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# How will simplifying and understanding the Unmanned Aircraft System (UAS) regulations or the drones program create visibility for the industry overall?

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## ABSTRACT

*"If you can't describe what you are doing as a process, you don't know what you're doing."* -W. Edwards Deming (1900-1993)

Simplification involves presenting information and informing users of every mechanism or explanation with step-by-step solutions of a process. This research project explores how overall awareness can be generated by simplifying and understanding the existing Unmanned Aircraft System regulations and drone operations. It explains in depth the difficulty it has along with the grey areas to be dealt with after being classified based on the activities and the entities involved in it.

The results have shown that the current regulations do not concern drone operations, but are based on the need for time. It was also noted that, in order to plan the legislation, the organisations involved within the sector were not thoroughly consulted. There are areas that have been partly addressed, such as safety and security; but, areas such as corporate social responsibility, communication, local and international authorities have not been addressed.

A proposal to understand a process-based categorisation has been introduced that not only includes the involved entities, but also provides an opportunity to include existing drone operations or operations to be carried out in the future. This defines the ability to address current issues along with the problems that need to be discussed in the future.

However, this analysis is focused on the individuals' survey, and their interpretation will vary according to their current industry awareness. The literature helps to explain the existing complications, but does not provide a straightforward guide to the potential outcomes that might have been addressed by the opinion of numerous industry scholars, which is subject to further study.


*Keywords: Simplification, standard operating procedure, regulations, process based categorisation*

# ACKNOWLEDGEMENT

It is true to say that this thesis is really the culmination of 12 months of hard work to complete an MSc in Management at Cranfield University and it would not have been possible without the help and support of several people. I would like to express my sincere gratitude to all of them.

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I would also like to thank the ARPAS-UK CEO as well as the colleagues who gave me this opportunity to work with them and helped me to understand the nuances of the industry.

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Last but not least, I am very much grateful to my family that I have always received unconditional love from them. For me, this means a lot.

Abhishek Kumar Dixit,

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# Chapter 1 – INTRODUCTION

The aim of this chapter is to provide context to the problem, to define the objectives of the thesis and to explain the thesis outline.

## 1.1 Simplification of business regulations

Simplification requires not only a shift in the business process but also cultural reform in how municipalities view those whom they control, and how regulators understand the importance and efficacy of regulatory processes (*Simplification of Business Regulations at the Sub-National Level: A Reform Implementation Toolkit for Project Teams*, 2006). In order to understand the requirements of an industry, it is necessary to understand the culture which has been part of it. Innovation is a term that has often been used to identify new proposals to better a sector; however, it, arguably, comes from the core of the culture of any organisation. It is important to classify the working culture of industry in order to understand it and how it affects others. Without categorization, it is difficult to define the specifics of the issues that may arise. Simplification is the act of reducing or eliminating process elements to reduce complexity and inefficiency. This also ensures that any restrictive or redundant conditions or re-introduced steps are reduced in scope. Simplification is a process consist of four phases.

1. **Diagnose:** It is necessary to identify the intent of the process in question, because the municipality will concentrate on goals and not procedures. At this point, the municipality will concentrate on ensuring what is achieved, rather than how it is achieved. And the current regulations of Unmanned Aircraft System (UAS) industry has no such input.
2. **Process Design:** The design process involves the analysis of each situation to decide if that is appropriate. Simplification involves taking a series of existing steps, restricting them to the minimum number required and reporting the outcome as a "process map." Nonetheless, process visibility is very low for the drone industry when it comes to defining the regulations.
3. **Implementation:** To appeal to every regulatory framework for a wide variety of people, it needs to be more transparent and accessible, whether individuals or companies. This requires (A) the establishment of central access points, and (B) the promotion by "many"

central points of greater accessibility. In the case of the drone industry, there are several actors such as Federal Aviation Administration (FAA), Civil Aviation Authority (CAA), American National Standards Institute (ANSI), and British Standard Institution (BSI) that have their own responsibility for the various tasks and, most notably, they have not yet included the municipalities.

4. **Evaluation:** The evaluation phase is designed to assess the efficacy of process changes. This is a post test, if the original goals were met and how well the project was being maintained. For example, the new regulation of the drone industry has a bit of a shift due to which the major operators who are the holder of Permission for Commercial Operation (PfCO) may have to shift their competence or they may not be qualified for drone operations.

## 1.2 Process simplification at ARPAS-UK

The author had a three-month internship in a Farnborough based company called ARPAS-UK as part of the Cranfield MSc in Management. The Association of Remotely Piloted Aircraft Systems UK (ARPAS-UK) is a non-profit association established in 2013 to represent the RPAS industry in the United Kingdom. ARPAS-UK works with its members to assist them with the numerous Remotely Piloted Aircraft System (RPAS) problems they face. ARPAS has formed partnerships with the Civil Aviation Authority (CAA) and National Apprenticeship Training Scheme (NATS) (They offer traffic solutions to the non-standard flights, such as survey flights, leisure flights, small unmanned aircraft, balloon/teeters flights, kite flights, etc.) for safety. ARPAS-UK is the only non-commercial professional body representing the operators and suppliers of the UK Small Unmanned Aircraft (SUA). The Association does not have any financial interests; all profits are used to promote membership interests and ensure the sector remains fair, safe and open (*About Us – ARPAS UK*, no date).

A business function is basically a set of activities that have to be carried out at different times. An efficient method can assist a work organisation in controlling its processes and its workers. But to the opposite effect, it would be a complicated process (Malhotra, 2012). After speaking about the company, it was found that it still needs to understand all the nuances of the industry

first as to the sector they must promote through their members and what they are really trying to take out of that sector. Claim was written from the viewpoint of the organisation which has been running since 2013 and still does not have a consistent website detailing all of their work. As there are no standard operating procedures in which sector they operate mainly on. Also from the point of view of management, each organisation had to monitor its customers' willingness to develop more and to know their preferences for future references. ARPAS would have to encourage users to follow the sequence as a standard operating procedure (SOP) by teaching them the regulations with full industry information to attract members and viewers. This will then leave them with the various options to choose from, and assist their members, customers, etc. at different stages of the industry.

## 1.3 Problem statement and background

The emphasis on legislation for the industry as a whole is on one group of entities which is the types of drones. This can also be clarified by understanding these divisions based on weight and visibility that restricts authorities to see the wider picture of issues related to their various operations such as distribution (delivery), communications, issues with international borders, they may bring 3D printers as payloads in the future to do actual repair work rather than passively transforming the details (Padmanabhan, 2017). To plan for any regulations, there must be a thorough analysis such as regulatory structure, emergency preparedness, the goals of the whole project, end results, etc. Yet in the case of the drone industry, it's the opposite to the extent where they don't really seem to have a consistent concept of their different operations as well as the regulations dependent upon them.

## 1.4 Aim and objectives of the study

The aim of this research is to determine how simplifying and understanding the regulations of the UAS (Unmanned Aircraft System) or the drones system can help UK enhance the experience of its users and enable the authorities to incorporate the drones into regulations for commercial purposes. It will also reflect an experimental view of divisions in this industry to provide some light for possibilities for future regulations. There are three principal objectives for this research:

1. Identify complications present in the current standards.
2. Map the current standards with an experimental process-based categorisation that illustrates regulatory requirements at a given level and enhances user experience to understand what this is all about.
3. Identify the requirements of new regulations and scopes in grey areas or need for correction in the previous regulations.

# Chapter 2 – LITERATURE REVIEW

Existing information created by scholars and practitioners has been reviewed in order to achieve the objectives listed in Chapter 1. Three key points quickly emerged while running an initial research to explore the scope of the subject. First, the industry in a glance to understand what has been done with the current regulations so far, secondly the grey area to be tackled and then finally the job of simplifying the operations in-order to address the regulations as an accepted standard accordingly.

## 2.1 Industry regulations in a glance

According to the details and shared information on website of Civil Aviation Authority (CAA), operations are considered to fall into one of three categories once the new drone regulations come into force (*Unmanned aircraft and drones | UK Civil Aviation Authority*, 2020). Those categories are below:

**Open Category -** This category does not provide third parties with any risk or a low risk. The activity under this category will be carried out in compliance with basic and pre-defined features and will not be subject to any further approval.

**Specific Category -** The operations under this category may present a greater risk with one or more operational elements falling outside the Open category boundaries. Based on a risk assessment, they will require CAA Operational Authorisation.

**Certified Category -** Under this category, activities pose the same level of risk for manned aviation and face the same regulatory structure (such as aircraft registration, operator registration, pilot licensing, etc.).

There are three main categories that govern the pilot to fly in an open category and the following are –

1) The unmanned aircraft must have a maximum takeoff weight of less than 25 kg
2) The unmanned aircraft must operate within visual line of sight (VLOS)

3) Unmanned aircraft are not permitted to fly above 120 meters (400 metres) Nonetheless, when overflying a fixed obstacle the 400ft height limit can be exceeded, provided that:

- The person responsible for the 'obstacle' got consent (i.e., the purpose for the flight is linked to a certain obstacle)
- The unmanned aircraft does not fly more than 15 m just above top of the obstacle and therefore must be held horizontally within 50 m of that (*Unmanned aircraft and drones | UK Civil Aviation Authority*, 2020).

Looking at people's safety and the drone itself with proper security overall, it is not practical for the drone to bear so much heavy weights as in payloads or other features incorporated in the drones and to fly over people, close to people or even far from people. That open category was therefore further sub-categorised as bellows –

**A1) Fly over people -** Drones in this category raise a very limited risk of harm or damage to people because of their lower weight (drone weighs less than 250g), their form of design, or because they are a toy ('inherently harmless'); it is not allowed to fly over open-air crowds.

**A2) Fly close to people -** For this category drones should not be heavier than 4 kg and flying is allowed only from uninvolved persons to a minimum safe horizontal distance of 30 m, as well as from uninvolved persons flying down to 5 m horizontally when selecting the low-speed mode of the drones. The operator must have completed the A2 CofC (Certificate of Competence).

**A3) Fly far from people -** This classification includes the very general categories of operations; the drone can operate mainly in areas clear of uninvolved persons; does not operate in areas designated for residential, commercial, industrial or recreational uses (*Unmanned aircraft and drones | UK Civil Aviation Authority*, 2020).

