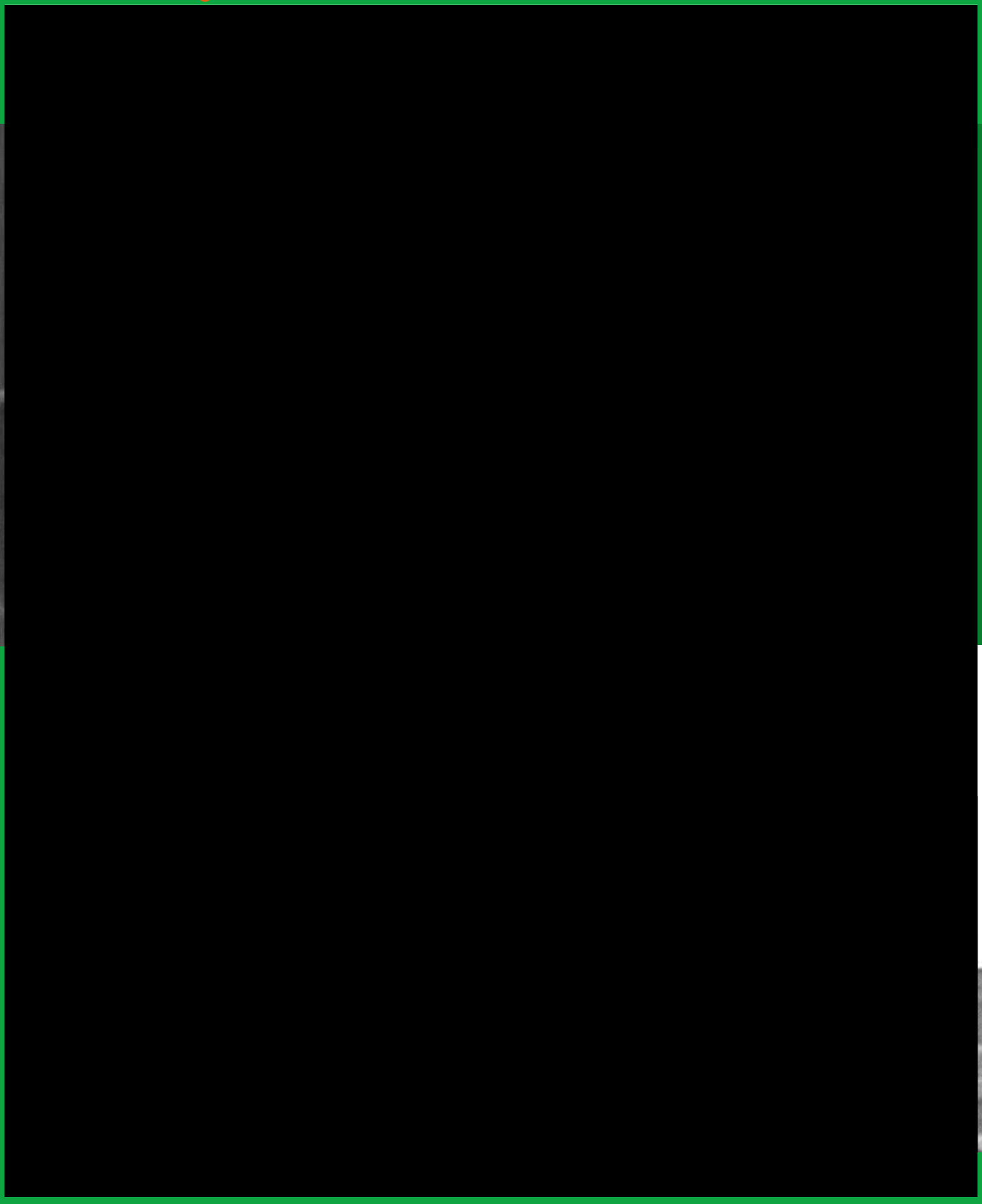
V.5.2 The Project Approach

Introducing our Team



Study Approach

In this section we provide an outline of simulation and what it assesses throughout the time an aircraft is interacting with Prague Airport (from airspace, on the ground, and then departing Czech airspace).

Airside simulation is a cost effective tool to assist in the long and short term planning and tactical decision making of an airport. It enables the benefits of proposed expansion plans or other changes to be modelled and tested to investigate areas of operational improvement, deficiencies and capacity gains before any costly infrastructure or complex operational changes are made. Arcadis will deliver the various tasks outlined in this proposal using Simmod PRO! as the analysis tool.

