Master Thesis U.S.E.

Contributing Factors in the Adoption of Unmanned Aerial Vehicles (UAVs) in Companies: A Grounded Theory Approach

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Abstract:

Unmanned Aerial Vehicles (UAVs) are an emerging technology companies can use to improve performance. This study's question is: What factors influence companies to adopt UAVs? Utilizing a grounded theory approach to collect data through semi-structured interviews with managers in the wind energy industry and secondary data from a UAV conference, this study helped explain and understand the adoption of technology by a company's decision-makers. The study's main findings identify factors that influence the adoption, expanding on existing theories of technology adoption, such as the Diffusion of Innovation (DOI) theory, the Technology-Organizational-Environmental framework (TOE), and the Technology Acceptance Model (TAM) by providing insights into the evaluation process and its stages, criteria for evaluation, and the roles of different individuals within the organization. In addition, it helps to understand why companies decide to adopt the technology as a service or with internal resources. The findings contribute to a better understanding of how companies adopt UAVs and technologies, and they can assist managers in increasing the integration of UAVs into their operations. The results also have implications for vendors, as they can develop better strategies for planning and anticipating organizations' reactions to this emerging technology.

JEL-codes: O33, Q55.

Keywords: Adoption of technology, Unmanned Aerial Vehicles, UAV, Acceptance model, Organization, Business to Business adoption, Windfarm, Energy industry.

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1. INTRODUCTION

The proliferation of new technologies in the 4.0 Industrial Revolution[4] has the prominence of becoming an integral part of companies' business future. One promising technology is the Unmanned Aerial Vehicle (UAV) (UAV) (Shakhatreh et al., 2019), which has been blooming across industries. UAVs incorporation in industries include the military, security services, utilities industries, energy, agriculture, and construction. The use of UAVs has allowed firms to reduce production costs, increase task speeds, improve safety, collect data more efficiently, and improve public relations and marketing (Maghazei et al., 2022). Like all technology, UAVs increase labor and capital productivity and decrease variable production costs; as a substitute input -given the same production level- it could decrease the use of labor. Therefore, it is expected that the use of this emerging technology will contribute to a more dynamic UAV industry and will increase potential for new businesses (Cohn et al., 2017; Cross, 2020). As Gartner Inc. has described, "[UAVs are an] emerging technology that will become a source of competitive advantage over the next decade" (Gartner Inc., 2019). However, UAVs are still in their infancy in mass adoption and utilization (Business Insider, 2021). This research is expected to contribute to a better understanding of the factors that are considered to explain their adoption or rejection in the future.

In 2017, Giones & Brem signaled that there was undoubtedly hype around UAVs and their applications for private and professional uses. They added that "[we see] UAV technology as an example of an emergent technology that has had a long evolutionary path. Advances in artificial intelligence, image processing, and robotics have equipped UAVs with autonomous functions and have stepped up their transformative potential." In 2022, according to a market analysis by Alvarado (2022), the global UAV market had an estimated value of US$30.6 billion, with a predicted Compound Annual Growth Rate (CAGR) of 7.8% until 2030, encompassing both commercial (companies' use) and recreational sectors (flying for enjoyment or as a hobby).

Interestingly, the commercial market is expected to expand at a faster pace of 8.3%, while the recreational market is predicted to decline. The UAV market is anticipated to reach US$55.8 billion by 2030 (Alvarado, 2022). For commercial use, the media has lately focused on the push of giant technology corporations, such as Amazon, Google, Uber, and others (Hawkins, 2022; Mogg, 2022), who have spearheaded innovative efforts by doing pilots of delivering products to customers. However, UAVs are increasingly being used for other commercial services such as farming, transportation, surveillance, inspection, and disaster management (Cohn et al., 2017; Shakhatreh et al., 2019). Some examples of its various applications include aerial footage for film and television, inspecting hard-to-reach areas for utility and energy companies, monitoring livestock for ranchers and rural veterinarians, and monitoring progress on building sites for engineering and construction firms (Cross, 2020). Despite these examples, many firms still hold hesitant and conservative attitudes toward its application (Kapoor & Klueter, 2021). The aim of this research was thus to identify as much as the scope of this study allows the factors that affect a company's adoption of UAVs.

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[4] "Industry 4.0—also called the Fourth Industrial Revolution or 4IR—is the next phase in the digitization of the manufacturing sector, driven by disruptive trends including the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics" (McKinsey, n.d.)

The review of the literature shows that extensive research has been conducted on UAV technology, exploring its technical capabilities such as robotics, control, and computer vision (Maghazei & Netland, 2019). These researches also analyzed the potential benefits of this technology, with the purpose of helping companies better understand the range of possibilities offered by UAVs. Additionally, the widespread availability of UAVs for hobby use, as well as the tests of delivery systems in urban areas conducted by large internet companies previously mentioned and their media coverage, has led to the development of research focused on regulatory topics and public acceptance of personal of UAVs. Nevertheless, additional work is needed about commercial acceptance, as currently those few studies on this topic have mainly focused on agriculture industry and delivery purposes in cities. This is in fact troubling because as it has been indicated in the previous paragraph, the economic value growth that will explain the UAV market will be pushed by its commercial use, but despite the promising growth of this technology in various industries and companies, there is currently a lack of research on the factors that contribute to companies adopting this technology for their processes. Such research is important as it could help explain the relationship between the drivers and barriers that will impact the continued growth of UAVs and expand the theories of adoption in relation to this new technology. This is a necessity that goes in line with the call made by Heim and Peng (2020) for research papers for the Journal of Operations Management on the ”technology adoption and diffusion of use”, as there is a need to investigate as to “deepen and enrich our present understanding of the contemporary developments taking place between technologies, organizations, [and] operations…”.

1.1. Purpose of this study

As mentioned previously, using UAVs as a solution to business needs is a promising technology. Furthermore, during the early stages of a firm’s adoption of UAV’s, those who are responsible on implementing the new technology are aware of these potentials and they need to understand the aspects considered for implementing it. Recognizing this and other stages in the adoption process will contribute to fill the gaps that exist in the research literature. In addition, decision-makers also need to be aware of the aspects other companies consider when implementing new technology (Taherdoost, 2019). Thanks to this knowledge, the seller (vendor) will be able to evaluate the likelihood of success or failure and offer their clients beneficial products and services, and the buyer (firm) will be able to be aware of the success and failure factors for the adoption of technology in their organization.

So, the primary goal of this research is to contribute to identifying factors that help understand a company’s adoption of UAVs. This investigation focuses on the question: “What factors influence companies to adopt UAVs?”. To identify and characterize those factors, this author performed exploratory research by collecting data through semi-structure interviews with thirteen managers from eleven companies in the wind energy industry, and secondary data from expositors from a UAV conference. The study used a Grounded Theory methodology to find the key variables and its relationships.

The results of this study detail the process of adoption of UAV, taking into account the complexities of an organization and the participants of the decision. The findings describe the factors, the criteria, and the focus of the evaluation of this new technology by an organization. In addition, this research gives a better understanding on how companies decide to adopt UAVs by purchasing it or hiring as a service. Thus, this study helps expanding theories of adoption by giving more insight on how companies take decision and who participate on these. It is this author's belief that the results of this study can help managers find ways to increase the introduction of UAVs in companies, whether these UAVs are acquired by services (hiring services) or by in-house adoption (purchases) with internal resources, all of which goes in line with Taherdoost (2019) who indicates that "in order to increase the level of technology usage and user adoption, the emphasis on factors that can influence on user acceptance should be raised." Furthermore, by providing an answer, vendors might develop better techniques for planning, assessing, and anticipating how organizations will react to this emerging technology (Taherdoost, 2019).

The research is structured as follows. First, a literature review about UAV and theories of technology adoption to understand what is the best approach for this research. Next, a detail of the methodology applied, explaining the type of data and analysis developed for this study and the procedures used. Finally, research findings are presented complemented with visual models to better understand the stages of the process and factors, which is followed by a discussion explaining how these findings build on the current theories, in addition to final considerations, and implications with suggestions for future research.

2. THEORETICAL FRAMEWORK

2.1. UAV technology and market trends

The commercial UAV industry is still young but has become popular in recent years due to its recreational usage, and its potential for business use. Specifically, on this latter use, it has been the miniaturization of electronic components and the increasing computing power of processing units that have made UAVs more affordable and accessible to a broader range of industries (Business Insider, 2021; Giones & Brem, 2017). UAVs could be flown as remotely controlled or autonomous vehicles, allowing companies to go almost anywhere, using this technology as a proxy (Cross, 2020). As, they can prove to be essential when humans cannot access or conduct hazardous or dangerous tasks quickly and effectively (Shakhatreh et al., 2019).

UAV services have been evolving rapidly, especially the recent years. Using the international database on patents, the Danish Technological Institute (2019) conducted a research nearly 35,000 patents related to UAV technology and, as seen in Figure 1. they found an accelerated growth in technological advancements related to UAVs in the last years, with 80% of patents published since 2016. The patents cover the technology; supporting technologies like materials, communications, navigation, and energy systems; and application technologies like photography or data analysis using a UAV platform. Major defense contractors, semiconductor manufacturers, IT consulting firms, and industrial conglomerates have all invested significantly in the UAV business (Business Insider, 2021).

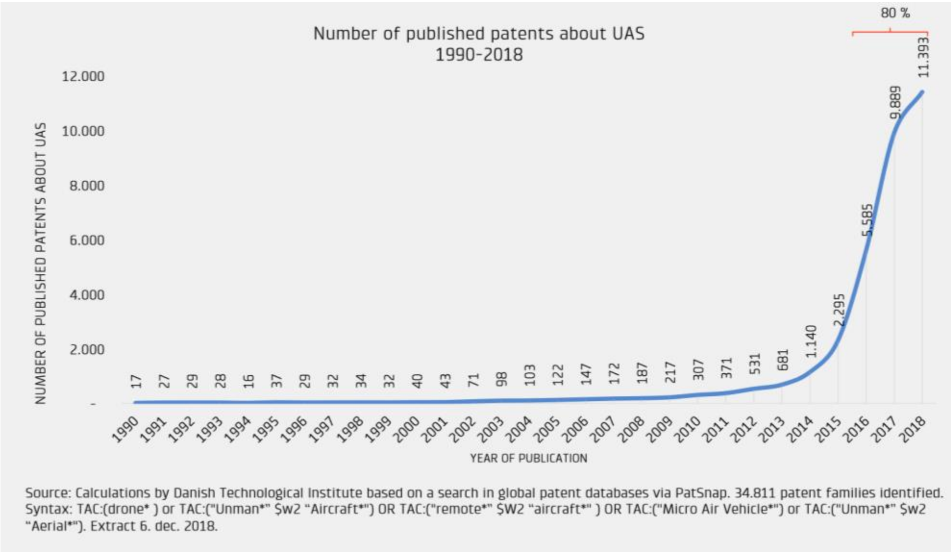

Figure 1. Number of published patents about UAV 1990-2018. Source: Danish Technological Institute (2019).

At the beginning of 2016, Price Water Cooper released a report about the emerging global market of UAV services for companies, and they estimated a potential market size of $127 billion dollars. The following year, more than $3 billion had been raised for funding exploratory UAV applications by startups (Cohn et al., 2017).

These statistics show UAV technology's dynamism and potential value for commercial use (Shakhatreh et al., 2019). This is supported by frequent technological breakthroughs by UAV manufacturers and researchers, cost reductions, enhanced availability of parts, new offerings from established companies, the continual entry of new startups, and changes in regulations (Maghazei et al., 2022). As this market evolves, it is promising that UAVs will offer even more benefits for companies in the future.

UAVs are among the newer technologies that companies must evaluate. While UAVs hold promises to help improve operations, they also have the potential to constrain them. UAVs, unlike conventional technology, it is technology that can fly, a feature that is not commonly found in other industries, such for example indoor manufacturing technology. Additionally, due to battery capacities, UAVs have specific limitations, such as flight time and payload. Furthermore, they can generate wind turbulence and noise and have cameras, raising safety and privacy concerns. Although UAVs can be equipped with various tools such as cameras, sensors, scanners, and robotic arms, they are not classified as "general purpose" technologies (Maghazei et al., 2022), which means that their benefits cannot be used elsewhere in a production system.

Moreover, due to their widespread use in consumer technology and marketing, most managers and engineers will likely be familiar with UAV technology and may wonder about its real and potential applications and capacities (Maghazei et al., 2022). All these traits make UAVs a different and unique type of technology. Therefore, investigating the adoption factor of UAVs by companies has become a necessary matter for businesses (Heim & Peng, 2020), and for the academia to understand the adoption of this new industry, as Giones and Brem (2017) said that “the emergence of a new industry often goes unnoticed to academic researchers until it has fully emerged and its actors become fully visible”.

2.2. Adoption research for UAVs

A review of the literature shows that the research on UAVs has been mostly focused on studying about technical feasibilities of UAVs, which is more true after 2006, when the first United States Federal Aviation Administration commercial UAV permit was issued. After that, technicalities have been developed for different purposes using UAVs, especially for commercial use (Ford, 2020). The industries and functionalities of use in the literature are related to Agriculture, Construction/Real State, Logistics, Health/Rescue, and Military, among others. Other studies have focused on the public acceptance of using UAVs in populated areas, mainly pushed by the potential usage for logistics and smart cities. Additionally, regulatory and policy purposes are also a type of study related to UAVs. Finally, some studies have tried to understand the adoption of UAVs for customers and for a certain industries.

Those researches that have focused on adoption of UAVs by companies have mainly taken into account the barriers or challenges on farmers and agriculture. And the rest have focused on the construction sector. None of these studies have specified the evaluation process. For more details of the 571 documents reviewed for this literature review can be found in Appendix A.

In the study "Unmanned Aerial Vehicles (UAVs): A Survey on Civil Applications and Key Research Challenges," Shakhatreh et al. (2019) indicate the market opportunities that UAV equipment manufacturers, investors, and business service providers have according to different industries. Figure 2 shows the predicted value of UAVs in critical industries, according to PricewaterhouseCoopers (2016). This means that it is the value of current company services and labor that are likely to be replaced very shortly by UAV-powered solutions. Interestingly, the most significant value can be found in the infrastructure industry, which includes the energy, water management, manufacturing, and construction sectors (Statista, 2022). However, the literature review shows that there are barely studies focusing on the potential adoption of UAVs in this industry, the most prominent, and the few found in the same industry were mainly for the construction sector, excluding other activities related to infrastructure industry, such as is the case of an important one, the energy sector. In addition, the studies found in this review were limited to the factors for adoption by companies and they did not include the evaluation and decision stages, as their characteristics. And neither they take into account the business to business context.