Drones are of various types that can bear different weights and have been graded in open category from C0 to C4 based on specifications such as drone weight and capabilities. The table below gives a clearer description of this category's classification, consisting of the appropriate category to fly in and the criteria.

| Classification | Categories available to fly in | Criteria |
|---|---|---|
| C0 | All subcategories | • Maximum take-off mass of under 250 g<br>• 19 m/s max. speed (42.5 mph)<br>• Unable to fly from controller more than 400 ft |
| C1 | All subcategories | • Total take off mass of less than 900 g<br>• If it interact with a human head, will transmit less than 80 joules of energy<br>• Planned and designed to reduce accident<br>• 19 m/s max. speed (42.5 mph) |
| C2 | A2 or A3 | • Total take off mass of less than 4 kg<br>• Planned and designed to reduce accident<br>• Does have a low speed mode restricting speed to 3 m/s (6.7 mph) |
| C3 | A3 | • Absolute take-off mass of under 25 kg<br>• Possess automatic models<br>• Featuring geo-sensitivity devices |
| C4 | A3 | • Maximum take-off mass of under 25 kg<br>• Unmanned aircraft that have no other automation features than simple stability of flight (such as more conventional model aircraft) |

*Table 2.1.1* - (*Understanding EASA Drone Regulations – Categories and Classes – Part 2*, 2020)

The only problem which emerged when writing this material was related to the legacy drones, as this whole process would take time for the manufacturers to understand. After research the other existing transitional structures have been found in place. When aircraft fail to reach C0 to C4, they will be allowed to fly indefinitely in A3 or A1 (if weighing less than 250 g).

The other questions that affect a little are about the categories that were classified worldwide regarding the weight of drones as a medium with a weight limit of 25 to 150 kg and the large one with a weight limit of more than 150 kg. The concerns are whether or not such types were ever intended to combine for commercial purposes. If yes then what are the criteria for the legislation they have to fulfill. If not then why was not that successful integrating with the drones' commercial alignment?

Upon further inquiry into this group, it was found from the CAA website that unlike small unmanned aircraft, unmanned aircraft with an operating weight of more than 20 kg are subject to the entire UK Aviation Regulations (as specified in the UK Air Navigation Order-ANO), although they may be exempted by the CAA from certain conditions ('The Air Navigation Order 2016', no date). Therefore, for anyone attempting to fly an unmanned aircraft weighing more than 20 kg, explicit permission in the form of an exemption from some of the ANO's requirements must be obtained before any flight could take place. If you are considering operating a UAS weighing more than 20 kg in UK airspace, you will find full details and requirements in UAS guidance document CAP 722 (*CAP 722: Unmanned Aircraft System Operations in UK Airspace - Guidance & Policy*, no date). For large model aircraft refer CAP 658 (Caa and Operations, no date).

## 2.2 Unattended (grey) areas for drones' regulations

Such above-mentioned regulatory classifications can better define Unmanned Aircraft Vehicle (UAH), one individual category and yet fail to identify the comprehensive nature of the industry with their regulations. It must be drawn up depending on the particular level of service such as pre-flight, operation, post-flight etc., the study shows that classification in the globe has always been depending on the two main categories of UAH weight and visibility (Stöcker *et al.*, 2017).

Because of this categorisation, the industry fails to respond to users about regulating the various entities connected to it, such as operator, operating area, corporate social responsibility, security and safety, etc., which complicates users to understand the industry as a whole unless they are completely involved. Ultimately, the only way to find the success of this is by creating a complete set of regulations over the life of the drones, starting from their

purchasing to their daily flight schedule, which is already out there, but because of their complexity, it is very difficult to understand.

| | Applicability | | Technical Requirements | | | Operational Limitations (Distances) | | | | | | | Administrative Procedures | | | Human Resources | Ethical Constraints | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country Issued and/or Last Updated [Reference] | Applicable for MA/UAVs | Classification (Weight, Purpose, Area, Visibility) | Weight Limits (Max) | Special Technical Requirements | Collision Avoidance Capability | Airports/ Strip | People | Congested Areas | Prohibited Areas | Additional | Max Height | VLOS/Lateral Distance | BVLOS | Application and Operational Certificate | Need for Registration | Insurance | Qualification of Pilots | Data Protection | Privacy |
| United Kingdom 05/2002 03/2015 [73] | MA/UAV | W, P | 7/20/150 kg | | for special operations | | 50 m | 150 m | | N/A | 122 m | 500 m, EVLOS possible | need for special approval | various approval requirements for different flight operations | N/A | N/A | pilot competency | refer to Data Protection Act, CCTV Code of Practice | advice to respect personal privacy |
| Australia 07/2002 09/2016 [74] | MA/UAV | W, P | 2/25/150 kg | N/A | N/A | 5.5 km | 30 m | | | emergency situation | 120 m | | need for special approval | >2/25 kg | N/A | recommended | license > 2 kg | advice to respect personal privacy | |
| Malaysia 02/2008 [75] | no distinction | W, P | 20 kg | Request equivalent level of compliance with rules for manned aircraft | | | N/A | N/A | N/A | N/A | 122 m | | if ATC capable | flight authorization and airworthiness certification | >20 kg | | license for pilot and commander | UAV operation shall comply with civil requirements | |
| United States 08/2008 06/2016 [76] | MA/UAV | W, P | 0,25/25/150 kg | N/A | N/A | 8 km | | N/A | | N/A | 122 m | EVLOS possible | need for special approval | >25 kg | registration number | depending on purpose | certificate | N/A | refer to related laws |
| Canada 2010 05/2015 [77] | MA/UAV | W, P | 2/25 kg | N/A | >25 kg | 9 km | 150 m | | | forest fires | 90 m | | N/A | >25 kg | N/A | depending on weight | pilot competency | advice to respect personal privacy | |
| France 2012 12/2015 [78] | MA/UAV | W, A, V | 2/8/150 kg | >2 kg | in populated areas and BVLOS | | not over crowds | N/A | | emergency situation | 150 m | 100 m/200 m/EVLOS | | for specific operation procedures | depending on flight scenario | | depending on flight scenario | Commercial use ask for permission to use data | advice to respect personal privacy |
| The Netherlands 2012 07/2016 [79] | MA/UAV | W, P | 1/4/25/150 kg | N/A | N/A | no fly zones | 50 m | | | moving cars | 120 m | 100/500 m | N/A | operational certificate | | | license | refer to related regulations | |
| Germany 12/2013 07/2016 [80] | UAV | W | 10/25 kg | >10 kg | May help to get BVLOS permission | | not over crowds | N/A | | emergency situation | 100 m | | need for special approval | general permission, single operational approval for >10-25 kg | N/A | | pilot competency | emphasize that actions might be subject to other laws | |
| Italy 12/2013 12/2015 [81] | UAV | W, A | 2/25/150 kg | For critical flights | N/A | 5 km | 50 m | 150 m | | N/A | 150 m | 500 m/EVLOS | in segregated airspace | for critical operations and/or > 25 kg | plate and electronic ID | | 0-25 kg certificate, >25 kg license | refer to Italian Data Protection Code | N/A |
| Austria 01/2014 08/2015 [82] | no distinction and if >500 m from pilot | W, A | 5/25/150 kg | depending on scenario | depending on scenario | | not over crowds | N/A | | N/A | 150 m | | need for special approval | general permission, single approval for risky operations | registration needed | | depending on scenario | N/A | N/A |

*Figure 2.2.1 – The classification of industry based on various categories (Stöcker et al., 2017)*

| | Applicability | | Technical Requirements | | | Operational Limitations (Distances) | | | | | | | Administrative Procedures | | | Human Resources | Ethical Constraints | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country Issued and/or Last Updated [Reference] | Applicable for MA/UAVs | Classification (Weight, Purpose, Area, Visibility) | Weight Limits (Max) | Special Technical Requirements | Collision Avoidance Capability | Airports/ Strip | People | Congested Areas | Prohibited Areas | Additional | Max Height | VLOS/Lateral Distance | BVLOS | Application and Operational Certificate | Need for Registration | Insurance | Qualification of Pilots | Data Protection | Privacy |
| Spain 10/2014 [83] | MA/UAV | W | 2/25/150 kg | N/A | N/A | 8/15 km | not over groups | | | N/A | 120 m | 500 m for 2-25 kg | 0-2 kg or special approval | flight authorization, NOTAM notification | registration and ID plate | | 0-25 kg certificate, >25 kg license | N/A | N/A |
| Azerbaijan 01/2015 [84] | no distinction | W | 20/150 kg | N/A | for BVLOS | | 50 m | 150 m | | N/A | 122 m | | in segregated airspace | for critical operations and/or > 20 kg | >20 kg | | pilot competency | N/A | N/A |
| Chile 04/2015 [85] | no distinction | W | 6 kg | many special demands | N/A | 2 km | 30 m | N/A | | <60 min | 130 m | 500 m | N/A | flight authorization | | N/A | license | N/A | N/A |
| Colombia 07/2015 [86] | | W | 25 kg | many special demands | N/A | 5 km | | | | intern. border | 152 m | 750 m | N/A | flight authorization | | | license | not allowed to violate the rights of privacy | |
| South Africa 09/2015 [87] | N/A | W, V | 7/20 kg | | N/A | 10 km | 50 m | | | N/A | 122 m | EVLOS possible | need for special approval | air service license, letter of approval and operation certificate | registration marks | | license | N/A | N/A |
| Japan 12/2015 [88] | no distinction and if heavier than 200 g | N/A | N/A | N/A | N/A | no fly zone | 30 m | | | N/A | 150 m | | N/A | for restricted areas | N/A | N/A | N/A | N/A | N/A |
| Nigeria 12/2015 [89] | no distinction | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | special authorizatio | N/A | | | flight authorization | N/A | N/A | manned aircraft license | license | N/A |
| Rwanda 05/2016 [90] | not for toy aircraft | N/A | 25 kg | N/A | N/A | 10 km | 50 m | | | N/A | 100 m | 300 m | | flight authorization, operational certificate | registration marks | | license | respect privacy of others, surveillance of people and property without their consent is prohibited | |
| China 09/2016 [91] | no distinction | N/A | 7 kg | N/A | | | N/A | | | 10 km to other aircrafts | N/A | | N/A | flight authorization and operational certificate | registration | N/A | certification | N/A | N/A |

*Figure 2.2.2 – The classification of industry based on various categories (Stöcker et al., 2017)*

## 2.3 Role of process simplification

A key to any business' success is applying equal weight to the People, procedures, systems, etc. Hence it is important to have processes. For example processes and people aligned to carry out Task A, but no system to carry out this task - horse before cart! Or a system capable of performing 10 tasks but a process requiring only 2 tasks. Processes need to be handled just the way our people and systems do. We risk knowledge/skill gap if we don't manage our people. They are unreliable if we don't control our processes. People, process and system management is constructive but if we don't handle them we become reactive. Reactive intervention to enhance current systems may be called simplification of the processes (Malhotra, 2012). Simplifying the processes performed by the operation of a drone will also help authorities see the bigger picture mentioned in Chapter 1 and this will certainly allow them to set regulatory boundaries.

