

Case Study

Making Bridges Safer Through Digital Design

Designing an end to end platform for bridge
inventory, monitoring and inspections

About me

I'm a Senior Digital **Product Designer** with **10+ years of experience** across **B2C and B2B digital services**.

I'm passionate about **combining design, technology and user insight** to **create purposeful experiences** across industries.

I specialize on **web/mobile apps, AI tools, IoT** and **digital transformation**, working with **medium/large companies and startups**.



1 dog + 3 cats

My background:

- Laurea Magistrale in **Computer Engineering @ Politecnico di Milano** (110/110 cum laude)
- M.Sc. in **Computer Science @ University of Illinois at Chicago** (4.0 GPA)
- Certified **AWS Developer Associate** (2019-2024) → Experienced in **cloud architectures** and **serverless microservices**
- Previous Jobs: **Research Assistant** (1.5 years @ UIC), **Web/Mobile Frontend Software Engineer** (2 years)
- **UX/UI Courses @ Interaction Design Foundation** + **10+ years of hands-on experience designing digital products**

Daily tools: Figma, FigJam, Notion, Jira and GitHub (AI + human brain!)

Today's Agenda

Introduction

Project Team

Project Overview

Design Process

Empathize

Define

Ideate

Prototype

Test

Wrap Up

Project Team

Provider: Nautes, a digital innovation company specializing in designing and developing tailor-made digital products for businesses.

Design & Development Team:

1 Senior Designer (me): Lead design, UX strategy and service design

1 Junior Designer: Public website design, research and co-design support

6 Developers: Frontend, Backend, Mobile app, QA engineering



Client: Tecnoindagini, a specialized construction diagnostics center providing comprehensive inspections and testing for new and existing structures. It assesses structural safety, material quality and seismic vulnerability.

Domain & Stakeholders:

Structural engineers & inspectors: field methodology and defect assessment

Public infrastructure operators: compliance and asset oversight

Timeline: March 2022 → Market launch Sep 2022

Digitalizing Bridge Census & Inspection

In **today's ageing infrastructure**, public infrastructure operators must keep tens of thousands of bridges and viaducts safe. The 2022 Guidelines (D.M. 204/2022) made census, inspection and classification a mandatory, standardized process. Yet most of it **still ran on paper, spreadsheets and disconnected tools**.

This case study follows the journey from that challenge to designing and delivering **INBEE: a web platform and mobile app that digitize every census and inspection sheet**, automatically compute each structure's attention classes (CdA, the risk index) and **export data** ready for **AINOP** (the **public infrastructure registry**).

My role as a **Senior Product Designer** in the project:

- **Framed the problem space** through research into bridge guidelines and direct immersion in on-site inspections.
- **Worked with engineers and structural experts** on AINOP interoperability.
- Translated a complex technical regulation into **clear, usable digital workflows**.
- Defined the **information architecture**, service blueprint and notification system.
- **Designed the UX/UI** for census, inspection and defect-evaluation flows.
- Shaped the **web platform** and the **field mobile app** as one coherent **design system**.
- **Prototyped and tested iterations** with people managing public administrations and inspectors.
- Worked alongside a junior designer, **mentoring** him while owning the overall design direction.

Design Thinking Phase

Empathize



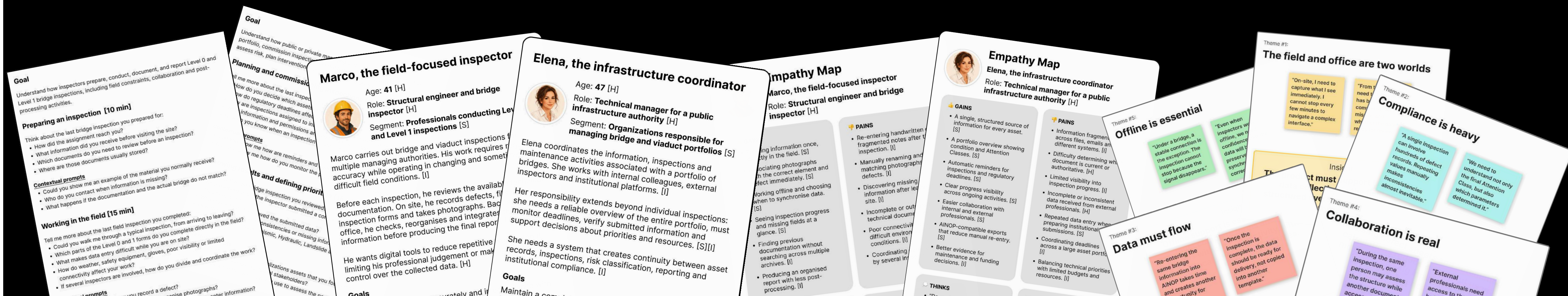
Understanding the Real Inspection Workflow

PROBLEM STATEMENT

“Why is keeping bridges safe and compliant still so manual, fragmented and hard to sustain?”

Design activities to gather insights:

- Conducted **contextual interviews** and studied the regulatory guidelines alongside structural engineers
- Facilitated **collaborative design sessions** with public infrastructure operators and professional inspectors
- **Field immersion** by taking part in inspections, reviewing inspection data and analysing the risk assessments.



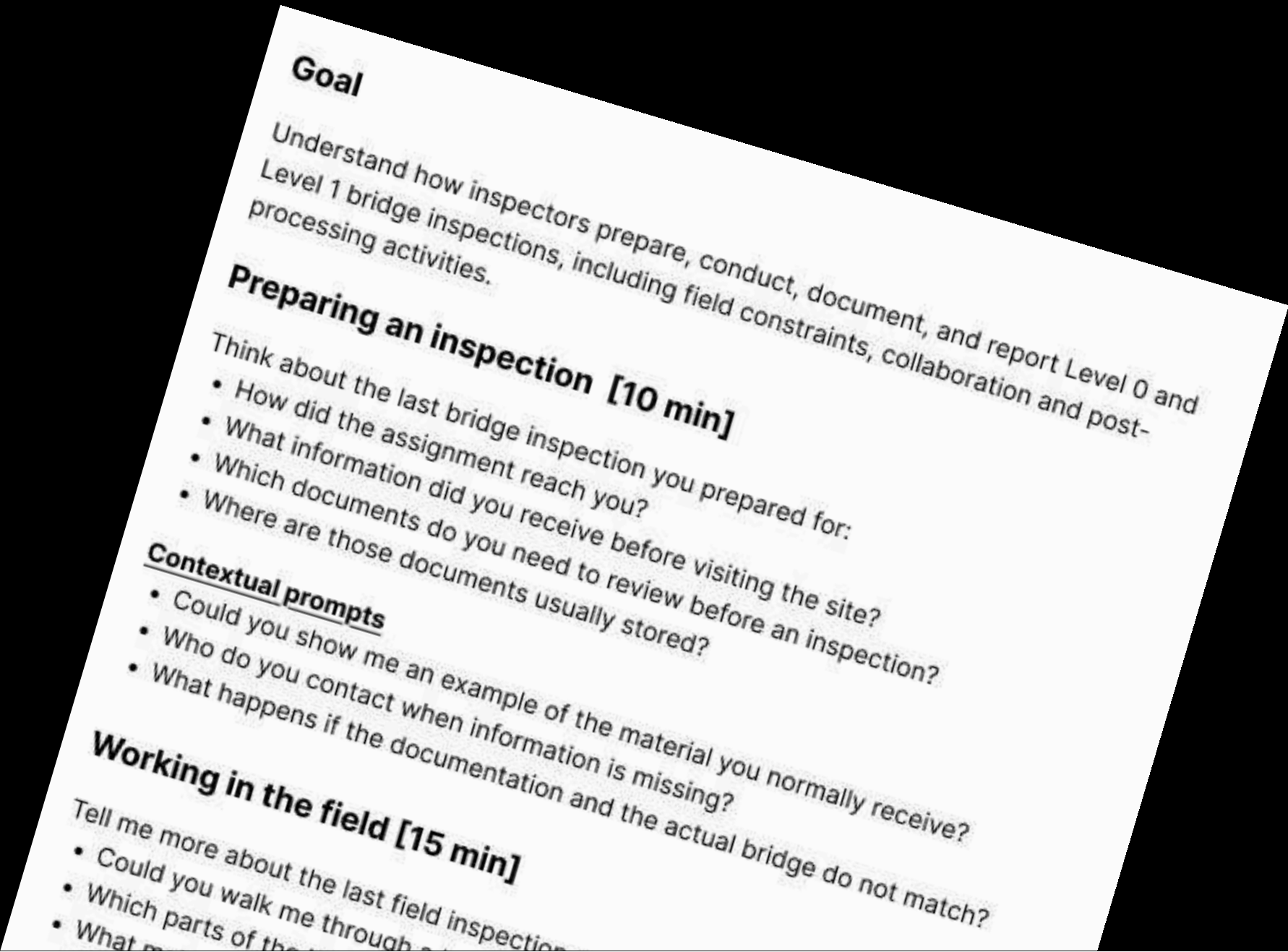
Understanding the Real Inspection Workflow