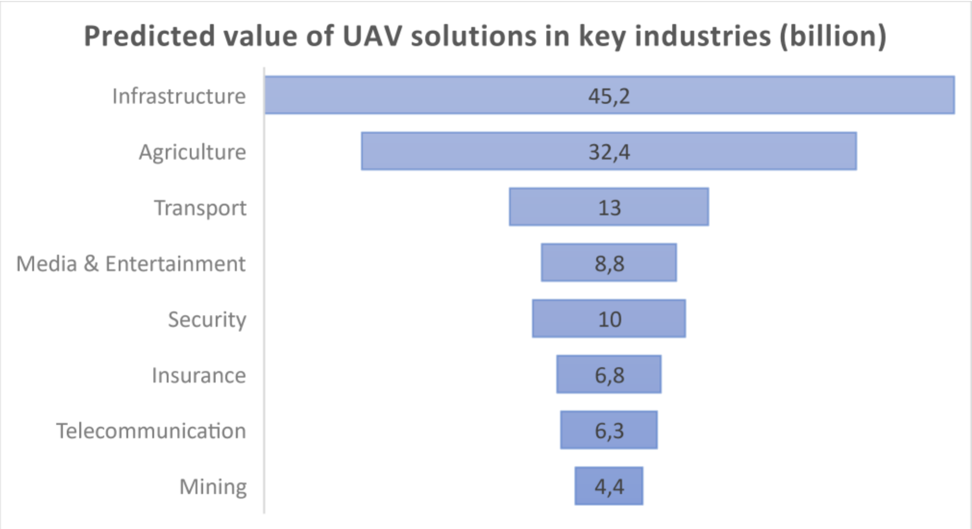

Figure 2. Predicted Value of UAVs related to the key industries. Source: PricewaterhouseCoopers (2016).

There is a clear gap in research about the adoption factors for UAVs that takes into account the drivers and barriers for the most valued industry for the UAV market, the infrastructure, and specifically the energy sector, whose potential is prominent given the "large-scale capital projects" it possess (PricewaterhouseCoopers, 2016), and taking into account the complexities of companies in the decision. Therefore, it is necessary to understand the theories and models that could help explain the adoption of UAVs.

To address this gap, it is crucial to examine theoretical models that can explain technology adoption. This will help determine if these models can be applied to the purposes of this research. The following section describes this analysis.

2.3. Technology acceptance models

Building on the research on UAV adoption covered in the previous section, to explain the approval of technology by firms it is essential to investigate theoretical models that might help understand decisions by companies, the stages followed by the firms, and find insights on whether this adoption is made by in-house recourses or by outsourcing it. Among the most cited and popular model is the Technology Acceptance Model (TAM) by Davis (1989), and its later successors, both the Technology Acceptance Model 2 (TAM 2) by Venkatesh & Davis (2000), and the Unified Theory of Acceptance Model (UTAUT) by Venkatesh et al. (2003). These models were created to explain the adoption of Information Systems, and not for other technologies such as UAVs (Bagozzi, 2007). And, since by definition, models are an abstraction of the reality, they are developed to explain a given event or process (John Brennan, 2018), therefore, the structure and purpose of these models confront limitations when the goal/purpose is to explain other technologies like UAV's. In this case, these models are focused on information systems. In addition, these models center on individual end-user perceptions to decide its adoption, rather than on organizational decisions with complexities, processes, and drivers. As Hedman and Gimpel (2010) raised awareness, indicating that, for example, TAM predictors may not be sufficient for emerging services related to new technology adopted by companies as they ignore context and contingency, as decisions in an organization can be influenced by group, cultural and social aspects, as a significant portion of behavior is organizational, collective or collaborative. When it comes to decisions about acceptance in a company, they are often made in collaboration with others and with consideration for how they align with the needs and goals of the group, therefore understanding the group, cultural and social aspects is crucial for successful implementation and adoption of technology (Bagozzi, 2007). And finally, given that these models do not focus on how the technology is adopted, they give no insights on the method by the adopter. Whether if the company implements the technology with in-house resources, or as a service by hiring a vendor.

Also famous are the Innovation Diffusion Theory (DOI) by Rogers (1962) and the Technology Organization Environment framework (TOE) by Tornatzky & Fleischer (1990). In both cases, Innovation Diffusion Theory and the TOE framework were created taking into account organizational factors. In the case of DOI, it is the only one that incorporates descriptions of the stages to decide, but it does not go on the details or explain how the initial factors found in this theory are affected on each stage, including the evaluation stage. This lack of detail and factors affecting the decision may be in line with some concerns raised about DOI applicability to organizations, as is the case of Jeyaraj et al. who analyzed 51 studies published between

1992 and 2003 using DOI and found that not all predictors met standards for explaining adoption, concluding that there is still a need to investigate further predictors associated with organizational adoption. For the TOE framework, even though it is a model that was created solely to explain adoption by companies, limitations have been highlighted as its broad and universal nature can make it challenging to use effectively in specific contexts. Furthermore, the framework may not fully reflect the complexities of technology adoption and deployment (and in this case, the type of adoption), particularly in dynamic situations where external influences have a significant impact on technology-related decisions; it has been argued that there is a need for additional research on organizational adoption and that there are opportunities to investigate additional variables such as sociological and cognitive factors, technology readiness, professionals' experience and skills, and change management capability, among others(Bryan & Zuva, 2021; Newcastle University, 2020). According to Baker (2012) even when using TOE as a framework, each particular technology or set being examined has its own set of characteristics or metrics because different innovations are influenced by different aspects when it comes to being adopted. Similarly, each industry will have its own factors affecting the adoption.

Gioia et al. (2013) indicated that "we believe that focusing too much on refining our existing constructs too often amounts to sharpening the wrong tools for gaining bona fide understandings. What we really need instead are some new tools." He then analyzes and suggests that although measuring and elaborating on constructs has been valuable for studying organizations, a crucial component is still missing from our knowledge of organizational dynamics. This missing component relates to understanding the essence of the organizational experience and the procedures involved in organizing and organizational development. An emphasis on comprehending the social world and how we learn about it is required to go deeper into these processes. The most important realization is that a large portion of our world is socially produced, underscoring the need to research social construction techniques. Instead of concentrating simply on quantifiable events or amounts, this involves paying more attention to how individuals of an organization construct and make sense of their experiences. Which in summary, the previous models have the limitation to not being able to further explain. Only TAM and its successors try to explain behavior, and therefore decision, but it lacks on understanding how this decision is developed and affected.

In addition, this author follows Bagozzi's (2007) recommendation, who recognizes the "remarkable accomplishments" of TAM and its successors, and suggests a path for future research. In his research, he has found out the limitations of this model and he indicates that theories that rely on intention and behavior often mistakenly regard behavior as the end in itself, ignoring the reality that, many times, behaviors are mere means to more fundamental ends. He also indicates that there is a large gap between developing intentions and acting. During this time, several psychological and practical elements are at play as he emphasizes the value of considering the phases and barriers between intention creation and the action of acceptance. And later, he says that given that decision-makers can realize that there can be barriers and temptations once they decide to adopt, these could change the orientation of their decisions in different ways than those focused only on behavior. Finally, Bagozzi argues that technology acceptance investigations have not considered group decision-making aspects, as they are essential in a company context, as these decisions are related to collective intentions. Additionally, he proposes shifts in the methodology of technology acceptance, as he suggests that utilizing a qualitative methodology for technology acceptance allows us to identify the relative efficacy of goals, motives, and values and linkages between them. Moreover, Vogelsang et al. (2013) also recommended using a qualitative approach for technology acceptance, as they indicated that it is better for discovering unknown constructs that are not in existing theories and where these constructs might turn out to be relevant for explaining technology acceptance.

Finally, given the purpose of this investigation, which looks for explaining the factors and stages that affect the adoption of an emerging technology in a firm, a technology which is part of a fast-developing market for commercial use, and taking into consideration the current models of adoption, their limitations, and following the suggestions by the researchers previously mentioned, then it is the belief of this author that a qualitative research method is particularly effective at examining this complex organizational environment (Palvia et al., 2003) with this new technology.

3. METHODOLOGY

3.1. Research design

The review of the literature on the previous chapter shows that there is a need to identify the evaluation process that firms follow in the adoption of new technology, like UAVs. To explore the contributing factors on each stage of this process, the research relayed on a qualitative methodology with focus on the factors that firms consider in the adoption of UAVs. The process to identify the factors at each stage will allow firms and researchers to have a structure for decision process and future research. Using an exploratory, discovery-oriented, and, more specifically, grounded theory approach (Glaser & Strauss, 2010) was appropriate given that UAVs are an emerging technology in their early stages that firms could adopt, allowing them to investigate people and companies in their "natural environment." It allows investigating concepts and theoretical elaboration to emerge from the data collected (Bryman, 2016). In addition, qualitative research permits acknowledging what the participants of the decision-making process consider relevant and essential as a point of orientation, which in contrast to a quantitative methodology, is the researcher who brings to the study the critical set of concerns to the structure (Bryman, 2016).

3.2 Data collection

To ensure a complete grasp of the problem, the data were gathered using a triangulation method. This approach combined different points of view, producing a comprehensive understanding. The data gathering process was carried out in two stages.

3.2.1. Semi-structured expert interviews

Using the factors and ideas from research in the literature review -Chapter 2- of this study and the gap of interest about the stages of the process, a semi-structured guideline interview was developed, and used for interviews (Appendix B shows an example). These interviews were conducted from March 2023 until the end of May 2023. For those who allowed the interviewees to be recorded, a transcript for each interview was created; for those that preferred not to record, notes were taken. The transcripts and the notes were used for the coding phase, in addition to post-interview self-audio notes as proposed by Saunders et al. (2009) for business research.

Potential interviewees were contacted by email, LinkedIn, and in person at a conference, the Wind Europe conference in Copenhagen, Denmark. The thirteen interviews with experts used a semi-structured format since it allowed for a more flexible iterative environment. The open-ended nature of the questions, which allowed for further discussion of the ideas and perspectives that earlier interviewees had already shared. This approach also made it easier to include follow-up questions depending on interviewee responses, giving more freedom to change the order and sequence of questions to fit the interviewee's direction (Bryman, 2016). In addition, given that information on the processes from companies that use edging technologies may be sensitive, a semi-structured interview process allowed for building a trusting moment with the interviewee to obtain detailed information that can unearth actual data.

The interviews were conducted with companies related to the wind energy sector, which is part of the infrastructure industry and -as mentioned in chapter 2- are the most promising market for potential benefits of using UAVs, and therefore, they are potential adopters (EnBW, 2023; European Commission, 2022; PricewaterhouseCoopers, 2020; Siemens Gamesa, 2023). To accommodate the personal needs of the interviewers, the interviews ranged between 30 minutes to 1 hour and 15 minutes. Interviews were done with managers from different areas/departments within the firm who could directly have the responsibility to adopt UAVs for their processes in their companies. Some of their positions were in the Maintenance & Operation, Evaluation, or Innovation departments. Companies were from different countries in Europe and America. These interviews were taken online using Microsoft Teams. These semi-structured interviews, as part of the iterative examination, with experts in the process of the decision of UAVs in companies, allowed data saturation to be achieved, which not required more interviews to be necessary. Table 2 summarizes the interviewees information. Given the sensible information provided by their companies, their names have been replaced with a referential code.

Table 2. List of interviewees.

Interview Code	Continent where interviewee office is located	Area of expertise or department
Interviewee E1	America	Development
Interviewee E2	America	Operations & Maintenance
Interviewee E3	America	Operations & Maintenance
Interviewee E4	Europe	Operations
Interviewee E5	Europe	Engineering
Interviewee E6	Europe	Operations & Maintenance
Interviewee E7	Europe	Operations & Maintenance
Interviewee E8	Europe	Engineering
Interviewee E9	Europe	Operations & Maintenance
Interviewee E10	Europe	Operations & Maintenance
Interviewee E11	Europe	Innovation
Interviewee E12	Europe	Innovation
Interviewee E13	Europe	Innovation

3.2.2. Secondary presentations and document analysis

In addition to interviews with decision-makers, data from other experts was gathered. Four presentations from expositors on UAV adoption by wind energy companies associated explicitly with offshore wind farms were analyzed. These presentations were recorded during the Amsterdam Drone Week (ADW) held between April 16 and April 18, 2023. The list of companies where experts are from is in Table 3. These experts were invited by EnBW and the Federal Ministry for Economic Affairs and Climate Action of Germany to share their varied viewpoints regarding the possibilities and challenges associated with implementing a new service of logistics for offshore windfarms using UAVs (Amsterdam UAV Week, 2023; EnBW, 2023). In addition to these recordings, pictures of their power point presentations were taken and used in some cases for the coding process.

Table 3. Lists of organizations' expositions at ADW 2023 used for data

Expositor code	Organization	Area or expertise	Country
Expositor G1	Green Giraffe	Energy Finance Consultant company	Netherlands
Expositor G2	Lufthansa Industry Solutions GmbH	Aviation Industry company	Germany and Europe
Expositor G3	GE Renewable Energy	Energy Industry company	United States and Europe
Expositor G4	Luftfahrt-Bundesamt	Regulator/Government organization	Germany

Following Charmaz & Thornberg (2021) recommendations for quality in grounded theory, in addition to the triangulation of data and the use of semi-structured interviews, the coding process was treated as preliminary and subject to adjustment or rejection, and after this process, it was compared to the relevant literature to identify fits, extensions, or differences with other ideas in the field of technology adoption.

Finally, following Charmaz & Thornberg (2021) criteria for quality in the major forms of grounded theory advocated by Glaser & Strauss (2010), as was indicated previously, the use of literature review, to make sure the wheel is not being re-invented; gathering rich data from experience of people; describing this the methodology a detailed as possible; and making an iteration process of the data.

3.3. Data Analysis

The data was collected following Gioia et al. (2013) and the qualitative content analysis. Interviews were recorded for those that allowed. Some experts preferred not to be recorded and only allowed to take notes about the interviews, since they indicated that some of the information they were providing was sensitive and strategic to their company. Recording and notes from interviews were transcribed using the transcription tool from Microsoft word and later analyzed using NVivo 14 software, a software designed for analyzing qualitative data. In addition, experts video presentations were transcribed and processed in NVivo in addition to the pictures from their power point presentations.

An important task for this research was to clarify the definition of acceptance or adoption of a technology as this research focused on: the factors that influence businesses' decision-making process to adopt UAVs, and the primary variable to understand the decision to adopt a UAV service by a company. According to Vogelsang et al. (2013) in the past, the term "acceptance" was challenging to define and quantify without other factors like intention to use or actual usage of the technology. Following their experience, a common notion of "acceptance" across all study participants was something this research attempted to achieve. The final decision of usage of the technology, taking into account the user's job and task area, and being the person/group who make the final choice on the adoption of the technology, considering the definition of acceptability by the interviews. This definition acknowledged that different users had different needs while utilizing the technology, but it also took more tangible action by considering the user's working environment as opposed to only the interviewee's intention to utilize it.

