, 6 and 7 domains, the population is essentially divided into four equal parts – 1 domain (24%), 2 domains (27%), 3 domains (25%), 4 or more domains (24%).

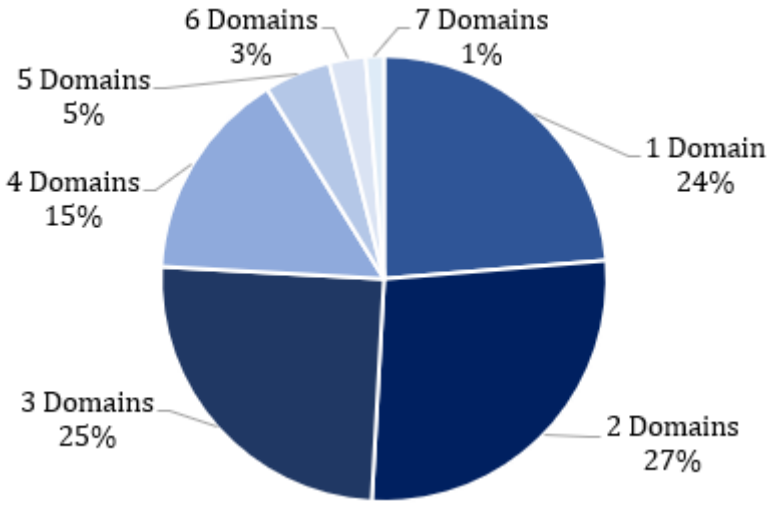


Figure 17 - Startups distribution, by number of domains

Funding by number of domains

*Table 10*and *Table 12* examine how investments change among the number of different domains covered by startups. In both diagrams classes 4, 5, 6 and 7 domains are grouped together, in order to create a more balanced division in the population and to avoid that the number of startups per category distorts the results. In particular, startups that focus on more than 3 domains lead both in terms of total funding and in average funding.

# DOMAINS	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
1	39	19%	$ 697.892.382	$ 17.894.676
2	51	14%	$ 517.893.870	$ 10.154.782
3	47	24%	$ 880.624.571	$ 18.736.693
4+	46	43%	$ 1.594.943.642	$ 34.672.688
TOT	183		$ 3.691.354.465	$ 20.171.336

Table 10 - Total and Average funding distribution, by number of domains

However, the impact of companies with more than 100 million of collected investments influence funding outcomes, so it is relevant to reanalyse investment allocation excluding those startups (*Table 11*) – Dt Dream (6 domains), Hyperscience (2), IronNet Cybersecurity (1), PayIt (7), Rubrik (3) and Samsara (4).

DOMAINS	HIGH-POTENTIAL STARTUPS					
	Dt Dream	Hyperscience	IronNet Cybersecurity	PayIt	Rubrik	Samsara
Cloud Services	x			x	x	
Communication & Transparency	x			x		x
Connectivity				x		
Cybersecurity	x		x		x	
Data Analysis & Intelligence	x					x
Data Storage	x	x			x	
Digital Payments				x		
Documents & Certificates		x				
Financial Services				x		
Property & Land Management						x
Smart City				x		
Software for PA	x			x		
Traffic & Road Management						x
TOT #DOMAINS	**6**	**2**	**1**	**7**	**3**	**4**

Table 11 - Domains of high-potential startups

Funding by number of domains – excluding high-potential startups

Although startups specialised in a single applicative domain are a minority, they are able to obtain more investments than companies with more domains.

Moreover, the funding distribution seems to follow an inversely proportional trend respect to the number of domains in the population; so, startups focusing on a specific service seem to benefit from specialization in a single domain.

# DOMAINS	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
1	38	36%	$ 587.392.382	$ 15.457.694
2	50	25%	$ 409.014.195	$ 8.180.284
3	46	20%	$ 327.624.571	$ 7.122.273
4+	43	18%	$ 293.854.316	$ 6.833.821
TOT	177		$ 1.617.885.464	$ 9.140.596

Table 12 - Total and Average funding distribution, by number of domains (excluding high-potential startups)

3.5 Key technologies

Nowadays digital technologies are widespread in entrepreneurial ecosystems and specifically, startups in GovTech sector are exploiting digital innovation trends. However, only 50% of the population leverages at least one of five key technical infrastructures that were accurately presented in the Literature review – Artificial Intelligence, Big Data, Blockchain, Cloud Computing and Internet of Things.

Funding by 5 key technologies

Table 13 illustrates the importance of adopting these specific technologies; indeed, 79% of total funding was assigned to those startups that implement the use of at least one of previously mentioned solutions. Differences in total and average funding are huge, showing how these technologies are a key factor in attracting capital investors.

KEY TECHNOLOGIES	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
Yes	91	79%	$ 2.912.455.987	$ 32.005.011
No	92	21%	$ 778.898.478	$ 8.466.288
TOT	183		$ 3.691.354.465	$ 20.171.336

Table 13 - Total and Average funding distribution, by key technologies

5 key technologies by number of startups

As illustrated in *Figure 19*, Artificial Intelligence is the most widely used technology (63 times), followed by Cloud Computing (36), whereas Big Data (21), Blockchain (19) and Internet of Things (19) are not that popular yet among startups in the population.

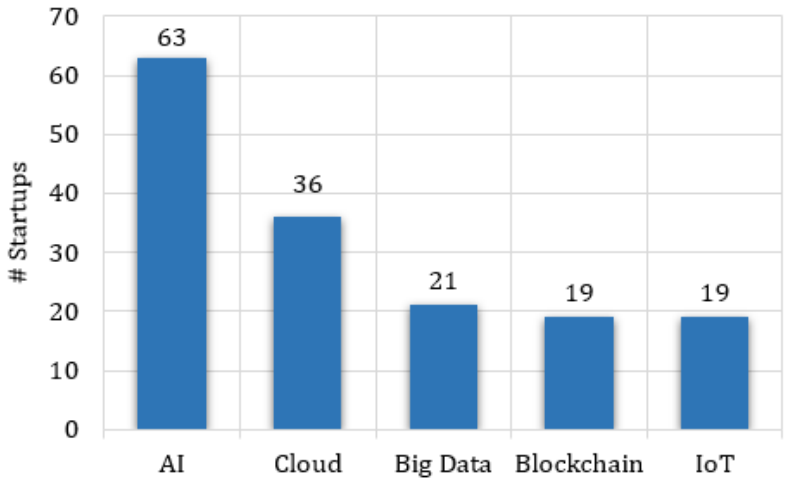


Figure 18 – Startups key technologies

Startup distribution by number of 5 key technologies

In addition to studying which are the most common technologies, it is equally important to investigate whether or not startups exploit the chance of leveraging two or more technological paradigms simultaneously.

Results show that more than 70% of startups focus on just one technological solution, 21% combine two different approaches and just 8% take advantage of synergies between three or more technological methods.

