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Defining the Market Potential of Industry Specific Drone Software

Case: Metropolia Innovation Hub of Smart Mobility

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The objective of this study was to define the market potential of industry specific drone software in the form of market analysis for Metropolia University of Applied Sciences, namely for the Innovation Hub focusing on Smart Mobility. The innovation Hub had an initiative to build a drone software for public sector use and the target of this study was to get information on the European markets in order to apply for funding and proceed with the initiative process.

The conceptual framework was based on the overview of the whole business environment including the cross industry factors defined as macro-environmental aspects, and the industry and its sub-aspects. Those were separated so that the macro environment analysis was decided to be conducted utilizing the PESTEL framework to identify political, economic, social, technological, environmental and legal factors affecting the business. Then market research was conducted as the approach for screening the industry, market and competitors.

Data was gathered through an online survey to prospect organizations and from well-known data sources such as publications of different EU organizations and industry insights. The data collected was interpreted to the form of market analysis organized per business environment dimension.

The outcome of this study is a market analysis to be utilized for applying for funding for the drone software initiative. The proposal contained market analysis including the key findings such as suggestions to revise the prospect segmentation and to evaluate possibilities for collaboration to deliver end-to-end solutions. The proposal also contained the consortium role suggestions to be utilized in the later phase of the initiative.

Keywords	Drone, Unmanned Aerial System (UAS), Market Research

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1 Introduction

1.1 Overview

Metropolia University of Applied Sciences Innovation Hub focusing on Smart Mobility has an initiative of a drone software specific to public sector usage. One concrete step to get this initiative from idea level to actual implementation project is to do market analysis to identify capabilities and limitations towards European markets. Based on this analysis there is a plan to apply funding for starting the project and the development of the software.

1.2 Business challenge

Utilizing drones in business is getting more and more popular because of technological progression and identification of use cases where drones can be seen as an advantage. Where this might have started with simple fit-for-all devices, nowadays this is about to change as we can see from news and media. Drones can be designed to lift and carry heavy items between locations or those can be equipped with powerful cameras or other tools of measurement to provide data for people to do their tasks remotely. Dull repetitive tasks, danger zones, hard to reach locations or other kinds of areas needing monitoring or surveillance are just the beginning when thinking of utilizing drones to replace human and automate activities.

Whenever planning to enter a new market it is wise to do research on the components of the surroundings. Being aware of the competitive environment including potential customers, rivals with competing products and other forces around oneself can make a difference when trying to succeed.

Metropolia Innovation Hub is planning to start a project which would focus on delivering an industry specific drone software for European markets targeting security critical functions in the public (i.e. governmental and municipality) sector. For getting the needed resources for this project there is a need for getting external funding. And to apply funding for this, there is a need for a market analysis which will be done in the form of this study.

This study is to answer questions related to potential customer need, competition in the target market and which kind of forces are impacting the business so that it is possible to evaluate what is the market potential of new drone software. Based on the findings, also a proposal for roles to be included in the project's define -phase will be given.

1.3 Case company

Metropolia University of Applied Sciences is an educational institute operating in multiple different faculties and located in 3 different campuses around Helsinki metropolitan area. It has revealed a strategy for the upcoming decade in which phenomenon based innovation and digitalization are some of the core values. (Metropolia 2020a)

The innovation hubs in Metropolia try to enable new ways to learn and enable solutions for the whole society against modern day challenges in multiple global areas e.g. climate change, urbanization and technological capabilities. The idea is to get collaboration across different actors from multiple domains in surrounding society. (Metropolia 2020b)

The innovation hub related to this thesis is the Smart Mobility which covers phenomenon related to e.g. digitalization and urbanization and the capabilities of which these could deliver to businesses and other organizations. (Metropolia 2020c)

For this initiative, there will be established a consortium including partner organizations from relevant fields of expertise who will then proceed to build the deliverables of the project.

1.4 Objective and scope

The objective of this study is to find out the market situation for a drone software specializing in governmental use in Europe, analyze and estimate the potential changes in a couple of years to come and propose needed role(s) at the define -phase of the initiative. The Smart Mobility Innovation Hub at Metropolia University of Applied Sciences will then be utilizing this information in their funding requests towards related authority and later when determining the scope for developing the actual software.

The thesis will cover political, economic, social, technological, environmental and legal aspects including also a survey to potential example organizations in selected areas of Europe. These will be mapped into specialist roles needed in the define -phase to build and empower a holistic work group which is able to take complex external world into consideration when designing the software.

Outcome of the study will be a market analysis and findings based partner role suggestion which can be utilized when applying for funding and starting to gather consortium for the project.

1.5 Key Terms and Concepts

Drone is commonly referred to as an aircraft which does not contain a human pilot onboard. It's the most visible part of the Unmanned Aerial System (UAS) which includes multiple different parts depending on the purpose it is designed to.

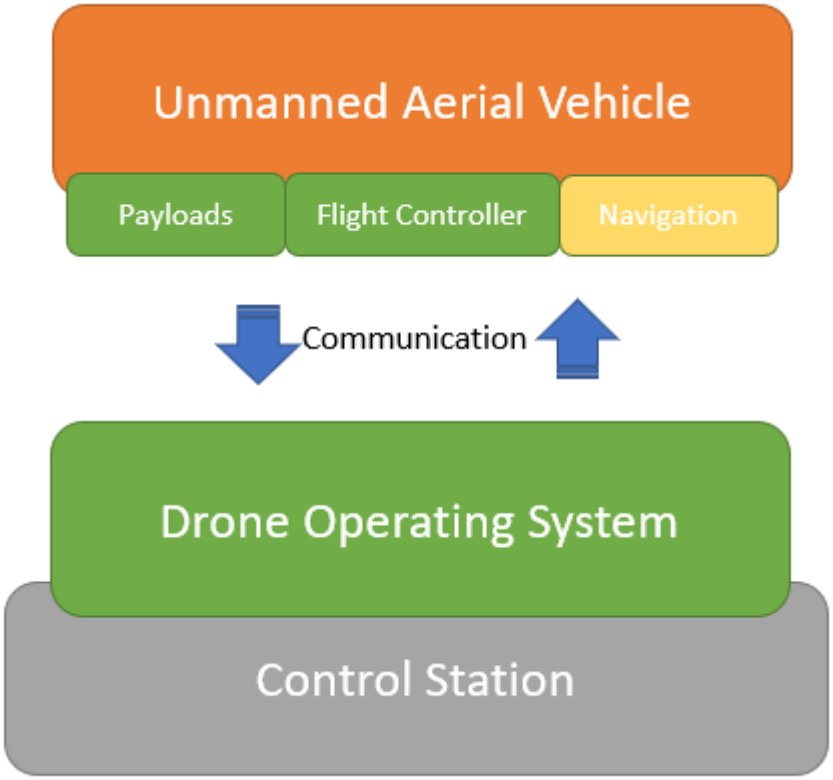

Figure 1. High level components of Unmanned Aerial System (UAS)

Figure 1 is illustrating the components of the unmanned aerial system at a high level. Due to the short history of the industry there are some variations in defining different terms components but in this study, following definitions are used.

Unmanned Aerial Vehicle also known as a drone is an aircraft without a human pilot inside. It can be remotely piloted or totally autonomous.

Payloads refer here to sensors, apparels and tools needed for the mission drone is designed for. This might be electronical like cameras, wi-fi hotspots or it might refer only to cargo.

Flight Controller or flight computer is the intelligence inside an aircraft translating operator's commands to motors (related to flight) and payload (related to mission) and sending needed response back to the operator or operating system in case of automated flight.

Navigation is relevant when trying to reach set targets and returning back to home base. The most sophisticated drones use a global navigation satellite system (GNSS) for navigation and at the other end of the spectrum this is done by the operators (pilot) visual perceptions.

Communication between the control station and the vehicle is done via radio waves. There are different solutions utilizing e.g. Wi-Fi, cellular or satellite networks depending on the range the drone is supposed to cover on its mission.

Drone Operating System refers to a software platform or application from where the flying instructions are given and where the data received from the device and payloads is reported to. There might be external (e.g. mobile) apps connected to manage drones remotely as well.

Control Station can be just a computer which has a Drone Operating system installed to or in some cases, it can be specially designed docking station for the drone.

The Software part, being the components color coded as green in Figure 1 (Drone Operating System, Flight Controller and Payloads), are in the focus of this study.

2 Research design

2.1 Research approach

The research can be defined as applied empirical research which starts with defining the business problem. Then it will follow the gate approach in use at the Metropolia University of Applied Sciences with minor changes due to the nature of the assignment as illustrated in Figure 2. This model will structurize the thesis and each part of that can be seen as the logical next step for the previous one.