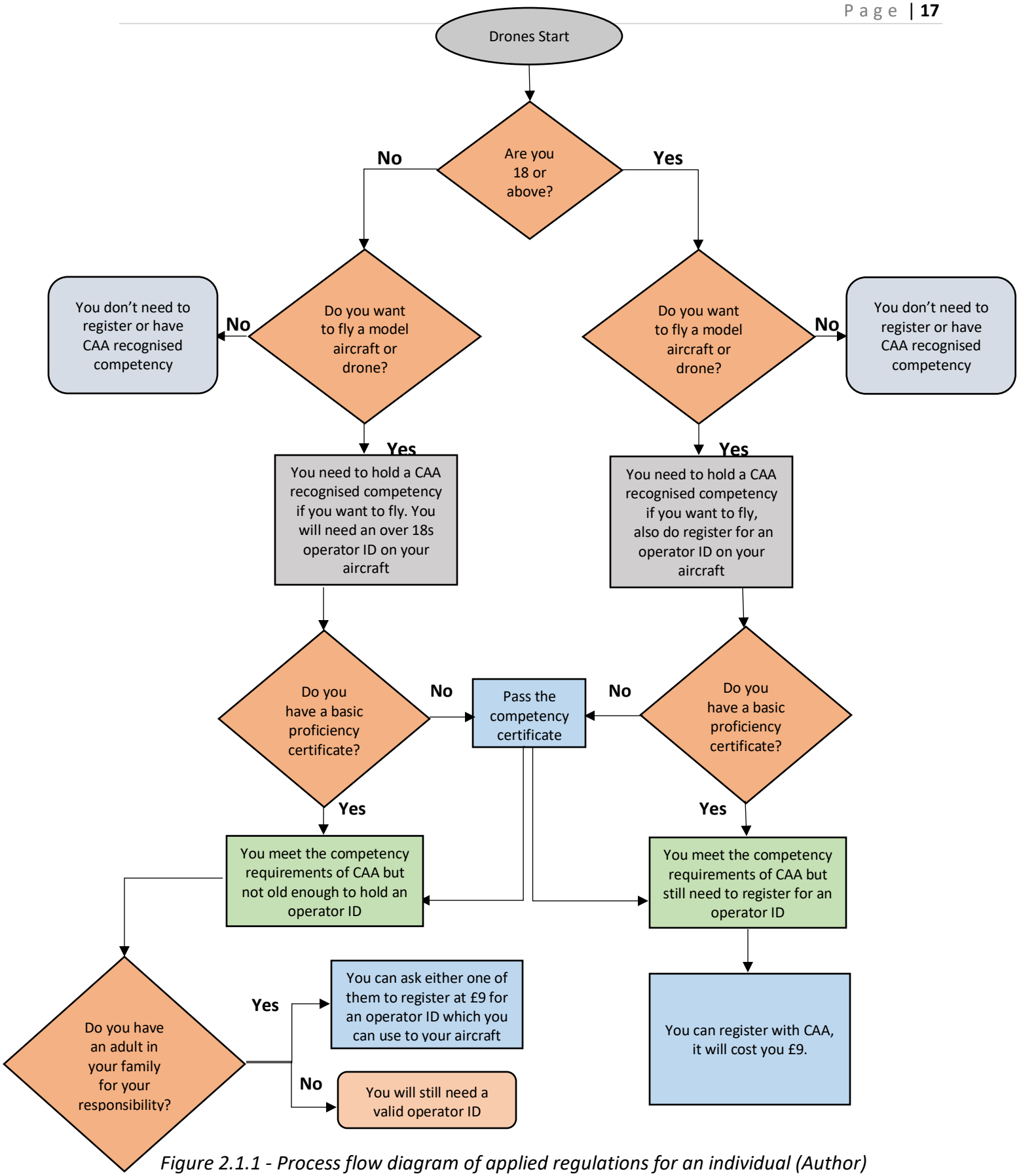



*Figure 2.1.1 - Process flow diagram of applied regulations for an individual (Author)*

# Chapter 3 – METHODOLOGIES

The aim of this study was to examine the state of the regulations and their workings in order to identify complications and areas that have not yet been addressed. Even then, the author has also tried to illustrate the regulatory requirements at a given level and enhances user experience in order to understand what this is all about by proposing an experimental step by step classification that is called the Standard Operating Procedure (SOP) in terms of management ('Standard Operating Procedures (What Are They Good For ?)', 2012).

To be more accurate, a deductive based approach was adopted and an experimental model was prepared first to approach the qualitative data. This method is most widely used in qualitative study, where it can be beneficial to provide a framework that directs the research process by reducing the potential for researcher bias in the data collection phase (*Business Research Methods*, 2020)

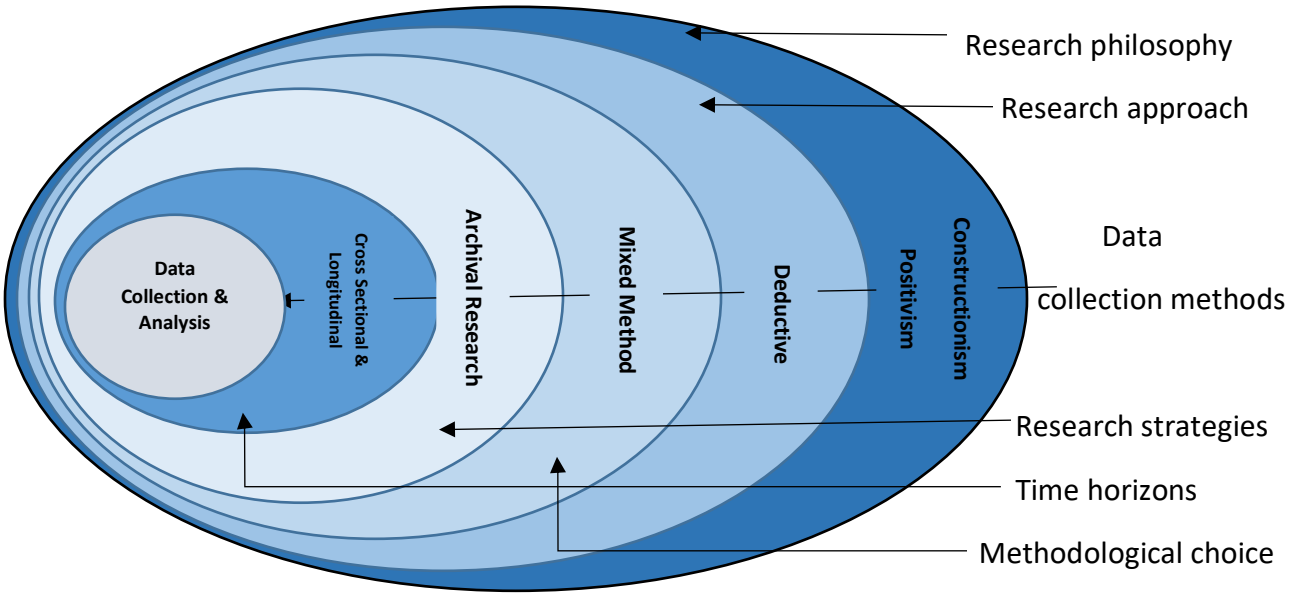



*Figure 3.1 Applied research onion (Author)*

## 3.1 Methods

Research types may be analysed from three distinct perspectives:

A) Applications of the study results.
B) The research objectives.
C) Enquiry approach used when conducting the analysis (Kumar and Ranjit, 2011).

The above research was carried out on the basis of all three types present in the industry currently listed. The study purpose is to define the laws so that individuals obey a clear pattern of law and order. The study has three objectives listed in the introduction chapter and the inquiry is carried out using a structured approach.

### 3.1.1 Research philosophy

The assumptions created by a philosophy of research provide the basis for the way the study would be carried out (Fick, 2011). A philosophy of research is a belief in the manner in which information about a phenomenon should be collected, interpreted and used. In comparison to doxology (what is believed to be true), the word epistemology (what is known to be true) includes the different philosophies of the approach to study. Thus, the aim of science is the process of translating things that are believed into known things: doxa to episteme (*Chapter Three: Research Methodology*, 2020). The philosophy behind this research has been used as constructionism (Lincoln, Lynham & Guba, 2011) which implies that each observer or group determines the inherent sense of the social phenomena (Kidd, Wengströ and Rowa-Dewar, 2010). In this theory, one can never conclude that what is learned between participants is interpreted in the same way, and the key approach is to examine inconsistencies and nuances in the respondent's understanding.

### 3.1.2. Research approach

There are two different approaches to deductive and inductive, but to follow constructivism, the method most used in this study is deductive. A number of accepted statistical criteria for approach validity, such as the number of respondents needed to determine a statistically meaningful outcome, are included in the qualitative results. By approaching such data in a

deductive way, it has helped to achieve better constructivism (Goddard, Wayne. & Melville, 2004). While a positivist philosophy guides this research approach, it can be used to analyse a wide variety of social phenomena including emotions and subjective perspectives. When there are large numbers of respondents available this approach is most effective.

This method focuses the hypothesis or hypotheses on a pre-existing theory and then conducts the research approach to evaluate it (Silverman, 2013). This approach is ideally suited to situations in which the researcher investigates whether the observed findings match with expectations based on prior study (Wiles *et al.*, 2010). The deductive method may therefore be considered especially appropriate for the positivist approach, which enables the formulation of hypotheses as well as the statistical testing of predicted outcomes to an agreed probability level (Snieder R. & Larner, 2009).

