Training Africa's drone pilots in a harmonised regulatory environment

1 INTRODUCTION AND CONTEXT

1.1 Background

With its decision EX.CL/Dec. 986-1007 (XXXII), the African Union (AU) has created one of the most important incentives for the AU and its Member States to use drones for stimulating development in Africa (see Figure 1). Through this decision, the AU identified drones as a disruptive technology that will boost the transformation of the continent. Indeed, during the last few years, drones have been used to address many development issues that still constitute a challenge for Africa. They are used in agriculture, health, infrastructure monitoring, land mapping and have the potential to find applications in many areas neglected for decades by governments and other development actors.

While significant improvement in terms of development and enactment of national regulations governing drone use have been done in 2018, 60% of African countries still do not have regulations in place or simply ban the use of the technology as shown in Figure 1.

Figure 1 Status of drone regulations across the continent

1.2 Challenges

The problem of lack of regulations is compounded by the lack of licensed drone pilot training and licensing centres. Those existing at present and which are accredited by the concerned national civil aviation authority are limited to South Africa. hence, lack of accredited drone pilot training centres, non-recognition of drone pilot licenses across national borders and lack of harmonization of existing regulations can pose serious challenges to the development of the drone-based service industry.

Several development agencies such as the Technical Centre for Agricultural and Rural Cooperation (CTA), United Nations Children's Fund (UNICEF), the African Development Bank, and others are supporting skills development in the use of drones, but none of these

efforts is done in coordination with the concerned national civil aviation authority, which in turn would legitimize the issuance of drone pilot licenses. Some start-ups like Global Partners in Benin and WeRobotics in Tanzania are supporting drone education and training in Africa.

However, these initiatives are isolated and centred around a few numbers of countries. For drones to become a critical tool in the development of African nations, as expected by the AU in its decision, there needs to be a critical mass of resource centres that masters the technology and adapts it to local needs.

The two challenges related to the limited knowledge and skills in operating drones and national regulatory frameworks governing the use of drones and which can be disabling, reinforce each other in creating a vicious circle that can delay the spread of drone-based solutions. Indeed, in many African countries, governments are concerned by the potential risks that drones present to public safety and privacy. National civil aviation authorities, for example, are worried about drone operators and hobbyists operating their crafts unsafely and causing accidents with airplanes putting at risk the lives of hundreds of individuals. Authorities are also concerned about the level of skills and competency of those operating the drones.

Several African countries are in the process of developing their own regulations on the use of drones and if this double challenge is not addressed, the new regulations are likely to mimic the already existing ones without including preferential treatment for priority applications of the technology like agriculture and humanitarian assistance. A case study below presents the drone industry in Benin, the knowledge of the drone regulation in the country and the constraints faced by the drone users.

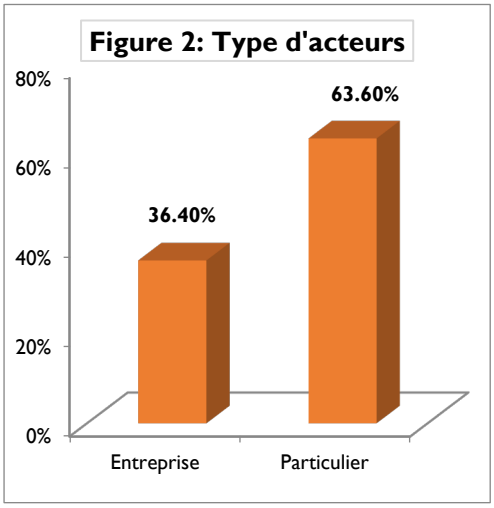
1.3 Benin case study

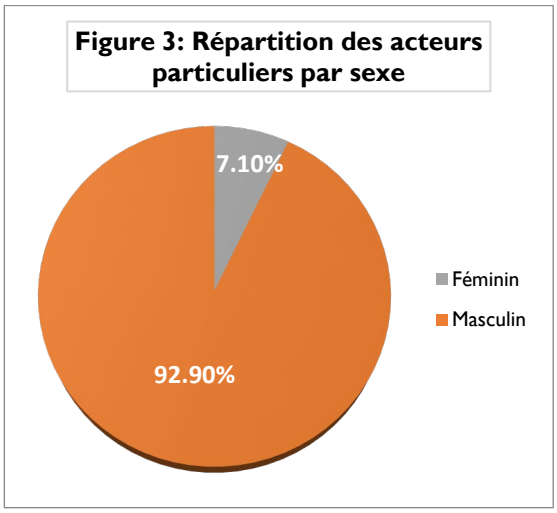
In Benin, the main applications of Unmanned Aerial Vehicles (UAV or drones) are in the field of cinematography, journalism and entertainment, where drones are used for filming video and taking pictures. Drones are also used in various other areas such as agriculture, land use planning and biodiversity conservation. However, drone users do not always follow the standards and good practices needed to guarantee the safety of people and goods when flying their drones. The National Agency for Civil Aviation (ANAC) in Benin, drafted and implemented the law on the use of drones (Decision No. 045 / ANAC / MIT / DCS-DRTA-DA / SA of 17 September 2018). However, drone users are not aware of the regulation and do not comply to it when operating their equipment. In addition, there is very little information on the drone sector in Benin, both on the actors operating in the field, the current practices, the sectors in which this technology is used as well as the knowledge and application of the regulations adopted by the National Agency of Civil Aviation. To overcome this lack of information on the drone sector in Benin a national census of drone users in Benin was initiated by Global Partners.

This census took place from February 27 to March 27, 2019. It was conducted according to a three-step methodology: the development and validation of the questionnaire, the deployment and validation of the online questionnaire, and the launch and implementation of a communication campaign in relation to the census. The questionnaire consists of four main parts, including the characteristics of the actor, the use of drones by the actor, the knowledge and the respect of the regulations and the perception on the environment related to the use of drones in Benin. A short summary of the results of this survey is presented infra.

