



D7.1 TANGO Pilot Evaluation Report

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List of Acronyms

Abbreviation / acronym	Description
AI	Artificial Intelligence
API	Application Programming Interface
BPMN	Business Process Modelling Notation
CP-ABE	Ciphertext-Policy Attribute-Based Encryption
DCBA	Device Continuous Behavioural Authentication
DPA	Data Processing Agreement
Dx.y	Deliverable number y belonging to WP x
EC	European Commission
EDAE	Exploratory Data Analysis Engine
eID	Electronic Identification
FL	Federated Learning
GDPR	General Data Protection Regulation
HVAC	Heating, Ventilation, and Air Conditioning
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
KPI	Key Performance Indicator
KYC	Know Your Customer
LBS	Location-Based Service
MLOps	Machine Learning Operations
MVP	Minimum Viable Product
NFC	Near Field Communication
NPS	Net Promoter Score
OBU	On-Board Unit
PAT	Privacy Assurance Tool
PDCA	Plan–Do–Check–Act
PEC	Privacy Enhancing Component
PEP/PDP	Policy Enforcement Point/Policy Decision Point
POC	Proof of Concept
POI	Point of Interest
RENOPS	Renewable Energy Optimised Scheduler
SEDSS	Self-Encryption and Decryption System
SOUD	Seamless Onboarding for Users and Devices
SSI	Self-Sovereign Identity
TAM	Technology Acceptance Model
TSM	Trustworthiness Scoring Module
UCBA	User Continuous Behavioural Authentication
UI	User Interface
UPCV	Ubiquitous Personal Context Vector
UTAUT	Unified Theory of Acceptance and Use of Technology
VM	Virtual Machine
VPN	Virtual Private Network

Abbreviation / acronym	Description
WP	Work Package
XAI	Explainable Artificial Intelligence

Executive Summary

This deliverable (D7.1) documents the TANGO platform evaluation activities, which are based on a structured, two-phase approach, encompassing both individual component evaluation and integrated pilot demonstrations and evaluations across six domains: hospitality, autonomous vehicles, smart manufacturing (two cases), banking, public organizations, and retail. The report consolidates the outcomes of Tasks 7.1–7.8 within WP7, thereby providing a comprehensive overview of how the framework’s technical solutions were validated in practice and how they contribute to the project’s objectives.

The purpose of WP7 was to validate TANGO’s ability to deliver trusted, privacy-preserving, and interoperable digital services that meet sector-specific requirements while remaining adaptable to diverse operational contexts. The challenge addressed is twofold: first, ensuring that individual technological components meet usability, security, and performance criteria; second, demonstrating that the integrated platform is effective and acceptable in real-world workflows. By addressing these challenges, the deliverable provides readers with clear insights into the framework’s current maturity, its added value across domains, and the improvements required for broader exploitation.

The evaluation methodology was designed around two complementary phases:

- **Phase I – Individual Component Evaluation:**

This phase assessed the functionality and usability of core TANGO components as stand-alone modules. The evaluation included tools such as Fides (secure data sharing), the Trustworthiness Scoring Module (TSM), Device Continuous Behavioural Authentication (DCBA), Federated Learning (FL), MLOps, the Privacy Enhancing Component (PEC), Explainable AI (XAI), and the RenOps scheduler. Components were tested either by expert users or by pilot representatives, depending on the presence of user-facing interfaces. The focus was on usability, technical maturity, security compliance, and the ability to address the targeted use cases. Feedback highlighted strengths such as robust security features, transparent risk assessment, and effective AI explainability, while also identifying improvement needs in areas such as user interface design, computational efficiency, and supporting documentation.

- **Phase II – Integrated Pilot Evaluation:**

This phase embedded TANGO’s components into operational workflows within six pilot domains. Each pilot represented a distinct real-world environment with specific regulatory, technical, and usability constraints. The evaluation investigated user acceptance, integration with legacy systems, GDPR and ethical compliance, workflow optimisation, and stakeholder satisfaction. For example, the hospitality pilot demonstrated improvements in guest onboarding and service personalization; the autonomous vehicles pilot validated safety and trustworthiness scoring methods; smart manufacturing pilots tested AI-driven process optimization and renewable-energy-aware scheduling; the banking pilot examined streamlined KYC processes; the public organizations pilot applied secure data sharing to visa applications; and the retail pilot validated personalized offers and privacy-preserving analytics.

Across both phases, the evaluation combined quantitative methods (surveys, scoring matrices, KPIs) with qualitative approaches (open questions, interviews, scenario walkthroughs). Established models such as TAM, UTAUT, ISO/IEC 25010, ISO/IEC 27001 and ISO/IEC 27002 were employed to ensure methodological robustness.

The combined results from both phases confirm the technical soundness and applicability of the TANGO framework:

- **Component-level validation (Phase I):** Components proved functional, effective, and aligned with the objectives of privacy-preserving, trustworthy data and AI use. Usability and learnability were generally rated positively, particularly for modules with clear user-facing dashboards. Specific enhancements were suggested, such as optimizing compute requirements for the Trustworthiness Scoring Module, refining localization accuracy in DCBA, enriching documentation for Federated Learning, and extending configurability in the Self-Encryption and Decryption System (SEDSS).
- **Pilot-level validation (Phase II):** Pilots demonstrated that TANGO can be deployed in diverse environments, meeting both operational and legal requirements. Stakeholders reported increased confidence in data handling, trust in AI-assisted processes, and efficiency gains in workflows. At the same

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time, challenges were identified, notably the need for smoother onboarding, improved actor-specific guidance, and tailored training materials to facilitate adoption among non-technical users.

- **Cross-sector insights:** A key outcome is the demonstration of TANGO's scalability and flexibility across domains. Whether supporting secure digital identities in public services, enhancing operational efficiency in manufacturing, or delivering personalized user experiences in hospitality and retail, the framework adapted successfully to sector-specific needs. Compliance with GDPR and ethical standards was consistently upheld, reinforcing TANGO's positioning as a trusted European solution.

The work reported in this deliverable contributes directly to the TANGO project by providing evidence-based validation of its technical and strategic value. The results demonstrate that TANGO is not only a collection of advanced digital tools but also a coherent platform capable of supporting sectoral digital transformation. The evaluation also lays the foundation for the broader validation report in D7.2, where KPI achievement, TRL advancement, and lessons learnt will be assessed in detail to guide exploitation and sustainability.

The phased evaluation confirms that the TANGO framework is technically robust, usable, and relevant to stakeholders across multiple domains. Its modular architecture enables cross-sector deployment while ensuring compliance with European regulatory and ethical requirements. Key areas for improvement—such as user experience refinement, documentation, and integration support—have been clearly identified and will inform the next stages of development and exploitation.

In summary, the outcomes of WP7 validated TANGO's readiness to act as a secure, trusted, and privacy-preserving digital infrastructure for Europe, while also highlighting concrete pathways for refinement and large-scale adoption.

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1 Introduction

1.1 Purpose of the document

This deliverable (D7.1) presents the integrated outcomes of Tasks 7.1 – 7.8 within WP7 - Pilot Demonstration and Validation, which is dedicated to the evaluation and validation of the TANGO framework across six domains. The purpose of this report is to document the full lifecycle of the pilot activities, from their planning and preparation to their execution and final assessment, providing an evidence-based account of how the technical solutions developed in TANGO performed both as stand-alone technology offerings and as one integrated platform in real-world contexts.

To this end, the document first reports on the outcomes of Task 7.1, where the pilot protocols and operational plans were defined; these plans covered deployment procedures, user engagement, training activities, and validation methodologies. These preparatory steps provided the foundation for user-driven testing, ensuring that the pilots could yield meaningful insights into requirements, usability, and privacy and security considerations.

Following this, the document reports the outcomes of Tasks 7.2 – 7.7, which contained the pilot from six domains (hospitality, autonomous vehicles, smart manufacturing (2 cases), banking, public organizations and retail) under the leadership of the pilot partners and Task 7.8, which had the goal of evaluating the integrated TANGO platform. This included systematic monitoring of pilot activities, collection and analysis of user feedback, and comprehensive usability and acceptance assessments.

By consolidating the results of the first and final phases of the pilots, this report provides a holistic overview of value proposition of TANGO's technical contributions, demonstrated through the seven distinct use cases. It identifies strengths, challenges, and areas for improvement, thereby contributing both to the refinement of the framework and to the formulation of an evidence-based exploitation strategy.

1.2 Relation to other project work

The present deliverable builds upon the outcomes of previous WPs (WP2–WP6), as the pilot activities reported here are based on requirements and specifications identified in WP2, as well as on the development of individual components (WP3–WP5) and the integration of the overall platform (WP6).

Furthermore, D7.1 is complemented by D7.2, which provides a broader validation report and analysis of lessons learnt across the project, with specific focus on KPI achievement, technology readiness level (TRL) advancement, and overall validation outcomes.

1.3 Structure of the document

The document is organised as follows:

- **Section 1 – Introduction** presents the purpose of the deliverable, its relation to other project work, and an outline of the document's structure.
- **Section 2 – Evaluation Methodology** details the methodological approach adopted for the assessment, distinguishing between Phase 1 (evaluation of individual components) and Phase 2 (integrated pilot evaluation).
- **Section 3 – Individual Component Evaluation – Results** reports on the evaluation of the individual technological components as stand-alone technology offerings, presenting the activities undertaken, the main outcomes, and suggestions for improvement.
- **Section 4 – Individual Component Evaluation during pilots – Results** reports on the evaluation of the individual technological components as part of the pilot activities, presenting the activities undertaken, the main outcomes, and suggestions for improvement.
- **Section 5 – Integrated Pilot Evaluation – Results** summarises the results of the integrated pilot evaluations across six domains (hospitality, autonomous vehicles, smart manufacturing (two cases), banking, public organisations, and retail), addressing deployment environments, legal and ethical issues, testing scenarios, and evaluation outcomes.

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- **Section 6 – Conclusions** consolidates the key findings from the pilots and highlights the implications for the further improvement of the TANGO framework and its modules.
- **Annexes** provide complementary material, including extended descriptions of pilot activities, detailed evaluation results, and supporting documentation.

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2 Evaluation Methodology

The evaluation methodology of the TANGO platform was developed to assess both its technical reliability and practical real-world applicability across seven different pilots. These pilots cover sectors such as smart hospitality, retail, smart manufacturing, autonomous vehicles, public administration and banking, each of which are associated with different regulatory environments and operational workflows, as well as varied user expectations. To evaluate and compare results across pilots, an adaptable framework was developed offering the necessary flexibility to reflect on the specific features and requirements of each sector.

The evaluation was structured as a two-phase process linking the assessment of individual modules with the overall evaluation of the platform in each pilot. The first phase focused on specific user-interacting components, such as mobile apps, dashboards, and credential wallets, which were evaluated for usability, security perceptions, responsiveness, and ability to meet user needs. The second phase examined the platform in its integrated form, embedded in real operational settings. It considered factors such as stakeholder satisfaction, adoption levels, GDPR compliance, and potential process improvements. The combination of the two phases captures both detailed user interactions and broader organizational effects, offering a more complete view of the platform's performance and limitations.

The methodology is based on established models used in the information systems field to examine technology adoption and acceptance. The combination of different models offered a multidimensional lens for evaluation. More specifically, the Technology Acceptance Model (TAM) [1] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [2] helped capture user perceptions of usefulness, ease of use, performance and effort expectations, social influence, and the availability of certain supporting conditions, affecting the likelihood of adoption across different domains. To broaden this perspective, the DeLone and McLean Information Systems Success Model (ISSM) [3],[4] was also added to assess system-level outcomes by examining system, information, and service quality, as well as user satisfaction, usage patterns, and generated benefits. Additionally, the ISO/IEC 25010:2011 [5] software quality model was applied to provide structured benchmarks for aspects such as functionality, usability, reliability, and security, thereby ensuring alignment with international standards (ISO/IEC 2011). Moreover, the ISO/IEC 27001:2013 [6] and ISO/IEC 27002:2022 [7] standards were applied to highlight information security and data governance, ensuring that the platform adheres to software quality benchmarks and best practices in information security and regulatory compliance (ISO/IEC 2013; ISO/IEC 2022).

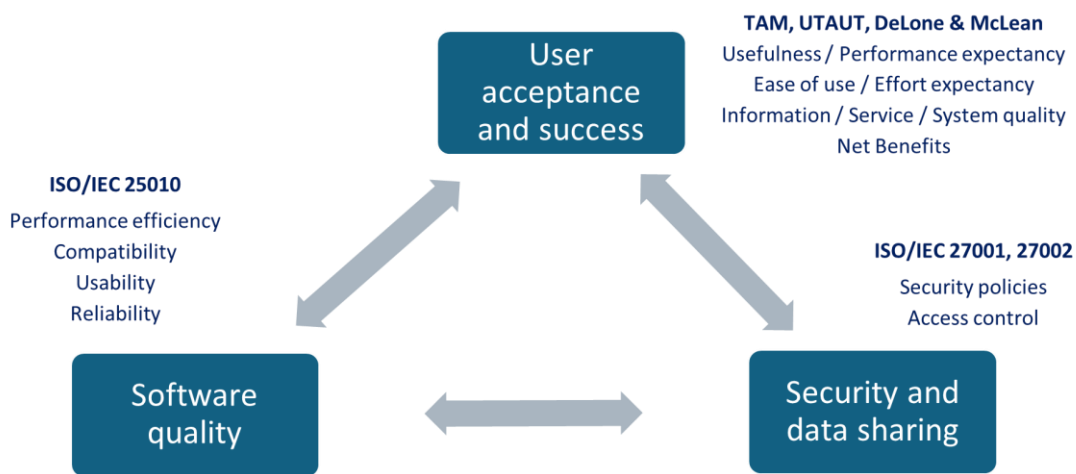


Figure 1: Main evaluation models and key variables used in the evaluation framework

As illustrated in Figure 1, the evaluation framework builds on three complementary dimensions: user acceptance and success, software quality, and security and data sharing. Each dimension is linked to established models and standards, with specific variables guiding the assessment process. User acceptance and success are informed by TAM, UTAUT, and the DeLone and McLean Information Systems Success Model, drawing on variables such as perceived usefulness, ease of use, performance, effort expectancy, social influence, system quality, information quality, service quality, and net benefits. Software quality is evaluated through ISO/IEC 25010:2011, focusing on attributes such as performance efficiency, compatibility, usability, and reliability. Finally, security and data sharing are assessed through the ISO/IEC 27001:2013 and ISO/IEC 27002:2022 standards, emphasizing variables

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such as security policies and access control. Together, these variables form a multidimensional framework that enables a systematic assessment of both system performance and the end-user experience.

To implement the evaluation framework, a mixed-method approach that integrated both quantitative and qualitative tools was used providing a comprehensive and more holistic view. On the quantitative aspect, structured data were collected through standardized surveys, scoring schemes, and key performance indicators (KPIs), focusing on issues such as usability, intention of adoption, and overall satisfaction. In parallel, qualitative insights were gathered through open questions and semi-structured interviews, allowing a deeper understanding of user experiences and expectations.

A key decision in the evaluation was to limit component-level testing to the front-end functionalities of the TANGO platform. These include user interfaces, web and mobile applications, dashboards, and digital wallets, which are the primary points of contact between users and the system. It is through these interfaces that individuals are granted access, use services, perform data sharing, and are able to assess usability, trust, transparency, and privacy-by-design. By contrast, back-end components such as distributed storage, blockchain integration, or federated learning require specialized procedures, load testing, encryption checks, penetration testing, and log analysis, that are carried out within technical work packages (e.g., WP3 and WP5) rather than pilot activities.

Concentrating on the front-end, the implementation of the evaluation is structured as a circular process that reflects the dynamic evolution of complex digital systems, following user-centred design approaches [8] [9] and iterative development. Therefore, the evaluation is not a linear or static activity, but it is organized into interconnected stages, each feeding insights into the next and enabling continuous refinement.

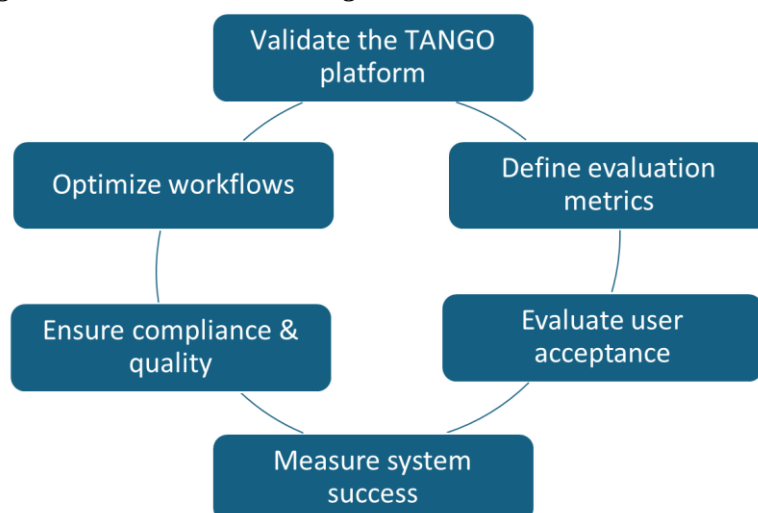


Figure 2: Evaluation process

As demonstrated in the above figure, the process begins with defining evaluation metrics (based on the selected evaluation models), and assessing user acceptance to explore perceptions of usability, trust, and willingness to adopt. It then examines the system's success, by considering both subjective impressions and objective indicators to determine whether the platform delivers real value. It also focuses on compliance and quality assurance, verifying that the platform meets legal, ethical, and technical requirements. Particular attention is given to GDPR, consent and identity control [10], transparency in data handling, and software quality dimensions, including usability, reliability, and security. Next, the focus shifts to workflow optimization, which investigates how the platform affects everyday operations in the pilots. This involves highlighting efficiency gains, and reducing administrative workload, thereby connecting the technology to organizational improvements. The final step is the validation of the TANGO platform, which goes beyond functional checks to confirm that the system remains consistent with its principles of privacy-preserving data sharing, trustworthy identity management, and compliance with European regulations.

The above stages form a comprehensive, theory-based, and user-oriented framework for evaluation and continuous improvement. As they are organized in a loop, insights gained in one area feed directly into the next, making the evaluation iterative and adaptive across different sectors and contexts. The evaluation approach balances adoption and success with technical reliability, compliance, and process efficiency, while ensuring that

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each pilot contributes context-specific evidence to a shared knowledge base that supports the platform’s scalability and long-term sustainability.

2.1 Individual component evaluation

The first phase of the methodology focuses on assessing individual front-end components, which are the user-facing elements of the TANGO platform. These interfaces, including mobile applications, dashboards, self-sovereign identity (SSI) wallets, visualization panels, and file exchange portals, represent the primary touchpoints through which users interact with the system, make consent decisions, and access services. Therefore, they are critical for shaping usability, perceived trust, and adoption potential.

Each component is tested through scenario-based evaluation, in which representative user personas (e.g., tourists, public service beneficiaries, clients, managers) engage in realistic journeys that reflect the pilot context. Evaluators, either expert users or target-group participants, perform tasks such as checking in with digital credentials, reviewing personalized service recommendations, or accessing privacy information. After each interaction, participants complete standardized surveys built on validated TAM, UTAUT, ISSM and ISO/IEC 25010 constructs, using Likert-scale items to measure usability, perceived security, functional relevance, visual appeal, and satisfaction. Open-ended questions complement the surveys by eliciting qualitative feedback, such as sources of confusion, suggestions for improvement, and unmet expectations.

To ensure reliability, this phase may also include device compatibility testing, verifying consistent performance across mobile phones, tablets, and desktops. In contexts where interaction patterns are unfamiliar, such as onboarding with an eID wallet, observational techniques or think-aloud protocols are applied to capture detailed insights into user experience. By decoupling individual modules from the full pilot flow, evaluators can identify specific usability gaps, assess technical maturity, and scope improvements at a granular level.

The results of Phase I provide early-stage evidence on usability and user acceptance, supporting iterative refinements of component design before large-scale integration. This reduces risk, aligns development with stakeholder expectations, and contributes to the overall quality and readiness of the platform for deployment in live operational environments.

2.2 Integrated pilot evaluation

The second phase of the methodology involves evaluating the platform as a fully integrated solution within each pilot’s operational environment. While Phase I focuses on the building blocks, Phase II examines the orchestration of those components in real-world workflows, involving multiple stakeholders and contextual variables. In this phase, each pilot site deploys the TANGO platform in a production or near-production setting, reflecting authentic service contexts. For example, in hospitality the platform can enable digital guest onboarding, in retail it may facilitate personalized offers, and in public administration it can support streamlined access to digital services through verified identities. These implementations are evaluated through a combination of user experience research, workflow observations, and stakeholder engagement.

The evaluation follows a mixed-methods approach. End users (e.g., hotel guests, citizens, clients, managers) engage with the platform during typical service interactions and subsequently complete post-task surveys aligned with the UTAUT model, capturing perceptions of usefulness, ease of use, social influence, and adoption intention. These surveys are complemented by Net Promoter Score (NPS) items and open-ended questions, which allow participants to share qualitative feedback. In parallel, semi-structured interviews are conducted with key stakeholders, including managers, retail staff, etc. These conversations focus on integration with legacy systems, staff acceptance, workflow efficiency, GDPR compliance, and training requirements. Rather than relying on linear improvement models, the integrated pilot evaluations are embedded within iterative Design Thinking cycles, emphasizing empathy with users, definition of challenges, ideation of solutions, prototyping, and testing. This cyclical process allows each pilot to capture feedback in context and immediately feed insights into refinements of both the platform and the evaluation instruments. The approach ensures adaptability to sector-specific requirements while maintaining coherence across pilots.

This second phase confirms whether the TANGO platform delivers value in practice, is accepted by users, and is feasible to maintain and scale. It also provides a deeper understanding of legal and ethical perceptions, particularly concerning data sovereignty, identity control, and compliance with European regulatory frameworks.

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3 Phase I – Individual component evaluation – Results

3.1 Introduction

The first phase of evaluation focused on the assessment of individual components that were suitable to be used and evaluated as stand-alone components. Some of these components had a user interface and were thus evaluated by representatives of pilot users (i.e. Fides, UCBA, FL, MLOps, PEC, XAI, RenOps), while others were evaluated by their own technical leader in semi-realistic conditions, in some cases in collaboration with the pilots (i.e. TSM, DCBA).

In this phase a qualitative evaluation approach was followed. The component evaluation took place through a questionnaire with open-ended questions, where the evaluators provided their feedback after having used and tested the relevant component.

The following table presents an overview of the components that were suitable for stand-alone testing during Phase I.

Table 1: Components evaluated in Phase I – Individual component evaluation

Component / Task	Full component title	Technical Partner	Short description	Related Pilots
FIDES (T3.1)	Blockchain-based Data Storage and Sharing	NORBLOC	The first version of the Fides platform for data sharing in Public Organizations context was used and evaluated by representatives of the pilot.	Public Organizations (VISAR)
TSM (T3.2)	Trustworthiness Scoring Model	FSDE	The TSM assesses a system's Trustworthiness following the IIC trustworthiness model, using system characteristics measured against defined attributes. These attributes reflect how well policies and protection objectives are fulfilled, with results combined through a weighted sum. The model allows aggregation into a single overall Trustworthiness score, ensuring a clear and transparent evaluation.	Autonomous Vehicles (IDIADA)
SEDSS (T3.4)	Self Encryption/Decryption	DUT	SEDSS is a secure encryption and decryption system that integrates self-encryption, self-decryption, and a multi-factor information recovery mechanism. It enables confidential data storage and sharing by allowing flexible multi-party key management, scalable encryption/decryption for diverse file types and sizes, and enhanced security through collaborative key recovery.	Smart Manufacturing (FMAKE)
DCBA (T4.4)	Device Continuous Behavioural Authentication	UTH	The DCBA monitors device's activity and leverages network and battery logs and statistics in order to feed an AI model that is able to characterize the activity as normal or abnormal. Network metrics are also leveraged to perform localization of the device for physical access control. In the latter case, a notification mechanism will alert managers or other users with details regarding restricted area violations	Smart Manufacturing (RIAS)
MLOps, AUTOML, Federated		EVIDEN	The Federated Learning component enables the training of neural network models across distributed devices without exchanging raw data, relying instead on	Smart Manufacturing (FMAKE),

Component / Task	Full component title	Technical Partner	Short description	Related Pilots
Learning (T5.2)			the sharing of model parameters. The approach enhances privacy, reduces data transfer needs, and leverages diverse local datasets to improve model quality. It requires aligned local datasets, a shared initial model, and a central aggregation node to consolidate results from multiple training rounds. Ultimately, the process produces a robust, unified ML model while preserving data sovereignty at the client side.	Banking (ABILAB/NTT)
PEC (T5.4)	Privacy Enhancing Component	UoG	PEC enables organisations to conduct comprehensive DPIAs, ensuring GDPR compliance, addressing privacy implications, and providing robust countermeasures for effective privacy risk management. It serves as a comprehensive platform offering the following capabilities: (i) evaluate the necessity of conducting a data protection impact assessment (DPIA) for organisations managing personal and sensitive data, ensuring regulatory alignment; (ii) perform DPIA for both generic processes and services, and AI applications that use sensitive data; (iii) identify and assess cyber threats that lead to potential privacy implications; and (iv) suggest countermeasures to mitigate the privacy threats.	Public Organizations, (VISAR), Retail (METRO), Autonomous Vehicles (IDIADA)
XAI (T5.5)	Explainable Artificial Intelligence	SQD	The XAI module describes AI models, their expected impact and potential biases. It helps characterize model accuracy, fairness, transparency and outcomes in AI-powered decision making. Apart from helping build trust in the predictions the ML models produce, it also helps debug the models in cases where bias in the decision making process is discovered.	Smart Manufacturing (FMAKE) Banking (ABILAB/NTT)
RENOPS (T5.6)	RENOPS Scheduler	XLAB	RENOPS-scheduler is a Python package that allows you to schedule and execute scripts at the time the most renewable energy is available. This reduces the carbon footprint and stabilizes the grid of operations. While its main focus are energy-intensive processing tasks such as big data analytics or AI model training, it may be used to shift any energy-intensive load such as HVAC.	Smart Manufacturing (FMAKE)

3.2 Fides (T3.1)

Fides is a distributed KYC (Know Your Customer) utility that enables banks and financial institutions to share validated KYC data across a trusted network. It allows customers to update their KYC information once, and share it securely with multiple institutions, enhancing data accuracy, compliance, and operational efficiency.

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The evaluation aims to assess Fides effectiveness in enhancing KYC data security, reducing onboarding time, improving user satisfaction with data management, and maintaining regulatory compliance. Key factors to measure include data integrity, user satisfaction rates, reduction in data handling effort, accuracy of data access control, and compliance with security standards.

3.2.1 Evaluation Overview

Component	Fides
Pilot Partner performing the evaluation	VISAR
Number of evaluation participants	2

3.2.2 Evaluation activities performed

During the pilot evaluation, we tested the platform from the perspective of all four actors: Employer, Applicant, VISAR, and Immigration Authority. The following step-by-step actions were carried out:

As the Employer:

- Logged into the Employer portal.
- Generated and sent invitation links to the Applicant.
- Accessed and reviewed the documents uploaded by the Applicant.
- Assigned a status to each document (e.g., approved, rejected).

As the Applicant:

- Accessed the platform using the invitation link received from the Employer.
- Uploaded required documents including passport, diploma, and employment contract.
- Verified successful submission and visibility of the uploaded documents.

As VISAR:

- Logged into the platform and accessed the Applicant's submitted documents.
- Checked the completeness and relevance of the documents for visa preparation purposes.

As the Immigration Authority:

- Accessed the final set of submitted documents for review.
- Viewed and examined the files included in the application for decision-making.

3.2.3 Main evaluation outcomes

- All four actors were able to access the platform and perform the actions relevant to their roles.
- The Employer successfully initiated applications by sending invitation links and reviewing documents submitted by Applicants.
- Applicant was able to access the platform via the invitation link, upload required documents and see their submission status.
- VISAR was able to view the submitted documents and check them for visa preparation purposes.
- The Immigration Authority could access the final submitted documents and review them as part of the decision-making process.
- Document upload and review features functioned as expected. Status changes made by the Employer were visible to other relevant roles.
- Each actor was able to complete their workflow without major technical issues. Navigation between sections and visibility of information were consistent throughout the test.

3.2.4 Suggestions for component improvement

Introduce actor-specific checklists to show clearly what actions were performed by each actor (e.g., document approved by Employer, verified by VisaRight, reviewed by Immigration Authority). This would improve transparency and make it easier to track the flow of decisions throughout the process.

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Add a mandatory consent checkbox in the Employer portal before reviewing applicant data.

3.3 Trustworthiness Scoring Module (TSM) (T3.2)

The TSM assesses a system's Trustworthiness following the IIC trustworthiness model, using system characteristics measured against defined attributes. These attributes reflect how well policies and protection objectives are fulfilled, with results combined through a weighted sum. The model allows aggregation into a single overall Trustworthiness score, ensuring a clear and transparent evaluation. Its straightforward scoring can, for example, support access control decisions. Yet, the main challenge lies in specifying the technical data that represent policies, which closely ties the method to the TANGO use cases.