CONTEXTUAL INTERVIEW SCRIPTS

INSPECTORS

Objective: Understand field habits, tools and pain points during on-site bridge inspections

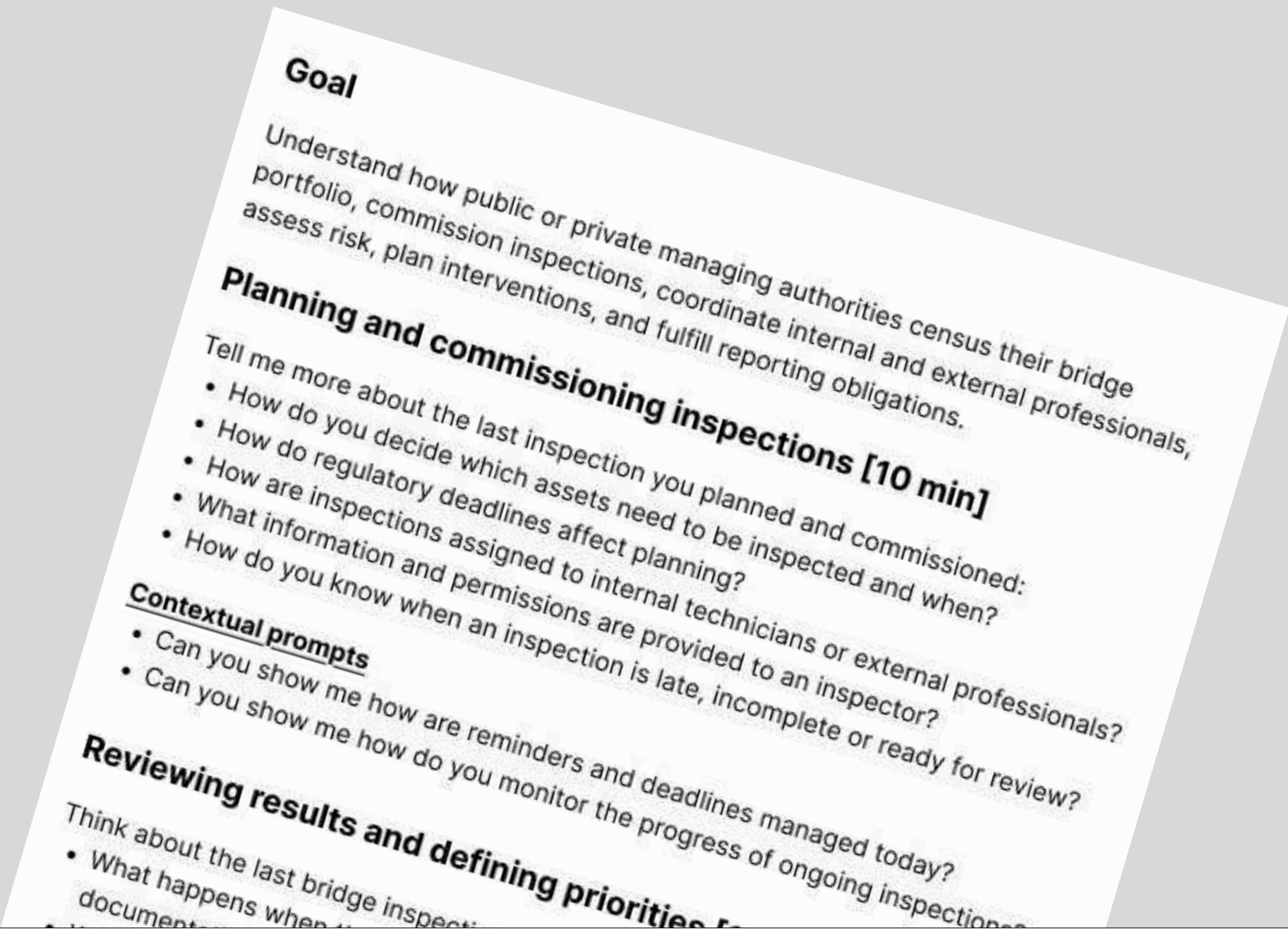
Inspector Interview Template (Notion)



INFRASTRUCTURE MANAGING AUTHORITIES

Objective: Explore compliance duties, asset oversight and reporting toward authorities

Infrastructure Managing Authority Interview Template (Notion)



Design Thinking Phase

Define



Understanding the Real Inspection Workflow

PERSONAS & EMPATHY MAPS

PERSONAS



Marco, the field-focused inspector

Age: 41 [H]
Role: **Structural engineer and bridge inspector** [H]
Segment: **Professionals conducting Level 1 inspections** [S]

Marco carries out bridge and viaduct inspections for multiple managing authorities. His work requires accuracy while operating in changing and difficult field conditions. [I]

Before each inspection, he reviews the documentation. On site, he records data on inspection forms and takes photographs. In the office, he checks, reorganises and inputs the information before producing the final report.

Goals

- Complete inspections accurately following the Bridge Guidelines. [S]
- Record observations and photographs.
- Reduce manual data entry.



Elena, the infrastructure coordinator

Age: 47 [H]
Role: **Technical manager for a public infrastructure authority** [H]
Segment: **Organizations responsible for managing bridge and viaduct portfolios** [S]

Elena coordinates the information, inspections and maintenance activities associated with a portfolio of bridges. She works with internal colleagues, external inspectors and institutional platforms. [I]

Her responsibility extends beyond individual inspections: she needs a reliable overview of the entire portfolio, must monitor deadlines, verify submitted information and support decisions about priorities and resources. [S][I]

She needs a system that creates continuity between asset records, inspections, risk classification, reporting and institutional compliance. [I]

Goals

- Maintain a complete and up-to-date infrastructure inventory. [S]
- Coordinate inspectors, activities, permissions and deadlines. [S]
- Monitor inspection status across the entire portfolio. [S]
- Identify critical assets and prioritise interventions. [S]
- Comply with ministerial guidelines and AINOP requirements. [S]
- Preserve a traceable history of interventions.

EMPATHY MAPS



Empathy Map

Marco, the field-focused inspector

Role: **Structural engineer and bridge inspector** [H]

GAINS

- Entering information once, directly in the field. [S]
- Associating photographs with the correct element and defect immediately. [S]
- Working offline and choosing when to synchronise data. [S]
- Seeing inspection progress and missing fields at a glance. [S]
- Finding previous documentation without searching across multiple archives. [I]
- Producing an organised report with less post-processing. [I]

PAINS

- Re-entering handwritten or fragmented notes after the inspection. [I]
- Manually renaming and matching photographs to defects. [I]
- Discovering missing information after leaving the site. [I]
- Incomplete or outdated technical documentation. [H]
- Poor connectivity and difficult environmental conditions. [I]
- Coordinating data collected by several inspectors. [I]

THINKS

- "Have I documented every relevant defect?" [H]
- "Will I need to return because something is missing?" [H]
- "Does the existing documentation match what I am seeing?" [H]
- "Can I trust the system to preserve everything I entered?" [H]
- "Will this tool actually save time once I am back at the office?" [H]

SAYS

- "I need to record the observation while I am in front of the element."
- "Photographs are useful if I can retrieve them in the right context."
- "On site, I cannot have a stable internet connection."
- "The tool should have a better assessment tool."

DOES

- Reviews the documentation.