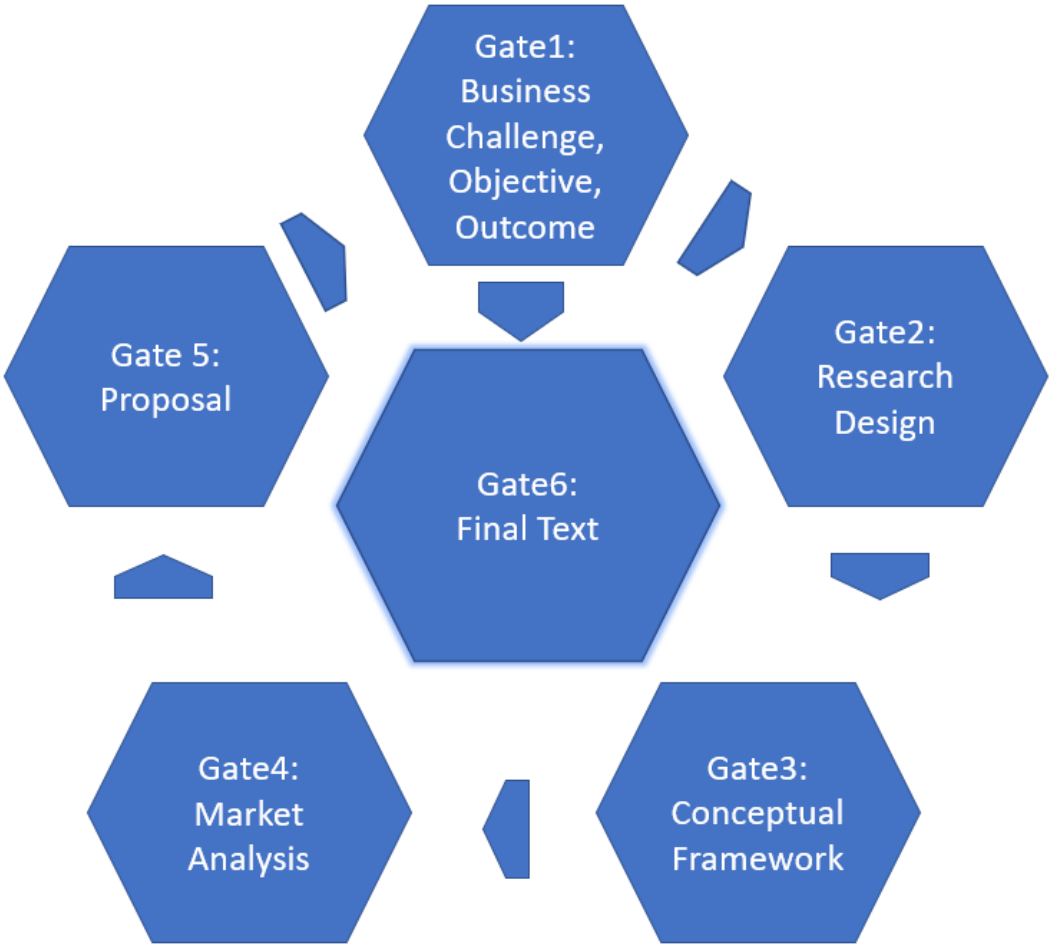

Figure 2. Gate Approach used in Metropolia during year 2018 with assignment specific modifications

Gates 1-5 can be seen from the section headings and the Gate 6 is completed once the thesis gets approved and published.

2.2 Research process

The gate approach used in constructing this study will be mapped into the design process valid for the Innovation Hub project designing the drone software platform this study gives insights to.

In general, when looking at the Innovation Hub software project as a whole, it can be seen to cover all the phases in the Double Diamond design process by the Design Council. The Double Diamond, shown in Figure 3, is a design process, or framework for innovation, where the idea will get researched data to gain understanding on the business problem or objective. That will be followed by the Define phase where the detailed to be definitions are collected from the insights delivered in the previous phase. It will include iterative discussion between the focus group and result identifying the main challenge for starting the development activities. The next phase is Develop which includes testing different approaches, building service blueprints for visualizing the concept and prototypes for modelling possible final version of the outcome. The final phase is Deliver which includes phasing the outcome deliverables into viable features, testing and evaluations to enable better success in future projects to come. (Design Council 2019)

This study will partly cover the Discover phase of the Innovation Hub initiative in terms of broadening the horizon from Finland into European market. The conceptual framework will give the literature backbone to find methods and components relevant to conduct market analysis in European level. Based on that framework, the market analysis will then complete the Discovery phase conducted as a secondary research to support innovation hub initiative by revealing the findings from the targeted market completing the market analysis.

The research is made by using both qualitative and quantitative methods. Existing literature and publications from the industry will play a major role due to the nature of the context being relatively new. Lastly the survey among the target group will be done to get more understanding from the potential customer base. Existing knowledge is to be gathered mainly from academic journals.

This will then be complemented by the business requirements and a proposal for a focus group i.e. consortium roles which can be taken into consideration when building up the group of experts in the project.

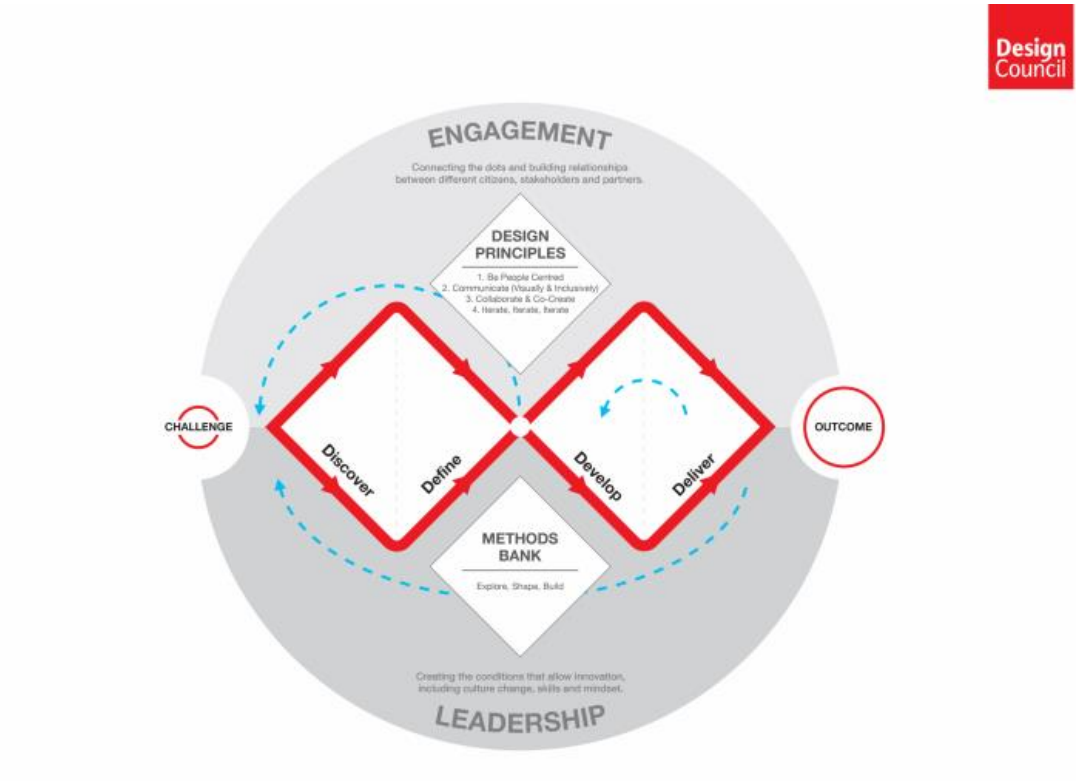

Figure 3. Double Diamond Model of the Design Process by Design Council (2019)

This thesis will cover Double Diamond's Discover phase design methods such as **Secondary Research** in form of market analysis to European drone market, **Choosing a sample** being defined prospect organizations within project scope and an **Online survey** which will be addressed towards this sample defined earlier.

The Define phase will continue by the Innovation hub outside this study, but with a suggestion for resources based on Discover phase findings.

2.3 Data collection

This study includes the market research for to be designed drone software for European market. Data is collected for evidence through existing materials from multiple publicly available sources and through self-produced materials in a form of web survey. These together will build a market analysis followed by a proposal to stakeholders.

2.3.1 Industry and market analysis

The first part in data collection is conducted by getting to know the industry and the European market as the target market of the initiative of Innovation Hub. The major sources for information are the publications of EU institutions and commercial actors reporting phenomenon related to the drone industry.

This will be enriched by self-produced material in the form of a web survey. The objective for the web survey is mainly to prove existing information gathered outside this research to be valid.

While the innovation hub has already quite a good understanding of the demand and potential for the industry specific drone software at the early stages of the study, there is still a great interest in finding out the situation in the rest of Europe. For getting more information on this it was decided to reach out to some potential users, or customers if you will, to see whether the maturity in using drones in other parts of Europe is anywhere near the same as in Finland. The main targets are to be identified and questions formed in order to get answers easy to analyze against existing knowledge from Finland. If the findings would follow the situation in Finland, the initiative could be widened to the rest of Europe as well.

Table 1. Survey questions mapped against main targets.

Question	**Main target**
Are drones used in European public sector?	Can we see the rise of drone usage in Finland to be unique, or is this trend applicable in the rest of Europe as well?

Are the ones using drones utilizing the software platform provided by the UAV manufacturer?	Are organizations using drones starting to seek fit-for-purpose solutions or do they limit their use cases based on capabilities of generally available payloads?
Are the ones using drones concerned on the security aspects?	Would there be an advantage to offer drone software made especially with security aspects in mind?
Would there be any interest in an industry specific drone software platform?	Does the public sector see their use cases any different than the private sector? Is there any potential in specializing this market only?
Would there be more interest on European service providers over the others?	Many of the service providers currently are US or China based. Would there be an advantage in case considerable contestants from Europe would be available?

These main targets seen in Table 1 are in line with the initiative objective and tries to answer the question: Would there be any interest in a secure industry specific modular drones software platform made in Europe?

Since there is no predefined list of survey attendees across Europe, it was decided that the author will go through all EU countries and their major cities (capital or relevant) with small exceptions being including Norway and Switzerland from outside since their size and relatively high gross domestic products (GDP) figures giving some ability to proceed with new technological innovations. The mandator also decided to exclude Malta and Luxembourg due to their small size and Slovakia and Slovenia due to similar ethnographies in surrounding countries included in the survey (i.e. Croatia, Czech Republic).

The decision on survey recipients was to select one from the government and one from a city or municipality organization. This will be searched by going through each governmental and city/municipality Websites trying to identify the right departments of the target organizations for this topic. In case relevant direct individual contact detail is published, he/she will be selected as a recipient. In case there will be no direct individual

contact published, the request for participation is to be sent to the switchboard either through general contact form with guidance to reply with a participant details or by asking to forward it to authority for the relevant field e.g. in logistics, police/fire department or health care.

Survey questions are to kept really limited in numbers and high level in technical details as there will no information on if we reach skilled or motivated people to answer in long and in depth surveys. Respondent anonymity will be clearly mentioned in the survey invitation to increase the response rate.

The survey is to be built so that first the drone usage (or plans to use) is to be identified and then in case of positive answers, more questions will be revealed. For those who have no plans on drones, the survey will be concluded quickly.

