

# Automatic Drone Docking and Deployment for Safety and Security Applications

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**Topic:** Designing an automatic drone docking and deployment system for safety and security applications.

Several safety and security issues cannot be sufficiently handled with the current resources and capacity of the first responders. In response to this, they wish to adopt a new safety and security concept (project UIVER), that incorporates autonomous drones to improve the verification time and effective response in case of incidents. In order to enable the use of autonomous drones, an automatic drone docking and deployment system needs to be developed. Robor Electronics, a company that develops products and services related to drones, is involved in the technical developments of this automatic drone docking and deployment system.

This bachelor assignment was commissioned by Robor Electronics. The goal of the assignment was to lay a foundation for the development of an automatic drone docking and deployment system and to determine how the system should be designed such that it fits the desired safety and security concept of the first responders.

An analysis was conducted to compile design requirements that were in turn translated into a preliminary system design. The analysis consists of a stakeholder analysis, literature and market research, operational scenario creation and timeline analysis.

Crucial aspects of the design of the system that impact the safety and effectiveness, are the integration into the airspace of the future and the integration into existing infrastructure and processes of the first responders.

Throughout the analysis, the fire department of Twente has been used as a starting point. The fire department of Twente is already actively using drones in their daily tasks and is progressive in the adaptation of new technologies around drones.

The alarm room is an essential entity in first responder operations and its continuity is crucial. The introduction of drones as a deployable unit must have the smallest possible impact on the primary tasks of the alarm room.

Current regulations do not permit autonomous drone flights beyond visual line of sight. However, newly proposed regulatory categories by the EASA show a transition towards a more risk-based approach.

The U-Space framework show a promising vision for the integration of drones in the airspace of the future, but does not really address how this new airspace interfaces with landing sites on the ground. To allow safe and effective drone operations there should be a well-defined interface that

describes the landing sites capabilities and restrictions. The ability to communicate between landing sites and UTM systems is crucial.

The market research shows that there are mostly all-in-one solutions available on the market. From the point of view of Robor Electronics, the development of an all-in-one solution is not the most desirable. Their strength is in the development of applications around drones and the integration of different payloads with different existing drones.

The main part of the analysis discusses what it means to have drones as a deployable unit in the context of first responder operations. It discusses the operational context, the drone deployment cycle, an operational scenario and a timeline analysis. Important results are:

- A drone mission coordinator is required to ensure safe and effective drone missions and to ensure the alarm room and first responders can focus on their primary tasks.
- Mobile landing sites can increase mission duration and effectiveness of drone missions.
- Knowledge of the parameters that influence the mission timeline are crucial for safe and effective missions.

In conclusion, a preliminary functional and physical design of the system has been created. The system has been decomposed into the following logical components:

- Drone
- Landing & Deployment System
- Wireless Power Transfer System
- Sheltering System

The design focusses on modularity, minimizing moving parts and contactless charging to ensure maximum availability, reliability and to reduce the need for preventative maintenance. The modularity of the design enables the creation of both fixed and mobile landing sites, which extends mission durations.