FEELS

- Frustrated



Empathy Map

Elena, the infrastructure coordinator

Role: **Technical manager for a public infrastructure authority** [H]

GAINS

- A single, structured source of information for every asset. [S]
- A portfolio overview showing condition and Attention Classes. [S]
- Automatic reminders for inspections and regulatory deadlines. [S]
- Clear progress visibility across ongoing activities. [S]
- Easier collaboration with internal and external professionals. [S]
- AINOP-compatible exports that reduce manual re-entry. [S]
- Better evidence for maintenance and funding decisions. [I]

PAINS

- Information fragmented across files, emails and different systems. [I]
- Difficulty determining which document is current or authoritative. [H]
- Limited visibility into inspection progress. [I]
- Incomplete or inconsistent data received from external professionals. [H]
- Repeated data entry when preparing institutional submissions. [S]
- Coordinating deadlines across a large asset portfolio. [I]
- Balancing technical priorities with limited budgets and resources. [I]

THINKS

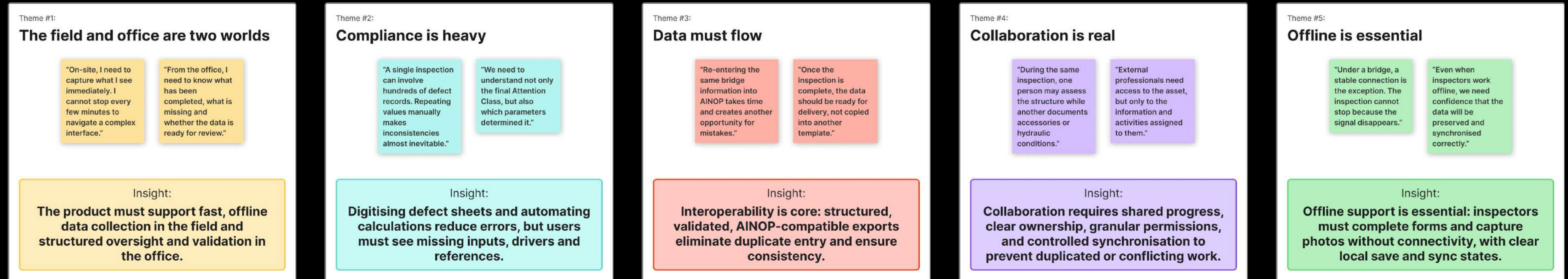
- "Do we have complete and current information for every bridge?" [H]
- "Which assets require our attention first?" [H]
- "Are the submitted inspections ready to be validated?" [H]
- "Can we demonstrate why this intervention was prioritised?" [H]
- "Will the exported data be accepted without further corrections?" [H]

SAYS

- "I need an overview of the portfolio, not another isolated report." [H]
- "Everyone should work with the same updated information." [H]
- "I need to know what is late before it becomes a compliance issue." [H]
- "A risk classification must be clear enough to support a decision." [H]

Understanding the Real Inspection Workflow

KEY BEHAVIORAL INSIGHTS FROM RESEARCH



- **The field and the office are two worlds:** inspectors need **speed on-site**, operators need **oversight and traceability**
- **Compliance is heavy:** the CdA (risk index) calculation and defect sheets are **error-prone by hand**
- **Data must flow:** everything has to be **exportable to AINOP (registry public infrastructures) without re-typing**
- **Collaboration is real:** several professionals often work on the same structure and inspection
- Inspections often take place in areas with **poor connectivity**, so the product must fully support **offline use**

Crafting the Compliance Backbone

DESIGN CHALLENGE (POV)

“How might we turn a complex, mandatory inspection standard into a fast, reliable digital experience for both inspectors in the field and the operators managing the public infrastructure assets?”

From there, we distilled four **design principles** that would guide every decision moving forward:

- **Compliance by design:** the Guidelines and the CdA risk index logic built into the flow, not bolted on
- **Field-first:** a mobile app that works fast and is resilient on real inspection sites
- **One system, two audiences:** a shared model serving inspectors and managing bodies
- **Interoperable by default:** data always ready to export into AINOP (Italy’s digital registry of public infrastructure)

Design Thinking Phase

Ideate



Designing Around the Workflow

I ran design sprints with developers, structural experts and inspectors to explore:

- **Structure setup and level entry:** L0 (desk-based inventory), L1 (field inspection) and L2 (risk assessment)
- **Data entry for defect sheets:** driven by element type and material
- **Automatic calculation of the bridge risk index (CdA)**
- **One-click export ready for AINOP**

Key concepts that emerged:

- **Save-as-you-go workflow:** breaking the inspection sheet into guided, level-based steps
- **Smart defect sheets:** showing relevant defects alongside visual references to support their assessment
- **Transparent CdA calculation:** showing each intermediate assessment step and how it contributes to the final risk
- **Web + Mobile app continuity:** start in the field on mobile, review, finish and manage on the web

Designing Around the Workflow

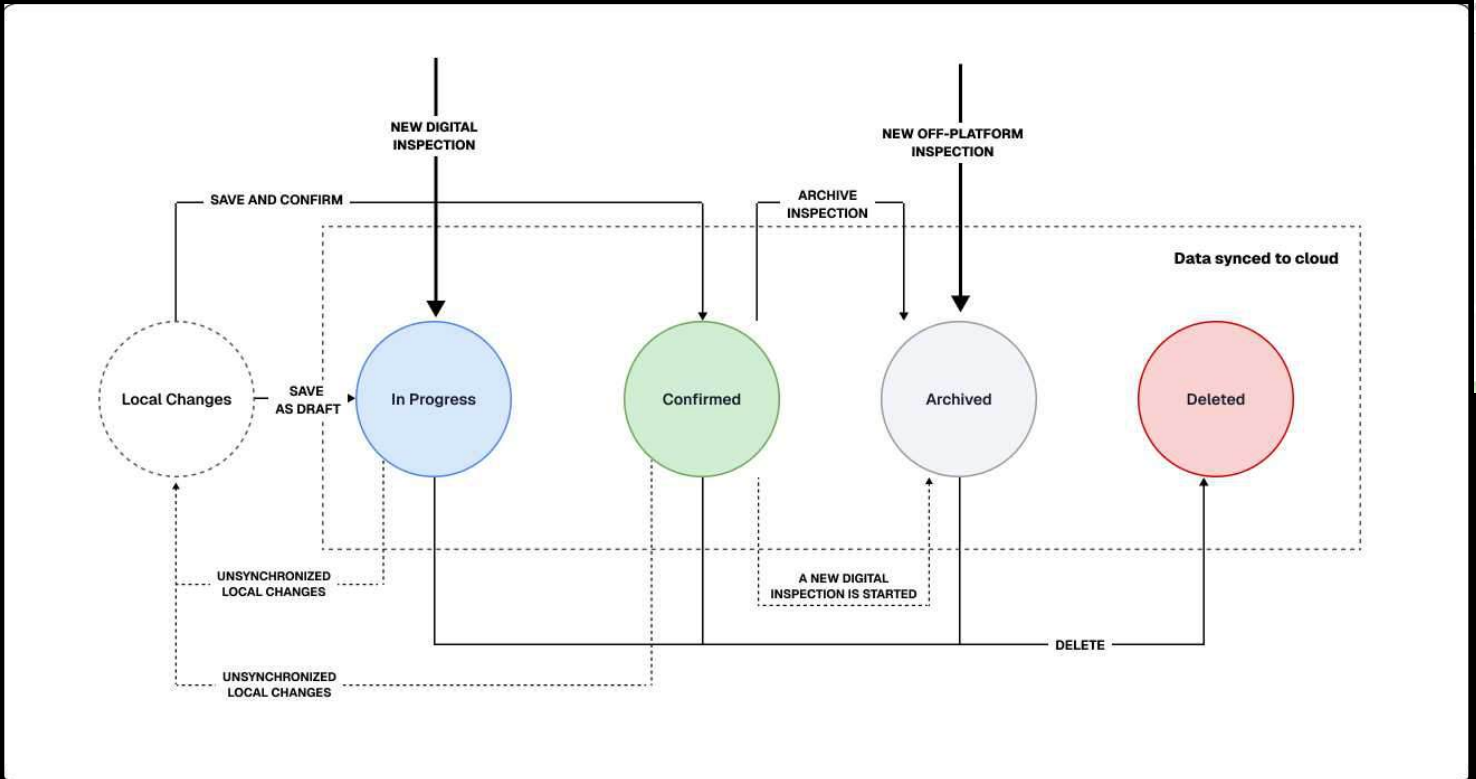
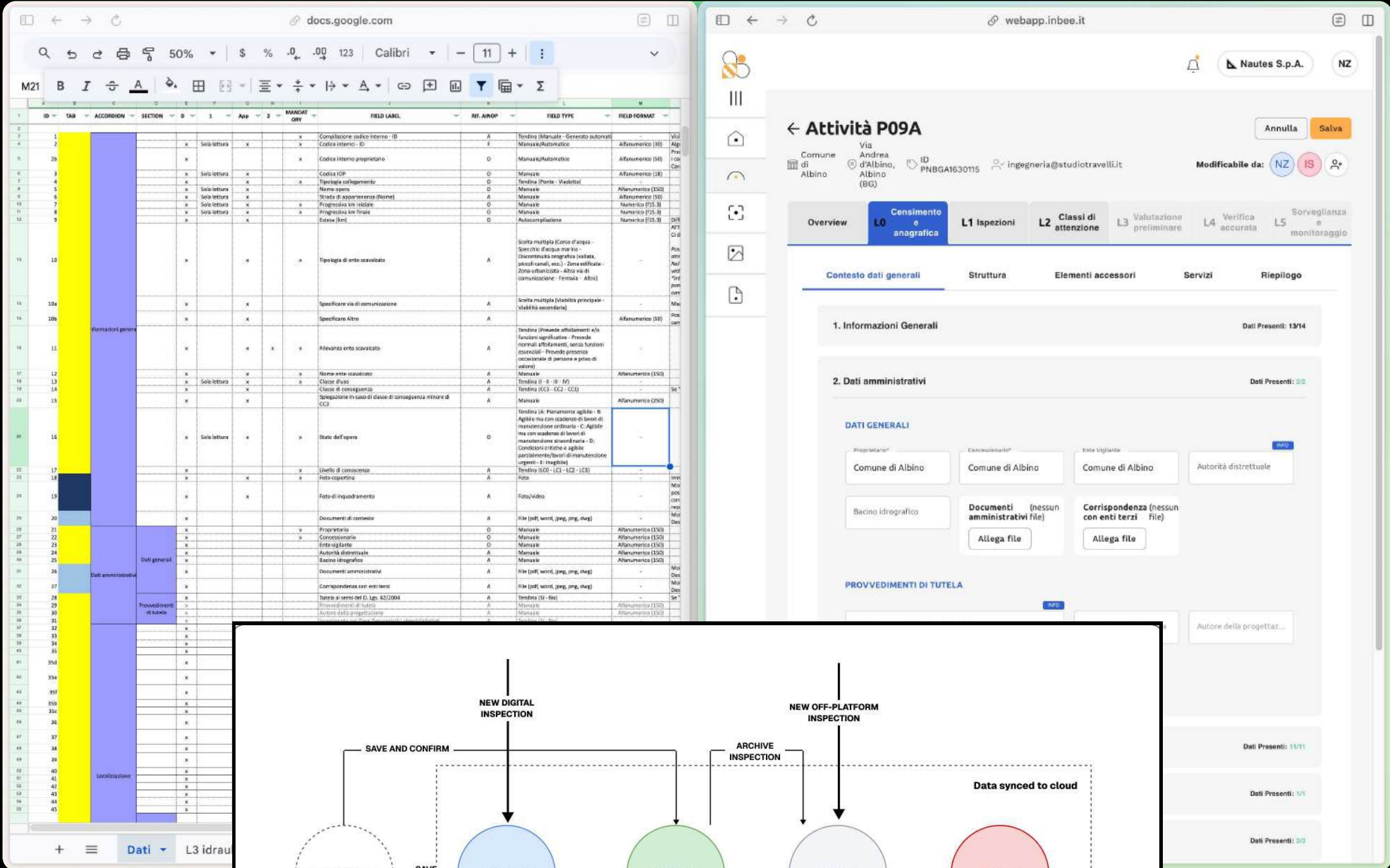
NIKO ZARZANI

