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Preparation Laboratory Experiment for Medical Transportation with Drones – Switzerland

Mike KREY, Marc SANDMANN, Mathias KLINGLER and Gzim KRYEZIU

School of Management and Law
Zurich University of Applied Sciences
Winterthur, Switzerland

Correspondence should be addressed to: Mike KREY; Mike.krey@zhaw.ch; krey@zhaw.ch

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Abstract

The healthcare sector in Switzerland is under big pressure concerning cost efficiency. Modern technologies such as drones aim for an improvement of this efficiency. In order to get an idea of the applicability of the use of drones in Healthcare in Switzerland, we conducted the paper "Use of Drones in Healthcare – Switzerland" beforehand. The essential take-aways from the paper are: 1. Drone technology can be used to deliver medical objects, telemedicine, emergencies and intra-hospitality. 2. The stakeholders´ attitude is more likely for the delivery and emergencies and less likely for the telemedicine and intra-hospitality drone. Based on the findings, a laboratory experiment for medical transportation with drones is conducted in the present paper. The laboratory experiment could not be executed due to a large gap between the identified requirements in this paper and the expectation from the drone manufacturer. Nevertheless, the preparation for a laboratory experiment is made and validated. Furthermore, a market analysis is conducted. This paper aims to give a first insight into the preconditions that have to be met before a pilot project can be executed, in order to have a successful pilot project.

Keywords: Drone, Healthcare, Case, Experiment.

Introduction

Today's Swiss health system is the result of historically grown structures. Each of the Swiss cantons is responsible for its own healthcare regime and bears most of its costs. However, major healthcare issues and decisions are settled on a national level, which causes conflicts of interests between the states and the country. There are 290 public hospitals and about 135 private hospitals in Switzerland (BFS 2015). Stakeholders for public hospitals are partially the cantons, but also private enterprises. This causes problems concerning the different priorities and interests. As an example: Private enterprises want to raise profit, whereas the states want to provide a high treatment quality for the patients, respectively for the Swiss citizen. The costs of the Swiss healthcare sector and, therefore, also the health insurances for the Swiss citizens are continuously growing (BFS Bundesamt für Statistik 2017).

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The high costs of the Swiss healthcare sector are not only a result of inefficiencies; they are also a result of the health sector´s higher quality compared to most countries worldwide (Sax 2008). The costs of the healthcare sector were 77,8 $ Billion (or about 77,8 CHF) in 2015 (BFS 2015). This means, every citizen paid 9`394 $ (or about 9`394 CHF) in 2015 for health insurances. Considering the demographic changes, the costs in healthcare will increase in the future, not only in Switzerland, but also globally.

Due to the current situation regarding the costs in the Swiss healthcare sector, new technologies, such as the drone technology, have the potential to increase efficiencies and reduce costs. To figure out which use cases exist and which of them are accepted, the paper "Use of drones in healthcare – Switzerland,, was conducted by us. The previous paper identified use cases for the Swiss healthcare hospitals based on the state-of-the-art research. Afterwards, a survey with the stakeholders was conducted, in order to get a statistical outcome concerning the stakeholders´ opinion about the different use cases. The findings from the survey were that the stakeholders are more likely for the transportation drone and the emergency drone and less likely for the telemedicine drone and the intra hospitality drone. The reasons behind the stakeholders´ attitude can be:

1. The time saving factor. Medical equipment can be transported fast from one hospital to another hospital or from a hospital to an emergency. In the healthcare sector, saving time can mean saving lives. Therefore, time is a key factor in healthcare.

2. The stakeholders´ opinion is that the delivery drone can increase the efficiencies in the healthcare sector in Switzerland, whereas the telemedicine drone and the intra-hospitality drone doesn`t. **3.** Stakeholders are skeptical about telemedicine drone and intra-hospitality drone because the object is too abstract.