3.3.1 Evaluation Overview

Component	Trustworthiness Scoring Module, Privacy Risk Scoring
Pilot Partner performing the evaluation	IDIADA
Number of evaluation participants	7

3.3.2 Evaluation activities performed

The evaluation was performed offline due to limited compute resources in the vehicle.

It took several processing steps:

First CAN-bus data and a video was extracted from a real-world drive. In a 2nd step these data were processed as they would be processed in an on-board unit with sufficient compute performance:

- The binary CAN-bus data were transformed in real numbers
- The video was processed, faces were blurred and potential privacy violations, e.g. when this blurring did not work perfect, were assessed

In a further pass the CAN-bus data were assessed to decide the most relevant attributes for the Trustworthiness characteristics Safety, Security, Reliability and Resilience.

Weights of attributes and characteristics as well as thresholds (minimum values) were specified and the TSM module was configured using them.

Then data were aggregated per second for each attribute to be used in the calculation of the weighted Trustworthiness scores.

3.3.3 Main evaluation outcomes

The evaluation illustrates the feasibility of the TSM in combination with the Privacy Risk Scoring. However, it demonstrates the need of more compute resources in the on-board unit to the compute intense video processing as well as for the transformation of the CAN-bus data.

Moreover, the specification of the TSM configuration often shows low scores due to safety and privacy violations. This indicates the need for a more finetuned specification of attributes, weights and threshold in collaboration with domain experts.

3.3.4 Suggestions for component improvement

- 1) TSM: The configuration of the Trustworthiness Scoring Module is the crucial step for application of the concept. Therefore weights, thresholds and attributes shall be assessed much more thoroughly for further refinement and applicability
- 2) PRS: The Privacy Risk Score module is rather compute intense. Maybe it is worth to research lighter models needing less compute resources.

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3.4 Self-Encryption and Decryption Software System (SEDSS) (T3.4)

SEDSS is a secure encryption and decryption system that integrates self-encryption, self-decryption, and a multi-factor information recovery mechanism. It enables confidential data storage and sharing by allowing flexible multi-party key management, scalable encryption/decryption for diverse file types and sizes, and enhanced security through collaborative key recovery.

3.4.1 Evaluation Overview

Component	SEDSS
Pilot Partner performing the evaluation	DUT
Number of evaluation participants	2

3.4.2 Evaluation activities performed

The testing of the Self-Encryption and Decryption Software System (SEDSS) follows a comprehensive evaluation process designed to ensure correctness, robustness, and efficiency. The testing flow is structured into the following major aspects: compatibility across file formats, verification of basic functionality, and performance benchmarking with respect to data size and format. Each aspect contributes to validating the reliability of SEDSS under diverse conditions, while also highlighting potential limitations and areas for improvement.

To begin with, compatibility with different file formats is systematically assessed. Since encrypted data must preserve the structure and usability of the original file, testing includes a wide range of formats: text-based files such as .txt and .csv, binary files such as .jpg, .png, and .mp3, and more complex formats including .pdf, office documents, and compressed archives. For each case, the file is encrypted and subsequently decrypted, followed by an integrity check using checksums or byte-by-byte comparison. Successful decryption is confirmed when the restored file is identical to the original and functions correctly in its intended application, thereby demonstrating format preservation.

The second stage of testing concerns the basic functionality of the system. Core operations—namely encryption, decryption, and key handling—are examined under both standard and edge-case conditions. Special attention is given to scenarios involving empty files, extremely small files, very large files, and malformed ciphertext inputs. Incorrect key usage is also tested to verify that the system handles errors gracefully, providing clear diagnostic messages rather than crashing. In addition, repeated cycles of encryption and decryption are conducted to ensure consistent and lossless output. This stage confirms the correctness and resilience of the system in diverse operating environments.

Finally, performance benchmarking is carried out to measure the time and resource cost of encryption and decryption across different scenarios. Controlled experiments are performed using files of varying sizes, ranging from kilobytes to gigabytes, as well as across different file types to account for format-specific overhead. The results allow for a quantitative assessment of scalability and efficiency, revealing potential performance bottlenecks in handling large datasets. This analysis provides actionable insights into optimizing the system and informs decisions about integrating additional encryption algorithms to balance security and efficiency.

3.4.3 Main evaluation outcomes

The encryption and decryption times for TXT files were measured across different file sizes ranging from 1 MB to 2 GB. For smaller file sizes (1 MB to 100 MB), the encryption times showed slight variations but generally remained under 6 seconds. As file sizes increased to 1 GB and 2 GB, the encryption times increased significantly to approximately 10.5 seconds and 21.5 seconds, respectively. Similarly, decryption times for smaller files were close to the encryption times and followed a similar pattern of increase with file size, reaching up to approximately 23 seconds for the largest file size tested.

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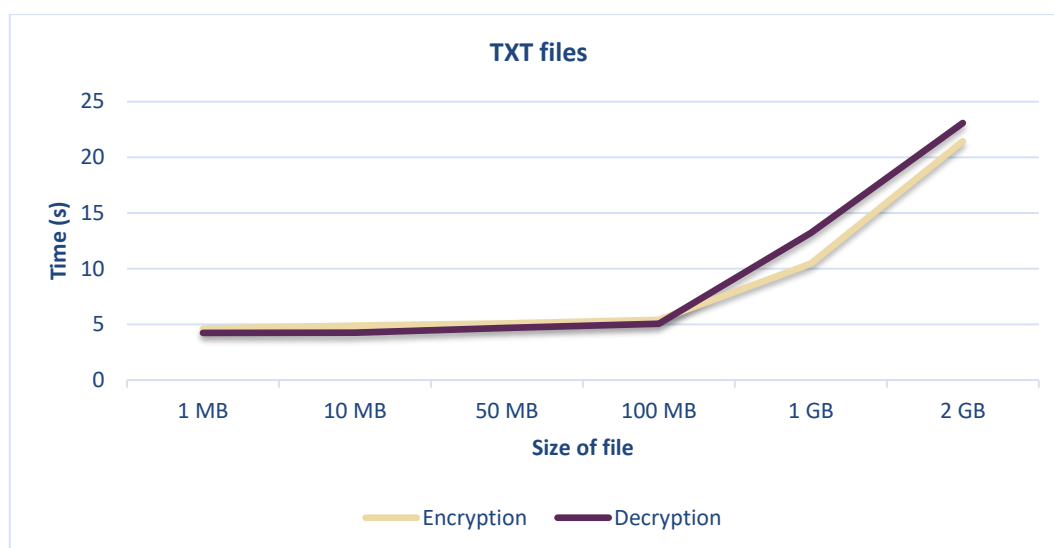


Figure 3: Encryption and decryption times for TXT files

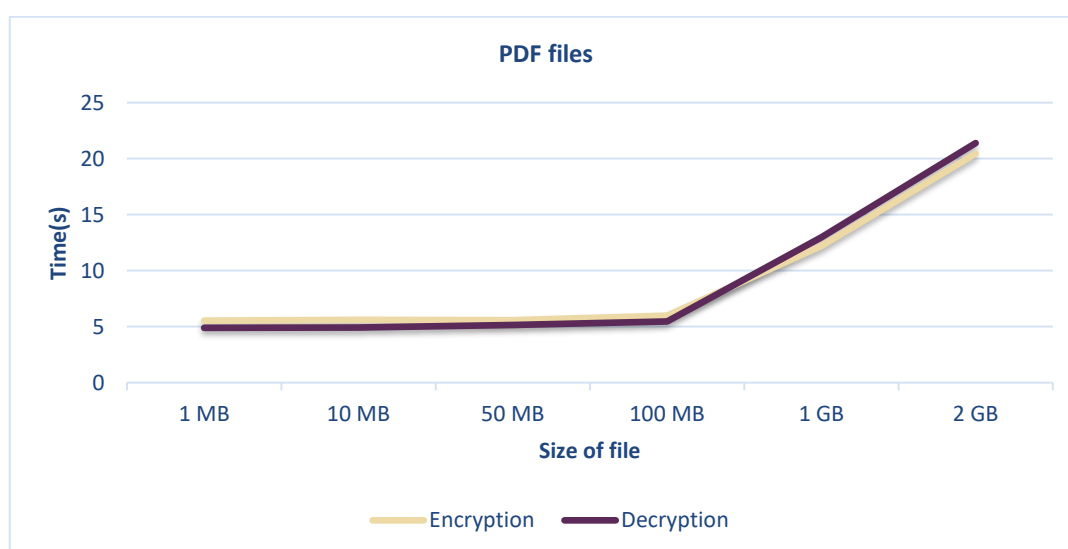


Figure 4: Encryption and decryption times for PDF files

Encryption and decryption of PDF files followed a slightly different trend. For smaller file sizes, encryption times were higher than for other file types, with times around 5.5 seconds for 1 MB files and increasing up to approximately 6 seconds for 100 MB files. Decryption times were slightly lower but followed a similar upward trend. For 1 GB files, encryption times were approximately 12.2 seconds, and for 2 GB files, the times were around 20.5 seconds. Decryption times for these large files were slightly higher, peaking at around 21.4 seconds.

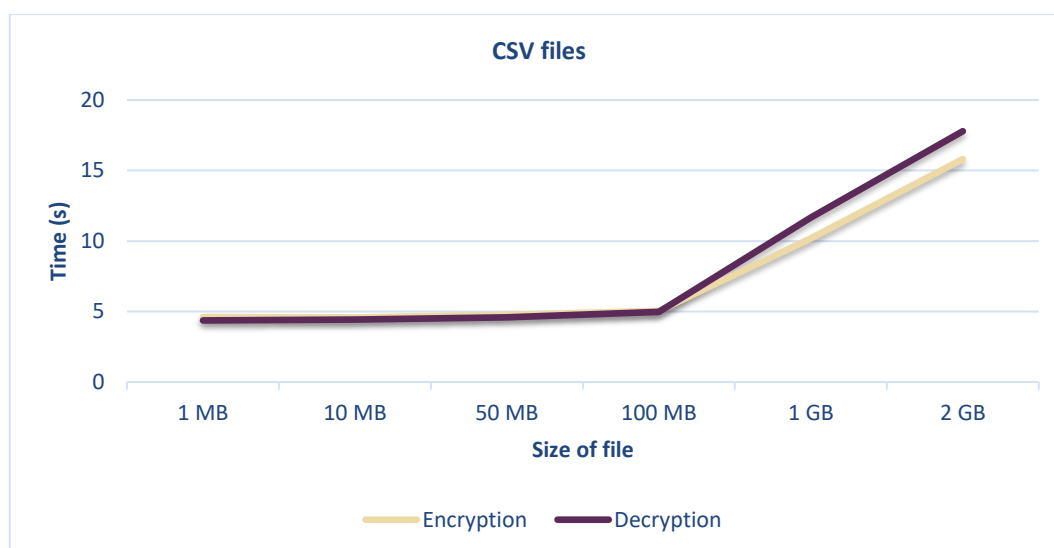


Figure 5: Encryption and decryption times for CSV files

The analysis of CSV files revealed that the encryption and decryption times exhibited a consistent pattern. For file sizes between 1 MB and 100 MB, the encryption times ranged from around 4.6 seconds to 5 seconds, while decryption times were slightly lower, staying under 5 seconds. As the file size grew to 1 GB, the encryption and decryption times increased significantly, with encryption times reaching up to around 10.2 seconds and decryption times peaking at approximately 11.7 seconds. The largest file size of 2 GB resulted in encryption and decryption times of approximately 15.8 seconds and 17.9 seconds, respectively.

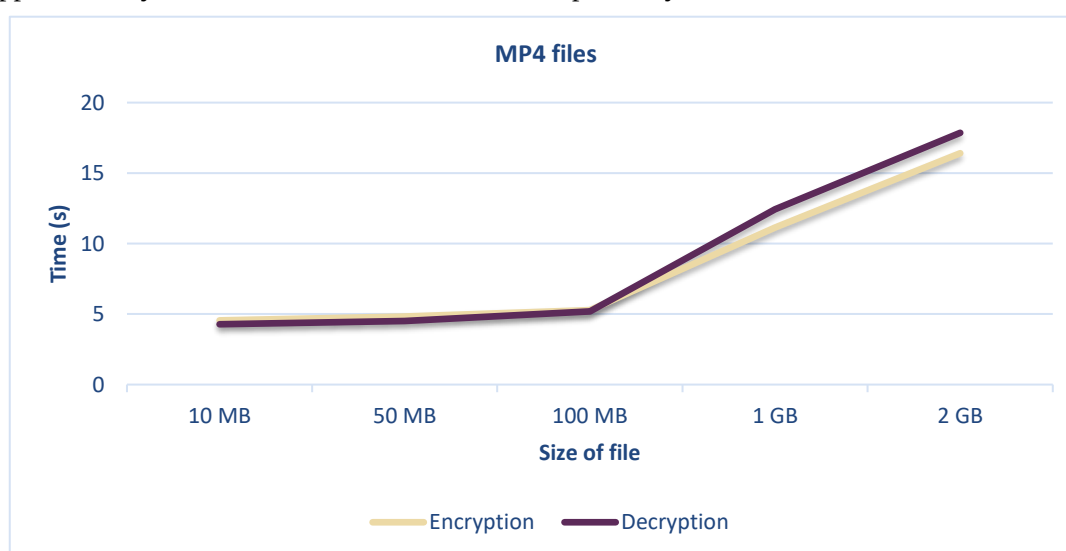


Figure 6: Encryption and decryption times for MP4 files

MP4 files exhibited a different behavior, particularly for larger file sizes. The encryption and decryption times for smaller MP4 files (1 MB to 100 MB) were relatively close, ranging from approximately 4.6 seconds to 5.3 seconds for encryption and slightly lower for decryption. However, for the 1 GB file, encryption times were around 11.1 seconds and increased to approximately 16.4 seconds for the 2 GB file. Decryption times followed a similar pattern, with the 1 GB file taking around 12.4 seconds and the 2 GB file peaking at approximately 17.9 seconds. These results illustrate the correlation between file size and encryption/decryption times across different file types, with processing times increasing as file size grows. Variations are observed based on the specific characteristics of each file type. However, since pilots in TANGO rarely need to encrypt very large files (e.g., those exceeding 100 MB), the SEDSS remains efficient for most use cases within the project.

Besides, we investigate the compatibility of encryption and decryption of SEDSS on various data formats and discuss the time consumption on the same file size with four typical file formats to showcase that SEDSS can

process various data formats, indicating that SEDSS is compatible with different usecases. We present the encryption and decryption times for 10 MB and 2 GB files across TXT, PDF, CSV, and MP4 formats.

We illustrate the time consumption of various encryption algorithms when applied to a 10 MB file. The results indicate that encryption times are relatively consistent across different algorithms, with only slight variations. This suggests that for smaller files, the choice of encryption algorithm may not significantly impact the overall performance. The efficiency observed in encrypting 10 MB files highlights the algorithms' capability to handle smaller datasets effectively, ensuring minimal processing delay and rapid data protection.

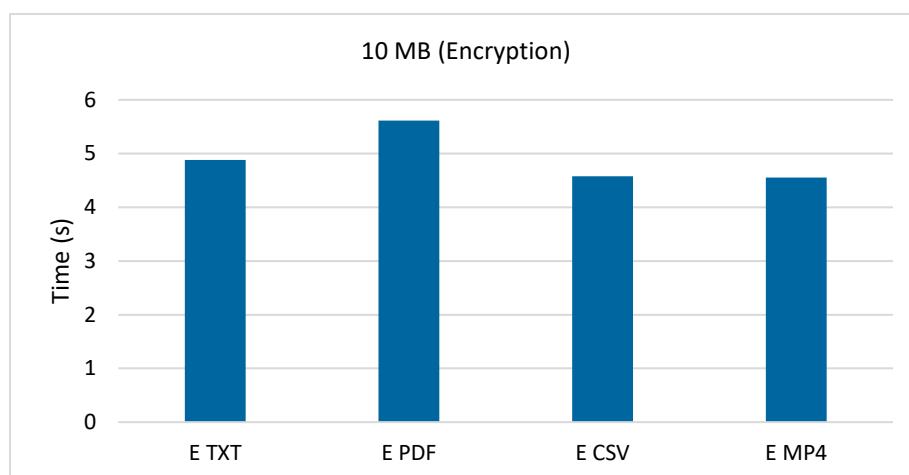


Figure 7: Encryption and decryption times for 10MB files

We also present the encryption time for a 2 GB file, revealing a stark difference in performance among the algorithms. As file size increases, the time required for encryption escalates considerably, emphasizing the scalability challenges faced by certain algorithms. This figure underscores the importance of selecting an appropriate encryption algorithm when dealing with large datasets, as some algorithms demonstrate markedly better performance in managing substantial data volumes. The comparative analysis of these figures underscores the critical need for balancing security and efficiency, particularly in environments where large data encryption is routine.

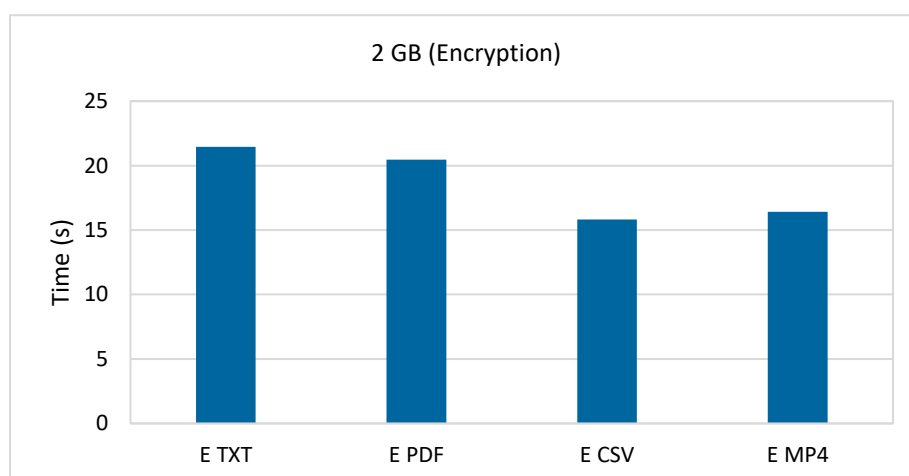


Figure 8: Encryption and decryption times for 2GB files

We check the time cost of decryption process on 10 MB file size against four data formats in the following figure. The result shows the time consumption of decrypting various data formats on a 10 MB file, with the times closely clustered between 4.2 and 4.9 seconds for different file types such as TXT, PDF, CSV, and MP4. Despite slight variations, the overall download times remain within a narrow range, indicating that the encryption algorithm is performing efficiently across different file types. This efficiency is particularly evident in the relatively quick processing times, suggesting that the algorithm effectively balances security and speed for smaller files, ensuring minimal delay and consistent performance.

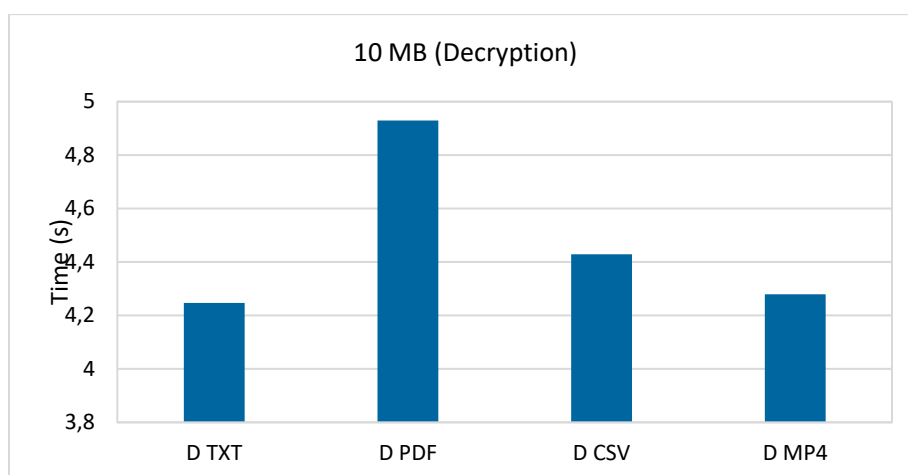


Figure 9: Decryption time on 10 MB file size against four data formats

We represent the time consumption of decrypting files with various formats when processing a 2 GB file. Our results show that decryption times for different file types of range between 17 to 22 seconds. Despite the larger file size, the encryption algorithm maintains efficiency across different formats, with only moderate increases in processing time. The consistent performance across diverse file types underscores the algorithm's capability to handle significant data volumes, ensuring reliable and swift encryption for large datasets.

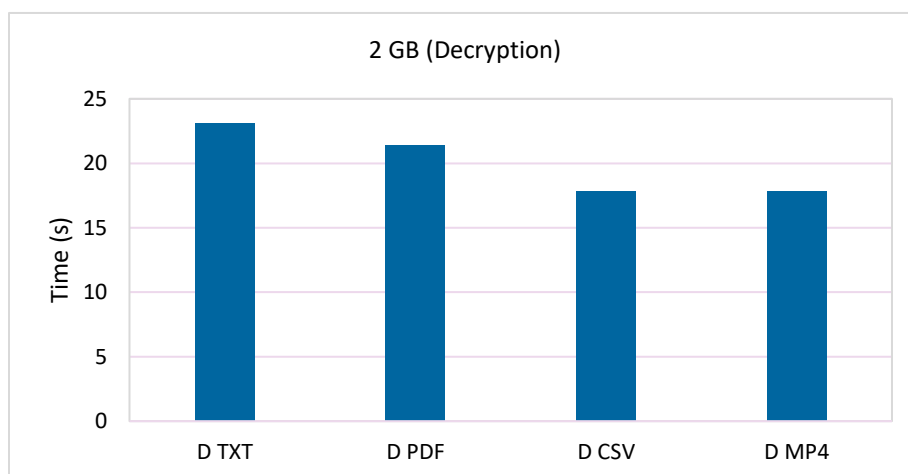


Figure 10: Decryption time on 2GB file size against four data formats

3.4.4 Suggestions for component improvement

Currently, the encryption and decryption time cost increases significantly for large data files (e.g., above 100 MB), which can result in long delays between user requests and server responses, ultimately harming the user experience. At this stage, the system only supports a limited set of encryption algorithms, which restricts flexibility in addressing different performance and security requirements.

To improve this, additional algorithms can be integrated into the Self-Encryption and Decryption Software System (SEDSS). By supporting a wider variety of algorithms, SEDSS can provide users with configurable trade-offs between security strength, computational cost, and encryption/decryption latency, making the system more adaptable to diverse use cases such as real-time communication, bulk file storage, or resource-constrained environments.

Since the integration of SEDSS into the TANGO framework is still in progress, the current testing has not yet been applied to any real-world use cases. Further evaluation will be conducted once the system is deployed on pilot servers, at which point testing with real-world data and user interactions will provide a more comprehensive validation of its effectiveness and reliability.

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3.5 Device Continuous Behavioural Authentication (DCBA) (T4.4)

The DCBA monitors device's activity and leverages network and battery logs and statistics in order to feed an AI model that is able to characterize the activity as normal or abnormal. Network metrics are also leveraged to perform localization of the device for physical access control. In the latter case, a notification mechanism will alert managers or other users with details regarding restricted area violations.

DCBA interacts with the PDP/PEP component in order to provide a “normality” score for authorizing users to access resources. It further interacts with the visualization component for providing historic data and statistics of normality scores and restricted area access (localization extension).

3.5.1 Evaluation Overview

Component	DCBA
Pilot Partner performing the evaluation	UTH
Number of evaluation participants	1

3.5.2 Evaluation activities performed

The evaluation of the DCBA Component was initially conducted in UTH premises in Volos, Greece. Specifically, our evaluation series focused on the localization aspect of the component, as functional tests of the integration with other TANGO components have been successfully performed and the demonstration of this integration is shown in the video link provided below. Therefore, the evaluation focused solely on the localization algorithm to determine its accuracy. It is important to note, as will also be shown in the demonstration video, that a small modification was performed to the Android application, in order to allow scanning for nearby Wi-Fi RSSI (Received Signal Strength Indicator) and Bluetooth Low Energy (BLE) RSSI signals to start simply by opening the app and pressing a single button. It is worth noting that two localization algorithms were implemented. The first, Least Squares Optimization, is an enhanced version of the Trilateration Localization algorithm and estimates the exact coordinates of the device. However, since this algorithm requires the precise coordinates of the access points—which are currently unknown in the RIAS premises—the algorithm ultimately chosen was the Euclidean Distance method, which outputs the estimated area of the employee's device. In general, the algorithm estimates the position of a device by analyzing signal strengths (e.g., Wi-Fi RSSI and BLE RSSI) from nearby access points. By comparing these measurements with known reference points, it can infer the device's location with reasonable accuracy.

The evaluation was conducted on a single floor in our premises—the second floor of the building—and monitored three distinct areas:

- OFFICE 2.04
- OFFICE 2.01
- DEMO-ROOM

These areas are in close proximity but are separated by walls and doors, except the *DEMO-ROOM*. The *OFFICE 2.04* is approximately 5–6 meters from *OFFICE 2.01* and 3–4 meters from the *DEMO-ROOM*. *OFFICE 2.01* is roughly 9–10 meters away from the *DEMO-ROOM*. In the image below, we can see the complete floor plan of the evaluation area:

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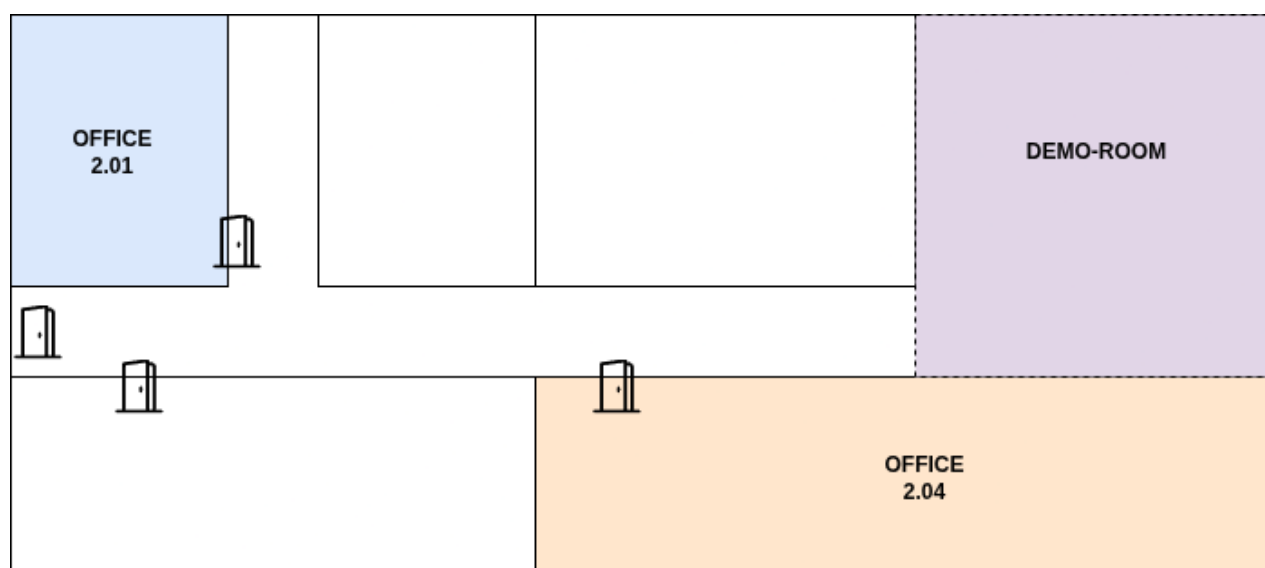


Figure 11: Floorplan of the DCBA evaluation area

The **evaluation route**, as demonstrated below in the section, began with our presence in *OFFICE 2.04*. We launched the application and entered *OFFICE 2.04*, where it scanned for RSSI signals from nearby WiFi and Bluetooth Low Energy (BLE) access points. These signals were transmitted to the server, and the localization algorithm (Euclidean Distance) correctly estimated that the device was in *OFFICE 2.04*. Next, we moved to *OFFICE 2.01*, and the localization algorithm again correctly determined the device's location based on both BLE and WiFi RSSI signals. Finally, we proceeded to the *DEMO-ROOM*, passing directly outside *OFFICE 2.04* (!). At that point, the Bluetooth RSSI scan completed while we were directly outside the *OFFICE 2.04*, causing the algorithm to temporarily misidentify the device as being in *OFFICE 2.04*. This occurred because, when the scan completed, the RSSI signals received matched those in the *OFFICE 2.04* heatmap, as this area was the closest to the device at that moment. However, as demonstrated in the following demo, if we wait until the next scan completes and the signals stabilize, the localization algorithm correctly identifies the device as being in the *DEMO-ROOM*, based on both BLE and WiFi RSSI signals. This evaluation route was repeated 50 times in total to verify the results. A demonstration video of the pilot conducted at our premises can be viewed at the following link: [UTH LOCALIZATION EVALUATION DEMO.mp4](#)

3.5.3 Main evaluation outcomes

Regarding the accuracy, the image below shows some metrics for each area. For example, in *OFFICE 2.04*, 9 out of 10 predictions were correct (meaning that in 10 attempts, at least 9 were accurately predicted). The 1 remaining misclassification labeled the area as the *DEMO-ROOM*, likely because the two areas are divided by only a single wall and the test point was located at the edge of *OFFICE 2.04*, close to the *DEMO-ROOM*. In *OFFICE 2.01*, the accuracy was 10 out of 10 given that this room is the most isolated from the surrounding areas, whereas in the *DEMO-ROOM* it reached 8 out of 10. The lower accuracy in the *DEMO-ROOM* is due to the lack of walls separating it from other areas, which occasionally leads to mispredictions as *OFFICE 2.04*. The image below shows the algorithm's accuracy across the monitored areas.