The qualitative approach taken from the constructivist model demands that the researcher avoid forcing upon the respondent his own interpretation of the nature of social phenomena (Biggerstaff, 2012). Typically, qualitative analysis is used to analyse the nature of social phenomena, rather than to try for a causative association between existing variables. For this study a combined methodology using both the qualitative and quantitative approaches was adopted. The study design is to be found below.

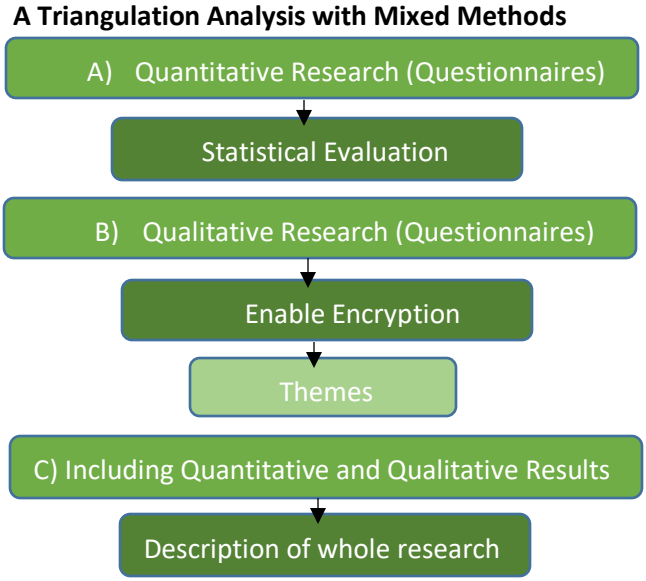



*Figure 3.1.2.1 Research design – Methodology – Methods (Author)*

### 3.1.3 Research strategy

An archival research approach is one in which the study is carried out using existing materials and that is what was used in this study (Fick, 2011). The primary idea was to prepare a base of the existing data and create an experimental design for the hypothesis. After which the evidence were obtained using the mixed research methodology to perform the evaluation in searching for the results. Deductive approach helped reduce the unclear hypothesis and offered a simple way to see the data mostly held in the centre of the study onion tree.

### 3.1.4 Time horizon

The time horizon is the time-frame by which the project is to be completed (Saunders *et al.*, 2009). Within the research onion two types of time horizons are specified: the cross sectional and the longitudinal (Bryman, 2012). The cross sectional time horizon is one that has already been defined, which involves collecting the data. Literature has findings about the current state of industry that supports first-type time horizon analysis.

A longitudinal time span for data collection refers to data collection periodically over an extended period of time, which is used when progress is analysed over time as a significant consideration for study (Goddard, Wayne. & Melville, 2004). And part of the research is also based on the industry's service, which is the hour's need or could be the hour's need soon. It can be seen that the author has provided the future viewpoint in line with this study, and then he has included the term longitudinal time period in this study to understand the future operations that might be the priority attraction of that phase.

### 3.1.5. Data collection

The compilation and analysis of data depends on the analytical approach employed (Bryman, 2012). Primary data for this research was collected through an online survey to test the hypotheses using a self-directed questionnaire. The reason this approach was chosen was to save time, improve efficiency when receiving responses, using an electronic communication system that each individual uses every day and the data can also be used in mixed methodology.

Secondary data for this study were obtained through Civil Aviation Authority's reliable websites which work closely with industry regulations. It also endorses Wilson's paradox which argues that sometimes the sources given may not be accurate (*ESSENTIALS OF BUSINESS RESEARCH 2*, no date).

## 3.2 The quality of research, drawbacks and ethical considerations

It is important to bear in mind that when this deductive method is put into practise, which is typically associated with quantitative analysis, sometimes the sequence represented in its pure form does not follow (Bryman, 2012). The author discussed above the use of a mixed approach to recognise and correct such mistakes with the clear evidence to justify them.

To obtain data from participants for research purposes at many educational institutions without ethical approval may position the researcher outside the institutions Code of Conduct (Fleming and Zegwaard, 2018). Ethical issues, such as informed consent, anonymity, the right to privacy and confidential data protection, have been tackled at all levels and universities have already approved a letter of approval (Appendix) for carrying out the study.

## 3.3 Instruments & Measurements

The resources used were the qualtrics survey app, along with its evaluation in the NVivo12 application, and the excel sheets used to draft them to find out their results and other purposes for estimation. All calculations were made after evaluating the current situation and the sector's requirements with potential market demand. Nominal scale was used during the entire assessment of the survey. This was measured in such a way that perhaps the situation has to improve even further in terms of future expectations and is backed by documentation and other findings collected from the survey.

Secondary data helps tackle the first objective. Primary data contrasts the present state of the sector with expected future performance and makes it easier to plan for the second objective in itself. Using the right methodology, mixed approach and other research after combining both data eventually helps to sort out the grey area that still needs to be discovered, explored and addressed.

# Chapter 4 – RESULTS & FINDINGS

This chapter offers a comprehensive view of the survey results and discusses their outcomes. To understand their potential benefits, it helps to understand the present challenges, which then helps to clarify the research's 1st and 3rd objectives.

## 4.1 Results from samples of surveys

It can be summarised, after reviewing all the survey data, that the whole industry is either unaware of the capacity of the drone or neglecting it. With the exception of a few operations, there are no step-by-step procedures {standard operating procedure (SOP)} for making legislation. No categories are defined at all that could explain the commercial application of the drone system or some other operational intent. The types of drones are well characterised according to their payloads. The CEO of ARPAS-UK said in a conversation that weight plays a crucial factor for the safety and protection of individuals now a-days, but speaking of the same risk in the Manned Aircraft System with pilot involvement, he only cited that the problem could be a roadmap to the future and that it is a topic of discussion for the drone industry.

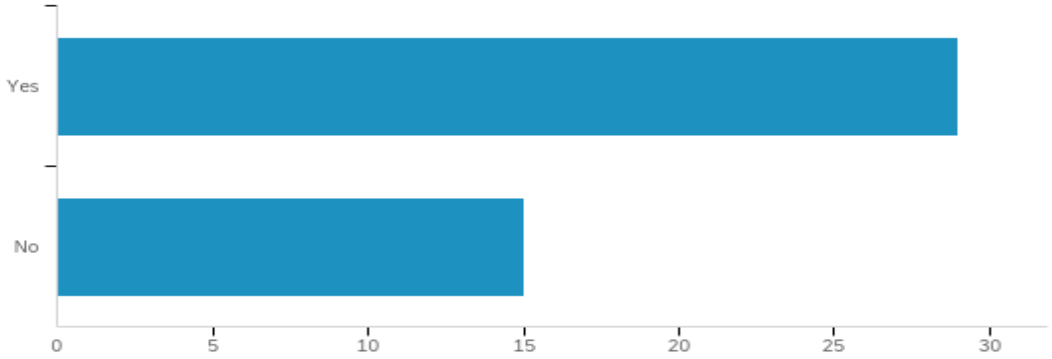
Other than that, for the purpose of creating regulations, the entities involved in the sector are not included in any way. There are many aspects around the drones, including the aircraft, the remote control, the operator, the flying zone, different operations, etc., but very few have been tackled in terms of regulation. A drone can conduct a range of operations that were totally overlooked before the regulations were even established today. There are numerous industries and sectors overlapping the drone industry, but there are no clear and specific categories for the drone industry, which also poses a question of transparency within the industry. In order to welcome the key players for better growth and new innovation in the industry as a whole, every sector of the industry has to be well designed and established. This is the obstacle in the current standard, and this has to be overcome by all means.

## 4.2 Findings from samples of surveys

In order to collect some data, there was a survey shared among people. At the beginning, the author tried to count the number of people who know about the industry or who do not know,

as countering the hypothesis and the answers to the problems present in chapter 1 would be more relevant.

**Q.1. Are you familiar with the drone industry?**




| # | Field | Minimum | Maximum | Mean | Std. Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.1. Are you familiar with the drone industry? | 1.00 | 2.00 | 1.34 | 0.47 | 0.22 | 44 |

| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 65.91% | 29 |
| 2 | No | 34.09% | 15 |
| | Total | 100% | 44 |

*Figure 4.2.1 Survey question 1*

Out of 44 individuals, 29 agreed that they are well aware of the industry, which is a strong count since it is a vote of 65.91% of individuals speaking about the industry's truth and importance.

After the analysis of responses, it can be concluded that there is no standard operating procedure followed to set up the regulations. 61.9% of people agree that there is no standard operating procedure to create the regulation and for question about various sectors within this industry, a very conflicting trend has been obtained. If an SOP was in view, then the people in the industry were also told about their work area, which they are not. In answering the

question, they seemed quite confused. The hypothesis written at the beginning of this chapter regarding the overlap of the industry seems to be valid. The results obtained by the survey are given below.