Based on the findings of the previous paper, a laboratory experiment with a transportation drone is conducted in the present paper. The laboratory experiment could not be executed due to a large gap between the identified requirements in this paper and the expectation from the drone manufacturer (more details in chapter 5). Nevertheless, the preparation for a labor experiment is conducted and validated. This paper aims to give a first insight into the preconditions that have to be met before a pilot project can be executed, in order for the project to be successful. Further, it also offers a market analysis about the drone transportation manufacturers. There are already pilot projects about transportation drones in the Swiss healthcare sector. In Lugano (DiePost 2017), Bern (TeleZürich 2018) test flights were conducted by the Swiss Post. In contrast to the pilot projects from the Swiss Post, the findings from this paper are publicly available for all stakeholders (e.g. drone suppliers, public hospitals, insurances, patients) (Post 2018).

The paper is structured as follows: Chapter 2 describes the objectives of the present project. Chapter 3 describes the preparation for a laboratory experiment in the healthcare sector in Switzerland. Chapter 3 is divided in three subchapters and describes the processes, use cases and requirements. Chapter 4 conducts a market analysis based on the requirements from chapter 3 for potential drone suppliers. Chapter 5 describes in detail why the laboratory experiment couldn't be executed. Chapter 6 describes the validation of the legal and medical requirements. At the end, chapter 7 contains the findings of the project followed by the conclusions in chapter 8.

Objectives

The objective of the present paper is the applicability of the use of transportation drones in the healthcare sector in Switzerland. Therefore, findings from the very beginning until the execution of a medical drone transportation are collected. This includes for instance different requirements and challenges to execute a medical drone transportation in Switzerland. Therefore, this paper can be seen as a first guidance for the application of a medical drone transportation in Switzerland. The main research question in the present paper is defined as follows:

Which requirements and challenges exist for a medical drone transportation in the healthcare sector in Switzerland?

From the main-question, more sub-questions can derive. All sub-questions are related to the scope of the present paper – drone transportation in the healthcare sector in Switzerland.

- How is the process of a medical drone transport designed?
- What kind of use cases for a medical drone transportation exist?
- Which operational, legal and medical requirements exist?
- Which type of drones fulfill the paper's requirements?
- What are the key challenges?

These research questions are analyzed in the following chapters.

Preparation Laboratory Experiment

This chapter describes the main tasks which must be done before conducting a laboratory experiment for a medical drone transportation. The preparation for a laboratory experiment is ordered as follows:

1. Define processes
2. Develop Use Cases
3. Analyze operational, legal and medical requirements
4. Conduct Market Analysis

The above-mentioned tasks have to be in this specific order, because of dependencies between each other. For example, the use cases are built on the processes. Therefore, the processes have to be defined first.

Processes – Drone Transportation

The present paper considers the standard processes and two exceptional Cases, named "emergency" and "crash", for a medical drone transportation. Other exceptional use cases are out of scope, because of the short period of time for the laboratory experiment. The process is built on the experience from the team members and on the findings from the pilot projects in Switzerland (Moor 2017). Two authors are employed in the Swiss healthcare sector. The following figure shows the standard process for medical drone transportation:



Figure 1: Standard process „medical drone transportation"

The standard process „medical drone transportation" can be divided into three sub processes – „Preparation", „Drone Transportation" and „Post Processing", and are described in the following section.

"Preparation" medical drone transportation

The drone is on a defined starting point. The accumulator of the drone is charged. A person, generally a medical staff member, loads the transportation objects into the transportation box of the drone. The transportation objects are for instance medicaments, blood tubes etc. and are referred to as "medical objects" in the following. As soon as the drone is prepared, the medical staff member gives the command to the drone to fly autonomously to a specific defined destination.

Medical „drone transportation"

The drone takes off and flies autonomously to the specific destination. The drone's software adapts to variables such as weather condition, buildings and other flying objects. Although the software requirements are an important topic, they will only be analyzed on the surface, not in detail. This topic must be analyzed separately in another paper. It will be checked if the main software requirements are fulfilled. At the end, the drone lands autonomously on the desired destination.