Characteristics of the actors

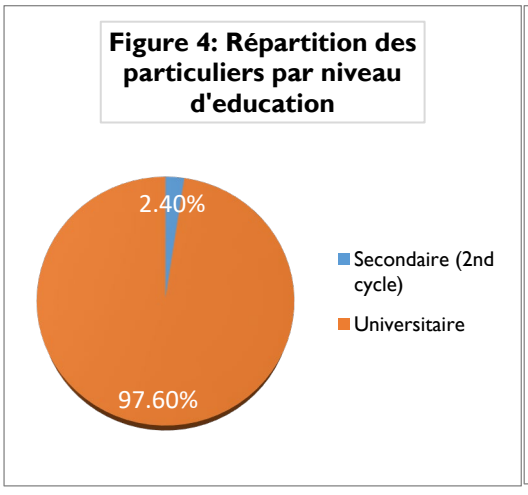
In this part we answer to questions related to the types of actors (individual or company), their geographical distribution, their practices, their level of education, etc. Figure 2 and 3 shows the distribution of the different actors.

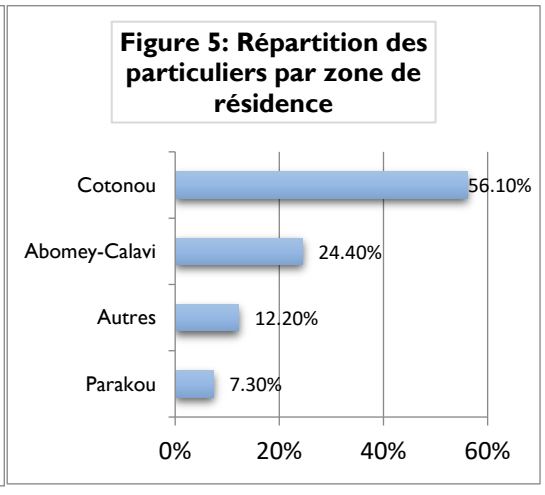




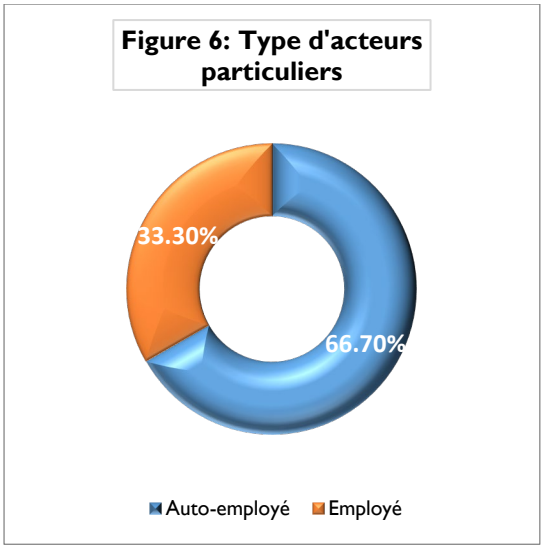
Approximately two-thirds of the identified actors are individuals, that is, actors who practice as hobbyists. When we consider the gender of the individuals, the drone pilot activity is largely dominated by men who represents 92.90% of the individuals surveyed.

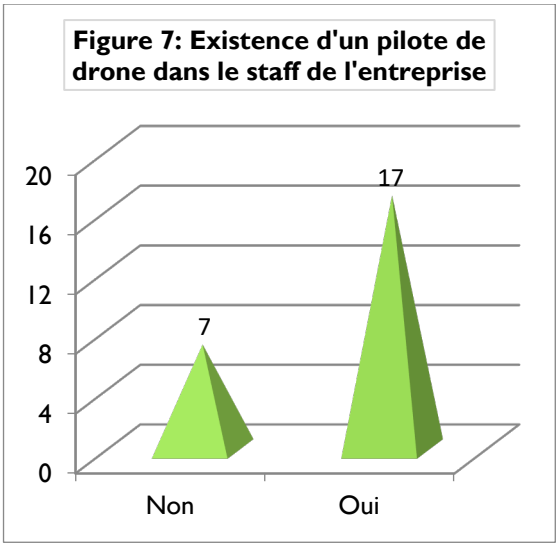
Most of the hobbyists are youth with a minimum age of 20 and a maximum of 41 years and an average age of 29.48 years (± 6.22 years). Figure 4 shows their level of education. Most of them appear to have a college degree. Thus, individuals operating in the UAV sector have a relatively high level of education which will allow them to quickly assimilate the theoretical and practical knowledge necessary to safely operate drones. The geographical distribution of these individuals (figure 5) reveals that more than half of them reside in cities. In addition, 4 out of 5 of the company surveyed reside in cities but operate virtually in the whole country.





About two out of three company operate as a service provider (figure 6) and most of the company have their own drone pilot in their staff. For example, 17 of the 24 companies using drones reported having at least one drone pilot in their staff (figure 7).



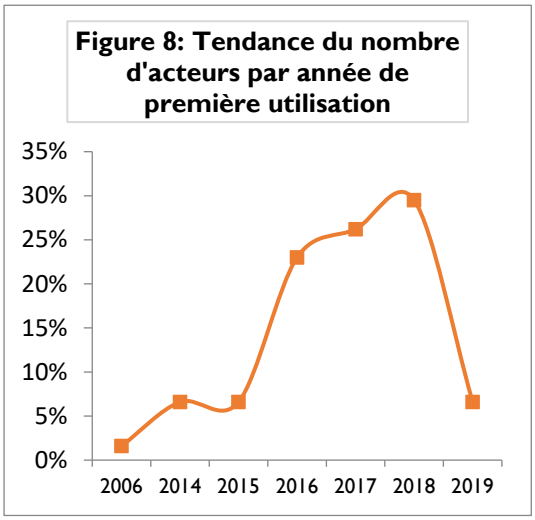


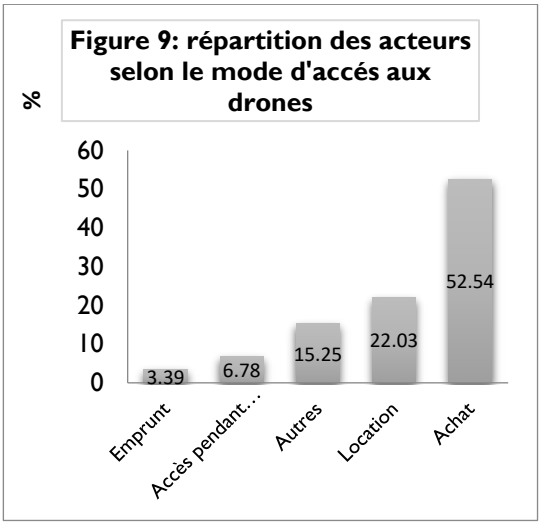
Use of drones by actors

This sub-section presents the results related to the year of first use, the modes of access to UAVs, the sectors where UAVs are used, the possession of a pilot license, the number of drones owned by UAV operators.