On top of getting the insights for our main goals there will be some additional questions in the survey as a nice-to-know basis in case it might come relevant or those would reveal some other angles to investigate later. All of the survey questions can be seen from Appendix 1 and the raw data including the answers received from the Appendix 2.

2.3.2 Macro environment analysis

The second part in chapter 4 includes the PESTEL framework and data collection to each of the dimensions included. In this part the generally acknowledged and relevant sources like EU, Eurostat and GSMA are used to get holistic and credible information to support the proposal.

2.4 Validity and Reliability

The conceptual framework used is common in market research studies and the secondary data collected against that in current state analysis is gathered from generally acknowledged sources and are publicly accessible. This information is then enriched with the primary data gained through a web survey. Analysis is based on the data collected from external sources and documented questionnaires including the target organizations, questions and response data aggregated.

3 Conceptual framework

The conceptual framework will first describe the business environment where organizations are operating by identifying the logical layers impacting it. It will differentiate market research from marketing research and then define market research in a more detailed level as a method of analyzing the industry and market layers from the business environment. Lastly it will explore the use of the PESTEL framework as a way to distinguish the macro-environment factors affecting the market.

3.1 Business environment

Running a successful business is not something that can be done without understanding all the related aspects affecting either directly or indirectly to oneself. These can be seen from Figure 4 as illustrated by Johnson & Whittington & Scholes & Angwin & Regnér (Exploring Strategy: Text and Cases 2017, 33).

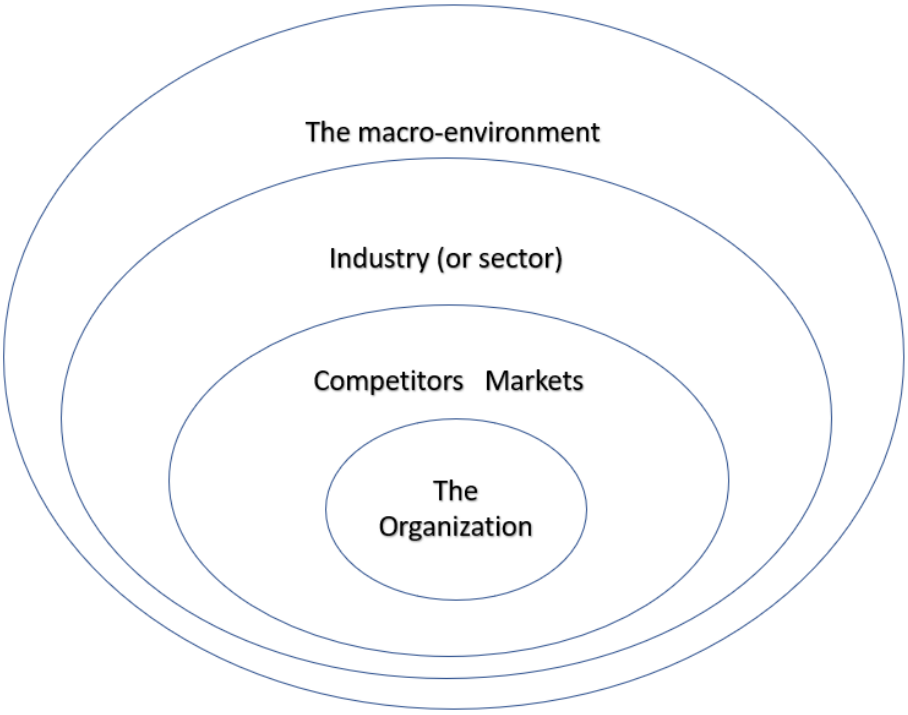

Figure 4. Layers of business environment (Johnson & al. 2017)

The outermost, Macro-environment layer consists of all those environmental factors which are to be affecting a vast group of organizations and industries and sectors. The

next layer is the industry environment which consists of those organizations at the same industry which might produce similar kinds of products or services by other means and so not being classified as direct competitors. Those ones are then at the competitors layer operating in the same markets with the organization itself. (Johnson & al. 2017, 33)

Since the organization and the product to be are unknown at this point, the focus in the upcoming chapters will be in understanding the surrounding layers to understand better on which kind of environment those are being developed. Innovation hub will then later, in case findings are seen to be favorable, map these against the organization and software to be developed.

3.2 Market research

Industry and market analysis will be conducted by a means of market research. It is important to understand the differences between the market research and marketing research although those do include similarities. The Entrepreneur.com defines the market research as following:

> *The process of gathering, analyzing and interpreting information about a market, about a product or service to be offered for sale in that market, and about the past, present and potential customers for the product or service; research into the characteristics, spending habits, location and needs of your business's target market, the industry as a whole, and the particular competitors you face.*
> *(Entrepreneur.com.)*

Marketing research can be seen as more holistic and which is covering the market research as a part of it. This is how the difference is seen by Marketing Insider:

> *The basic difference is that market research is concerned with investigating markets (customers, consumers, distribution, etc.) while marketing research is concerned with investigating any issues related to marketing (consumer behavior, advertising effectiveness, sales force*

effectiveness, etc. as well as everything contained in market research) (Marketing-Insider 2020)

This is accompanied by Shopify which states that the value of market research will be in understanding the state and changes in the industry, customers and legislation in order to better focus on the resources and efforts in your business (Shopify.).

A good market research will deliver important outcomes to the company. It gives clarity and explanations to the problem for the personnel and decision makers and lastly, it enables changes based on data out of which the insights are given. (Qualtrics 2020)

Conducting a market research can be one single activity or constant process during the company lifecycle. Based on the findings, companies can make more precise business decisions e.g. on launching a new product or service, entering to new markets or making modifications to existing deliverables. It can be seen as a process with multiple steps as identifying the problem, defining the research design and data collection methods, collecting and analyzing the data and finally reporting the findings. (Kotler & al. 2017, 33) These will be explained in the following chapters.

3.2.1 Problem identification

The first step in the process should be the identification of the research problem. This can be extracted from either market symptoms or opportunities where symptoms are problems or changes the company is facing in its existing operations and opportunities are more to be described as potential which might be gained by starting some new operations. (Sarstedt & Mooi 2019, 13)

Once the problem has been identified, it can be classified into three different types. “Ambiguous problems” are those where the understanding of the issues to be solved is very limited. “Somewhat defined problems” are the ones where the underlying issues are known but the relationship of those are still a mystery. In “Clearly defined problems” tend to be more related to symptoms, where the relationships are known as well but there is still lack of knowledge on how to optimize this. (Sarstedt & Mooi 2019, 13)

3.2.2 Research design in market research

The research design in market research is linked to the research problem. In case the topic is still un-researched in a particular context the research design will be exploratory research where the objective is to explore the situation and solve ambiguous problems. Through this kind of research it is possible to generate hypotheses, identify and refine future research problems and set priorities and rescope planned activities. Descriptive research is about describing the topic in question. It can be the logical next step to exploratory research where the *ambiguous problems* are identified although not mandatory. It can be used to describe customers and competitors and define and segment market sizes. The research design suitable for *clearly defined problems* is the causal research which is used to understand the relationship between variables e.g. what would happen to variable A in case of variable B would be altered. This causal research is the least used out of these three different research designs and is mostly relevant for studies related to symptoms. (Sarstedt & Mooi 2019, 13)

3.2.3 Methods of data collection in market research

Data collection methods are the ways to collect empirical data. While there are many ways, it might be that all of those are not suitable for the specific purpose behind the research.

Primary data is something the researcher will gather and collect by himself. There are two ways to gather primary data. Either by observations or by asking. The characteristics of the primary data are that it is recent and fit for purpose but can be expensive and takes lots of resources to gather. (Sarstedt & Mooi 2019, 29-30)

Observation is a method where the researcher makes notes on the behavior of the target group. There are multiple ways to observe the target group with the common factor being that the observer is silent in means of not distracting the targets in their activities. This could be done e.g. by eyesight and notes or by delivering test products to the real market to see what kind of behaviors it will trigger. (Sarstedt & Mooi 2019, 58)

The other way to gather primary data is by asking. Means can be in-depth interviews, focus groups or surveys. In-depth interviews and focus groups are done by interviewing

either single or multiple respondents and can result in both qualitative and quantitative data. The latter one is possible in cases where the sessions are well structured in terms of question and answer categorization to get comparable data out from different sessions. Surveys can be conducted in multiple ways and is quite scalable and hence a useful method when the target group is big in quantity. In case of a small target group it might be best to administer the survey via more time consuming in person or telephone interviews which can result in high response rates and reveal more insights outside the predefined questionnaire. For larger target groups the web survey is likely the best option since it is quick to set up and easy to spread to a wider audience. (Sarstedt M. & Mooi E. 2019, 58-80). One must keep in mind that web surveys where the researcher does not have any previous relationship to the target group might result in relatively low response rates (Surveymonkey 2020).

Secondary data is data already available, generated by someone else, possibly aimed for a different purpose and it might be generated well in advance before the research in hand. The characteristics of the secondary data are that it is usually bigger in sample size, has more authority and is quick to access. On the other hand, it might be relatively old and not fitting precisely to the problem or include data errors not shown to the interpreter.(Sarstedt & Mooi 2019, 55-57)

These secondary data sources can be company internal in forms of existing research studies, company records on area in focus or e.g. sales reports where relevant. External secondary data can be gathered from multiple sources relevant for the research. These include but are not limited to publications from governments, trade associations, research and consulting companies, literature databases in forms of printed and online materials. (Sarstedt & Mooi 2019, 55-57)

3.2.4 Collecting and analyze the market research data

In this study the primary data is collected through the survey towards prospect organizations in the target market and that will be accompanied by secondary data gathered from external sources by utilizing the PESTEL framework as a strategic tool.