**Q.5. Is there any Standard Operating Procedure (SOP) by which the regulations were drawn up or proposed?**

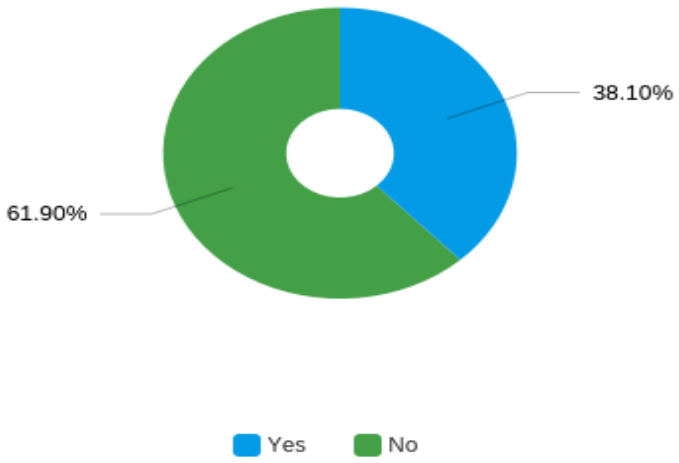
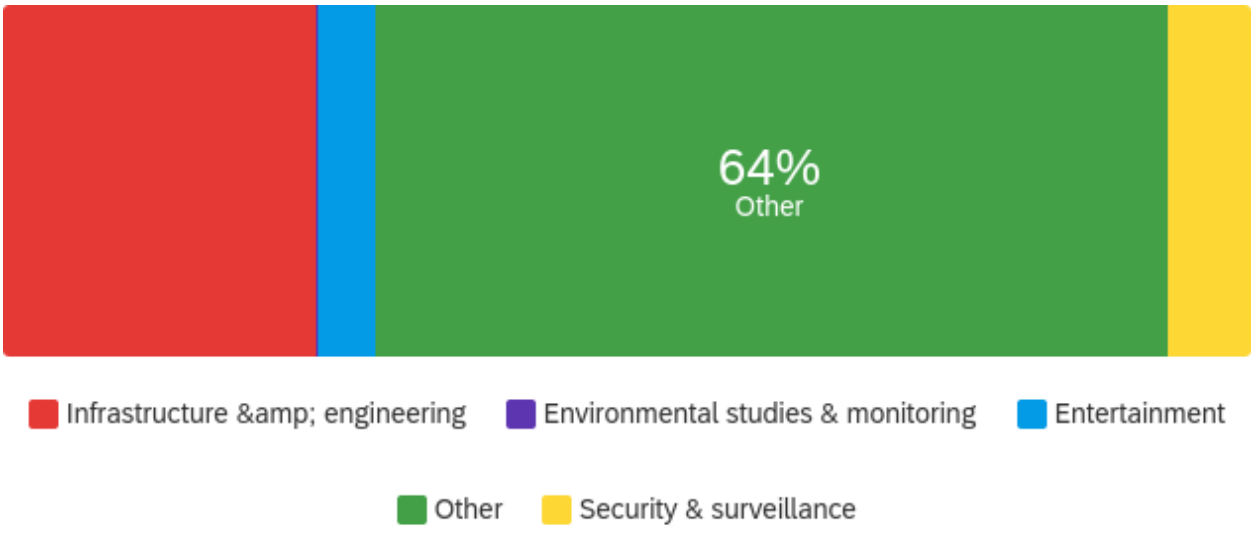



*Figure 4.2.2 Result of survey question 5*

**Q.2. What is the sector of the industry you or your company are working on?**



| # | Field | Minimum | Maximum | Mean | Std. Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.2 What is the sector of the industry you or your company are working on? - Selected Choice | 1.00 | 8.00 | 4.84 | 2.29 | 5.22 | 44 |

| # | Answer | % | Count |
|---|---|---|---|
| 1 | Infrastructure & engineering | 25.00% | 11 |
| 3 | Environmental studies & monitoring | 0.00% | 0 |
| 5 | Entertainment | 4.55% | 2 |
| 6 | Other | 63.64% | 28 |
| 8 | Security & surveillance | 6.82% | 3 |
| | Total | 100% | 44 |

**Q2_6_TEXT - Other**

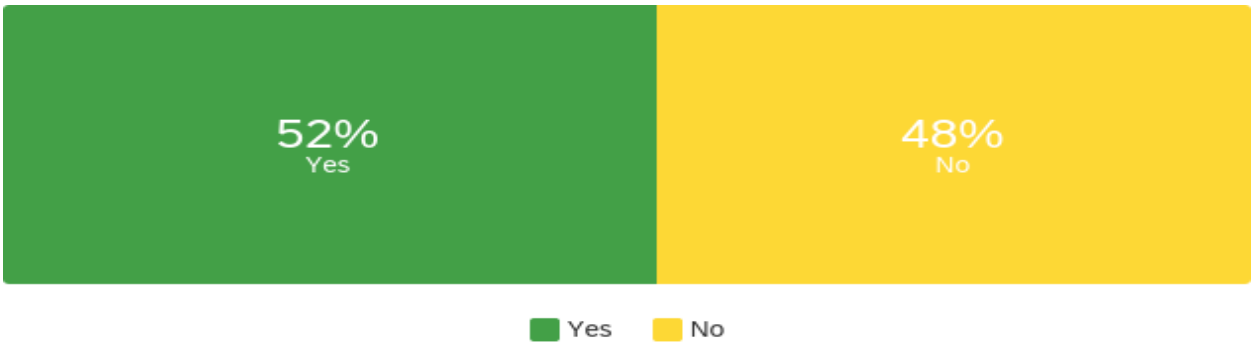
| Other – Text |
|---|
| IT |
| Photography |
| Tourism |
| Logistics |
| Fashion |
| Advisory |
| Fossils and paleobiogeography |
| Social science |
| Finance Sector |
| Financial |
| Chemicals and pharmaceuticals |
| BSI |
| Education |
| Education |
| Military (this font is very hard to read) |
| Student |
| Education |

*Figure 4.2.3 Result of survey question 2*

This could also be said that the maximum number of individuals still do not know what kind of operation of drones can be useful in their business, so they do not take into account at all that they are in one sector of this business. Also, if there is no such provision by the authorities so far, then it is very difficult for a person to say what industry sector suits their job best.

Almost half of them, when posing the question of the commercialisation of the individual sector, accept the reality that they are not yet ready and most accept that they have not even attempted to contact the local authorities for safety and security purposes.

**Q.3. Do you think your industry is ready for commercialisation of drones if all the safety and security procedures in place?**

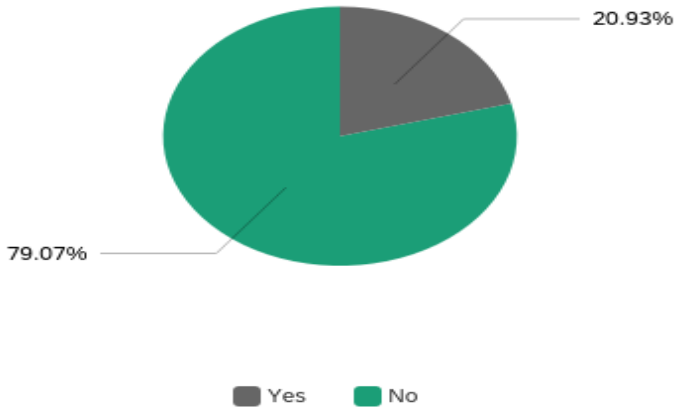



| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.3. Do you think your industry is ready for commercialisation of drones if all the safety and security procedures in place? | 1.00 | 2.00 | 1.48 | 0.50 | 0.25 | 44 |

| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 52.27% | 23 |
| 2 | No | 47.73% | 21 |
| | Total | 100% | 44 |

*Figure 4.2.4 Result of survey question 3*

**Q.4. Has your industry consulted local authorities on the use of drones, except for the aviation authority?**




| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.4. Has your industry consulted local authorities on the use of drones, except for the aviation authority? | 1.00 | 2.00 | 1.79 | 0.41 | 0.17 | 43 |

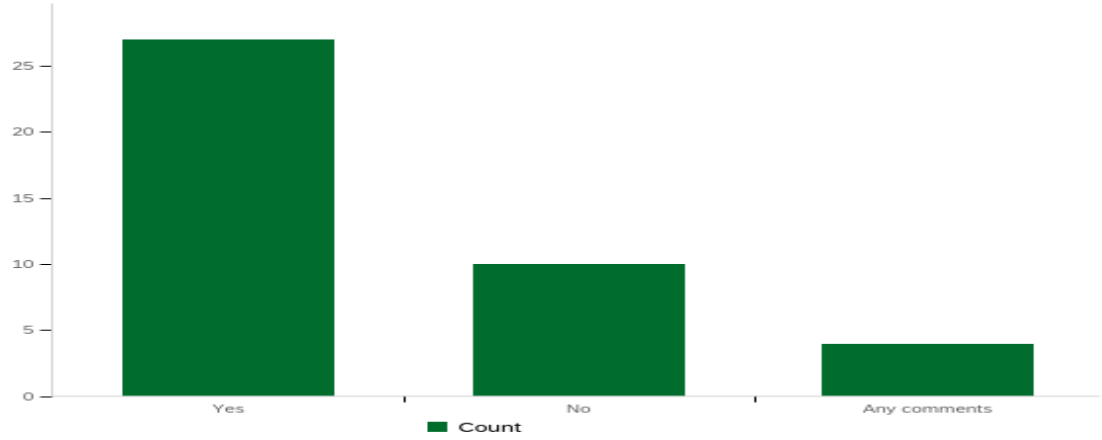
| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 20.93% | 9 |
| 2 | No | 79.07% | 34 |
| | Total | 100% | 43 |

*Figure 4.2.5 Result of survey question 3*

The above findings show that the industry needs somewhere to fix these problems and the management obviously sees it as an unresolved standard operating procedure (SOP). It is about systemising and documenting all of the processes in order to develop a Standard Operating Procedure (SOP) (*What is a Standard Operating Procedure (SOP)?*, 2012). The participants believes in a clear structure for the regulations consisting of all the relevant industry entities such as Unmanned Aircraft Vehicle, remote control, operator, various operations, and so on to

resolve the current problems found in the industry. When analysing the approach to such regulatory formation, a clear picture of potential issues to be resolved according to particular operations is seen. The participants also believes in a mentality that works to form certain structures and they accept the truth that the same mentality works everywhere.

**Q.6. Do you think of providing a consistent framework for the regulation of the entire drone industry consisting of its relevant entities such as operator, various operations, operating area, skills involved, etc.?**




| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 65.85% | 27 |
| 2 | No | 24.39% | 10 |
| 3 | Any comments | 9.76% | 4 |
| | Total | 100% | 41 |

## Q6_3_TEXT - Any comments

| Any comments – Text |
|---|
| Will distribute the works in different sectors of the industry. |
| It will give an idea to individuals about their specific work field within the sector |
| It will improve the visibility towards industry for an individual |
| Don't know |

*Figure 4.2.6 Result of survey question 6*

The remaining answers to the questionnaire have been included in the appendix for reference. The author has also assessed that when there is a working SOP in place, it is easy to fix the upcoming issues. The other questionnaire represents the same phase in which questions have been established between a Standard Operating Procedure (SOP) addressing potential issues. In the arsenal of an organisation, simplification may be one of the most significant and underutilised instruments (*Work simplification | Deloitte Insights | Global Human Capital Trends 2015*, 2015).

# Chapter 5 – DISCUSSION & RECOMMENDATIONS

This chapter gathers data from chapters 2 ( literature review) and 4 (results & findings) and then produces an experimental categorisation based on the common results of these chapters, which helps to achieve the proposed objective 2 of the study, which is the author's recommendation to the industry. It also includes the discussion of the findings identified.