Figure 8 shows an increasing number of drone users since 2006 with a significant increase in 2016. In fact, 23%, 26% and 30% of the actors surveyed used the drones for the first time respectively in 2016, 2017 and 2018. We anticipate the upward trend observed since 2016 to continue in the coming years. This is the result of the various training organized by companies in the sector including Global Partners.

The modes of access to the equipment are diversified. Figure 9 shows the distribution of actors according to their modes of access to UAVs. The analysis of the figure shows that half of the actors possess their own drones while 22% of these actors rent them. About 7% of the actors surveyed had access to drones during their training.





We count a total of 80 drones used by the different actors including 63 multicopters and 17 fixed-wing drones. It should be noted that the maximum number of multicopters held by an actor is 12 drones.

The sectors in which the actors first provided a service are of great importance in order to appreciate how they enter the industry and the existence of local capacities in the different sectors. Figure 10 shows the distribution of the sectors. It is important to stress that the coverage of events such as political rallies, concerts and other events of large gatherings remains the first entry sector for actors. This sector is followed by the environment and tourism with 17% and 16% respectively.

As for Figure 11, it shows the sectors in which the actors are providing drone services. The values in Figure 11 represent the percentage of actors who have already served in each sector. Thus, the sum of the percentages does not give 100%.

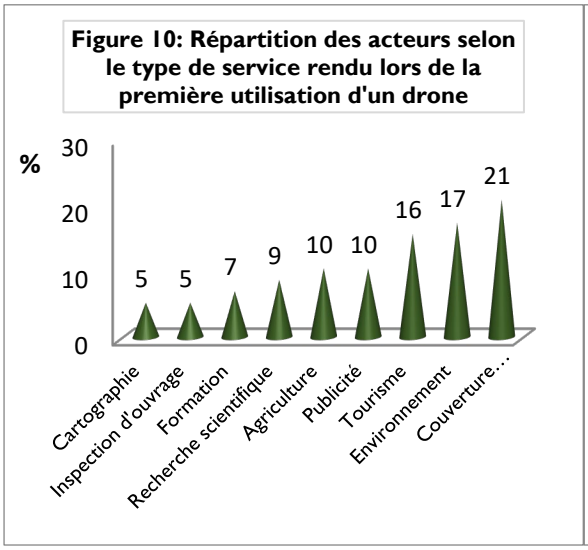


Figure 10: Répartition des acteurs selon le type de service rendu lors de la première utilisation d'un drone

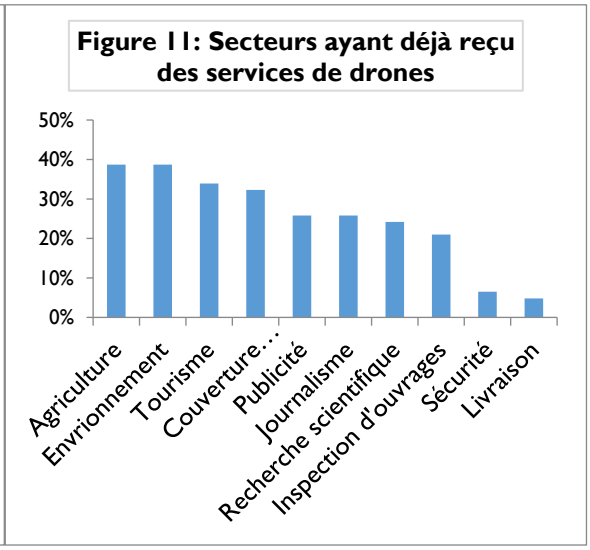


Figure 11: Secteurs ayant déjà reçu des services de drones

It should be noted that between 2006 and 2019, there was a significant change in the sectors in which the actors use drones. The first three sectors are agriculture, environment and tourism. This denotes the existence of local skills to use drones in these different areas.

A good use of the drones for the various services in the above-mentioned fields supposes a certain level of knowledge and skills on the use of the drones. Figures 12 and 13 respectively show the distribution of the actors' perception of their own skill levels.

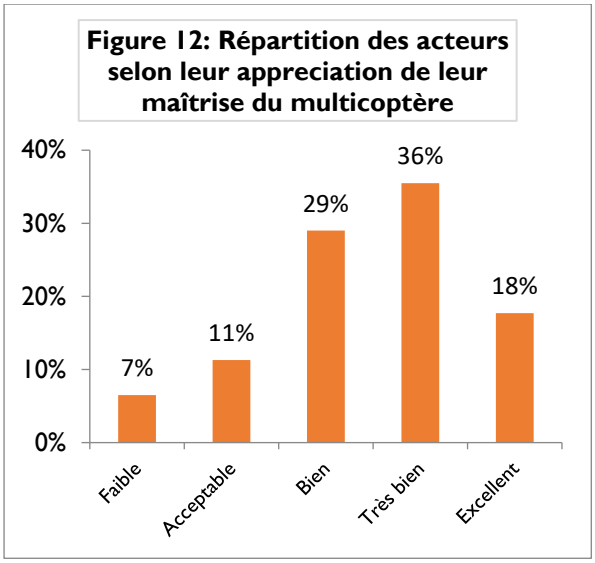


Figure 12: Répartition des acteurs selon leur appreciation de leur maîtrise du multicoptère

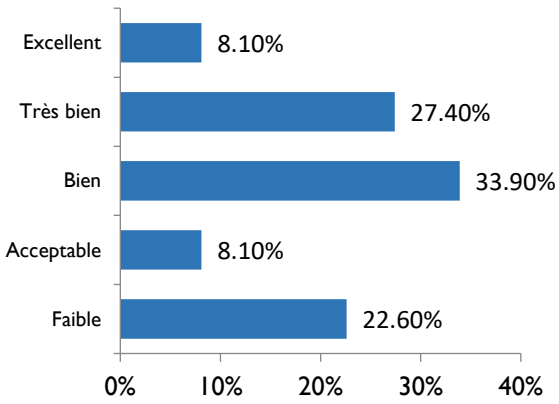


Figure 13: Répartition des acteurs selon leur appreciation de leur maîtrise du fixedwing

Figure 12 reveals that 82% of the actors think that they or their drone pilots have at an acceptable command of multirotors. Indeed, 29%, 36% and 18% said they have a good, very good and excellent control of these types of drones respectively. For fixed-wing, the proportion of those reporting at good control is lower than that of the propeller drone. Indeed, 69.30% of the actors think that they or their drone pilots have an acceptable command of fixed wing drones which are in general rarer than the propeller drones because of their costs. For this type of UAV, about 34% said they had good control, while only 27.4% and 8.10% said they had very good and excellent control respectively. These results reveal the existence of local capabilities if they have the right skills.