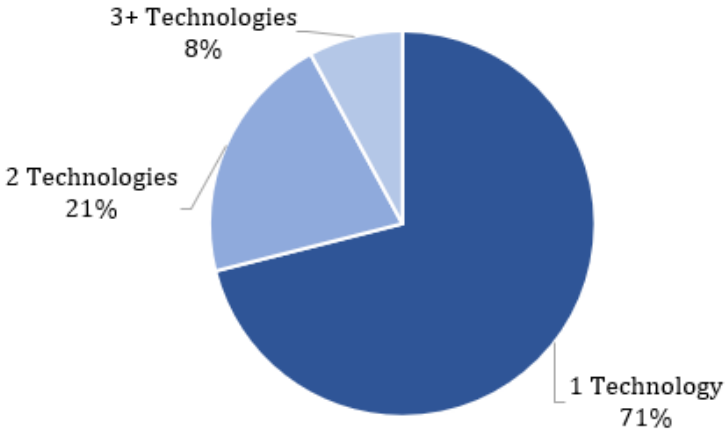


Figure 19 - Startups distribution, by number of key technologies

Funding by number of 5 key technologies

After having presented the relevance of five "key" technologies in the first table of the section, next figures examine whether the adoption of two or more solutions concurrently give startups the opportunity to collect more investments than those obtained by startups with a single technological architecture.

Since just few companies (9 out of 114, that is the 8% shown in the pie chart) make use of more than two technologies, these startups were aggregated to the category of startups adopting 2 key technologies.

Table 14 shows that, although the overall amount of investment is for the most part divided into equal shares, the average funding for startups belonging to '2, 3+' class is more than doubled compared to startups with one technology.

# TECHNOLOGIES	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
1	63	48%	$ 1.398.964.387	$ 22.205.784
2, 3+	28	52%	$ 1.513.491.600	$ 54.053.271
TOT	91		$ 2.912.455.987	$ 32.005.011

Table 14 - Total and Average funding distribution, by number of key technologies

Nevertheless, the results are influenced by the group of six companies with a total funding higher than 100 million of dollars each so, it is appropriate to reanalyse funding distribution net of "big" startups – in this case companies in the analysis are Dt Dream (2 technologies), Hyperscience (1), Rubrik (1) and Samsara(3).

TECHNOLOGIES	HIGH-POTENTIAL STARTUPS			
	Dt Dream	Hyperscience	Rubrik	Samsara
Artificial Intelligence		X		X
Big Data	X			
Cloud Computing	X		X	X
Internet of Things				X
TOT #TECHNOLOGIES	**2**	**1**	**1**	**3**

Table 15 - Key technologies of high-potential startups

Funding by number of 5 key technologies – excluding high-potential startups

In this configuration, total funding and average funding decrease by about 64% and 62% respectively, and at the same time, investment allocation changed – more than two-third of total funding is assigned to '1' category of startups. As regards average investments, outcomes are in contrast with what emerged in the previous table showing a clear balance between average funding amounts.

# TECHNOLOGIES	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
1	61	70%	$ 737.084.712	$ 12.083.356
2, 3+	26	30%	$ 316.902.274	$ 12.188.549
TOT	87		$ 1.053.986.986	$ 12.114.793

Table 16 - Total and Average funding distribution, by number of key technologies (excluding high-potential startups)

Therefore, if on one side leveraging at least one of five key technologies is essential to attract investments (*Table 13*), on the other side *Table 14* and *Table 16* suggest that there is no clear evidence on whether combining more technological approaches leads to benefit from capital investors.

3.6 Business Model

3.6.1 Territorial Focus

Since a public entity governs and regulates a specific area of competence which is legally defined and limited within a certain geographical sphere, the 228 startups were classified considering the territorial influence of the PAs they collaborate with.

Startup distribution by territorial focus

39% of the population serves both national and local contexts, while 30% is focused exclusively on local affairs and 12% on national scopes. International public services are less frequent among startups: only 7% of startups implements solutions whose relevance is international and 6% extends its services on both international and national basis. Lastly, 15 startups (7%) develop services with no specific territorial relevance.
When assuming an overall perspective, around three-quarters of companies (172) are able to work with local governments, showing that new venture initiatives in GovTech are strongly attached to the ecosystem where they are established.

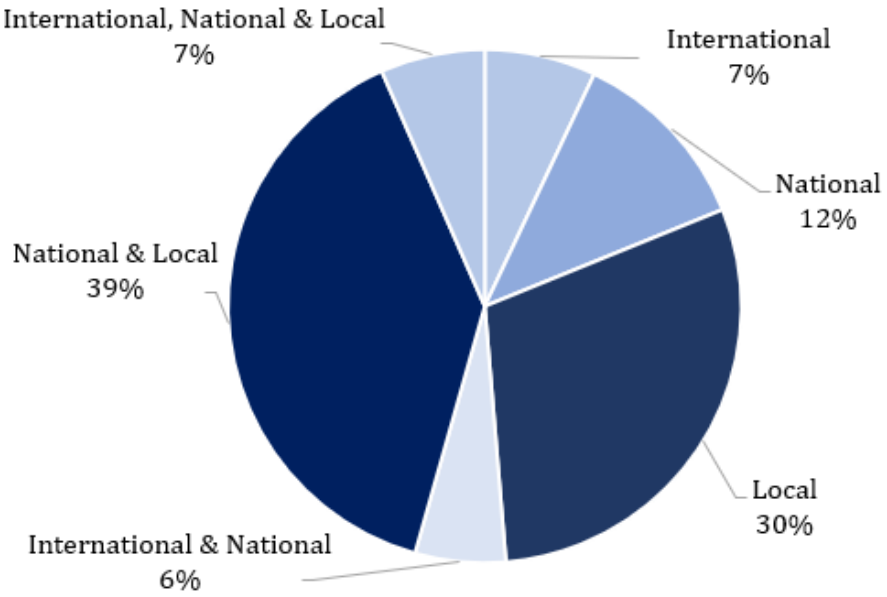


Figure 20 - Startup distribution, by territorial focus

Funding by territorial focus

Largest portions of total investments are collected by the most numerous startup categories, that are 'National & Local' (41%) and 'Local' (36%), whereas other classes are all below 10%. Furthermore, it is clear that startups which offer a public service with local relevance in their business portfolio – 'Local', 'National & Local' and 'International, National & Local' – turned out to be more inclined to obtain investments, as shown by average funding values. Indeed, all other categories do not reach the overall average funding threshold.

TERRITORIAL FOCUS	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
International	12	2%	$ 67.054.524	$ 5.587.877
National	23	9%	$ 328.778.308	$ 14.294.709
Local	54	36%	$ 1.336.739.112	$ 24.754.428
International & National	8	3%	$ 114.066.301	$ 14.258.288
National & Local	72	41%	$ 1.504.816.177	$ 20.900.225
International, National & Local	14	9%	$ 339.900.043	$ 24.278.575
TOT	183		$ 3.691.354.465	$ 20.171.336

Table 17 - Total and Average funding distribution, by territorial focus

3.6.2 Business focus

Within this section companies are divided into two distinct categories: startups that offer their product or services exclusively to public sector entities, and startups that also work with private sector business.

