THE NEW SPECIFIC OPERATIONS RISK ASSESSMENT APPROACH FOR UAS REGULATION COMPARED TO COMMON CIVIL AVIATION RISK ASSESSMENT

F. Nikodem, J. S. Dittrich, A. Bierig
Institute of Flight Systems, German Aerospace Center (DLR)
38108 Braunschweig, Germany

Abstract
Unmanned aircraft systems (UAS) of all shapes and scales are enjoying increasing popularity. An UAS' purpose and scale can reach from very small toys up to large systems the size of common civil aircraft and able to transport several tons of payload or even passengers. In recent years, the European Aviation Safety Agency (EASA) began to develop a regulatory framework for all kinds of UAS. In traditional civil aircraft, critical failures pose a high risk for humans such as pilots, cabin crew or passengers. For UAS, the potential risk of fatalities and damage to critical infrastructure depends on the actual operation in combination with the operational environment. Therefore, the focus of the regulation can be changed from an aircraft centric risk assessment towards an operation centric risk assessment. Throughout this paper, an overview of the latest regulatory developments in the UAS category is given. Furthermore, the paper describes and discusses the similarities and differences between a common civil aviation qualitative risk assessment and the new Specific categories operation centric risk assessment approach by the EASA.

1. INTRODUCTION

In recent years the use of UAS for private and commercial operations has increased dramatically. The EASA was the competent authority for UAS with a take-off weight of more than 150 kg from the very beginning. In contrast, for UAS with lower take-off weight, the competent authorities of each of the EASA member states were responsible to regulate operational approvals. This led to flight permissions and regulations that differ from member state to member state. In an attempt to standardise UAS operation approvals even below 150 kg take-off weight, the EASA created three categories of UAS operation with increasing level of rigour [1]. The Open category comprehends low risk operations that need almost no regulation such as flying toy drones. The second category is called Specific category and covers a wide range of intermediate risk operations with small and lightweight toy drones up to UAS with a considerable amount of wingspan and weight. The third and last category is the Certified category for UAS operations that pose risks to humans comparable to that of traditional manned aviation. Following that approach, the Joint Authorities for Rulemaking of Unmanned Systems (JARUS) developed a new methodology to assess the risk of an UAS operation in the Specific category. The Specific Operations Risk Assessment (SORA) is a qualitative approach and takes various factors into account to recommend a set of requirements for the UAS and the operation. These requirements depend on the aircraft system itself, the area of operation in air and over ground, and strategies to mitigate possible harm to others. However, the known recommended practices in civil aviation offer several different risk assessment approaches. Therefore the necessity of a whole new approach is questionable. This paper describes a comparison of the SORA and an established qualitative risk assessment in civil aviation.
Within this paper the authors give an overview of the current regulatory basics in civil aviation as well as the recent developments of the European UAS regulations. Furthermore, a qualitative operation oriented risk assessment approach commonly used in civil manned aviation is chosen and compared to the risk assessment method of the SORA process.
The Paper is organized as follows: Section 2 is an introduction to the latest regulatory framework for manned civil aviation as well as some of the most common risk assessment processes. Section 3 deals with the current European UAS regulation and gives an overview about the SORA. Related work is presented in section 4 and put into perspective of the UAS regulation and the research topic of this paper. In section 5, the comparison between the established qualitative risk assessment in manned aviation and the SORA approach is developed. The paper closes with a conclusion and further research topics on SORA in section 6.

2. MANNED CIVIL AVIATION

2.1. Regulatory Framework

The processes of risk- and safety assessment of common civil aviation is strongly influenced by the regulations and rules established by national and international authorities. In order to comprehend the origin of the risk and safety methodology, it is necessary to give a short overview of the regulatory framework of the EASA. This framework evolved over the years to the current point. The paper describes the framework in its latest version. In 2002, the European Parliament introduced the Regulation (EC) No 1592/2002 as Basic Regulation to establish the EASA as regulatory organization as well as common rules of civil aviation [2]. On July 4th, 2018, the EASA introduced the latest version of the basic regulation, the Regulation (EU) 2018/1139 [3]. In 2012, the European Commission released the latest version of their Commission Regulation on rules to attain an initial airworthiness and environmental certification of aircraft including products and parts as well as the certification of design and production organizations [4]. There are several other Commission Regulations in place to deal with other aspects of aircraft airworthiness such as Continuing Airworthiness, Air Operations or Air Crew. This paper, however, focuses on the risk assessment that is necessary to gain an initial airworthiness certification. An important part of the Commission Regulation on initial airworthiness for certification of aircraft is the Annex I, Part-21.