„Post processing" medical drone transportation

A person takes the medical objects out of the box. The drone flies autonomously back to the starting point. Alternatively, the drone can be reloaded with other medical objects before flying back to the starting point. The accumulator of the drone gets loaded whenever the drone is back on starting point.

Use Cases

The use cases are built on the processes „medical drone transportation" defined in chapter 3.1. The project Team defined five different variables that can influence the drone flight. The Variables are:

- Weather
- Height
- Transported object
- Velocity
- Flight distance

For the laboratory experiment, the variables «Transport object» and «Flight distance» are defined as a constant. For the transported object, the transportation box is limited by weight and size. We assume that different medical objectives (like vaccines, blood sample, urine sample) do not differ much in weight and size. Therefore, the variable «Transport object» is constant, and only one medical objective will be used. Furthermore, the distance is defined as constant, because the necessary distance for the laboratory experiment is between 656 feet (200m) – 1640 feet (500m) and the max. distance of a medical transportation drone is about 3280 feet (10km). Therefore, the variable «Flight distance» is not a limitation constraint. The flight distance is set to just 656 feet, because one of the legal requirements is that the drone has to be seen during the whole flight by the team members in order to conduct a laboratory experiment without permission.

The variations of the variables «weather», «height» and «velocity» are chosen to cover most of the use cases. The following table shows the variations of the variables for the laboratory experiment.

Table 1: Characteristics laboratory Experiment

Variable	Variation
Weather	Dry, rain, snow, windy
Height	20m, 80m
Transport object	One Transport object
Velocity	30km/h, max.
Flight distance	200m

The variable «Weather» has four, the «Height» two and the «Velocity» has two characteristics. This results into 16 use cases for the laboratory experiment plus the two exceptional cases «emergency» and «crash».

Requirements Analysis

In order to execute a medical drone transport in Switzerland, different legal and medical requirements have to be fulfilled. For example, drones over 66 pounds (30kg) need an approval from the Federal Office of Civil Aviation (FOCA). Furthermore, the transportation box has to fulfill medical standards as well.

Beside the legal and medical requirements, depending on the use case, different operational requirements have to be fulfilled. The operational requirements are based on the use cases of the present paper. The canton hospitality in Winterthur (KSW) is used as reference hospital.

The following chapters describe the requirements in detail:

- Operational requirements
- Legal requirements
- Medical requirements

Operational Requirements

The operational requirements can differ among enterprises due to different environmental factors or hospital specific characteristics. The following requirements are based on the conditions from the KSW. The following table lists the operational requirements.

Table 2: operational requirements

Operational requirements
1. The drone must fly between 32 – 328 feet (10 – 100 m) height. It must be possible to fly over the hospital's highest building (KSW 2017)

2.	The drone must fly at least 18 miles per hour (30km/h). The medical delivery must be time saving, for emergency and efficiency purposes (Claesson et al. 2017)
3.	The drone must fly autonomously, for efficiency purposes.
4.	The project team must be able to control the drone, in order to reduce effort and costs.
5.	The take-off and landing must be nearly vertically, due to limited space in a hospital area.
6.	The drone must be able to operate between 23F (–5°) and 86F (30°) The drone must be able to operate non-stop, for emergency deliveries and efficiency purposes. (SGSV, Schweizerische Gesellschaft für Sterilgutversorgung and Schweizerische Gesellschaft für Spitalhygiene Swissmedic 2016)
7.	It must be possible to install a transport box to the drone. The box size must be at least 30x30 inches and weigh max. 10pounds (content included).

Legal Requirements

A medical drone transportation can be conducted with or without permission in Switzerland. The requirement for this paper and for the laboratory experiment is to conduct the experiment without a permission, because of the project time limitation of three months. The approval for a permission can take up to six months and therefore, exceed this period of time. Therefore, for the laboratory experiment only a medical drone transportation without permission is possible.