Startup distribution by business focus

As shown in *Figure 22*, companies that collaborate only with the PA are a minority (42%) compared to companies for which there is a coexistence between public and private sectors (58%).

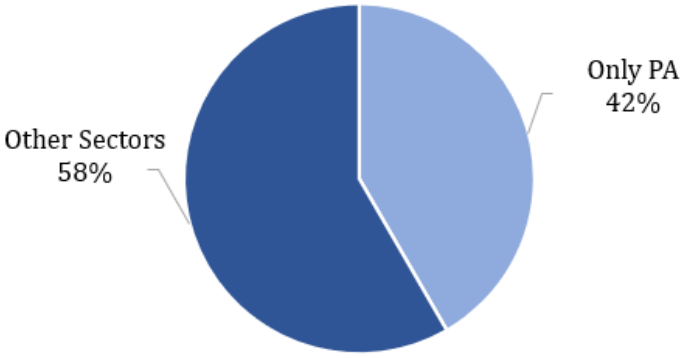


Figure 21 - Startup distribution, by business focus

Funding by business focus

Moreover, total and average investment values are definitively in favour of that part of population in contact with private entities. Companies specialized in public sector services raised just 15% of total funding amount and at the same time, they have an average investment about four times lower than the value of startups belonging to 'Other Sectors' category.

Ergo, results suggest that having a diversified portfolio, where public sector represents only a part of the entire corporate business, leads to gain advantages in attracting financial capitals respect to those companies that exclusively specialize in serving specific needs of the public sector.

BUSINESS FOCUS	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
Only PA	75	15%	$ 550.324.379	$ 7.337.658
Other Sectors	108	85%	$ 3.141.030.086	$ 29.083.612
TOT	183		$ 3.691.354.456	$ 20.171.336

Table 18 - Total and Average funding distribution, by business focus

3.6.3 Stakeholder focus

When delivering services to public administration, startups address their value proposition to three main actors: public administration itself, enterprise and citizen, or a combination of them (public administration is always included). For this reason, it is relevant to analyse how GovTech startups relates with their stakeholders. When two or more actors interact with each other, a 'platform effect' emerges; in other words, platform focus describes the capability of the startup to systemically involve more parties and create synergies from a wide network of relations, regardless the existence of a digital or physical platform.

Startup distribution by stakeholders focus

In most cases startups collaborate with two actors – 'PA & Enterprises' (38%) and 'PA & Citizens' (19%); 30% of the population does not create a platform effect by involving other stakeholders besides public administrations; finally, 29 startups (13%) propose a three-side interaction.

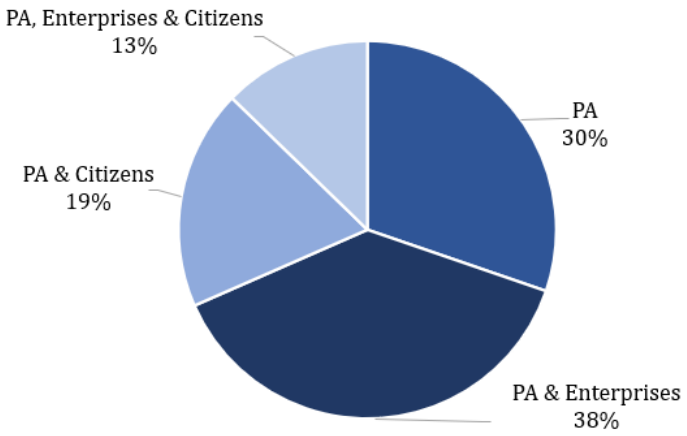


Figure 22 - Startup distribution, by stakeholders focus

Funding by stakeholders focus

More than half of total investments (52%) are concentrated in the 'PA & Enterprises' category, 36% are distributed among companies that act exclusively with PAs, while the remainder is divided between companies belonging to 'PA & Citizens' (7%) and 'PA, Enterprises & Citizens' (5%). There are similar results also for average investments as well, except for first two classes; in fact, although total funding amount for 'PA & Enterprises' startups exceeds total funding value for 'PA' companies by more than half a billion, average investments are practically the same.

Therefore, all these considerations might reveal that it is difficult to find a correlation between the capability of a startup to attract investments and the 'platform effect'.

STAKEHOLDER FOCUS	# STARTUP	% FUNDING	TOT. FUNDING	AVG. FUNDING
PA	53	36%	$ 1.339.764.969	$ 25.278.584
PA & Enterprises	72	52%	$ 1.930.706.360	$ 26.815.366
PA & Citizens	34	7%	$ 252.791.390	$ 7.435.041
PA, Enterprises & Citizens	24	5%	$ 168.091.746	$ 7.003.823
TOT	183		$ 3.691.354.456	$ 20.171.336

Table 19 - Total and Average funding distribution, by stakeholders focus

3.6.4 Pricing

As described in the Literature review (Chapter 1.3) startups are temporary organization in search of a scalable, repeatable and profitable business model. This definition explains why even 79% of startups provides misleading information regarding pricing strategies. Although in the majority of cases the analysis did not bear fruit, taking into consideration those few startups for which it was possible to define a pricing model, results show that: 28 startups offer public services through periodical subscription fees, 8 companies implement asset sale methods, 5 adopt licensing pricing models and 4 make customers pay through proportional usage fees. Sometimes companies offer a bundle of complementary products for which combining multiple pricing strategies is indispensable; this is the case of Hayden AI that sell or lease sense cameras and at the same time, use subscription fees for both the portal and the mobile app to provide traffic safety solutions.
No further investigations and analysis were performed due to lack of data.

3.6.5 Mission Statement

The last analysed dimension regarding business model is the mission statement which can be considered the "calling card" of startups that want to attract capital investors. In fact, a company's mission statement is the first thing that capture the attention of third parties when a company introduces itself.

Figure 24 summarize the number of startups that mentioned the three variables, that are 'Stakeholders', 'Components', 'Goals', each one with its different dimensions. As far as the 'Stakeholder' variable is concerned, the terms 'Society' is the most frequently used (56 times); this might reveal that startups aim to introduce themselves as entities with social goals, whose products or services serve to improve and benefit communities. Most popular terms regarding 'Components' dimension are 'Industry' (69 mentions) and 'Competency' (67) as startups want to be specific in describing which are their areas of competence firstly, and at the same time, they want to make third parties aware that their innovative products or services enhance both efficiency and effectiveness within public sector sphere. Lastly, the 'Goals' dimension shows that 'Motivation' (65 startups) and 'Control Mechanism' (63) are the most frequent objectives. That is why the majority of

startups include motivational messages (based on excellence or social benefit) in their mission statement, but also because most times startups mention as control mechanism at least two of the subsequent components: industry, customer, geographic scope and competency.