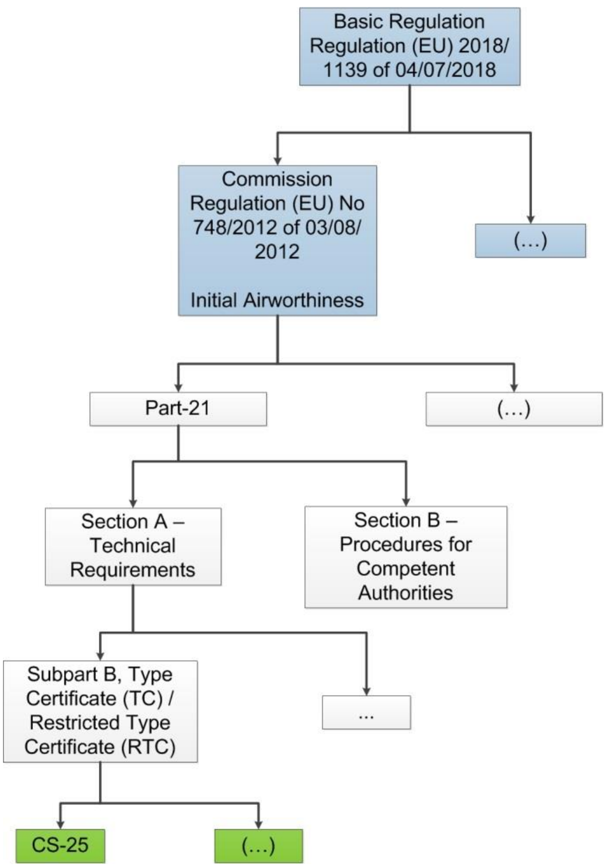

Figure 1: Breakdown of the regulatory framework of manned civil aviation from Basic Regulation to CS-25

Annex Part-21 is divided into Section A – Technical Requirements and Section B – Procedures for Competent Authorities. Section A is organized into several subparts whereas Subpart B describes the actions to gain a Type Certification (TC) or a restricted TC for the aircraft. A valid TC or restricted TC is necessary to operate the aircraft in civil airspace [4]. To obtain a TC, the manufacturer has, amongst other things, to comply with the applicable Certification Specification for the aircraft type. There are several Certification Specifications available such as the CS-25 for large airplanes and the CS-23 for Normal-Category airplanes [5] [6]. A breakdown of the regulatory framework is shown in Figure 1. Taking the CS-25 as an example, an important part from the risk and safety point of view is paragraph CS 25.1309 "Equipment, Systems and Installations". It deals with design and installation requirements of systems and equipment for large airplanes. In particular, the paragraph deals with the severity and occurrence of system and component failures. It also refers to the acceptable means of compliance AMC 25.1309 of CS 25 Book 2 Subpart F. The purpose of the AMC 25.1309 is to describe acceptable means to demonstrate compliance with the requirements of paragraph CS 25.1309.

2.2. Risk Assessment

Risk Assessment is a major part of the overall safety assessment process performed throughout the complete airplane life cycle. There are several acceptable means of compliance in civil aviation that deal with safety. Among these are the SAE ARP 4754A [7], ARP 4761 [8], ARP 5150 [9] and ARP 5151 [10], as well as the DO-178C [11], DO-254 [12] and DO-297 [13] (Figure 2). ARP 4754A is a widely spread recommended practice that introduces and describes a whole civil aircraft and systems development process. ARP 4761, on the other hand, introduces and explains the safety assessment process that needs to be performed throughout the development process. It further describes the use of safety assessment guidelines and methods used during the process. ARP 5150 and ARP 5151 describe methods and tools to assess risk, mainly throughout the operational phase (Figure 2). Especially ARP 5150: "Safety Assessment of Transport Airplanes in Commercial Service" will be discussed in more detail within this document. Because of its focus on risk assessment with regard to transport airplanes already in operation, ARP 5150 seems appropriate for comparison with the SORA developed for UAS operation. It is assumed that in most cases the operational risk assessment would have to consider already existing UAS. Those UAS would have to be applied to as much different operational scenarios as possible. Therefore ARP 5150 is chosen over the ARP 4754A and ARP 4761, which focus specifically on civil aircraft already in operational phase.