Since the focus of this research is on the use of UAVs by firms, this study focused on firms in an industry that has more potential to its use, as indicated in chapter 2. The infrastructure industries possess great amounts of infrastructure that might benefit from flying robots and therefore, with the most potential. This is the case for the wind energy sector, where wind turbines are amongst the most important assets for a sustainable energy supply (Deutsches Zentrum für Luft- und Raumfahrt, 2022). Therefore, the emphasis of the research was on the wind energy industry for the following reasons: a) it possess a serious amount of infrastructure (windfarms); b) and, its market it is expected to continue growing in the future (International Energy Agency, 2021) as the sector of cleaner energy sources is growing across most markets. Specifically, renewable energy sources are among the most competitive energy sources (Nagdeo, 2021). These companies have a diversity of places where the assets of infrastructure are allocated (onshore and offshore). These companies represent a pulling demand for UAVs, as the market for UAVs used for energy is expected to reach US$6 billion (ADM, 2022). From these firms, this author selected managers that had a decision-making option related to potential use of UAVs in their companies. And mainly, this study had access to managers who are evaluating to build or already have offshore or onshore wind farms.

The data was incorporated on NVivo as it allowed for the management and organization. It allowed to better identify and extract core themes and interpret data related to the research question. After a thematic analysis, which went through the information to identify common themes found in transcripts, and using Coding, data was broken down into parts and labeled, as this allowed looking for patterns, connections, and links between codes to extract core themes and interpret and connect to the research question. Later, this was checked with the secondary data to triangulate those variables found (Gioia et al., 2013) for validity and robustness.

Coding was structured in three main stages following Gioia's (2013) recommendations. Figure 3 shows the process where the three are considered:

I. The first-order analysis used the information gathered to diverge and extract categories or "codes," with a potentially significant number of categories following the number of interviews this study had (13). Just as the information was re-read, there was an expectation of reducing the number of categories by finding similarities and finally labeling and attempting to describe them.

II. The second-order analysis focused on understanding concepts[5] that could be identified from the previous step, especially those that might be new compared to those found in the literature. After this, a search to reduce these themes into "aggregate dimensions" was generated. These final products are referred as Factors for this research. Data Structure was generated with these two critical steps. Once again, the literature was reviewed and compared to see if there were examples from what was gathered and if concepts were appearing.

III. Finally, the aggregated dimensions found were revised with the secondary data collected from the experts' presentation to verify the dimensions.

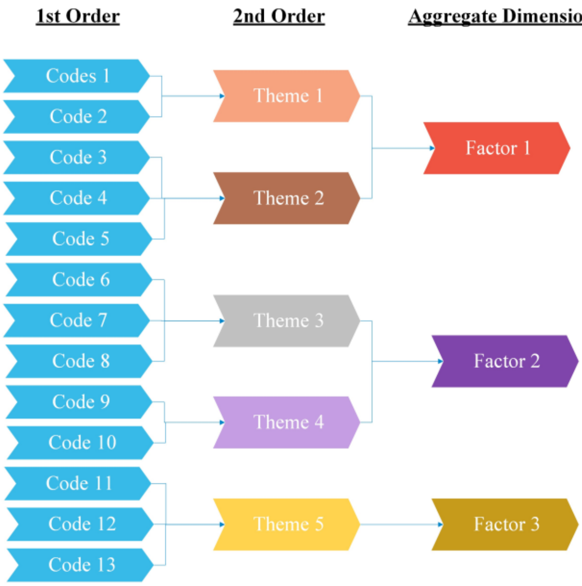

Figure 3. Data Structure of the coding process. Codes created from the data, then a 2nd order theme is created codes and finally, dimensions, which for the purpose of this study will be called factors, are generated. This author's codebook can fully see in Appendix C for more transparency.

3.3. Limitations

Data saturation may have been achieved given the time restraint of 5 months for this research. However, there is more space for relationships between factors as there was a limited number of pivoting during the research process. With more time available, this limitation could have been reduced.

A second area for improvement is that the primary data source was from only one sector, which may have specific factors that are only significant to them rather than others. For example, an industry that requires UAVs for its infrastructure solutions and process in a very urbanized area might have other factors associated with public acceptance. These differences could also affect the relationship between factors found and the decision-making process, where for different industries, it may have a positive and negative effect on others.

A third implication could be a bias by those experts from the conference on UAVs, as they might be more interested that UAVs can be used in companies' processes than others outside

[5] Bryman (2016) has the following definition for concepts: "[they] are the way that we make sense of the social world. They are labels that we give to aspects of the social world that seem to have common features that strike us as significant. The social sciences have a strong tradition of concepts, many of which have become part of the language of everyday life."

the activity. This bias was controlled by starting with the data from managers from the decision-maker companies and then verifying it with the data from the UAV conference.

4. RESULTS AND FINDINGS

Based on data analysis from the primary and secondary data, this author has identified eleven factors affecting the determination of a firm to UAV technology in the wind energy industry.

Experts remarked that in companies, the decision-making includes activities and factors that take place during different moments before the final decision to adopt a technology, which fulfills the Cambridge Dictionary (2023) definition of a process, in this case, focused on evaluating the adoption. Given the importance of adopting new technology for companies, as it helps create economic value and competitive advantage (Pisano, 2015), evidence confirms that the more giant a company is, the more widely they use an *evaluation-decision process* to adopt technologies (Powell, 1992).

Rogers (1962) already recognized that societies, organizations, and even people have processes for adopting technology but did not detail how these are configurated and related to the factors. Experts interviewed in this study described how different the two stages in the process are before the decision point. Moreover, they indicated that the decision to adopt technology is affected by a series of essential factors at each stage.

Therefore, this author will illustrate the adoption process as it consists of two stages. Diagram 1 shows the two main stages, the initial stage, the Acknowledgement stage, and the following stage, the Evaluation Stage, both previous to the adoption of the technology. Both stages will be described in the following two sections.

Diagram 1. The two stages of the process of adoption by a firm and the final action of adoption

Acknowledgement Stage

Diagram 2 shows the factors to be considered in the adoption process during the first stage and how they are interrelated according to the data gathered. This stage starts with an initial knowledge that the firm obtains about the technology and the vendor that offers it. Initially the firm recognizes the existence of the technology which can be affected by the market push generated by the industry and potential vendors, and the market push that this firms generate, whether by a problem-solving or by a tool perspective. The firm will continue focusing on gathering all the information necessary for the next stage, the Evaluation stage.

The next subsections describe the six factors considered by the firm during this stage.

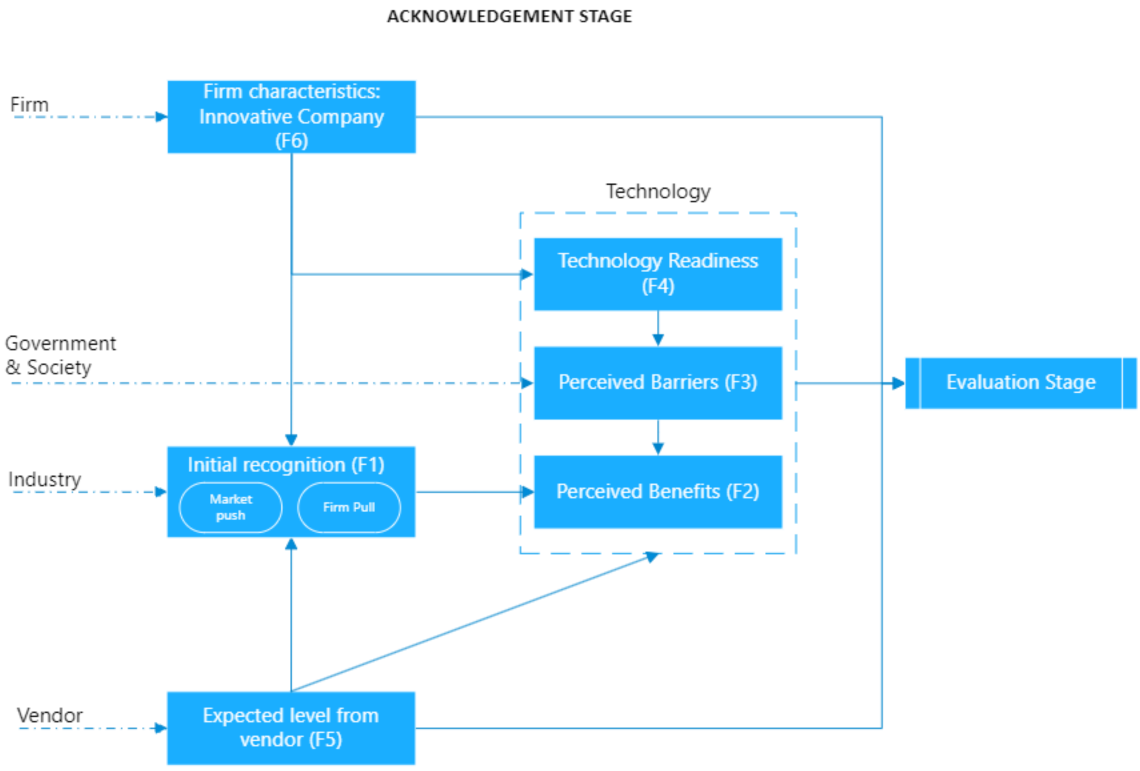

Diagram 2. First stage for adoption of technology: the Acknowledgement stage. From left to right chronologically shows the six factors that come to play a role in the stage, which later connects with the following stage, the Evaluation Stage.

4.1. Initial recognition (F1)

The findings show that there are two main forces that are trying to find a connection in the market of UAVs. The first is the push that the competitors can generate on other companies when using technology and the industry evolution from which the industry belongs to. While the second force is the firm itself as it can contact the technology as it tried to solve a challenge they have, or to understand more about the tool they discovered from the market.

4.1.1. Market Push

4.1.1.1. Competitors, Vendors and Industry Trends

The adoption of UAVs based on market trends and competitiveness emerged as the first subfactor from the interviews. The energy industry is continuously monitored by experts, who also monitor what their competitors are doing. They would consider implementing UAV technology if a competitor did so and if it makes sense for their particular operating and maintenance setup (Interviewee E10). This was highlighted given that a firm needs to know what the industry is doing so as not to lose competitive advantage, but always take into account the distinctive features of their own business, such as different turbine types and maintenance strategies, as the decision to adopt UAVs is not solely based on the actions of competitors but also the suitability and applicability of the technology to their specific needs. In addition, experts emphasized that their industry was a fast evolutive one in comparison to the oi & gas and that the challenges they have push their companies to push for innovations, which goes in line with Koch et al. (2021) findings that industries where the company belong to can be a factor for the adoption of robots.

This push includes a vendor marketing and contacting firms. As one expert specified that suppliers frequently contact them with new technologies and benefits (Interviewee E12). Before considering adoption, participants underlined the importance of examining and confirming the claims made by technology suppliers. They employ various channels, including direct contact and research, to gather information and assess the technology's suitability for their operations.

4.1.2. Market Pull

The results revealed a second subfactor that was centered on problem-solving and the investigation of new technologies. Experts emphasized the energy sector's difficulties, including getting to offshore wind farms, caring for giant turbines, and dealing with safety issues. They agreed that UAVs could address these issues, enhance productivity and safety in various operations, and new tools may be discovered or presented to the company, and if they seem helpful, could be included as one of their usage options. As Maghazei et al. (2022) indicates “many emerging technologies, including drones, were developed for non-OM (Operations & Maintenance) applications and are being pushed onto OM problems.” Experts indicated that companies have goals, and so they look into technology to see if it can help them achieve these goals. There are two main ways to approach the technology, the first and probably the most important for the adoption is thru the problem-solving, where the company starts with a challenge they want to solve and that can be matched with a technology. The second is the approach is trying to introduce the tool into their operations, by understanding its existence and finding a potential use for the company in accordance to their goals. Both are explained next:

Approach by Problem-Solving: According to the interviewees, companies' issues motivate one strategy for using UAVs in the energy sector. With this approach, businesses pinpoint specific issues or roadblocks in their operations and look for ways to address them successfully.

One interviewee mentioned the need for various access methods for offshore wind farms, such as heavy lift vessels, service operation vessels, transfer vessels, and helicopters (Expert G3). They emphasized the restrictions and limitations related to each access method. UAVs were considered a good answer for quick access exchange and maintenance tasks, especially when other access means were limited. UAVs' capacity to access remote locations, conduct visual inspections, and gather data was deemed helpful for lowering costs and enhancing safety. This issue approach is supported by Interviewee E13 who indicated, "…sometimes it's that you have a concept or a system that … it's giving you headaches all the time, or you think that it could be better that you see some other things. Or maybe I can use this one instead of this system that we have. And then you look and talk to the suppliers, find the approach they have, what benefits the system has."

Interviewee E2, for instance, brought up the issue of bats running into wind turbine blades, which could harm the animals and the turbines themselves. The business actively investigated market options to address this problem, including using machine learning systems with several cameras to monitor the approach of bats to the turbine. This strategy exemplifies a problem-solving mentality in which the business actively seeks thoughts or technology to lessen particular operational issues. In addition, Interviewee E13 stressed the significance of recognizing problems and locating appropriate solutions. His company follows a philosophy of being a first runner, continuously seeking new concepts and technologies to improve its operations and strengthen its business case.

Experts also covered the significance of being proactive in recognizing and resolving issues. They stressed the need to continually look for novel ideas and technological advancements that could help them run their business more efficiently. UAVs were viewed as a component of a larger strategy for innovation and ongoing improvement. Identifying particular challenges or opportunities and evaluating viable solutions inform adopting new technology.

Approach by the Tool: The availability of new tools and technologies is a different approach to using UAVs in the wind energy sector. This strategy entails studying the industry, keeping an eye on new technologies, and thinking about ways to incorporate them into operations or replace current practices. Even if they do not currently have an issue but if they perceive a chance for change, they create business cases for potential solutions. For example, Interviewee E1 mentioned that his company actively seeks out new technologies offered to them, and Interviewee E13 said, "sometimes you don't have a problem, but you see something that is interesting that can give you a better improvement in your way of doing things and improve your business case." They explore channels, such as direct contact with suppliers or research, to identify potential tools or technologies to benefit their operations, or vendors approach them to offer the technology. This helps them to be in constant advantage to their competitors as it to find first a technology that will improve their operations.

Experts suggested that their companies are open to evaluating new offerings and considering their potential value. However, Interviewee E10 emphasized that his company adopts a selective technology approach, which means they keep track of industry trends and initiatives but only adopt a technology if it makes sense for their specific operational and maintenance setup. In addition, they evaluate they integrate the alternatives during the evaluation process to the tool and the service.