## 5.1 Complications under existing regulations

To achieve the best possible outcomes, it is important to choose structures that meet the intended goals, the essence of the findings of present study, and the frameworks which are essential to those processes (Hernaus, 2008). It is clear that laws are often drawn up on the basis of the needs of specific times, after evaluating the current literature for industry regulations. It is not on the basis of the entities or operations concerned and, thus, there is no Standard Operating Procedure that will define what is important along with its significance. Regulations based on process-based categories must also be simplified. Not only would it help to see the industry from multiple interconnected frameworks, it will also help to pose the right question for their inventions. Process-based organisation's primary emphasis is on the horizontal axis, which stresses the relationships between the functions. This style of organisation is more versatile, adaptive, and sensitive than conventional ones. In addition, it handles alterations easier (Hernaus, 2008). In the formulation of regulations, not understanding the entities and the different operations of drones can lead to complications, but taking them into account can simplify the entire operating process with the required output and related regulations. For example, if the recipe is known, it will always be easy to find the ingredients. Likewise, as entities and operations are identified, it would be much easier to shape regulations accordingly. The various operations should be discussed first, and then a full collection of regulations should be prepared with the specifications of their structure.

## 5.2 Gray areas and scopes

Multiple drone operations are present worldwide, and some of them are hot topics such as drone delivery, drone maintenance work, etc. It is not even possible to begin thinking about

their requirements if there is no standard operating procedure to identify a set of boundaries for regulations because all of these would not only have been understood but also handled if there had been a step-by-step activity for everything within the industry. Literature encourages safety and security features, but the findings reject the involvement of local authorities for the same reason. The research carried out by the author was about drone delivery, and it was found that people are still interested in seeing other types of drones for delivery, such as medium drones. Since looking at it from a single operation perspective, it was discovered that safety and security are still the grey areas for the industry to develop. It has also been found that the latest payloads do not contribute enough to any of these subjects.

If the commercialisation aim has to be met, which can be solved by setting up a separate frequency, the communication standard could be another subject in its grey field. Other than that, if the industry sees the larger image of drone commercialisation, then except for the pilot involvement which clearly differentiates these two industries, there must be a very similar structure of the Manned Aircraft System. For UTM, there should be a complete framework that is in place but not efficient. The respondents agree that, together with a framework incorporated inside payloads for restricted and non-restricted zones for full traffic as defined only for aerodromes, international authorities should come together to resolve these issues.

## 5.3 Recommendations

An experimental process-based categorisation is recommended by the author, which explains regulatory requirements at a given level and improves user experience to understand what this is all about. It will also allow the various regulatory areas to be further explored and set a clear course for future scopes in different operating sectors as well as related industry entities. The explained structure is below.

| Drones |
| --- |
| 1. Connected Devices |

<table>
<tr><td>1. A. Unmanned Aircraft Vehicle (UAV)<br>Required regulations for aircraft based on different categories, payloads and details of vehicle such as Nano (upto 250 grams), Micro (from 250 grams to 2 kg.), Small (from 2 kg. to 25 kg.), and so on.</td><td>1. B. Remote Control<br>Required regulations for the software incorporated in remote control.<br>Such as Camera, Sensors, Zone information, etc.</td></tr>
<tr><td colspan="2">2. Operator<br>Operator licensing rules (Unmanned Aerial Operator Permit) or RAL (Remote Pilot License) regulations.</td></tr>
<tr><td colspan="2">3. Various Operations<br>This section is for various operations, such as delivery, maintenance, etc., and the author's intent is to control those operations in accordance with the correct Standard Operating Procedure (SOP) at different stages of the requirements.</td></tr>
<tr><td colspan="2">4. Operational Area</td></tr>
<tr><td>4. A. Aircraft Base<br>For this section, the regulations for setting up an aircraft base station such as an airport for the manned aircraft system should be considered.</td><td>4. B. Flying Zone (Air Integration)<br>Under this section, the flying zone rules, as designed for the aerodrome-only by authorities, may be classified as red , green, etc.</td></tr>
<tr><td colspan="2">5. Corporate Social Responsibility<br>If it reduces carbon footprints or is sensitive to any emergency situations, protection, etc., this section can discuss the different regulations responsible for overall sustainability.</td></tr>
<tr><td colspan="2">6. Security and Privacy<br>To address the overall security with complete privacy from the connected devices to the confidentiality of each process involving the different relevant entities such as operator, operating area, data etc., and unique sets of regulations must be in place.</td></tr>
<tr><td colspan="2">7. Training and Maintenance<br>Regulations over time in order to perform the best practices and training. Any routine system maintenance set-up, operational job adjustments, and other information needed by the time must also be included.</td></tr>
</table>

*Table 5.3.1 – Recommended categorisation for preparing the regulations (Author)*

# Chapter 6 – CONCLUSION

The aim of the research was on the drone industry and its objectives were, A) to identify the present complication within the regulations. B) Offering an experimental categorisation that allows users to understand what the industry and regulations are all about. (c) Discussing the grey areas of the regulations.

## 6.1 Summary

It can now be said that the entire industry needs a clear categorisation that might allow people to understand their particular field of work, whether they are users or customers. Those categories could also describe the various unique operations unique to those categories within this new industry. Operations and each entity involved should be well defined, whether in the regulatory process or elsewhere, should be discussed all the time. The present problems are due to the categorisation and non-existence of an SOP. The step-by- step process that could explain what to do and then how to do was found to be much more successful than how to do and then what to do (Lowell S. Hardin, 1949). Overall, there should be an SOP to prepare a guideline for categorisation based on processes as well as included entities, and then it would be quicker and easier to find out the regulation along with future corrections or new implementations.

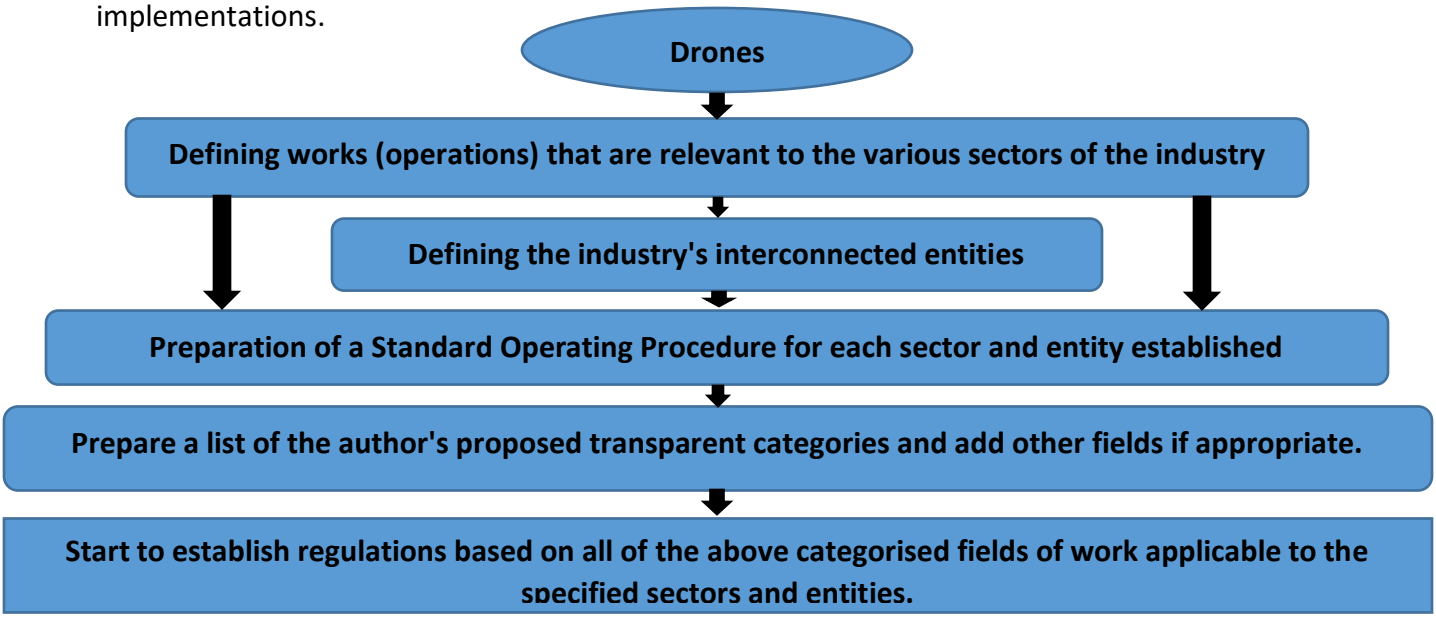



*Figure 6.1.1 An illustration of the concluding summary (Author)*

## 6.2 Limitations

From the limited number of survey respondents of 45 individuals, the results were obtained along with one interview with the CEO of the internship organisation. It would have been much stronger if the survey could have been filled by the many individuals who are the current member of the internship company and that could have been said as one advantage of the report, but the precaution was taken to observe the literature and the above problem was countered by a brief understanding of the discussion.

Another constraint is the number of interviewees. While the distribution by position within the panel is representative of fact, it would have improved the validity of the research by gathering more opinions, particularly when considering a subject such as regulations, where opinions differ significantly.

## 6.3 Further study

The proposed category could be the subject of further study according to aspects of the new industry, several areas have to be discussed accordingly, such as corporate social responsibility, and the need and responsibility have to be validated as well. It is important to plan category of operations that can be performed by the drones and whatever the obstacles that fall in between can be thoroughly studied for further planning of regulations that are still a matter of research as it depends upon those different operations.