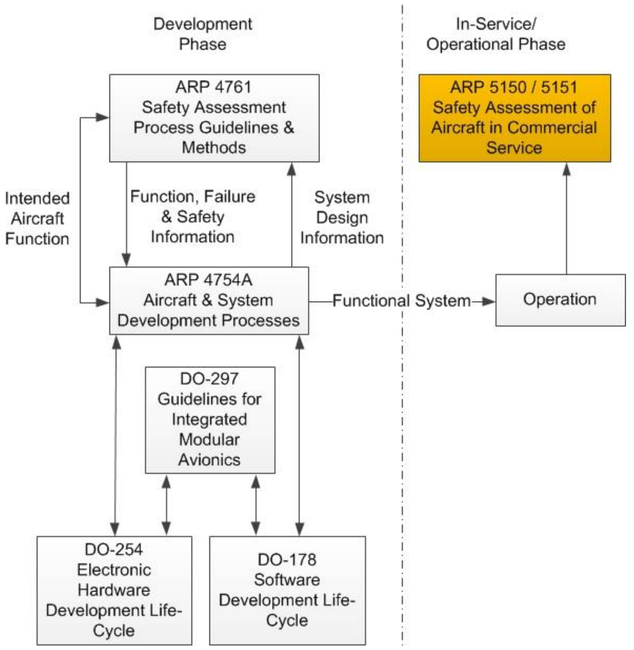

Figure 2: Connection of the SAE ARP and RTCA DO standards according to [7]

2.3. ARP 5150 Risk Assessment Root Cause Analysis

The aerospace recommended practice ARP 5150 describes a structured, continuing safety process for the operating fleet and as well as several tools and methods to conduct the assessment of risks. The ARP 5150 describes the following methods [9]:

- Root Cause (Event Tree) Analysis
- Weibull Analysis
- Monte Carlo Simulation Analysis
- Corrective Action Scheduling
- Sensitivity Analysis
- Reliability Growth Modelling
- Human Factors Methods & Tools
- Fleet Risk Exposure Analysis

It is beyond the scope of this document to explain and discuss the whole process and all of the presented methods. However, the Root Cause (Event Tree) Analysis will be explored in detail, because it is a qualitative approach to assess risk and seems to share some similarities with the SORA, which is discussed later in the document.

The Root Cause or Event Tree Analysis in context of ARP 5150 is a risk assessment approach which is relatively simple to use. It has a clear structure and allows for comprehensive documentation of the assessment process [9]. The standard Root Cause Analysis consists of three main tools, the event tree, the root cause disposition chart and the action item list.

The event tree is roughly comparable with a fault tree. Instead of a main failure, there is the main undesired event that is going to be examined on the top of the tree. Just like the fault tree, the event tree evolves with other plausible minor events that contribute to the main event. In contrast to the common fault tree, however, no logical gates are used, but instead the causes are regarded as independent from each other. As causes and contributing minor causes evolve, the event tree becomes a more or less root like structure. If the top level undesired event is narrowed down to one or more causes that cannot be broken down further, the root cause of the top level event is found. In fact, one main event may have more than one root cause, as shown in Figure 3. The less specific the top event is, the more root causes it probably has.