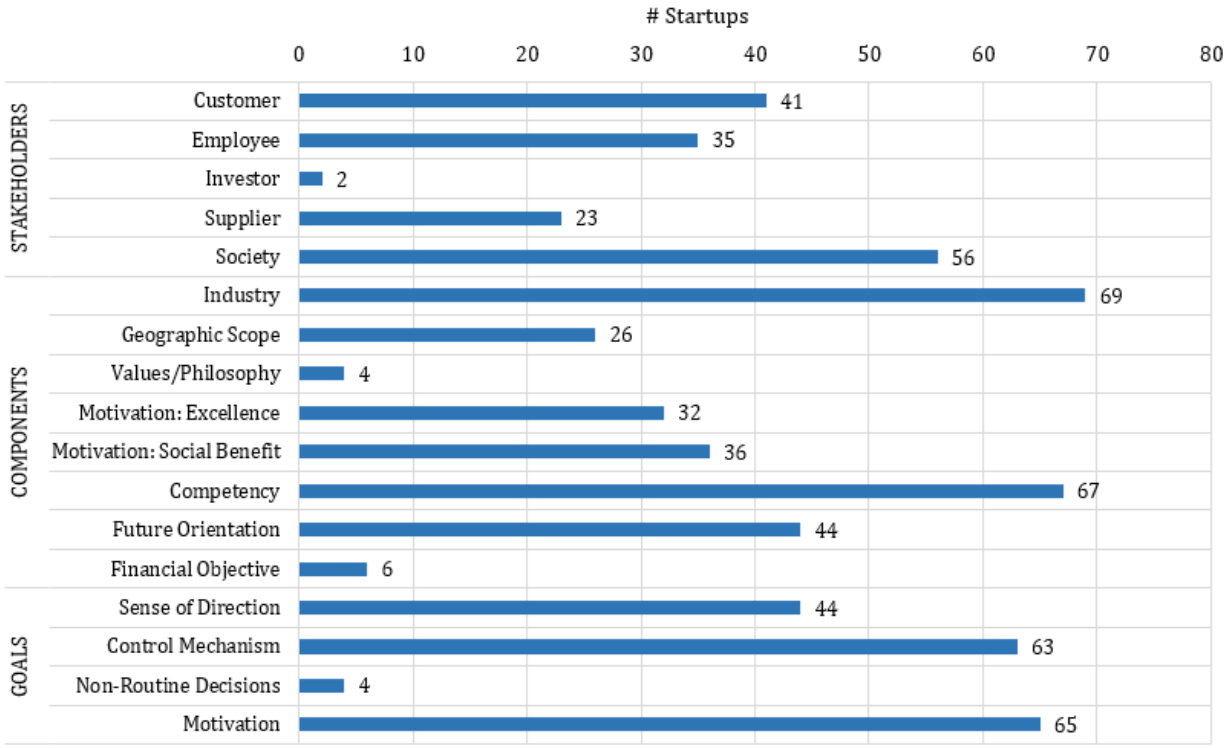


Figure 23 - Startups mission statement

3.7 Founders

3.7.1 Educational background

Founders' educational background by number of startups

Figure 25 shows the most frequent university macro-subjects per number of startups. First three categories are definitively the most popular study areas among founders – 'Computer & Informatics', 'Economics & Management', 'Engineering'.

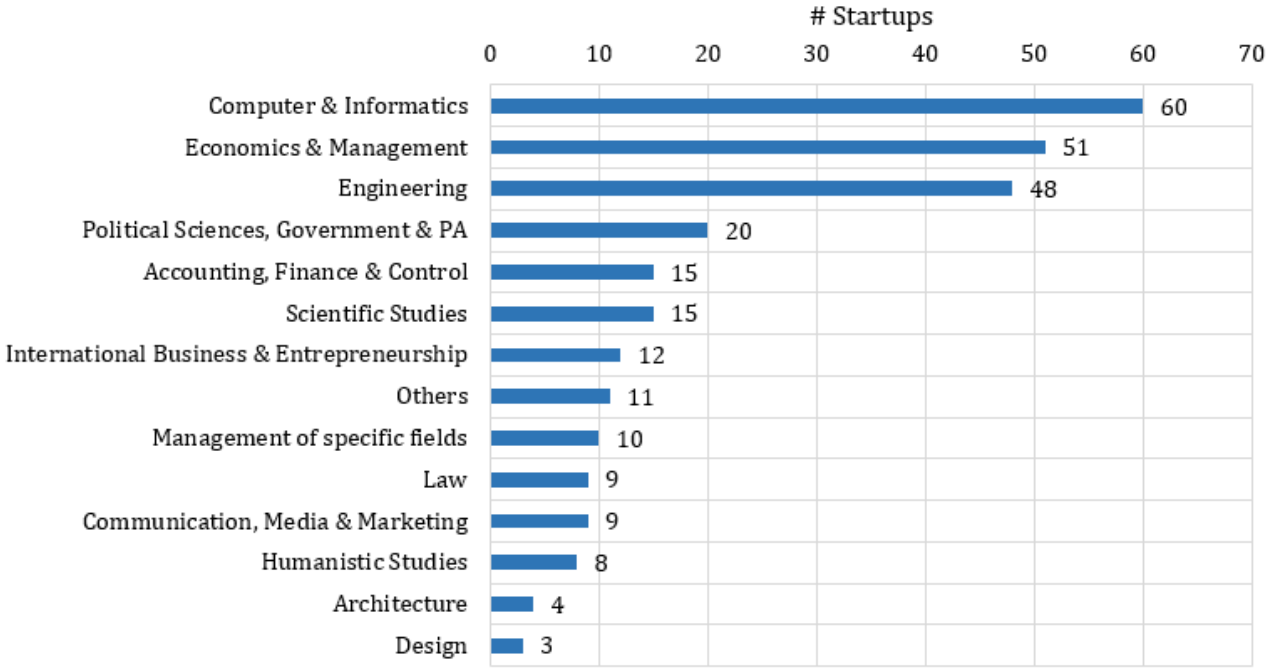


Figure 24 – Founders' educational background by number of startups

Funding by number of different educational background

During the first analysis the population is divided into two distinct classes: (1) companies whose founders have a homogeneous educational background, that is all startups for which one single educational macro-subject was identified; (2) companies whose founders have a heterogeneous educational background, all startups for which at least two educational macro-categories were assigned. Results highlight that startups referring to 'More than 1' class clearly prevails both in terms of total and average funding,

suggesting that having a heterogenous educational background might be a crucial factor for attracting investments.