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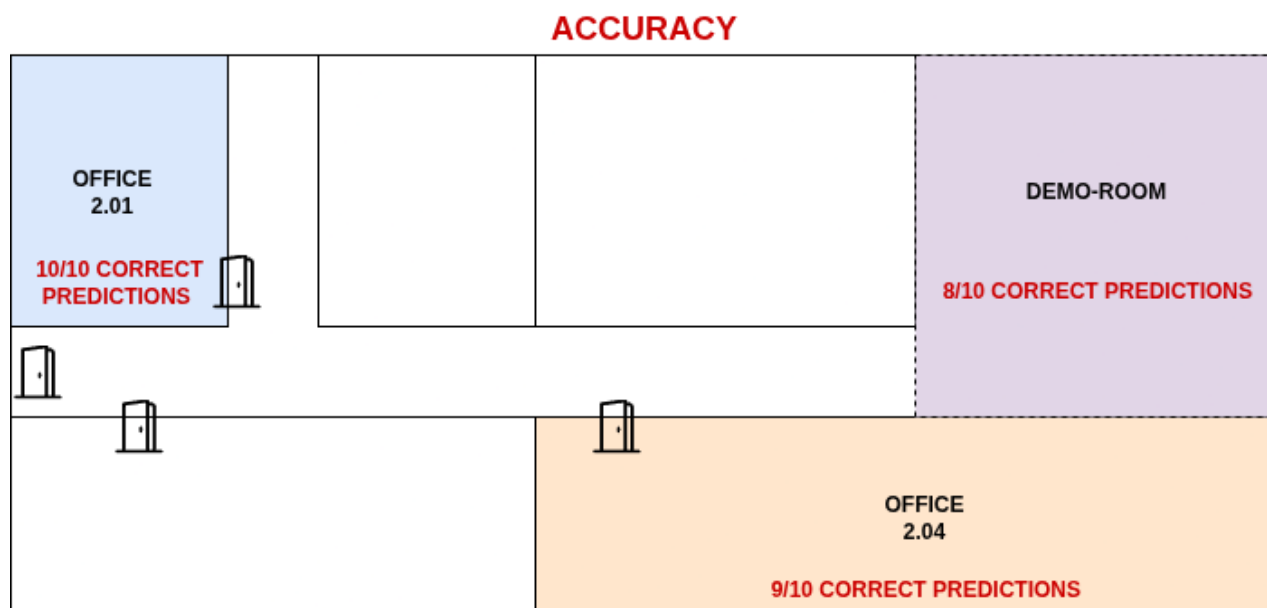


Figure 12: DCBA algorithm's accuracy across the monitored areas

For configuring the heatmaps in our premises, we took approximately 15 measurements for each area, resulting in 45 different scans from the application (15 per area) to generate the heatmap and begin the evaluation. Increasing the number of measurements generally improves the accuracy of the algorithm. Additionally, the access points we used included 3 Wi-Fi and 2 Bluetooth access points, respectively.

We have also performed several evaluation tests for the localization component in RIAS premises and the restricted areas that we examined are as follows:

- Warehouse
- Packaging Lines
- Sorting Lines 1 to 3
- Sorting Lines 4 and 5
- Sorting Lines 6 to 8

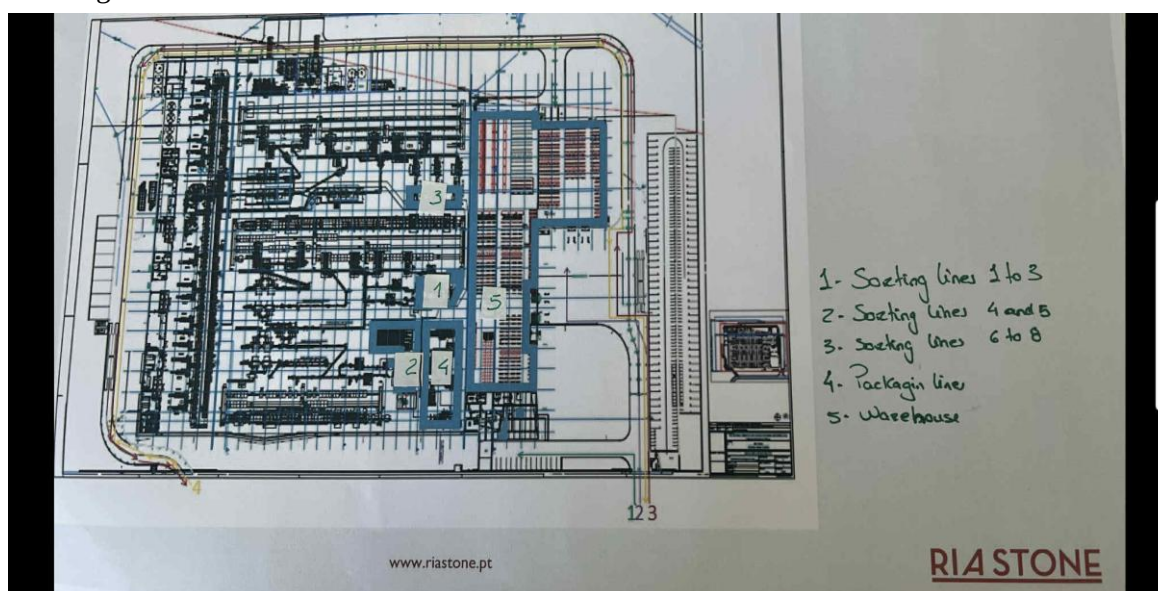


Figure 13: RIAS shopfloor floorplan

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Although we used a larger number of access points for the RIAS scenario—15 in total—the results at the RIAS premises may still differ slightly. This is because some of the monitored areas—specifically the *SORTING LINES 4 and 5* and the *PACKAGING LINES*—are very close to each other (2–3 meters apart) and are not separated by walls. As a result, during the testing at the RIAS premises from May 19 to May 22, the algorithm occasionally misestimated the device’s location, indicating we were in the *SORTING LINES 4 AND 5* when we were actually in the *PACKAGING LINES* and vice versa. For areas that are more isolated from the rest of the monitored spaces—for example, the *WAREHOUSE* located in the logistics section, which is positioned at the far end of the facility and physically separated from the other restricted areas—the algorithm achieved higher accuracy. In these cases, the predictions were correct in approximately 9 or 10 out of every 10 attempts, resulting in an **average accuracy** of about **92%**.

Additionally, most of the localization algorithms—especially the Euclidean Distance—require common access points across the monitored areas. However, this was not the case in our scenario. For example, the *WAREHOUSE* and *SORTING LINES 4 AND 5*, as well as *SORTING LINES 4 AND 5* together with *SORTING LINES 6 to 8*, did not have any common access points. The only common access points available during our testing were a few autonomous robots equipped with pre-installed WiFi. However, because these robots continuously moved throughout the facility, the WiFi measurements they provided were not consistent and varied depending on their exact location at the time of measurement. For accurate and reliable localization, it is crucial to have stable and fixed access points that provide consistent signals. The absence of common access points across the monitored areas introduced additional challenges and increased variability in our testing, making it more difficult for the algorithm to achieve optimal performance. To address this, we slightly modified the heatmap by adding extra access points, which allowed the system to work with reduced accuracy. Areas that did not receive signals from these access points in the heatmap were assigned a value of –120 dBm. For better understanding, the heatmap for a single area (for example the *WAREHOUSE*), is shown below:

1	AREA	e8-6d-e9-0f-d5-f2	e8-6d-e9-0f-d5-e1	e8-6d-e9-0f-d5-e2	e8-6d-e9-0f-d5-e0	e8-6d-e9-0f-d5-30	e8-6d-e9-10-37-a2	e8-6d-e9-0f-d8-31	e8-6d-e9-0f-d8-20	e8-6d-e9-0f-d8-32	e8-6d-e9-10-37-a0	e8-6d-e9-0f-d8-21	e8-6d-e9-0f-d8-22	e8-6d-e9-0f-d5-f0	e8-6d-e9-0f-d5-f1	60-12-3c-31-f6-e1
2	WAREHOUSE	-89	-87	-87	-87	-83	-87	-81	-64	-83	-87	-120	-120	-120	-120	-120
3	WAREHOUSE	-73	-67	-67	-120	-66	-120	-67	-120	-67	-120	-120	-120	-73	-73	-120
4	WAREHOUSE	-120	-120	-120	-120	-67	-120	-67	-51	-67	-120	-51	-51	-120	-120	-120
5	WAREHOUSE	-67	-120	-120	-120	-89	-120	-89	-120	-89	-120	-120	-120	-68	-67	-80
6	WAREHOUSE	-83	-85	-87	-85	-120	-120	-120	-120	-120	-120	-120	-120	-85	-83	-120
7	WAREHOUSE	-89	-120	-120	-120	-120	-120	-120	-120	-120	-120	-120	-120	-89	-89	-120
8	WAREHOUSE	-74	-120	-85	-120	-69	-120	-69	-77	-69	-120	-76	-120	-75	-75	-120
9	WAREHOUSE	-78	-69	-69	-69	-120	-120	-120	-120	-120	-120	-120	-120	-78	-78	-120
10	WAREHOUSE	-74	-120	-120	-120	-85	-120	-85	-120	-85	-120	-120	-120	-74	-74	-120
11	WAREHOUSE	-77	-83	-85	-85	-120	-120	-120	-120	-120	-120	-120	-120	-78	-77	-120
12	WAREHOUSE	-69	-120	-120	-120	-89	-120	-120	-120	-89	-120	-120	-120	-69	-69	-120
13	WAREHOUSE	-89	-120	-120	-120	-85	-120	-120	-120	-120	-120	-120	-120	-89	-89	-120
14	WAREHOUSE	-120	-120	-120	-120	-120	-80	-89	-87	-89	-120	-120	-89	-120	-120	-120
15	WAREHOUSE	-120	-89	-89	-87	-75	-120	-75	-65	-76	-120	-65	-65	-120	-89	-120
16	WAREHOUSE	-78	-72	-73	-73	-72	-120	-72	-59	-120	-120	-120	-120	-78	-78	-120
17	WAREHOUSE	-89	-87	-85	-87	-50	-120	-51	-39	-50	-120	-39	-38	-89	-89	-120
18	WAREHOUSE	-85	-85	-83	-83	-44	-120	-44	-43	-44	-120	-43	-43	-89	-89	-120
19	WAREHOUSE	-120	-120	-120	-120	-81	-120	-81	-80	-79	-120	-79	-79	-120	-120	-120
20	WAREHOUSE	-89	-120	-120	-120	-85	-76	-89	-120	-89	-120	-120	-120	-89	-89	-120
21	WAREHOUSE	-83	-120	-120	-120	-85	-82	-85	-120	-120	-120	-120	-120	-85	-85	-120
22	WAREHOUSE	-78	-120	-120	-120	-70	-120	-69	-120	-70	-120	-120	-120	-77	-78	-120
23	WAREHOUSE	-66	-120	-120	-120	-81	-120	-81	-120	-120	-120	-120	-120	-65	-65	-120
24	WAREHOUSE	-59	-120	-120	-120	-89	-120	-120	-120	-120	-120	-120	-120	-59	-59	-120
25	WAREHOUSE	-70	-76	-76	-76	-120	-120	-120	-120	-120	-120	-120	-120	-70	-70	-120
26	WAREHOUSE	-63	-71	-71	-70	-120	-120	-120	-120	-120	-120	-120	-120	-63	-63	-120
27	WAREHOUSE	-63	-120	-120	-120	-120	-120	-120	-120	-120	-120	-120	-120	-63	-62	-120
28	WAREHOUSE	-75	-120	-120	-120	-65	-120	-66	-63	-66	-120	-64	-65	-75	-75	-85
29	WAREHOUSE	-79	-89	-120	-89	-43	-120	-43	-38	-44	-120	-40	-41	-79	-79	-120

Figure 14: Heatmap for single area

A challenge we encountered involved an unexpected issue with the operation of the smartwatches that are used to track the location of the employees. Our Android application deployed on the smartwatch requires internet access to transmit the RSSI signals to the server, where the localization algorithm estimates the device location. Based on this estimation and the restricted areas associated with the employee’s role, the system determines whether to generate an alert. However, during continuous testing, we discovered that when the smartwatches are connected to a phone via Bluetooth, they automatically disconnect from WiFi to conserve battery, receiving all data through

the paired smartphone instead. This behavior caused frequent loss of network connectivity, preventing the application from functioning correctly. We resolved this issue by disabling Bluetooth entirely on the smartwatches. After this adjustment, the application ran continuously for 5–6 hours in our premises and lost network access only once. Previously, the smartwatch would lose internet connectivity every 5 to 20 seconds after connecting to a network. Our Android application, however, requires approximately 30 to 50 seconds to complete a scan—this is standard behavior in Android OS to collect all scan results—and the duration depends on the number of nearby access points. In areas with many access points, scans typically finish in about 30 seconds, while in areas with few or no access points, they take slightly longer. As a result, the smartwatch would lose network access before the scan could complete, disrupting the device’s functionality. To prevent this issue, Bluetooth must be turned off on the smartwatch.

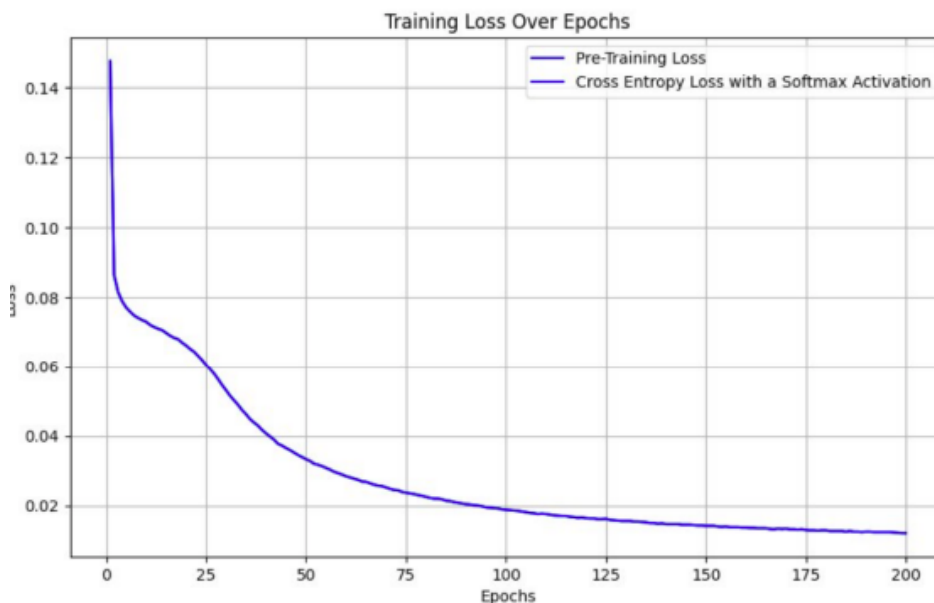
Regarding the **Behavioural Modeling** part, we did not evaluate it since there was no such a requirement from a specific pilot. However, we have implemented this component and we have obtained some initial small-scale evaluation results regarding the behaviour of the devices. Specifically, we tested it internally on a Lenovo Tablet. First, we captured logs from the tablet over five and a half days of normal operation, resulting in a log file of several MB in size. The goal was to train a machine learning model based on Transformer technology on normal device behaviour, in order to evaluate the proportion of abnormalities it could detect in real time. For evaluation, we randomly shuffled the dataset to detect deviations in the sequence of logs, which reflect how the user interacts with the device. The specifications of the hardware that ran the Machine Learning Model were:

Component	Specifications
Processor	13th Gen Intel Core i9-13900KF x 8
Memory	128.0 GB DDR5
Graphics	NVIDIA GeForce RTX 4070
Disk Capacity	5.0 TB

PRE-TRAINING PHASE

The main idea behind this approach is that we first pre-trained the machine learning model on the sequences of these logs, allowing it to learn the relationships between log event occurrences and to capture the patterns and correlations among all the log events. The loss achieved during the pre-training phase is shown in the image below.

Pre-Training Phase (Loss)



Dataset Size: 50 MB
 Number of Logs: ~400,000
 Training Duration: 24 hours
 Window Size: 20
 Number of Epochs: 200
 Learning Rate: 2e-5
 Batch Size: 64

Figure 15: Loss achieved during the pre-training phase

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FINE-TUNING PHASE

Next, we fine-tuned the pre-trained model to predict the most probable upcoming log events based on the previous log sequences. In this way, the model further learns the relationships between these logs and how they typically appear during normal device operation.

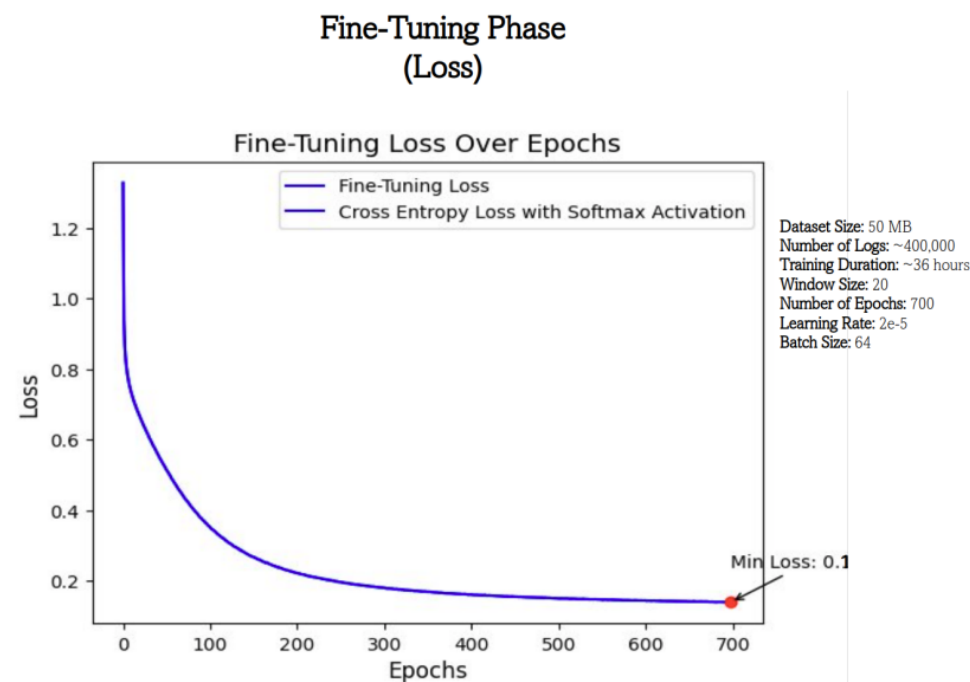


Figure 16: Loss achieved during the fine-tuning phase

EVALUATION PHASE

First, we evaluated the model on the same dataset used for training and, as expected, detected no abnormalities. This outcome confirms that the model correctly identifies the normal behavior of this specific device, since it was trained on this dataset.

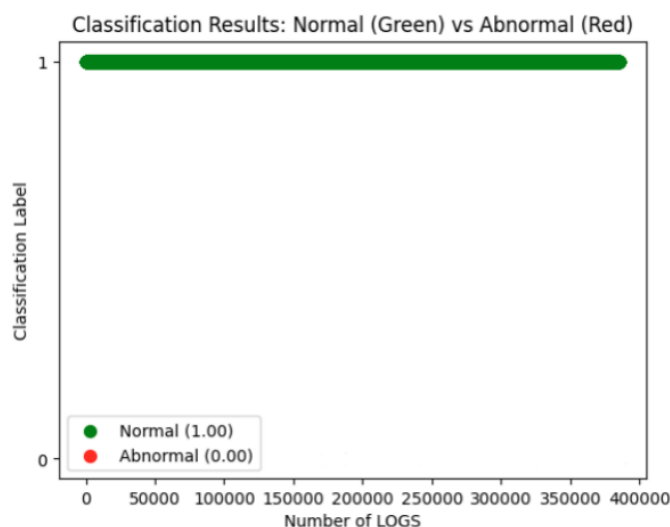


Figure 17: Evaluation phase outcomes

Next, we randomly shuffled 5% of the dataset, which created an expected abnormality rate of 5%. This altered the sequence of the logs, resulting in a new device behaviour.

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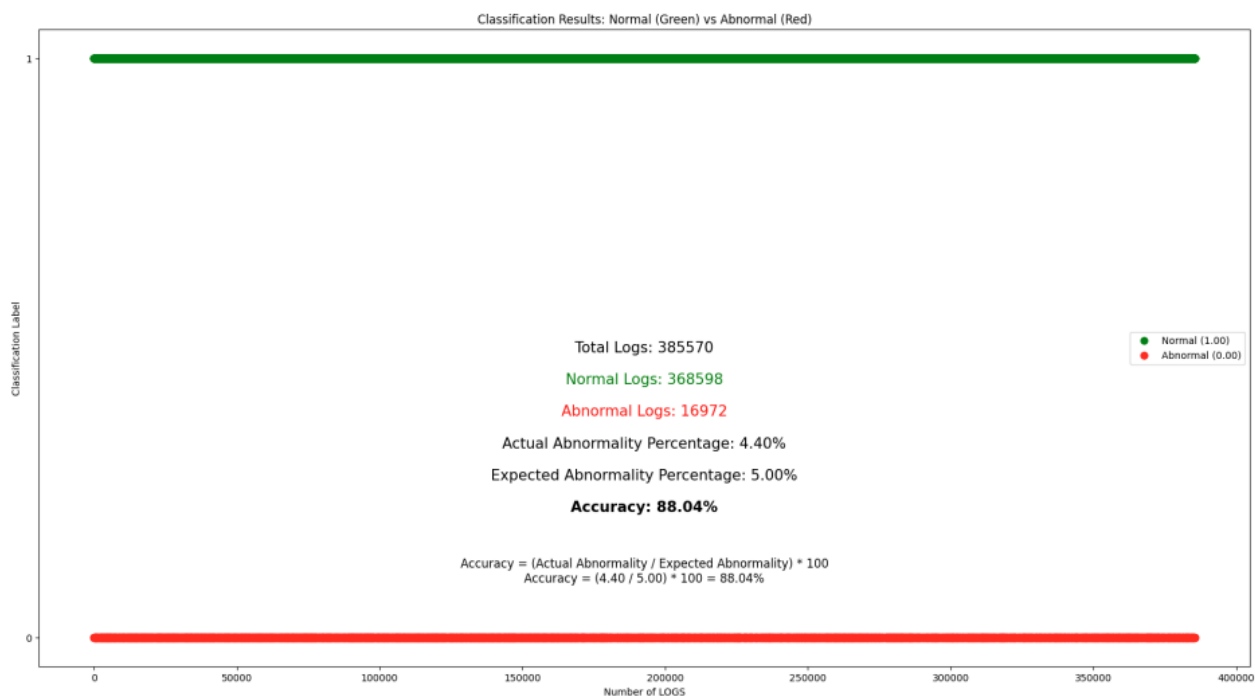


Figure 18: Classification results

And if we zoom in on the plot image:

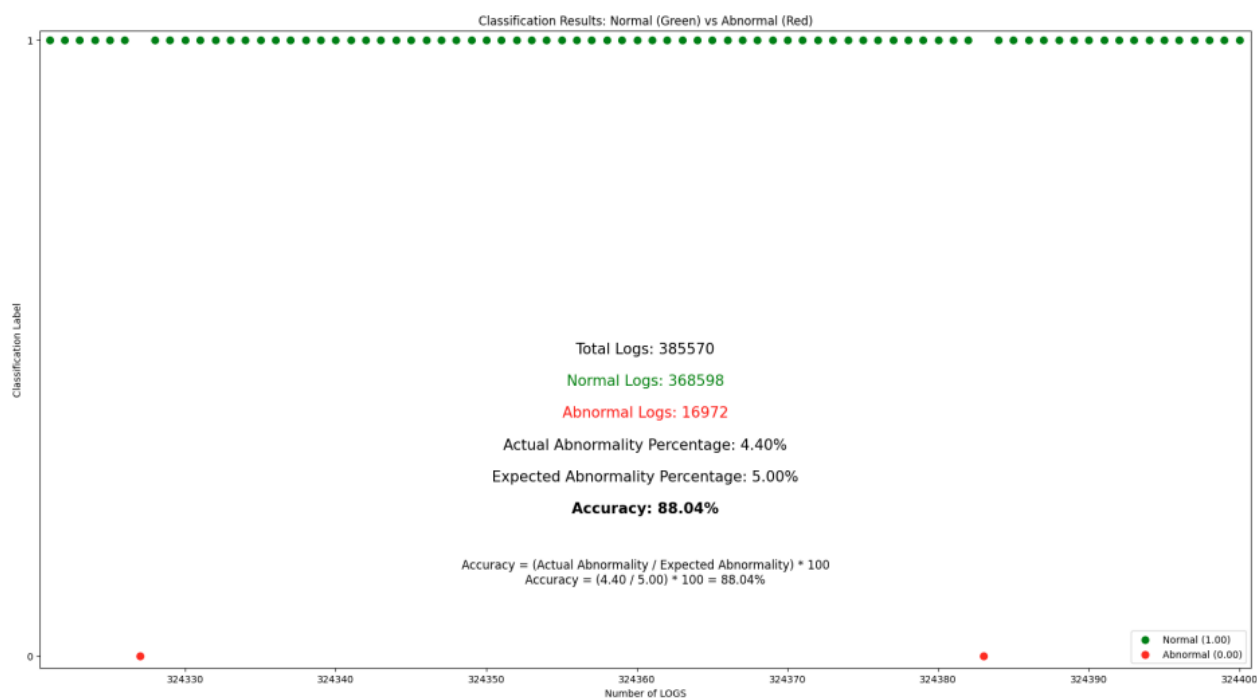


Figure 19: Classification results – zoom in

The actual abnormality percentage can be calculated as follows:

$$\text{Actual Abnormality Percentage} = \frac{\text{Abnormal Logs}}{\text{Total Logs}} \times 100 = \frac{16972}{385570} \times 100 = 4.40\%$$

Resulting in an accuracy of:

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$$Accuracy = \frac{\text{Actual Abnormality Percentage}}{\text{Expected Abnormality Percentage}} \times 100 = \frac{4.40}{5.00} \times 100 = 88.04\%$$

Then, we repeated the same process, but this time shuffled 10% of the dataset:

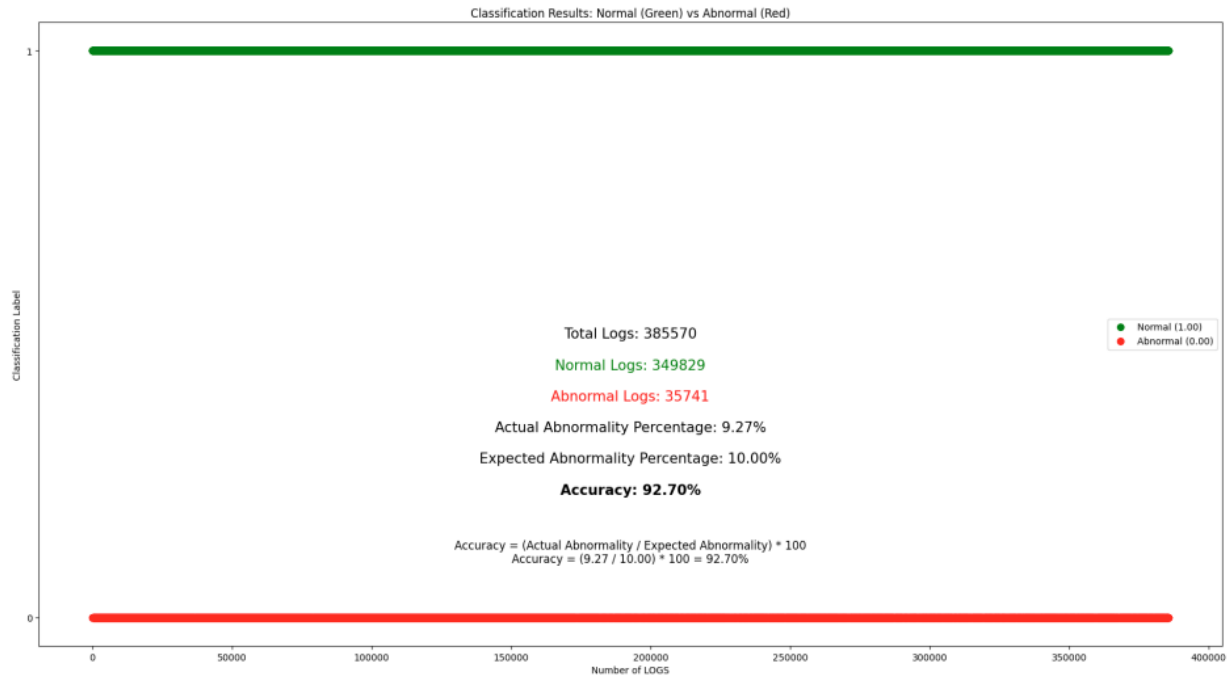


Figure 20: Classification results – shuffled dataset 10%

As observed, the actual abnormality percentage can be calculated in the same way:

$$\text{Actual Abnormality Percentage} = \frac{\text{Abnormal Logs}}{\text{Total Logs}} \times 100 = \frac{35741}{385570} \times 100 = 9.27\%$$

Resulting in an accuracy of:

$$Accuracy = \frac{\text{Actual Abnormality Percentage}}{\text{Expected Abnormality Percentage}} \times 100 = \frac{9.27}{10} \times 100 = 92.70\%$$

Finally, we randomly shuffled 20% of the dataset. This again altered the sequence of the logs, resulting in a new device behaviour.