The primary data collection via survey starts with setting the goals for the survey which is the basis of getting the answers this survey data can later answer to. One must then

decide the type of survey fitting the purpose and start designing the questionnaire items. Understanding the item relevance within the respondents is crucial to get answers. Those should also be such that are feasible to answer without doing offline work distract participants from the survey forms. Thing to remember also is that if the questions are not relevant or the respondent is not willing to answer those, they might give up and refrain from returning the survey. In order to gain higher response rates it might be better to favor close-ended questions which will give the respondents the options for answering unlike in open-ended questions where they need more effort to compile an answer. (Sarstedt & Mooi 2019, 61-64)

Collecting external secondary data from various external sources can be a huge task due to materials available and accessible via the internet. Once a data source is located one should make an assessment on the validity of the data. It might be a generally trusted source which, if feasible, might be backed up with data from other sources giving the result which can be seen to be ending in the same conclusion.

3.2.5 Reporting the data for analysis

The data gathered needs to be illustrated in meaningful forms. Data in quantitative form is logical to present in charts, tables and graphs where qualitative data needs to be summarized in other means to make it feasible to analyze.

3.3 Macro-environment analysis

The outermost part in the business environment is the macro-environment layer including those factors affecting multiple industries. To widen the industry and market analysis also this layer will need analysis to get the holistic view on what can be expected when establishing a new business.

Interlinking aspects in the competitive business environment which need to be kept in mind can be divided into six great factors of the macro environment; demographic, social-cultural, natural, technological, and political-legal (Kotler & Keller 2016, 95). Each of these can be analyzed with the PESTEL framework which is a tool to monitor these factors illustrated in Figure 5. It has some small variation to Kotler's theses in factors but covers the same landscape.

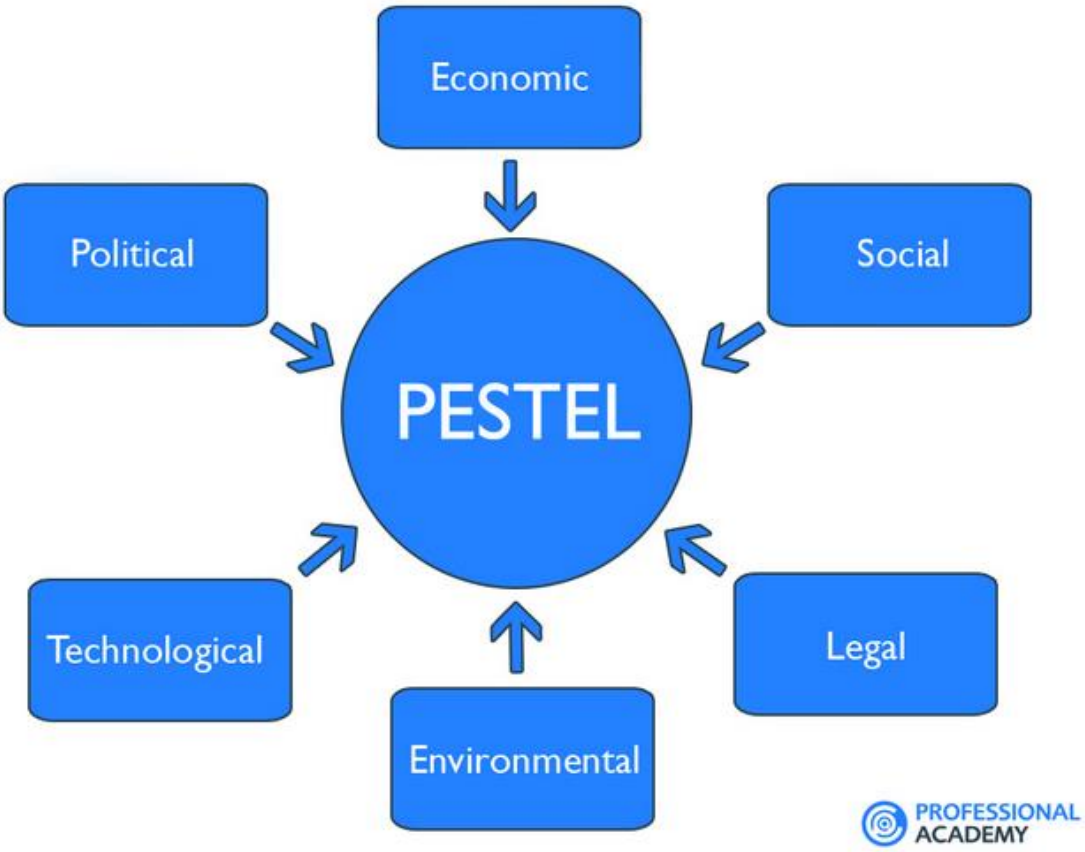

Figure 5. PESTEL Factors visualized by Processional Academy (2020)

Each of the factors has relevance to the business and it would be beneficial to evaluate those regularly. PESTLEAnalysis.com (2016) suggests that following topics would be investigated per factor, that being e.g.

Political - decisions & policies, taxes, lobbying and corruption.
Economic - economic outlook, rates, inflation and taxes.
Social - lifestyles, attitudes, social classes, population and ageing.
Technological - Tech innovations, solutions availability and automation.
Environmental - climate & weather, recycling & waste, energy and pollution.
Legal - Regulation in multiple areas, laws and patents.

4 Market analysis for drone software specific to public sector

In this study the market analysis is mapped to the Discover phase of the Double Diamond approach. In this phase the existing world is investigated and findings will be made available for the Double Diamond's Define phase of the design process. Here the content covers general description of the industry followed by the market and competition findings. Then there will be findings in terms of PESTEL framework and light web survey to prospect organizations identified.

4.1 Industry Description

Drone industry is growing due to technological evolutions towards automation and finding new use cases to utilize drones. As expected by the Drone Industry Insights, the market revenue is getting higher in all of the continents with compound annual growth rate (CAGR) being over 13% within the next 5 years ending to be up to 43 billion US dollars at the year 2025 and Europe having multibillion US dollars growth estimations. (Drone Industry Insights 2020a)

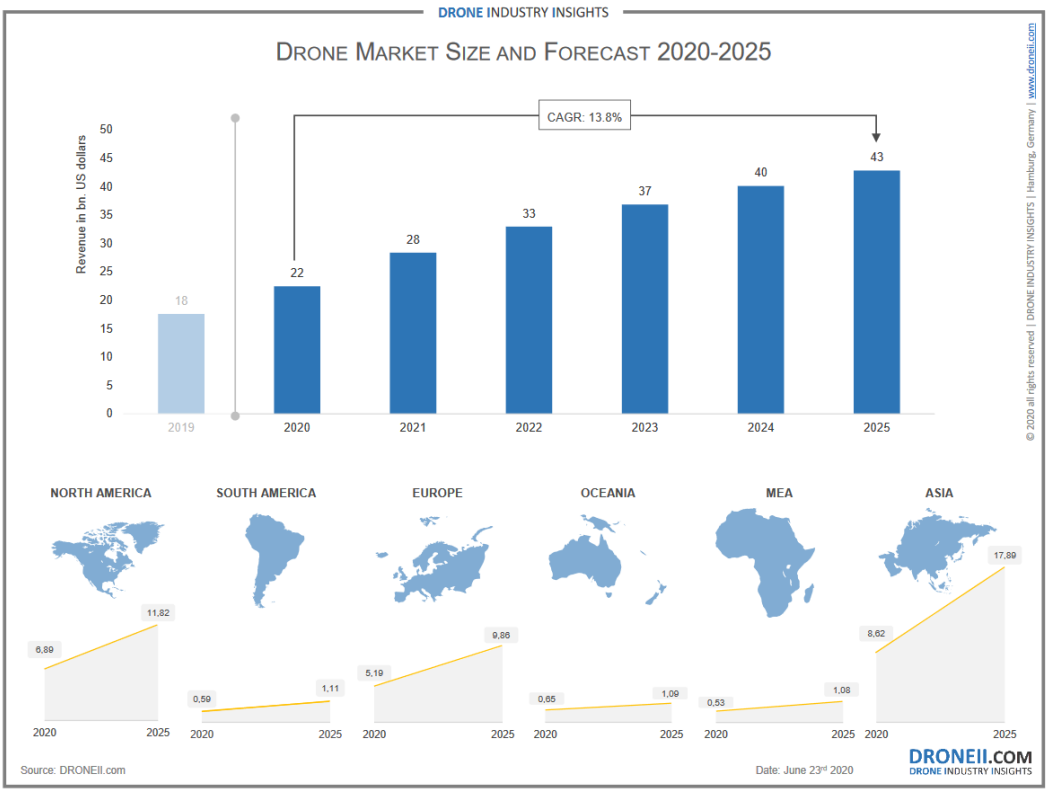

Figure 6. Drone Market Size and forecast by Drone Industry Insights (2020a).

There are lots of different sub-segments in the industry due to the multiple components included in the Unmanned Aerial System and those can be classified under three major elements; Hardware, Software and Services. When Drone Industry insights conducted a survey with close to 700 respondents from these sub-segments, the results show that they consider the top 5 most important market driving roles to be (1) end-to-end solution providers, (2) rule making authorities, (3) drone manufacturers, (4) drone-as-a-service providers and (5) software manufacturers. The role of drone and software manufacturers have been decreasing when comparing the previous years where the roles of rulemaking authorities and drone-as-a-service providers has increased. (Drone Industry Insights 2020b)

Drone markets can be segmented into multiple sectors for example based on use cases and target customer groups. SESAR (2016) defines these as following

- Military - payload variations based on mission, e.g. air strikes, and surveillance
- Government and Commercial - payload variations based on mission, e.g. delivery, situational awareness and lifting tasks

- Leisure (consumer) - mainly equipped only with high resolution camera

While the market can be classified with these three segments, manufacturers still tend to serve more than one segment if applicable.

The consumer segment is filled with easy-to-operate devices designed for consumer use. In many cases these drones are used by hobbyists but in businesses as well before scaling up to the next level due to more complex use cases.

In the commercial segment the users are corporations, cities, institutions and civil governments. Often use cases are related to reducing or replacing manpower to get value in the areas of construction, agriculture, insurance/claims, offshore oil/gas and refining, police, fire and coast guard.