#DIFFERENT EDUCATION BACKGROUND	# STARTUPS	% FUNDING	TOT. FUNDING	AVG. FUNDING
1	56	20%	$ 641.160.911	$ 11.449.302
More than 1	77	80%	$ 2.497.467.561	$ 32.434.644
TOT	133		$ 3.138.628.472	$ 23.598.710

Table 20 - Total and Average funding distribution, by number of different educational background

Funding by educational background (top 3 per number of startups)

EDUCATIONAL BACKGROUND	# STARTUPS	% FUNDING	TOT. FUNDING	AVG. FUNDING
COMPUTER & INFORMATICS	28	13%	$ 357.509.106	$ 12.768.182
MANAGEMENT & ECONOMICS	25	18%	$ 517.332.846	$ 20.693.314
ENGINEERING	15	6%	$ 182.485.566	$ 12.165.704
COMPUTER & INFORMATICS - MANAGEMENT & ECONOMICS	9	24%	$ 665.801.799	$ 73.977.978
COMPUTER & INFORMATICS - ENGINEERING	10	35%	$ 999.003.232	$ 99.900.323
MANAGEMENT & ECONOMICS - ENGINEERING	9	3%	$ 81.402.737	$ 9.044.749
COMPUTER & INFORMATICS - MANAGEMENT & ECONOMICS - ENGINEERING	2	1%	$ 15.112.007	$ 7.556.004
TOT	98		$ 2.818.647.293	$ 28.761.707

Table 21 - Total and Average funding distribution, by top 3 educational background

Neverthless, the previous analysis does not consider the "essence" of different study areas. For this reason, *Table 21* discusses how investements are distributed among startups that have at least one of the three most common study fields – 'Computer & Informatics' (49 startups), 'Management & Economics' (45), 'Engineering' (36). Largest portions of overall investments are achieved by companies whose founders are specialized both in 'Computer & Informatics' and both in 'Engineering' (35%) or 'Management & Economics' (24%). So, companies (19 startups) whose founders combine these latter two subjects with a background in 'Computer & Informatics' obtain more investments than other startups. 'Management & Economics' and 'Computer &

Informatics' categories collected respectively 18% and 13% of remaining investments, while other classes have less than 10% each. For what concerns average funding, results are similar; indeed, the two leading categories are the only ones to have a value clearly above the overall average and the gap with other classes of startups is enormous.

Still considering the same macro-subjects, but with a more generic perspective, *Table 22* points out that startups whose founders have at least two of the top three educational background, regardless of which they are, receive about two thirds of total investments (62%). This result is even more impressive considering that 'More than 1 of the top three' companies are less than half of the '1 of the top three' startups; as a consequence, average funding amount for the first mentioned category are more than three times bigger than the average funding value for startups whose founders have homogeneous university experiences.

Therefore, once again analysis point out that a heterogeneous educational background could prove to be a determinant in driving entrepreneurial success in GovTech startup sector.

EDUCATIONAL BACKGROUND	# STARTUPS	% FUNDING	TOT. FUNDING	AVG. FUNDING
1 of the top three	68	38%	$ 1.057.327.518	$ 15.548.934
More than 1 of the top three	30	62%	$ 1.761.319.775	$ 58.710.659
TOT	98		$ 2.818.647.293	$ 28.761.707

Table 22 - Total and Average funding distribution, by top 3 educational background (general perspective)

3.7.2 Professional background

Previous work experience

Startup distribution by founders' previous work experience

Figure 25 illustrates that only a minority of startups were founded by entrepreneurs with past work experience in the field of public administration (18%).

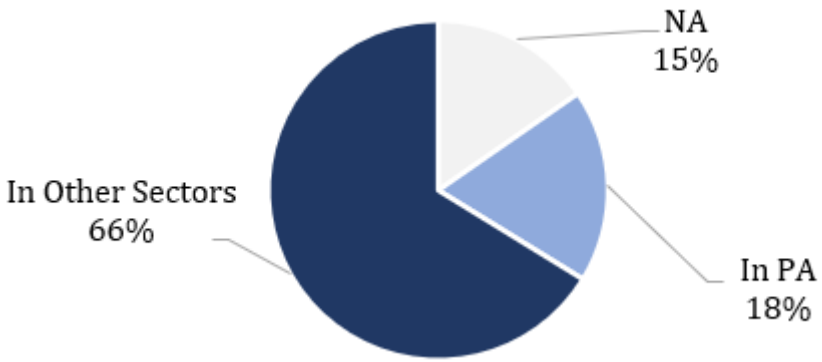


Figure 25 - Startup distribution by founders' previous work experience

Funding by founders' previous work experience

Simultaneously, when studying funding distribution, 88% of the entire capital was allocated to the most numerous category, where founders did not have a professional career within public sphere in the past. In addition, 'In Other Sectors' startups stand out also as regards the amount of average investments, which are about 40% higher than average funding value for 'In PA' startups.

So, there are no evidences that might suppose a possible positive correlation between the fact that some startups have founders with past work experience in public administration and the entrepreneurial success of startups themselves.

WORK EXPERIENCE	#STARTUPS	# FUNDING	TOT. FUNDING	AVG. FUNDING
In PA	30	12%	$ 404.782.918	$ 13.492.764
In Other Sectors	126	88%	$ 2.910.901.932	$ 23.102.396
TOT	156		$ 3.315.684.850	$ 21.254.390

Table 23 - Total and Average funding distribution, by founders' previous work experience

Previously founded startups

Startup distribution by previously founded startups

It is also interesting to study founders' entrepreneurial spirit by examining if founders have previously founded other startups. Data illustrates that 46% of the 228 startups were established by entrepreneurs who had founded other companies earlier, while 39% of the population is composed by startups whose founders have no previous experience in the establishment of new ventures.

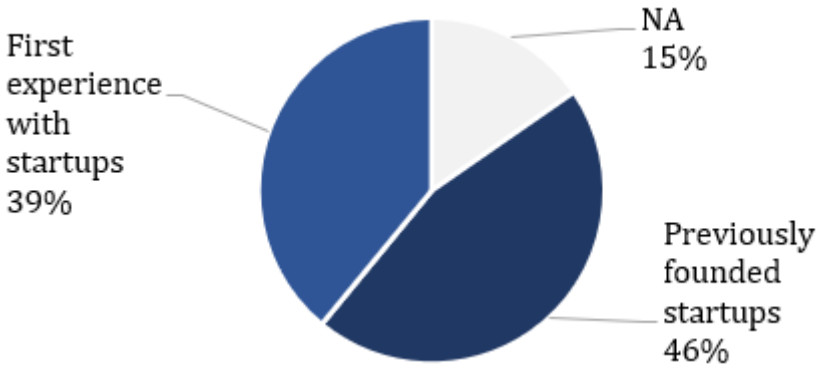


Figure 26 - Startup distribution by previously founded startups

Funding by previously founded startups

Table 23 - Total and Average funding distribution, by previously founded startups reveals that 81% of total funding was collected by startups whose founders gained experience in the establishment of new companies. Moreover, those companies also excel in terms of average investments received – average funding amount for 'Previously founded startups' category of startups is more than three times greater than the average funding value for companies belonging to 'First experience with startups' class.

In conclusion, results might lead to relevant considerations: supposing that it is possible to approximate and evaluate the "entrepreneurial spirit" variable through data on previously founded startups, a positive correlation might emerge between founders' entrepreneurship and the ability of startups in attracting capital investors.