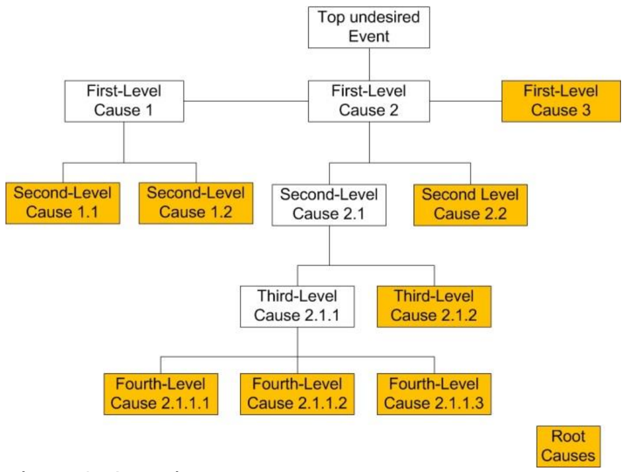

Figure 3: Generic Event Tree

When the event tree analysis is conducted in a satisfying manner, the next step is to create a root cause disposition chart. This chart is used to track all known data of each cause, including supporting and refuting evidence for its contribution to the top level event as well as action items for each cause. Action items are normally assigned to events and causes to gather more information about the contribution of the cause to the top level event [9]. The action items themselves are explained and tracked in the action item list. With the use of the gathered information, it has to be determined if the root cause is a probable contributor to the top level event or if the found cause is unlikely to be a contributor and therefore can be closed. At the end of the process, a well-documented set of key contributors to the top level event will remain that have to be addressed by mitigation actions. An additional advantage of the event tree is the option to convert the tree into a fault tree. This can be done by adding gates like the commonly known “And/Or”-Gates.

It is important to understand that the event tree application and risk assessment in general is an iterative process that needs several iterations by the assessment team to be complete.

3. UNMANNED CIVIL AVIATION

3.1. Regulatory Framework

Since the beginning of the 21st century, the use of unmanned aircraft systems (UAS) constantly increased. To cope with the rising number of UAS in civil applications, the EASA released a policy statement regarding the airworthiness certification of UAS in 2009. The content of the policy statement is based on certification requirements derived from Annex Part-21 of the Commission Regulation [14]. In 2015, the EASA introduced three new UAS categories included in a new regulatory framework [15]. The categories Open, Specific and Certified were established to facilitate low and medium risk UAS operations, where a whole certification process according to Part-21 would be inappropriate.

The Open category covers low risk operations. This category requires only a few operational rules, such as “stay away from people”, as well as product safety requirements and mass limitations.

The Specific category covers medium risk operations, for which an authorization from a national aviation authority is required

The Certified category covers operations with higher risks that are comparable to risks in manned aviation. Hence, the requirements to obtain an authorization under the Certified category are quite similar to those of manned aviation [15]. In 2016, EASA released the draft of a new annex of the Commission Regulation for unmanned aviation. The new annex is named Part-UAS and covers the regulation of the Open and the Specific category [1]. In the Specific category, a risk assessment has to be carried out in order to attain operation permission by the competent authority. The risk assessment considers the risk not only of the operation, but the operator competences and UAS performance and characteristics as well. One acceptable means of compliance to perform such a risk assessment is the use of the SORA methodology proposed by JARUS [16].

3.2. SORA Methodology

The SORA is a holistic risk assessment methodology currently under development by JARUS [16].

The SORA methodology is an iterative process to assess the risk of the intended operation with regard to the UAS used as well as the operator capabilities. The input to the SORA process is a concept of operations document (ConOps) which contains the description of the intended operation, technical data of the UAS and information on the operator.

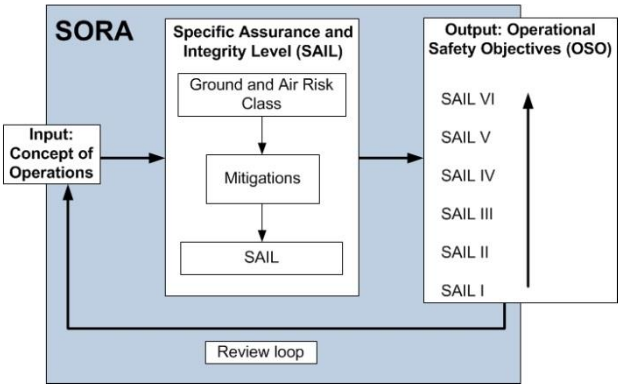

Figure 4: Simplified SORA process

The SORA process uses the information about the operation and the characteristics of the UAS to assess the so called ground risk and air risk. The ground risk is the estimated qualitative risk for people and infrastructure on ground to be hit by the UA. It is composed of different categories that take the characteristic dimension, the expected kinetic energy and the overflown area into account. The characteristic dimension is usually represented by the wingspan or the rotor diameter of the UA. It is divided into four UAS classes. These classes are for UAS with 1 m, 3 m, 8 m and over 8 m of characteristic dimension. The air risk describes the qualitative risk to have a mid-air collision with manned aircraft. The air risk is based on the typical expected airspace density of a certain airspace class. For example, the airspace density in airspace class C is expected to be much higher than in airspace class G over rural environment. Both, ground and air risk are combined in a Specific Assurance and Integrity Level (SAIL). The SAIL classification is tied to a set of requirements that have to be met in order to gain an approval for the intended operation by a competent authority. The SAIL classification reaches from SAIL I to SAIL VI with increasing levels of rigour (Figure 5).