The government, or military segment is specialized in defense and military use cases and is starting to be quite isolated from the previous two markets. Here the drones will enable cheaper and safer options for manned aircrafts which can be also significantly smaller in size as the technology evolves. (Goldman Sachs 2016)

The drone industry is filled with actors in all of the areas from component manufacturers to end-to-end service providers and many of these companies are small in size and young in age (Drone Industry Insights 2020c). Some of them will prosper and some will not and it is clear that new entrepreneurs will come and try their chances since the industry is growing as seen from market forecast by Drone Industry Insights (2020a) in Figure 6. Due to the relatively young age of the industry and still developing technological capabilities this can be predicted to last still for some time but as it is seen in many other industries, once the saturation starts to develop, it is likely that companies will continue their growth by buying direct and indirect rivals out from the market.

4.2 Target market

As Europe being the scope of this thesis let's look at the insights of this region especially.

It is predicted that in Europe drone related revenue will close to double during the next 5 years (Drone Industry Insights 2020a). This is accompanied by European Commission

which predicts that the drone industry will directly employ more than 100 000 people within the next 20 years (European Commission 2020a).

European market is and will be more and more regulated. European Commission has launched an initiative The Single European Sky (SES) to watch over and harmonize air traffic in Europe. Operating under this initiative, an entity called SESAR coordinates and concentrates all EU research and development activities in the area of Air traffic Management. This will set and suggest capabilities and limitations to players in the market.

SESAR has also published an European Drones Outlook Study (SESAR 2016) which will look all the way to year 2050. Key takeaways from that are following:

- Expectations for certified systems to borders, maritime surveillance and other governmental missions
- Fleet sizes will grow due to new use cases
- EU level regulation and technology decision and guidelines to be expected by 2026 in order to create an ecosystem for creating an EU wide single drone market
- Expectations for an EU wide unmanned aircraft traffic management (UTM) system, which will support both manned and unmanned flights, to be built.

It seems clear that Europe will try to be seen as a single significant player against China and USA which have companies dominant in their own specialty areas like consumer and defense related products.

It will be easier to adapt to regulation when the single market approach by European Union gets matured and overrides the differences within each of the member states. And since Finland being the home country for Innovation Hub, the solution suitable for Finnish market should be easy to deliver also to the rest of Europe as well since the regulation matches. This together with the predicted rise of use cases and fleet sizes will likely also cause some pressure in getting needed personnel to develop drone related software.

While the EU wide unmanned aircraft traffic management (UTM) system is already at the horizon, all the activities should be designed keeping that in mind. Aligning the design

with this might give some advantage against the players already in the market who might need to make some changes to comply with the new systems.

4.3 Competition

There are lots of players in the drone industry and it is possible that the still unpresent big multi industry IT giants might be interested to join in case favorable outlook continues. It should still be highlighted that in this fragmented market, the sub-segmentation and specialization to different use cases plays a huge role when defining competition. Roughly, the industry can be divided into three main segments being Hardware, Software and Services and each of these having multiple sub-segments being e.g. drone platforms, passenger drones and components in Hardware; flight management, navigation and data analytics in Software and drone-as-a-service, training and retailers in Services segment (Drone Industry Insights 2020c).

Competition in this particular domain can also divided into those sub-segments defined; to the end-to-end solution providers which always deliver their own device and software platform to operate with and to software manufacturers who have provided a software to build solutions utilized either by single or multiple different UAV brands either by building on top of some end-to-end solution or by utilizing emerging open source infrastructure providers now trying to consolidate the market.

Competitors can be categorized into direct, indirect and other potential competitors based on the market commonality and resource similarity. In this context the market commonality is high when the identified rival is serving similar customer needs and resource similarity is measured by the similarity of the output of one's deliverables. (Bergen & Peteraf 2002, 157-169)

Since the specific details of the end result of Innovation hub initiative is only to be defined, it is yet impossible to name any direct, indirect or other potential competitors. But to get some perspective for later phases in the initiative, in 2019 there were more than 29 drone software companies identified themselves to be focusing on drone operating systems, more than 200 end-to-end solution providers and at least 4 open source projects in the industry. (Drone Industry Insights 2020c)

The vast number of players and technologies are due to the relatively short history of the industry and many of the companies are small in personnel and turnover. In future, it can be expected the market will be saturated once customer organizations have identified and harnessed their most relevant operations to be handled with drones resulting in natural growth of the market to be slowed down. At this point some of the players will start to increase their market share at the expense of others and small but efficient operators are likely to be bought by the bigger organizations.

Specialization to specific areas looks like a good idea to differentiate in the market but it will come with downside if that limits the customer segmentation more than anticipated. The risk in focusing only to public sector as a customer is based on two findings from CompTIA study (2019) on US market:

1. The reported growth opportunities and anticipated utilization of drones seem to be quite industry free, meaning that those are likely to be scenarios which are operated in private and public sectors. These being (1)Mapping and Surveys, (2) Inspections and (3) Security, Surveillance or monitoring.
2. The drone management model is turning towards the path where the organization using the drones are buying the management at least partly as a service.

If the anticipated use cases are valid for the private and public sector and the drone management model is outsourced to drone service providers, it is worth considering whether to see initiative's customers to be these drone service providers instead of the public sector directly.

When defining the customers then it is possible to start identifying the direct and indirect competitors as well. It is likely that there could be two alternative routes to follow. Either to act as a software provider for the public sector or being a part of some wider ecosystem which will provide drone-as-a-service management models for large customers.

4.4 Customers

The initial customer segmentation for the drone software was set to be European public sector including governmental and municipal organizations which have operations in fields where drones could be utilized. The organization structure and purchasing

processes vary between the European countries as well between the municipalities within the countries so more detailed investigation is needed in the later phase of the design project to identify the most potential organizations. Even without this exact list it is possible to map potential functions from the public sector to use cases for identifying prospects.

Table 2. Use case mapping to functions in public sector

Use Case	**Function / Organization**
Border Control	Customs, Border force
Construction	Engineer's office
Lifting & Delivery	Postal office, Engineer's office, Hospitals, Nursing homes
Mass events control	Police departments, Fire departments
Rescue	Fire departments, Emergency departments
Situational awareness gathering	Aviation authorities, Police, Fire departments, Customs
Traffic control	Aviation authorities, Police departments, Customs

Table 2 lists the use cases to potential functions in prospect organizations.

4.4.1 Survey

The survey was sent to 45 recipients (Appendix 1), seen as prospects, on 1st of October 2020 and was available until the end of 18th of October 2020. One reminder email was sent to recipients in countries not yet answered on 14th of October 2020.

At the end the survey resulted in 7 answers making the response rate as 15,6% which still is quite realistic for surveys sent to recipients to which one does not have any existing relationship (Surveymonkey 2020). Out of these who responded, 4 (57,1%) were utilizing drones in their organization and to these we will next have a look reflecting answers against the main targets set for the survey.

As illustrated in the Table 1 there were five main targets for the survey and the responses can be linked to those as follows.

Main target 1, "*Can we see the rise of drone usage in Finland to be unique, or is this trend applicable in the rest of Europe as well?",* was answered via question shown in Figure 7 (Appendix 4). A slight majority of all the respondents are utilizing or planning to utilize drones in their operations.

Main target 2, "*Are organizations using drones starting to seek fit-for-purpose solutions or do they limit their use cases based on capabilities of generally available payloads?",* was answered via question shown in Figure 8 (Appendix 4). All of the respondents who are using or planning to use drones have plans to use software provided by someone other than provided by the drone (UAV) manufacturer.

Main target 3, *"Would there be an advantage to offer drone software made especially with security aspects in mind?",* was answered via questions shown in Figure 9 and Figure 10 (Appendix 4). All of the respondents who are using or planning to use drones have concerns related to data security when using drones and have plans for related security assessments.

Main target 4, *"Does the public sector see their use cases any different than the private sector? Is there any potential in specializing this market only?"*, was answered via question shown in Figure 11 (Appendix 4). Half of the respondents who are using or planning to use drones would be interested in an industry specific drone software platform.

Main target 5, *"Many of the service providers currently are US or China based. Would there be an advantage in case considerable contestants from Europe would be available?"*, was answered via question shown in Figure 12 (Appendix 4). All of the respondents who are using or planning to use drones would be interested in European over non-European software platforms.

4.4.2 Summary of survey results

It can be assumed that this kind of approach to reach recipients might not result in a very high response rate since the difficulty to reach correct recipients, the organization might be in a situation in which the topic is not relevant at this moment or participating in a survey organized by some unknown and foreign actor might seem phishing. On top of this, it is more than likely that all of the requests sent did not reach the recipient due to spam filter settings in the receiving end.

Main target 1 was to find out if there are similar drone usage intentions in the rest of Europe as the innovation hub has been observing in Finland. There were not any answers from Finland in this survey but among the answers received we can see that potentially similarities can be drawn to remaining Europe as well. On the other hand it is clear that Europe should not be seen as a single homogenous area proceeding at the same pace in this topic since there are lots of variation within the countries and cities in terms of culture, geographics, and local legislation which might have causing locations specific barriers or enablers for this industry as well as to any others. More detailed surveys would be needed to get more accurate data on whether the respondents even understand the potential of the drones.

Main target 2 results being 100% on can be interpreted in multiple ways. It could be due to the small amount of respondents or misunderstanding the question. The easy way to start using drones is to purchase these leisure drones which by a default are using software delivered by the drone manufacturer and then potentially leveraging the use with third party payload apps on top of the existing drone operating system. Either the respondents have understood the question so that these payload apps are seen as software platforms or they have already passed this early phase and are actually already using or planning to use commercial drones where the software platform provider is someone other than the UAV manufacturer. This latter option would be beneficial for the initiative in respect of the target market being in some extent matured enough to consider separate software to be used in drone operations.

Main target 3 answers were logically inline as concerns on data privacy should lead to actions, investigation and then fixing the issues identified. Where the results can be seen as expected since the grown understanding of data security which is important to all businesses and industries, it also supports the idea of a data secure software platform

for this industry. The market is aware of the subject and is willing to execute assessments to make sure no breaches will happen.