Simulation Software

We will use SimmodPRO! to assess airfield capacity at Prague Airport.

Simmod PRO! has detailed airspace functionality allowing the modelling of changeable departure and arrival procedures, route allocation and control depending on the levels of traffic. For example the use of stacks for arriving aircraft during arrival peaks or the use of more direct routes during quieter periods.

Simmod PRO! can be used to capture the specific approach rules for aircraft landing at Prague Airport including the release from multiple stacks, radar vectoring onto the appropriate instrument approach path (ILS, GNSS and MLS) and then maintaining vertical and horizontal separation. On landing, the software can be used to replicate specific runway occupancy times for different aircraft types and selection of exit based on any number of operating rules. Simmod also provides a Missed Approach function to validate missed approach procedures and impacts on capacity.

Using the logic function of Simmod PRO! it can be used to accurately model what happens should an aircraft arrive at the airfield early or late and needs to wait somewhere for its stand to become available or to have its stand reallocated. The logic can be used to input detailed procedures for stand reallocation including airline preferences, aircraft size considerations and adjacency rules.

After taxiing to the designated stand, using the Simmod enhanced passenger disembarkation functionality, we have the ability to model different disembarkation times and procedures based on load factors and stand configuration, bus and other GSE resource availability.

The first step in modelling the departure sequence of an aircraft will be at the departure gate. Key to capturing the departure process accurately is capturing the interaction with the processes in the terminal building and aircraft turnarounds which can result in aircraft departing later (or in some cases earlier) than expected.

Using Simmod PRO!, Arcadis has the capability to model this schedule perturbation, introducing variation and therefore more realistic aircraft departure times.

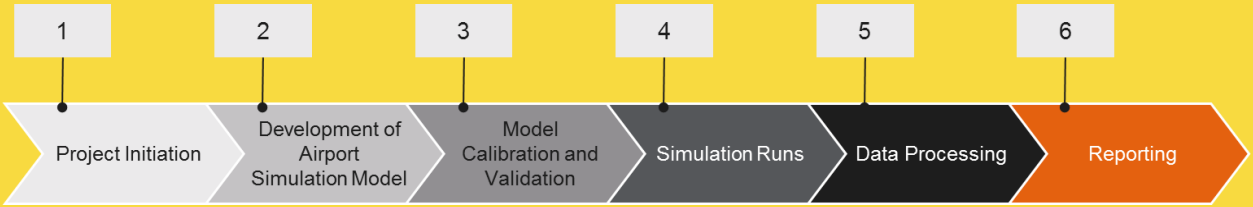
In order to replicate aircraft pushbacks in an accurate way, Simmod PRO! provides the functionality to apply time distributions and blocking rules to aircraft pushbacks. The pushback timings can be applied to different airline and aircraft types and for different stands. The blocking rules can be applied in order to replicate aircraft blocking other aircraft pushing back from simultaneous stands and taxiing aircraft. Non-standard pushbacks can also be modelled using Simmod PRO! in order to replicate tactical decisions by NATS to improve airfield flows.

Simmod PRO! provides the functionality to apply different taxiing speeds depending on aircraft type, airline and also aircraft location (ie.Taxiway, taxi lane etc) to accurately capture the taxi time of aircraft. Using the logic functionality of Simmod PRO! specific taxiing operations can be implemented based on the most granular of criteria.

Using Simmod PRO! logic, allocation to multiple departure queues can be built into the model to account for sequencing and differing SID usage, climb gradients and climb speeds, intersection departures and departure queue optimisation allowing best utilisation of the taxiway structure available. The runway take-off and line up assumptions are built into the Simmod model to ensure that the runway flows accurately reflect reality. In addition holding areas for de-icing and slot staging can be modelled.

Key Steps and Anticipated Scope of Works

Our 6-stage approach to airfield simulation modelling is encapsulated by means of the graphic below which allows our team to successfully evaluate and assess airfield options:



By clearly defining each stage, a simulation model is able to be developed that can then interrogate issues and problems to be able to arrive at robust solutions.