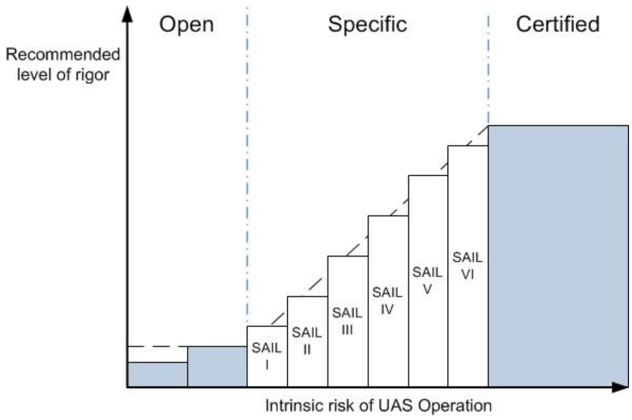

Figure 5: Increasing levels of rigour in the Specific category

The set of requirements targets the main threats of UAS operation identified by JARUS [17]. These threats are:

- Technical issue with the UAS
- Human error
- Aircraft on collision course
- Adverse operation conditions
- Deterioration of external systems supporting the UAS operation

Each of these threats that could possibly lead to an operation out of control event is addressed by several Operational Safety Objectives (OSO). OSO are meant to lower the possibility of the assigned threat to evolve into an operation out of control event. These OSO are also referred to as threat barriers in versions prior to the draft version V2.0 of the SORA methodology. Depending on the assigned SAIL, each threat barrier has one of three levels of robustness. The robustness can either be low, medium or high and is divided into assurance and integrity levels.

	Low Assurance	Medium Assurance	High Assurance
Low Integrity	Low	Low	Low
Medium Integrity	Low	Medium	Medium
High Integrity	Low	Medium	High

Table 1: Threat barrier robustness determination matrix

The SORA defines integrity *"as the safety gain provided by each mitigation [or threat barrier]"* [16]. Assurance is defined *"as the proof that the claimed safety gain has been achieved"* [16]. In general, a low assurance is a declaration of the operator that the requirements are met. For a medium assurance, the operator provides supporting evidence that the requirements are met. That can be done though means of testing, simulation or proof of experience. The high level assurance includes an acceptance of the supporting evidence by a competent third party.

To lower the SAIL to be reached, the operator has the opportunity to use defined mitigations to lower the risk of the operation below the intrinsic risk. The intrinsic risk within SORA is the ground or air risk without any mitigation applied. The mitigations to reduce the intrinsic ground risk were referred to as harm barriers in releases of the SORA documents prior to draft version V2.0. These barriers are meant to reduce the possible harm to third parties on the ground or in the air if the UAS operation went out of control. The possible mitigations are:

- Emergency Response Plan (ERP) in place, operator validated and effective
- Effects of ground impact are reduced
- Technical containment in place and effective

In case the operation went out of control, the ERP should cover measures to be taken to limit crash escalating effects. Those effects could be fire or injured people resulting from the crash. "Effects of ground impact are reduced" means a reduction of impact dynamics such as the size of the crash area or impact energy. Technical containment is meant to reduce the number of people at risk. This includes the concept of a safety buffer and a strategy to recover from emergencies, for example with the help of a termination or monitoring system [18].

The mitigations can have a low, medium or high robustness as shown in Table 1, depending on how much they reduce the ground risk.

The air risk can be reduced by strategic mitigations. These mitigations usually take the form of a separation of the UAS from manned aircraft.

Among other options, separation can be achieved through:

- The restriction of operation of the UAS in a part of the airspace with low density of air traffic
- Operational restriction to a certain time of the day
- Operational restriction by the time of exposure

With the help of the mitigation strategies, the operator can reduce the assigned SAIL without reducing the safety of third parties, according to the SORA methodology.

4. RELATED WORK

Throughout this paper, a comparison between the Specific categories operation centric risk assessment and one specific qualitative method of the risk assessment in manned civil aviation is given. Since the SORA process, especially the details, are relatively new, not much research work regarding SORA was found. However, this section offers a small overview of research done in the very recent years that the authors consider to be comparable to SORA.