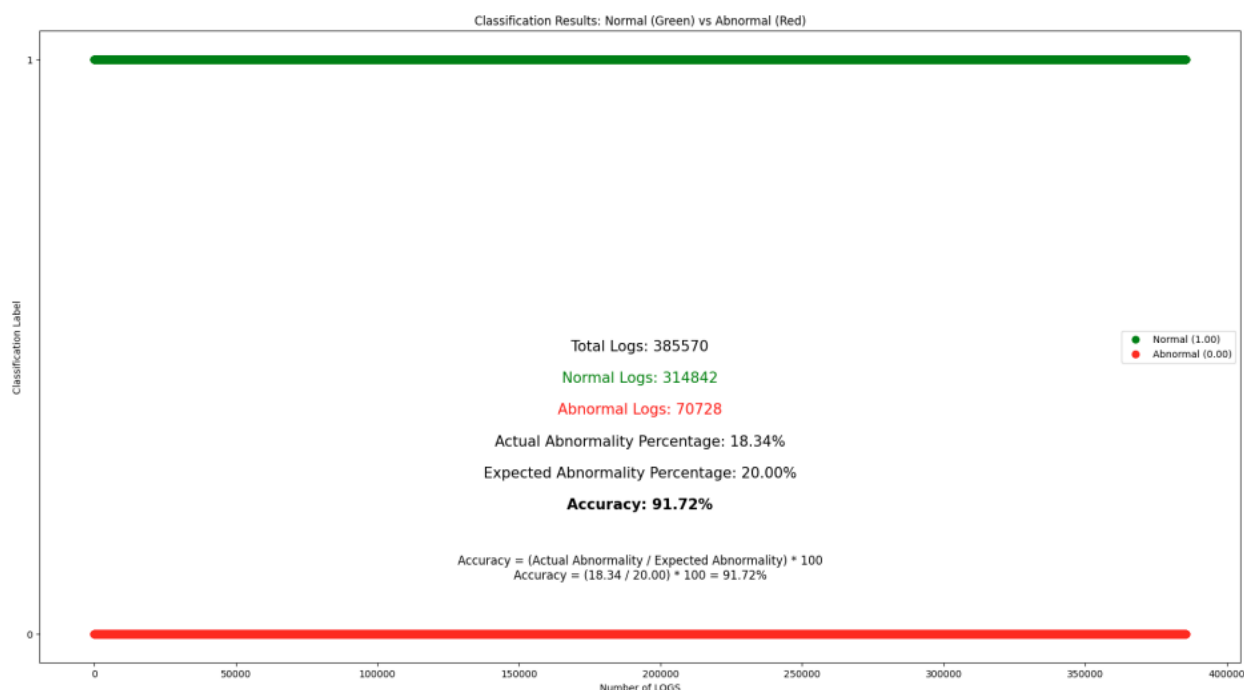


Figure 21: Classification results – shuffled dataset 20%

The actual abnormality percentage can be calculated as follows:

$$\text{Actual Abnormality Percentage} = \frac{\text{Abnormal Logs}}{\text{Total Logs}} \times 100 = \frac{70728}{385570} \times 100 = 18.34\%$$

Resulting in an accuracy of:

$$\text{Accuracy} = \frac{\text{Actual Abnormality Percentage}}{\text{Expected Abnormality Percentage}} \times 100 = \frac{18.34}{20} \times 100 = 91.72\%$$

Thus, the **average accuracy** of the machine learning model can be calculated as:

$$\text{Average Accuracy} = \frac{88.04\% + 92.70\% + 91.72\%}{3} = 90.82\%$$

3.5.4 Suggestions for component improvement

The main limitation mentioned in the previous section concerns the placement of access points. For example, in the RIAS premises, some access points were very close to each other, and the monitored areas were also very close together. This made it more difficult for the Euclidean Distance algorithm—a widely used localization method—to achieve maximum accuracy.

A simple but crucial recommendation is to place the access points at the corners of the main shop floor, with one additional access point in the center or middle of the facility. This way, each monitored area will receive a distinct set of RSSI signals from these access points, making it much easier to differentiate one area from another and improving the overall accuracy of the localization algorithm.

3.6 Federated Learning (FL) (T5.2)

The Federated Learning component enables the training of neural network models across distributed devices without exchanging raw data, relying instead on the sharing of model parameters. The approach enhances privacy, reduces data transfer needs, and leverages diverse local datasets to improve model quality. It requires aligned local datasets, a shared initial model, and a central aggregation node to consolidate results from multiple training rounds.

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Ultimately, the process produces a robust, unified ML model while preserving data sovereignty at the client side. Originally introduced in WP2 and WP5 deliverables, the latest version was delivered in D5.2.

3.6.1 Evaluation Overview

Component	Federated Learning
Pilot Partner performing the evaluation	FMAKE
Number of evaluation participants	2

3.6.2 Evaluation activities performed

FMAKE has performed the following steps to evaluate the component:

1. Pulling the Docker container from Tango's Harbor. Slight modification of the compose files to link to the correct folder.
2. Configuring the environment to support two nodes. A default Docker installation has been used. The GPU were not detected, so the testing happened 100% on CPU.
3. A typical model training has been performed using Federated Learning. The training evolutions (NMSE metric per epoch) has been evaluated. The final model has been checked briefly.

For this testing, a limited set of data has been used.

3.6.3 Main evaluation outcomes

The component performed as expected and some improvements have been identified (see below). The screenshots below show (part of) the tests that have been performed.

```

$ docker compose -f ./docker-compose.fmake.2clients.yml up
[*] Running 3/0
✓ Container client-one Created 0.0s
✓ Container server Created 0.0s
✓ Container client-two Created 0.0s

Attaching to client-one, client-two, server
client-two | 2025-01-03 09:49:29.834054: I tensorflow/core/util/port.cc:153] oneDNN custom operations are on. You
client-two | may see slightly different numerical results due to floating-point round-off errors from different computation or
client-two | ders. To turn them off, set the environment variable 'TF_ENABLE_ONEDNN_OPTS=0'.
client-two | 2025-01-03 09:49:29.834807: I external/local_xla/xla/tsl/cuda/cudart_stub.cc:32] Could not find cuda
client-two | drivers on your machine, GPU will not be used.
client-two | 2025-01-03 09:49:29.836941: I external/local_xla/xla/tsl/cuda/cudart_stub.cc:32] Could not find cuda
client-two | drivers on your machine, GPU will not be used.

0[100.0%] 3[100.0%] 6[100.0%] 9[100.0%] 11[100.0%] 14[100.0%] 17[100.0%] 20[100.0%]
1[100.0%] 4[100.0%] 7[100.0%] 10[100.0%] 12[100.0%] 15[100.0%] 18[100.0%] 21[100.0%]
2[100.0%] 5[100.0%] 8[100.0%] 13[100.0%] 16[100.0%] 19[100.0%]
Mem[|||||] 14.5G/30 GB Tasks: 212, 1920 thr 100.0%; 22 running
Swp[|||||] Load average: 29.30 18.17 8.07
Uptime: 01:05:07

Main I/O
PID USER PRI NI VIRT RES SHR S CPU%MEM% TIME+ Command
21026 root 20 0 7499M 3431M 376M R 94.2 10.9 3:06.43 python nodeEntry.py
21409 root 20 0 7499M 3431M 376M R 93.1 10.9 2:45.75 python nodeEntry.py
21411 root 20 0 7499M 3431M 376M R 89.5 10.9 2:41.03 python nodeEntry.py
22528 root 20 0 7515M 3461M 378M R 86.6 11.0 0:37.03 python nodeEntry.py
21410 root 20 0 7499M 3431M 376M R 84.2 10.9 2:42.35 python nodeEntry.py
21403 root 20 0 7499M 3431M 376M R 82.5 10.9 2:40.78 python nodeEntry.py
21408 root 20 0 7499M 3431M 376M R 81.9 10.9 2:42.60 python nodeEntry.py

```

Figure 22: FL Training on CPU

```

"node_type": "server",
"server_id": "server",
"client_id": [
  "client-one",
  "client-two"
],
"dataset": {
  "source": "hdf5",
  "config": {
    "dataset_filename": "a_training_data.hdf5",
    "features": "frames",
    "targets": "labels"
  }
},
"model": {
  "model_type": "pytorch",
  "config": {
    "model_filename": "a_model.pth",
    "epochs": 2,
    "batch_size": 64,
    "metrics": ["neg_mean_squared_error"],
    "send_gradients": true,
    "dataloader_args": {"shuffle": false},
    "module_filename": "a_model.py"
  }
},
"num_rounds": 10,
"compression": false,
"add_noise": false,
"debug_activated": false,
"debug_verbosity": 0,
"debug_level": "debug"

```

```

"node_type": "client",
"server_id": "server",
"client_id": "client-one",
"dataset": {
  "source": "hdf5",
  "config": {
    "dataset_filename": "a_training_data.hdf5",
    "features": "frames",
    "targets": "labels"
  }
},
"model": {
  "model_type": "pytorch",
  "config": {
    "model_filename": "a_model.pth",
    "epochs": 2,
    "batch_size": 64,
    "dataloader_args": {"shuffle": true},
    "module_filename": "a_model.py"
  }
},
"num_rounds": 10,
"compression": false,
"debug_activated": false,
"debug_verbosity": 0,
"debug_level": "debug"

```

Figure 23: FL Server and node configurations

```

server      | INFO : ("info_msg": "Model loaded from ./data/a_model.pth.")
client-two  | 2025-01-03 09:49:43,868 - aiohttp.access - INFO - 172.19.0.2 [03/Jan/2025:09:49:42 +0000] "POST /res
t/update-from-server HTTP/1.1" 200 173 "-" "Python/3.11 aiohttp/3.8.6"
client-one  | 2025-01-03 09:49:43,884 - aiohttp.access - INFO - 172.19.0.2 [03/Jan/2025:09:49:42 +0000] "POST /res
t/update-from-server HTTP/1.1" 200 173 "-" "Python/3.11 aiohttp/3.8.6"
client-two  | INFO : ("info_msg": "Received weights from server...")
server      | INFO : ("info_msg": "Model initialized.")
client-one  | INFO : ("info_msg": "Received weights from server...")
client-two  | INFO : ("info_msg": "HDF5 file loaded.")
client-one  | INFO : ("info_msg": "HDF5 file loaded.")
client-two  | INFO : ("info_msg": "Model loaded from ./data/a_model.pth.")
client-two  | INFO : ("info_msg": "Model initialized.")
client-one  | INFO : ("info_msg": "Model loaded from ./data/a_model.pth.")
client-one  | INFO : ("info_msg": "Model initialized.")
client-two  | INFO : ("info_msg": "Training completed.")
client-one  | INFO : ("info_msg": "Forwarding gradients to server...")
server      | 2025-01-03 09:52:56,601 - aiohttp.access - INFO - 172.19.0.4 [03/Jan/2025:09:52:56 +0000] "POST /res
t/update-from-client HTTP/1.1" 200 173 "-" "Python/3.11 aiohttp/3.8.6"
server      | INFO : ("info_msg": "Received gradients from client-two... 1/2 clients")
client-one  | INFO : ("info_msg": "Training completed.")
client-one  | INFO : ("info_msg": "Forwarding gradients to server...")
server      | 2025-01-03 09:52:58,982 - aiohttp.access - INFO - 172.19.0.3 [03/Jan/2025:09:52:58 +0000] "POST /res
t/update-from-client HTTP/1.1" 200 173 "-" "Python/3.11 aiohttp/3.8.6"
server      | INFO : ("info_msg": "Received gradients from client-one... 2/2 clients")
server      | INFO : ("info_msg": "Gradients aggregated")
server      | INFO : ("info_msg": "HDF5 file loaded.")
server      | INFO : ("neg_mean_squared_error": 109.31885919570922)

```

Figure 24: FL Training loop

3.6.4 Suggestions for component improvement

Some questions and suggestions have been shared with the component leader during testing:

- GPU seems not supported. Should the compose files or the Docker image be modified to allow for using the GPU(s)?
- Is the data the same on all nodes? Or each node has its own subset?
- Missing the documentation of all parameters and their impact on the component.
- Can metrics of single nodes be logged?

The component leader took into account most of the questions, clarified doubts, and released a new version of the component. Beside better documentation in the final release, the new version caters for GPUs.

3.7 MLOps (T5.2)

The MLOps component integrates MLFlow, MinIO, Jupyter, and PostgreSQL to support the scalable development, deployment, and management of ML models. It streamlines the full ML lifecycle, improving quality, reliability, and efficiency while reducing costs and errors. Key features include support for Jupyter notebooks, LLM evaluation, and customisable MLFlow pipelines for regression and other tasks. The component also enables model versioning, metric tracking, and performance comparison across experiments. Integration with components such as RENOPS and XAI, as well as tracking of FL metrics, has been validated in real pilot scenarios.

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3.7.1 Evaluation Overview

Component	MLOps
Pilot Partner performing the evaluation	FMAKE
Number of evaluation participants	3

3.7.2 Evaluation activities performed

During the evaluation, FMAKE has deployed the MLOps package, based on MLFlow, from EVIDEN locally. Afterwards, a machine learning model was trained in collaboration with the MLOps tool. Finally, the training output was reviewed with the MLOps user interface.

3.7.3 Main evaluation outcomes

During the evaluation, screenshots were taken from the most important steps. They are shown below.

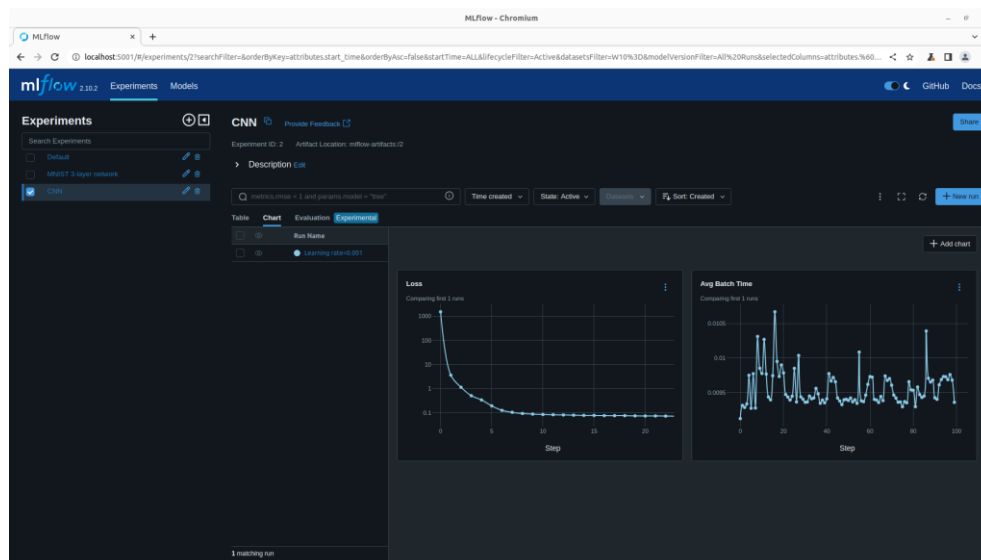


Figure 25: User interface after training

The interface provided all the necessary information to evaluate the training/model performance (loss function). The code snippets below show the adaptations that were made to integrate the MLOps tool into the training phase.

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```
def train(batch_size, epochs, ds_size=10000, lr=0.001, momentum=0.9):
    # Setup mlflow to point to our server.
    run_name = f"Learning rate={lr}"
    mlflow.set_tracking_uri("http://localhost:5001/")
    mlflow.set_experiment("CNN")
    mlflow.start_run(run_name=run_name)

    # Log parameters
    mlflow.log_params(
        {
            "batch_size": batch_size,
            "epochs": epochs,
            "ds_limit": ds_size,
            "lr": lr,
            "momentum": momentum,
        }
    )

    # Log epoch
    mlflow.log_metric("Loss", total_loss / (i + 1), step=epoch)
    mlflow.log_metric("Epoch Time", batch_time, step=epoch)
    mlflow.log_metric("Avg Batch Time", batch_time / (i + 1), step=epoch)

    # Log total training time
    total_training_time = time.time() - epoch_tic
    mlflow.log_metric("Total Training Time", total_training_time)
```

Figure 26: Code snippet of the MLOps integration

From the experiments performed during the evaluation, the MLOps is working as expected.

3.7.4 Suggestions for component improvement

No issues have been identified. The MLOps tool has been tested as standalone tool. It is probably out-of-scope, but it would also be nice to see it integrated with other components like federated learning as future work beyond the project's duration.

3.8 PEC (T5.4)

PEC enables organisations to conduct comprehensive DPIAs, ensuring GDPR compliance, addressing privacy implications, and providing robust countermeasures for effective privacy risk management. It serves as a comprehensive platform offering the following capabilities: (i) evaluate the necessity of conducting a data protection impact assessment (DPIA) for organisations managing personal and sensitive data, ensuring regulatory alignment; (ii) perform DPIA for both generic processes and services, and AI applications that use sensitive data; (iii) identify and assess cyber threats that lead to potential privacy implications; and (iv) suggest countermeasures to mitigate the privacy threats.

3.8.1 Evaluation Overview

Component	PEC
Pilot Partner performing the evaluation	VISAR, METRO, IDIADA
Number of evaluation participants	6

3.8.2 Evaluation activities performed

- Initial Access and Authentication:**
 - Accessed the PEC platform and reviewed the login and registration process.
 - Registered an account and navigated through the authentication system.
- DPIA Need Assessment:**
 - Completed the initial questionnaire that assesses whether a Data Protection Impact Assessment (DPIA) is required.

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- Answered predefined questions related to data processing risks and automated decision-making.
3. **Application and AI Assessments:**
 - Filled out detailed forms regarding the use case, purpose, data processing, and AI system implementation.
 - Provided information about the types of data involved and identified potential privacy risks.
 4. **Threat and Risk Visualization:**
 - Analyzed the automatically generated privacy risks and threat categories.
 - Reviewed the graphical representation of risks, privacy impact scores, and mitigation suggestions.
 5. **Mitigation Review and Suggestions:**
 - Evaluated the suggested mitigations for identified threats.
 - Explored mitigation strategies and noted their effectiveness.

3.8.3 Main evaluation outcomes

1. **Functionality and Effectiveness:**
 - The platform successfully identifies privacy risks and threats, providing valuable mitigation suggestions.
 - Visual representation of risks through charts and graphs enhances user understanding without overwhelming them with text.
2. **Ease of Use:**
 - The structured approach helps guide users through DPIA, AI assessment, and risk visualization efficiently.
 - However, answering all the open-ended questions and questionnaires can be time-consuming.
3. **Challenges:**
 - Several questions in the DPIA and AI assessment forms appear repetitive or could be merged to improve user experience.
 - Completing all assessments in one sitting may be challenging.

3.8.4 Suggestions for component improvement

We believe the questionnaire process could be improved by reducing redundancy and merging similar questions in the DPIA and AI assessment sections. Additionally, clearer explanations or tooltips would help guide users through complex topics. A progress bar feature could also be introduced to help users estimate the time needed to complete the assessment.

Finally, the visualization of threats could be improved by incorporating interactive filtering based on severity and type, along with clearer explanations of mitigation strategies, supported by real-world case studies or best-practice guidelines.

3.9 XAI (T5.5)

The XAI module describes AI models, their expected impact and potential biases. It helps characterize model accuracy, fairness, transparency and outcomes in AI-powered decision making. Apart from helping build trust in the predictions the ML models produce, it also helps debug the models in cases where bias in the decision-making process is discovered.

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3.9.1 Evaluation Overview

Component	XAI
Pilot Partner performing the evaluation	FMAKE
Number of evaluation participants	3

3.9.2 Evaluation activities performed

FMAKE has received a Python package for explainable AI (XAI). This will be used to explain the data-driven black-box models that were trained by FMAKE before the evaluation. The initial plan was to test it only with one model, but the evaluation activity has been extended with more models. In particular:

- Evaluation on initial model with camera images
- Evaluation on a more recent (and advanced) model with camera images
- Evaluation on model with spectral data.

For all these models, the Python package has been executed and the results were interpreted.

3.9.3 Main evaluation outcomes

The results of the initial model seem correct; but they show very similar values for both model outputs

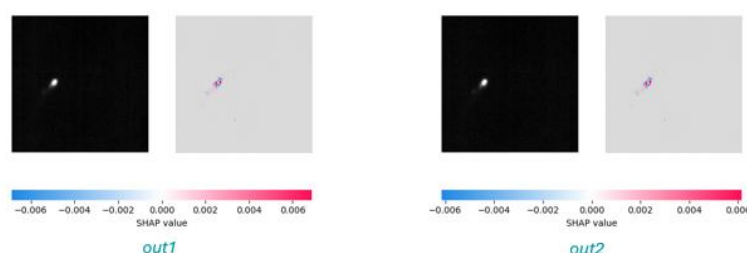


Figure 27: SHAP values of initial model

The XAI package includes several methodologies: Deeplift, integrated gradient and SHAP. They yield similar results. The more recent and advanced model relieved similar results; but included more details of the melt pool; as shown below.

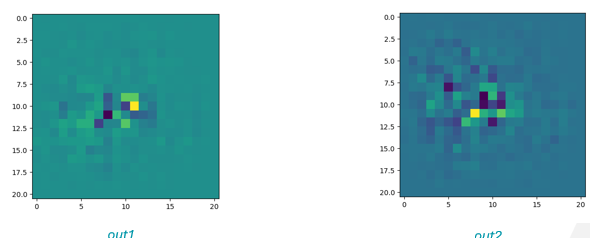


Figure 28: Deeplift applied on the recent model

From this analysis, it is clear that both model outputs correlate with the melt pool. One could argue that the second output (*out2*) is focussed on a bigger area around the melt pool. From a physical standpoint, it is hard to judge where it is correct, but intuitively it makes sense.

Finally, the same XAI package has been tried on a different type of model where spectral information is used as model input. This will allow to give a more physical interpretation to the achieved results and better display the advantages of XAI. The model input is a spectrogram of acoustic measurements. The figure below shows the output of the XAI analysis

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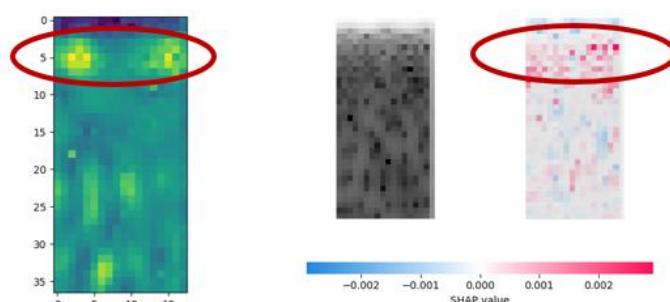


Figure 29: Explainability applied on a model using spectral data (left: Deeplift, right: SHAP)

The XAI tool directly highlights the interesting frequencies, where probably most of the interesting information is available. This will allow to train the model more specifically or improve the hardware of the sensor installed in the machine.

3.9.4 Suggestions for component improvement

It is clear from the evaluation that the XAI tool is working. Some non-critical minor issues have been identified while using another model, but it has been fixed and discussed with the component responsible. A few suggestions for improvement have been made:

- Would be nice to provide a way to add a different type of dataset (e.g. by providing the class or interface)
- Currently, the tool works with one sample at a time. Is there a way to aggregate the results?
- The result metrics are sometimes confusing. Would it be possible to identify how reliable they are?

Note that these suggestions are not critical to make use of the tool, they are nice-to-haves.

3.10 RenOps (T5.6)

RENOPS-scheduler is a Python package that allows scheduling and executing scripts at the time the most renewable energy is available.

This reduces the carbon footprint and stabilizes the grid of operations. In cases where the electricity price is variable, the scheduler also reduces utility costs. While its main focus are energy-intensive processing tasks such as big data analytics or AI model training, it may be used to shift any energy-intensive load such as HVAC.

3.10.1 Evaluation Overview

Component	Renops scheduler
Pilot Partner performing the evaluation	FMAKE
Number of evaluation participants	2

3.10.2 Evaluation activities performed

FMAKE has existing methods, developed in Python, to train machine learning models for additive manufacturing. During the component evaluation, FMAKE used these existing methods to train models, but the Renops scheduler decides when the training needs to run. Due to the amount of data, the training was forced to run locally. Although the scheduler is capable to detecting the most suitable location to run, this capability was not explored. Only the timing aspect of the scheduler was evaluated.

3.10.3 Main evaluation outcomes

Based on existing code, FMAKE made a script “train.py” that will execute the training. This script was provided to the scheduler, as shown in the screenshot below.

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```

renops-scheduler -r 1 -d 24 train.py "configs/Default.yaml"
RUNNING RENOPS SCHEDULER...
Location not specified, running automatic location detection! Found: Brussels, BE
Task has to be finished by: 2023-08-08 07:00:15.244246
Found optimal time between 2023-08-07 11:00:00 and 2023-08-07 12:00:00
Renewable potential at that time is: 0.58
waiting until 2023-08-07 11:00:00 to execute train.py...
Executing train.py configs/Default.yaml now at 2023-08-07 11:00:04.644883
-----
ClearML Task: created new task id=0b5c862df69543d59081d9a3d62451c5

```

Figure 30: train.py script

Together with the script, an expected execution time and a deadline was provided. As shown above, the scheduler was able to find an optimal time to run the training, based on availability of renewable energy.

In order to validate the selected time slot, we looked to the energy prices in Belgium. They correlate (partially) with the availability of renewables.

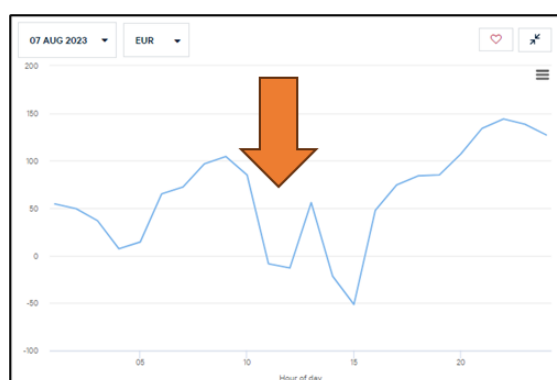


Figure 31: RenOps selected time to start the calculations

From this graph, it is clear that the Renops scheduler selected a reasonable time to start the calculations.

3.10.4 Suggestions for component improvement

During the testing, no issues or bugs were identified. Some potential improvements were discussed, but they are not critical for the performance:

- Use of electricity prices instead of renewables availability
- Possibility to pause the calculation; or split it over different periods. It will also help to deal with long calculations or in case the expected duration is unknown.

4 Phase 2 – Individual component evaluation during pilots – Results

4.1 Introduction

In the second evaluation phase a thorough assessment of individual components took place within the frames of pilot activities. The components evaluated in this phase constituted the user-facing elements of the TANGO platform and were part of the pilot user experience.

In this phase a mix of qualitative and quantitative evaluation approach was followed. The component evaluation took place through a questionnaire both using the Likert scale and open-ended questions. Pilot users provided their feedback after having used the relevant component, as this was integrated in the TANGO platform.

The following table presents an overview of the components that were evaluated by pilot users during Phase II.