However, when we refer to the possession of a license or a valid drone pilot certificate, we notice that the great majority (74%) of the actors do not have a license (Figure 14).

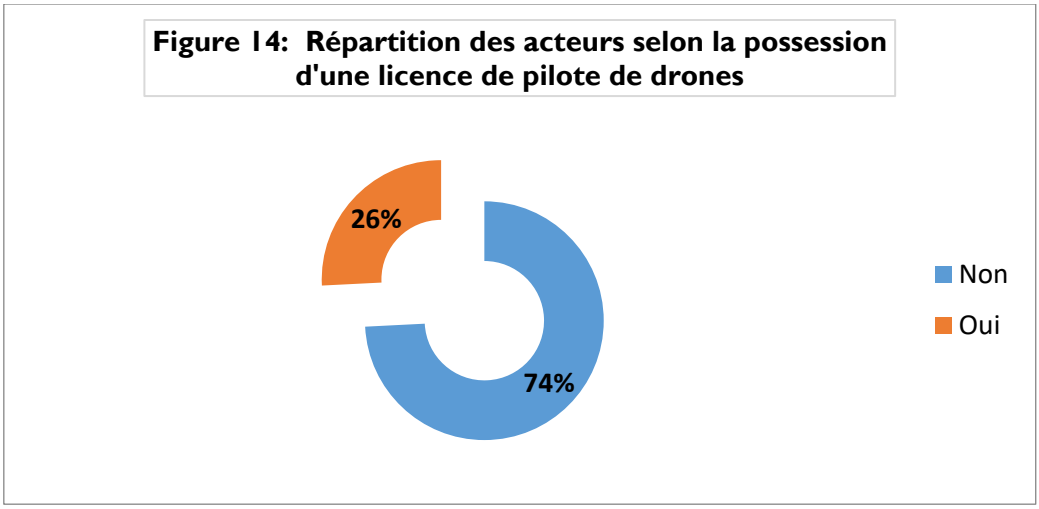


Figure 14: Répartition des acteurs selon la possession d'une licence de pilote de drones

In addition, the organizations that issued the licenses for the remaining 26%, might not have offered critical theoretical knowledge on the use of UAVs. Most of the trainees have just undergone a very short introductory training. This poses the problem of the quality of the drone pilots currently operating in the country. It is therefore necessary to take appropriate action in this direction in order to reinforce the capabilities of drone pilots in Benin.

The success of drone projects depends on the quality of the drone data collected but also and above all the quality of the analyses performed on the data. This assumes the existence of local expertise in drone data analysis. Thus, we sought to know if the actors have the skills needed to analyse UAV data in addition to drone piloting skills. The actors surveyed possessing analytical skills were asked to assess their own level of mastery. The results are presented in Figures 15 and 16, respectively. Most of the actors (63%) reported being able to analyse the data collected with drones. Of these, about 78% of them reported that they have a “moderate” level in drone data analysis. Respectively, 37.84%, 21.62% and 18.92% reported having "good", "very good" and "excellent" levels in drone data analysis. This reinforces the local capacities in terms of the skills needed to conduct a drone project.

Figure 15: Compétences en analyse des données de drones

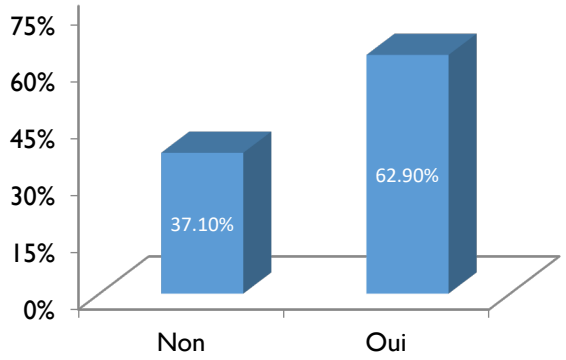
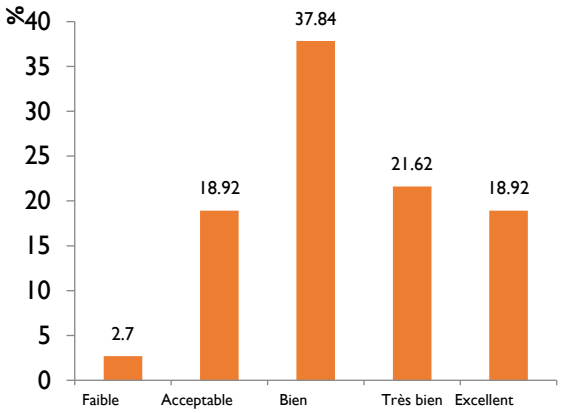


Figure 16: Perception des acteurs sur leur niveau de maitrise de l'analyse des données de drones