The *Project Initiation* phase involves meeting with key staff at Prague Airport in order to fully understand the operation of the airfield. This is important in order to understand the nuances across the airside environment. The Arcadis team will ensure key KPIs for the model are *developed* and agreed, as well as ensure that all relevant data is able to be obtained.

The next step is one of the more important for this phase of work *Model calibration and validation*. This will be to incorporate any operational changes that have taken place and to ensure that what happens in reality is reflected appropriately within the model. This is an essential step in any modelling exercise and the Arcadis team will bring a robust methodology to ensure that the model is fully validated and therefore replicating reality as closely as possible.

Some of the measures used to calibrate and validate the simulation model are as follows:

- Journey time comparison
- Hold time comparison
- Push back time comparison
- Departure queue length analysis
- Visual flow and bottlenecks analysis

Essentially, we want to ensure that (for example) a morning flight schedule that results in a particular delay or queue on the airfield, is appropriately reflected in our Simmod PRO! model.

Arcadis understand the importance of having a robust and defendable calibrated base model of the airside operation. This is why we will invest a significant portion of our time in ensuring the base model is accurate and correct. This will allow Prague Airport to make *Data Driven Decisions* that are then used to inform future capacity analysis decisions.

Our team will have a number of staff visiting Prague Airport during this phase of work, recording aircraft times for taxi, runway occupancy time etc. This will involve liaison with the operations teams to provide airside escorts and access to the runway, ATC tower and airfield operations hubs.

Our next step involves *Simulation Runs*. During this phase we want to ensure that any unique scenarios are accurately reflected in the model, as well as operating throughout the entire simulated timeframe. Arcadis will complete multiple iterations to ensure the simulation runs are robust, correctly providing a detailed record of airfield movements, delays and queues.

During the *Data Processing* phase, our team will ensure that comprehensive results for the initial KPIs are accurately reported. In addition, we will ensure that the detailed analysis of flights are recorded from entering local airspace, ground movements and aircraft finally departing Czech airspace.

The final stage of simulation modelling involves *Reporting*, and ensuring that the simulation results are in line with the required management dashboards. Arcadis also ensure that the animation feature of the model allows a retrospective review of aircraft interactions. At the end of this process is a calibrated and validated simulation model and tool that Prague Airport can be confident reflects operational reality.

In addition our team is able to be on stand-by to deliver Prague Airport an operational response to any additional airfield situations that arise throughout the design and construction works for the Terminal 2 project.

Usability of Airfield Simulation Outputs

In any simulation project, knowing what to model (and when to stop) is one of the most crucial elements of providing a best value service to our clients. The Arcadis team experience allows for extremely detailed modelling to be undertaken in order to capture very specific rules and procedures however these have to be balanced with the effort taken to undertake these changes and the value of the outputs provided.

The Simmod PRO! viewer will allow Prague Airport to view and playback each scenario without the requirement for a license or software installation. This can be used to better understand the reasons behind the simulation outputs and how capacity issues such as bottlenecks and queuing occur.

With Simmod PRO! reporting functionality, we can produce high level management dashboards, showing only high level results providing senior management with an informative overview but the granularity of the data also allows for very detailed reporting. All outputs can be visually presented and tailored to Prague Airport requirements.

Key Airfield Simulation Outputs

Key outputs of each of the analysis of the selected development options completed by the Arcadis team are:

- Arcadis will identify the physical capacity of key airfield pinch points and propose when, against forecast demand these need to be addressed.
- Propose improvements to Prague Airport operating policies and procedures that will improve on-time performance and reliability, whilst maximising asset utilisation
- Confirm the effectiveness of the proposed internal master plan to deliver capacity to accommodate forecast demand and perform against agreed targets that are to be agreed. Part of this element will be to identify any additional requirements or redundant proposals.
- Identify high level dependencies between additional taxiway capacity (runway crossing, holding capacity, dual taxiway schemes) and demand increased or apron expansion.

Each of the development options will be summarised in a report outlining the impact of the airfield capability.

Finally, as appropriate and as agreed with Prague Airport, Arcadis will provide analysis to inform and justify the introduction and timing of airfield development schemes including statistical analysis of appropriate financial, operational and environmental benefits.

Finally, Arcadis also bring Prague Airport a wealth of further airfield design tools, such as Airport Office and Path Planner, which can be used to assess specific situations in a detailed specific manner, to best deliver operational reliability, cost efficiency and compliance with EASA regulations et al.