Anyway, if the reader is interested in a medical drone transportation with permission, further information is provided here. If the requirements listed in the table cannot be fulfilled, an approval is needed. Quote FOCA:“To qualify for an exemption from the FOCA, a safety test is required. Standard procedures may be applied for certain operations, and these procedures are being constantly supplemented. For operations that cannot qualify for a standard procedure, a complete safety test in accordance with the JARUS Guidelines on Specific Operations Risk Assessment (SORA) is required”. More details about the approval process are available on the FOCA homepage (FOCA n.d.). The legal requirements for the use of drones without approval are based on the regulations from FOCA and are defined as follows:

Table 3: legal requirements without approval (BAZL 2018a) (BAZL 2018d)

Legal requirements without an approval
1. The drone must be seen by the team during the whole flight.
2. The drone must have a safety distance of minimum 328 feet (100 m) to the crowd (24 persons or more)
3. The drone must comply with the no-fly zones. The interactive Remotely Piloted Aircraft System map shows the locations where restrictions apply. In the areas that aren’t marked with a color, a flight without an approval is allowed (BAZL 2018c).
4. For the drone with more than one pound (500g) weight, an insurance coverage of at least one million CHF is necessary
5. The team must be able to regain manual control over the drone at anytime.
6. The drone must weight under 66 pounds (30 kg).

Under consideration of the interactive “Remotely Piloted Aircraft System map”, a location evaluation is made. The goal is to find a suitable location where a laboratory experiment can be conducted. The location has to be aligned with the legal requirements and reflect the geographical conditions from the KSW as good as possible.

The location evaluation identified a hill near the local community Elgg in Winterthur. It fulfills the geographical conditions and legal requirements. Furthermore, crowds are not expected in this area. The following picture shows the location.



Figure 2: Location laboratory experiment

Nevertheless, when carrying out a laboratory experiment with a drone, it should be clarified with the local authorities whether other restrictions (e.g. on major occasions) exist (BAZL 2018d).

Medical Requirements

The transportation of medical objects has to fulfill strict requirements. These medical requirements depend on the specific object that has to be transported (e.g. blood samples, urin samples). The present paper investigates the requirements of blood samples and medicine that does not contain narcotics. Medicine that does contain narcotics is excluded because it has to comply with much stricter guidelines, such as multilevel checks, signatures, witnesses etc. The strict guidelines for narcotics are governed by BetmG (BAZL 2018e).

The requirements to transport a blood sample in Switzerland are regulated under the SDG (Regulation on the transport of dangerous goods by road) under SR 741.261 (BAZL, 2018). There is also a brochure with information from the Department of Biological Safety (FBSO) (Heilmittelinstitut 2007).

The following table summarizes the medical requirements for blood samples and medicine without narcotics:

Table 4: medical requirements for blood samples and medicaments

Medical requirements for blood samples and medicine without narcotics
Requirements for medicine Transportation • The medical objectives must be transported in a temperature range between 35.6F - 46.4F (2°-8° degrees) • The Transport box must be waterproof (no moisture) (BAZL, 2018) • No direct light (SGSV, Schweizerische Gesellschaft für Sterilgutversorgung and Schweizerische Gesellschaft für Spitalhygiene Swissmedic 2016) • In addition, the storage of the drugs is defined by the drug manufacturers. These rules must be guaranteed during transportation.

Market analysis

The present market analysis is based on the "Drone Market Environment Map 2018" (Team Droneil n.d.) and the "Drone Industry Insights 2018" (Team Droneil n.d.). The "Drone Market Environment Map 2018" gives an overview of all drone manufacturers, ordered by category. The "Drone Industry Insights 2018" investigates the players of the drone market. Therefore, an exhaustive Drone market analysis can be conducted.