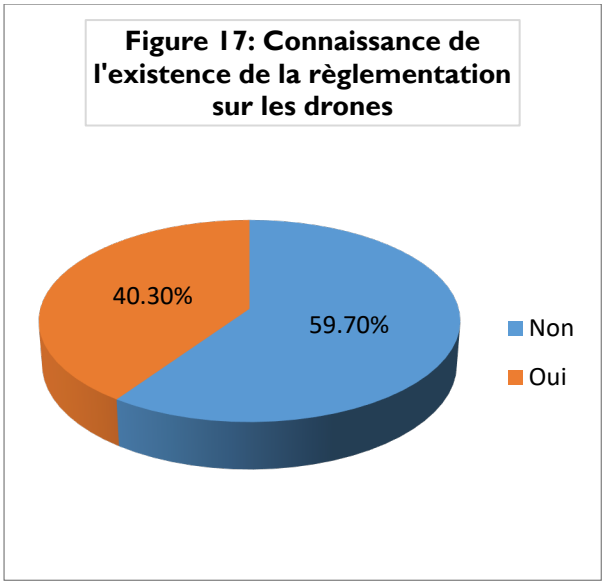


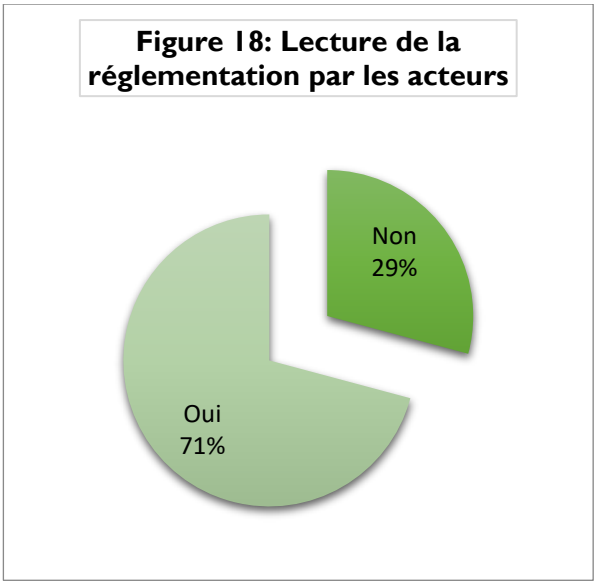
Although the actors claimed to have good skills in drone use and data analysis, the lack of a certification body in Benin poses the much-debated question of the “need of a regulation of the sector”. Since September 2018, Benin has a regulation on drones. But is this regulation known to the actors? Do the actors respect the different requirements of the regulations? These are some of the questions that will be addressed in the next session.

Knowledge and application of the regulation on drones in Benin

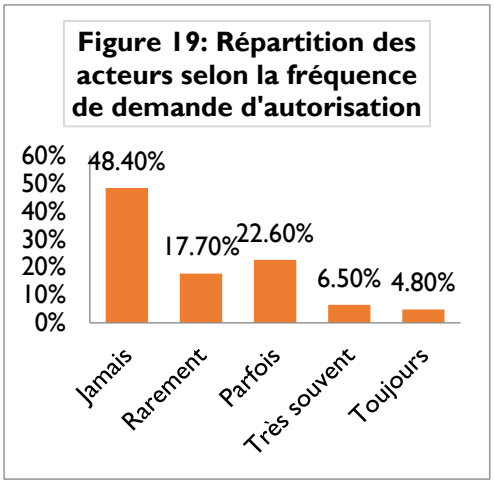
This section will be analysed through the knowledge of the existence of the regulation, the respect of some provisions of the regulation such as the request of authorization before any flight, the perception of the actors on the impact of the strict respect of the regulation on the development of the drone sector and their perception on how enabling is the drone environment in Benin.

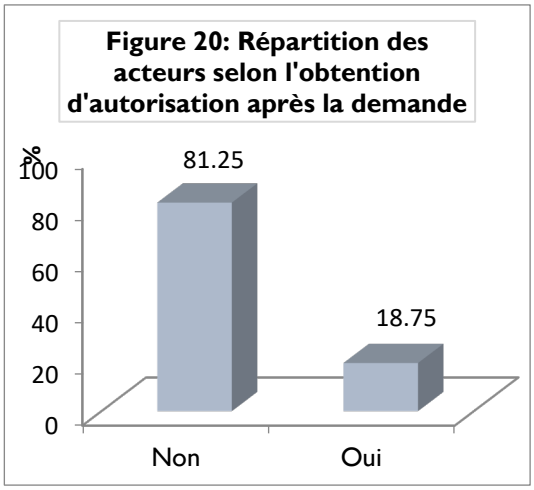
Figure 17 below shows the distribution of actors according to their knowledge of the existence of a regulation in Benin. The majority of actors are not aware of the existence of regulations. Indeed, only 40% of the actors declared having some knowledge of the regulation. Of these, 71% said they read the document (Figure 18). The two figures show that regulations were still very little known by the actors when the census is conducted.





An important provision of the regulation is the application for an authorization before proceeding to the use of a UAV. Figure 19 shows the frequency of authorization request by the actors. It shows that almost half of the actors (48.4%) have never asked for an authorization before using their UAV equipment in different parts of the national territory. In addition, the frequencies with the highest shares are "sometimes" and "rarely" with respective percentages of 22.6% and 17.6%.





These results reveal that the civil aviation authorities have virtually no idea about the use of drones in the country. These somewhat disturbing but not surprising results (in terms of knowledge of the regulation) can be explained by two main factors. First, it is possible that the actors do not apply for an authorisation because they are not aware of the regulation as shown in Figure 17. On another hand, it is likely that this requirement is not respected because actors do not know where they can request such authorisation or whether or not their request will be processed on time for them to conduct their operation as shown in Figure 20. 81.25% of the actors who made requests for authorization never obtained it before implementing their drone project. These results pose a problem related to the processing of requests related to the use of drones.

It is necessary that civil aviation authorities have appropriate and known structures to deliver the certificates. Mechanisms should be put in place to process requests within a reasonable time. In addition, it is important to sensitize the actors on the regulation in general and in particular on the importance of obtaining an authorization before using their drones.

Constraints to the development of the UAV sector in Benin

The actors were asked to list the three main constraints to the development of the UAV sector in Benin. The constraints were grouped into several categories and the proportion of actors who mentioned each constraint category among all its constraints was calculated. The results are shown in the table below. The analysis of the table shows the difficulty that actors have in accessing drones represents the most mentioned constraint. Accessibility here includes, on the one hand, the high cost of drones when purchasing it as well as related customs taxes but also the low availability of renting alternatives. This first constraint is followed very closely by the lack of information of the population (active and non-active) on the importance of drones for development with a percentage of 31%. The other two major constraints that follow are the lack of accredited training centres and overly strict regulations (25% and 23%).

Tableau : Contraintes au développement du secteur des drones au Bénin

Contraintes	**Proportion (%)**
Accessibilité difficile aux drones	32
Manque d'information de la population sur l'importance des drones	31
Absence de centres agréés de formation	25
Réglementation trop stricte	23
Difficultés de maintenance des drones	9
Non délivrance ou lenteur dans la délivrance d'autorisation	9
Insuffisance de professionnels compétents	9
Absence de volonté politique	8
Manque de connaissance des textes par les acteurs	8
Autres	6
Inorganisation des acteurs du secteur	5
Non-respect de la réglementation	3
Prix élevé des services de drones	3
Manque de client	2
Absence d'entreprises leaders dans le secteur	2
Manque d'information des acteurs du secteur	2

In sum, the results show that there is a non-negligible local sector that can potentially develop the drone industry and its applications so that it contributes to the economic and social development of the country. Although there is local capacity, the sector faces many constraints that will hinder its progress if nothing is done. It is important to undertake targeted and effective actions to address those constraints.