In 2014, Clothier and Walker published a chapter titled "The Safety Risk Management of Unmanned Aircraft Systems" [19]. They discuss a general safety and risk management approach for UAS following the so called ALARP (As Low As Reasonably Practicable) idea. They introduced a risk management process including various common risk assessment approaches. Those are embedded in communication and consultation, risk treatment and monitor and review actions. Clothier and Walker set their focus for hazards on mid-air collision with other participants and collision with third parties on ground or infrastructure as primary hazards. In contrast to SORA, they also introduced secondary hazards in form of debris falling to the ground. Throughout their publication, they discussed general options to analyse and evaluate risk introducing the ALARP framework. Regarding risk treatment, mitigation options are discussed for mid-air and ground collisions that are relatively similar to the mitigation strategies SORA offers or requires. One example would be See & Avoid options or the use of

geofence. Since this chapter was meant to briefly discuss the introduced safety risk management process of UAS, it might be worthwhile to perform a detailed comparison to the SORA methodology in the future.
In 2016, Guglieri and Ristorto published a paper dealing with RPAS (remotely piloted aircraft systems) with a take-off mass of 25 kg or less and proposed a safety assessment regarding the requirements established by the Italian aviation authority ENAC (Entre Nazionale per l'Aviazione Civile). At that time, the authorization and regulation of UAS with a take-off mass of less or equal than 150 kg was under responsibility of the national aviation authority of each EASA member state [20]. In their methodology, they focused on ground impact and discussed a risk analysis for light RPAS considering effects like population density, shelter and failure probability. Despite being outdated by the EASA's announcement to establish a common regulatory framework for any UAS type throughout the EASA member states, the intended methodology shows some similarities with the current SORA versions V1.0 and the draft V2.0. Guglieri and Ristorto discuss the need for safety as well as the possibility of shelter in case of small UAS. Neglecting the air risk component of the SORA methodology, the discussed use case seems to apply for the 1 m and 3 m class mentioned in section 3.2 with SAIL I or SAIL II scoring regarding the operation. The quantitative approach to the risk assessment intended by Guglieri and Ristorto might be an interesting comparison to mathematical model of the SORA. Even though the SORA is a qualitative approach there is a mathematical model behind the risk classification that is not yet published.
In 2018, a paper was published by la Cour-Harbo comparing the stepwise iterative SORA process to a high fidelity risk modelling (HFRM) [21]. He used a set of two different, relatively small UAS and eight different flight scenarios to compare the results of the SORA methodology with the HFRM. As common basis, he used the fatality rate. La Cour-Harbo concludes that despite their differences, the SORA and the HFRM approach are largely in agreement. However, backup assumptions needed to be applied due to the lack of exact knowledge and data.

5. RISK ASSESSMENT COMPARISON

The common basis for the comparison done throughout this paper is the qualitative assessment approach instead of the fatality rate used in the work by la Cour-Harbo. The main idea of SORA is to establish an easy to use qualitative risk assessment. Therefore, from all of the methods shown in ARP 5150, the one with the most qualitative approach was chosen as described in section 2.3.
It is necessary to have a common understanding of the underlying assessment mechanism to be able to compare both risk assessment approaches.
The Root Cause Analysis starts with a top level undesired event such as a high level failure event. However, the applicant is more or less free to choose on which level of detail the event tree should start. A detailed or specific top level event, such as rudder actuator failure, seems to be adequate to find root causes to that event in a short amount of time. A more general top level event, for example loss of the aircraft, evolves in a more spread-out event tree. In civil manned aviation, the undesired top level event, among some others, might be death to people or loss of the aircraft since those two events are highly linked in manned aviation. A further development of the causes of loss of the aircraft might lead to the high level causes shown in Figure 6.

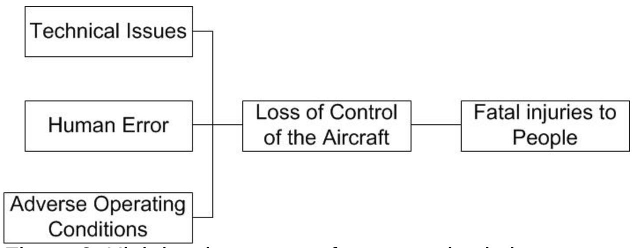

Figure 6: High level event tree for manned aviation

Technical Issues include all kind of causes with technical failure background. Some of those are the failure of system components, fatigue of materials used, manufacturing issues or maintenance issues. Human Error is related directly to errors done by the crew including the pilot or to errors done by the maintenance personnel. Adverse Operating Conditions refer to all possible causes related to the operation, such e.g. as severe weather conditions.
The SORA risk model shown in [17] has a very similar approach.