Main target 4 can be seen as the most complex one to interpret since the results are 50% interested, 50% not interested in industry specific software platform. Based on the knowledge that all of the respondents are using software platform provided by someone other than the UAV manufacturer, it seems that either the platform provider has not succeeded as well as expected or the software features are lacking something relevant from the subscriber point of view. With this sample it is impossible to make sufficient conclusions on the reasons behind the answers.

Main target 5 was to get an understanding if there would be some political or other intangible aspects involved as there is already US and China rivalry in many sectors. It's likely that public sector tenders need to be transparent and open but there still might be some wormholes which can lift certain players above others. At least from applicable law in contracts point of view, collaboration between European counterparts can be seen as an advantage. Although the sample here is very limited, this will support the innovation hub plan of targeting to European markets.

In respective to the main goals set, the results were positive and will give support in proceeding with the initiative. Due to the limited number of recipients, these figures and an analysis derived from those cannot be seen as definite but those will support the hypothesis on rest of Europe acting similar to Finland where initiative has already more solid understanding on potential demand for this kind of drone software specific to the public sector.

4.5 Macro-environment

The PESTEL approach was used to identify current status and phenomenon within each of the dimensions surrounding the industry. Observations were done by searching articles and news stories relevant for the topic all the way from 2016. In upcoming sections all of the PESTEL dimensions; Political, Economic, Social, Technological, Environmental and Legal aspects are targeted by observatory actions.

Since the political and legal dimensions in PESTEL are in some parts overlapping, in this study those have been separated so that political dimension covers mainly industry specific aspects where legal dimension concentrates into more generic constraints of legal aspects.

4.5.1 Political

There are 27 countries and capital cities in European Union (EU) which all have their country specific variation in air traffic regulation. This is about to change when EU level regulation for UAS will become applicable at the end of year 2020. The details are in Regulations EU 2019/945 (on unmanned aircraft systems and on third-country operators of unmanned aircraft systems) and EU 2019/947 (on the rules and procedures for the operation of unmanned aircraft). All the existing authorizations and certifications given by the national laws should be converted into these latest by July 1 2021. (EASA 2020a)

The Regulation 2019/945 defines the 5 classes based on UAV dimensions and operations purpose as well as the baseline for operators from third-countries in the EU area. These 5 classes do not directly dictate anything towards software providers but are relevant e.g. when designing the equipment needed for the operation planned to be performed e.g. in terms of weight and dimensions. It also defines the status for the third-country operators who need to comply with EU regulation if they plan to enter the EU market. They shall apply recognition from the country they first intend to operate although the same applies for the operators from the member states as well. (European Commission 2019a)

This regulation is getting more concrete forms during the fall 2020 when the European Union Aviation Safety Agency (EASA) which is responsible for safety and environmental protection related to civil aviation, published a broker system for exchanging drone registration data among member states. At its first phase, it will enable single registration of drone usage to be valid in the whole EU making entry to the EU market easier from a registration point of view. The registration is for drone operators and certified drones for business purposes. This system will be built in increments and is aimed to be in full utilization during the year 2024. (EASA 2020b)

The 2019/947 is about operations and personnel related to UAS. It defines three main categories in which EU maps UAS operations being Open, Specific and Certified and requires UAS operators to register themselves in case operating in Open category with certain specifications and in all cases in Specific and Certified categories where the operations include risks to privacy, protection of personal data, security or the environment. Operating in the Certified category requires also a certification to be acquired from an applicable EU official in a member state. And where it gives UAS operators the possibility to apply permission received in one member state to others as well, It also gives member states the possibility to prohibit or limit UAS operations in their area based on safety and environmental reasons against all or specified UAS categories or classes. (European Commission 2019b)

Since the 2016 United States presidential election the polarization of the world has gotten only stronger. There are strong political and financial agendas which drive actors in the political scene to different directions. Big world powers like the USA, China and Russia are moving away from each other and terminating some of the existing agreements and commonly used practices to gain benefits over the counterparts. While others, mainly smaller countries and European tend to drive formerly predominant agreement society where global agreements and rules were widely recognized and obeyed. From the year 2017 US has set restrictions on China and Chinese IT companies and these can have effect on third parties (i.e. countries and organizations) via bilateral relationships between the countries. This applies basically to all from Europe to the West in the short term. In European Union, where the rule of law principle is spreading countries into different battlefronts, this could cause a similar kind of barrier of entry for businesses if this kind of progress continues.

This is something to recognize especially in the drone industry, since the majority of the technology components are coming from China which is also the home country of one of the market leaders, Shenzhen DJI Sciences and Technologies Ltd, commonly known just as DJI.

One thing to remember still is that the political atmosphere can dramatically change after the elections in case there will be changes in the government's base of support.

4.5.2 Economic

European Union being a single market has its advantages as well as disadvantages. Mainly operating with a single currency it gives some stability when looking into exchange rate variations with European customers even though there would be clients outside the Euro area.

European Commission (2020b) predicts in its Summer 2020 forecast GDP to drop 8.7 percentage points during 2020 before rising 6.1 percentage points in 2021 when looking specifically to the Euro area, while in general EU area figures are -8.3 and 5.8 percentage points. At the same, Euro appreciation has risen against the US dollar and Chinese yuan.

Diving into recession is mainly due to the ongoing COVID-19 pandemic which will hit all industries globally but since the nature of drone industry this might be seen more as an opportunity - solutions can prevent physical contacts between humans. Huge global push towards digitalization and automation is likely to give funding to operations which require or at laser can take advantages on using drones.

4.5.3 Social

Ageing is a global trend and it is present in Europe as well. People are having fewer children per family which will change the balance between young and elderly. Eurostat studies show that while the total population will increase until 2050 the percentage of under 65 years old out of all people is going to decrease. While the ratio was just over 30% in 2018, it is estimated to rise over 50% by the year 2068. (Eurostat 2020)
This will impact on services related to transportation, social encounters, medical and wellbeing and safety required in the area.

The major refugee crisis Europe encountered in 2015 needs to be acknowledged in drone context as well. That was the year when the unstable conditions in Asian and African continents triggered masses of people seeking asylum from Europe due to civil wars, persecution and poverty. While the majority of the countries were struggling in the limits of their capacity to manage with immigrant flows through Europe the crowdiest times seem to be in the past for now. It is still obvious that the movement can be restarted

due to unstable situations in surrounding areas putting the pressure back at least in the outer borders of European Union.

Europe being one of the advanced continents in technology wise, today's youngsters and working class are more and more educated and aware of technical capabilities when interacting with each other and with local authorities and are expecting seamless customer experiences is each channel in use. Automation, plug and play or easy-to-use are drivers which need to be acknowledged when trying to get people's attention in all areas of life.

4.5.4 Technological

Digitalization will have maybe the single most impact to the drone industry. Vast number of use cases are to be revealed when developers around businesses are starting to think about automation and ways to reduce human work due to increased demand generated by globalization and streamlined value chains. Electrical vehicles in the automotive industry will lead the way when designing longer lasting batteries also available for the drone consumption which will then enable longer operation times for the fleet.

Development in the digital cellular networks in the form of 5G will enable more possibilities to communicate between the base station and the UAV. GSMA (2019) indicates that utilization of 5G network would enable full automation for operations related to Beyond Visual Line of Sight (BVLOS).

4.5.5 Environmental

Megatrends like climate change and increase of extreme weather can be seen as opportunities for using drones. These changes generate more and more possible scenarios where to utilize drones e.g. in the areas of situational awareness related to weather or other phenomenon like the rise of the sea level or forest fires. These observations are likely to have some kind of connection to governmental or municipality operators since the land, forests, ports and harbors usually are heavily affected.

Urbanization has increased a lot in the past 50 years and the prediction is that the two-thirds of the world's population will live in urban areas within the next 50 years and in

Europe this share is even higher, more than 83% of the population. When moving to urban areas people are expected to have higher standard of living mainly due to possibility for higher income. (Our World in Data 2019)

When people are living in urban areas they will also live closer to each other meaning that the living space needs to be searched from above. What possibilities this could bring to the drone industry? Well constructions sites will be delivering higher buildings to support higher density of living and when it will be getting more and more crowded, there will be an increasing need for authorities to have situational awareness and mass event control. All potential use cases for public sector drone operators.

While urbanization itself is a phenomenon, one other visible and tangible issue will follow it right on its tail; waste management problems. When the living standards rise, then changes the consumption habits as well. Where this might open wide possibilities for private sector drone operators in forms of goods delivery, it might force the public sector to invent something to keep waste management under control.

4.5.6 Legal

European Union as seen as a single market will start to provide a framework for the drone industry and all operators working in it despite the country of origin. This will eventually lead to a situation where acting against EU level definitions in a single member state will likely escalate to be valid in the whole EU area.

As the home country of Innovation hub being Finland which is part of the EU, there will be no contradictions on which court should be applicable on hearing the case in juridical disagreements. The defendant's home country will be that court and in this particular case where the drone activity is taking place in the customer's operation area, this can be any of the countries customers are acquired from.

When designing any personal data gathering activities it is to be acknowledged that European Union started to apply General Data Protection Regulation (GDPR) in 2018 which is to be obeyed by all parties utilizing and transferring personal data of EU citizens. Drone operators must be cautious on storing personal data including related flying route and destination information on their operations.

5 Proposal

This chapter will summarize the key findings derived from the Market analysis (Chapter 4) which will be the proposal for the study objective. The first paragraph will include the proposal including the suggestions for further studies to get more detailed information to support decisions, and lastly proposals for consortium roles for the Define -phase of the design project. The second paragraph will describe the validation of the proposal with the mandator.