PREVIOUS STARTUPS	# STARTUPS	% FUNDING	TOT. FUNDING	AVG. FUNDING
Previously founded startups	89	81%	$ 2.674.178.588	$ 30.046.950
First experience with startups	67	19%	$ 641.506.262	$ 9.574.720
TOT	156		$ 3.315.684.850	$ 21.254.390

Table 23 - Total and Average funding distribution, by previously founded startups

Operational status of previously founded startups

Lastly, the operational status of previously founded companies was accurately evaluated. *Figure 28* - Operational status of previously founded startups shows that in half of the cases companies are still active, whereas 36% of startups are closed and 13% belongs to the category 'Merged & Acquired'. So, it is possible to affirm that most of previously established companies (50% of active combined with 13% of merged and acquired) have been successful.

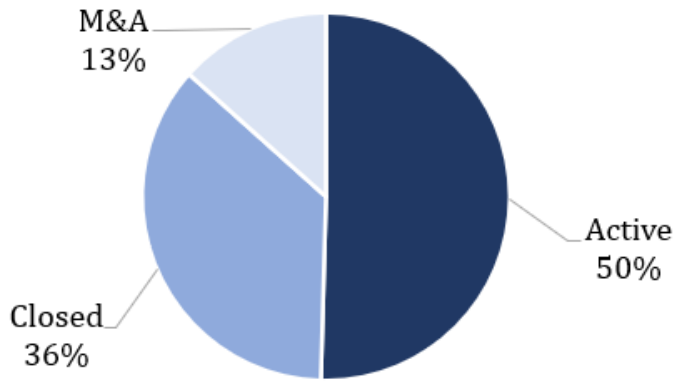


Figure 27 - Operational status of previously founded startups

CHAPTER 4 – DISCUSSION

In this chapter, the results previously presented are elaborated and discussed to provide a scientific interpretation of GovTech startup ecosystem. In particular the answers to the research questions will be provided and, consequently, we will delineate the main contributions that may be useful to enrich the scientific knowledge about the topic for both practitioners and scholars.

4.1 RQ1: How many GovTech startups are there? What are their features?

a) How many startups work in GovTech?

Overall, the GovTech entrepreneurial ecosystem is populated by 228 international startups.

b) Where, in which countries, is GovTech gaining momentum?

Most of the GovTech startups are concentrated in highly entrepreneurial ecosystems where there are favourable economic conditions and opportunities for the establishment and development of new business models. More than half of startups were born and operates in the United States; almost one third of those is located in California, where Silicon Valley is home to 11 new GovTech ventures, as well as to some of the most technological international firms such as Apple, Facebook and Google, showing how this is a leading region in fostering digital innovation. Another substantial part of startups is heterogeneously displaced in many other locations around the world and the distribution is basically in line with the social and economic performance of the various countries. Indeed, it is not surprising that, apart from the US, United Kingdom and China stand on the podium as countries with the highest concentration of GovTech startups. These countries contribute to the territorial supremacy of the continents in which they are located, respectively: North America startups account for 56% of the entire population, European ones for 24%, while Asian companies for 12%.

c) *Where, in which countries, is the interest of investors in GovTech gaining momentum?*

The interest of investors is not homogenous within GovTech international ecosystem. As matter of fact, geographical context factors influence not only startup concentration in certain regions, but also investment distribution among continents so that, in general, the largest portions of funding are practically proportional to the higher concentration of startups in certain regions. The presence of both fast-growing companies and big investment rounds in US and China unbalances the continental performances of North America and Asia, which lead both in total and in average funding. Indeed, a group of six startups – five of them located in US and one in China – account for 56% of the entire amount of investments in GovTech startup sector. On the other side, Europe ranks third for what concern total funding amount but drops to the fourth position – surpassed by Middle East – when considering the average investment per startup, alerting potential limits for European startups to scale-up.

d) *How big is the interest of investors in GovTech startups?*

Although GovTech is an emerging sector, the development of eGovernment services through private-public collaborations will radically change the way stakeholders interact with public administrations leading to benefits for communities and their citizens. That is why capital investors start glimpsing and examining new investment opportunities in the public sector. Nevertheless, if it is true that the ecosystem exists, GovTech startups still represent a small minority in the world of digital entrepreneurship, both in term of number of existent firms and capacity to gain the attention of investors and, consequently, capitals for the growth. The majority of startups, about half of them, are in the very first rounds of investments – Pre-Seed, Seed, Angel – while a quarter of them are looking for first rounds of venture capital financing, proving how the sector on the whole is still immature, even though investors are increasing awareness of GovTech growth potential.

e) *What organizational structure do GovTech startups have?*

The organizational structure characterizing startups in the GovTech field does not present substantial peculiarities compared to a traditional organizational structure of a generic startup. In fact, startups in the population are mainly composed by a limited number of founders and a small number of employees – except for few cases, relating to those

startups that received most of the investments, where number of employees seems to be more similar to the size of a medium-large company.

f) Which public domains are mostly approached by startups?

Startups domains of expertise vary from general purpose services to ecosystem specific-products and the range of public services provided by each startup in the GovTech industry is very different. Some companies which focus on a single domain, or still on a limited range of related services, try specialising their business strategy on a set of specific needs, while the others create whole industry specific competencies by offering unrelated service domains to public institutions. Overall, strategies regarding the type and the range of domains covered are quite heterogenous among different startups in the field; anyway, the most widespread domains refer to 'data analysis and intelligence', 'communication and transparency', and 'cybersecurity'. This points out the centrality of data analytics in the effort of government towards the digital transformation and, on the other side, the relevance of theme such as privacy issue, trust and data security as an enabling factor for the adoption of eGovernment solutions by citizens and businesses, which are very sensitive to these themes.

g) What are the key technological infrastructures in the sector?

Exactly half of the entire population implement GovTech solutions by adopting at least one of the five key technological paradigms – Artificial Intelligence, Big Data, Blockchain, Cloud Computing and Internet of Things. The majority of those startups leverage Artificial Intelligence infrastructures, a smaller portion opts for Cloud Computing solutions, while Big Data, Blockchain and Internet of Things applications are less popular among GovTech startups. More in detail, about 30% of those companies is trying to enhance its value proposition by exploiting the complementarity of more technological architectures simultaneously. In this context, entrepreneurs, despite their innovation-oriented approach, always seek the right balance between proposing highly innovative solutions which might be hardly adoptable and scalable in public administrations, and offering digital services which are consistent with both technical advancements and the readiness of the market to adopt them.

h) Which business model mainly characterizes the GovTech startup ecosystem?

The analysis of business model settings highlights some interesting behaviour and traits typical of a startup in GovTech.

Around three-quarter of the population collaborates with local public entities, even though some of these startups aim at scaling and enlarging their territorial influence at national, or even international level. This evidence might have several interpretations. Primarily, since local public administrations have limited resources and skills, the concrete implementation of internally developed eGovernment projects is often very complicated and therefore, they create new business challenges for public-private collaborations. In addition, entrepreneurs may be more confident in launching new business initiatives in locally bounded environment because public sector needs, opportunities and threats on a local basis are more manageable and, exploiting networking, it is easier to get in touch with local public managers and understand their needs.

