



Wanted: Robotic Condition Assessment of Sewer Network



Briefing: Fraport Digital Factory Project “Robotic Condition Assessment of Sewer Network”

Problem/goal description and technology focus:

At Frankfurt Airport, there are various sewers for the maintenance of the entire infrastructure, which serve drainage, wastewater disposal, and surface water drainage. The entire sewer system must be completely inspected for damage within a ten-year cycle. The inspection for existing damage and repair needs is carried out annually, with a newly defined focus and scope each year. Upon completion of the inspections, the resulting inspection reports are submitted to the authority responsible.

Each calendar year, approximately 30 kilometers of sewers with diameters ranging from 150 to 3000 millimeters are typically inspected. About 60% of the rainwater sewers and 20% of the wastewater sewers have a diameter of greater than or equal to 400 millimeters.

Before inspecting the sewers, a preliminary cleaning of the sewers is currently carried out as standard to remove any potential contamination that could hinder inspection and damage assessment. The degree of contamination is currently analyzed only after cleaning and varies significantly. With a contamination level of 0-10%, the sewers are considered lightly contaminated, and with 10-30%, they are considered heavily contaminated.

For the inspection of the sewers, manually operated robotic probes with cable connections are currently used, which record video footage from inside the sewers. The recordings are manually reviewed, evaluated, and assigned to different damage classes during and after capture. Based on the recorded damage classes, necessary repair measures are derived and planned.

The current inspection process is often prone to errors, as the robotic probes used reach their limits even with minimal contamination, stones, or other concrete irregularities. Additionally, the manual implementation and evaluation process is very time-consuming and costly.

Damage inspections have been carried out for some time, resulting in extensive databases containing video footage and cataloged damage data. This data, of varying quality, is categorized by damage groups and object areas and can serve as a basis for testing new approaches. Inspectors use the DWA standard (German Association for Water, Wastewater and Waste), which sets norms for sewer inspection. The investigation is carried out according to a defined abbreviation system. The data is prepared in the ISYbau format during the inspection for easier data exchange, facilitating further processing, classification, and the creation of refurbishment proposals.

What we are looking for:

We are searching for a technical solution for the automation of camera inspections of sewer systems using robotic solutions such as drones or similar technologies.

Goals of this project:

- Inspection for sewer contamination: Determining the need for cleaning based on predefined parameters and indicators to optimize the cleaning interval.
- Autonomous drone flight through rainwater sewer shafts with a diameter of DN800 or smaller and a length of at least 100 meters.
- Data collection and damage detection: Use of a reliable detection model to identify and report potential damages.
- Creation of detailed images when needed for a more precise damage analysis of specific spots.
- Increased efficiency by reducing the time and cost-intensive manual execution and evaluation of inspections.

Optional goals:

- Precise 3D capture and mapping: Enabling subsequent investigations through accurate 3D capture of the sewer interior.
- AI-supported damage classification: Automatic classification of damage images according to defined categories.
- Technology integration: Use of LoRaWAN technology to support control and data transmission.
- Autonomous drone flight through rainwater sewer shafts with a minimum diameter of DN400.
- Automatic inspection of the shafts (usually 1 meter in diameter, depth between 1.5 and 7.5 meters)

Schedule and milestones:

- If interested, please contact us at digitalfactory@fraport.de with information about your company and a short outline of your solution (max. 5 slides) by December 5th, 2024.
- Solution provider presentations (pitch) from January 7th to January 9th, 2025
- Shortlisting of providers asked for a quote by January 10th, 2025
- Submission of quotes by January 20th, 2025, 8 am CEST
- Contracting and start of cooperation within 2-3 business days after quotes have been submitted
- End of project and final presentation by solution provider on March 26th, 2025

Acceptance criteria:

Requirements / characteristics / functionalities of the MVP

- Drone is able to fly inside the sewers (diameter > 80cm)
- Localization of damages inside a sewer
- Verifiability of damage reports (video recordings, 3D model, etc.)