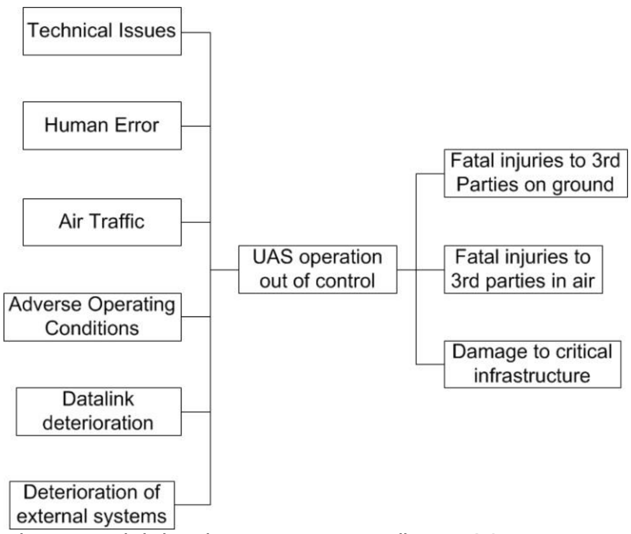

Figure 7: High level event tree according to SORA

The threat "Aircraft on Collision Course" included in [17] seems to be more detailed than the other

threats. Therefore, the authors suggest the usage of the term air traffic instead, because it includes the threat of aircraft on collision course within a more general context.
Compared to the general event tree performed with ARP 5150, there are some noticeable differences in SORA. The unwanted top level event known from the event tree in Figure **6** is now divided into three parts. The diversion into third parties on ground and in air is plausible regarding the mechanism of mitigation strategies implemented in SORA, since some mitigation only apply to third parties on ground or only to third parties in air. The added damage to critical infrastructure now becomes a considerable unwanted top level event because not every UAS crash will eventually lead to injuries to third parties. The central cause changed in SORA from loss of control of the aircraft to a more general *"operation out of control"*. It is plausible to take a wider approach that considers the whole operation, since the sole loss of UAS control does not automatically lead to harm of third parties. Also included in the SORA based event tree is the idea of a higher dependability on datalink connection and external services, lacking a pilot or any other kind of operator on board.
The next step according to ARP 5150 is to further develop each root of the tree. Figure 8 shows the further development of the technical issues root. In an action item list that is updated with each root level, it can be determined if the root is a probable contributor to the main cause. It can also be determined if it is worthwhile to further develop the root and the actions necessary to gather more information.

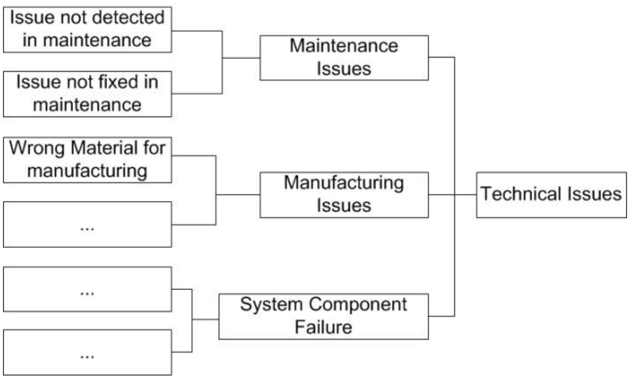

Figure 8: Technical Issues root developing

A fully developed event tree can now be the basis for further actions such as mitigation actions for each uncovered root cause. However, the appropriate rigour of the different mitigation strategies has to be assessed by the applicant.
Basically, the SORA process offers one further developed root cause level, which has several root causes identified for each root shown in Figure 7. The roots for the technical issues cause are in short [16]:

- Operator competency
- UAS manufacturing competency
- UAS maintenance competency
- Inappropriate or no standards during UAS development
- Inappropriate C3 link performance
- UAS safety and reliability not considered during design phase
- Inspection of the UAS regarding the ConOps
- Lack of defined, validated and adhered operational procedures
- Inappropriate crew training
- Lack of recovery ability from technical issue