More than half of startups diversify their business portfolio by also addressing private sector challenges and therefore, GovTech sector does not represent the only business. Many strategic choices may justify the coexistence between public and private sectors. Some entrepreneurs may find public administrations as attractive customers but at the same time, they could perceive working exclusively with public sector as a risky business model, so they differentiate the customer base offering products to complementary sectors. Others may try applying in GovTech knowledge and products developed in other industries to enlarge the market reach. In a limited number of cases, where products are generally standard and not industry tailored, GovTech is just a field of application for services that well fit in many other sectors.

Furthermore, it is relevant to point out that in addressing public needs only a minority of startups target public administrations directly, while most companies, which also target citizens and enterprises, try to exploit a platform business model and so, capture value from all these stakeholders – in detail, the majority of companies targets both public administrations and enterprises.

When investigating pricing models, it is not surprising that 79% of startups provide misleading information proving how, in most cases, newly born companies rely on undefined and non-scalable pricing strategies.

The willingness of GovTech startups to meet public sector requirements is disclosed by their mission statements. In fact, most cited terms are 'industry' and 'competency' showing how startups want to be straightforward about their value propositions; in other words, they aim to impress and persuade public customers by emphasizing how their digital products can enhance both effectiveness and efficiency of eGovernment services.

i) What kind of educational and professional background do startup founders have?

For what concerns educational background, entrepreneurs within GovTech sector are mainly specialized in 'computer and informatics' field, revealing how their interest and predisposition towards digitalization might find some correspondence with their academic career. When investigating professional background, just about a fifth of startups was established by founders with a previous administrative-managerial work experience in public administrations, while most companies were founded by entrepreneurs with past work experiences in multiple non-public sectors. Moreover, founders show a strong entrepreneurial spirit as most of them have previously founded other companies before launching new venture initiatives in GovTech; among previously established companies about two-third have been successful confirming that in most cases founders' entrepreneurial spirit is sustained by a winning ability to run a business.

In conclusion:

a) How many startups work in GovTech?

Overall, the GovTech entrepreneurial ecosystem is populated by 228 international startups.

b) Where, in which countries, is GovTech gaining momentum?

The majority of startups is concentrated in the US, while the rest is widespread around the world, especially in European and Asian countries.

c) Where, in which countries, is the interest of investors in GovTech gaining momentum?

Investments follow the geographical distribution of startups and most of them are concentrated in few leading companies. So, North America, Asia and Europe spark greater interest for investors.

d) How big is the interest of investors in GovTech startups?

Although on the whole the emerging GovTech sector is still immature, investors are increasing awareness of its growth potential.

e) What organizational structure do GovTech startups have?

Most of startups has a limited number of founders and a small number of employees.

f) Which public domains are mostly approached by startups in GovTech?

Mostly approached domains are 'data analysis and intelligence', 'communication and transparency' and 'cybersecurity'.

g) What are the key technological infrastructures in GovTech?

Most utilised technological infrastructures are artificial intelligence and cloud computing.

h) Which business model mainly characterizes the GovTech startup ecosystem?

The majority of startups serves local public institutions and diversify the customer base working with both with public sector – targeting public administrations – and private sector – targeting enterprises. However, in most cases startups fail in providing a well-defined pricing model, highlighting their novelty.

i) What kind of educational and professional background do GovTech startup founders have?

Entrepreneurs are mainly specialized in computer and informatics field and at the same time, most of them have previously founded other startup before entering the GovTech business.

4.2 RQ2: What characteristics and factors determine differences in the performance of GovTech startups?

After having presented the main features of the GovTech startup ecosystem, the following step analyses and interprets differences in the performance of startups, suggesting which dimensions may favourite the success. To evaluate the success of startups, the ***amount of investments received*** – starting from the beginning of 2018 to date – has been considered as a significative proxy, also because data sources lack further financial and economic information on startups.

a) Geographical perspective

Headquarter location and geographical context factors, such as the presence of highly digital entrepreneurial ecosystem and socio-economic conditions of countries, certainly influence the performance of startups. As already illustrated in RQ1, in general, ***investments distribution around the world is practically proportional to the geographical distribution of startups in certain regions, which in turn depends on regional economic performance***. Therefore, if favourable economic and entrepreneurial conditions facilitate the establishment of new companies, as a consequence, those companies might be more attractive for capital investors. As a matter of fact, the vast majority of total investments in GovTech sector is concentrated in North America, where more than half of startups are located in.

b) Domains of activity

Focusing on GovTech domains, results show that ***the specialization in a single specific domain of expertise allows startups to attract more investments than startups which aim to diversify their service proposition on more domains***. This statement might be explained considering that, as startups are young companies with limited resources – both financial resources, skills and human ones, as well as limitations in product or service offerings – capital investors may recognise greater growth potential in startups that aim to concentrate their resources in a specific domain, rather than in those companies that allocate their resources across multiple service domains and so, inevitably, they do not fully exploit the potential of each single domain of expertise.

c) Key technologies

Findings from a technological perspective reveal that ***GovTech startups which leverage at least one of the five key technologies – Artificial Intelligence, Big Data, Blockchain, Cloud Computing and Internet of Things – turn out to be more attractive to capital investors***. However, ***results fail in suggesting whether a concurrent adoption of two or more technological paradigms may allow startups to succeed***. Thus, misleading outcomes leave space for a few interpretations. On one hand considerations might be very similar to the ones provided for service domains; indeed, some startups may seek excellence through specialization, aiming to funnel all their knowledge and skills on a single technological solution. On the contrary, others may try to exploit synergies by leveraging the complementarity of more technological infrastructures. Despite it is difficult to suggest which technological strategy might be successful, it is reasonable to assume that, independently from the number of technologies, entrepreneurs should find the right trade-off between developing high-tech innovative products and addressing public needs. In fact, due to the complexity of public sector, digital products must fulfil market requirements, otherwise even the most advanced technological implementation become worthless and its potentialities untapped; only in this way capital investors may recognize tempting investment opportunities in GovTech sector.

d) Business model

Business model decisions strongly influence the performance of startups. In this case, the analysis covers several strategic business dimensions.

Starting with the *territorial focus*, ***startups whose services target the needs of local administrations, exclusively or in part, collect more investments than startups focusing on wider territorial scopes, that are companies serving national and/or international public institutions***. Considering that government layers can be framed between local, national and international level, this findings could indicate a certain readiness of the local level of PAs in implementing innovative government solutions or, on the other hand, the understandable choice of startups to focus on a smaller scope to reduce risk and gain experience before scale up.

Overall, results from the analysis of *customer portfolio*, show that ***startups which collaborate with both the public and private sectors attract more investment than startups with a focus only on the public administration sector***. Diversifying the customer base seems to pay off. This can be related to the fact that investors consider

startups active in both public and private business as less risky counting on a double source of revenues and on a twofold knowledge and experience.

When investigating the different *actors involved* in delivering of public services, ***there are no particular evidence that might indicate whether or not creating the 'platform effect' – by involving other stakeholders beyond public administration – makes startups more attractive in obtaining investments***.

e) Founders

Studies concerning founders' background point out important considerations. Before presenting which factors might influence the success of startups in GovTech sector, it is necessary to make a premise: since founders' background is not a strategic decision-making variable which directly impact on the performance of a company, it should be considered as a variable whose impact on the success of startups is merely 'potential' and 'indirect'.