5.1 Key findings

Based on the market analysis the key findings can be listed as follows:

1. **The target market is heavily regulated but single - timing for an entry is good**

European Union is on its way to consolidate the regulation to be the same across the member states. This regulation is to be overruling those multiple domestic variations making it easier to adjust the solution to be designed into all member countries. It still must be noticed that the regulation is not complete yet and some changes or delays to plans might occur during the time before actual implementation of this new regulation. **Due to the complex EU regulation it is recommendable to have a specialist role in the consortium to interpret the regulation into the nonfunctional requirements for the system to be developed.**

2. **Industry is not saturated - acquisitions and joint efforts to be expected**

The drone industry holds lots of small companies delivering either hardware, software or services constructed on top of various technologies and the IT giants are still in the shadows. The trend of outsourced management of drone operations might lead customers to seek for end-to-end solution providers instead of building their drone solution from the parts of multiple different providers. Collaboration with other vendors is recommended to build these end-to-end solutions for the customers. This to attract prospect organizations with less inhouse knowledge to start utilizing drones in their operations.

3. **Predicted use case seem to be common for public and private sector**

While the initiative focuses on the public sector over private organizations, the predicted use cases might not hold as definite sector variation. Also some of the public sector organizations are purchasing their services from the private sector operators as we can see from Finnish health care sector already. The difference here might be more in the data included in the operations which might be more delicate when operating with the public sector. The suggested approach would be to comply with the industry specific regulation on the public sector side which most likely would be utilizable in the private sector as well. With this approach the segmentation could be better defined once the initiative reaches the Develop phase. In this point also a more specific market research should be arranged targeting prospect organizations known to have interest in the solution to get validation on demand.

4. **Macro-environmental trends seem to be favorable but also open to disruptions**

Besides the single market aspect in the EU, many of the macro-environmental dimensions hold favorable elements for the rise of use cases where drones could be utilized. People are getting older and wealthier in Europe and are utilizing more and more services without leaving home. They are packing themselves into urbanized areas making those heavily crowded. Big cars might soon need to be switched to something smaller and agile to mingle between the high risers of urban city center labyrinths. Are the solutions based on flying drones or something else? At least we are not yet used to see commercial drones in our daily lives but with the technology in hand and the use cases creating the demand, drones can be one of the solutions for fulfilling these emerging needs.

5.2 Validating the proposal

The validation of the proposal was done on 7th of December 2020 in the online meeting with the author and the head of Innovation Hub who was the mandator of the study. In this meeting the objective of the study was compared to the outcome from the software project point of view. Key findings no. 1 & 2 were said to be especially helpful for getting the additional funding and findings no. 3 & 4 are relevant for the following steps in the design of the software.

6 Conclusion

This section will summarize the study and describe the outcome against the objective set in the very beginning of the process. It will also include the personal reflection describing the work from the researcher point of view throughout the journey.

6.1 Summary

The innovation hub in Metropolia University of Applied sciences has an initiative to design and build a drone software for the public sector to be offered European wide. This plan has already raised some domestic interest but broadening the scope was something yet uninvestigated. Funding was needed to get further on the initiative and for that there was need for gathering information from the market to be entered.

The research objective was to find out the market situation for a drone software specializing in governmental use in Europe, analyze and estimate the potential changes in a couple of years to come and propose needed roles at the define -phase of the initiative. Here the initiative is seen to follow the design process with four phases being Discover, Define, Develop and Deliver where the research conducted in this study was part of the Discover phase and the outcome would provide tools to proceed with the Define phase of the initiative.

In the conceptual framework the entire business environment dimensions including the cross industry factors defined as macro-environmental aspects and the industry and its sub-aspects were separated so that the macro environment analysis was decided to be executed utilizing the PESTEL framework to identify political, economic, social, technological, environmental and legal factors affecting the business. Then the industry, market and competitors were to be analyzed via market research approach.

Primary data was gathered through online survey to prospect organizations and the secondary data to analyze the business environment was gathered from well-known data sources like publications of different EU organizations. The data gathered was interpreted to the form of market analysis which was organized per business environment dimension. That was then compressed to the proposal being the key findings from the analysis.

The findings give generally positive insight for the plans to continue the initiative. The target market can be seen as potential for newcomers due to the regulations aspects to be followed and the industry in general is not yet saturated giving the possibilities to take a share from the markets by well-designed end products. The initiative should be aware of the possible changes in the competition in case of acquisitions and rising demand for end-to-end solutions which might be usable for both public and private sector customers. The macro-environment aspects indicate favorable trends as well but other emerging technologies might compete to fulfill the same use cases as predicted to be covered with drones.

The validation of the market analysis and the key findings was conducted with the head of the Innovation hub where the objective was compared against the outcome from the software project point of view. The outcome was stated to deliver needed help for the project in means of funding and further development.

6.2 Outcome against the objective

The objective of this study was to find out the market situation for a drone software specializing in governmental use in Europe, analyze and estimate the potential changes in a couple of years to come and propose needed roles at the define -phase of the initiative running background. The thesis outcome met the objective by conducting the market analysis and compressing the key findings and the role identified in the proposal. Innovation hub has now market analysis from the European context along with the suggestions to utilize in the following phases of the initiative.

6.3 Personal reflection

A short but still long journey. That would be how I would describe the process of writing this study. That is mainly due to two reasons. Firstly, this study was conducted during a very special year when the global pandemic forced the majority of the meetings to be held virtually. For me, it was shown by removing the daily commuting between the office and home that being usually the time and place where to switch from working mode to

researcher mode. It took some months to fully adapt to this new situation and the days felt really long and endless before finding some buffer between day job and writing.

Secondly, the timeline set for this study appeared to be really ambitious. December 2020 was set as the initial goal for the study completion in the spring 2020, when this topic was introduced. At that time it seemed to be plenty of time although the technology and the industry was really unfamiliar to me. Summer time went with familiarizing those and then the autumn was really intense when trying to proceed parallelly with the theoretical and data gathering parts. a couple of vacation weeks was needed to fully concentrate on completing this in time.

From the content side, the only thing which left some irritation for me was the survey, which did not result in as high response rate as I hoped. Outside of that it was quite close to my expectations knowing that producing text has not ever been one of the strengths of mine. There were some times where the writing seemed to be overwhelming and ideas of giving up were near. Luckily there were people who uplifted the spirit and pushed me forward chapter by chapter until the happy end.

With these last words I want to thank Oscar Nissin for the topic and my supervisor Pia Hellman for the guidance during the journey. Special thank you also to all of my fellow students for giving the inspiration during the courses and to my late friend Olli Orpana for showing the example by signing up for Master’s studies.

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Appendix 1: Survey questions

Questions	Type	Value	Audience
What is the main country your organization operates in?	Picklist	<list of EU countries>	For all
What type of organization do you represent?	Picklist	Govn/City or Municipality/Business	For all
What is your role in the organization?	Open		For all
Does your organization have a guidance/playbook/process on using drones?	Boolean	Yes/No	For all
Are you utilizing or planning to utilize drones (unmanned aircraft)?	Boolean	Yes/No	For all
Are you using or planning to use drone platfrom provided by someone else than the drone manufacturer?	Boolean	Yes/No	For all
What drone brand(s) have you used/are you planning to use?	MultiSelect Picklist	Acecore/Airbus/Airobotics/Asctec/DJI/Force1/Schiebel/EHang/Antwork/Walkera/Skydio/Swellpro/Something else/I don't want to share	For those who use or plan to use
Are you concerned on data security of the used device and connected platform?	Boolean	Yes/No	For those who use or plan to use
Are you concerned on physical security of the used device?	Boolean	Yes/No	For those who use or plan to use
Are you planning or have you performed any data security assesments related to data security of using drones?	Boolean	Yes/No	For those who use or plan to use
For which kind of operation areas are you using or planning to use drones to?	MultiSelect Picklist	Traffic Control/Border Control/Rescue/Constructions/Mass events control/Lifting&Delivery/Situational Awarness Gathering	For those who use or plan to use
Would you be interested in drone platform focusing to business/governmental use?	Boolean	Yes/No	For all
Would you be interested in drone platform of European origin?	Boolean	Yes/No	For all
What would be the key factor(s) on selecting new next drones	MultiSelect Picklist	Data Security; Physical Security; Price; System Provider backgroud; Platform designed for govn/biz use	For those who use or plan to use
Does your staff have or any trainings or certifications related to drones?	Boolean	Yes/No	For those who use or plan to use
If Yes, what kind of trainings/certifications?	Open		For Those who have answer Yes

Appendix 2: Survey raw data

Time	What is the country your organization operates in?	What type of organization do you represent?	Your role in the organization?	Does your organization have a guidan	Are you utilizing or planning to utilize dro	Are you using or planning to use drone software platfrom	What drone brand(s) have you used/are you planning to use?	Are you concerned on data security of the used devic	Are you concerned on physical security of the used device?	Are you planning or have you performed any security assessments related to data	For which kind of operation areas are you using or planning to use drones to?	Would you be interested in drone softwar	Would you be more interested in drone	What would be the key factor(s) for you when selecting new/ next drones?	Does your staff have any trainings	What kind of trainings/certifications?
1.10.2020	Sweden	Governmental	Expert	No	No											
2.10.2020	France	Governmental	Expert	Yes	Yes	Yes	DJI	Yes	Yes	Yes	Some other	Yes	Yes	Data Security, Physical Security, Platform designed for govenrmental/business use	Yes	UAS Pilot Certificate - UAS Inspector
2.10.2020	Latvia	Governmental	Expert	Yes	Yes	Yes	DJI, Something else	Yes	Yes	Yes	Situational Awarness Gathering, Some other	No	Yes	Data Security, Physical Security, Price, Platform designed for govenrmental/business use, Something other	Yes	Remote pilot training
4.10.2020	Estonia	Governmental	Decision Maker	No	No											
5.10.2020	Sweden	City/Municipality	Project manager	No	Yes	Yes	Something else, I dont want to share	Yes	Yes	Yes	Traffic Control, Situational Awarness Gathering, Some other	Yes	Yes	Data Security, Physical Security, Price, Platform designed for govenrmental/business use, Something other	No	
6.10.2020	Germany	Governmental	Expert	No	No											
15.10.2020	Netherlands	Governmental	Expert	Yes	Yes	Yes	DJI	Yes	No	Yes	Situational Awarness Gathering	No	Yes	Something other	Yes	ROC, RPAL, specific corporate training