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# Appendix

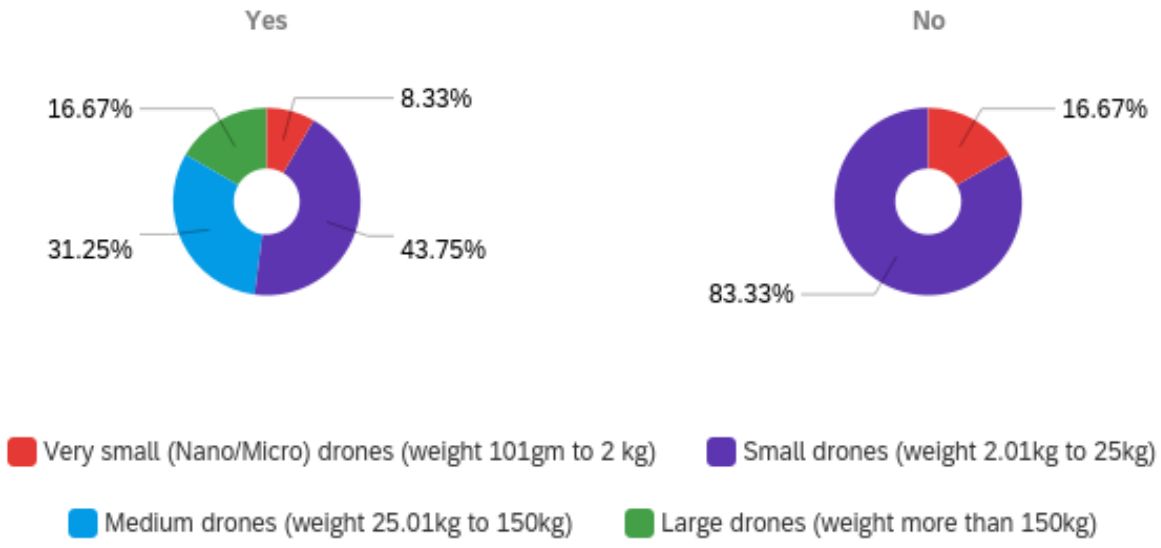
## Appendix 1 – Screenshot of survey questionnaire reports and cure approval letter

Default Report

*Unmanned Aircraft System (UAS)*

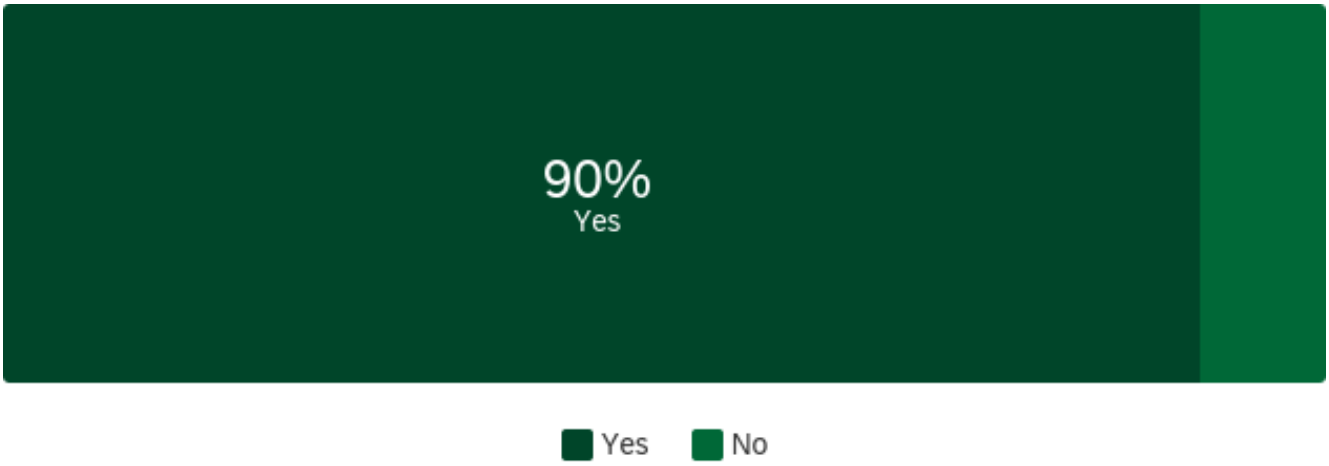
**October 12th 2020, 4:42 am MDT**

### Q.7. Which types of drones will be the most useful for the delivery operations?



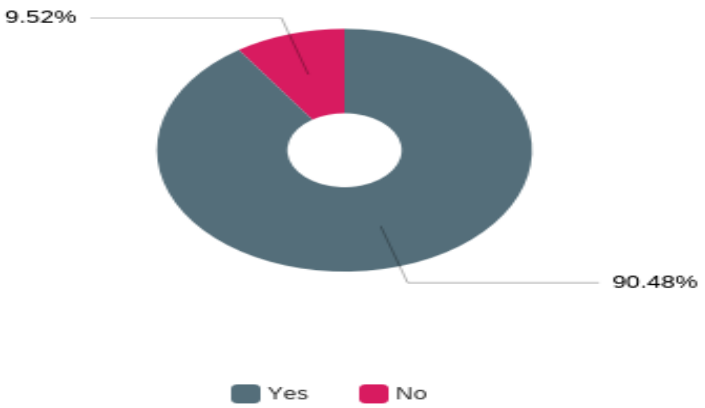

| # | Answer | % | Count |
|---|---|---|---|
| 1 | Very small (Nano/Micro) drones (weight 101gm to 2 kg) | 9.26% | 5 |
| 2 | Small drones (weight 2.01kg to 25kg) | 48.15% | 26 |
| 3 | Medium drones (weight 25.01kg to 150kg) | 27.78% | 15 |
| 4 | Large drones (weight more than 150kg) | 14.81% | 8 |
| | Total | 100% | 54 |

### Q.8. Should there be any standard for the products delivered to the doorstep for the deliverable and non-deliverable category according to the nature of the product such as hazardous, eatables, etc.?

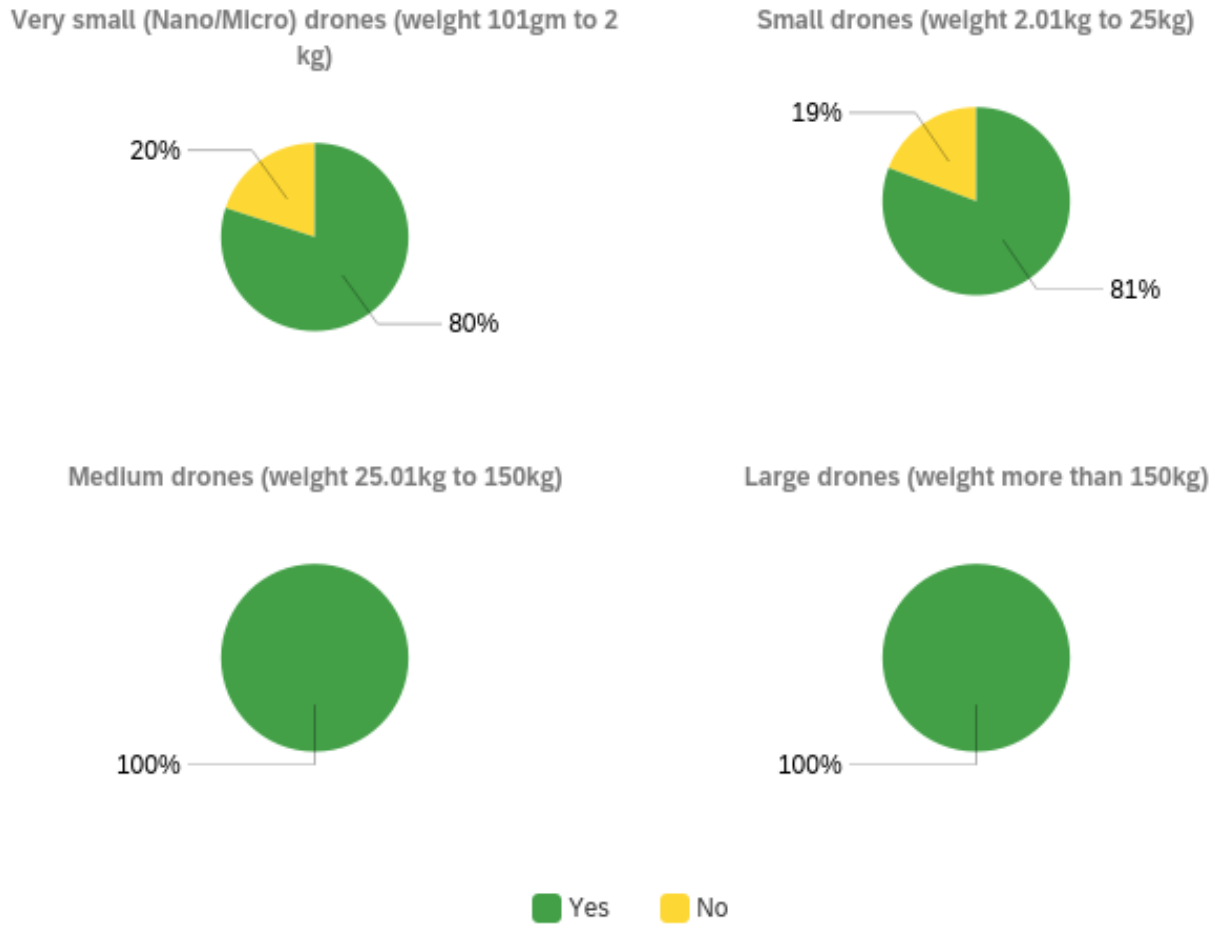



| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.8. Should there be any standard for the products delivered to the doorstep for the deliverable and non-deliverable category according to the nature of the product such as hazardous, eatables, etc.? | 1.00 | 2.00 | 1.10 | 0.29 | 0.09 | 42 |

| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 90.48% | 38 |
| 2 | No | 9.52% | 4 |
| | Total | 100% | 42 |



## Q.9. Do you think the other types of drones from medium and large categories should be integrated in the future for the purposes of delivery or supply chain?




| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.9. Do you think the other types of drones from medium and large categories should be integrated in the future for the purposes of delivery or supply chain? | 1.00 | 2.00 | 1.12 | 0.32 | 0.10 | 42 |

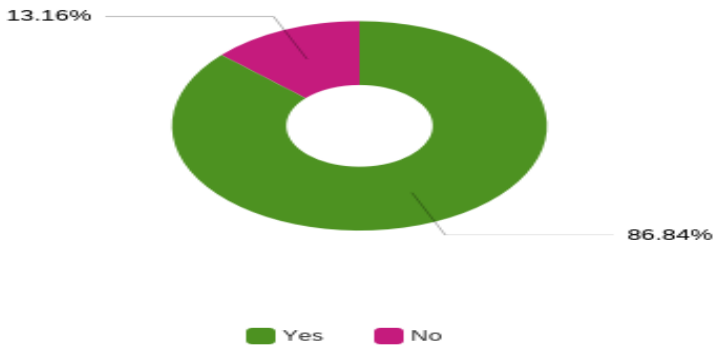
| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 88.10% | 37 |
| 2 | No | 11.90% | 5 |
| | Total | 100% | 42 |