Table 2: Components evaluated in Phase II – Individual component evaluation during pilots

Component / Task	Full component title	Technical Partner	Short testing description	Related Pilots
UPCV (T3.2)	Ubiquitous Personal Context Vector (Recommender)	VTT	The UPCV provides personalized recommendations, service personalization and advertising, based on user behaviour.	Smart Hospitality (ANYS)
SSI-Agent (T4.1) / SSI-Wallet (T4.1)		EVIDEN, VTT, UMU	Self-Sovereign Identity (SSI) is a digital identity model that enables users to own, control, and share their identity information without relying on centralized intermediaries. The SSI wallet allows for the individual to store their verifiable credentials within their device. The wallet will ensure that the user always controls over the data they disclose and is made aware of previous disclosures.	Smart Hospitality (ANYS), Autonomous Vehicles (IDIADA), Smart Manufacturing (FMAKE, RIAS), Retail (METRO)
SOUD (T4.2)	Seamless Onboarding for Users and Devices	QBE	The Onboard SSI is a mobile remote digital onboarding platform for users that are able to provide their physical identity such as passport or eID (electronic Identification), in order to verify their identity and then forward that information to the SSI management component in order to create the relevant Verifiable Credentials.	Smart Hospitality (ANYS), Autonomous Vehicles (IDIADA), Smart Manufacturing (FMAKE, RIAS), Retail (METRO)
UCBA (T4.3)	User Continuous Behavioural Authentication	QBE	UCBA supports both web applications and mobile devices, enabling continuous user assessment across platforms. It learns each user's unique behavioral patterns—such as typing dynamics, mouse interactions, touch gestures, or device handling—to provide seamless and ongoing authentication while the user accesses a web or mobile application. By analyzing these behavioral signals in real time, UCBA strengthens security without disrupting the user experience.	Retail (METRO)
EDAE (T5.1) & VIS (T6.4)	Exploratory Data Analysis Engine / Visualization	EXUS / SQD	Exploratory Data Analysis Engine (EDAE) has developed a series of services for ensuring data quality in order to be used by other TANGO components.	Smart Hospitality (ANYS), Smart Manufacturing (RIAS),

Component / Task	Full component title	Technical Partner	Short testing description	Related Pilots
			Reports extracted from EDAE are used by the VIS component. The Visualisation and Reporting Techniques component implements data visualisation interfaces to analyse big amounts of information, gathered from multiple sources and thus help decision-making pilot users to make informed, data-driven, decisions.	Retail (METRO)
PAT (T5.4)	Privacy Assurance Tool	FUJ-LU	The Privacy Assurance Tool (PAT) is a desktop-like web application designed to facilitate secure and transparent data sharing between users and organizations, particularly in B2C data collection scenarios. It features separate environments for users and organizations to enhance privacy and security, with a focus on the Smart Hospitality pilot. PAT allows users to manage data sharing preferences and consent, while organizations can request data with customizable requirements.	Smart Hospitality (ANYS), Autonomous Vehicles (IDIADA)

4.2 UPCV (Recommender) (T3.2)

The UPCV provides personalized recommendations, service personalization and advertising, based on user behaviour. It was used in the Smart Hospitality pilot to recommend activities to tourists based on their preferences.

The main goals of this evaluation were to answer the following questions:

- Did users find any problems in the UI of the component?
- Was it easy for users to find information on the web app?

4.2.1 Evaluation Overview

Component	UPCV
Pilot Partner performing the evaluation	UPRC, UOM, EVIDEN, UTH, QUADIBLE, VTT, INTRA, SQD, UMU, FN, KUL, FMAKE
Number of evaluation participants	20

4.2.2 Main evaluation outcomes

The Recommender Component was evaluated by 20 participants representing a wide range of Smart Hospitality Pilot partners, including universities, companies, and research institutes. The evaluation period spanned from early May to late July 2025. Testers used a mix of smartphones, laptops, and PCs, running various operating systems such as Android (versions 10 to 15), Windows (10, 11, and 14), and macOS (Ventura, Sonoma). This ensured diverse testing environments and device coverage.

The core function of the component—delivering personalized points of interest (POIs) based on user preferences—was generally successful. Most evaluators confirmed receiving recommendations aligned with their selections, particularly around popular attractions in Mallorca. However, some noted inconsistencies: the ranking of results didn't always match expectations, with some relevant POIs appearing low on the list or not at all. A few evaluators were specifically looking for certain experiences like food recommendations or iconic landmarks (e.g. Palma Cathedral), which were absent or insufficiently highlighted.

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While most users affirmed that the component functioned properly, some expressed doubts about whether it adapted dynamically to their preferences. A number of respondents mentioned that the recommendation list didn't clearly update when selections were changed, or the changes were too subtle to detect. This impacted their sense of feedback and control within the system. Despite these concerns, the majority of users achieved their intended goals, with many reporting at least partial alignment between selected interests and the generated list.

Few users experienced technical difficulties, and most found the interface smooth and responsive. One minor recurring issue involved the page not reloading from the top when selecting a new POI, which affected user orientation. Some participants testing on mobile devices noted initial confusion with the layout, though this tended to resolve with continued use. Overall, the component demonstrated strong technical stability, with 80% of participants stating they “never” encountered issues such as crashes or non-responsiveness, and only one user reporting occasional problems.

User suggestions focused on enhancing personalization and visual usability. These included allowing users to “favorite” or tag recommended items, improving labeling or categorization of POIs (e.g., icons for food, beaches, landmarks), and enabling more visible feedback on preference changes. Navigation improvements were also proposed—such as breadcrumb trails, expand/collapse lists, and clearer grouping or tiles for visual structure. These enhancements would improve both user experience and trust in the personalization logic.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 3: UPCV Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use	0.00%	0.00%	15.00%	30.00%	55.00%	4.4
Ease of Learning	0.00%	0.00%	5.00%	35.00%	60.00%	4.55
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness	0.00%	5.00%	15.00%	60.00%	20.00%	3.95
Reliability	0.00%	10.00%	20.00%	55.00%	15.00%	3.75
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Issues Encountered (lower is better)	80.00%	15.00%	5.00%	0.00%	0.00%	1.25
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction	0.00%	0.00%	20.00%	55.00%	25.00%	4.05



Figure 32: UPCV Evaluation results

Table 4: UPCV Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)						15.00%	25.00%	10.00%	30.00%	10.00%	10.00%	7.25

The evaluation of the Recommender Component in the Smart Hospitality Pilot demonstrated that the tool is functional, user-friendly, and capable of delivering generally relevant personalized suggestions based on user preferences. Most participants experienced a smooth interaction with minimal technical issues and rated the component highly in terms of ease of use, learnability, and overall satisfaction. While the component showed strong reliability, some users noted that the ranking and responsiveness of the recommendations could be improved, particularly to reflect changes in user preferences more clearly.

4.2.3 Suggestions for component improvement

User suggestions focused on enhancing personalization and visual usability. These included allowing users to “favorite” or tag recommended items, improving labeling or categorization of POIs (e.g., icons for food, beaches, landmarks), and enabling more visible feedback on preference changes. Navigation improvements were also proposed—such as breadcrumb trails, expand/collapse lists, and clearer grouping or tiles for visual structure. These enhancements would improve both user experience and trust in the personalization logic.

- **Improve Adaptation Transparency:**
 - Show how recommendations are changing based on selections.
 - Add labels, categories, or icons to better organize POIs (points of interest).
- **Enhance UI/UX:**
 - Use tile views or expandable menus (accordion-style).
 - Mark selected or viewed recommendations (checkboxes, favorites, etc.).

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- Include scroll-top triggers or better anchor linking.
- **Personalization Features:**
 - Let users “build a list” or “save preferences”.
 - Consider push notifications or dynamic updates when new relevant suggestions become available.
- **Explainability:**
 - Provide brief tooltips or summaries explaining how recommendations are generated.

4.3 SSI Wallet (T4.1)

Self-Sovereign Identity (SSI) is a digital identity model that enables users to own, control, and share their identity information without relying on centralized intermediaries. The SSI wallet allows for the individual to store their verifiable credentials within their device.

The wallet ensures that the user always controls over the data they disclose and is made aware of previous disclosures.

The SSI wallet interacts with the authorization process in Tango. Also directly with the SSI issuer and verifier.

The main goals of this evaluation were to answer the following questions:

- Assess Functionality
- Evaluate Usability
- Measure Performance
- Measure Performance

4.3.1 Evaluation Overview

Component	SSI Wallet
Pilot Partner performing the evaluation	UPRC, UOM, Eviden, CEA, INTRA, ATOS, METRO, IDIADA and FMAKE
Number of evaluation participants	32

4.3.2 Main evaluation outcomes

The evaluation of this specific component was performed by users from different industries, including universities, research centers, and companies. The main goal of this activity was to assess the functionality, usability, and user satisfaction of the SSI Wallet component. The evaluations were performed during the last months of the project (May to August 2025). All evaluators used Android smartphones, and the software versions ranged from version 10 to 15, ensuring a broad compatibility check.

Regarding the main outcome of the evaluation, a large majority of participants successfully created and managed their decentralized digital identities and verifiable credentials. Most users were able to issue and verify credentials without errors, though a few encountered issues such as failed submissions, credential acceptance delays, or scanning difficulties. Despite these technical hiccups, most participants reported that they were ultimately able to complete the process and achieve their goals.

The SSI Wallet generally functioned as expected for most evaluators. Users noted that the wallet was responsive during credential issuance and verification tasks. A few participants experienced slow responses or intermittent issues, which some attributed to temporary network congestion or simultaneous usage by multiple testers. One common problem mentioned was the failure of the "Open in wallet" link, although copying QR information served as a practical workaround.

Most users confirmed that they achieved their primary evaluation objectives, successfully verifying and issuing credentials. However, several evaluators encountered difficulties. These included technical failures during

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verification, confusion around which credential to use at specific stages, and errors triggered during interactions with the issuer. Some users were unable to complete the evaluation due to device restrictions or unsupported app installations.

When asked about usability challenges, responses were mixed. Many users reported a smooth experience, especially when guided by clear instructions. However, few found the onboarding process unclear, especially regarding which credentials were needed at various steps. One participant mentioned the lack of a logout option as a minor usability issue when switching users. Another noted difficulty scanning passports, a recurring pain point seen in earlier pilots as well.

In terms of technical stability, feedback was largely positive, although not without exceptions. While some users reported issues such as pending buttons or unsupported device behavior, most found the component stable and reliable. The frequency of problems such as crashes or non-responsiveness was relatively low, with the majority stating they "rarely" or "never" encountered such issues.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 5: SSI Wallet Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use	5.88%	11.76%	23.53%	47.06%	11.76%	3.47
Ease of Learning	5.88%	11.76%	23.53%	52.94%	5.88%	3.41
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness	5.88%	0.00%	29.41%	58.82%	5.88%	3.59
Reliability	0.00%	17.65%	11.76%	58.82%	11.76%	3.65
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Issues Encountered (lower is better)	41.18%	29.41%	17.65%	5.88%	5.88%	2.06
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction	0.00%	11.76%	17.65%	41.18%	29.41%	3.88

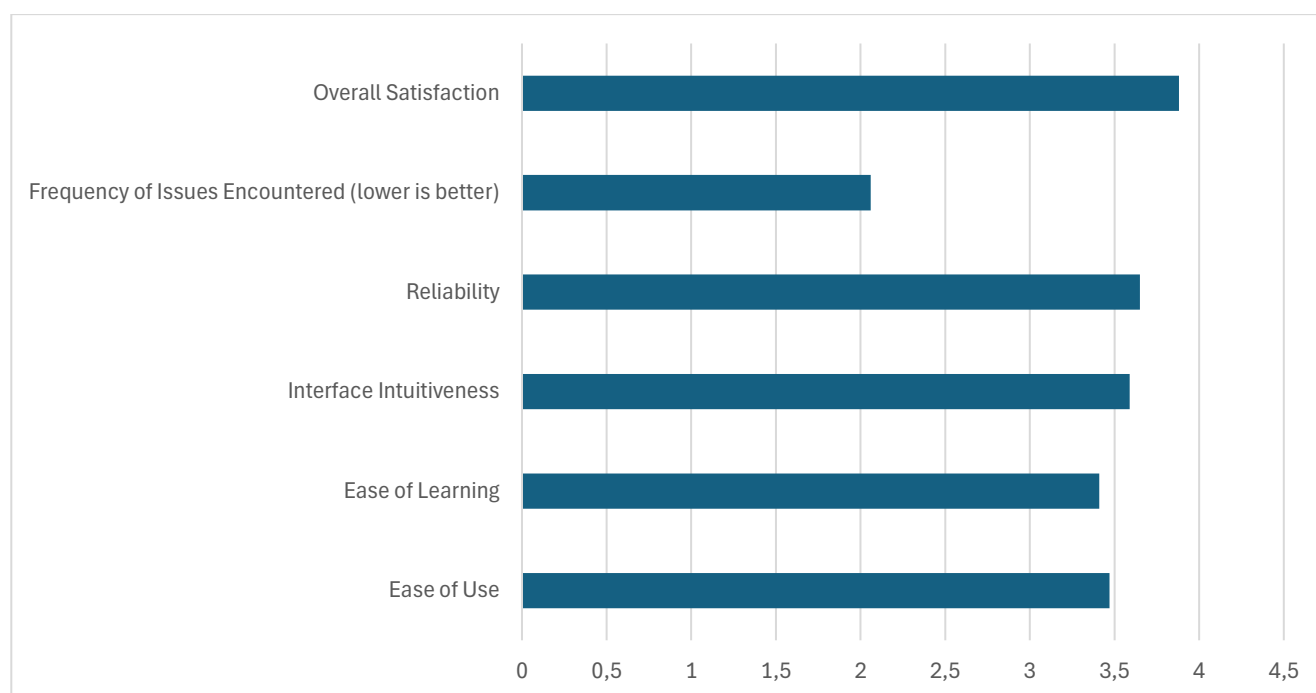


Figure 33: SSI Wallet Evaluation results

Table 6: SSI Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)			5.88%		11.76%	5.88%	23.53%	23.53%	5.88%	17.65%	5.88%	6.59

4.3.3 Suggestions for component improvement

Suggestions for improvement focused on interface clarity and instructional detail. Participants recommended adding step-by-step guidance during the credential exchange process and including visual cues, such as user photos, within credentials to reinforce identification. Accessibility was also mentioned, particularly concerning compatibility with older devices or OS versions.

Therefore, participants proposed the following improvements:

- **Enhanced Instructions:** More detailed, step-by-step guidance should be provided to reduce onboarding friction and improve clarity.
- **Accessibility:** The app should support a wider range of Android versions and address issues related to older or restricted devices.
- **Error Feedback:** Improve error handling and messaging during the credential submission process to assist with troubleshooting.
- **Account Management:** Consider adding features such as user logout and better multi-user handling.

4.4 Seamless Onboarding of Users and Devices (SOUD) (T4.2)

Seamless ePassport Onboarding that connects to the SSI system. Connects to the SSI component from T4.1.

The main goals of this evaluation were to answer the following questions:

- seamless onboarding is achieved and that verification is performed correctly for a ‘correct’ user.
- onboarding should fail and the component should detect that a passport does not match a given user, if someone uses an incorrect passport

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- onboarding should fail and the component should detect that an eID does not match a person performing verification, if the person onboarding has a different eID.

4.4.1 Evaluation Overview

Component	SOUD – Seamless Onboarding
Pilot Partner performing the evaluation	UPRC, UOM, EVIDEN, FUJ, UTH. CEA, ECO, ATOS, INTRA, DUT, METRO, UOM, SQD, VTT, UMI, FN, FMAKE
Number of evaluation participants	21

4.4.2 Main evaluation outcomes

The evaluation of the component was performed by 21 participants and was conducted between May and August of 2025. All the participants that were involved, used Android smartphones, representing various models and OS versions, ranging from Android 10 to 15, ensuring in that way a diverse and representative test base.

A core focus of the evaluation was the ability of the ePassport component to support seamless onboarding and accurate user verification. Most participants successfully completed the onboarding and identity verification steps. The system effectively recognized and validated legitimate passport data for correct users. However, a few evaluators experienced problems, such as difficulties capturing passport images or failures in the face recognition process. In one notable case, the application failed to read a newer-generation German passport, likely due to layout changes unaccounted for by the component's image recognition system. These issues, although not pervasive, highlighted limitations in the application's flexibility and responsiveness to diverse document formats.

Functionality-wise, the component performed as expected for the majority of users, though not without technical friction. Several evaluators reported needing multiple attempts to capture passport photos or complete NFC-based chip scans. Some users described the app reverting to the welcome screen upon failed steps, especially during face matching, disrupting the flow of the onboarding process. Despite these setbacks, most respondents were ultimately able to issue their ePassport credentials and access the final verification summary page.

Participants faced a range of technical and usability challenges. Common complaints included lighting sensitivity during passport photo scanning, unclear instructions, inconsistent face recognition, and app behavior that didn't allow users to easily retry failed steps. While some evaluators experienced no major issues, others encountered persistent problems requiring repeated attempts. The variability in user experience suggests that while the system is generally functional, its robustness and fault tolerance need improvement.

Reported technical weaknesses included inconsistent passport scanning under different lighting conditions, inadequate handling of unexpected passport layouts, and vague UI language during critical steps. A number of users also felt the need for clearer interface cues and error handling mechanisms that would guide them smoothly through retries, rather than restarting the entire flow.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 7: SOUD Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use	0.00%	9.52%	42.86%	42.86%	4.76%	3.43
Ease of Learning	0.00%	9.52%	33.33%	42.86%	14.29%	3.62
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness	0.00%	14.29%	38.10%	47.62%	0.00%	3.33

Reliability	0.00%	0.00%	66.67%	33.33%	0.00%	3.33
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Issues Encountered (lower is better)	9.52%	33.33%	33.33%	19.05%	4.76%	2.76
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction	0.00%	0.00%	42.86%	52.38%	4.76%	3.62

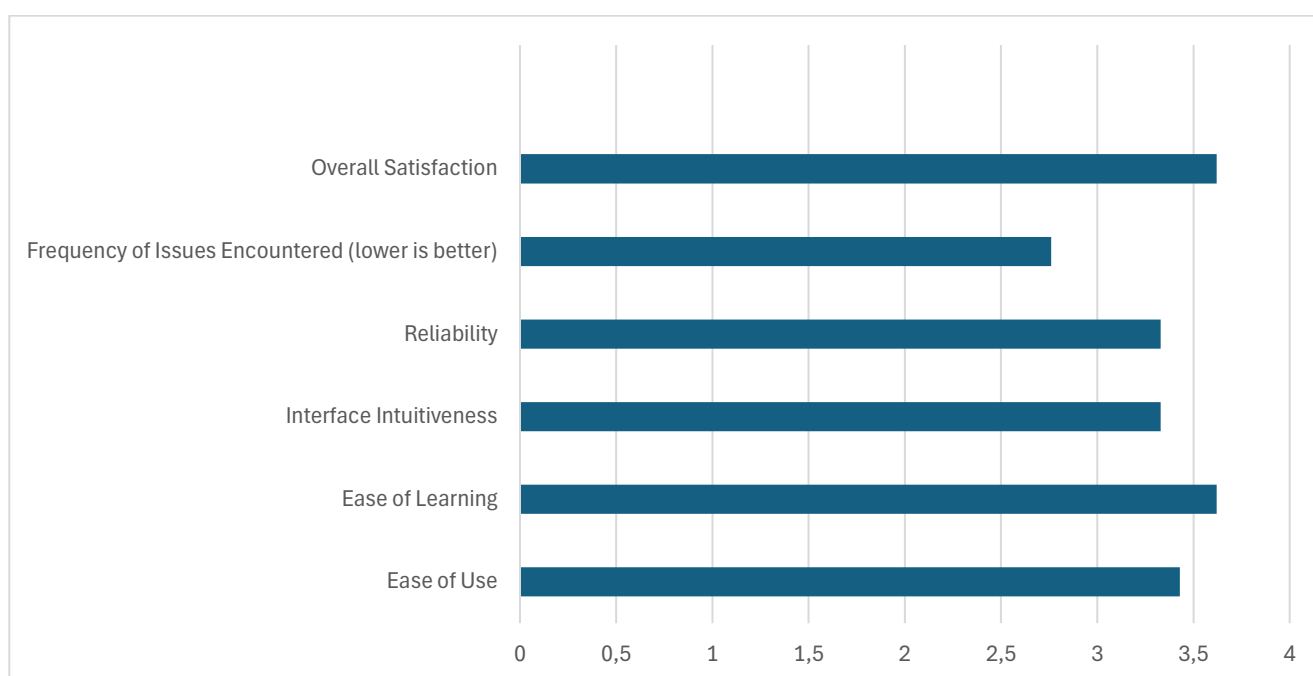


Figure 34: SOUD Evaluation results

Table 8: SOUD Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)	0.00%	0.00%	0.00%	4.76%	0.00%	19.05%	23.81%	33.33%	14.29%	0.00%	4.76%	7.48

4.4.3 Suggestions for component improvement

Suggestions for improvement focused on several recurring themes. Many participants recommended adding a manual capture button for passport and face photos, as the current automatic capture process felt abrupt and lacked user control. Others suggested enhanced visual instructions for positioning the passport and clearer error messages. Face recognition accuracy and scan reliability were also cited as key areas needing refinement. A few evaluators requested broader accessibility, such as compatibility with a wider range of devices and the inclusion of national ID scanning.

- Add **manual photo capture controls** instead of (or in addition to) automatic recognition.

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- Include **step-by-step instructions** or illustrations to guide scanning (especially MRZ and NFC).
- Enhance **passport scanning under varied lighting** conditions.
- Improve **face recognition feedback** to reduce guesswork on why attempts fail.
- Make UI text clearer (e.g., labeling confirmation buttons more explicitly).
- Improve accessibility across Android versions and devices.

4.5 User Continuous Behavioural Authentication (UCBA) (T4.3)

UCBA supports both web applications and mobile devices, enabling continuous user assessment across platforms. It learns each user's unique behavioral patterns—such as typing dynamics, mouse interactions, touch gestures, or device handling—to provide seamless and ongoing authentication while the user accesses a web or mobile application. By analyzing these behavioral signals in real time, UCBA strengthens security without disrupting the user experience.

4.5.1 Evaluation Overview

Component	UCBA
Pilot Partner performing the evaluation	METRO
Number of evaluation participants	4

4.5.2 Evaluation activities performed

The UCBA (User Continuous Behavioural Authentication) component was evaluated as part of the Retail Pilot by two partner organizations: UPRC and METRO. The evaluation took place during the last months of the project, utilizing two different types of devices — a Xiaomi 14T Pro smartphone running Android 14, and an HP laptop using Windows 11. This diversity allowed testing across both mobile and desktop environments.

Participants used the UCBA component in real-world retail pilot workflows. The component's main function — continuous behavioral authentication through user interaction (typing patterns, touch gestures, etc.) — was tested during standard application usage. Behavioral deviation detection was observed as a core part of the authentication process.

Despite few participants expressing uncertainty about the outcomes and process, the others confirmed the component successfully tracked user behavior and even detected deviations, thereby fulfilling its functional requirements.

4.5.3 Main evaluation outcomes

Feedback on UCBA was mixed due to varied familiarity levels among participants. Some of the evaluators noted that they were unsure how to interpret the outcomes and what to expect from the test. The others, however, reported that the component worked as expected and successfully monitored user behavior. Notably, it identified behavioral deviations during testing, showcasing the intended continuous monitoring feature.

In terms of usability, the component received positive usability scores. All evaluators rated it “Easy” to use and learn, with a moderate to very intuitive interface. Half of the evaluators reported no issues or bugs, while the others gave no definitive feedback, indicating possible need for clearer onboarding or evaluation guidance.

Reliability was positively acknowledged, rating the tool “Extremely reliable”, and all of them indicating a lack of crashes or performance issues. Regarding the Net Promoter Score, users gave a rating of 3, and the others gave a 7, indicating moderate willingness to recommend the tool to peers.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

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Table 9: UCBA Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				50.00%	50.00%	4.50
Ease of Learning				50.00%	50.00%	4.50
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness			50.00%		50.00%	4.00
Reliability					50.00%	5.00
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Issues Encountered (lower is better)		50.00%				2.00
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction			50.00%	50.00%		3.00

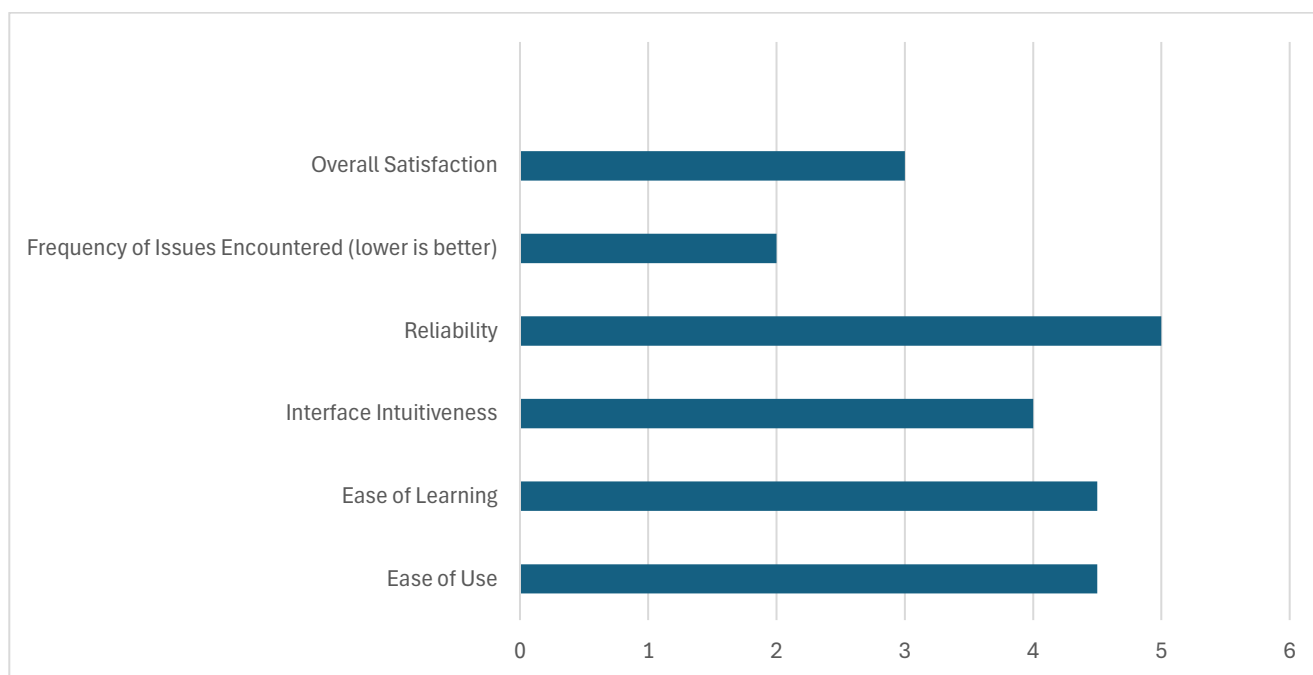


Figure 35: UCBA Evaluation results

Table 10: UCBA Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)				50.00%				50.00%				5.00

The evaluation of the UCBA component within the Retail Pilot demonstrated that the system functions as intended, successfully tracking user behavior and detecting deviations in real time. Despite one evaluator expressing uncertainty about the evaluation process, the others confirmed positive performance outcomes. Usability, reliability, and interface intuitiveness were rated positively, with no bugs or technical issues reported. To enhance user understanding and trust, future iterations would benefit from improved onboarding support and clearer visibility into behavioral metrics. Overall, UCBA shows strong potential as a seamless, non-intrusive authentication solution in retail environments.

4.5.4 Suggestions for component improvement

No specific bugs or usability weaknesses were identified in the evaluation responses. However, due to the ambiguity in interpretation by some evaluators, it is recommended to provide:

- Clearer guidance on expected outcomes during evaluation sessions.
- A brief onboarding walkthrough or usage video for evaluators unfamiliar with behavioral biometrics.
- A real-time feedback dashboard showing detected behavior patterns or deviations for transparency and trust.

These measures could help users better understand the functioning and usefulness of the UCBA tool, especially in pilots involving non-technical participants.

4.6 EDAE & VIS (T5.1 & T6.4)

Exploratory Data Analysis Engine (EDAE) has developed a series of services for ensuring data quality in order to be used by other TANGO components. Reports extracted from EDAE are used by the VIS component.

The Visualisation and Reporting Techniques component implements data visualisation interfaces to analyse big amounts of information, gathered from multiple sources and thus help decision-making pilot users to make informed, data-driven, decisions.

4.6.1 Evaluation Overview

Component	EDAE & VIS
Pilot Partner performing the evaluation	INTRA, FN, EXUS, VTT, QUADIBLE, FMAKE, EVIDEN, SQD, NOR, UOM, UPRC, UMU, METRO, RIAS
Number of evaluation participants	30

4.6.2 Main evaluation outcomes

The Visualization and Reporting components was evaluated by 30 participants from various Pilots (e.g. Smart Hospitality, Smart Manufacturing, Retailers) partners including UPRC, UMU, Atos, VTT, INTRA, and others. The evaluations occurred between May and August 2025 and were conducted across a wide range of devices including smartphones, tablets, laptops, and PCs running on Android (versions 10–15), Windows (10, 11, Enterprise), Linux (Ubuntu), and macOS (Ventura, Sonoma).

The primary outcome of the evaluation was highly positive, with nearly all participants successfully accessing personalized reports visualizing statistics such as hotel energy consumption, room behavior, and traveler insights in the smart hospitality pilot or identifying the most profitable items in wholesale insider retail sector. The majority

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described the reports as clear, informative, and visually well-presented, offering meaningful insights into consumption patterns and user behavior. Some noted the reports loaded quickly and offered detailed breakdowns via charts and graphs. Regarding the Smart Hospitality use case, a few advanced users appreciated that the reports were generated securely via integration with the NADIA API.

Most evaluators confirmed the component functioned as expected. Minor network-related delays were reported during live demonstrations but were not considered major functionality issues. One user reported a problem with smartphone rendering, where large graphs became difficult to read on smaller screens.