Appendix 3: Survey recipients

Country	Type	Organization
Bulgaria	Governmental	Ministry of Transport, Information Technology and Communications
Bulgaria	Municipality	Sofia Center for Urban Mobility EAD
Croatia	Governmental	The Croatian Civil Aviation Agency
Croatia	Municipality	Zagreb City Office of emergency management
Cyprus	Governmental	Ministry of Transport, Communications and Works /Department of Electrical and Mechanical S
Cyprus	Municipality	Limassol Technical Department
Czech Rep	Governmental	Civil Aviation Authority
Czech Rep	Municipality	Prague TECHNICAL ROAD ADMINISTRATION
Denmark	Governmental	The Danish Transport, Construction and Housing Authority
Estonia	Governmental	Ministry of Economic Affairs and Communications
Estonia	Municipality	Tallinn Transport Department
Finland	Governmental	Ministry of Transport and Communications
Finland	Municipality	Helsingin kaupungin Turvallisuus- ja valmiusyksikkö
France	Governmental	The General Directorate of Civil Aviation (DGAC)
France	Municipality	Paris, Department of Prevention, Security and Protection
Germany	Governmental	Federal Ministry of Transport and Digital Infrastructure
Germany	Municipality	Senatsverwaltung für Umwelt, Verkehr und Klimaschutz Berlin
Greece	Governmental	MINISTRY FOR INFRASTRUCTURE AND TRANSPORT, HELLENIC CIVIL AVIATION AUTHORIT
Greece	Municipality	Athens, Urban Infrastructure and City Planning
Hungary	Governmental	MINISTRY OF INNOVATION AND TECHNOLOGY
Hungary	Municipality	Budapest Road Operator
Ireland	Governmental	Department of Transport, Tourism and Sport
Ireland	Municipality	Dublin Transportation department
Italy	Governmental	delle Infrastrutture e dei Trasporti
Italy	Municipality	Community of Rome
Latvia	Governmental	State Agency Civil Aviation Agency
Latvia	Municipality	Riga City
Lithuania	Governmental	Information Society Development Committee
Lithuania	Municipality	City Of Vilnius, Traffic Management Division
Netherlands	Governmental	The Human Environment and Transport Inspectorate
Netherlands	Municipality	Amsterdam
Norway	Governmental	Ministry of Transportat and communications
Poland	Governmental	Association of Unmanned Vessel Operators in Poland
Poland	Municipality	Warsaw
Portugal	Governmental	GABINETE DO SECRETÁRIO DE ESTADO ADJUNTO E DAS COMUNICAÇÕES
Portugal	Municipality	Porto
Romania	Governmental	Autoritatea Aeronautica Civila Romana
Romania	Municipality	Bucharest
Spain	Governmental	Senado de Espana
Spain	Municipality	Madrid
Sweden	Governmental	Swedish Airports and Air Navigation Services
Sweden	Municipality	Stockholm City Planning dept
Switzerland	Governmental	Federal Office of Civil Aviation
Switzerland	Municipality	Bern Directorate for Security, Environment and Energy

Appendix 4: Survey results

Main target 1: Are drones used in European public sector?

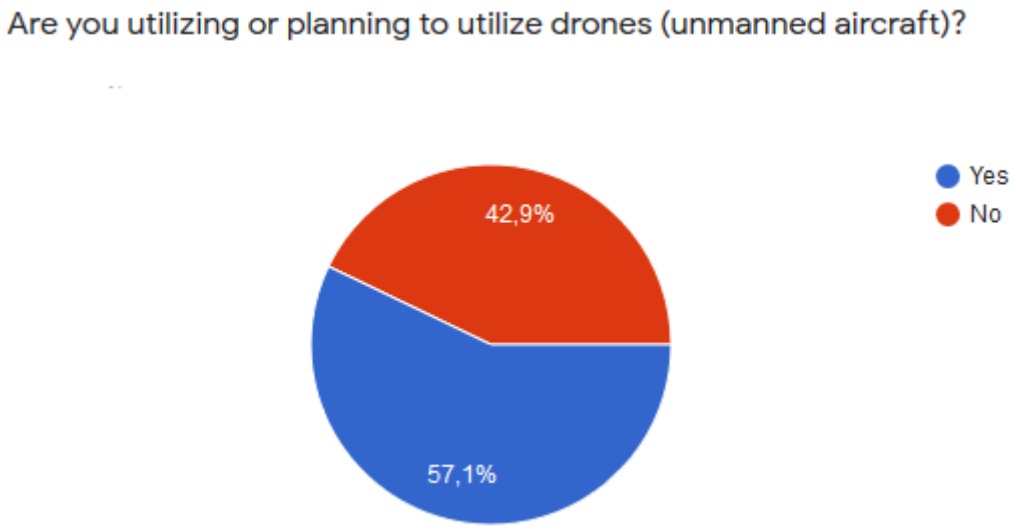

Figure 7. Drone utilization plans among the respondents

Main target 2: Are the ones using drones utilizing the software platform provided by the UAV manufacturer?

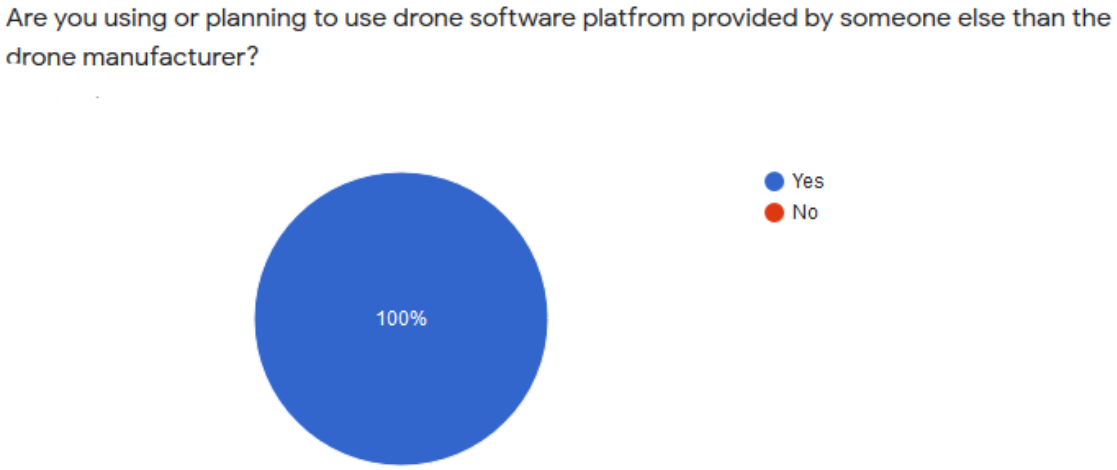

Figure 8. Respondents target to utilize platform other than drone manufacturer offers

Main target 3: Are the ones using drones concerned on the security aspects?

Are you concerned on data security of the used device and connected software platform?

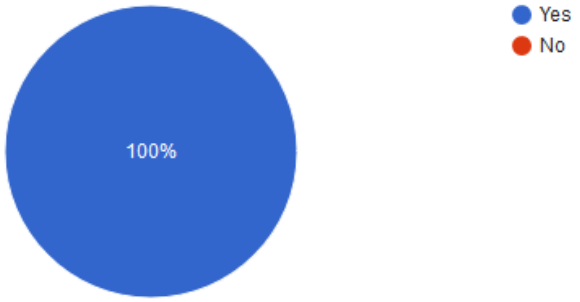

Figure 9. Respondents concerns on data security

Are you planning or have you performed any security assessments related to data security of using drones?

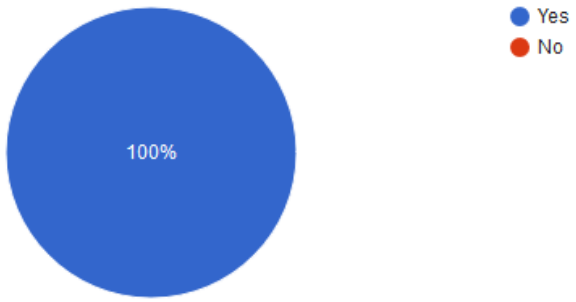

Figure 10. Respondents actions on security assessments

Main target 4: Would there be any interest in an industry specific drone software platform?

Would you be interested in drone software platform designed especially to business/governmental use?

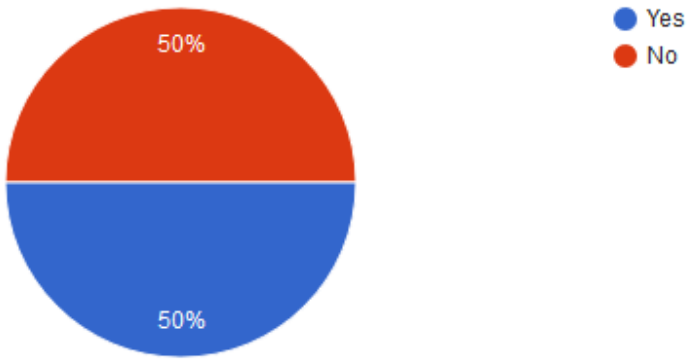

Figure 11. Respondents intents towards industry specific software

Main target 5: Would there be more interest on European service providers over the others?

Would you be more interested in drone platform of European origin over non-European ones?

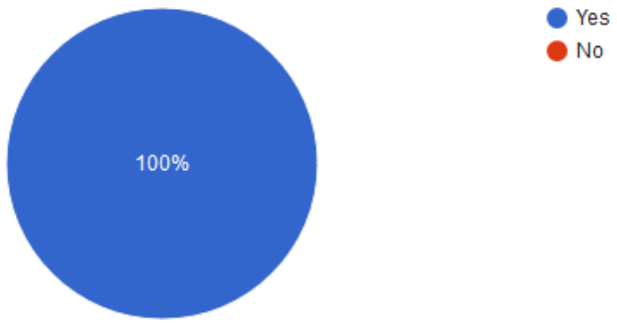

Figure 12. Respondents interest on European software platform