From the "Drone Market Environment Map 2018" the "Delivery Systems" and "Logistics" categories are chosen and analyzed:



Figure 3: Drone Market Environment Map 2018 - Delivery Systems



Figure 4: Drone Market Environment Map 2018 – Logistics

The drones from the "delivery systems" and "logistics" category are rated by their homepage and the "Drone Industry Insights 2018"-Website. At this point, the project team did not contact the manufacturers. The following criteria had to be fulfilled in ordered to be considered for further analysis:

- Information on the product "drone" is generally available on the homepage.
- Information about the drone has to be in English or German.
- At least one drone seems to fit one of the use cases defined in chapter 3.2.
- A delivery drone for rather small transportation objects must be offered.
- The drone must be available.
- The drone must able to operate in urban areas.

The manufactures which fulfill all the criteria are listed in table 5. The rating on these potential players is based on the manufacturer's website. If necessary, assumptions were made. The following table lists the potential manufacturers.

Table 5: potential manufacturers

Nr.	Potential Supplier / Drone Type	Homepage	Rating
1.	Matternet – «M2 Drone»	https://mttr.net/product	suitable for the present use case

2.	Flytrex – «Flytrex Mule»	http://www.flytrex.com/drones/	suitable for the present use case
3.	airborne drones – «The Walker»	https://www.airbornedrones.co/delivery-and-transport/	suitable for the present use case

The rating of the potential Suppliers is based on the manufacturer's website and the «Drone Industry Insights 2018»-Website.

1. The "M2 Drone" is a drone from Matternet Inc. with her headquarter in Menlo Park – California. The company has 11-50 employees and was founded in 2011. "In March 2017, Matternet became the first company which is authorized for full operations of drone logistics over densely populated areas in Switzerland. In May 2018, Matternet was selected to carry out drone logistics operations for US hospitals under the FAA's drone integration program" (Matternet n.d.).
2. The „Flytrex Mule" is a drone from Flytrex Aviation Ltd with her headquarter in Tel Aviv - Israel. The company has 11 – 50 employees and was founded in 2013. "In August 2017 Flytrex launched the world's first fully operational, regulatory approved, on-demand drone delivery service in Reykjavik, Iceland, and became the leading competitor in the race to deploy a true on-demand delivery service via autonomous vehicles" (Flytrex 2018).
3. "The Walker" is a drone from Airborne Drones Ltd with her headquarter in Cape Town – South Africa. The number of employees is smaller than the other two potential Suppliers. The company was founded in 2013. No use case is found on the homepages from Airborne Drones Ltd for "The Walker"(Airborne 2018).

Merging Possibilities and Requirements

This chapter analyses the matching between the requirements identified in chapter three and the identified drones from the potential suppliers in chapter four. In order to evaluate the drones from the potential suppliers Matternet, Flytrex and Airborne, all of them were contacted by E-Mail. Due to different reasons regarding the framework of the laboratory experiment and the drone suppliers, a collaboration could not be made in such a short time. The reasons are listed in chapter five. The results of the analysis are:

Operational Requirements: The operational requirements (see chapter 3.3.1) can mostly be fulfilled by all potential suppliers. None of the potential suppliers has provided any information regarding the drone's ability to operate during different weather conditions.

Legal Requirements: The possibility of a manual takeover is unclear for all three suppliers. The manufacturers did not respond to this specific question. Matternet, for instance, has installed a parachute on his drone for the pilot project in Ticino (Switzerland). The parachute should automatically open if all electronic fails (Die Post 2017).

Medical requirements: Based on the information found on the potential suppliers' websites, it is unclear whether the medical requirements can be fulfilled or not. Furthermore, this question was addressed to the supplier by E-Mail. Because of the lack of answers to this specific question, it is to assume that there are no standard products available for each application. Matternet is specialized in the use case analyzed in the present paper – Drone transport in urban areas in the healthcare sector in Switzerland. In conclusion, it is to assume that operational requirements are fulfilled, legal requirements are not fulfilled and no standard products are available for the medical requirements. Furthermore, all three potential suppliers have a similar rating; however, Matternet is slightly better rated than the other two suppliers. All three suppliers were contacted and asked to rent or sell us a drone for the laboratory experiment.