2 PROJECT RATIONALE

2.1 Summary project description

The Aviation Program in the Department of Applied Engineering and Technology at Eastern Kentucky University (EKU) has developed an extensive curriculum on drone piloting certification in the US and has a proven record in training many generations of professionals in aerospace management, aerospace technology, and professional flight.

The project aims at addressing the challenges described in section 1.2, building on the existing and tested curriculum offered by EKU via the development of an online self-thought, remotely assisted[1]version. Making this training available online, will help address the lack of qualified training centres in Africa and allow individuals to gain the theoretical knowledge and practical skills[2] necessary to obtain a drone pilot certification. The project will also encourage the harmonization of national drone regulations in the countries where it will operate. Indeed, through meeting and discussions with selected national of civil aviation authorities, the specificities of the regulations will be included in the course curriculum. This will guarantee the concerned authorities that the applicants have the theoretical knowledge and skills required to operate drones safely.

This project will also help develop training materials to be used to deliver face-to-face training via affiliated centres in Africa. The harmonization and standardization of training curricula on the use of drones in Africa will help define a set of standards and quality metrics needed to guarantee the operators' competency in this fast-growing drone industry. This standardization will also set a background for a uniform accreditation of drone businesses and facilitate the mobility of drone operators across African countries.

The project will rely on the Africa Goes Digital network of drone operators to deliver face-to-face training using the approved curriculum. Africa Goes Digital is a network of companies that provide drone service in Africa and that aims at accelerating the digital transformation of the continent. At present the network accounts for 30 plus members in 19 African countries.

To start, members meeting a set of criteria, will be allowed to test the curriculum in their respective countries easing its adoption at a large scale. A pilot phase will be conducted in **Benin** during which the training materials will be evaluated, improved, and tested at the secondary school level and in higher education.

3 PARTIES INVOLVED

3.1 Global Partners

Global Partners is a Benin based start-up developing and providing drone solutions for agriculture, land use planning, surveillance, and biodiversity conservation. Global Partners has a team of GIS analyst, agronomists, researchers, and drone operators and uses drones with advanced sensors and imaging capabilities to map and analyse crops, monitor infrastructure, road networks and buildings, and assist urban and regional planners. Tailored training are also offered to different stakeholders.

Global Partners has become one of the leading training centers of drone operations in West Africa. During the last three years, the start-up trained more than 400 stakeholders (rangers, researchers, policymakers and students) on the safe use of drones. Training focuses on agriculture, urban planning and conservation. Global Partners also worked with international

[1] An instructor monitors the class, has office hours (online) and interacts with students.
[2] Using the network of AfGoesDigital, some enterprises will be selected to offer the face-to-face training following an already established curriculum by EKU

organizations in training staff working in protecting areas on using drones to identify and prevent illegal unsustainable practices that affect biodiversity in protected areas. The illegal unsustainable practices Global Partners focus its training on are poaching, uncontrolled bushfires, agricultural encroachments, and timber and fish overexploitation. Specifically, Global partners contributes to biodiversity conservation in the W-Arly-Pendjary (WAP) parks, a complex of three protected areas that covers three different countries: Benin, Burkina-Faso and Niger. During the last two years, in the WAP complex as well as in the transboundary biosphere reserve of the Mono Delta (Benin and Togo), Global Partners developed ecological monitoring programs using drones were animal habitats, soil occupation, and agricultural activities are mapped and monitored.

Global Partners is also a research and development centre that is conducting ground-breaking research on a variety of issues related to the economy, sociological, and technological aspects of the use of drones. In 2016 and 2017 Global Partners conducted field experiments to test how drones can be adapted to farmers' needs for pesticides and examine farmers' willingness to pay for drones' services. In the first phase, researchers compared the performance of a spraying drone with that of an operator using a backpack manual sprayer. The research proved that drones are more efficient, more accurate, save time and money and have a reduced impact on the environment. In parallel, researchers conducted surveys to evaluate farmers willingness to pay for drones' services. A total of 177 cotton farmers were involved in one of the studies and of 232 rice farmers in the second study. The two studies took place in Benin. The results show that farmers are willing to pay an average of $5-$10/ha for the drone services. The main services demanded are spraying, re-seedlings, and detection of stresses (insects and other attacks). Factors such as education level, farm size and the number of dependants affect their willingness to pay.

In 2018, Global Partners started a collaboration with the Belgium development agency ENABEL in addressing production challenges faced by pineapple producers in Benin. The start-up uses its drones to provide actionable data to pineapple producers. The start-up is also conducting multiple studies on the constraints faced by pineapple producers as well as factors of efficiency in the production system.

Global Partners also supports the educational mission of the University of Abomey-Calavi and the University of Parakou in Benin, by training the next generation of conservationists and policymakers on the use of drones in research and development. Global Partners contributes to the research efforts of these two universities. Students conduct their internship at Global Partners and are introduced to new methods and technologies such as artificial intelligence, predictive analytics, geographic information systems, etc.

3.2 Eastern Kentucky University, Aviation Program in the Department of Applied Engineering and Technology (EKU Aviation)

Eastern Kentucky University is a regional comprehensive university in Richmond, Kentucky. The Aviation Program in the Department of Applied Engineering and Technology, EKU Aviation, is the only program of its kind in Kentucky that provides the aerospace industry with the best trained and safest professional pilots, and the most forward-thinking managers coming out of academia today. Students that graduate from the EKU Aviation program are professionally prepared for all facets of the aerospace and aviation industry to include piloting, flight instruction, aviation management, and aerospace technology. The program now boasts one of the nation's first FAA-approved 1,000-hour Restricted Airline Transport Pilot (R-ATP) athorizations. The FAA is the Federal Aviation Administration of the United States, a national authority with powers to regulate all aspects of civil aviation in the U.S. EKU Aviation is granted by the FAA special authority. This authority allowed EKU to designate its Aviation-Professional

Flight graduates as eligible to take the R-ATP check ride at 1,000 total flight hours. The FAA has also added EKU's Aviation-Aerospace Technology (AT) degree to its federal register of approved 1,000-hour R-ATP degrees.