USER FLOWS



IDEATE

INSPECTION MODEL & FINITE STATE MACHINE



EMPATHIZE

DEFINE

IDEATE

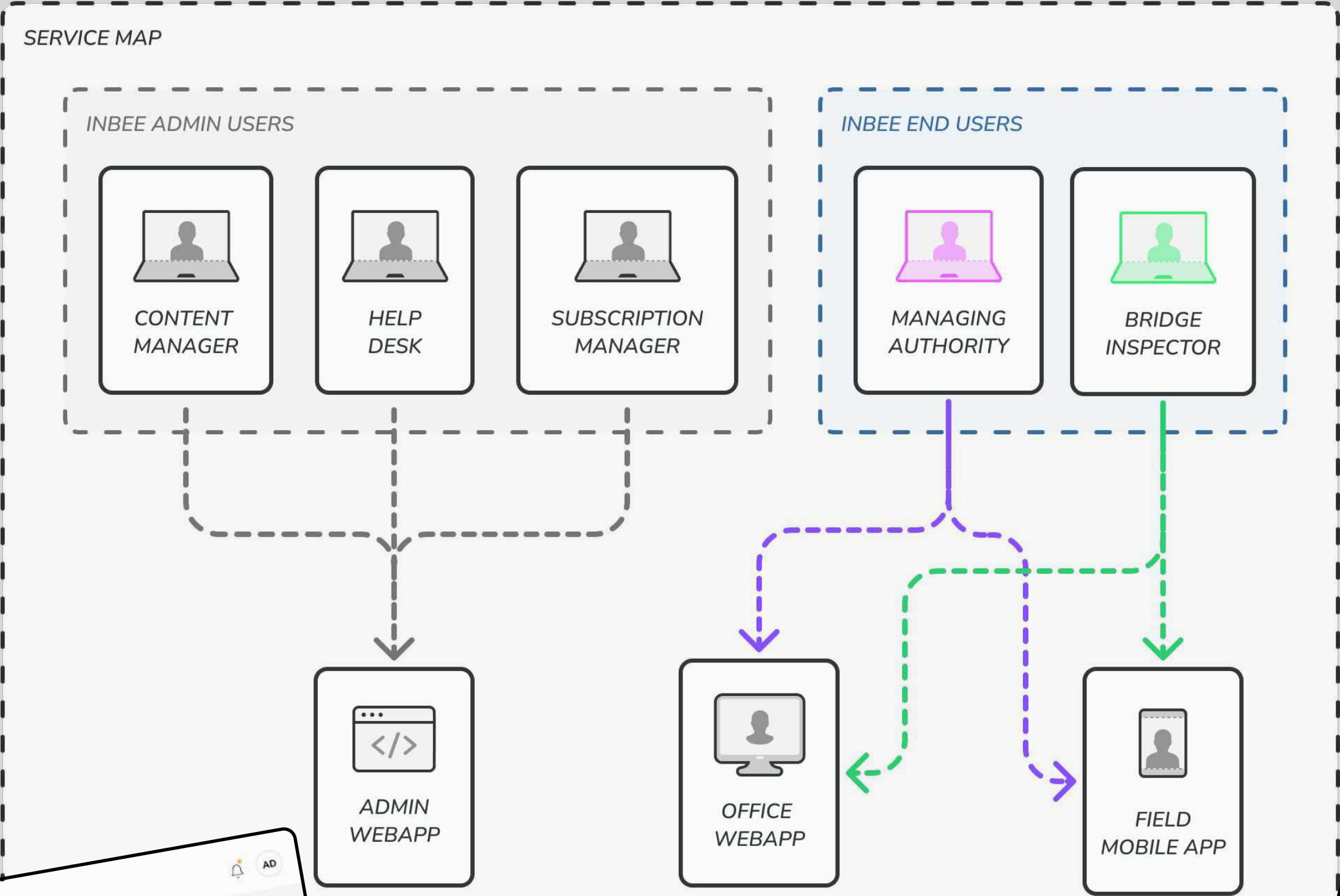
PROTOTYPE

TEST

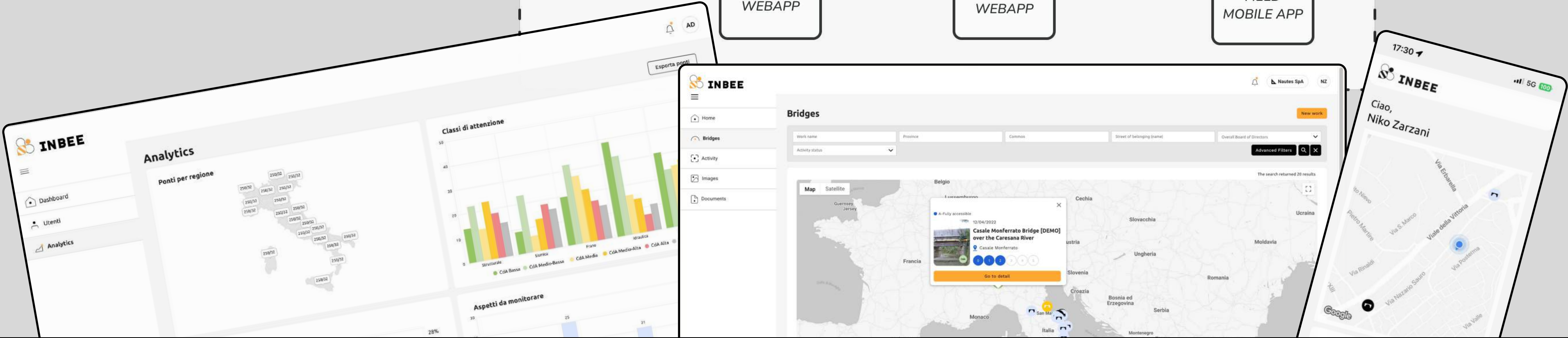
Designing Around the Workflow

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SERVICE MAP



IDEATE



EMPATHIZE

DEFINE

IDEATE

PROTOTYPE

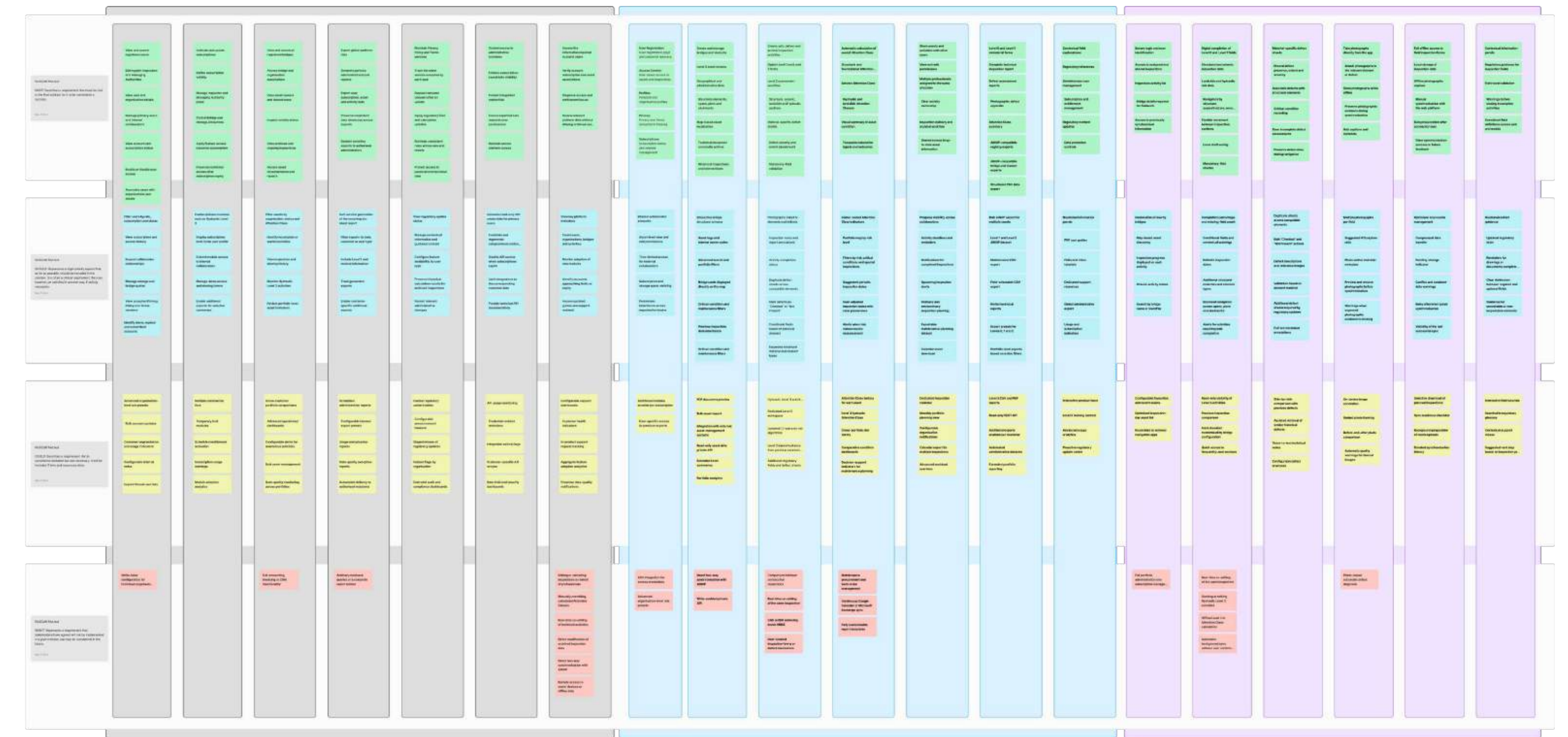
TEST

Prioritizing What to Build First

Before moving into detailed prototyping, I defined and validated the MVP boundaries through co-design workshops and a prioritization framework.

I applied the MoSCoW (Must, Should, Could, Won't) method to organize all features by user type (Inspector, Public Operator, INBEE Admin), touchpoint and implementation priority.

The initial goal was to identify and prioritize the core features that deliver user value, satisfy the Italian guidelines and stay aligned with business and technical feasibility.



Feature prioritization board — MoSCoW by touchpoint (Figma)

Design Thinking Phase

Prototype



System Architecture: Web, App & AINOP

I worked with developers and structural experts to shape a three-part system:

- **Web platform:** census, inspection management, defect evaluation, CdA, reporting and asset overview