Laboratory Experiment

The laboratory experiment could not be executed, because no suitable drone could have been rent or bought from Matternet, Flytrex or Airborne. First, the project team preferred to rent one of the drones «M2 Drone», «Flytrex Mule» or «The Walker» mentioned in chapter 4. The suppliers did not offer the possibility to rent a transportation drone. Due to the limited budget of about 3000$, buying a drone was not possible. Flytrex, for example, lists a price of 9'000 $ for its drone "Flytrex Mule". Nevertheless, it is unclear from the website what services are included in the price (Flytrex 2018). Because of the above-described situation, alternative options were analyzed. Based on the market analysis in the present paper, smaller drones were searched that can autonomously transport small objects up to 1,5 pounds (700g), but no suitable

drone could be found, because no one was available. The team discussed another option, to buy a small drone and fly it manually without any transportation objectives. However, it turned out that there are no valuable findings from such an experiment, because the two most important aspects, autonomous flying and transportation would be excluded. For these reasons, the present project was changed from the «Laboratory experiment for medical transportation with drones – Switzerland» to «Preparation laboratory experiment for medical transportation with drones – Switzerland». Additionally, the legal and medical requirements were validated by professionals. The results of the interviews and the validation are shown in the next chapter.

Validation of the legal and medical requirements

The information about the legal and medical requirements is mainly derived from the official institutions FOCA, SDG and BAG. This chapter investigates the practical application of the legal and medical requirements. For the validation, four professionals (employees from the KSW) were interviewed, in order to find out if the requirements are correct and complete. The interviewed person had the opportunity to add requirements if necessary. The table below summarizes the results of the interviews and describes the job functions of the interview partners.

Table 6: Interviews

Summary interview results	
Director Laboratory Medicine	
Are the requirements correct?	No
Are the requirements complete?	No
Note: • A delivery consists of transport box (primary) and transport tube (secondary). The secondary packaging should also be liquid-tight. • The transport box must be rigid and firm	
Employee FOCA	
Are the requirements correct?	Yes
Are the requirements complete?	Yes
Pharmaceutical Assistant	
Are the requirements correct?	No
Are the requirements complete?	Yes
Note: • The temperature must be separated in different groups: o Refrigerator temperature 35.6F – 46.4F (2°-8°) (only Vaccines) o Frozen below -0.4F (-18°)	

(all medicaments and samples)	
Head of manufacturing drugs	
Are the requirements correct?	Yes
Are the requirements complete?	No
Note: • A temperature trigger is additionally necessary to report the exceeding of a temperature. • Every company who offers medical transportations must have a GDP license (Good Distribution Practice). The GDP license is a European license, which is obligatory also in Switzerland (Flytrex 2018) (BAZL 2018b).	

The validation has led to changes in the medical requirements. The legal requirements have not changed compared to chapter 3. Some of the results were just a more detailed description of the requirements. Other, however, were essential and would have led to bigger changes of the transportation box (e.g. GDP license for suppliers). From the validation of medical requirements, it can be deduced that the requirements in chapter 3 provide a good guide to launch a medical drone transportation project. Nevertheless, the requirements shouldn't be considered as complete. Therefore, we recommend using this paper as a starting point into the field of medical drone transportation. For every project, it is to assume that different requirements have to be added due to specific project requirements.

Findings

During the development process of the present paper, all findings were collected and are listed below. The findings come from the research, preparation of a drone transportation, contact with the manufacturers, interviews with professionals, inputs from KSW and location evaluation.