## Q.10. Does any approach function to regulate drone operations such as delivery, maintenance, entertainment, and other potential operations, etc.?


| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.10. Does any approach function to regulate drone operations such as delivery, maintenance, entertainment, and other potential operations, etc.? | 1.00 | 2.00 | 1.27 | 0.44 | 0.20 | 37 |

| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 72.97% | 27 |
| 2 | No | 27.03% | 10 |
| | Total | 100% | 37 |

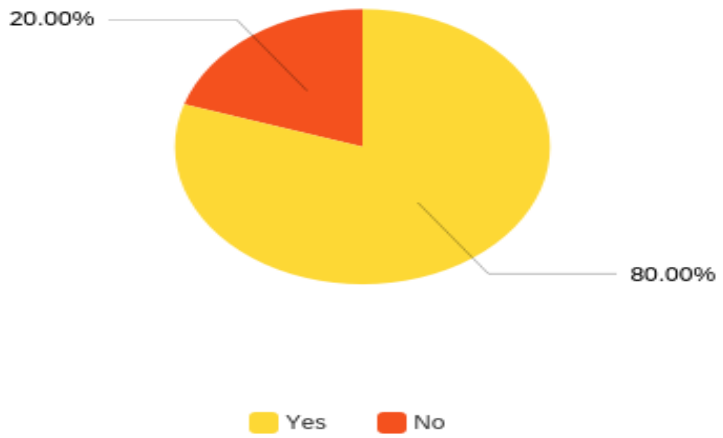
## Q.11. Do you think that the international authority should work together for such operations, considering that local authorities, as in manned aircraft setting, should be given priority?



| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.11. Do you think that the international authority should work together for such operations, c | 1.00 | 2.00 | 1.13 | 0.34 | 0.11 | 38 |

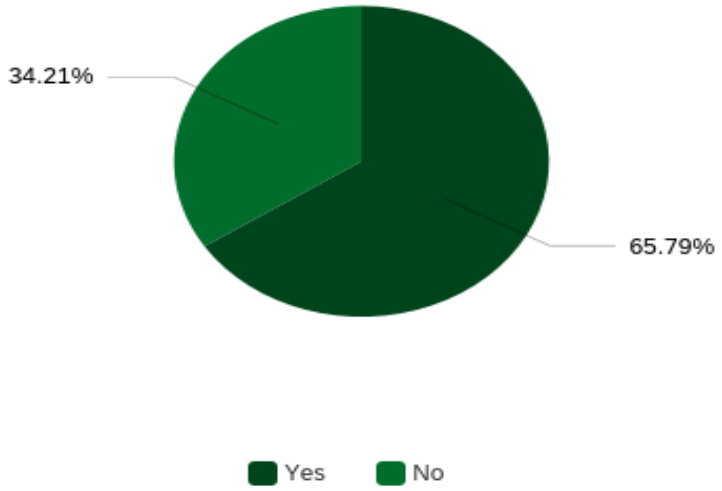
| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 86.84% | 33 |
| 2 | No | 13.16% | 5 |
| | Total | 100% | 38 |

**Q.12. Would it be appropriate to incorporate local authorities to design their own free and restricted air zones in order to implement them as payloads for enhanced traffic, security, and safety (an UTM feature), as suggested by different restriction zones of aerodromes?**




| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 73.68% | 28 |
| 2 | No | 18.42% | 7 |
| 3 | Any comments | 7.89% | 3 |
| | Total | 100% | 38 |

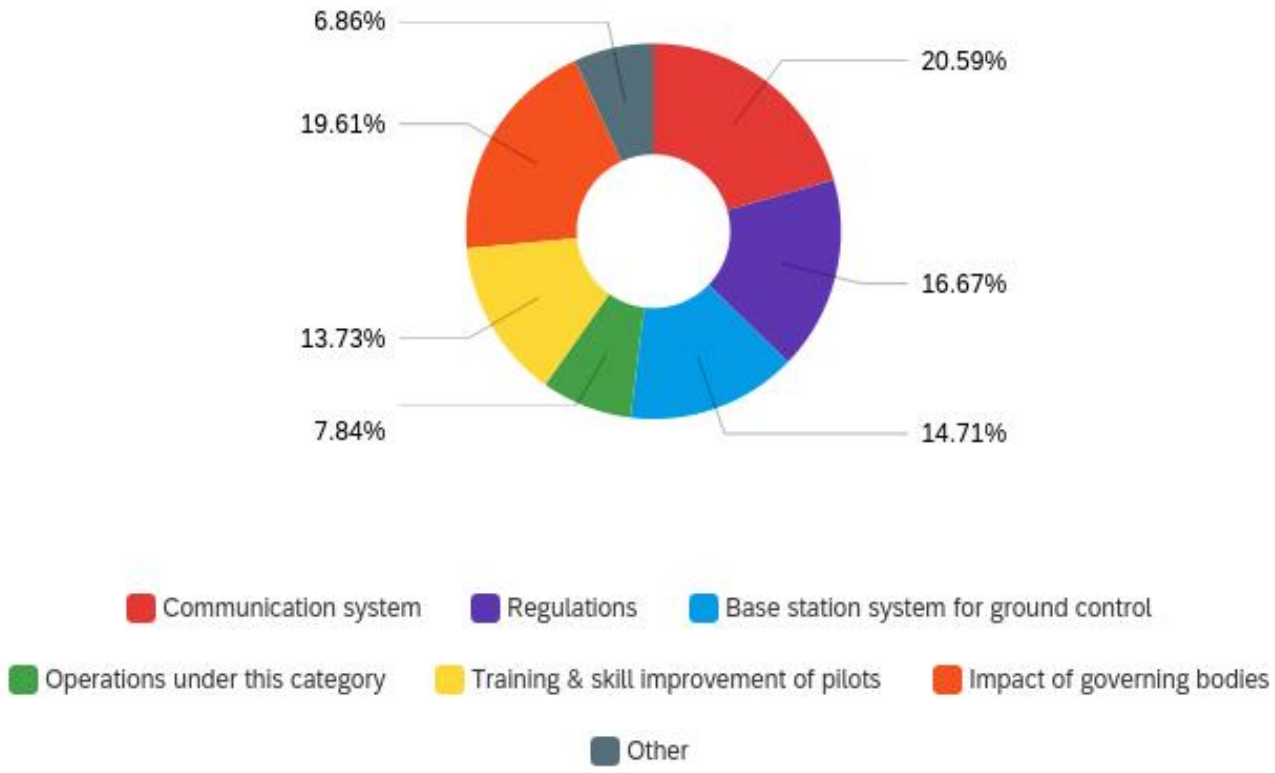
**Q.13. Do you think that operation beyond visual line of sight (BVLOS) would allow users (local people) to trust their security and safety in some way, rather than the other visual line of sight (VLOS) operations?**




| # | Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---|---|---|---|---|---|
| 1 | Q.13. Do you think that operation beyond visual line of sight (BVLOS) would allow users (local people) to trust their security and safety in some way, rather than the other visual line of sight (VLOS) operations? | 1.00 | 2.00 | 1.34 | 0.47 | 0.23 | 38 |

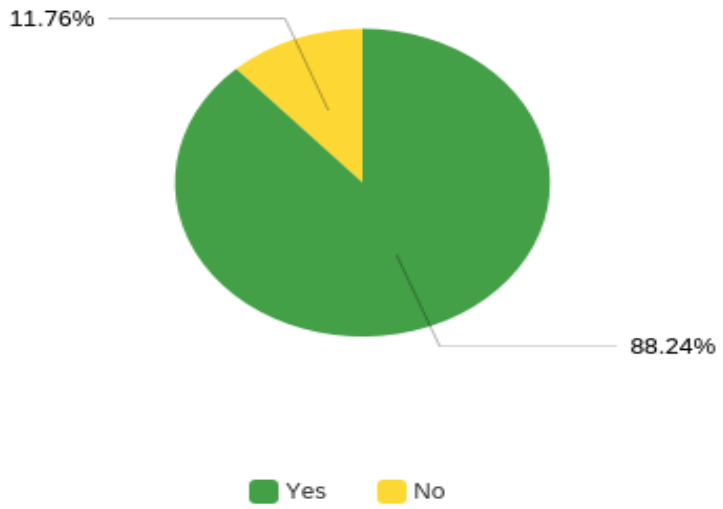
| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 65.79% | 25 |
| 2 | No | 34.21% | 13 |
| | Total | 100% | 38 |

## Q.14. If the above question is regarded then what are the key areas that need to be improved?




| # | Answer | % | Count |
|---|---|---|---|
| 1 | Communication system | 20.59% | 21 |
| 2 | Regulations | 16.67% | 17 |
| 3 | Base station system for ground control | 14.71% | 15 |
| 4 | Operations under this category | 7.84% | 8 |
| 5 | Training & skill improvement of pilots | 13.73% | 14 |
| 6 | Impact of governing bodies | 19.61% | 20 |
| 7 | Other | 6.86% | 7 |
| | Total | 100% | 102 |

**Q.15. Do you think a separate frequency system would allow medium to large types of drones to work for supply chain purposes under beyond visual line of sight (BVLOS) in the future?**




| # | Answer | % | Count |
|---|---|---|---|
| 1 | Yes | 75.00% | 30 |
| 2 | No | 10.00% | 4 |
| 3 | Any comments | 15.00% | 6 |
| | Total | 100% | 40 |


**Word frequency query result**

30 July 2020

Dear Mr Dixit ,

Reference: CURES/12051/2020
Title: How will simplifying and understanding the UAS (Unmanned Aircraft System) regulations or the drones program create visibility for the industry overall?

Thank you for your application to the Cranfield University Research Ethics System (CURES).

**We are pleased to inform you your CURES application, reference** CURES/12051/2020 **has been reviewed. You may now proceed with the research activities you have sought approval for.**

If you have any queries, please contact CURES Support.

We wish you every success with your project.

Regards,

CURES Team

**Example of Cranfield University Research Ethics System**