THE UAS TRIBUNE

DACUS

Co-funded by the European Union

Demand & Capacity Optimisation in U-space
A Balancing Act

By Jan-Alexander Kleikemper
DACUS Consortium, Europe

The main project objective of DACUS was to develop a service-oriented and performance-based approach Demand and Capacity Balancing (DCB) process to facilitate drone traffic management in urban environments. The project intended to integrate relevant demand and capacity influence factors (such as CNS performances availability), definitions (such as airspace structure), processes (such as separation management), and services (such as Strategic and Tactical Conflict Resolution) into a consistent DCB solution.

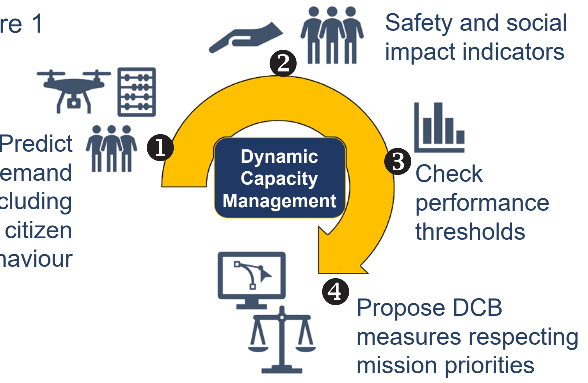
The DACUS project has explored how DCB can be provided within a U-space environment, developed a Concept of Operations (ConOps) for drone DCB in urban airspace and developed models to test fundamental aspects of this concept.

The proposed DCB process fundamentally relies on three U-space services to provide a solution: The Strategic Conflict Resolution, the Dynamic Capacity Management, and finally the Tactical Conflict Resolution, whose performances will determine the need to implement DCB solutions prior to the execution phase. These do not work in isolation but count on information provided by the entire U-space ecosystem. For this information exchange to work, the ecosystem must be based on a highly dynamic and interconnected service infrastructure.

The DCB process begins at the strategic level (several days before operation) and continuously monitors and updates the traffic situation until the actual moment of flight execution. Only when necessary, will it act on the traffic itself (i.e., a potential collision or exceeding of a capacity threshold is identified). To take a decision on whether to intervene or not, the DCB process must first quantify the level of uncertainty of the demand, for which it uses published operation plan data and other external influence factors (e.g., weather information). In parallel, a series of risk-based and social indicators are constantly monitored. These include the expected impact of operations on levels of safety, noise and visual nuisance. This requires the processing of a series of metrics (such as expected noise levels and populations densities) and other impact indicators, which are fundamental for the definition of the capacity of a given airspace.

The developed Dynamic Capacity Management (DCM) service integrated two models that reached a comparatively high level of maturity during the project duration: the Collision Risk Model, which quantified the air and ground risks as a limiting factor to determine the maximum number of drones in an urban area, and the Societal Impact Model, which measured the visual and noise effects over the population as another limiting factor. The functionality of the DCM system is explained in Figure 0.1.

Figure 1



DACUS DCB ConOps draws several parallels between existing processes in manned aviation and those proposed for U-space (such as rules of the air, operational phases, capacity enhancement and DCB in air traffic management) with the aim of highlighting differences, but also commonalities. The main differences within the U-space environment come down to the much shorter time horizon for decision-making and planning (in many cases hours instead of days), a more pronounced effect of external influence factors (such as environment, noise, and third-party risk, among others) and a much higher focus on uncertainty quantification and prediction (rather than dealing with deterministic metrics).

It has become evident that this environment is much more dynamic and multi-facetted than in traditional air traffic management, which requires the DCB concept to do the same. The concept must incorporate new business models, novel vehicles, non-human centric approaches to traffic management, much smaller operating scales, greater levels of information fidelity, diverse mission requirements and associated flight profiles, greater inclusion of societal metrics and shorter timeframes for implementation. The proposed DCB concept is based on these requirements and makes use of the state-of-the-art of relevant research to achieve them (e.g., CORUS ConOps or SESAR ER3 sibling projects).

The DCB process proposed by the DACUS project is outlined in Figure 0.2 (*next page*).

The proposed concept is built on a series of principles, which guide the DCB decisions within the U-space framework. These principles are:

1. Application of collaborative decision making to include Drone Operators within the decision-making process;
2. Prioritizing the fulfilment of mission objectives as a service to Drone Operators when selecting DCB

measures;

3. Allowing for "free-route" operations whenever constraints allow;
4. Minimization of the number of instances in which changes to drone missions are required;
5. Incorporation of predictions and the quantification of uncertainty into the DCB process, to increase robustness of DCB measures within a dynamic operating environment;
6. Recognizing the Operation Plan as the "single point of truth" which maintains continuous up-to-date information about the situation and expected evolution of the drone operation.

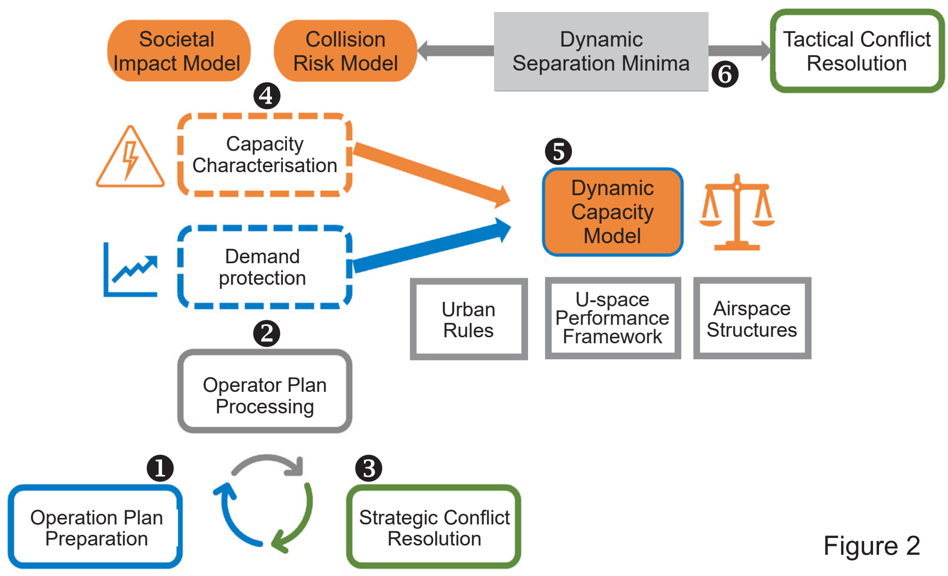


Figure 2

With the DACUS project ending in December 2022, the project consortium is emphasizing the importance of a Demand and Capacity Balancing process through the Dynamic Capacity Management service to be part of the next U-space ConOps revisions.

The DACUS Project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement. No 893864.

The project's lifetime was from July 2020 until December 2022.

11 Partners were involved in the consortium, namely: CRIDA (Spain)/Coordinator, Aha (Iceland), Boeing Research & Technology (Spain), ENAIRE (Spain), EUROCONTROL (Belgium), Ineco (Spain), ISA Software (France), Sopra Steria (France), Jeppesen (Germany), Toulouse Métropole (France), TU Darmstadt (Germany).

For more information: dacus-research.eu
Contact: info@dacus-research.eu