- **Mobile app:** field-first data capture for inspections, resilient to poor connectivity on site
- **Interoperability layer:** data export ready to import into AINOP, plus the mapping with internal IOP codes

Security & compliance were core:

- **Qualified by the National Cybersecurity Agency (ACN)**
- **Role-based access** for infrastructure operators, inspectors and collaborators
- **Data model mapped** to the official italian **guidelines sheets**

System Architecture: The Core Modules

Level 0 – Bridge Census

Purpose: Register a structure and its identity data
Input: Bridge/viaduct type, geometry, IOP code
Output: A structured asset record, ready to inspect and sync with the AINOP public registry

Level 1 – Visual Inspection

Purpose: Capture the on-site visual defect survey
Input: Elements, materials, photos, defect codes
Output: Level 1 inspection sheet ready for defect assesment

Level 1 – Defect Evaluation

Purpose: Evaluate defects and their severity
Input: L1 defects, element type, extent & intensity (K1/K2)
Output: Defect scores feeding the class calculation

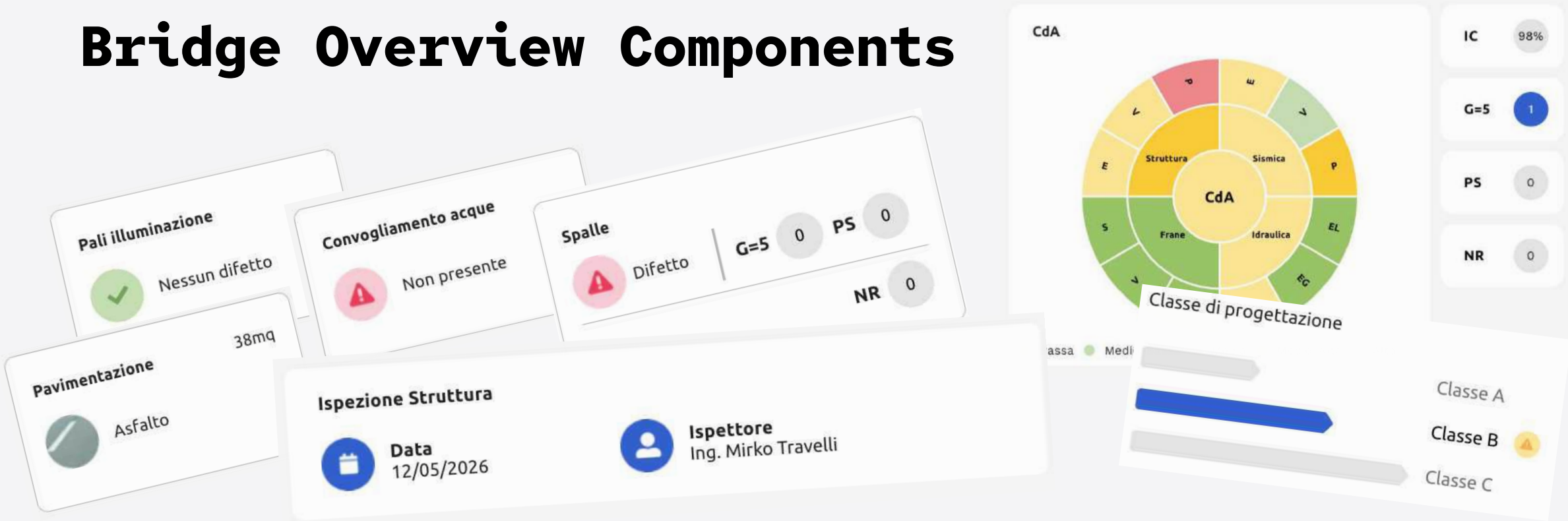
Level 2 – Risk Index Computation

Purpose: Compute the structure’s Attention Classes (CdA)
Input: Structural, seismic and hydraulic defect data
Output: Automatic Risk Index evaluation, ready to export