Regarding goal achievement, nearly all users indicated that they were able to complete their intended tasks and found the visualizations helpful. A few exceptions were related to device limitations (e.g. poor mobile connectivity or lack of linked room sensors), but these were external to the component itself. Participants generally found the reports useful for both personal insight and broader analysis.

Most users experienced no technical difficulties or frustrations. The only recurring complaint was related to the multistep onboarding and app-installation process, particularly for first-time users. Others suggested that while the system worked fine once loaded, integration between login, room assignment, and sensor data could be streamlined further. One user noted a mismatch between room IDs and occupancy tracking, which may require back-end improvements in data alignment. On the other hand, regarding the retail pilot there experienced no difficulties.

Suggestions for improvement in smart hospitality included enhancing mobile responsiveness, such as resizing charts and optimizing visuals for small screens. Participants also proposed clarifying the time-of-day segments (e.g. morning, noon) in charts by adding explicit hour ranges. Another recommendation was to ensure room IDs and reservation IDs are consistently linked for more accurate personalization and analytics. Regarding the retail sector, the areas of improvement would be to visualise and categorize the shops with the most profitable product category to do category.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 11: EDAE & VIS Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use	0.00%	4.35%	0.00%	34.78%	60.87%	4.52
Ease of Learning	0.00%	4.35%	4.35%	26.09%	65.22%	4.52
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness	0.00%	0.00%	13.04%	47.83%	39.13%	4.26
Reliability	4.35%	4.35%	0.00%	65.22%	26.09%	4.04
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Issues Encountered (lower is better)	65.22%	17.39%	4.35%	4.35%	8.70%	1.74
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction	0.00%	4.35%	8.70%	34.78%	52.17%	4.35

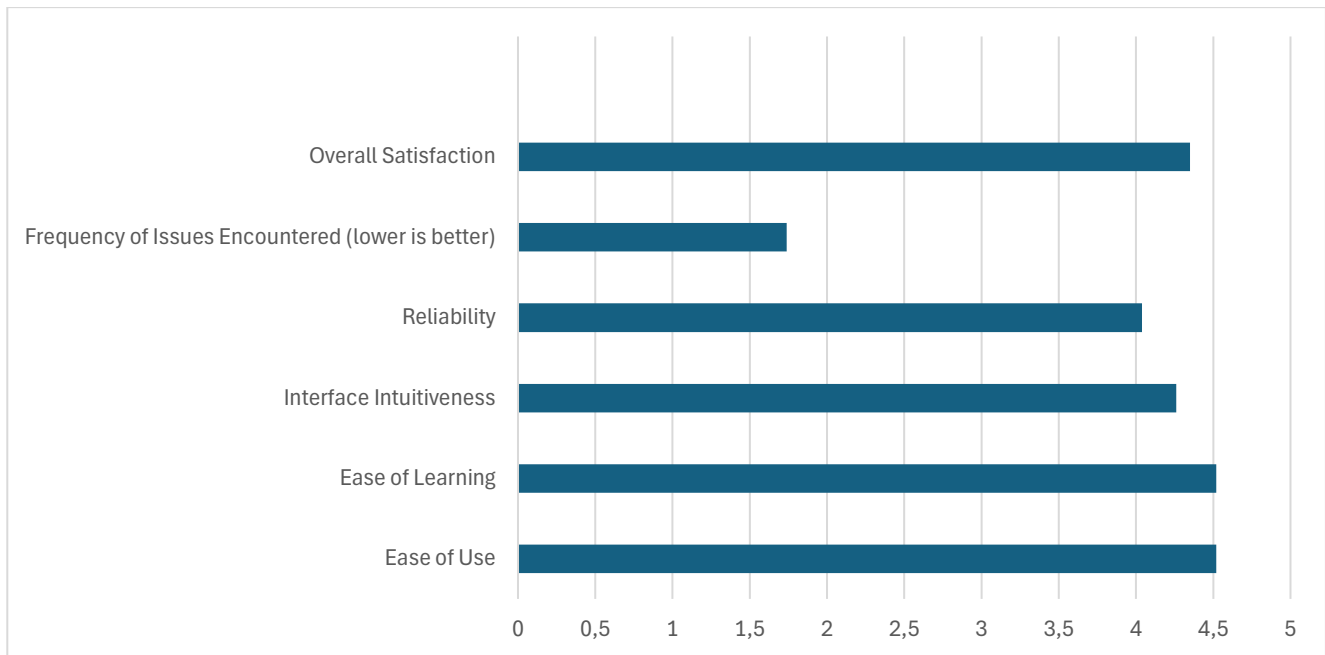


Figure 36: EDAE & VIS Evaluation results

Table 12: EDAE & VIS Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)	0.00%	0.00%	0.00%	4.35%	0.00%	4.35%	8.70%	8.70%	21.74%	26.09%	26.09%	8.17

The evaluation of the Visualization and Reporting components in the Smart Hospitality & Retailer Pilot demonstrated strong performance, reliability, and user satisfaction. Participants consistently praised the clarity and usefulness of the visualized reports, which offered detailed insights. Usability and learnability were rated very highly, with users finding the interface intuitive and the component stable across various devices. While minor issues were noted—such as chart readability on smaller screens and occasional data mismatches—these did not significantly impact the overall experience.

4.6.3 Suggestions for component improvement

Suggestions for improvement included enhancing mobile responsiveness, such as resizing charts and optimizing visuals for small screens. Participants also proposed clarifying the time-of-day segments (e.g. morning, noon) in charts by adding explicit hour ranges. Another recommendation was to ensure room IDs and reservation IDs are consistently linked for more accurate personalization and analytics.

- **Enhance Data Linking:** Improve connection between reservation IDs, room occupancy, and associated data points.
- **Refine UI Labels:** For example, specify time ranges (e.g., “morning = 6am–10am”) in pie chart legends.
- **Improve Device Compatibility & Access:** Simplify access without requiring multiple apps or QR scans.

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- **Dynamic Data Updates:** Consider real-time or periodic updates to dashboard metrics for responsiveness.

Regarding the re tailer pilot:

- **Enable graph customization** to allow users to adjust chart types, metrics, or axes as needed.
- **Visualize and categorize** shops by their most profitable product categories to support category management strategies.
- **Add a summary table** for top 10 products showing their percentage contribution to total sales in retail vs wholesale.
- **Simplify pie chart labels**, making profit numbers for each store less condensed and more readable.

4.7 Privacy Assurance Tool (PAT) (T5.4)

The Privacy Assurance Tool (PAT) is a desktop-like web application designed to facilitate secure and transparent data sharing between users and organizations, particularly in B2C data collection scenarios. It features separate environments for users and organizations to enhance privacy and security, with a focus on the Smart Hospitality and autonomous vehicles pilots. PAT allows users to manage data sharing preferences and consent, while organizations can request data with customizable requirements.

4.7.1 Evaluation Overview

Component	PAT
Pilot Partner performing the evaluation	UPRC, UOM, EVIDEN, UTH, ECO, KUL, FN, XLAB, INTRA, NOR, FMAKE, QBE, SQD, VTT, IDIADA
Evaluation dates	May – August 2025
Number of evaluation participants	34

4.7.2 Main evaluation outcomes

The evaluation of this specific component was conducted by 34 participants. The assessment of the evaluation took place between the last months of the project (May to August 2025), using a broad variety of Android smartphones but also including laptops and PCs.

Most participants reported that during the login process authentication was performed and completed successfully through the TANGO platform and the SSI Wallet application. The process was described by evaluators as smooth, easy, and truly functional, with most of them highlighting an intuitive user experience. A few users also noted that the component remembered previous check-ins, which enhanced its usability. Among the evaluators, there was only one user, who reported that the process failed due to technical issues with camera access and during the passport scanning. Moreover, almost all the respondents confirmed that the component functioned as expected that they were able to successfully complete their check-in. However, there was one exception, who experienced specific issues with device compatibility and browser-based camera access.

Therefore, most of them concluded that the component is useful and easy to use. Feedback indicated that the check-in flow was logical, and instructions—particularly when using the dashboard in combination with the mobile wallet—were sufficient for guiding users through the process. However, some participants offered valuable suggestions for improvement. These included simplifying the user interface, pre-filling more form fields using scanned passport data, and providing clearer guidance on credential selection and usage. Visual consistency across steps was also highlighted as an area for improvement to reduce user hesitation and potential abandonment.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

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Table 13: PAT Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use	3.85%	3.85%	11.54%	50.00%	30.77%	4
Ease of Learning	0.00%	11.54%	11.54%	50.00%	26.92%	3.92
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness	0.00%	11.54%	23.08%	57.69%	7.69%	3.62
Reliability	0.00%	0.00%	7.69%	76.92%	15.38%	4.08
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Issues Encountered (lower is better)	73.08%	11.54%	11.54%	3.85%	0.00%	1.46
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction	3.85%	3.85%	11.54%	57.69%	23.08%	3.92

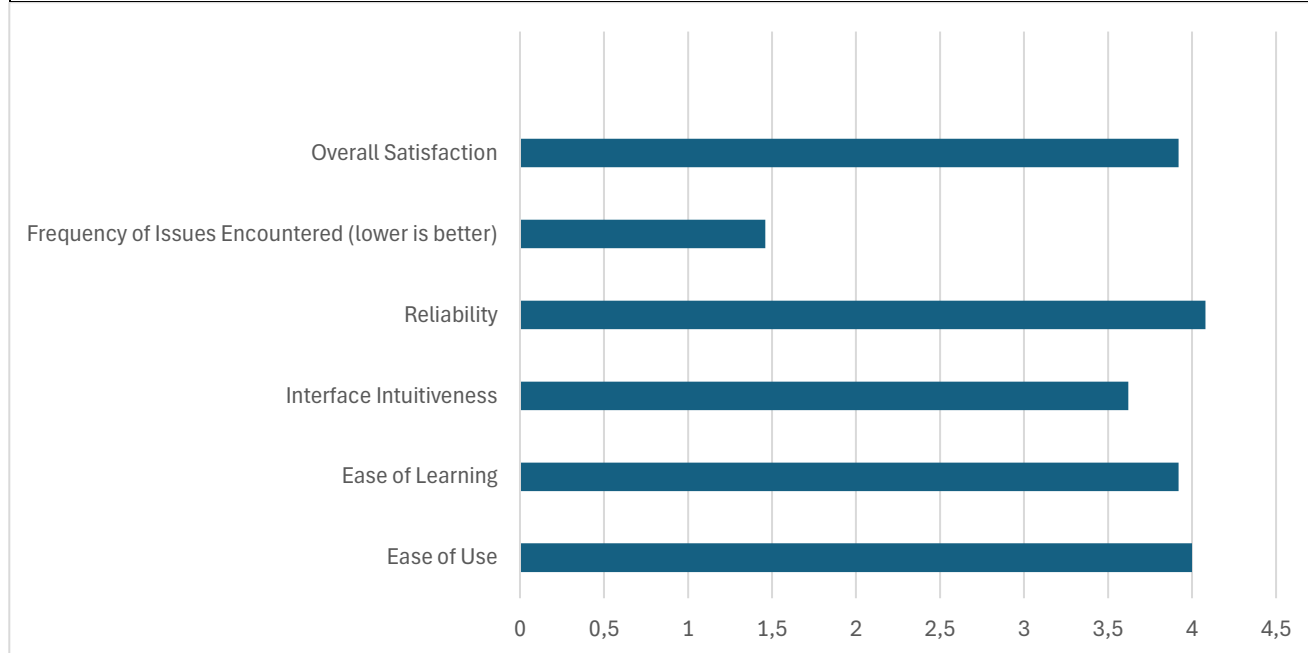


Figure 37: PAT Evaluation results

Table 14: PAT Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)				3.85%	3.85%	7.69%		19.23%	26.92%	19.23%	19.23%	7.81

4.7.3 Suggestions for component improvement

some participants offered valuable suggestions for improvement. These included simplifying the user interface, pre-filling more form fields using scanned passport data, and providing clearer guidance on credential selection and usage. Visual consistency across steps was also highlighted as an area for improvement to reduce user hesitation and potential abandonment.

- **UI and UX Enhancements:**
 - Improve visual consistency and page transitions.
 - Clearly display confirmation messages at the top of the screen.
 - Introduce more visual cues and step-by-step guidance in plain language.
 - Streamline or combine redundant steps.
- **Automation and Smart Features:**
 - Auto-fill fields using scanned passport data.
 - Guide users to select the appropriate credential automatically.
- **Technical Fixes:**
 - Improve camera access compatibility across browsers and devices.
 - Deactivate the check-in button after a successful check-in or show a "You're already checked in" notice.

5 Phase 2 – Integrated pilot evaluation – Results

5.1 Overview of pilot evaluation activities

The second phase of pilot evaluation was completed with the evaluation of the seven TANGO pilot use cases across six domains, where the TANGO platform was used and evaluated as a fully integrated solution within each pilot's operational environment. Phase II activities focused on the orchestration of TANGO components in real-world workflows, involving multiple stakeholders and contextual variables.

The following table presents an overview of the pilot uses cases through which the TANGO platform was evaluated.

Table 15: TANGO pilot cases used in Phase II evaluation

Pilot / Lead partner	Description
Smart Hospitality (ANYs)	<p>The Smart Hospitality pilot aimed at improving the experience of tourists at the hotel by:</p> <ul style="list-style-type: none"> • Increasing the knowledge of the hotel on the tourists' preferences to offer better services • Improving the hotel check-in process • Adapting the room functionalities to the client's requirements • Offering personalised information to the clients based on their preferences.
Autonomous Vehicles (IDIADA)	<p>The Autonomous Vehicles pilot, coordinated by IDIADA, focuses on integrating TANGO's decentralized data governance and AI-driven personalization into a controlled automotive testing environment. This pilot primarily explores how trusted data flows and verifiable digital credentials can enhance data sharing, model validation, and safety compliance in autonomous driving scenarios.</p>
Smart manufacturing – Factory shopfloor (RIAS)	<p>The smart manufacturing pilot aims at enhancing workplace safety, optimize workflows, and validate TANGO's consent-based data control architecture through the monitoring of employee movement and access within the factory premises.</p>
Smart manufacturing – 3D printing (FMAKE)	<p>The pilot focuses on secure and trustworthy sharing of data and AI models among internal departments and external stakeholders (such as customers and suppliers), primarily for quality assurance and predictive maintenance in industrial manufacturing environments.</p>
Banking (ABILAB / NTT)	<p>The Banking Pilot explores the application of Federated Learning (FL) to anti-fraud detection in a multi-bank setting. Its objective is to leverage the collective intelligence of different financial institutions while maintaining the privacy and sovereignty of their customer data. By enabling banks to share model parameters rather than raw data, the pilot aims to build a robust global fraud detection model that adapts faster to emerging fraud patterns.</p>
Public Organisations (VISAR)	<p>The Public Administration pilot demonstrates how TANGO can strengthen trustworthy data governance in interactions between public sector organizations and citizens. The pilot aims to ensure that sensitive personal and administrative data can be shared across distributed systems in a legally compliant, privacy-preserving, and transparent way.</p>
Retailers (METRO)	<p>The Retailers pilot demonstrates how TANGO technologies can enhance data-driven decision-making in the retail sector while ensuring privacy, trust, and compliance. It focuses on empowering IT managers and business managers (marketing, sales, product) to securely analyze distributed retail data from different locations using TANGO's identity, policy, and analytics components.</p>

The following table presents a mapping of TANGO components that were used in each of the pilot cases. The components list is sorted per WP.

Table 16: TANGO Components used per pilot case

Component	Hospitality	Vehicles	Man. FMAKE	Man. RIAS	Public Sector	Retail	Banking
FIDES (T3.1)					X		
TSM (T3.2)		X					
UPCV (T3.2)	X						
CP-ABE (T3.3)			X				
PEP/PDP (T3.3)	X	X	X	X		X	
SEDSS (T3.4)			X				
SSI-Agent (T4.1)	X	X	X	X		X	
SSI-Wallet (T4.1)	X	X	X	X		X	
SOUD (T4.2)	X	X	X	X		X	
UCBA (T4.3)						X	
DCBA (T4.4)				X			
EDAE (T5.1)	X					X	
MLOps (T5.2)			X				X
FLEVIDEN (T5.2)			X				X
AUTOML (T5.2)			X				X
TornadoVM (T5.3)						X	
PEC (T5.4)		X			X	X	
PAT (T5.4)	X	X					
XAI (T5.5)			X				X
RENOPS (T5.6)			X				
UI (T6.3)	X	X	X	X		X	
VIS (T6.4)	X			X		X	

5.2 Legal and Ethical Considerations during the Pilot Phase

During the implementation phase of the use pilotes, there were specific challenges and problems related to personal data and ethical issues, due to the fact that the survey included human beings. Therefore, in order to deal with this kind of issues, a specific legal documentation, called Data Processing Agreements (DPAs) and informed consent forms were developed by the legal partner and send to all evaluators and pilots in order to ensure that all those sensitive issues will be handled based on legal and ethical standards.

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With respect to personal data processing, DPAs were put in place in all instances where multiple processors were involved in handling participants' personal data, under the overall responsibility of a designated controller. These consent forms were developed in order to ensure that all the operating activities that will take place in the use cases will be complied with the General Data Protection Regulation (GDPR). The controller retained ultimate accountability for ensuring that processing activities remained lawful, transparent and secure.

Furthermore, to meet the legal requirements for lawful data processing and to regulate the participation of individuals external to the core consortium (i.e., third-party participants), specific inclusion criteria were established for participation in the TANGO pilot activities. These criteria governed the selection of individuals who took part in testing and evaluating the functionalities of the TANGO framework. In alignment with GDPR requirements, particularly Articles 6 and 7, dedicated consent forms were prepared, disseminated and duly signed by the data subjects. These forms ensured that consent was obtained freely, based on clear and comprehensive information and included provisions allowing data subjects to withdraw their consent at any time without adverse consequences.

Upon the conclusion of each pilot activity, the relevant documentation, including signed consent forms and DPAs, was uploaded to the project's secure cloud infrastructure, in accordance with internal organisational protocols and data security requirements. Any personal data collected during the pilots were retained either on the premises of the data controller or in a secure cloud environment, in line with the data retention and access provisions defined in the applicable agreements.

5.3 Pilot 1 - Smart Hospitality

5.3.1 Pilot overview

The main objective of the Smart Hospitality pilot was to improve the experience of tourists at the hotel by:

- Increasing the knowledge of the hotel on the tourists' preferences to offer better services
- Improving the hotel check-in process
- Adapting the room functionalities to the client's requirements
- Offering personalised information to the clients based on their preferences

To this end, the goals of the pilot were to:

- Gather information of the clients to be able to offer them a personalised experience
- Ensure data privacy of the clients
- Increase the digitalisation of the hotel by making them aware of the different existing solutions and the power of data

TANGO contributed to preserving clients' privacy, enabling the delivery of services while ensuring a respectful, secure and trustable use of clients' personal data. The TANGO platform was used to provide effective resiliency against multiple attack vectors aiming at exploiting a range of vulnerabilities of the host device.

During the pilot activities two types of datasets were used:

- Personal data provided by the Hotel Customers upon check-in at the Hotel.
- Historic and real data collected by the NADIA platform on selected rooms' use of energy (temperature, use of electricity, etc.)

5.3.2 Deployment environment / Legacy systems integration

The Smart Hospitality pilot was deployed in Playa de Muro, Mallorca, Spain, utilizing a real-world operational environment. The deployment setup includes both physical infrastructure at the hotel facilities and virtual environments hosted by AnySolution services. The systems are interconnected to facilitate a seamless interaction between tourists, hotel personnel, and the TANGO platform components.

The deployment required configuring digital identity mechanisms using a secure digital wallet. This enabled guests and staff to authenticate and access services via QR codes and secure credentials stored on their smartphones. Each user could assume multiple roles (e.g., tourist, manager, employee) with different levels of access and service offerings.

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Integration with legacy systems was approached via API-based interconnections. For example, TANGO components are designed to integrate with the hotel's Property Management System (PMS) for real-time check-in, room assignment, and guest service personalization. Although full PMS integration is still under development, preliminary tests demonstrated the feasibility of synchronizing room data, energy consumption, and user behavior patterns across systems.

The energy monitoring tools were deployed in coordination with existing hotel infrastructures. These tools provided guests with personalized activity suggestions and feedback on their environmental impact while ensuring minimal disruption to existing hotel operations.

5.3.3 Legal / Ethical issues

In the context of the first pilot, Smart Hospitality, a dedicated DPA was executed to regulate the roles and responsibilities of the parties involved in the processing of personal data. This was deemed necessary due to the participation of multiple data processors handling personal data of pilot participants. ATOS assumed the role of data controller, maintaining overall responsibility and oversight for the processing operations in accordance with Article 28 of the GDPR.

The participants in this pilot were representatives of the project partner organisations, acting in the role of simulated hotel guests. Prior to their involvement, they signed dedicated informed consent forms that clearly outlined the scope and purpose of the data processing activities. These forms ensured that consent was obtained in full compliance with Articles 6 and 7 of the GDPR, with particular emphasis on the principles that consent must be freely given, specific, informed and capable of being withdrawn at any time without adverse consequences.

The personal data collected during the pilot have been securely stored at the premises of ANYS in encrypted (pseudonymised) form. Data retention has been strictly limited to the period specified in the consent forms, in compliance with the principles of purpose limitation and data minimisation as set out in Articles 5 par. 1 (b) and 5 par. 1 (c) of the GDPR. Upon expiration of the retention period, the data will be permanently and irreversibly deleted, in line with the applicable data protection standards and the terms of the relevant agreements.

5.3.4 Pilot Implementation and Testing scenarios

The pilot was implemented in Playa de Muro, Mallorca, Spain, with a controlled group of users, all of which were project consortium members. In addition, employees and the Manager of the Garden Hotel reviewed the TANGO services for the Hospitality pilot and provided valuable feedback. Two main stakeholders were involved:

- The Hotel Customer (i.e. tourist)
- The Hotel Manager

The testing scenarios for the Smart Hospitality pilot case are the following:

Table 17: Smart Hospitality pilot: Tourist / Hotel customer scenario

Scenario Step	Description	Components involved
Tourist onboarding	Before travelling, the tourist installs the SSI Wallet and ePassport apps on NFC-enabled devices to acquire a digital identity (ePassPort) on their mobile phone. The tourist creates a secure digital wallet for identity credential storage and uses that to register to the TANGO platform.	SOUND (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services. PEP/PDP
Tourist checks-in at the hotel using digital wallet identity	The tourist initiates the check-in process by scanning a QR code and submitting required data via the PAT form. For this purpose, the tourist digital identity stored on the tourist's mobile phone is used.	UI PAT PEP/PDP

Scenario Step	Description	Components involved
Tourist receives suggestions for activities and services.	While on location, the tourist has access to activity recommendations through the Recommender component.	UPCV UI for getting access to various services.
Hotel room settings are monitored and set according to tourist preferences.	While staying at the hotel, the NADIA platform gathers data from sensors installed in the room. The data refers to: room temperature, light usage, AC usage, etc.	NADIA platform
Upon check-out the tourist evaluates the overall experience.	At check-out, the tourist evaluates the overall experience on a dedicated application provided by the hotel.	Hotel mobile app for service evaluation.
Upon check-out the tourist receives a report on energy and resources	After check-out the tourist receives a report about the energy and resources used during their stay.	UI for getting access to various services. EDAE and VIS for data analysis and display

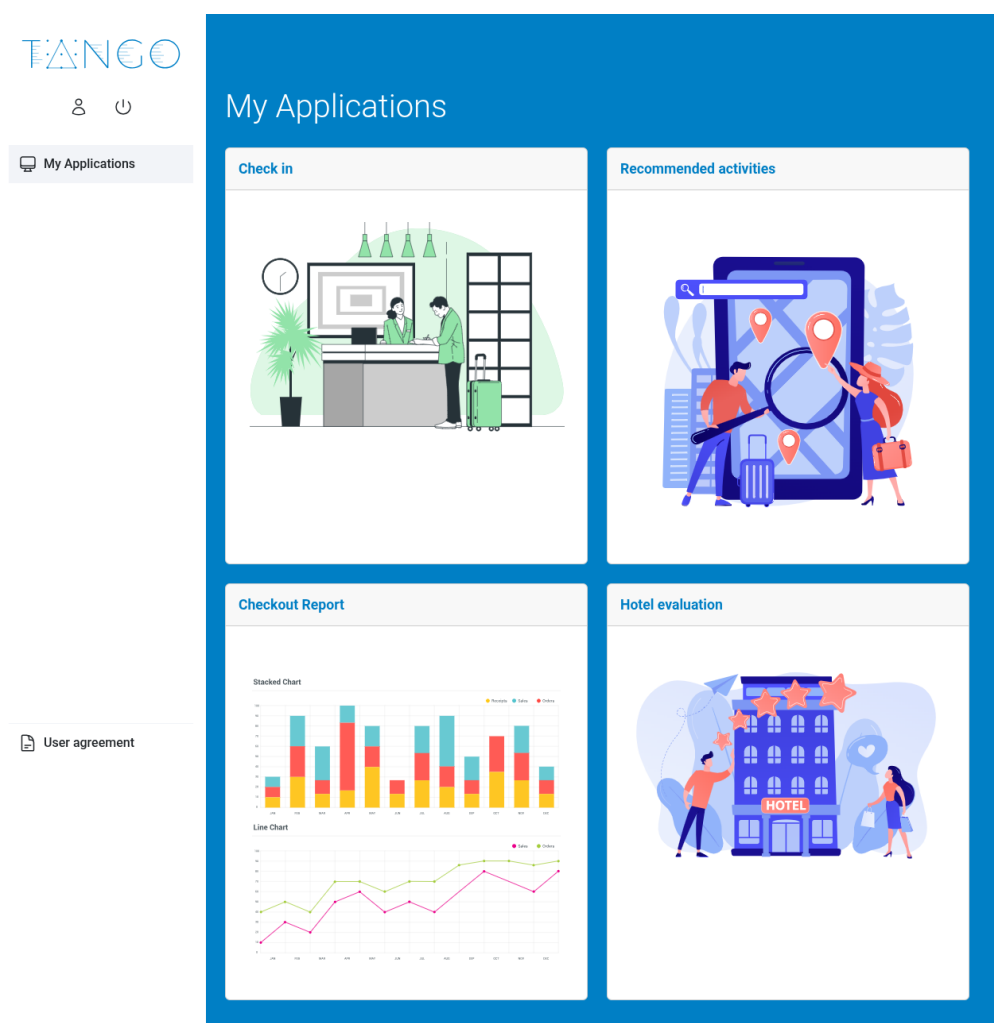


Figure 38: Smart Hospitality pilot: The tourist dashboard

Table 18: Smart Hospitality pilot: Hotel manager scenario

Scenario Step	Description	Components involved
Managers and hotel employees onboarding	The manager installs the SSI Wallet and ePassport apps on NFC-enabled devices to acquire a digital identity (ePassPort) on their mobile phone. The manager creates a secure digital wallet for identity credential storage and uses that to register to the TANGO platform.	SOUND (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services. PEP/PDP
Managers access reports on energy and resources consumption and on tourist satisfaction.	The manager has access to reports based on customer data that is collected by various existing hotel platforms (e.g. NADIA, user experience evaluation platform, etc.). Managers' access varies depending on their level (local, regional, group manager).	PEP/PDP CP-ABE EDAE VIS

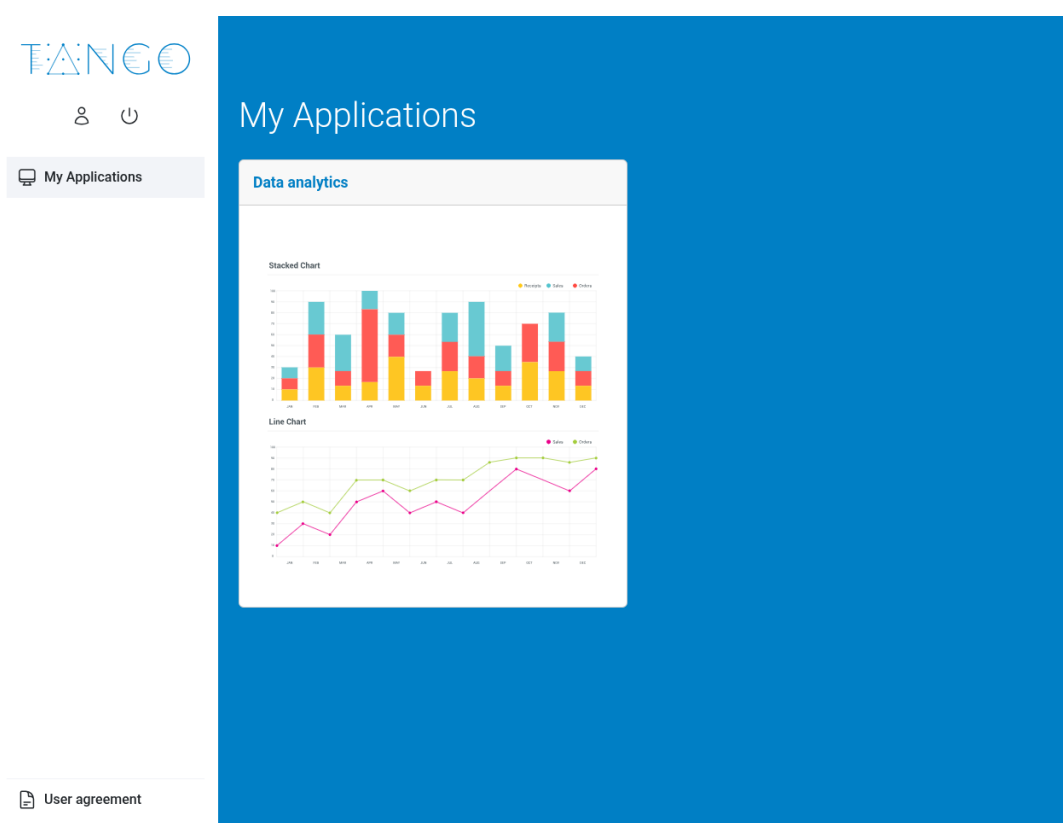


Figure 39: Smart Hospitality pilot: The Manager dashboard

5.3.5 Evaluation results

The purpose of this pilot was to evaluate the TANGO digital platform in a real-world testing scenario, in order to support tourists, from the process of onboarding to check-in, to deliver personalized services, and provide them with data and figures. 24 participants took place from different industries and the final evaluation took place during the last months of the project (May to July 2025).