EKU Aviation has distinguished itself by the quality of its program and the innovations introduced to align its program with the safest airport and flight training operation standards possible. For example, the Safety Management System (SMS) at EKU is an innovative, proactive, and systematic approach to managing safety that is integral to all ground and flight operations with the objective of achieving and maintaining the highest levels of safety standards and performance. EKU students and faculty are the key resources to the success of the SMS.

EKU aviation is one of the FAA examination centers not only for aviation but also for drone pilot certification. The school has also developed a drone pilot certification course that helps drone users understand the rules and regulations that govern safe drone operations in the national airspace. The course covers subjects such as:

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation
- Aviation weather sources and effects of weather on small unmanned aircraft performance
- Small unmanned aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communication procedures
- Determining the performance of small unmanned aircraft
- Physiological effects of drugs and alcohol
- Aeronautical decision-making and judgment
- Airport operations
- Maintenance and pre-flight inspection procedures

EKU Aviation has a staff of pilots, engineers, and flight instructors with extensive experience in the aviation industry.

4 PROJECT IMPLEMENTATION

This project will be implemented over a period of 7 months over four phases: (i) tailoring existing training materials to selected national conditions, (ii) workshops in **Benin**, and **Senegal** on drone regulation, harmonization, and standardization of the training curriculum, (iii) pilot phase in Benin, and (iv) extension of the drone academy programme to one member of Africa Goes Digital association based in Senegal.

4.1 Tailoring Existing Training Materials to Existing Nationals Conditions and Development of Online Course

EKU has already developed a drone certification curriculum. However, the curriculum is based on regulations applicable in the U.S. The Federal Aviation Administration (FAA) rules for

Remotely Piloted Aircraft System (RPAS)[3] operations other than model aircrafts, cover a broad spectrum of commercial and government uses for drones weighing less than 55 pounds. Even though these regulations follow the highest standards, the project team will consult with civil aviation authorities in Benin and Senegal to adapt the online course to the specificities of each country. The current format of the course is presented in Annex 1.

In parallel, a training manual on how to fly drones safely will be developed. This training manual is designated to serve during the face to face training to be delivered in the affiliated centres. It will be tested with students during phase (iii) of the project in Benin. It will help learners get a good understanding and the latest skills related to the use of drones. The manual will introduce learners to how drones work. It will demystify the mechanics behind Unmanned Aerial Systems (UAS), the different components and how they fit together. Different tutorials included in the face to face training also teach learners practical skills on how to operate drones. Pre, during, and post-flight procedures will be detailed. UAS loading, maintenance, inspection, lost link procedures, batteries maintenance, radio communication, crew management, and many other topics will be discussed in this training material.

4.2 Workshops on Regulations and Harmonization of the Curriculum

Drone regulations are specific to each African country. Through a series of two workshops organised in collaboration with the regional office of ICAO, the project team will meet with representatives from the concerned national civil aviation authority to learn about those specificities and integrate these into the online curriculum. To start with, the workshops will be organized in two countries as a case studies: Benin and Senegal.

Following each workshop, adjustments will be made to the online curriculum. The curriculum will incorporate the particularities of each country. Recommendations will also be made to national civil aviation authorities based on the regulations in force in other countries and ICAO recommendations. This may contribute to a desired harmonization of national regulations. It also represents the first step for national civil aviation authorities to accredit the online course. After the pilot phase in Benin and Senegal, it is envisaged that additional funding (non-CTA) till allow for the replication of the process in other African countries.

4.3 Drone Training Pilot Phase in Benin

The training materials will be tested during a pilot phase in Benin. Two groups of learners will be selected. Students in secondary schools and undergraduate and graduate students at the university.

The pilot phase will start with two workshops. One with the staff and pedagogues at the ministry of primary education. The objective of this workshop is to evaluate the contents of the training materials designed for secondary school students and how the training fits with their cognitive capabilities. Recommendations made during the workshop will help improve the quality of the training materials. The second workshop in collaboration with the Ministry of Higher and Technical Education will also gather faculty members at the Abomey-Calavi University and at the University of Parakou. Participants to the workshop will be given a complete set of the lesson plans, classroom activities, presentations, and flight simulators. Their experience in evaluating these materials will be shared through focus groups and suggestions for improvements made. The workshop will also help choose the best department or group of trainees that will take part in the pilot training program. Both the Ministry of Primary and Secondary Education and the Ministry of Higher and Technical education have expressed

[3] otherwise termed as unmanned aerial vehicle (UAV) or more frequently ‘drones’

their interest in taking part in this pilot project and extending it to other schools in the second year of the project.

A 7 days training for trainers will gather teachers and faculty members that will be involved in the pilot phase. This training will ensure that they have a good hands-on experience before delivering the training in their respective schools and department at the university.

4.4 Extension of the Drone Academy Program to Members of Africa Goes Digital

Lessons learned during the pilot phase in Benin will help improve the training materials. A training the trainer's workshop will be organized with company members of the Africa Goes Digital consortium. This workshop which is an extension of this project will help familiarize participants with the training materials.

Before the workshop, the project team will ensure that civil aviation authorities recognize the training both theoretical through the online course and practical using the training materials. All the training materials will be shared with the civil aviation authorities as well as the evaluations of the pilot project in Benin. Agreements with the civil aviation authorities will ensure that the drone academy program is recognized as a valid certificate for drone operations in their respective countries. Africa Goes Digital businesses will be evaluated for their capacity to organize the training and facilitate testing for pilot certification. The best companies will be chosen as accredited training and testing centres[4]. The evaluation criteria of the training centres involve:

- Examination of office space, equipment, and access to reliable internet connection to ensure the highest standards for training and online final examinations
- Background check of the staff to ensure the credibility of the affiliated centres
- Adoption of general guidelines on security and code of conduct for a safe use of drones

5 FUNDING SOURCES

Many sources of funding are targeted for this project:

- CTA (Euros 20,000): This funding will help implement the pilot phase
- DIV Innovation Venture ($150,000): This funding (to be applied for) would help extend and replicate the project in the 18 countries where Africa Goes Digital members are present.
- Global Partners: in-kind contribution equivalent to $15,000 for the rent of drone hardware, software, other materials and equipment, office space, administration
- Eastern Kentucky University: in-kind contribution by making the online course (currently available via its e-campus platform) freely or available at a reduced cost (to be confirmed) available to AfGoesDigital members and trainees in Africa.