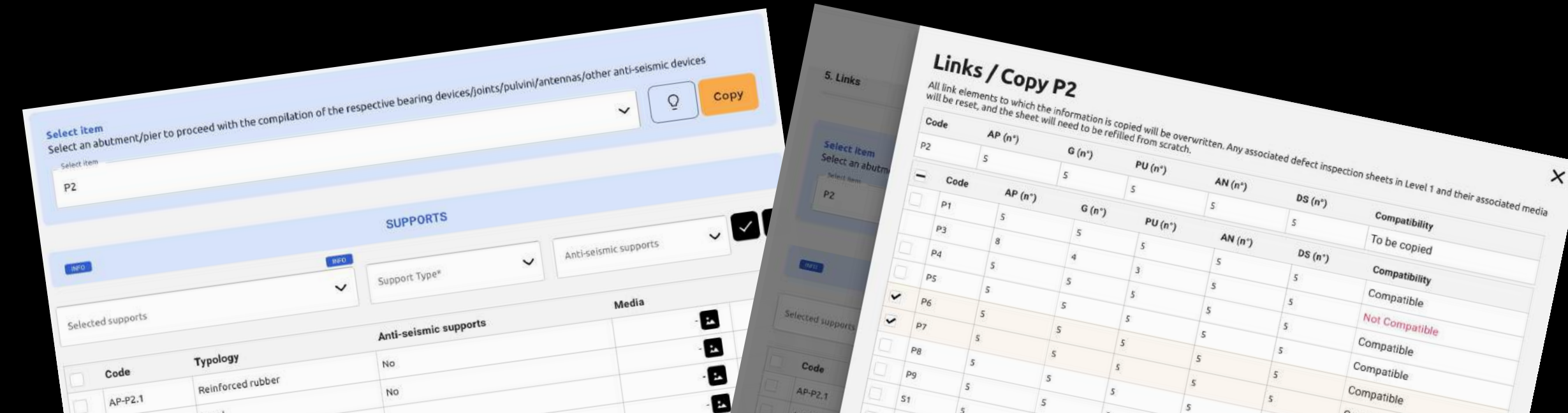
Design System

Rather than building a design system from scratch, we used **Google Material UI** and **AMCharts** as a solid foundation and **extended it with custom components and interaction patterns**, creating a shared framework for consistent and scalable user experiences across the product.

Bridge Overview Components



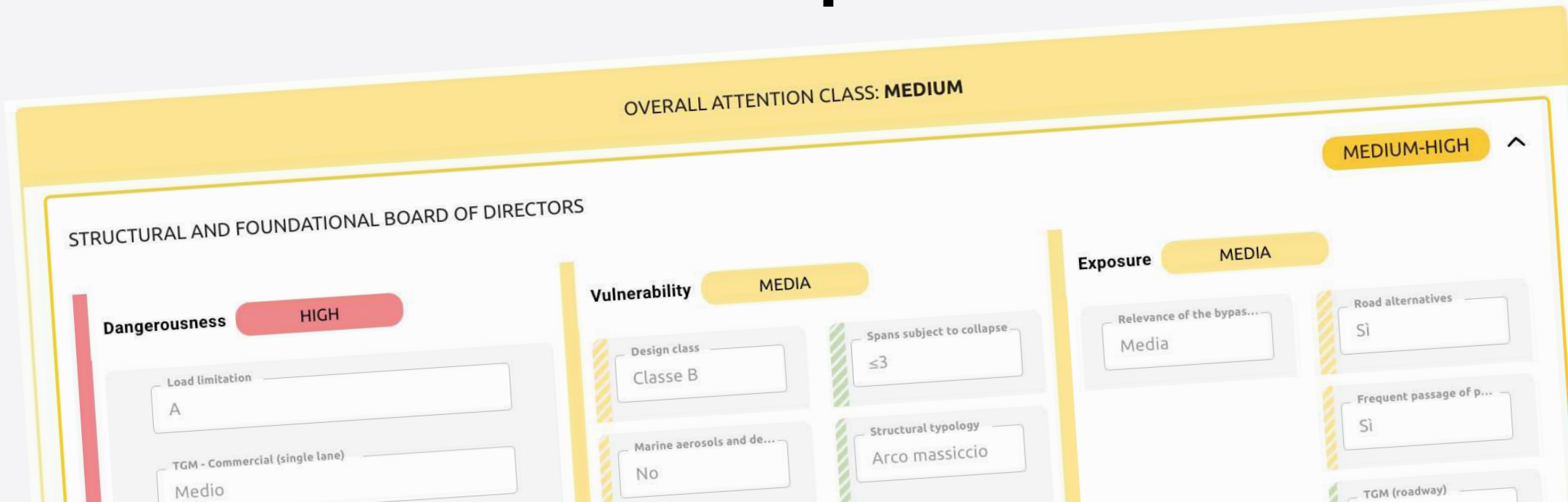
Quick Edit Tables + Elements Copy&Paste



Level 1 Defect Sheets



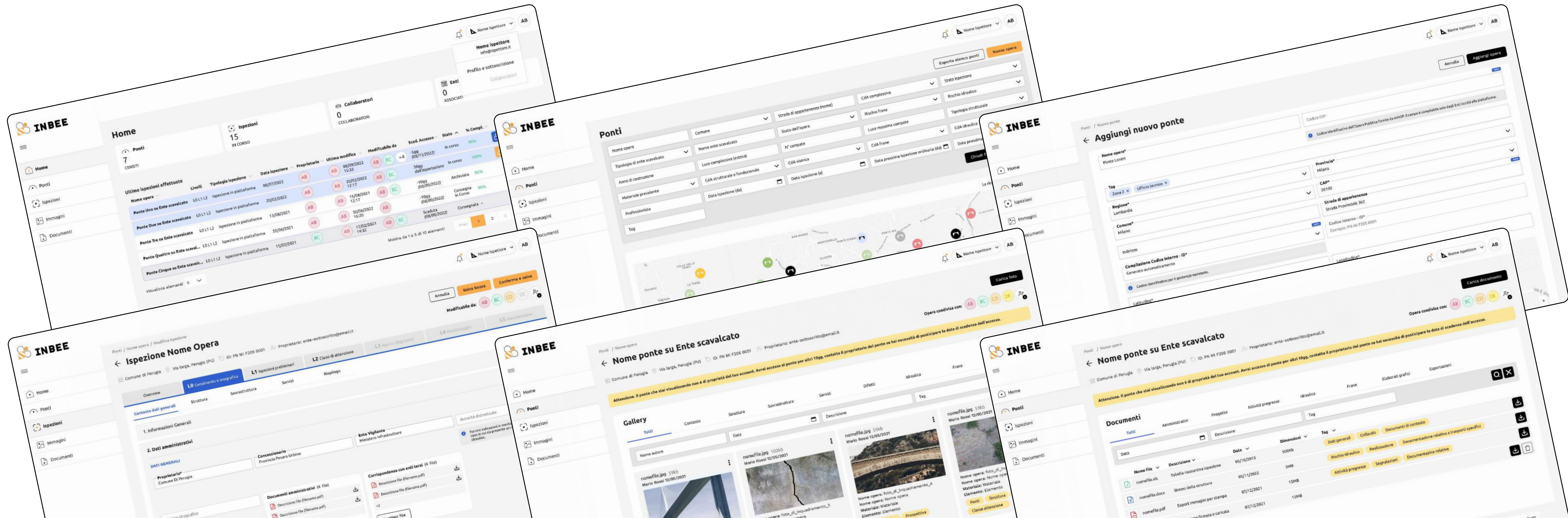
Level 2 Risk Index Computation



Bridge Inspector Prototype

I've also prepared interactive prototypes using **Adobe XD** of the **Bridge Inspector WebApp** showcasing the platform experience for:

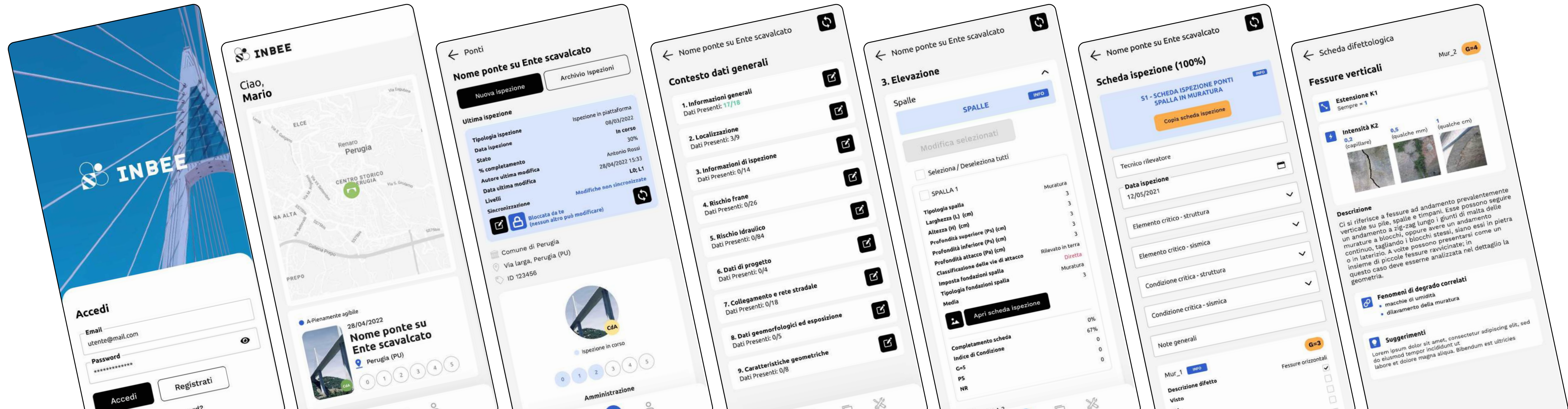
- **Creating and filling** bridges inspections
- **Bridge assets** management (images, videos, document)
- **Monitoring** of bridges risk index and **inspection planning**