All the evaluators used different kind of devices, such as smartphones, PCs, and laptops, which were using different softwares, such as Android, iOS, Windows. This broad device variety allowed evaluators to assess cross-platform performance and usability. The participants engaged in activities such as ePassport onboarding, credential exchange via SSI Wallets, hotel check-in, interaction with the recommendation engine, and data visualization through user dashboards.

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Most evaluators were able to complete the full set of tasks outlined in the pilot. They successfully navigated from registration and credential exchange to receiving tailored recommendations and accessing consumption analytics. However, some reported partial success due to technical issues, especially related to the ePassport application. Several users experienced challenges installing the ePassport APK or faced errors during the passport scanning process, particularly on iPhones or older Android devices. A few participants were unable to progress past the onboarding phase, while others completed the flow only after multiple attempts.

The general consensus indicated that the platform is functional and shows promise, though it is not without areas for improvement. Many users described the system as secure and conceptually well designed. Once initial authentication was completed, the subsequent experience—such as check-in and data analytics—was smooth. Nevertheless, the onboarding process, particularly involving ePassport scanning and switching between different applications, was repeatedly identified as a bottleneck.

Participants appreciated the idea of a secure, decentralized, and intelligent hospitality platform. However, many expressed a need for improvements in user experience design, clearer step-by-step guidance, and fallback options when technical problems arise. Suggestions for enhancement included simplifying the onboarding and login process, increasing the sensitivity and reliability of passport scanning, offering temporary Android devices for users without compatible phones, and refining the recommendation logic to better reflect user preferences.

Technical feedback centered largely on the ePassport module, which many found inconsistent or difficult to use. Issues ranged from camera access failures in browsers, long scanning times, to total incompatibility with certain mobile operating systems. Some noted that network instability or older devices compounded these problems. Despite these challenges, many users found the remaining platform components—such as check-in, recommendations, and reporting—stable and functional.

From a usability perspective, the platform received generally favorable reviews. The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 19: Smart Hospitality Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use		16.67%	12.50%	62.50%	8.33%	3.63
Ease of Learning		12.50%	25%	50%	12.50%	3.63
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness	4.17%	4.17%	33.33%	54.17%	4.17%	3.50
User Friendly		12.50%	37.50%	50%		3.38
Supporting Material		25%	66.67%	8.33%		3.83
Reliability		8.33%	25%	66.67%		3.58
Accuracy		4.17%	20.83%	75%		3.71
Effectiveness of access control measures		4.17%	16.67%	62.50%	16.67%	3.92
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	25%	45.83%	12.50%	16.67%		2.21

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Frequency of security issues (lower is better)	70.83%	20.83%				1.38
	Very	Insecure	Neutral	Secure	Very Secure	
Security	4.17%		25%	45.83%	25%	3.88
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
ePassport	12.50%	8.33%	29.17%	33.33%	16.67%	3.33
SSI Wallet	8.33%	4.17%	16.67%	50.00%	20.83%	3.71
Check-in	0.00%	4.35%	21.74%	47.83%	26.09%	3.96
Recommender	0.00%	4.17%	20.83%	54.17%	20.83%	3.92
Visualisation & Reporting	0.00%	8.33%	8.33%	45.83%	37.50%	4.12
Hotel evaluation	0.00%	0.00%	12.50%	58.33%	29.17%	4.17
TANGO Platform		4.17%	12.50%	58.33%	25%	4.04

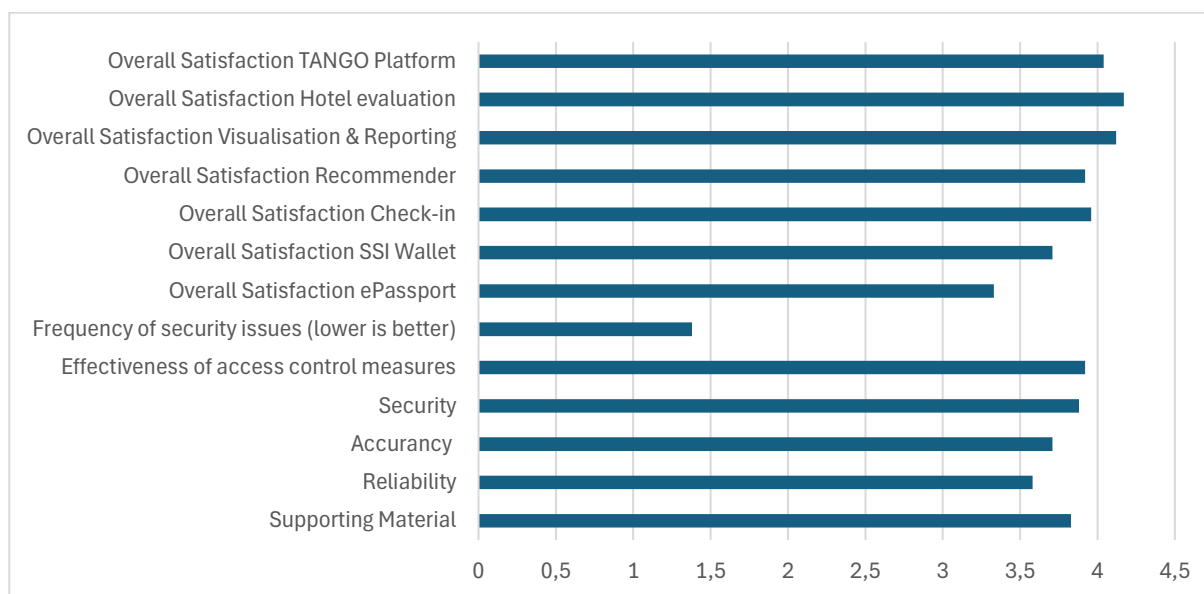


Figure 40: Smart Hospitality Evaluation results

Table 20: Smart Hospitality Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)		4.17%		4.17%		8.33%	16.67%	12.50%	20.83%	16.67%	16.67%	7.29

5.4 Pilot 2 - Autonomous Vehicles

5.4.1 Pilot Overview

The Autonomous Vehicles pilot, coordinated by IDIADA, focuses on integrating TANGO's decentralized data governance and AI-driven personalization into a controlled automotive testing environment. This pilot primarily explores how trusted data flows and verifiable digital credentials can enhance data sharing, model validation, and safety compliance in autonomous driving scenarios. It targets interactions among different stakeholders (data providers, OEMs, and test operators), emphasizing secure, consent-based access to high-value test and performance data. The use of Self-Sovereign Identity (SSI), policy-based access control, and context-aware trust scoring supports a next-generation framework for collaborative vehicle testing and certification.

5.4.2 Deployment environment/ Legacy systems integration

The pilot is deployed within IDIADA's test track and virtual infrastructure, supported by a single-node Kubernetes cluster tailored for the TANGO services. This cluster hosts various TANGO components such as the FIWARE Connector, Trustworthiness Module, Policy Enforcement Point (PEP), and Data Connector. Consumer organizations (e.g., clients requesting test results) operate via Docker-based Linux hosts and mobile applications, enabling secure access to services like the ePassport, SSI Wallet, and TANGO dashboard.

From a technical standpoint, the integration of legacy systems is accomplished via REST APIs and SQL-based data management systems, with compatibility ensured for standard formats like JSON and CSV. Data flow is mediated through authentication tokens and attribute-based encryption mechanisms to safeguard sensitive datasets and enforce granular access control.

Furthermore, TANGO components support both centralized orchestration (from the central cluster) and local autonomy (pilot-level clusters), allowing the IDIADA setup to remain resilient and isolated when needed. The deployment was carefully mapped to meet stringent network and certificate requirements (public TLS certificates, VPN options, FQDN resolution).

5.4.3 Legal / Ethical issues

In the Autonomous Vehicles pilot, all activities were conducted within IDIADA's secured and controlled testing environment, with access strictly limited to IDIADA personnel. Given that a single entity (IDIADA) was solely responsible for all personal data processing operations and thus acted as the sole data controller, there was no requirement to establish a DPA, as no external processors were involved.

Instead, dedicated informed consent forms were prepared, distributed to and duly signed by all participating users. These forms outlined the scope and purpose of the data processing, ensuring that consent was obtained in accordance with the requirements of Articles 6 and 7 of the GDPR, particularly emphasising that consent must be freely given, specific, informed and capable of being withdrawn at any time.

The personal data collected, primarily through the user registration forms, were intended for the creation and management of user profiles, facilitating access to autonomous taxi ride services. All data were securely stored on IDIADA's local servers and retained for a limited period, as specified in the corresponding consent documentation. Upon expiration of the retention period, the data will be anonymised in a manner that irreversibly prevents identification of data subjects and may subsequently be used for analysis, reporting, or the enhancement of the service, in line with the GDPR principles of purpose limitation and data minimisation (Article 5 par. 1 (b) - (c)).

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5.4.4 Pilot Implementation & Testing scenarios

The IDIADA pilot took place at IDIADA premises with the participation of IDIADA employees. Tests revolved around secure data sharing between trusted data providers (IDIADA) and data consumers (IDIADA clients) who requested access to the mpas developed by IDIADA in relation to their premises. The request to access IDIADA maps is performed through the TANGO platform, ensuring that the client is indeed authorised to view such information. In addition, actual access to the map files is enabled through the TANGO platform following specific authorization and access rights policies.

The scenarios for the Autonomous Vehicles pilot case are the following:

Table 21: Autonomous Vehicles pilot: Client scenario (B2B)

Scenario Step	Description	Components involved
Client onboarding	The client acquires a digital identity (ePassport) on their mobile phone. The client uses the digital identity to become onboarded to TANGO, to be able to use TANGO services related to the scenario.	SOUND (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services. PEP-PDP
The client asks IDIADA to access their maps.	The client submits a request to IDIADA to access the maps.	UI for getting access to various services. PAT
The client gets access to the maps.	The client accesses the appropriate files.	UI for getting access to various services. PEP-PDP
The access period expires. The client is no longer able to use the maps.	TANGO restricts access to the files when the permitted period is over.	SSI CP-ABE

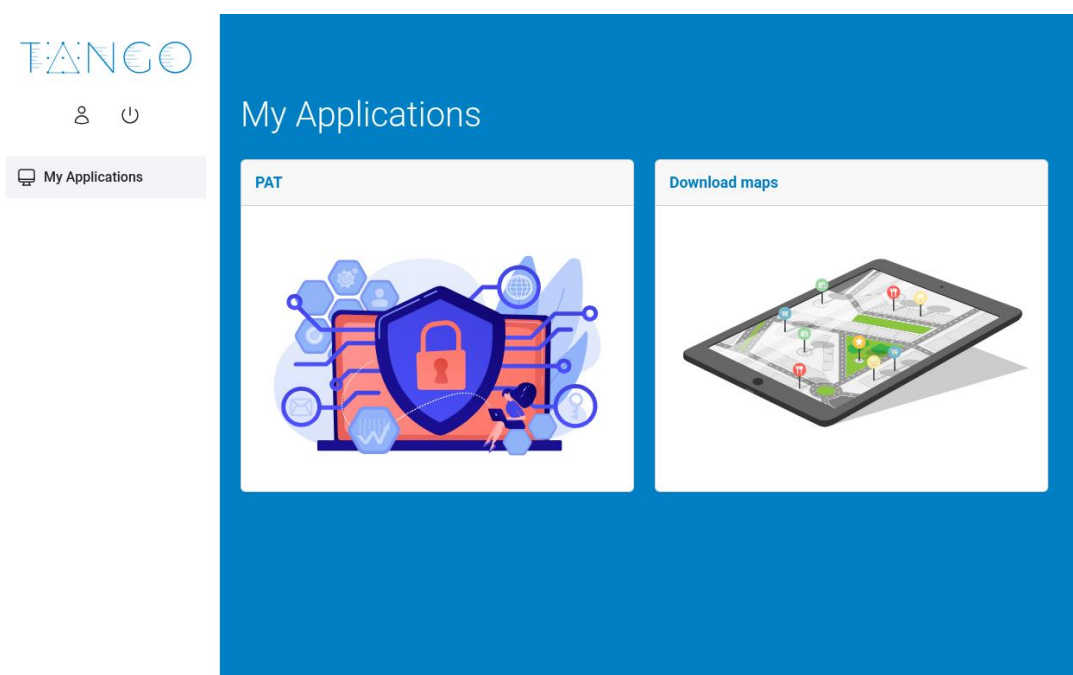


Figure 41: Autonomous Vehicles pilot: The client dashboard

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Table 22: Autonomous Vehicles pilot: Car passenger scenario

Scenario Step	Description	Components involved
Passenger onboarding	<p>The passenger acquires a digital identity (ePassport) on their mobile phone.</p> <p>The passenger uses the digital identity to become onboarded to TANGO, to be able to use the TANGO services related to the scenario.</p> <p>The vehicle device is onboarded to TANGO.</p>	<p>SOUD (ePassport)</p> <p>SSI Agent/Wallet</p> <p>UI</p> <p>PEP/PDP</p>
Passenger arrives at IDIADA and registers for the car ride	The passenger is authenticated by TANGO to perform a test ride.	<p>SOUD (ePassport)</p> <p>SSI Agent/Wallet</p>
Passenger performs the car ride. During the ride, the onboard device communicates securely with the IDIADA server, exchanging information. Car safety is monitored and evaluated by TANGO	<p>The car application is authenticated and authorized to access the IDIADA maps to perform the requested ride.</p> <p>TANGO ensures secure communication</p>	TSM

5.4.5 Evaluation results

The Autonomous Vehicles Pilot tested the TANGO platform in two distinct real-world scenarios to evaluate usability, reliability, and performance in mobility-related contexts:

- **Maps Scenario:** Focused on downloading and managing autonomous driving maps from the platform, testing access control, usability, and file retrieval success under different OS and device conditions.
- **Passenger Scenario:** Simulated the experience of a passenger interacting with TANGO for secure identity verification and registration during a trip.

These scenarios targeted different user journeys and technical features of the TANGO platform, enabling a comprehensive evaluation from functional and experiential standpoints. The scenarios included 11 experts for evaluation.

Maps Scenario

The evaluation of the TANGO platform in the context of autonomous vehicles focused on map download functionality following user authentication via e-passport. The pilot was conducted by IDIADA during the summer, 2025, using different devices and softwares. The process included onboarding with the e-passport, accessing the TANGO platform, browsing available maps, and successfully downloading a selected map.

From a functionality perspective, the platform met expectations without any bugs or critical usability challenges. The evaluators explicitly confirmed goal achievement and noted no difficulties or frustrations during the process. The experience was described as smooth and complete, highlighting the system's reliability and ease of use.

Regarding user satisfaction, all interface aspects—ease of use, learnability, intuitiveness, reliability, and overall satisfaction—received high scores. Security was also perceived as very high, with no reported security issues. Access control measures were deemed effective, and the accuracy of the information provided was rated as very good. Supporting materials were marked as "very available," and no external support was needed during evaluation.

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This pilot demonstrated exceptional stability, as the platform never crashed or became unresponsive. User feedback, though limited to one participant in this scenario, paints a strong picture of usability, trust, and system performance in a highly technical use case. Overall, the evaluator was fully satisfied and gave a 8.78/10 score for the likelihood of recommending the platform.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 23: Autonomous Vehicles Evaluation results (Map Scenario)

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				44.44%	55.56%	4.56
Ease of Learning			11.11%	33.33%	55.56%	4.44
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness			11.11%	55.56%	33.33%	4.22
User Friendly				66.67%	33.33%	4.33
Supporting Material			11.11%	66.67%	22.22%	4.11
Reliability			11.11%	66.67%	22.22%	4.11
Accurancy			11.11%	44.44%	44.44%	4.33
Effectiveness of access control measures				66.67%	33.33%	4.33
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	66.67%	33.33%				1.33
Frequency of security issues (lower is better)	55.56%	33.33%	11.11%			1.56
	Very	Insecure	Neutral	Secure	Very Secure	
Security		11.11%	22.22%	44.44%	22.22%	3.78
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
ePassport		22.22%	11.11%	33.33%	33.33%	3.78
SSI Wallet		11.11%	33.33%	33.33%	22.22%	3.67
User Interface			11.11%	33.33%	55.56%	4.44

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
TANGO Platform			11.11%	55.56%	33.33%	4.22

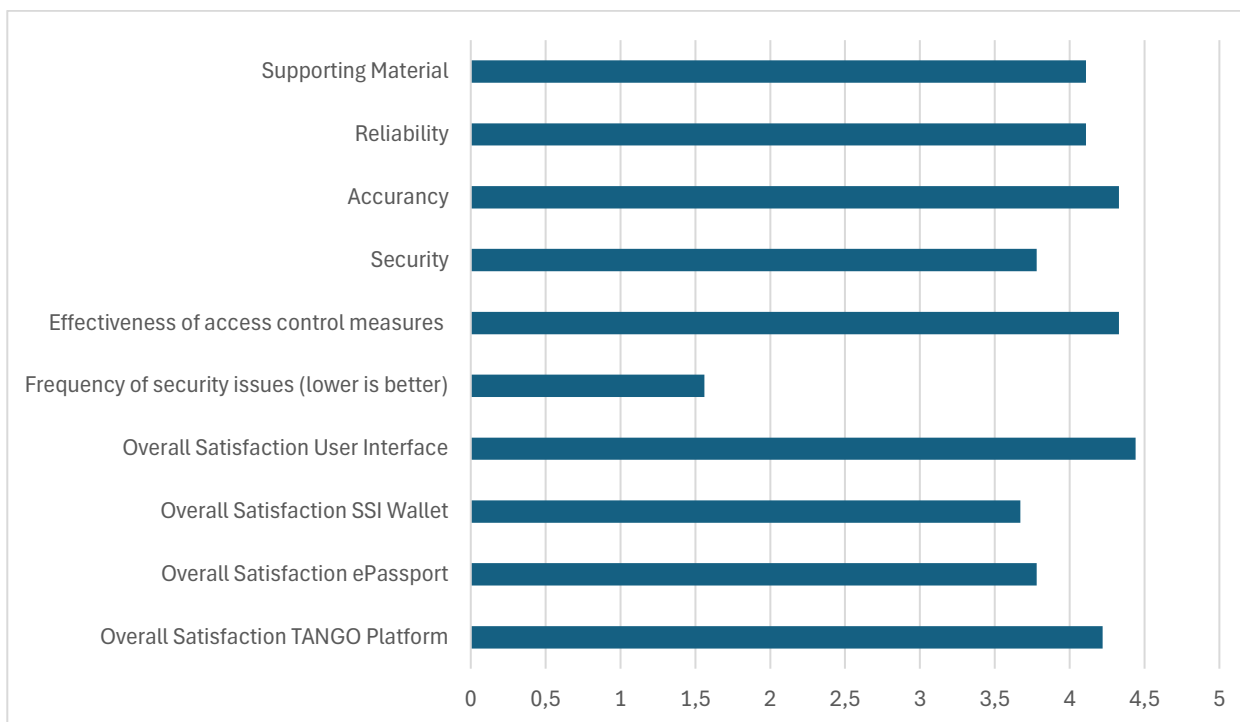


Figure 42: Autonomous Vehicles Evaluation results (Map Scenario)

Table 24: Autonomous Vehicles Net Promoter Scores (Map Scenario)

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)							11.11%		33.33%	11.11%	44.44%	8.78

Passenger

Two partner organizations, UPRC and IDIADA, carried out the evaluations during August 2025, using smartphones with Android 14 & Android 15 as software. The activities included registration, identity verification, and interaction with the TANGO platform within the simulated autonomous vehicle experience. All evaluators confirmed that they completed all required actions without difficulty, and the system behaved exactly as expected. No frustrations or challenges were reported, and one participant explicitly mentioned that the process was smooth from start to finish. The functionality of the TANGO platform during the passenger scenario appeared to be fully mature.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 25: Autonomous Vehicles Evaluation results (Passenger Scenario)

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				50.00%	50.00%	4.50
Ease of Learning			50.00%	50.00%		3.50
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness				100.00%		4.00
User Friendly				100.00%		4.00
Supporting Material				100.00%		4.00
Reliability				50.00%	50.00%	4.50
Accurancy				50.00%	50.00%	4.50
Effectiveness of access control measures				100.00%		4.00
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	100.00%					1.00
Frequency of security issues (lower is better)	100.00%					1.00
	Very	Insecure	Neutral	Secure	Very Secure	
Security				50.00%	50.00%	4.50
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
ePassport		50.00%		50.00%		3.00
SSI Wallet				100.00%		4.00
PAT (registration)				50.00%	50.00%	4.50
TANGO Platform				100.00%		4.00

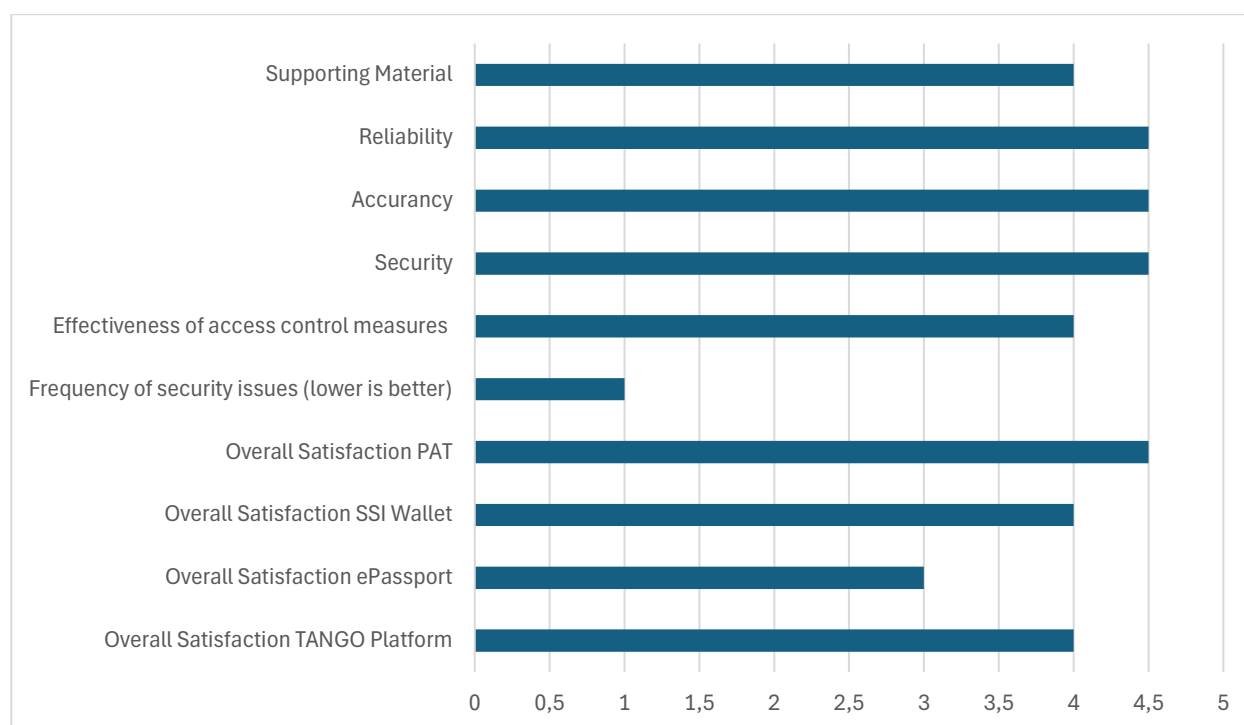


Figure 43: Autonomous Vehicles Evaluation results (Passenger Scenario)

Table 26: Autonomous Vehicles Net Promoter Scores (Passenger Scenario)

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)									50.00%		50.00%	9.00

Though the sample size is small ($n=2$), the consistency of the responses reveals strong user confidence in the platform. The only slight variation was in the learning curve, where one user gave a “Neutral” score — possibly indicating that a minor onboarding enhancement (e.g., tutorial screens) could be helpful for first-time users. Otherwise, the platform was seen as secure, accurate, and highly usable, with zero incidents of failure, positioning it well for broader public deployment.

Across both scenarios, the TANGO platform demonstrated robust technical reliability, excellent usability, and strong user satisfaction. The Passenger Scenario results confirm that the platform is mature and intuitive enough for public-facing mobility use cases, with no bugs or onboarding difficulties. Meanwhile, the Maps Scenario confirmed the platform's scalability and cross-platform functionality, with successful outcomes even under complex OS combinations.

Importantly, both evaluations revealed zero technical faults, reinforcing the notion that the platform is deployment-ready for broader autonomous vehicle applications. Minor improvements suggested — such as map previews and onboarding enhancements — are evolutionary, not critical, pointing toward a well-engineered baseline experience.

The pilot's success not only validates core features but provides strong user-based evidence for wider integration in real-world intelligent transportation systems.

5.5 Pilot 3 - Smart Manufacturing – Case 1: Factory shopfloor safety monitoring

5.5.1 Pilot Overview

The RIAS pilot focuses on demonstrating the value of the TANGO platform in a smart manufacturing context, particularly within a ceramic tableware production facility. It aligns with Industry 4.0 goals by integrating secure data-sharing mechanisms, cybersecurity models, and real-time location services into a live industrial environment. The primary objectives are to enhance workplace safety, optimize workflows, and validate TANGO's consent-based data control architecture through the monitoring of employee movement and access within the factory premises. The use of location-based services (LBS), employee credentialing, and dynamic data access policies enables a more secure and efficient factory floor ecosystem.

5.5.2 Deployment environment/ Legacy systems integration

The deployment environment is RIAS's real-world manufacturing plant, which contains significant structural complexity due to metallic infrastructures and process machinery. To support the pilot, a Wi-Fi Location-Based Service (LBS) system was deployed after a thorough wireless coverage analysis. This evaluation identified key access points (APs) across both 2.4GHz and 5GHz bands, mapping the propagation constraints and suggesting optimization paths for network reliability and channel deconffliction.

Devices involved in the pilot — such as smart watches and mobile phones used by employees — were used as sensing and data collection units, providing real-time information to the TANGO platform.

TANGO's deployment required the setup of Docker containers or a local Kubernetes cluster, ensuring compatibility with RIAS's on-premise infrastructure. Existing employee workflows were only minimally disrupted, as onboarding and location tracking were integrated into routine operations.

5.5.3 Legal / Ethical Issues

In the context of the Smart Manufacturing pilot conducted by RIAS, the individuals participating in the testing activities were employees of the participating organisation. This arrangement raised significant ethical concerns, primarily due to the inherent power imbalance that characterises employer - employee relationships. In such settings, it was essential to ensure that all ethical principles, particularly those relating to voluntariness and autonomy, were duly respected and rigorously implemented.

To guarantee that employee participation was entirely voluntary and free from any direct or indirect pressure, specific informed consent forms were developed and distributed. These documents clearly described the scope and nature of the pilot activities and explicitly stated that participation was based solely on the individual's free will and was in no way connected to their employment obligations. This approach aimed to align with key ethical principles and the GDPR's requirement that consent be freely given, specific, informed and unambiguous (Article 4 (11) and Article 7).

Moreover, to further mitigate potential ethical risks, participation was deliberately limited to a small group of ten employees, all of whom held managerial positions. This strategy was adopted to ensure that participants were sufficiently informed, had a high level of awareness of the pilot's goals and processes and could exercise genuine freedom of choice without concerns of hierarchical pressure.

In terms of monitoring activities, it is important to emphasise that only corporate devices (i.e. work-assigned mobile phones) were subject to monitoring. At no point were employees' personal devices included in the pilot activities. Furthermore, the tracking of location data was carried out in a privacy-conscious manner: no GPS-based tracking was employed. Instead, an alternative system was used that provided only approximate location information, thus avoiding the collection of precise geolocation data and reducing intrusiveness.

