From concepts to operational requirements – A Methodology to Derive Technology-Neutral Vertiport Infrastructure Specifications

Julia Arndt[1]
[1] *DLR Cochstedt, National Experimental Test Center for Unmanned Aircraft Systems, julia.arndt@dlr.de;*

The development of vertiports is taking place in an environment of high technological and regulatory uncertainty. Whilst initial concepts for vertiports and U-spaces are already available, it is currently unclear to what extent standards and systems will be established and how scalable operations could take place. The DLR-project VERTIFIED is precisely designed to address this gap.
By developing operational concepts and establishing a vertiport research infrastructure at the National Test Centre for Unmanned Aircraft Systems in Cochstedt, VERTIFIED aims to investigate, test, validate, and demonstrate future concepts of Innovative Air Mobility under realistic conditions.
For this purpose, two demonstrator configurations are being implemented. An urban vertiport demonstrator models operational and infrastructural concepts in an urban environment. In addition, a second demonstrator is being integrated at the test center, which is located at the airport Magdeburg-Cochstedt, to investigate the integration of vertiport-related processes into an existing airport infrastructure. Both demonstrators enable the analysis of different use cases for vertical take-off and landing (VTOL) aircraft and future electrical VTOL operational scenarios. The planned vertiport research infrastructure will examine take-off and landing procedures, ground operations, passenger and cargo handling, security and surveillance functions, meteorological data collection, energy and charging processes, as well as digital vertiport services in another project.
The focus is not solely on the procurement and construction of the research infrastructure, but in particular on the methodological derivation of requirements through the early involvement of relevant stakeholders. The aim is to create a technology-neutral yet application-oriented basis for future procurement.
Stakeholders were identified and prioritised using the Stakeholder Salience Model developed by Mitchell et al. [1], which enables a systematic assessment based on the characteristics of power, legitimacy and urgency. On this basis, the stakeholders were classified and appropriate participation strategies (Integrate, Consult, Inform, Monitor) were defined.
To ensure the ongoing involvement of stakeholders, two complementary formats of participation were implemented. The first one consisted of two stakeholder forums, in which representatives from industry, academia and public authorities discussed operational scenarios, concepts for vertiports, technical as well as operational requirements. The aim was to identify initial requirements for use cases, design and technology systematically.

Furthermore, a requirements catalogue was developed iteratively. The starting point were operational scenarios for passenger and freight transport, along with the resulting requirements for future vertiport operations. These were combined with the “Prototype Technical Design Specifications for Vertiports” from EASA [2], existing concepts for integration into U-space and existing airport infrastructure, as well as the results of the stakeholder engagement.
As a second stakeholder engagement format, a two-part webinar series was held with potential industry partners and other interested organisations in the run-up to the planned procurement processes. In the first webinar the project objectives, operational concepts and the integration of U-space and systems-of-systems approaches were presented. The second webinar focused on the requirements for the infrastructure to be procured and the upcoming tendering process. This technical exchange enabled further validation and refinement of the requirements catalogue.
Subsequently, all requirements were consolidated, assessed for feasibility and harmonised in terms of content. The difference between functional, non-functional and interface requirements was identified in order to map out operational, technical and integration-related aspects systematically. This was followed by a classification into the categories of landside and airside infrastructure, meteorological and environmental systems, security, surveillance and digital systems, and energy and charging infrastructure. This structure formed the basis for the drafting of a specification for the two vertiport demonstrators.
The methodology developed thus forms the link between conceptual vertiport approaches and their practical implementation in the form of technology-neutral, specifications. It comprises the interlinked steps of stakeholder identification, requirements gathering, consolidation, validation and translation into a service specification. At the same time, it is evident that the early involvement of industry and public authorities, in particular, helps to identify potential for adaptation and modularity at an early stage and to integrate these into the requirements catalogue. This demonstrates how robust and technology-neutral procurement requirements can be systematically derived from operational scenarios, regulatory frameworks and the needs of relevant stakeholders.
The result is a transparent catalogue of requirements, complete with an implementation plan and specifications, which brings together operational aspects, infrastructural components and integration into U-space, whilst also taking future technological developments into account. The study shows that the early involvement of relevant stakeholders improves the completeness and traceability of the requirements derivation process, thereby laying the foundation for a transparent, innovation-friendly and future-proof procurement process.

[1] Ronald K. Mitchell et al. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts. Academy of Management Review*, 22*(4), 853–886. https://www.jstor.org/stable/259247

[2] European Union Aviation Safety Agency (2022). Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category (PTS-VPT-DSN). https://www.easa.europa.eu/en/document-library/general-publications/prototype-technical-design-specifications-vertiports

Biography
Julia Arndt

Julia Arndt is a mechanical engineer and has been working at the National Experimental Test Center for Unmanned Aircraft Systems of the German Aerospace Centre (DLR) since 2024. Within the VERTIFIED research project, she leads the main work package on stakeholder management and is responsible for involving relevant stakeholders and supporting the procurement process.