4.2. Perceived benefits (F2)

Companies are more inclined to invest in technologies that offer a greater benefit for their business over time. This was highlighter during interviews with experts from the energy industry. Therefore, obtaining information on the new technology's benefits—which may be economic-technical, safety, image, or environmental—contributes to the acceptance/rejection by the firm.

The technology must prove that it has the potential to be a good project or can deliver a significant benefit. Wind energy companies can only devote time and resources to research the technology further if the benefits are significant. The experts underlined the need to grasp the technology's benefits, which ultimately might include lowering operational expenses, increasing output, eliminating hazards, and boosting efficiency. This shows that as information increases, the uncertainty decreases.

4.2.1. Technical benefits and use case impacts

The subfactor focuses on the UAV technology's product and service offerings, highlighting its technological benefits and how it improves operational effectiveness. UAVs, in the opinion of experts, significantly improve quality and efficiency by reducing human interference (Maghazei et al., 2022). UAVs reduce expenses and increase quality by eliminating the need to send employees overseas for inspections manually, as underlined by Interviewee E6. Interviewee E9 agreed and discussed how UAVs could replace expensive and dangerous operations involving human specialists descending and hanging. The experts also noted UAV capabilities as another component of technical quality. Flight time and payload capacity are two crucial features that Interviewee E10 mentioned. Longer flight times and greater cargo capacities allow UAVs to cover wider regions and transport cutting-edge inspection tools, enabling more thorough and adequate inspections. These qualities are essential in the energy sector, where equipment like wind turbines and solar panels is frequently dispersed over large distances. Businesses can strengthen their asset management, inspection processes, and decision-making by utilizing UAVs with longer flight times and greater cargo capacity.

The potential for cost savings and improved efficiency through UAVs was a vital subject from the interviews. The experts outlined several ways that UAVs can help achieve these goals. As indicated by Interviewee E9, UAVs can expedite inspections, enabling more frequent evaluations of asset status. This regular revision enables businesses to detect problems promptly and implement fixes, lowering downtime and maintenance expenses.

Interviewee E8 stressed the importance of thorough inspection reports and the valuable data provided by UAVs. These reports offer a comprehensive range of data, facilitating a better comprehension of asset performance and quality. This improves decision-making and makes it easier to take preventative and proactive measures. One essential factor emphasized by Interviewee E11is the availability of precise and timely data. Interviewee E11 emphasized the need for high-quality and easily accessible data to leverage UAV technology's advantages. Companies can optimize operations, improve performance, and guarantee asset reliability thanks to data-driven insights.

Finally, Interviewee E1 also emphasized how the automation provided by UAVs decreases operational downtime. Businesses may expedite operations and reduce human error using UAVs' precise and autonomous capabilities. Expert G3 also highlighted the digitalization element of UAVs, highlighting their potential to replace manual inspection operations with automated, data-driven processes.

These technical benefits can be reflected with the use of use cases, which can be viewed as a type of problem-solving that employs a specific technical intervention while varying the related contexts and aims in order to seek valued solutions. Increased operational effectiveness and cost savings follow from this, which could make the adoption of UAVs a more cost-effective capital than human labor costs (Koch et al., 2021) whether by acquiring or hiring as a service. All potential use cases help drone vendors and prospective customers findings common ground (Maghazei et al., 2022).

4.2.2 Safety

Experts highlighted the importance of safety in the work environment as a very important subfactor for the wind energy industry's adoption of technologies. This industry is characterized by big infrastructures requiring construction, maintenance, and operation that require physical work in part of their processes, which could generate physical hazards to workers (Expert G3). For example, for the maintenance phase of the wind farms, workers have to carry parts up to the top of the wind turbine and then hang with ropes from 100 meters to do the necessary repairs, plus they travel by boats or helicopters. Interviewees indicated that UAVs might help decrease or eliminate these risks and therefore increase the levels of safety, reducing the manual tasks and human interaction with these hazardous processes (Interviewee E3).

4.2.3. Environmental

The interview transcripts revealed a consistent theme: environmental advantages. Interviewees FC and KE stressed the decrease in CO_2 emissions as a key benefit of implementing UAVs in the energy sector. The "huge reduction of CO_2" attained by UAV use was noted by Interviewee E4, demonstrating a beneficial effect on sustainability depending on the case use that this technology is given. Like Interviewee E4, Interviewee E1 talked about the significance of environmental impact assessments and how UAVs can help with problems like dust and carbon dioxide emissions. Interviewee E1 asserts that the potential of UAVs to aid in resource conservation and lessen environmental effects may favorably affect granting environmental and social permits. These quotations demonstrate the acceptance of UAVs as a viable tool for the energy sector's emissions reduction and environmental performance improvement.

External actors can create this benefit, as is government. Some regulations, for example, the European Emissions Trading System that sets caps on the CO_2 emissions for specific industries, could generate a perceived benefit to using electrical UAVs that can help a company reduce their CO_2 (Reuters, 2023).

4.2.4. Company image

Another benefit, only some experts mentioned and with less importance, is positively improving the firm's image in the industry, among investors, society, and future potential company workers. With the use of UAVs, the firm may seem like a technologically sophisticated and computerized firm helps the marketing of the firm, or it could be helping reduce the CO_2 if used on its electric forms, which goes in line with helping the environment, which is of interest to society (Rafi, 2021). In addition, experts stressed that brand image is crucial for their business in the competitive industry, given that it helps them attract new talent and sets them apart from other organizations (Jones, 2021). Interviewee E1 recognized that although using UAVs may lessen the demand for human work, he did not visualize society seeing negativity using UAVs in their industry.

4.3. Perceived Barriers (F3)

The study found a number of obstacles to technology adoption, with a summary of the ones that are most prevalent. Each major barrier is subsequently discussed in detail. It is believed that these restrictions may progressively lose some of their perceived influence as more businesses adopt the technology.

4.3.1. Safety

4.3.1.1. Risks and hazards

The usage of UAVs can be seen from a benefits perspective as beneficial for safety, but it also raises safety issues with its use, which is a key theme that came across in the interviews. Participants stressed the need to prioritize safety and voiced concerns about possible collisions and accidents. As Interviewee E12 said, "[if we] look to products that are out there like a taxi driver (using UAVs to transport people from onshore to offshore), that sort of sits great with some people that can't wait to do it and other people [will say] no way. I'm not a pilot. I didn't sign Up for this, that's not how working offshore it should be". They underlined the significance of ensuring the UAVs work safely without threatening people or damaging property. Safety concerns were repeatedly emphasized as one potential main barrier when considering the adoption of UAV technology. Experts highlighted concerns regarding the risk of injury from UAV use. They emphasize the need to prevent mishaps and ensure the UAVs do not collide or injure anyone. Additionally, they stress the importance of controlled operations and safety precautions (Interviewee E10), as, for example, particularly large UAVs carry significant weights and may pose substantial dangers if not adequately controlled.

Finally, it is important to understand that these issues are differential according to the use case that the UAV is applied. A photographic inspection use of the UAV might be less risky than using UAVs for transporting personnel from onshore to offshore.

4.3.1.2. Acceptance by personnel from the firm

Acceptance and perception were significant barriers driving UAV adoption in these companies. In a less portion, some participants raised concerns about the difficulties in winning support for routine UAV operations, particularly from employees who might feel uncomfortable using the technology (Interviewee E12). Integrating UAVs into daily operations was a substantial adjustment, and some could object. Depending on whether UAVs are seen as a disruptive or enabling technology, technical personnel's attitudes may need to be more amenable to change. For example, Interviewee E12 said, "Technology works, [as] it's doing what it needs to do, but actually having the acceptance [from personnel] for that to be part of routine operations is a very different thing. So there's a big hearts and minds battle, you know, for example, what if we started transferring people from Vessels to the top and nasals in an aircraft." This acceptance will depend on the use case for which the UAVs are used.

4.3.2. Regulations and standards

The concern about regulations has an essential component on safety, as the deployment of UAV technology in the energy sector depends critically on norms and laws. Experts stressed the necessity for UAVs to go through technical qualification processes and acknowledged the existence of rigorous regulations and safety measures governing UAV use. A crucial aspect of the decision-making process was identified as compliance with these safety norms and standards. In addition, social acceptance of communities (for example, where infrastructure is close to urban areas) and the legal repercussions of using UAVs were also emphasized. Experts underlined how crucial it is to address community concerns to avoid rejection and detrimental effects. Negative repercussions of using UAVs could be complaints from communities, which need to be minimized in order to be able to implement UAVs in projects. In addition, it was highlighted that UAV technology should be used responsibly to guarantee results and prevent unanticipated adverse effects.

4.3.2.1 Regulatory compliance

In order to ensure safe and legal UAV usage, experts underlined the need for businesses to follow local laws and secure the required certifications and licenses. Compliance with regulations was considered essential to ensure safe and legal UAV usage within the industry. Quotes such as "And, obviously, [we need] that the company fulfills with the local legislation" (Interviewee E2) and "The real hurdles that we currently see are the regulatory [ones]" (Expert G4) highlight the importance placed on complying with regulatory requirements.

An important issue was recognized as having outdated or insufficient laws, as they frequently need to cover particular use cases or technological developments related to UAVs (Interviewee E12). This emphasizes the requirement for current and pertinent regulations to make it easier to include UAVs in wind energy operations. For example, Interview F8 indicated that "especially when you will have to move beyond the line of sight and for unmanned UAVs, automation is tricky at the moment. There is still uncertainty in regulation."

Additionally, in the data analysis, it was found that acquiring permissions and clearances for UAV operations required stringent procedures, assessments, coordination, and adherence to safety rules which could generate a problem in delivering the required regulations that companies need. Permissions from authorities or specific stakeholders, such as owners of wind farms (Interviewee E10), are frequently required of businesses and are a minimum necessary to work.

4.3.2.2. Pilot certification and quality

Finally, there is essential for the industry to work with certificated and trained UAV pilots. The experts emphasized the requirement for qualified people with a thorough awareness of safety regulations, operating processes, and technical skills. The safe and responsible usage of UAVs in energy-related applications was deemed to require training and certification programs.

4.3.3. Risks to infrastructure and UAVs

Because the primary infrastructure, in this case, is a wind farm, which serves as the cornerstone of the company's production, experts are aware of the possible harm UAVs could bring to wind turbines, which are significant assets in the energy sector. This expert (Interviewee E2) emphasizes the importance of adequately considering turbines' physical integrity and functionality when introducing UAVs into operations. This also applies to UAVs, as the infrastructure—in this example, moving blades—could endanger the flying machines (Interviewee E10). As intrusive as UAVs can get, their operations may cause problems with the structural integrity of wind turbines. The fact that wind turbines pose a significant risk highlights the necessity of caution and meticulous planning while deploying UAV activities close to these assets.

4.3.4. Costs of the technology, integration with company processes and infrastructure impact

Costs might be critical in establishing the viability of using UAVs for various use-cases in a business. As a result, experts stressed that while considering the installation of this technology, it is critical to examine the financial element. Although experts did not consider hiring a UAV service or buying the technology to be an exorbitant financial investment, their remarks centered on their existing experience utilizing UAVs for inspection purposes rather than addressing other use cases that would require more advanced UAVs. However, while exact cost figures were not revealed during the interview, the experts underlined the importance of assessing costs against potential advantages throughout the review stage, but given the importance on safety and quality of these companies, reducing cost and compromising quality was not possible (Ali et al., 2021).

Another type of costs that experts mentioned as a very important was the costs of integrating UAVs into their organization, infrastructure and processes (Geroski, 2000). Ali et al. (2021) found that costs of implementation associated to changes in process and infrastructure are one of the most important determinants of adoption of UAVs by companies. Similarly, experts in this study stated a strong desire to achieve as a seamless integration as possible for their firms.

They stressed the critical need for operational and system integration that is particular to their context. As Interviewee E12 stated, "any company entering the market needs to fully understand the logistical challenges and the way we deal with our logistics offshore to form a good offering." This claim emphasizes the value of developing a thorough grasp of the operational needs and limitations experienced by energy corporations during offshore activities. Aligning operational procedures with the UAVs' capabilities and constraints is essential for successfully adopting UAV technology. The successful deployment of UAVs in the energy industry depends on maintaining interoperability with existing systems. System compatibility is critical for efficiently integrating UAVs and promoting collaboration with operational systems. UAV service providers must adjust their technology and services to interact smoothly with the activities of energy companies. Such integration can significantly improve the efficiency and efficacy of energy operations, hence encouraging broader adoption of UAV technology. For example, experts stressed how crucial it is to integrate UAV technology with the well-established flight management and coordination systems energy firms use for their offshore and marine helicopter operations.

Finally, experts also indicated that the infrastructure might need to be modified or gathered for UAV adoption to succeed, which might mean a cost for the firm. The experts pointed out, for instance, that UAVs used for logistics may need specific landing sites on windmills, ships, or land-based locations, and thus, requiring necessary adjustments and ensuring the availability of suitable landing locations might be difficult. To get beyond these obstacles, integrating UAVs into the current infrastructure of energy firms requires considerable design and consideration.

4.3.5. Perceived Low benefits

The research indicates that businesses may be concerned about the UAV technology's possible limitations in the energy sector. They are concerned that the promised technology and benefits may not be as tangible as they appear once implemented. Interviewee E3 points out that if the inspection quality is poor, even if a top-of-the-line UAV is employed, its usefulness will be jeopardized. Interviewee E10 is concerned that a particular process might not be calculated as expected and that, once implemented, it could require extra resources, such as extra UAV pilots for certain operations, like cargo lift or transport, which can have limitations and impact overall efficiency. The comment from Interviewee E4, who underlined that failure to satisfy key performance indicators (KPIs) or contractual requirements can lead to contract cancellations, supported the concern over insufficient benefits. These concerns highlight the necessity of addressing issues related to inspection quality, operational constraints, and the capacity to meet performance and contractual expectations. Companies in the energy industry can be cautious about the practical benefits of adopting UAVs and seek assurance regarding their effectiveness.

4.4. Technology readiness (F4)

A significant element in UAVs' adoption in the energy sector has been revealed to be their level of maturity. Experts indicated reservations about investing in unproven tech and underlined the need for established businesses that can provide trustworthy services. One interviewee (Interviewee E12) stated, "We don't want an immature product... We want somebody who's matured to the market." Other interviewees confirmed this viewpoint and stressed the value of investing in established technologies to prevent potential setbacks and productivity losses, as experts highlighted the need for the product to be well-developed, tested, and have a track record of successful applications. Firms need the technology to do what they require to do to feel that it is mature and according to their quality standards. Given that wind energy companies prefer to use UAVs as a service instead of purchasing or producing them (this will be explained in more detail in section 4.7.2.3.), the maturity of the vendor affects the technology readiness. There is a demand for well-known businesses with a track record of providing UAV services. Given that for new technologies, it might be possible that firms have no clear access to comparative data about the technology being used and experimented. It is therefore that organization attempts to determine the maturity of a new technology and/or capability (Mankins, 2009), and experts mentioned that using pilots could help them achieve this goal for new technologies.