- Data preparation in isybau format for easy data exchange and further processing.
- Continuous connection and video transmission to the server during the flight.
- Video recordings must be possible in 360°.
- At junctions, the operator should be able to specify the direction, or the drone should independently recognize the entrance (connection) to be flown.

List of KPIs the MVP will be validated against

1. System availability > 90%
2. Scan process in < 30 seconds per meter including setup time
3. Evaluation period of scanned data < 10 minutes
4. Seamless flight without repositioning of the drone of more than 200 meters

These KPIs must be achieved by March 26th, 2025 or verifiably achievable.

Affected product/service/process:

- Sewer inspection process according to EKVO

Involved Fraport business units:

- Digital Factory & IT
- Integrated Facility Management
- Central Infrastructure Management

Requirements concerning data:

Collection, processing personal data

- No processing of personal data, as only the inside of sewers is captured and analyzed

Collection, processing of non-personal data

- Collection of video recordings and sensor data to analyze the surfaces inside the sewers
- System-side processing of the captured data to detect potential damages using computer vision or a similar visual detection approach

List of standards and norms the solution must comply with:

- GDPR
- IT Security Act (IT-Sicherheitsgesetz)
- DWA-M 149-2
- DWA-M 150
- EKVO
- VSB recommendations for sewer inspections

Evaluation criteria:

Should you be invited to pitch, you will be evaluated according to the following criteria:

1. Customer reference: Customer references in the aviation industry (airports, airlines) or in similar industries, not older than 3 years (*simple scoring*)
2. Effectiveness: Can this technology solve the problem? (*triple scoring*)
3. Maturity of the solution: Existing product or new development? (*triple scoring*)
4. Efficiency: How well can the technology solve the problem (KPI achievement, MVP scope)? (*triple scoring*)
5. User Interface: User-friendly, clear interface – the following criteria will be assessed: graphics, design, clarity and intuitive user interface, practicability (*triple scoring*)
6. Data collection and storage: Where is the data stored (e.g. on-premise/cloud)? (*simple scoring*)
7. Data sharing: Possibility of data sharing (data flows into data lake or similar, APIs etc.?) (*simple scoring*)
8. Access: Is there a user concept, can different users be assigned different access rights etc. (*simple scoring*)
9. Primary scope of rollout: Use of additional areas, scalability (FRA) (*simple scoring*)
10. Other possible applications, e.g. in other airport areas or for different use cases (*simple scoring*)
11. Use in the Fraport Group: Use for subsidiaries (*simple scoring*)
12. GDPR compliance / compliant with German law (*simple scoring*)
13. Visualization: Were a demo/photos/videos shown? (*simple scoring*)
14. Presentation style: Convincing presentation and reaction to questions (*simple scoring*)
15. Price indication: Was a first indication provided, info about pricing model? (*simple scoring*)
16. Speed of implementation: Describe timeline, prove feasibility (*simple scoring*)

Please keep the evaluation criteria in mind for your presentation and be responsive to the demanded content. Should you not be able to address all points in your pitch due to time restrictions, please make sure to include all information in the presentation you send us afterwards.

Based on the aforementioned criteria, Fraport will select suitable providers for a shortlist and ask for a cost proposal.

Should you not be able to offer us the whole solution and wish to work with a partner, please provide information about the partner and your previous experience. Please keep in mind that Fraport will commission one contractor only. Your partner needs to be commissioned as a subcontractor on behalf and for account of you as the contractor. Should you be shortlisted and asked to submit a cost proposal, Fraport will only accept a comprehensive offer.

Further hints and instructions

You will have 30 minutes to pitch your solution idea to us. Please plan for 15-20 minutes of presentation at maximum, so that we have time for questions. You may present in German or English language and we would appreciate to receive your presentation slides afterwards (please send us a version that we are allowed to distribute internally for information purposes).