The findings are:

- The future process for a medical drone transportation has to be defined exactly before conducting the experiment.
- The enterprise specific characteristics and policies have to be considered.
- Depending on the use cases, different requirements have to be fulfilled.
- The operational requirements are different for each enterprise. Therefore, the fulfillment of these requirements has to be synchronized with the information of the drone suppliers.
- There are different legal requirements, depending on whether an approval is necessary or not.
- For a real business application, an approval is necessary. It can take up to several months to get an approval.
- If an approval is necessary, it is to be expected that additional requirements have to be fulfilled
- Beside the requirements regarding the drone flight, different requirements for the transportation box exist.
- Depending on the transportation object (for instance medicine or blood tubes) different requirements exist.
- Only a few drone manufacturers provide marketable drones.
- The existing drone manufacturers offer drones only for a few use cases of medical transportation.

To summarize:

- At the moment, there are not any modular standard drones for medical transportation available on the market. Therefore, a high effort in costs and collaborating with the drone supplier is expected for executing a medical drone transportation in Switzerland.
- There is a standard list in order to check if an approval is necessary or not. If an approval is necessary, different extra requirements may have to be fulfilled, depending on each use case. Therefore, a high effort in collaborating with the FOCA is expected as well. This collaboration also contains strong connections to the drone supplier because of the compliance of the requirements.

Due to the above key findings, a high initial effort for developing a customized drone for the specific use cases is expected. The following figure 5 summarizes the root cause of the initial effort that is necessary for a specific drone transportation in Switzerland. It is assumed that interaction of the stakeholders is iterative.

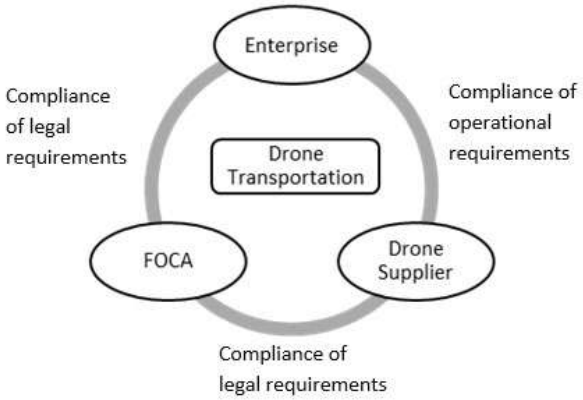


Figure 5: overview interaction enterprise, FOCA, Supplier

Conclusion

First, the lack of modular standard products from the drone supplier can be interpreted as a well-known phenomenon for new transportation systems – "the chicken and egg problem". On the one hand, drone suppliers cannot invest in drones for different use cases for different countries, because of high initial investment and no secure demand expectations. One the other hand, the supply of medical drone transportation does not increase as long as no standard products exist. The enterprises with a specific use case are rarely interested in a cooperation on the development process of a drone.

Further, the law situation is complicated, not only in Switzerland, but also worldwide (Francis 2018). The law situation in Switzerland requires an execution of the whole approval process for each use case. For drone suppliers and enterprises, it is unclear how much time and effort is needed for the approval. Furthermore, the risk of not getting an approval is possible as well. The return on investment in a business case can hardly be calculated. This can be a reason why the expected growth in the drone market still does not unfold its full potential. However, the project team tries to estimate the time and costs for the preparation of a pilot in Switzerland. It is to emphasize that the estimation is based on the knowledge gained during the present project and the project before ("Use of drones in Healthcare – Switzerland„) and therefore with a high uncertainty. Nevertheless, it should give an orientation about the project scope for a pilot project. The total costs including project management, requirements analysis and development of the drone, approval process etc. are expected to be between 100'000 to 300'000 $ (100'000 – 300'000 CHF). The time period is estimated to be between six and twelve months, depending on the use case and the state of development of the drone. The administration costs and costs for the FOCA are excluded from the estimation. Further investigations are needed to get a deep understanding on the subject "medical drone transportation". Further investigations can be:

- Business Case analysis for different use cases
    - How do the hospitals currently transport medicines and blood tubes (by car, bicycle or/and motorcycle)?
    - What are the advantages and disadvantages comparing to the current transportation methods?
    - Is it cheaper to use drones? Under which conditions is it cheaper?
- Which are the software requirements regarding "medical drone transportation"?

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