Moreover, interviewees highlighted the rapid evolution of UAV technology and that it might be necessary in some cases to wait for the market to mature further. The interviewee (Interviewee E10) mentioned that while UAVs would be a valuable tool in their operations, they still perceived the technology as being in its early stages and emphasized the need for more maturity. Particularly in terms of the technology capabilities and limitations, it was highlighted that this might still be a challenge. It is expected that technologies can adapt as the industry evolves too. To conclude, interviews indicated that the technology is ready to be used, but there are still challenges that have to confront. Interviewee E6 indicated, "[UAV technology] now is less novel but it is not standardized yet, we need to see how are the capable assessments and how it impacts the processes they have."

4.5. Expected level from vendor (F5)

New vendors in an industry might be classified as entrepreneurial startups or businesses diversifying from other industries. When startups dominate, both the industry and its underlying technology confront legitimacy concerns, as the success or failure of the early movers sets a precedent for subsequent entrants. In contrast, when established enterprises enter an emerging industry, they can compete effectively by leveraging their reputation and complementing assets (Giones & Brem, 2017). Experts indicated that the vendor expected level affected how the technology is perceived as a technology that is ready for prime time, as the technology's process of use depends upon a provider of this service, in this case, the vendor. The vendor level also affected the potential barriers for adoption, for example, if the vendor had expertise and knowledge about regulations, ran a responsible business, aligned to the compliances of the company, and provided a service and integration costs accepted by the firm. Furthermore, finally, experts commented that this factor affects the perceived benefits as it can understand the industry and use case value hidden in the service to provide and the technology used. However, experts still expected certain levels and characteristics from vendors themselves that were evaluated as a factor during the evaluation stage for the adoption of UAVs. These are described below:

4.5.1. Vendor's previous experience

After the data was analyzed, it became clear that the vendor's prior experiences were a recurrent theme. The experts emphasized the significance of supplier and product maturity in the uptake of UAV technology. Interviewee E12 stated, "[it] involves looking at a mature product and you know that product needs to have experience being used," highlighting the need for a product tested and proven in real-world situations. "We always do a vendor quality check... And they need to have a track record" (Interviewee E10) as it demonstrates that the supplier has successfully delivered similar services or products. Companies favor suppliers who have invested resources in their development and have advanced their products or services beyond the prototype stage.

Interviewee E11 indicated that they must check four possibilities "They have already done it, they have not done it. They have already tried it, [or if] they have not," This experience required would be better appreciated for these types of companies if it is experience abroad. The experts stated they preferred vendors with experience using UAVs in similar situations. They viewed having international experience as a mark of legitimacy and dependability.

Nevertheless, this vendor experience also has to do with its significant industry experience as it is valued by businesses, particularly in an industry like wind energy. For experts, experience shows that the provider is knowledgeable about the particular difficulties and needs of the energy sector, which increases their dependability and ability to provide high-quality services. The vendor's readiness and capacity to meet the demands of a sizable market are referred to as maturity.

4.5.2. Expected compliance and assurance

Geroski (2000) mentioned that vendors "can often be the deciding factor between successful, rapid diffusion and outright failure." Companies request that their suppliers follow specific rules and prove they *comply with the law* (Interviewee E2). Regulation adherence guarantees the security and legitimacy of UAV operations within the sector. Suppliers may be required to adhere to a company's internal policies and standards, such as safety procedures, quality control measures, and ethical standards. These guidelines are essential for building confidence and ensuring providers can fulfill the requirements for conducting business. Because it poses legal risks and sparks questions about safety and moral behavior, breaking the rules and business policies can significantly impede adoption.

Financial stability and *resource availability* are critical considerations for companies adopting UAV technology. Suppliers need to demonstrate their financial capacity to sustain their operations and meet the demands of the market, "We want them at least to come with something that it has been a prototype or something that they have done properly they have tested it before we go… if we have to go and finance all of the companies that come with the good ideas, then we don't have a finance for our own projects" says Interviewee E13. Companies want to ensure that their suppliers have a solid balance sheet, indicating financial health and the ability to fulfill their commitments. "So they need to have a bit [financial] and they need to be healthy, they need to be a healthy company." (Interviewee E10) Financial stability is essential for minimizing risks, such as suppliers going out of business or compromising safety due to budget constraints. Companies also consider the availability of resources, as they cannot finance all the companies with promising ideas. Vendors must show that they have invested in their products or services and can deliver on their promises. This helps companies avoid investing in immature products or startups that may not have the resources to scale up effectively.

Commercial agreements have been noted as a critical element in the uptake of UAV technology. Business managers raised concerns regarding the UAV technology vendors' suggested payment structure. One expert raised concerns about upfront payments and the requirement for financial flexibility, saying that the suggested business structure might need to be more practical for their company. Another professional stressed the value of bargaining and developing a payment plan that benefits the provider and the customer. Businesses must evaluate the viability and sustainability of the business concepts that are put up to them. Experts noted the necessity for business models that complement their organizations' objectives and financial resources. They voiced worries about contract management fees, payment schedules, and the potential for exclusivity or advantages. This shows that negotiating a commercial deal that benefits both parties is essential for UAV technology to be adopted successfully in the energy sector. Furthermore, firms are looking for business models from vendors that offer long-term value and allow them to accomplish their goals while posing the fewest risks.

Another significant factor revealed in the interviews was *service level*. Experts emphasized the need to develop a comprehensive service around UAV technology. This entails owning the appropriate aircraft and providing after-sale services like technical support and training. The experts emphasized the value of a reliable and accommodating service, mainly when prompt assistance is necessary, suggesting that businesses consider using UAVs.

4.6. Firm characteristics: Innovative company (F6)

Several interviewees cited the existence of specialized innovation departments or teams within their firms, who in some cases were in charge of investigating and recommending new technologies to other areas of the company, encouraging an active attitude to innovation. This finding suggests that businesses with established innovation departments are more likely to adopt UAVs because they may have a team that is committed and focused on actively seeking out and evaluating new technologies or fostering innovation processes to discover novel solutions and tools, such as UAVs.

The interviews also suggested that being a part of a team that prioritizes innovation significantly impacts the potential success of adopting an UAV. The interviewees highlighted that management pays more attention to and supports a team that is committed to innovation and has specific goals because, in their words, "you are much more focused if you are part of a team that is working and focused on getting innovation on their agenda." This targeted strategy enables improved resource and effort alignment to pursue innovative objectives. In addition, Interviewee E13 indicated that having a department specialized in innovation helped to obtain more support from top managers in the company on adopting the new technology.

The firm's fast-paced and agile approach is the second issue related to its attribute. When analyzing innovations, interviewees underlined that businesses must act quickly in decision-making and execution. They spoke of a sense of urgency in innovation endeavors, saying that "we do what we can learn and we get it done at a fast pace" and that delays frequently result from waiting for in-depth input or involving too many stakeholders. Businesses prioritizing efficiency and agility will be better able to take advantage of possibilities and stay one step ahead of rivals in embracing UAV technology.

The interviews showed that these quick-thinking companies had a responsibility to develop quickly. They strongly emphasize having the courage to try new things, learn from mistakes, and take measured risks. By functioning in this way, businesses can shorten the time needed for research and development while accelerating the adoption process. This flexible strategy helps businesses that may use UAV technology to improve their operations while keeping a laser-like focus on safety and legality. These findings do not suggest that this traces decrease the barriers, but instead generate more tools to evaluate them, decreasing the time to adoption.

These characteristics go in line with what Hidalgo & Albors (2008) mentioned, as "from an internal perspective, innovation is driven by senior management attitudes, marketing, information technology departments and the organization's employees. Collaborative efforts support and facilitate the innovation management process." The findings about the firm characteristics imply that the likelihood of effectively implementing UAV technology is increased by an organizational configuration that graphically communicates the significance of innovation and offers a clear implementation roadmap. These findings are aligned with (Cohen & Levinthal, 1990) original theory of absorptive capacity, which relates that firms can acquire and assimilate knowledge and exploit or use the knowledge that has been absorbed (Harrington & Guimaraes, 2005). Even though they focused on IT technology, they suggested that firms with this capacity have a higher rate of technology adoption.

Almost all interviewees reflected that the industry was a very fast paced in terms of technology and that may affect the adoption of new innovations. This goes in line with Sepasgozar (2012) who indicated for example that in comparison, the construction industry, companies in this field are cautious and avoid risks when it comes to adopt new technologies, as they prefer to wait until a technology has been proven successful by other companied, particularly competitors, before implementing it into their own operations.

4.7. Evaluation Stage

The second stage is the Evaluation stage, which heavily affects the adoption of new organizational technologies. This stage focuses on evaluating the different inputs gathered and acknowledged in the previous stage and deciding an action on the technology, whether to adopt or not to adopt it. Decision-makers adopt the technology based on their job mission and the company's goals following their beliefs. This author describes in this section the phases of the evaluation stage and the key factors that moderate the decision and the decision-makers involved.

On the next page, Diagram 3 graphically shows the substages that this stage is divided, which experts indicated have two different focuses. The substages are the qualitative and the quantitative, and they can occur chronologically one after the other (first the qualitative and later the quantitative), or only one occurs during the process before making a decision. The first substage is related to the qualitative focus that relies on more subjective, market and technological decision criteria. In contrast, the second substage focuses on a more quantitative perspective and rational and financial-indexed decisions. For any evaluation of technology adoption, money is an essential input (Stadler et al., 2021). However, the primary importance relies on the expected benefits that can be evaluated, considering the costs associated with these benefits. This means that depending on the manager and their criteria and goals, he or she could focus on different types of benefits perceived from the UAVs in comparison to the costs. These will be described in more detail in the Qualitative and Qualitative focus substages.

Interestingly, the information obtained from the first stage of the process serves as an input for this Evaluation stage for decision-makers. These evaluations are subject to a cost-benefit analysis, so the greater the uncertainty, or lack of information, the greater the cost versus the benefits. And therefore, negatively affecting the decision to adopt. And the opposite goes to the less the uncertainty, the less cost, therefore positively affecting the decision. Factor 6 can affect how a company tries to reduce the costs of uncertainty by being more proactive and developing tests that could help them find a technology that provides comparative advantage and that has not been used previously (Porter & Millar, 1985).

In addition, this author's findings show that, as depicted in Diagram 3, organizational costs of implementation can affect the decision-makers participating in the evaluation, amplifying the criteria for evaluation and factors and including potential influencers in the decision. Finally, the firm may decide whether to adopt an in-house strategy or hire an UAV as a service. For simplicity reasons the factors from the previous stage where not included, but they are present during the evaluation stage.

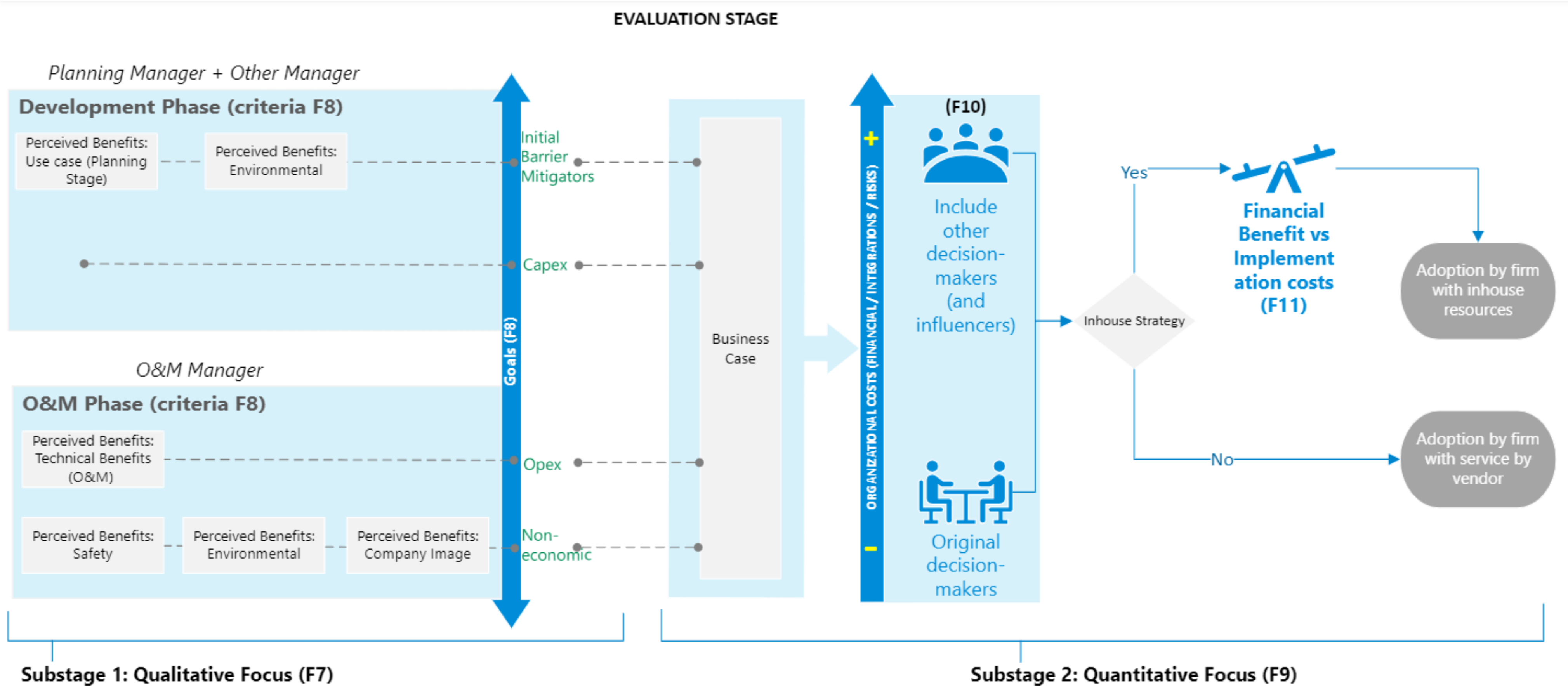

Diagram 3. It displays the second Evaluation Stage—the five moderating factors (identified by capital "F" followed by a number). The qualitative substage is located on the left side of the diagram. Based on the principal decision-maker goals and criteria for the wind farm industry according to their lines of work. These criteria and goals show the specific benefits perceived in relation to the UAVs. On the right side of the diagram, the quantitative substage factor is represented, which includes decision-makers, influencers, and the adoption process. Furthermore, the adoption process can occur either in-house or as a service. For simplicity visual reasons, factors from the previous stage were not included, but they are taken into account for the evaluation substages.

4.7.1 Substage 1.

Following is the description of the two factors associated to this substage.