Bridge Inspector Field Inspection Prototype

I've also prepared interactive prototypes using **Adobe XD** of the **Bridge Inspector Mobile App** showcasing the mobile experience for:

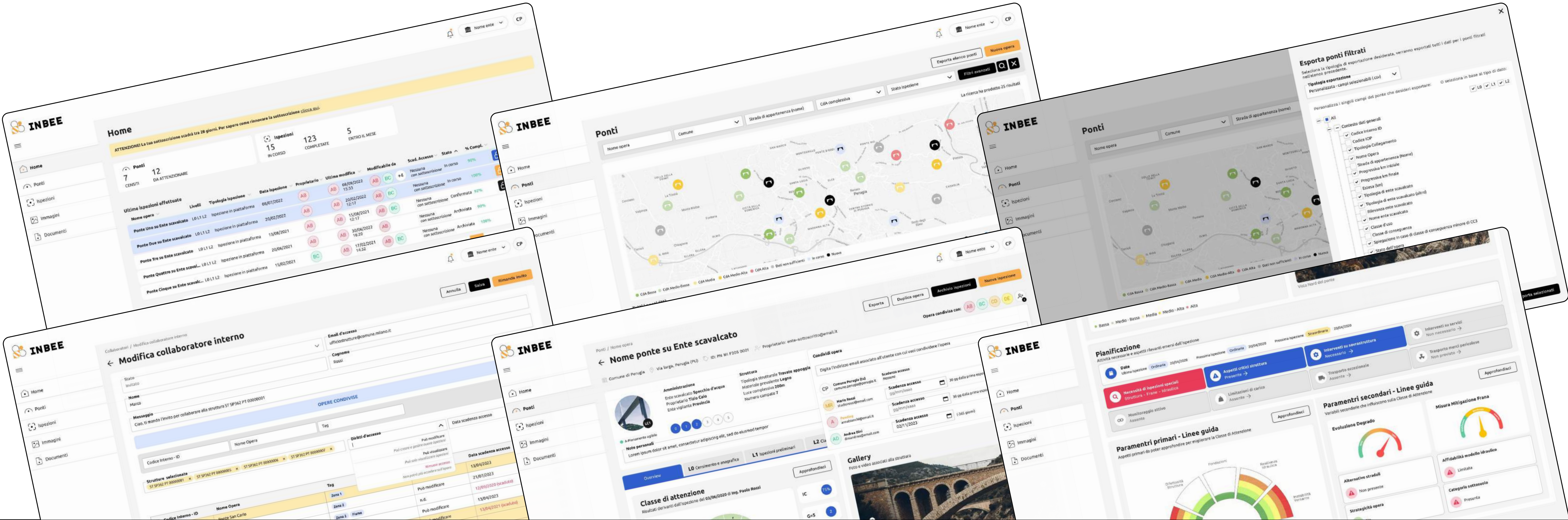
- **Locating** of bridges ready to be inspected
- **Locking inspections** to prevent edit conflicts
- **Working offline** and later sync to cloud when connection is stronger
- **Assess and evaluate bridges defect** using visual references



Infrastructure Managing Authority Prototype

I've also prepared interactive prototypes using **Adobe XD** of the **Infrastructure Managing Authority WebApp** showcasing the platform experience for:

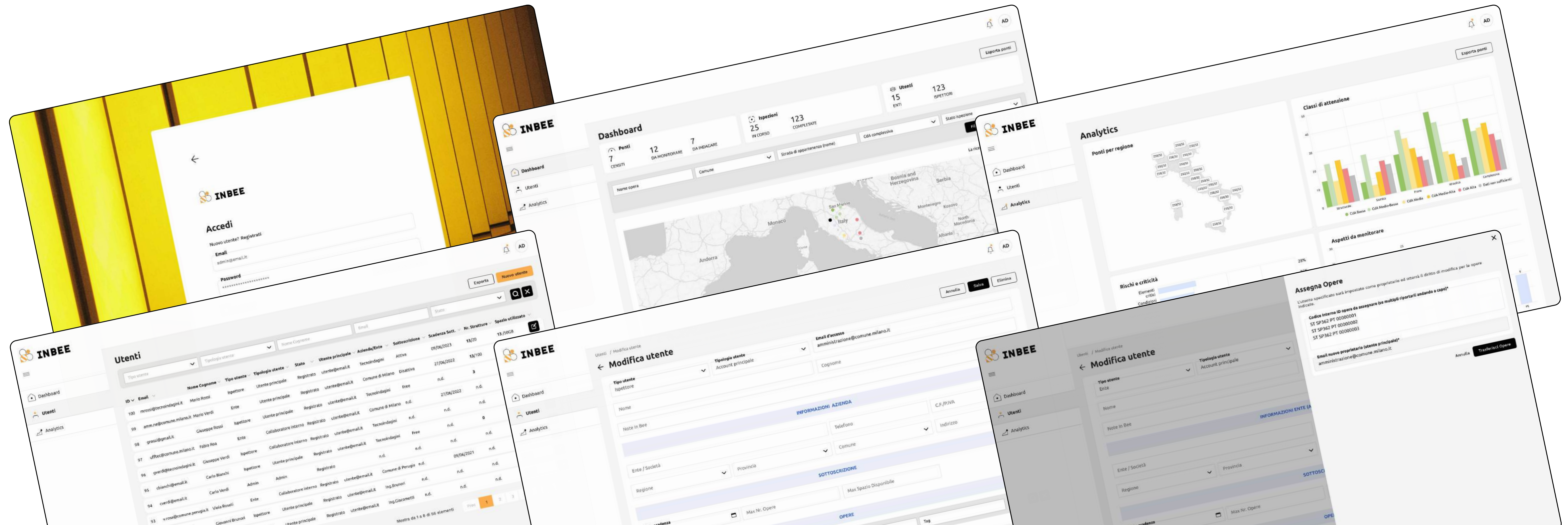
- **Monitoring** of bridges and inspections
- **Internal and external collaborators** management
- **Documentation export** and **AINOP** integration



INEBEE Admin Prototype

I've also prepared interactive prototypes using **Adobe XD** of the **Admin WebApp** showcasing the **administration experience** of the platform for:

- **Monitoring** of bridges and inspections
- **Help desk** activities
- **Subscription** activation and management