For each of these roots, SORA also has requirements to be fulfilled that can be viewed as mitigation actions regarding the root cause. In difference to the follow up of the Root Cause Analysis as described in ARP 5150, the applicant does not have to further determine appropriate mitigations as the connection between mitigation action because the level of rigour and the assessed ground and air risk is done within the SORA process (see Table 1**)**. The cause "UAS maintenance competency" shall be mentioned as an example.
The integrity and assurance requirements for low and medium robustness are as followed:
Low:

- The UAS maintenance procedures are defined and cover at least the UAS designer instructions and requirements
- The maintenance team is defined
- The maintenance procedures are documented
- The maintenance conducted on the UAS are documented in a maintenance log
- The training of the maintenance team to maintain the UAS is self-declared with evidence available

In an inverse formulation, those five requirements would resemble the root causes of the maintenance competency root. For this specific example, the event tree may take the form of Figure 9.

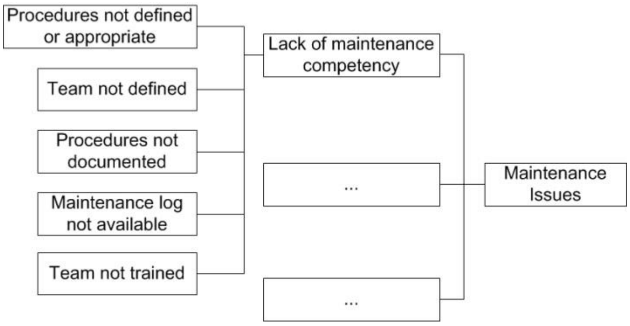

Figure 9: Root causes of Maintenance Issues

It can be seen that even with the low level requirements, potential causes for a lack of maintenance competencies are addressed.

Medium, in addition to low:

- The maintenance procedures take the form of a maintenance program
- Maintenance team is competent
- The maintenance procedures are validated against a recognized standard
- Maintenance syllabus includes the UAS designer instructions and requirements for maintenance
- The maintenance team has undergone initial training by the operator

The medium level requirements do not introduce any new root causes but further expand the mitigation actions. The high robustness requirements do expand the medium level requirements.

6. CONCLUSION

The root cause analysis of the ARP 5150 and the threat / operational safety objective methodology of the SORA process have much in common. The basic idea of an event tree with an undesired event at the top was shown to exist in the SORA too, even if it is not explicitly stated in the draft version V2.0 of the SORA process. The differences in the undesired top level event can be easily explained by the point of view from manned aviation to civil aviation including UAS operations. Manned aviation can be understood as a special case of the civil aviation, where the aircraft is the centre of interest because of its passengers. In all other cases, the whole operation is in the focus. This is shown on the right and middle parts of the event trees of Figure **6** and Figure 7.

Another major difference shows up when the root cause analysis and the risk assessment part of the SORA process are applied. The SORA process gives the applicant an already relatively far developed “event tree” including a set of mitigation actions as well as a pre-defined level of rigour depending on the general risk estimation that has to be performed before in the process. The Root Cause Analysis as described in ARP 5150 offers a structured solution if performed carefully. It also offers a fully retraceable documentation of decisions made and focus points set throughout the risk assessment process. However, performing the root cause analysis on a top level seems to be time consuming. The risk assessment group has to meet and discuss on several iterations to gather more information to further develop the tree or to close roots. It is up to the applicant to decide if the increased effort is worth the benefit of a well-structured documentation and the possibility to have a baseline for failure tree generation. The applicant has also to keep in mind that he may need other tools to develop the appropriate level of rigour for mitigation actions necessary regarding the EASA regulations.

During the comparison, three main questions arose that need further research.

The first is; does the SORA already address all important root causes regarding injuries to third parties or damage to infrastructure? That question should be further targeted within a use case where an additional complete root cause analysis is performed. This should also include considerations on how to find appropriate mitigation actions depending on the actual level of risk.

The second question that arises is linked to the first one. Where does the pre-set level of rigour come from? Are the required mitigations appropriate?

The third question should target the fact that the SORA explicitly sets injuries of third parties as undesired top level event. There are plenty of use cases where the risk of injuries to crew members is as high as or higher than third parties. For every operation in visual line of sight, it can be assumed that at least parts of the crew are relatively near to the UAS, therefore having a higher risk of being struck than third parties. It needs to be analysed if the SORA already considers the remote crew safety in an appropriate way or if an additional root cause analysis has to be performed to assess and mitigate especially the risk of the remote crew.

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