4.7.1.1. Qualitative focus (F7)

In this stage, the decision maker generates a "superficial" validation of the technology to verify if it is worth the time spent on it, sometimes called a qualitative evaluation. This substage will be affected by the factors from the previous stage. It is expected that this stage has a higher degree of subjectivity involved, as more quantitative methods to evaluate will have higher focus on the following substage. Not always there is a clear division between the qualitative focus substage and the quantitative substage, but some experts commented that the first one could be taken from informal conversations between manager and experts in the area that he or she directs, or developing a formal meeting for evaluation. In addition, to lessen the uncertainty of implementing the innovation, businesses try to be informed about its benefits and drawbacks so that they are aware of all of its implications (Sahin, 2006). Therefore, this stage (or the following) can include pilots or tests with the technology and vendors, especially when there are no previous experience to do a vicarious trial (or observing the technology at work from others). This helps validate information about the technology and reduce barriers (Maghazei et al., 2022), as well to help managers in setting expectations (Maghazei & Netland, 2019) and in the evaluation stage. To do a pilot, given that incurring in the pilot incurs on costs to the firm (time, financial, etc.), there is probably a certain level of acceptance or interest previous to the decision which requires more information to advance in the evaluation process, and is for this reason that pilots are made with the support of firms, and also the reason of why pilots are done during the evaluation stage. A factor that can affect the willingness to do pilots are the characteristics of the firm, whether it is a more innovative firm or not.

4.7.1.2. Manager criteria and goals (F8)

Wind farms are managed as a long-run term projects in the wind energy industry. They usually have a series of phases, but due to their time length, two of the most critical ones are the Development phase (sometimes this includes the feasibility or evaluation, planning, and permitting) and the Operation & Maintenance phase (Brendan Heneghan, 2019). Each phase may focus on different factors according to the goals that the projects has to fulfill in that phase, and therefore will affect the decision-making process of adopting new technology differently. These goals will be reflected in the perspective and criteria that each manager leading a phase has, and therefore in the adoption of a technology. Different audiences with different criteria and goals that have to be matched with the benefits of the UAVs. In this case, we used UAVs when interviewing the experts to assess their potential benefits and investigate what they perceived from the potential use case of UAVs. Each stage is described below:

A) Development phase: In this phase, wind energy companies have goals associated with gaining planning consents, such as environmental impact assessments and project permits, as well as activities required to define the design and engineering features (BVG Associates, 2017). In this stage, decisions are aligned with a capital intensive criteria; for the planning of this project, they focus on reducing costs associated with the capital investment cost (Capex), which denotes the cost of acquiring land and constructing the wind turbine (ARETA, 2020), and the significant financial cost-benefits of the wind farm project in the long run (ETEnergyworld, 2022). In addition, activities also seek significative benefits associated with decreasing substantial barriers that may not be evaluated from a cost-benefit perspective but instead on the possibility of proceeding with the wind farm project are valuable, as is, for example, obtaining a regulatory permit (using UAVs to evaluate the fauna in the area of impact of the project or using UAVs to decrease the impact on birds flying towards the windmills) or following a regulatory rule of reducing CO2 by using UAVs instead of other technologies that may need oil and gas.

B) Operation and Maintenance (O&M) phase: In this stage, managers are more focused on the benefits related to improving the maintenance and operation of the wind farm. As Ren et al. (2021) indicate, the primary objectives of a successful maintenance strategy are to maximize financial gains, increase component longevity, lessen the need for emergency repairs, cut down on overtime labor costs, and lessen the uncertainty and stress brought on by equipment failures. The operational costs (Opex), which includes the expenses on the upkeep and maintenance of the wind generator (ARETA, 2020), and the levelized cost of energy (LCOE) are two indexes that these managers value, but only sometimes in this stage, but more in the following stage. High maintenance costs are a significant barrier to the development of offshore wind farms. Though windfarm performance diminishes over time, appropriate and adequate maintenance techniques and processes can reduce downtime caused by aging equipment (Ren et al., 2021). Specific use cases with UAVs are identified that are beneficial for this phase and align with these managers' strategies. In addition, other non-economic goals that may worry them are essential for this phase, such as safety and image, which could also benefit them using UAVs. A list of use cases related to benefits of the phase of the project can be seen in Appendix D.

Each phase has different perceived benefits that fit into the wind farm project, and therefore each manager has a different perception of the benefits. The same is the case for its barriers. For example, diagram 4 divides benefits according to what experts believe UAVs capacities and vendors service could give a better use case for their goals. In the Development phase, experts expected that a UAV could help, for example, with the revision and planning of the site and generate the animal survey of the area, which could help dimmish potential beginning barriers for the project associated with government regulations. While another example is that during the Operation and Maintenance phase, managers visualize UAVs helping with more cyclical tasks, for example, repairing blades, helping with logistics, and routinely inspecting the windfarms. The technology benefits has to be matched using the use case with the specific audience that it is meant to be, in this case, managers and their criteria and goals. Experts commented that sometimes that is the problem with vendors who come as investors to offer a tool as UAV, but do not try to specifically match the use case related to the specific audience, which will not mean in an adoption by the firm.

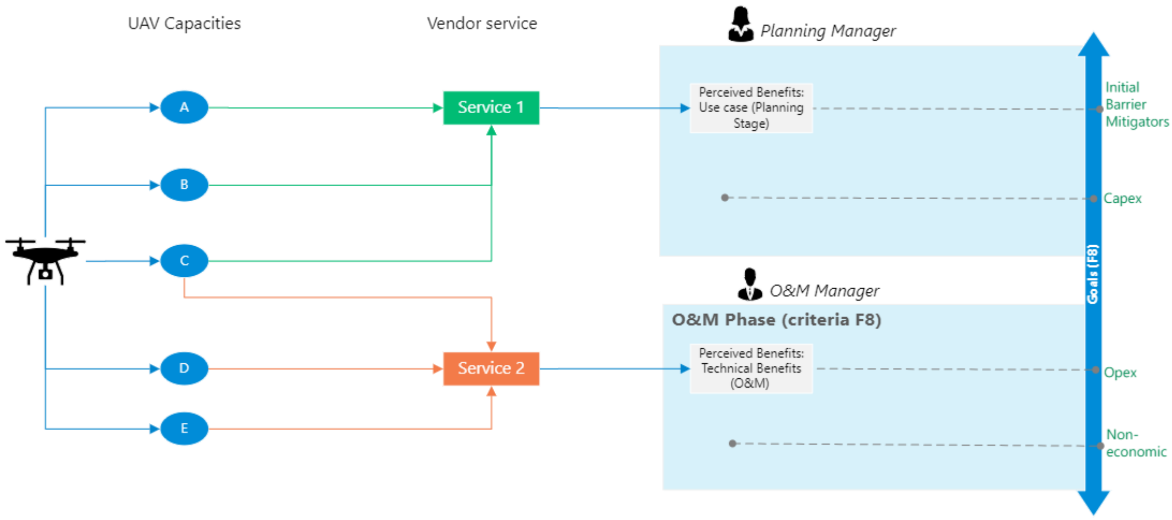

Diagram 4. It shows the specific combinations of UAV capacities and the vendor's service. This combination can provide specific benefits according to different manager perspectives. These benefits are affected by the criteria and goals that managers have in accordance with the wind energy company project's phase and goals.

4.7.2 Substage 2

Following is the description of the three factors associated to this substage.

4.7.2.1. Quantitative evaluation (F9)

This second substage is focused on a qualitative evaluation, where numbers play a more critical deal in the decision of adoption. Factors from the Acknowledgement stage are taken into account. It could be more common that the first substage of Qualitative focus could precede this substage. There are various reasons why the evaluation could pass to a more formal evaluation scenario of substage 2. The costs related to the technology overpass the original manager's decision (Development or O&M managers). This would require other managers with higher financial budget decisions to require a more structured, quantitative revision of the technology. Also, another case could be that, as we will see later in the following factors, the number of participants in the decision increases, or there is a strategy in the firm for adopting technology. These may require to have a more qualitative approach for their evaluation. The original manager's goals and criteria reflected in substage one will be incorporated into the evaluation subprocess, in addition to other managers' perspectives and criteria, requiring a qualitative perspective to create tools that speak a common language between decision-makers.

In that case, the decision may require generating a business case, which can include a more significant number of factors previously described to be evaluated strategically. Experts mentioned that in this scenario of higher costs, the business case plays a significant role when implementing new technologies. This factor represents a subprocess that can include previous factors for the evaluation. Interviewee E1 indicated that "everything translates into that you need to go ask for resources." When it comes to using UAVs, businesses face a typical dilemma. While adopting UAVs can lower variable costs, a trade-off involves incurring a fixed cost when purchasing them (Koch et al., 2021) or comparing the expenses involved with contracting a UAV service from a provider. The experts emphasized the need to describe the cost-benefits of the technology and provide explicit knowledge of how the technology may aid the organization. The business case should illustrate how the technology saves money (Maghazei & Netland, 2019), eliminates risks, enhances operations, helps with project barriers, and or generates non-economic benefits necessary for the company, and therefore, shows how it is a good business for the firm's goals to adopt the technology. The financial perspective is supported by Koch et al. (2021) who investigated the adoption of robots in different industries and found that if the financial benefit exceeds the fixed cost of robot adoption. In this same study, they found that the use of robots for the replacement of lower-skilled tasks and a higher number of manufacturing and production workers in a firm tend to be linked to better benefits from adding robots into the manufacturing process, which this author believes is related to the relative cost that higher skill tasks might require higher costs of adoption. For example, repairing wind turbine blades requires highly skilled limiter personnel that require hanging from ropes in the turbines and manually do analysis and repairs to the blades. These high-skill tasks will require modified processes and infrastructure to adopt UAVs capable of doing the same tasks at better capacities than humans today. In addition, it may include alternatives to the proposed technology and process and if the technology requires a complement initially not indicated by the vendor.

4.7.2.2. Company decision-makers and influencers (F10)

As shown in diagram 3, as costs needed for the integration of the technology to the current infrastructure or processes, or the potential costs associated to risks increase with the potential use of this technology, keeping benefits fixed and significant, this will increase the number and type of decision-makers and its hierarchy in order to evaluate the adoption of the technology. It is interesting that not only stakeholders from inside the company could have a significative saying, but there are *decision influencers* from outside the company who could impact the evaluation and, therefore, the adoption decision on the technology.

The impact is more significantly associated with critical assets, such as the engine of the wind farm or the wind turbine tower. If this is the case, the firm could ask the technician company that initially produced and installed the wind turbine to request a pronouncement about the new technology to be applied, in this case UAVs, and to know their opinion about the impact of the UAVs. This opinion might influence the decision-makers on the technology adoption. Another example are insurance companies, whom the firm could request a formal statement about the scope and limitations that current insurance policies could have with accidents caused by the new technology, UAVs, flying on the wind turbine. Finally, the number of decision-makers may increase already at the first substage, but given that their main reason for joining the decision is associated to a potential costs association, their evaluation will be more related to quantitative information and evaluation than a qualitative one, therefore that is why this author suggests that it could have a greater importance during this substage. These findings about business group decisions and influencers go in line with Yu & Tao (2009) who indicate that firms must also address the interests of multifaceted stakeholders when the decision-making process occurs.

4.7.2.3. Firm strategy for technology hiring as a service or purchasing the technology (F11)

Whether or not a vendor should be used relies mainly on the technology's relevance to the core business, the difficulty of internal adoption, and the cost-benefit analysis in the long run. Some businesses outsource everything outside their core competencies and areas of business activity and maintain focus (Darwish, 2021). Other experts commented that firms might want to internalize some of the technology and use cases (services) to save the organization's money as it expands significantly and has higher control of the process (Louise Davis, 2017). For instance, some maintenance and operation-related activities for a wind farm could be partially internalized (in-house), while other firms might outsource practically all of their processes. In the latter situation, if the technology or use case is not essential to the operation of the business, the decision will primarily be based on the cost-benefit analysis of internalizing it for cost savings (extra benefits) and the potential impact on complexity when integrating it into their operations, which may call for new human capital, obtaining permits, and the removal of obstacles outside of their area of expertise (UAV pilot certificates). Some firms may have a division point between what could be outsourced and not with criteria as anything that is not part of the infrastructure of the wind farm or assets (for example, a wind turbine or a substation can be regarded as assets), and that could require constant movements (like a vessel or a UAV) then it might be better to work with a vendor (Darwish, 2021). It will depend on the strategy the firm has lined previously, as it might not be worth it for the business to invest in and create internal know-how, preferring to keep it external with a vendor when these entry barriers rise.

5. DISCUSSION AND CONCLUSION

5.1. Discussion

This research utilized a grounded theory approach to determine the factors and their inter-relationships that firms consider to be important in the adoption of technology by companies. Based on the literature review, this study adds to the existing research on technology acceptance the relevant factors and inter-relationships that influence the business-to-business decision-making of technology in each stage. Through this approach and the methodology followed in chapter 3, this research contributed to the gap that existed in the literature regarding the process that firms follows on how new technology is adopted. The study on the factors, their interrelationship, and how they are considered during the two stages will provide future research to build and improve the acceptance process.

Relative to the Diffusion of Innovation (DOI) Theory, this has input factors (Relative advantage, Compatibility, Complexity, Trialability, and Observability) which in some way can be adjusted to the ones indicated in the first stage of the findings of this study. Rogers (2003) described the decision-making process as "an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation." However, DOI does not try to go into more detail about how this motivation (or motivations) explains the decision-makers actions.

Furthermore, as Lyytinen & Damsgaard (2001) indicate, DOI has limitations related to understanding the organizational structure, critical processes, and key players. Specifically in the organizational context, these authors believe that the evaluation process from DOI is limited and difficult to apply, as it is focused on the inputs that the decision-maker has previous to the evaluation, but does not give more details on how this evaluation process works, in this case, for organizations. This might be because DOI's primary goals are to explain the how, why, and the rate at which an innovation is adopted and spread in a population or social system, which includes a broad perspective of innovation, not only technological but of ideas.

This two-stage framework for organizations has the same intentions as DOI, describing and dividing the adoption process into stages. Similarities can be found between both models, as the **Acknowledgement** stage from this study aligns with the *Awareness* and *Persuasion* stages from DOI, and the **Evaluation** stage from this study aligns with the *Decision* stage in Roger's theory. Some of the factors considered by Roger are also similar to those found in this study; however, a difference with Roger's is that this research focuses on emerging technologies, not ideas. Furthermore, DOI does not explain how factors play a role in his *Decision* stage, and commenting that it is challenging to gather further empirical evidence given the personal decision focus (Rogers, 2003). This research instead found factors influencing the decision-making process during this stage, going more in detail for the context of a company. As is the case, this study explains that companies have responsibilities and tasks to do. Managers have decisions to make and be accountable for the decision-making of a new technology, which is different from personal decisions. Therefore, the factors have to be related to the company's goals in order to be able to explain them to others in the company, which makes the evaluation process more tangible than for an individual consumer of technology.