Design Thinking Phase

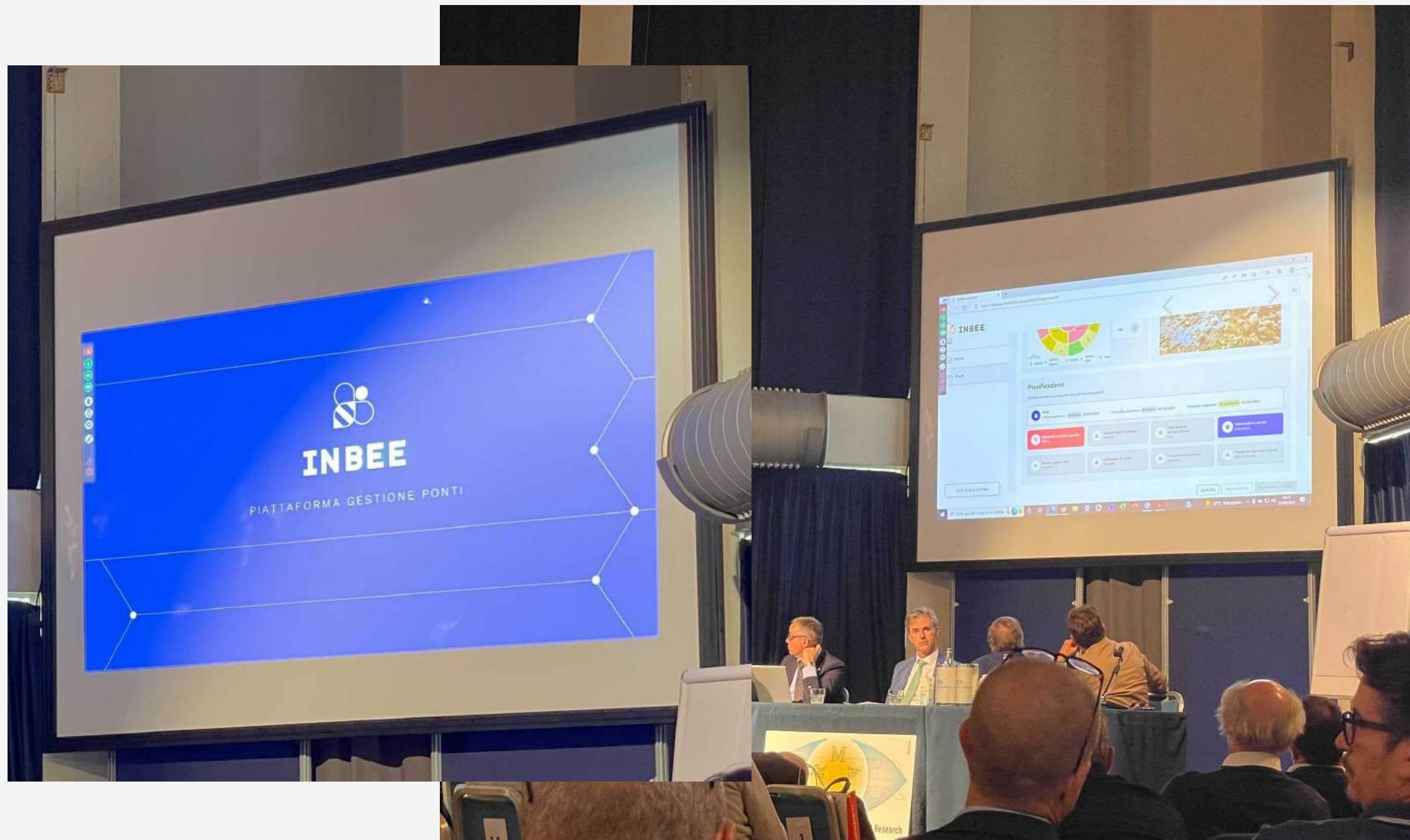
Test

Deliver & Iterate: Getting new feedback

BETA TESTING

GETTING OUT OF THE BUILDING

To validate the product in the real world, we released a free DEMO and onboarded early public infrastructure operators and inspectors. Watching them use INBEE on real structures surfaced insights no internal test could.



GETTING TO KNOW NEW USERS AND CUSTOMERS

We ran hands-on sessions and field trials with professional inspectors, capturing feedback directly against real bridges and their inspection sheets.



Deliver & Iterate: What Didn't Work

FRICITION: DEFECT SHEET COMPLEXITY

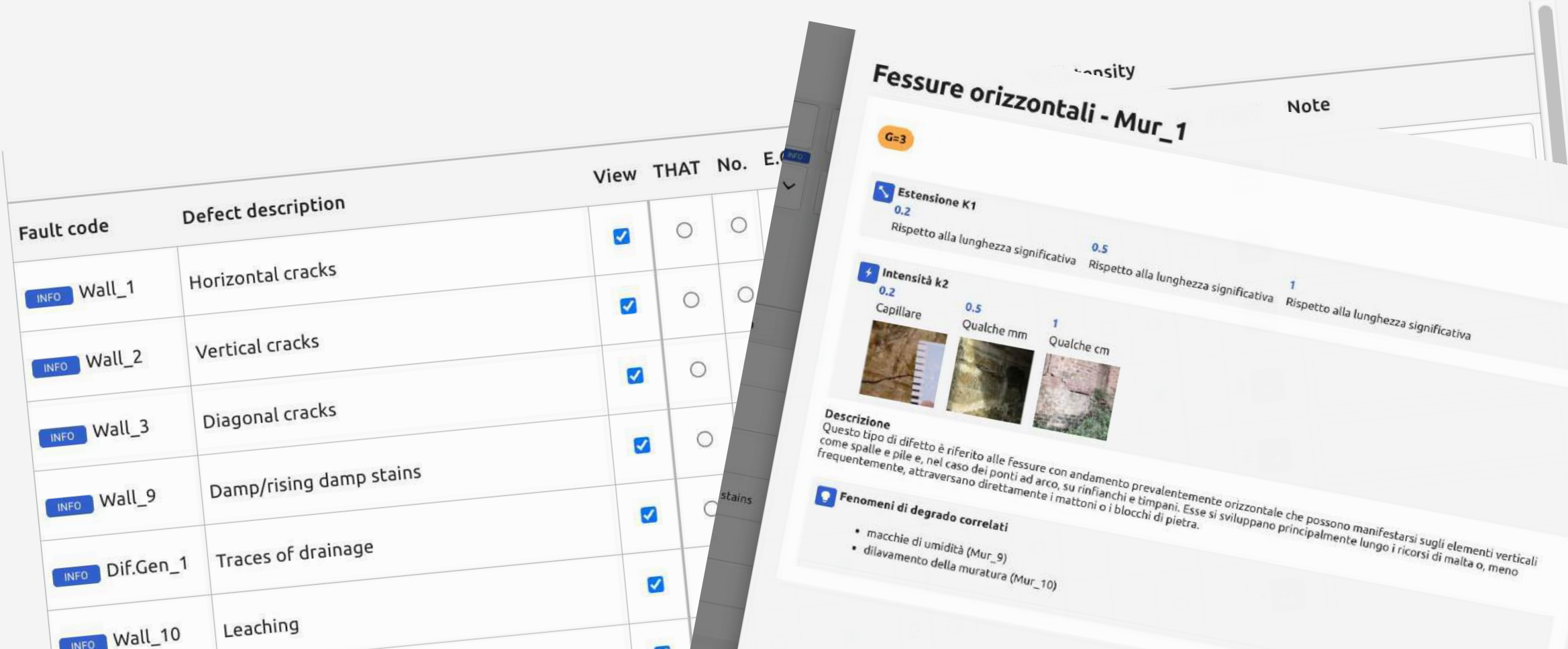
Inspectors filled defect sheets slowly and the omission risk was high

Inspectors added compatible defects one at a time through a filtered search. Although incompatible defects were already excluded, the process remained slow and made it difficult to see everything that needed to be checked for each structural element, increasing the risk of omissions.

FROM OVERWHELMING TO GUIDED

We redesigned the sheet as a pre-filled, context-aware checklist showing all defects valid for the selected element type and material. Inspectors could review the complete set at a glance, supported by inline guidance, reference images and severity indicators (K1/K2).

→ After iterating with inspectors, field testing indicated faster completion, fewer omissions and greater confidence in the inspection results.



Deliver & Iterate: What Didn't Work

FRICITION: ONBOARDING & INVITES

New users dropped off before reaching value.

Registration, subscription states and the operator-to-inspector invitation flow were confusing.

ONBOARDING REDESIGN

- Let new users explore **sample bridges** before subscribing with an **interactive first use guide**
- **Simplified registration** asking less informations and clarified the free / demo / trial states and added an FAQ section about subscription
- **Streamlined the invitation flow between infrastructure operators and inspectors** and improved the email content and CTAs

→ **Smoother activation and a clearer path from demo to subscription**



Deliver & Iterate: What Worked

ADOPTION METRICS (LIVE PRODUCT, 3 Years)

- **500+ professional inspectors registered**
- **750+ public infrastructure operators onboarded**
- **13,000+ bridges and viaducts tracked inside the platform**
- **Qualified by the National Cybersecurity Agency (ACN)**

LESSONS LEARNED

- **Splitting** a huge inspection standard into **guided**, level-based steps made **compliance approachable**
- Inspectors **trust the tool** when defect sheets mirror exactly **how they work on site**
- **Automating** the CdA removed the most **error-prone, tedious part of the job**
- **Seamless AINOP export** was the feature that **turned interest into adoption** for managing authorities

Final Thoughts

The real success of INBEE lies in **transforming a complex regulatory and safety obligation into a clear, reliable daily workflow** that supports every stage, from field data collection to assessment and office review.

By combining human centered design, deep domain expertise, and robust system architecture, we created a product that **helps teams continuously monitor thousands of structures, maintain regulatory compliance and keep infrastructure data aligned with the national database.**

This project reinforced my belief that:

- Great product **design can make even a dense, mandatory standard feel simple** and trustworthy
- **Field and office users need one coherent system**, not two disconnected tools
- **Cross-functional collaboration** with domain experts **is essential** when designing regulated products
- Designing for **interoperability** (AINOP) is what **turns a good tool into an adopted one**

As complex systems and services continue to evolve, I'm excited to **apply these insights to human-centered products that make complexity actionable, support better decisions and empower users** to act with confidence.



Thanks!