[4] This will be done under the supervision of civil aviation authorities

Annex 1 Current format of the course

Course Description:

This course provides an introduction to Unmanned Aircraft Systems (UASs). A history of UAS, typical applications and an overview of regulations, airframe, and power-plant systems, sensors, ground control stations, airspace, weather, and other foundational skills needed to safely operate UAS in the U.S. airspace systems will be covered.

Student Learning Outcomes:

Students completing this course should be able to:

- Explain some of the significant milestones in the history of UAS.
- Describe several commercial and military applications of UAS.
- Identify and define the major components on an UAS.
- Explain how sensing systems function in an UAS.
- Describe the fundamentals of airframe and power-plant design for UAS
- Describe the fundamentals of communication, command, and control for UAS.
- Explain the basic principles of detect and avoid.
- Interpret a VFR sectional aeronautical chart.
- Locate and interpret NOTAMs.
- Evaluate launch sites for UAS operations.
- Explain the different classes of airspace and the restrictions on UAS operations in each.
- Read and interpret aviation weather reports including METARs, TAFS, SIGMETS, and AIRMETS.
- Describe the rules for sUAS operations as defined in FAA CFR part 107.
- Determine the effects of aircraft loading, weight and balance on UAS operation.
- Use proper radio communication procedures.
- Identify physical and psychological factors that affect UAS operations.
- Describe pre-flight and preventative maintenance procedures for an UAS.
- Explain airport operations that could impact UAS operations.
- Apply aeronautical decision making and judgement during use of UAS.

Course Schedule

Unit 1: History and Applications

Week 1: Introduction and History of UAS (Unmanned Aircraft Systems)

Week 2: Applications of UAS, National Airspace System

Week 3: Components of an UAS

Week 4: Sensing

Unit 1 Test

Unit 2: FAA Part 107 Regulations-(Remote Pilot Test Prep) (Will be adapted for each African country)

Week 5: Regulations

Week 6: NAS-National Airspace System

Week 7: Safety, NOTAMS, weather and weather reports

Week 8: Loading and Performance

Week 9: Operations

Unit 2 Test

Unit 3: UAS systems, design and operation

Week 10: UAS Design

Week 11: Airframe and Power-plant

Week 12: Electrical Systems

Week 13: Communication Systems and Communication procedures

Week 14: Command and Control

Week 15: Detect and Avoid/Collision Avoidance

Unit 3 Test

Course Requirements:

- Weekly readings of textbook and supplemental materials.
- View weekly video lessons.
- Complete weekly review questions related to readings, videos, and other supplemental materials.
- Successful completion of unit tests.
- Unmanned Aerial System (UAS) research and presentation project.
- Final Exam and Certification

Review Questions

The review questions highlight key points of each week's material. The questions are designed to help you reflect on what is important and prepare you for the unit tests and the final project. **Review questions must be completed to unlock the Unit Tests.** Completing all review questions completely, accurately, and on-time will is mandatory.

Unit Tests

Unit tests will cover a sampling of all the content covered in weekly videos, PowerPoint slides, textbook materials and or supplemental materials for each unit. The review questions are meant to help prepare you for the unit tests.

Unit 1 Test- 10 open-ended short answer questions. (30 minutes time limit)

Unit 2 Test -60 multiple choice questions. Designed to simulate the FAA Remote pilot exam (will be adapted for each country). (60 minutes time limit)

Unit 3 Test-10 open-ended short answer questions. (30 minutes time limit)

All review questions within a unit must be completed to unlock Unit tests. All unit tests must be completed to unlock the final exam.

UAS Project-Grading Rubric will be provided on blackboard

Students will design a theoretical UAS (Unmanned Aircraft System) to serve a real-world non-military application. The design will be presented in a PowerPoint presentation and will include all of the following:

- Description of application for which a UAS can be used with justification why a UAS is preferable to a manned system.
- Aircraft type (Lighter than air, VTOL, fixed wing, auto-gyro etc.) and rational for why this type of aircraft is the best choice for this application.
- Aircraft design with rational for design elements (i.e. tail design, wing or rotor configuration, number of motors/engines, size of aircraft, range, etc.).
- Description of:
    - sensors for navigation and flight data (altitude, airspeed, vertical speed, attitude, position, etc.).
    - sensors for detect and avoid systems.
    - airframe design and materials (wood, fiberglass, foam, carbon fibre, metal etc.).
    - Power-plant design and materials (electric, gas, fuel systems, power systems).
    - communication system(s) (communication between pilot and aircraft, communication between pilot and other aircraft, communication between sensors and ground control station).
- Details of command and control station (parts of the system, operator interface and controls).
- Operational limits (ceiling, range, weather, wind speed limits, cross wind limits etc).
- Impacts to manned air traffic and how these threats will be mitigated.
- Special launch and recovery requirements.

Final Exam (2 hours time limit)

In addition to the previous evaluations, student will pass/fail the final comprehensive exam in order to be delivered a Remote Pilot Certificate for small unmanned systems.

Final Exam-100 multiple choice questions that cover units 1, 2, 3. Most of the questions will be pulled from a bank of FAA sample questions in addition to questions specific to each country. About 20% of the exam will cover units 1 and 2 while the remaining 80% will be representative of the FAA remote pilot exam. The final project is mainly used as a measure of your understanding on the content of units 1 and 2.

Student Progress:

Student grades are available throughout the semester in the Learning Management system. Student grades are also reported in banner on the schedule located on the colonel compass and/or EKU calendar. In addition, students may check their progress via “my grades” in Blackboard.

Annex 2 Partners' Responsibilities

Task	Partners			
	Global Partners SARL	Eastern Kentucky University	Civil Aviation Authorities	GeoRisk Afric SARL
Development of training materials		√		
Set up of online course		√		
Workshop with civil aviation authorities in Benin, and Senegal	√	√	√	√
Workshop with Benin Ministry of Primary Education	√			
Workshop with Benin Ministry of Higher Education and universities	√			
Training of trainers in Benin	√			
Pilot phase at the university and at the secondary school in Benin	√			
Evaluation of the pilot phase	√	√		
Evaluation of capacity of AfGoesDigital members organizations for training and testing centres in Benin and Senegal		√	√	
Accreditation by EKU Aviation and National Civil Aviation Authorities (respectively in Benin and Senegal) of the chosen training and testing centres in Benin and Senegal		√	√	
Submission of end-of-project report	√	√		