Since researchers have stated DOI and Technology-Organizational-Environmental framework (TOE) as being very similar and closely related (Baker, 2012), it is no surprise that similar differences appear between this author's findings and TOE. The TOE includes three classifications for factors in a broad way. However, compared to DOI, it does not try to explain the process or the evaluation factors, but rather the organization and technology's input-output perspective and characterization perspective. Some scholars have critiqued the TOE paradigm for presuming that technology adoption follows a straight line. Nevertheless, it has been demonstrated that it is not the case, as adoption in companies is frequently a complex process (Baker, 2012).

Researchers proposing a further expansion of TOE have proposed that adoption studies should consider not just the technological, organizational, and environmental contexts but also task characteristics and individual aspects (Premkumar, 2003). Following these recommendations, this research in relation to TOE, helps to fill this gap. In addition, through the data gathering and analysis process, this research was able to identify factors and stages of the decision process. And it goes beyond and identifies factors that affect the personal evaluation of these individuals, following their goals and criteria under the company's mission and tasks. These are reflected in the responsibilities that managers have according to their area. Moreover, the findings go beyond identifying the decision-makers and how these can vary during the evaluation stage.

Davis model, the Technology Acceptance Model (TAM) and its successors hypothesized that attitude towards the system is a considerable factor whether used or rejected by the user (Bryan & Zuva, 2021). In TAM 2, Davis added two variables to help explain the motives for adoption besides the input factors, including *affective attitude* and *cognitive attitude*. Nevertheless, following Bryan & Zuva (2021) suggestions, the behavior should not be regarded as a goal in and of itself but rather as a means to an end. The primary goal should be on behavior as a fundamental target. Which goes in line, as mentioned in chapter 2, with what

Hedman & Gimpel (2010) indicate, that TAM may not be sufficient for understanding an organization's adoption. Therefore, this research found out that in the case of businesses, it was an important step to consider goals and factors that can affect the decision to adopt or not adopt a technology and how these goals are moderating over the adoption; in this case, by an evaluation process in the company. Relative to TAM, in the business context the hedonic factor has less importance for adoption of technology. As in a business context, even though decision-makers may have both attitudes described in TAM 2, this research found that the cognitive attitude is a more important one as inside the company context, goals and processes push managers to behave according to their mission. These were described concerning factors 7, 8, 9, 10, and 11. This also includes, compared to TAM, factors related to an organizational, industry, and group decision perspective.

It is not the purpose of this research to generate a theory for all forms of technology adoptions, since at this time the focus is on the wind energy industry. Also, as other researchers have pointed out, it appears doubtful that a single theoretical explanation for the adoption and diffusion of all types of inventions can be developed (Baker, 2012). Nonetheless, as shown in this research, existing theories and models on adoption of technology in the organization context are possible to expand with the methodology used in this research, contributing to a better understanding of the adoption of technology.

During the review of the literature, the only research that it was found that focused on adopting UAVs for companies that mentioned an evaluation process was by Maghazei et al. (2022), where they focused on how companies should evaluate the decision to adopt UAVs. However, the mentioned research concentrates on finding the best process for managers to adopt UAVs satisfactorily but their research does not try to explain how companies do the decision-making process. Therefore, their research does not include the main factors in the first stage and does not include other decision-makers individuals. However, it is interesting that some common concepts between Maghazei et al.'s (2022) study and this research are raised, as is the case of the use case, pilots, and two criteria similar to the ones found in this study.

Companies recognize the importance of having efficient and effective decision-making processes in place. Given that strategic decisions significantly impact firm performance and the ability to sustain a competitive advantage. With complex business environments and numerous stakeholders, processes help consider the perspectives of all parties involved. By doing so, companies can make informed decisions that align with their overall goals and objectives (Hitt & Collins, 2007). Processes for evaluation are vital for companies. Each stage comprises different activities and factors or moderators as an essential part of adoption that research has left apart from studying, which is supported Sepasgozar & Davis (2018) who investigated the process of adoption of technology in the construction industry and recognized the gap in the literature of the evaluation process in technology acceptance. Understanding that the decision stage can be a complex part of the process. However, their findings were simplified to the conversations and agreements developed in a negotiation between a vendor and a buyer during conferences, not specifying the factors for the company evaluation.

In therefore, that the results of this study build upon from previous theories in explaining in more detail the process of evaluation, and the factors that moderate this decision, acknowledging that the adoption not only corresponds to an evaluation of benefits and easiness to use versus the barriers, but it mainly corresponds to the missions and goals that the company has, and that are inherent in decision-makers in the organization that they represent, which can include reasons of quality, cost-reduction, and safety, among others.

This study goes beyond previous studies focusing on inputs to a customer or organizational' adoption of technology at a single stage, to generate a framework that includes different stages of the adoption process. And that these criteria can vary depending on the decision-maker and the stage (qualitative or quantitative), therefore perceiving differently the benefits that fit to their needs and the costs, or focusing differently in accordance to the focus of the stage, which finally affect their decision to adopt. Also, from the initial recognition, companies know their goals and look for the benefits from the technology. The challenge approach seems more important as it perceives how it will look at the new technology. Moreover, as previously indicated, the use case allows managers to find the hidden value of this technology.

In addition, this study also goes beyond previous studies to understand how this process could increase the number of decision-makers and how this can affect the evaluation by adding what these other decision-makers can bring to the table.

Furthermore, finally, this study adds to the gap in the adoption of UAVs' explanation for companies by understanding essential factors that affect the business-to-business (B2B) adoption of the technology. It explains the mechanisms for adopting the UAV in a company context, specifically for the wind energy industry, part of the infrastructure industry that has barely studied UAV adoption. Adding to the explanation of their adoption, the factor behind their decision to adopt in-house resources or hire it as a service. Surprisingly, factors that are related to vendors in business adoption of technology have not been highlighted in previous studies, so therefore this study helps to give a better understanding of how these participants affect the adoption; from the factors related to the technology, the *Expected level from vendors*, and the factor *Firm strategy for technology hiring as a service or purchasing the technology* are of particular relevance. Understanding these factors can be essential for marketing purposes of new technological innovations.

For managerial implications, vendors may unlock the value from UAV to firms by keeping the factors and process of adoption at the forefront as they develop their UAV services (Cohn et al., 2017). Moreover, use cases are essential for managers to visualize and correctly evaluate the technologies.

Therefore, the first practical implication from this study is that adoption must be understood as a complex process influenced by several factors and that the ultimate success of innovation adoption, defined for this research as the decision to adopt it, is partially, but importantly, dependent on what happens after the Acknowledgement stage. This means that for providers of industrial UAV services, the effort continues when their product reaches the buyer's first awareness and extends far beyond to meet the evaluation criteria from the many decision-makers in the evaluation stage of the process.

A second practical implication is that these two stages can be combined with internal and external company information to formulate marketing strategies aimed at generating positive adoption from firms but also to firms that desire to adopt technology, as they can see these factors to understand the factors that are important for a positive implementation, understanding that there is a possibility that new factors emerge as necessary for its continuing adoption in the firm in later stages. It is critical to realize that these two stages serve as a starting point for positively addressing a firm's needs to decide to adopt and post-adoption desire to continue using it. This is important from the vendor's perspective, whether they are focused on selling technology or providing a service.

5.2. Limitations and future research

This research focuses on revisiting adoption technology models for companies to include stage perspectives of the process and its factors. However, as with all studies, it has its limitations. First, in this study, there is a possibility of sample bias as this researcher could not find and interview managers who were not thinking about UAVs. This could be because all companies in the industry already see it as a must-do, as they mentioned, and given that they are big companies, they tend to adopt more technologies from Industry 4.0. (Frank et al., 2019). These could affect some factors, as is the case of Barriers. Therefore, future research could amplify the scope of countries and companies to find firms that are not thinking on adopting UAVs.

Secondly, due to the time limits and the difficulty of findings similar interviewees, this author was not able to find a more specific inflection point for a company's decision to adopt or not a UAV and, precisely, to weigh the factors found by their importance in the decision process. Venkatesh et al. (2013) suggest that technology investigation to "engage in mixed methods research [helps] to provide rich insights into various phenomena and develop novel theoretical perspectives." They give examples when using qualitative approaches for emerging technologies and later using quantitative ones to test the models. Therefore, this author recommends applying quantitative research methodology to validate and measure the weight of each factor and proxy, allowing us to understand what factors are more important and confirming the relationships explained in this study.

In addition to the time constraints to develop this research, exploring more in detail the tools and methodologies used for each criterion and understanding more in detail the characteristics of the business case, could be helpful for UAV vendors. This could help connect and weigh the relation between the **Evaluation** stage and the input factors from the **Acknowledgement** stage. For example, the vendor level is expected to be essential to these criteria. And there could also be differences between industries or company characteristics like size. From the first stage of the process, it would be interesting to analyze which initial recognition stage from the technology by the firm has a higher degree of acceptance, the problem-solving or by the tool itself.

Finally, given that all companies that were part of the data used for analysis were big. It would be interesting to understand more profoundly and confirm if the size is an essential factor that affects companies' decisions and strategies to do in-house adoption of technology and explore more in detail what is the ratio of the cost of in-housing related to the size of the company for an adoption decision with internal resources.

5.3. Conclusions

This research analyzed the factors that affect the adoption of UAVs by firms using a qualitative approach. The study provided a detailed view, using the wind energy industry context, by conceptualizing the stages and aspects involved in the adoption of technology by companies. The findings not only corroborate previously discovered elements but also introduce original factors that have not been thoroughly investigated in conjunction with existing models for adoption. This study collected valuable data from decision-makers and proposed a model that explains the early stages of technological adoption. The findings of this study can be used to develop a theoretical foundation for future technology adoption research.

Understanding the evaluation criteria, elements, and participants is critical for understanding how technology adoption occurs inside firms. Existing models frequently need more clarity in applying various criteria, stages, and personnel during the evaluation process, limiting their applicability in real-world corporate contexts. The elements discovered in this study contribute to our understanding of technology adoption theories for businesses by giving a comprehensive, context-specific, and dynamic viewpoint. These findings contribute to a more nuanced and practical understanding of the adoption process, allowing researchers and practitioners better to understand the intricacies and dynamics of organizational technology adoption.

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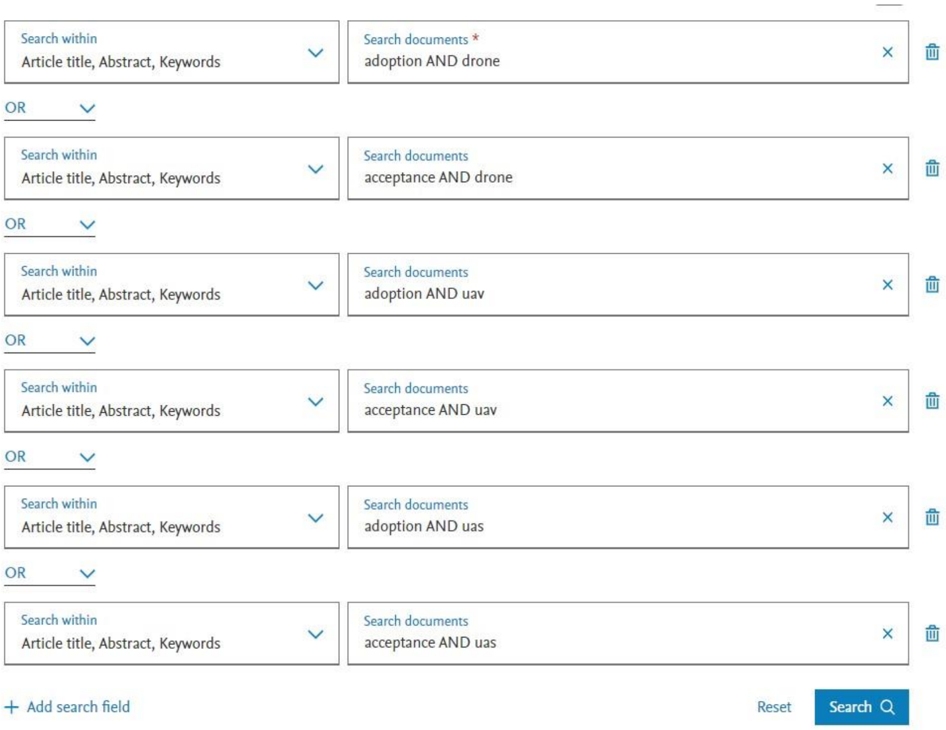
7. APPENDICES

Appendix A. Details of articles reviewed for literature review of UAVs
The revision of the literature to identify the focus of investigation was developed following these steps:

1. A revision of key words using Scope, a well renown comprehensive abstract and citation database for scholarly literature. The Keywords and its combinations were the following:



2. The search was developed on may 19, 2023 and it resulted in 571 research articles. These were download in an excel format, and categorized by analyzing the abstract of each document. The final categorization was the following:

Category	**Number of articles**
Company adoption	2
Company adoption - Agriculture and farmers	14
Company adoption - Construction	9
Military adoption	3
Government adoption	1
Business to Customer	14
Public Acceptance	35
Regulatory - Policies	14
Technical - Use case	267
Other	98
N/A	114
Total	**571**

Appendix B. Semi-Structured interview guideline

SCRIPT FOR INTERVIEW ON FACTORS FOR ADOPTING DRONES

I. Introduction:

a. My name is Alvaro Goncalves, a Master's Student of Business Development & Entrepreneurship at Utrecht University. I am part of a research project, specifically my thesis, on implementing drones in B2B. Ampelmann is interested in this topic, so I am doing an internship with them. I would like to know if it is ok to record the interview to be sure that the information is used in the most precise way possible in the thesis. All information is confidential and no information that can be indicated to a particular person or company will be published in the research.

b. As part of my thesis and project, I am going to ask questions on factors and variables thar academic research consider relevant in the adaptation of new technologies and used in drones within a firm's manufacturing and maintenance processes.

The literature on how businesses implement new technology within the production & maintenance processes, have identified a series of factors that companies should consider. But, the literature provides limited insights into how those factors are used in the implementation of drones.

My interest in this interview is to determine if these factors found in the literature are relevant for companies like yours or what others may be important. And, it is around those factors that I will be asking you questions. I am also open to any suggestions you may have during this interview.

If you desire, I will share with you my thesis findings.