Starting with the *educational perspective*, findings suggest that ***startups whose founders have a heterogeneous educational background obtain more investments than companies whose founders have a homogeneous educational background***. Therefore, entrepreneurs with a study experience in multiple fields might positively influence the ability of startups to receive funding.

In addition, the analysis of *professional background* points out that ***there are no relevant implications explaining the relation between the success of a startup and entrepreneurs' previous work experiences in public administration***. Although founders who experienced administrative-managerial roles in public administration sphere may have been conditioned in the choice of starting a new business in GovTech sector, the previous work experience in public sphere does not seem to be a determinant in attracting capital investors.

Lastly, the entrepreneurial spirit – assessed through 'previously founded startups' variable – might suggest that ***startups whose founders have previously founded other startups attract more investment than startups whose founders have no experience in founding new companies***. Therefore, findings shows that having experience in the foundation of new companies might impact on the performance of startups, suggesting that establishing new companies requires not only an entrepreneurial will and determination, but also the ability to properly manage and run a business, where talent

and skills are not enough. Successful founders need entrepreneurial spirit and predisposition as well as managerial know-how, but also and above all, experience.

In conclusion:

a) ***Geographical perspective*** – investments distribution around the world is practically proportional to the geographical distribution of startups in certain regions, which in turn depends on regional economic performance.

b) ***Domains of activity*** – the specialization in a single specific domain of expertise allows startups to attract more investments than startups which aim to diversify their service proposition on more domains.

c) ***Key technologies*** – GovTech startups which leverage at least one of the five key technologies turn out to be more attractive to capital investors. However, results fail in suggesting whether a concurrent adoption of two or more technological paradigms may allow startups to succeed.

d) ***Business model***

   Territorial focus – startups whose services target the needs of local administrations, exclusively or in part, collect more investments than startups focusing on wider territorial scopes, that are companies serving national and/or international public institutions.

   Business focus (customer portfolio) – startups which collaborate with both the public and private sectors attract more investment than startups with a focus only on the public administration sector.

   Stakeholders focus (actors involved) – there are no particular evidence that might indicate whether or not creating the 'platform effect' makes startups more attractive in obtaining investments.

e) ***Founders***

   Educational background – startups whose founders have a heterogeneous educational background obtain more investments than companies whose founders have a homogeneous educational background.

   Professional background (previous work experience in PA) – there are no relevant implications explaining the relation between the success of a startup and entrepreneurs' previous work experiences in public administration.

Professional background (previously founded startups) – startups whose founders have previously founded other startups attract more investment than startups whose founders have no experience in founding new companies.

4.3 Limitations

The Methodology implemented under the supervision of the Digital Agenda Observatory of Politecnico di Milano and followed as a guideline along the entire thesis work, has the objective to obtain a rigorous and replicable research model. Therefore, it is essential to stress that certain limitations have influenced the research process and its results. First of all, from a content point of view, the novelty of theme represents a serious obstacle for a comprehensive knowledge of the argument since GovTech lacks extensive academic and market research. Moreover, other structural limitations concerning the process methodology are subsequently described:

- *Data source*: the online platform Crunchbase was identified as a comprehensive and reliable data source. However, it is reasonable to suppose that it does not include data about all the existing startups in the world and data could not be real-time updated, rendering the database potentially incomplete and partially obsolete; in addition, being a US database, there can be some disparities between US and non-US startups.
- *Data integration*: after having extracted initial basic data from Crunchbase, the online sources of startups – mainly the website and LinkedIn – have been analysed to integrate further relevant information. However, the consultation process has been heterogeneously managed since different startups have different online sources. Thus, if most of startups have well-structured online sources with a multitude of reliable and easily interpretable data, on the other side some startups present less exhaustive online sources, forcing the authors to rely on reasonable deductions for data integration process. For this reason, although the whole methodological process has been finalized to ensure as its best the objectivity of findings, the work is certainly influenced by authors' subjectivity and so, the quality of data may be questioned. Main examples relate to service domains and technological paradigms: in both cases, respective data has been integrated only when online sources gave a clear and precise evidence of information, but despite

this, the thesis has an intrinsic and inevitable, albeit minimal, lacks of complete subjectivity.

4.5 Future research

The thesis has laid the foundation for future researches in GovTech sector. In detail, RQ3 – "*Which strategic variables and context factors may favour the success of a young high-tech GovTech startup?*" – has not been further investigated. However, the relevance of this question is out of doubt. Indeed, since all findings and interpretations (that address RQ1 and RQ2) are the result of a descriptive analysis, future research should incorporate these considerations into an econometric model (Milano & Murrieri, 2019), in order to test whether each of these dimensions has an impact on startup performances, and in which direction, *ceteris paribus*. In this way, further researches, through comprehensive analysis, should update the work to enhance the reliability of our outcomes and so, on the whole, enrich the knowledge in the GovTech field. Therefore, the thesis represents a valid source of inspiration for several related in-depth studies that may carry on the investigation of this emerging sector, which is still largely unexplored.

Chapter 5 - CONCLUSIONS

In an always changing environment, where the diffusion of information and communication technologies pervades and affects many contexts of the society, and where digital innovation creates a multitude of several opportunities and challenges for private sector, it is undeniable that public sector requires urgent and deep changes to keep up the pace of digital transformation and guarantee both an effective and efficient service to its stakeholders. Indeed, private sector, which can be considered as the pioneer of the technological development, is exploiting this innovative wave by transforming the way in which it creates and delivers value to the market. At the same time, citizens are embracing the use of digital technologies, transforming their habits in everyday life, thus encouraging the way in which they interact with society and enterprises. In this context, however, innovative digital solutions and services in public administrations are still missing. Moreover, the socio-economic impacts and benefits that could originate from the adoption of innovative eGovernment services are enormous. That is why GovTech, despite being largely unexplored, is a hot topic which is gaining momentum and it will play a central role in the future. Even more so, considering the COVID-19 pandemic situation, public administrations around the world need to accelerate the adoption of eGovernment services to enhance the way they interact with communities. In fact, if on one hand we are living in a medical-health emergency, which is compromising the socio-economic performance of countries worldwide, on the other side, public institutions should understand the strove of different opportunities that can rise from this situation. With an easy example, managing and monitoring the healthcare system would be much easier if PAs had developed effective digital tools to facilitate the rapid exchange of data and information with third parties and with each other public entities. So, without questioning that the actual pandemic represents a threat for the society (both considering its health and economic implications), from an innovation perspective this emergency might open the doors to undertake a digital breakthrough in the public sector.

In conclusion, for all these purposes, the thesis provides a persuasive overview of the GovTech international entrepreneurial ecosystem of startups, both describing its main features and suggesting successful factors. For this reason, the work represents a good starting point to become familiar with the argument as it offers a big illustrative picture

on the GovTech startup ecosystem and moreover, it acts as a springboard for further investigations and future researches.

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