II. Challenges, benefits and use of drones:

1. For this interview and the thesis, please tell me about your role in the company and your experience in the offshore/onshore wind/oils-gas energy industry.	
2. What are the main problems you face during the construction process of windmills? And in the maintenance process?	
3. Based on your experiences, what are the main challenges you face in implementing technology in offshore/onshore wind energy systems?	
4. Will those factors be similar if you implement drones? Do you believe that drones can help to overcome these challenges? If so, in what ways?	
5. Have you ever used or considered using drones for your offshore wind energy systems (or Oil & gas) for manufacturing or maintenance processes? (if they have used them – how many years?) **(If they have not, then go to section III.B.)**	
III.A. Factors from people familiar with drones:	
6. A) compared to the one that you have used already, What would be a better drone for you? **B)** Or what would need to have to use it?	**A) used:** **B) only investigated:**
7. How relevant is the relationship that you have with a provider company? Do you normally prefer	

to hire from a previous company? Or it is not that common?	
8. Under what conditions would you consider a new company?	
9. What benefits do you think the company can gain from adopting new drones in its onshore/offshore wind energy systems?	
10. Are there any concerns or risks your company has regarding adopting drones for offshore wind energy systems? If so, what are they? (Note to me: there are risks/uncertainty to using drones, financial, and implementation/project).	
11. How do you perceive the cost of implementing a new advanced drone for your company? Is it feasible for your company to spend on drone services?	
12. Have you researched or analyzed the potential ROI of using drones for your offshore wind energy systems? What did you find in your research? (idea: if they have not done any research - if you were going to evaluate using drones, what benefits would be the most important for its acceptance, and that you think it would be possible for drones?) (note to me: this idea is related to question 9)	
13. Do you have a policy/rules in your company regarding the implementation of new technology?	
14. Would this policy be the same for drones? What are the differences between this policy/processes/rules for implementing drones? **(Continue with question 15 in section IV.)**	
III.B. Factors from people not familiar with drones:	
6. (Indicate to the person what drones can do according to the literature – **appendix 1**). Do you believe that drones can help to overcome these challenges? If so, in what ways? Why?	
7. What are your reasons for not considering drones?	
8. Are there any concerns or risks your company has regarding adopting drones for offshore wind energy systems? If so, what are they? (Note to me: there are risks/uncertainty to using drones, financial, and implementation/project).	
9. What conditions would have to happen for you to consider drones? (Note: examples of conditions are cost, financing, adaptability, complement or substitute of labor, usability, strategic, etc.)	

10. What kind of information would you need/consider to implement drones for construction and maintenance purposes? (Note: this question is related to 9)	
11. Does your company have a specific policy/process/rule/strategy regarding the use of new technologies? Would that policy be the same if you decide to use drones? (note to me: maybe this question might be better with other questions) **(Continue with question 15 in section IV.)**	
IV. Regulations / Stages / other participants	
15. Are there any regulations or laws that might affect the adoption of drones in your company's offshore wind energy systems? If so, how would it be addressed? (idea: Among the government regulations, which ones do you believe are limiting your company?)	
16. How would the process/steps be for evaluating your company's use of drone services? Which factors would be the most important things your company would have in mind to decide? (Note: for the methodology, it is necessary to make the same question twice).	
17. (If there are other people participating in this process?) What are their main factors for deciding to use drones?	
18. What reasons would make a contract not to be acquired? (note to me: this question should only be asked based on the information received in previous questions).	
V. Conclusion:	
19. In your opinion, are any of the following factors influencing your company's decision to adopt drones for its offshore wind energy systems? (Note: Name factors from **Appendix 2** that the interviewee has not indicated previously)	
20. Is there anything else you would like to add or share regarding the potential adoption of drones in your company's offshore wind energy systems?	

Thank you for your time and your valuable insights.

Appendix 1: Benefits and possibilities with drones

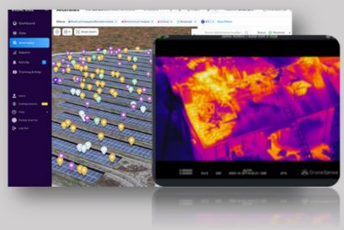
Drones

Transform
- Warehouse management
- Maintenance management
- Lifesaving and disaster management
- Repairing

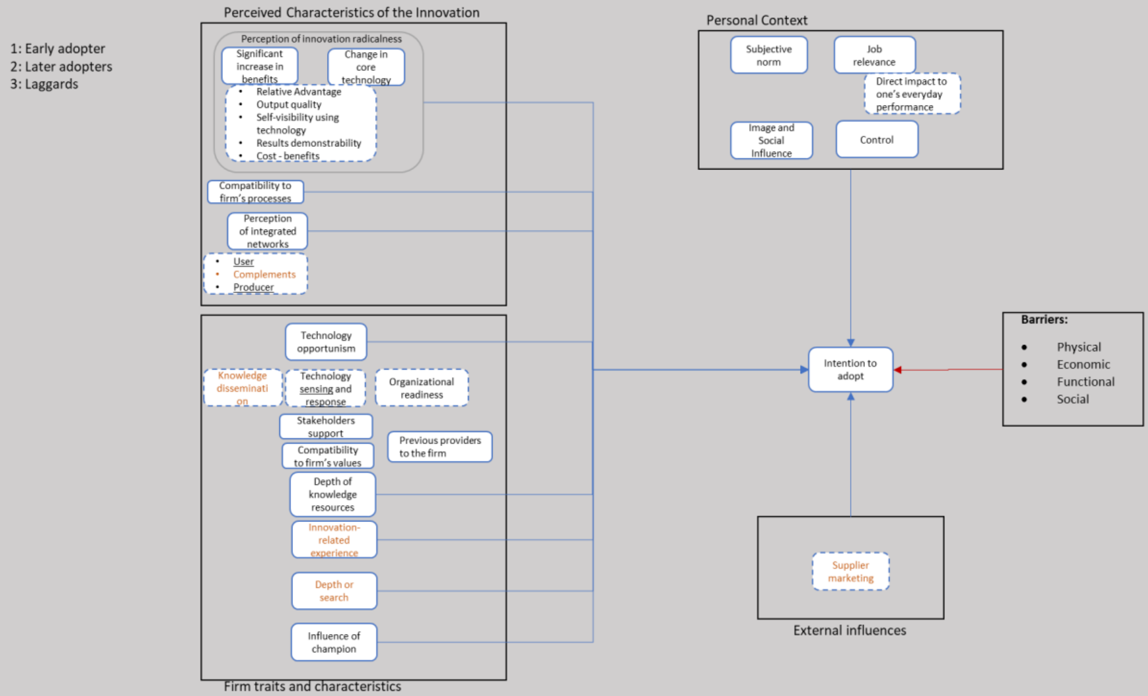
See
- Visual inspection
- Monitoring
- Photography and filming

Sense
- Thermal inspection
- Hazard identification
- Nondestructive testing (DNT)
- Inventory management
- 3D mapping

Move
- Delivery
- Manual spraying



Appendix 2: Potential factors based from models of adoption



Appendix C. Codebook

Aggregate Dimension	Nth orders
Evaluation Stage	
Firm strategy for technology hiring as a service or purchasing the technology	Strategies for maintenance and operation
	Inhouse maintenance
	Big company
	Outsource maintenance
	Smaller company, may rest in the technology operator - outsource it
	Rent a service
	Level of specialization
	Open bidding vs direct bidding
	Why not produce or buy
Company decision-makers and influencers	Health and safety area
	Managers
	Technicians
	Various stakeholders that participate in the decision
Qualitative and Quantitative	Evaluate technology
	Evaluation criteria
	Increase in cost for firm resources to evaluate the system
	Prioritize projects
	Qualitative and then quantitative finance business case evaluation
	Safety and test check
Manager criteria and goals	Documentation and certifications from third parties
	Final report
	Iterations
	Development
	Big impact or low impact to adopt earlier
	Environmental permit then I may due a special contract to obtain permits and in the future we work together
	Capex
	Evaluation stage
	Higher value presented to manager
	How to internally finance this innovations
	O&M
	Top manager applies if cost is higher than budget of the area
	High cost of service
	Cultural or size or main office of the company
	Evaluate company
	Then add to list of providers
Expected Level from Vendor	Product readiness
	It has done tests
	It has experience
	Asks for references

	No experience then we do a pilot
	Previous experience with drones
	Vendor company requirements
	Accident rates in vendor
	Certain financial maturity
	Vendor does not need too much finance
	Certifications
	Increase in risk increase in certificate level and increase in requirements for the company and costs
	Company maturity
	Experience in the offshore sector
	Good employer as a vendor
	Has vendor financed good part of the project already
	Insurance
	New vendors
	Ready to deliver job
	SAP requirements to added to the vendor system
	Team
	Vendor compliance requirements
	Vendor experience
	References
	Vendor policies
	Company will require to add to their own policies
	Policies of compliance can be related to strategies of company in website
	Vendor processes
	Process is customized to that industry and not only has a technology
	Vendor service model
	Commercial structure is good or bad
	Advanced payment
	Confidentiality agreements
	Easy to implement the service
	Post sale fast responses
	Representation in the country of the service
	Service not only technical
	Service process standardization
	Training offered to their personal
	Vendor can survive and compromise the service in the future
Firm Characteristics - Innovator company	Awards to innovation solutions in the company
	Do test with the innovation company
	Technical validation process
	Don’t wait for university research projects because takes too long
	Having a process for innovation

	Innovation department
	Better process for innovation and for presenting to management
	Helps risk adverse areas
	Open challenges - Venture client
	Test solutions after the call
	Work with key areas to generate challenges
	Mandate from top to innovate fast
	Not everybody in the company needs to know what they are doing
	Procurement areas also look for innovations
	Risk tolerance company
	2 years process
	If no experience, we do pilots, but if another comes with experience, you prefer that
	Company generates a toolkit
	The area itself looks for innovations
	Innovation in processes
Acknowledgement Stage	
Initial Recognition	Diffusion of technology
	Approach from Tool or Challenge
	Approach from Challenge
	Approach from Tool
	Company saw it in the market
	They go check vendors
	Vendor approached
	Register in the system as a vendor
	Company Pull
	Do studies
	Search innovations
	Conferences
	Effects of pushing innovation
	Push for innovations
	YouTube
	Diffusion inside the company
	Explaining internally the value proposition for the company
	Then company may require to change certain things from the innovation and that may generate a problem
	Industry push
	Market Push
	Follow other companies
	Initiatives in the market
	Vendor approach them
	Renewable Energy market evolution and challenges
	Compared to oil & gas they do not make us much money

	Compared to todays 4 transportation systems
	EPC - construction future
	Before you need to start with inspection to gain experience
	Fastest growing industries
	Offshore are difficult to access
	If there is an accident with a worker, it is difficult to access
	Repairing and decommissioning
	Windmill evolutions and challenges
Perceived Barriers	Damage
	Are the windfarm still in the warranty period
	Call the Windfarm producer to check technology
	Damage to their infrastructure
	Does windfarm producer has experience with the technology
	How invasive it is the technology
	Integration with company processes
	Company requires to change certain things
	Easy use of suites of data and integration
	How you will put in the vessel operatively
	Includes the logistical challenges
	Integration with company process
	Needs to integrate with our system and vendor still has not developed the system
	Onshore to offshore requires stopping the turbine when landing on it
	Space in the boat
	Time needed for the maintenance
	Weather and zone conditions problems
	No emergency landing sites when onshore to offshore
	Salty spray water
	Strong wind, gusts in hover
	Low benefit
	Low quality
	Needs to understand the technical benefits
	Not reaching their KPIs and agreements in contract
	Modifying infrastructure
	Modify infrastructure
	Not a problem to change the landing zone in the turbine
	Regulations
	Permits to fly
	Cargo drone permits
	Hard to request permits
	Beyond lone of sight
	It can be a cost for companies to update these permits constantly

	particular to each site or country
	Our company is regulated so changes we have to inform government
	Permit from Windfarm and other participants
	Permits for repairing
	Permits from offshore to onshore
	Pilots permits and experience
	Uncertainty about automated flights
	Safety
	Convincing others in the company that it is safe
	Onshore problems with close to houses
	Safety evaluations
	Safety regulations in the vendor
Perceived Benefits	Benefits
	Business Case
	Cost - benefit
	Index used for evaluating
	Reduces costs
	Service costs of drones
	Needing more than one drone
	Maximize the operation and generation and user case
	Index for evaluating
	Index used for Qualitative Impact
	Each evaluator will have its own index of evaluation
	What each stage has as a budget, and how much impact you can cause on that stage
	Repairing blades and windfarms
	Working hours offshore are precious
	Not always the cost
	Index of safety reduction
	Time saving
	Company Image benefit
	Environmental benefit
	Obtain my environmental permit including drones on it
	Reduce CO2 use
	Potential user case
	Bird deterrent system
	Blade cleaning
	Blade inspections
	Windfarm inspection
	Blade repairing
	Cable cleaning connexion
	Cable connections

	Cable inspection
	Automatized flight for cables that focus on bad cables and get details
	Vegetation growing toward cables
	Cable route planning
	Construction status check
	Environmental animal survey
	Inspection inside the machine
	Logistics
	Construction of energy towers in difficult places
	Construction stage
	Onshore to offshore transportation of parts
	Spare parts cargo - repairing
	Maintenance
	Predictive and proactive maintenance
	Patrol windfarms for unwanted people
	Sensor installation in cables
	Substation operations
	Safety
	Even if it costs more than with humans
	Technical benefit
	Automatization
	AI analysis
	Higher automatization more cost saving
	Less humans intervention
	Reduction of cost of Labor
	Data associated with the process
	Data to learn
	Design Standards
	Functionality
	Hard to find experts that repair blades
	Inspection
	Not having to use lifting platforms in windfarms
	Quality inspection
	Reduction of time of process
	Repairing blades that then last longer
	Stop times for maintenance
	Technical Documentation
	UAV stays in the windfarm
	Use people for other services instead
	Green goals
Technology Readiness	Technology Challenges
	Adapt as windfarms are changing

	Challenges for the technology
	Flying distance
	Flying without visual contact
	Lift higher weight
	Recharge or last longer
	Early stage technology
	Understand the technology and its application
	Technology interest
	Interested on use it soon
	Looks like a mature product

Appendix D. List of use cases as gathered from the data

Ord	Technical use case name	Phase
1	Windfarm patrol	O&M
2	Bird deterrent System	O&M
3	Weather condition calculations	Development
4	Zone planning revision	Development
5	Environmental Animal Survey for Development	Development
6	Cable Route planning for Development	Development
7	Vessel to Vessel cargo delivery for Construction	Development
8	Delivery parts for construction of Wind Turbine - Vessel to Wind Turbine	Development
9	Construction status check	Development
10	Delivery of parts for maintenance - Vessel to Wind Turbine	O&M
11	Delivery parts for maintenance - onshore to offshore	O&M
12	Win Turbine infrastructure repair	O&M
13	Wind Turbine inside inspection	O&M
14	Wind Turbine tower inspection	O&M
15	Blade inspection	O&M
16	Blade cleaner	O&M
17	Blade repair	O&M
18	Substation inspection	O&M
19	Installation of sensors in cables	O&M
20	Cable inspection	O&M
21	Cable connexion cleaning	O&M
22	Obtaining data related to their processes	O&M