From a data protection perspective, the involvement of multiple project partners in the processing of employees' data necessitated the conclusion of a dedicated DPA. RIAS acted as the data controller, bearing overall responsibility for the processing operations. The controller's role included the collection and secure storage, limited to a predefined period, of employees' location data. Importantly, no biometric or special categories of personal data were collected during this pilot. The purpose of data processing was confined to evaluating occupational safety risks, optimising industrial workflows and assessing the performance of TANGO's technological solutions. All other partners involved in the pilot acted as data processors under the terms of the DPA, in accordance with Article 28 GDPR.

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5.5.4 Pilot Implementation & Testing scenarios

The TANGO pilot for Smart Manufacturing was scheduled to take place at RIAS premises in Aveiro, Portugal, with the participation of workers and supervisors from the RIAS factory. There were two scenarios implemented. First, the Workplace Safety & Zone-Based Monitoring scenario, with workers deliberately moving through the factory area to non designated areas, in order to demonstrate how TANGO can capture unauthorised access to specific areas of the shopfloor. Second, the Workflow Optimization via Movement Tracking scenario was designed for the shopfloor supervisor, who has access to a report on authorization violations through TANGO.

The testing scenarios involved two personas: **Worker and Supervisor**.

Workplace Safety & Zone-Based Monitoring (worker)

Employees carry mobile devices that transmit real-time data about their presence in specific factory zones. The goal is to detect unauthorized entries into restricted or high-risk areas, enhancing workplace safety and enabling rapid response protocols.

Table 27: Smart Manufacturing pilot: Workplace Safety & Zone-Based Monitoring scenario

Scenario Step	Description	Components involved
Worker onboarding	<p>The factory worker acquires a digital identity (ePassport) on their mobile phone.</p> <p>Organization issues employee credential through SSI Agent, that is stored in worker's SSI Wallet.</p> <p>Worker downloads and installs DCBA client app on smartphone.</p>	<p>SOUD (ePassport)</p> <p>SSI Agent/Wallet</p> <p>DCBA</p>
Worker enters the factory premises – activates location monitoring via smart device.	<p>Worker enters shopfloor and launches the DCBA client app.</p> <p>Client app initiates WebSocket connection with server, sending session ID and device ID (Android_id).</p> <p>Server verifies session ID and initiates or replaces device session.</p> <p>Server calls the verifier passing as state the session ID and as auth_callback an endpoint of the server. Server retrieves QR code from SSI Verifier, sends it to the client app for being displayed to worker's smartwatch.</p> <p>Worker scans smartwatch QR Code using SSI Wallet and starts the OIDC process.</p> <p>SSI Verifier validates verifiable credential exchange, returning authentication code and state to the server, which is then used to get a JWT access token.</p> <p>Server decodes JWT to extract worker's DID and role, associating the device with worker, the state (session ID) again with the worker, and identifying authorized access areas based on the role.</p> <p>Upon successful verification, server instructs DCBA client app to start real-time monitoring.</p>	<p>DCBA</p> <p>SSI Wallet</p>
Worker is at their designated work area. The worker's location on the shopfloor is monitored to prevent unauthorized access to certain areas.	TANGO is monitoring the worker's location.	DCBA

Scenario Step	Description	Components involved
Worker moves to unauthorized area. The system notifies the supervisor.	The worker's location triggers an alert. The supervisor/manager receives a push notification on their mobile device. The incident is registered in the factory incidents list.	DCBA
Worker ends the shift.	Worker logs out via DCBA client app at shift completion, ending session and monitoring	DCBA
The supervisor and the manager have access to all access violations reports.	The manager receives a report with incidents at the end of the week.	PEP-PDP VIS

Workflow Optimization via Movement Tracking (supervisor/ manager)

Using location data and consent-based identifiers, RIAS analyses movement patterns of employees and machinery to identify bottlenecks or inefficiencies in task allocation, space usage, or access routes.

Each scenario validates the functionality of TANGO's data-sharing framework, including SSI credential management, fine-grained access control, and user consent capture, all in a live industrial setting. Employees also complete feedback questionnaires before, during, and after the pilot to assess usability, transparency, and perceived privacy.

Table 28: Smart Manufacturing pilot: Workflow Optimization via Movement Tracking scenario

Scenario Step	Description	Components involved
Employee (supervisor / manager) onboarding	Employee acquires a digital identity (ePassport) on their mobile phone. Organization issues employee credential through SSI Agent, that is stored in worker's SSI Wallet.	SOUR (ePassport) SSI Agent/Wallet
Employee has access to all monitoring and access violations reports.	The manager receives a report with incidents at the end of the week.	VIS

My Applications

DCBA - Worker Zone Access Management



Restricted access alerts

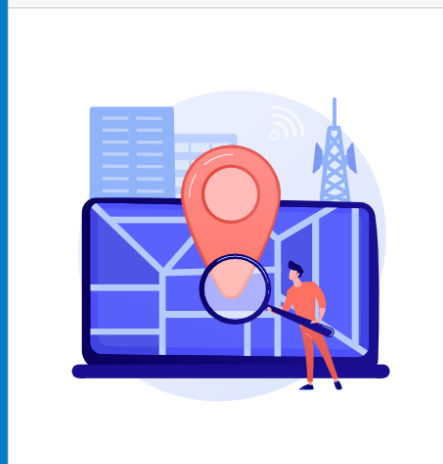


Figure 44: Smart Manufacturing pilot: The manager dashboard

5.5.5 Evaluation results

The Smart Manufacturing Pilot at RIAS was scheduled to take place at RIAS premises in Aveiro, Portugal, with the participation of workers and supervisors from the RIAS factory, to evaluate the performance and adaptability of the TANGO platform in a live industrial context. The primary objective was to assess how the platform supports identity verification, real-time behavioral monitoring, access control enforcement, and alert generation within a factory environment. The pilot focused on two user profiles — a worker and a manager — both utilizing Android-based devices (smartphone and smartwatch), reflecting modern factory-floor mobility needs. Evaluation activities were designed to simulate realistic operations, including entry into restricted areas, detection of unauthorized behaviors, and immediate supervisor notification.

DISCLAIMER:

Pilot implementation settings and test devices were thoroughly tested by UTH prior to the pilot activities (please refer to section 3.5 for more details), both at UTH premises and in Aveiro. However, when the actual pilot devices were purchased, the technical team faced persistent issues with setting up the smart devices and having them function as expected in the pilot. Although everything appeared to be configured correctly, the smartwatch localization scans were never triggered. UTH spent significant effort to resolve the issues that emerged on site. They identified and resolved several bugs that only appeared in Aveiro, but not in their lab in Volos, Greece. What deepened the concern was that, at the University of Thessaly (UTH) in Greece, identical smartwatches running the same application version, connected to the same RIAS server, were performing scans successfully every ~30 seconds. This suggested that the problem was location-specific, potentially linked to hardware/software discrepancies between smartwatch models in Portugal versus Greece. Even after modifying and reinstalling the application, the RIAS devices continued to fail, while the UTH devices worked perfectly. This inconsistency has raised the possibility of underlying hardware-level incompatibilities.

Handling these issues led to significant delays in the pilot implementation. Unfortunately, by the submission date of this Deliverable, it was not possible to find a satisfactory solution to the issues. In order to perform some basic

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evaluation activities for the RIAS Pilot, two members of the RIAS team, who were present during the testing phase conducted by UTH in Aveiro and had seen the pilot in full operation, were requested to complete the evaluation questionnaires, acting as potential users / observers of the pilot activities. Although this does not qualify as actual pilot evaluation, it still provided some insight about the user acceptance and effectiveness of the TANGO technologies within the frames of the specific pilot. The following paragraphs present the outcomes of this evaluation.

Two evaluators successfully evaluated the assigned tasks, including onboarding, movement tracking, and alert-triggering scenarios. They reported that the system functioned largely as expected, with goals achieved and core features validated.

Despite the technical difficulties during the deployment phase, the evaluation of the TANGO platform in the RIAS Smart Manufacturing Pilot revealed strong usability and user satisfaction. Once operational, the platform was described by both evaluators as intuitive, easy to navigate, and well-adapted to both worker and managerial roles. Users evaluated the platform as easy to learn, with no navigational challenges, which suggests that the interface design is effective for industrial contexts. However, the existing issues related to smartwatch compatibility and installation underscore the need for better deployment readiness and hardware standardization support, especially in environments using diverse Android devices.

The following tables and figure provide useful insights regarding the rest of the questions from the evaluation questionnaire.

Table 29: Smart Manufacturing Case 1 Evaluation results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				100.00%		4.00
Ease of Learning				100.00%		4.00
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness				100.00%		4.00
User Friendly				100.00%		4.00
Supporting Material				100.00%		4.00
Reliability			100.00%			3.00
Accuracy				100.00%		4.00
Effectiveness of access control measures				100.00%		4.00
Effectiveness of reducing privacy violation incidents					100.00%	5.00
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	50.00%	50.00%				1.50
Frequency of security issues (lower is better)	50.00%	50.00%				1.50

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
	Very	Insecure	Neutral	Secure	Very Secure	
Security				100.00%		4.00
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
ePassport				50.00%	50.00%	4.50
SSI Wallet				50.00%	50.00%	4.50
DCBA					100.00%	5.00
Visualization & Reporting					100.00%	5.00
TANGO Platform				100.00%		4.00

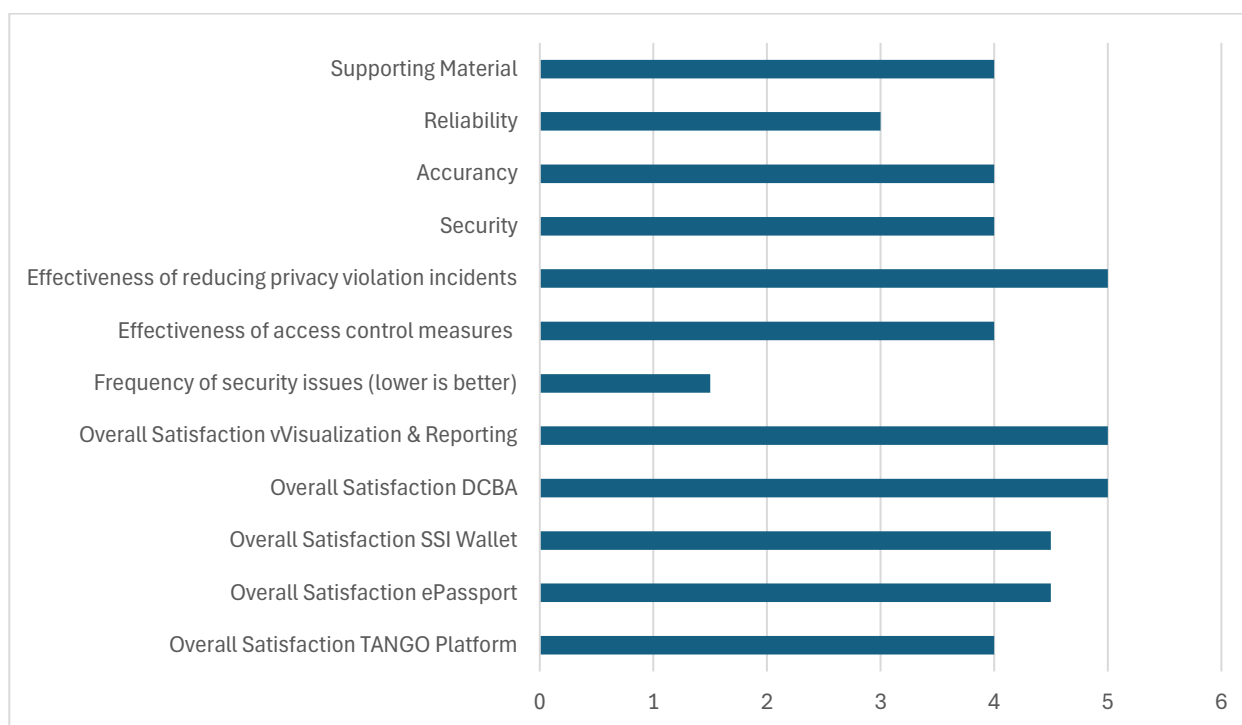


Figure 45: Smart Manufacturing Case 1 Evaluation results

Table 30: Smart Manufacturing Case 1 Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)									50.00%	50.00%		8.50

In conclusion, the pilot validated the TANGO platform's maturity and potential for deployment in smart manufacturing scenarios. Once functional, it delivered a secure, responsive, and user-friendly experience. However, the initial deployment failures — due to device-level inconsistencies — present a notable challenge to scalability. Future rollouts should prioritize thorough hardware compatibility testing, enhanced technical support during installation, and multi-site validation to ensure consistent and reliable performance across different environments.

5.6 Pilot 3 - Smart Manufacturing – Case 2: 3D printing

5.6.1 Pilot Overview

The FMAKE pilot, led by FMAKE, aims to implement and validate the TANGO architecture within a smart manufacturing setting. The pilot focuses on secure and trustworthy sharing of data and AI models among internal departments and external stakeholders (such as customers and suppliers), primarily for quality assurance and predictive maintenance in industrial manufacturing environments. The pilot demonstrates how self-sovereign identity (SSI), policy-based access control, and trust scoring mechanisms can facilitate the sharing of AI model insights and operational data while ensuring compliance with data governance and cybersecurity requirements.

A particular emphasis is placed on verifiable credentials (VCs) to enable access control to shared insights and models, such as defect detection models in quality control or energy usage models. This represents a novel way to establish inter-organizational collaboration across the supply chain, empowering smaller manufacturers or suppliers to interact with the same level of trust and data protection as larger enterprises.

5.6.2 Deployment environment/ Legacy systems integration

The FMAKE pilot was deployed within a controlled manufacturing lab environment, utilizing a dedicated testbed equipped with edge devices and industrial-grade servers. The TANGO stack was deployed using Docker and Kubernetes environments hosted within a secure local network. It integrates with the organization's existing MES (Manufacturing Execution System) and PLM (Product Lifecycle Management) tools via API connectors.

To facilitate legacy system integration, the pilot uses TANGO's Data Connectors and FIWARE-based interoperability layer, allowing real-time and historical data to be ingested, processed, and shared securely. The legacy applications were not modified directly; instead, adapters and secure APIs served as a non-invasive integration approach. Attribute-based access controls (ABAC) and policy definitions further enable legacy data to be selectively exposed to external entities under secure, controlled conditions.

5.6.3 Legal / Ethical Issues

This pilot was designed to assess the functionality and effectiveness of the TANGO framework across two distinct use cases: (i) the execution of 3D printing jobs by FMAKE customers, and (ii) the training of a machine learning (ML) model using a federated learning approach. Of these two scenarios, only the first involved the processing of personal data. Specifically, participants used the system to assess the correctness of its operations and to provide feedback regarding user satisfaction and their overall experience with the framework.

In the context of the 3D printing scenario, the processing of personal data necessitated the implementation of appropriate legal safeguards. A dedicated DPA was concluded, as multiple entities were involved in processing operations. FMAKE acted as the data controller, with responsibility for overseeing compliance with data protection requirements and ensuring the lawful, fair and transparent processing of data in accordance with the GDPR, particularly Article 28.

To further ensure the lawfulness and ethical soundness of data processing activities, informed consent forms were prepared, distributed to and signed by all participants. These forms clearly articulated the purposes of data collection, the nature of the data involved, the rights of data subjects and the voluntary nature of participation. Consent was obtained in accordance with Articles 6 par. 1 (a) and 7 GDPR, ensuring that it was freely given, specific, informed and capable of being withdrawn at any time.

All personal data collected in this pilot have been securely stored on FMAKE's premises, in an encrypted (pseudonymised) form. Data retention was strictly limited to the period specified in the consent documentation. After this period, the data will be permanently deleted or anonymised, in line with the GDPR principles of purpose limitation and data minimisation (Article 5 par. 1 (b) and (c)).

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5.6.4 Pilot Implementation & Testing scenarios

The FMAKE Smart Manufacturing pilot comprised of two scenarios. The first is centered on 3D printing workflows and tests how TANGO ensures secure onboarding and controlled file access between customers and FMAKE employees. The second focuses on privacy-preserving AI model retraining. The scenarios involve two main personas: customers/employees who submit and access design jobs, and data scientists who analyze and improve digital twin models.

The scenarios for the Smart Manufacturing (3D printing) pilot case are the following:

Table 31: Smart Manufacturing pilot: 3D printing files sharing (customers and employees)

Scenario Step	Description	Components involved
Customer / Employee onboarding	Users acquire a digital identity (ePassport) on their mobile phones, which is stored in an SSI Wallet and linked with the TANGO platform. Through this process, customers and staff are registered, roles are defined, and authorization rules are set using policy configurations.	SOUR (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services.
Design file preparation and upload by customer	Customers prepare 3D printing designs locally using existing CAD tools, independent of TANGO. Once ready, they upload the files through a secure TANGO interface, which triggers the CP-ABE encryption and SEDSS decryption mechanisms. The encryption is executed transparently via the control plane, ensuring that only authorized roles can access the file. The file is then uploaded to the FMAKE server, with TANGO enforcing fine-grained policies that control who can open, view, or modify the design. Access rights evolve dynamically as the printing job progresses and are revoked after completion to maintain strict confidentiality.	CP-ABE SEDSS UI
Printing process	FMAKE personnel, acting under defined roles such as print operator or technical expert, retrieve encrypted design files to prepare them for manufacturing. The Policy Enforcement Point (PEP) and Policy Decision Point (PDP) ensure that access is restricted to job-specific personnel and only for the duration of the job. Once the phase is completed, access is automatically revoked. This creates a fully auditable access trail and demonstrates how TANGO supports time-bound, role-based access control in sensitive industrial workflows.	PEP/PDP UI CP-ABE

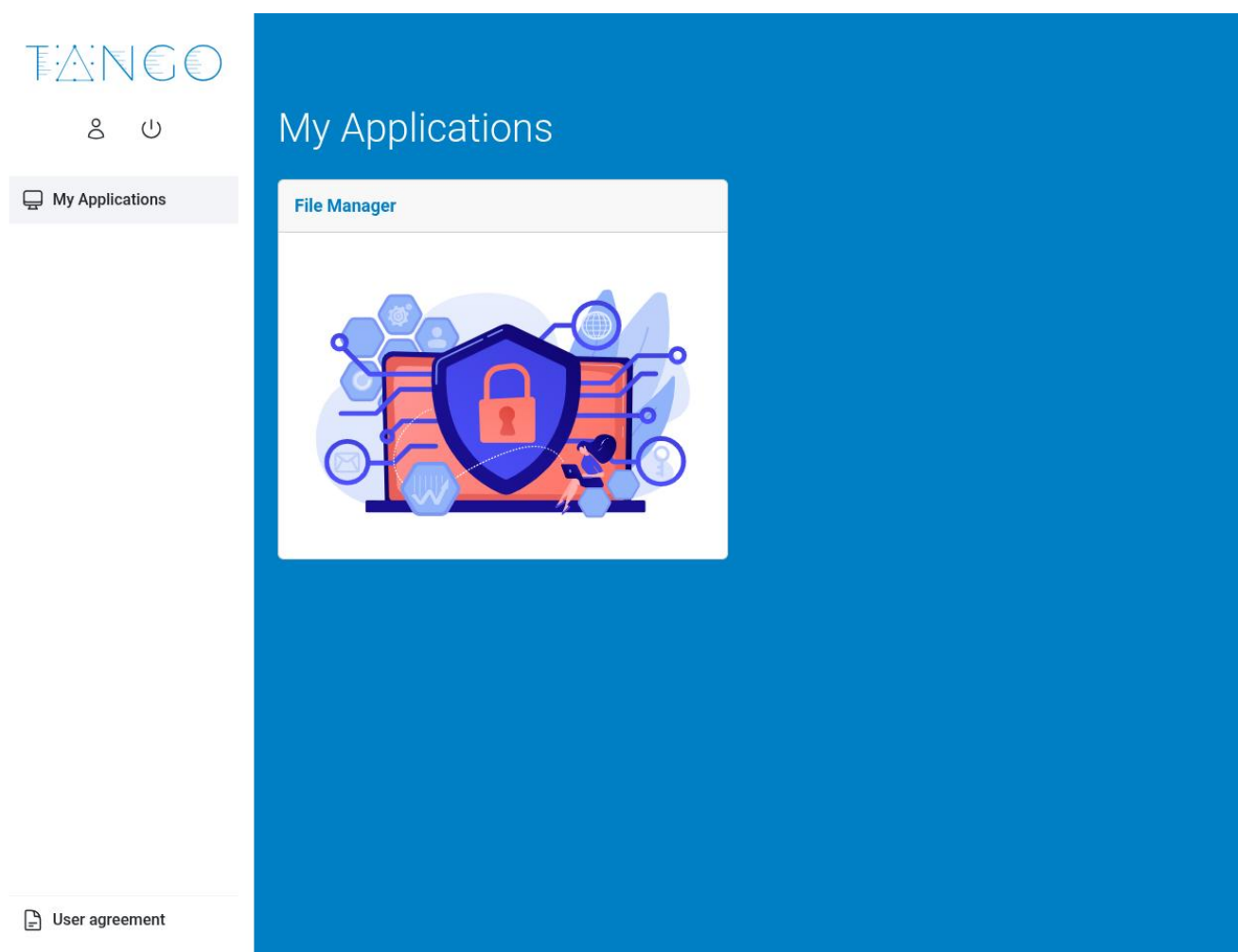


Figure 46: Smart Manufacturing pilot: The customer/employee dashboard

Table 32: Smart Manufacturing pilot: 3D printing data scientist

Scenario Step	Description	Components involved
Employee (data scientist) onboarding	Users acquire a digital identity (ePassport) on their mobile phones, which is stored in an SSI Wallet and linked with the TANGO platform. Through this process, customers and staff are registered, roles are defined, and authorization rules are set using policy configurations.	SOUND (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services.
The data scientist investigates the existing data in the summary print job report, to check if the quality issue was predicted by the model.	This activity is performed through existing tools and platforms.	---

Scenario Step	Description	Components involved
The data scientist updates the model by retraining it.	Using credentials similar to those of customers and employees, data scientists log into the system and analyze summary print job reports to verify whether anomalies were predicted by existing models. When necessary, the data scientist retrains the digital twin models by combining datasets from multiple locations (edge, cloud, or customer environments). The training process leverages MLOps pipelines, FLEviden for federated learning, RenOps orchestration, and XAI for model explainability. Importantly, the federated learning setup ensures that raw data remains at its source, and only model updates are exchanged. This scenario highlights TANGO's ability to support secure, distributed AI retraining without compromising data sovereignty.	MLOps, FLEviden RenOps XAI
The retrained model is downloaded from the TANGO platform to the printer.	This activity is performed through existing tools and platforms.	---

5.6.5 Evaluation results

The TANGO platform was evaluated in the Smart Manufacturing domain by multiple user personas, each representing a unique role in the data lifecycle within manufacturing environments. In this context, two key roles—Client and Data Analyst—provided structured feedback after interacting with TANGO modules such as MLOps, Scheduling, XAI, Federated Learning, and File Exchange. These personas reflect users with differing responsibilities: the client focuses on secure file sharing and task execution, while the data analyst engages with advanced AI workflows and performance optimization.

The evaluation followed a structured methodology including open-ended responses and Likert-scale ratings. Both types of data offer insights into usability, technical functionality, feature completeness, reliability, and suggestions for improvement. The analysis below captures the user experience and performance perception of the TANGO platform from each of these two roles, and contributes to refining the system's user interface and technical integration across pilot scenarios.

Data Analyst

The Data Analysts evaluated several advanced modules of the TANGO platform in depth, including MLOps, Scheduling, Explainable AI (XAI), and Federated Learning. The platform was tested both in isolated components and integrated configurations over several months. Participants reported successful deployment of machine learning models, training monitoring, and optimization scenario testing (e.g., based on CO₂ emissions or electricity prices). The main achievement was the adoption of XAI and Scheduling modules, which were highlighted for their flexibility and ease of use.

Challenges included manual integration between modules, which caused additional configuration efforts. One participant noted a lack of technical documentation and a steep learning curve when using custom datasets or models, which required advanced programming knowledge. Suggestions included more automated connections between modules and more comprehensive guides. This highlights a difference in experience between developers and operational users, with analysts seeking more developer-centric refinement and automation.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

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Table 33: Smart Manufacturing Case 2 Evaluation results (Data analyst)

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				33.33%	66.66%	4.67
Ease of Learning				66.66%	33.33%	4.33
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness			66.66%	33.33%		3.33
User Friendly			33.33%	66.66%		3.67
Supporting Material			33.33%	33.33%		3.50
Reliability			33.33%	66.66%		3.67
Accuracy				100.00%		4.00
Effectiveness of centralized model				66.66%		4.00
Accuracy from detecting and preventing fraudulent transactions				33.33%	33.33%	4.50
Reliability during the weights aggregation process				66.66%		4.00
Effectiveness of access control measures					33.33%	5.00
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	66.66%					1.00
Frequency of security issues (lower is better)	33.33%	66.66%				1.67
	Very	Insecure	Neutral	Secure	Very Secure	
Security				33.33%	33.33%	4.50
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Federated learning / MLOps				66.66%	33.33%	4.33

XAI				66.66%	33.33%	4.33
TANGO Platform				100.00%		4.00

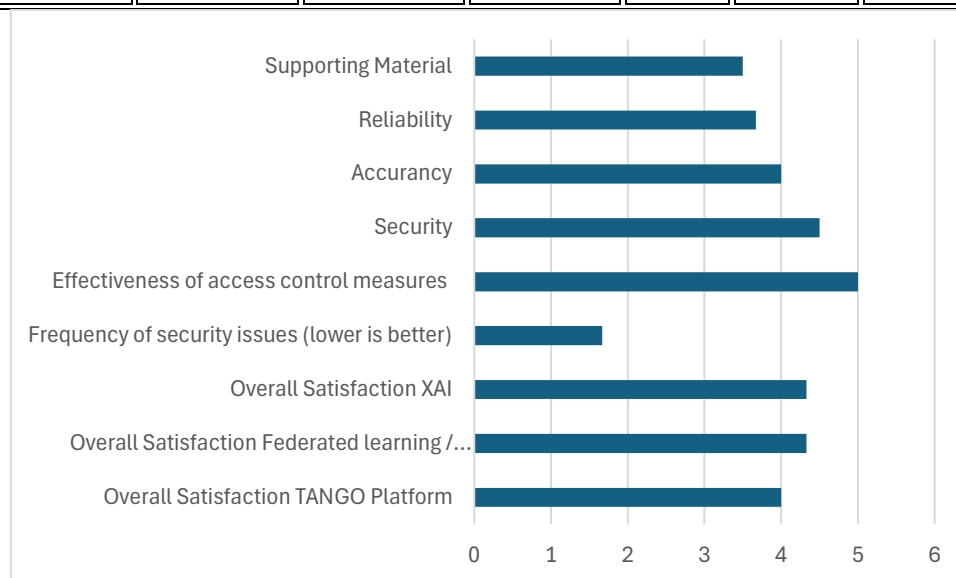


Figure 47: Smart Manufacturing Case 2 Evaluation results (Data analyst)

Table 34: Smart Manufacturing Case 2 Net Promoter Scores (Data analyst)

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)								33.33%	66.66%			7.67

Client

The feedback which was collected by representative users, imprinted the user experience regarding the file-sharing operations, which are login, upload and download of files, their review. All this activities are going to take place inside the digital platform. The interaction begins with the interaction of the front-end user interface, which has been designed specifically for non-technical users. The evaluators of this persona used specific systems, such as laptops and desktops.

Participants completed the evaluation tasks successfully, which included logging into the platform, uploading print files, reviewing the list of shared files, and downloading files as employees. One participant noted bypassing the onboarding process but was still able to perform the core interactions without issues, indicating the intuitiveness of the interface. Users confirmed that the TANGO platform functioned as expected during their tasks. One noted that “everything worked fine,” while another highlighted the platform’s support for secure file sharing. This underscores the system’s effectiveness in facilitating basic business interactions within the pilot.

Moreover, they reported achieving their intended goals during the evaluation. However, one clarified that features such as onboarding, encryption, and file expiration were not actively evaluated. Neither participant experienced any difficulties or frustrations, suggesting that the system is user-friendly for non-technical personnel. While no technical bugs were reported, users expressed the need for a file deletion feature within the platform.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

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Table 35: Smart Manufacturing Case 2 Evaluation results (Client)

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use			50.00%		50.00%	4
Ease of Learning				50.00%	50.00%	4.50
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness				100.00%		4.00
User Friendly			50.00%	50.00%		3.50
Supporting Material			50.00%		50.00%	4.00
Reliability			50.00%	50.00%		3.50
Accuracy				100.00%		4.00
Effectiveness of reducing data processing time				100.00%		4.00
Effectiveness of access control measures				100.00%		4.00
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	100.00%					1.00
Frequency of security issues (lower is better)	50.00%	50.00%				1.50
	Very	Insecure	Neutral	Secure	Very Secure	
Security			50.00%	50.00%		3.50
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
SSI Wallet				100.00%		4.00
ePassport		50.00%	50.00%			2.50
Upload/ download process				100.00%		4.00
TANGO Platform				50.00%	50.00%	4.50

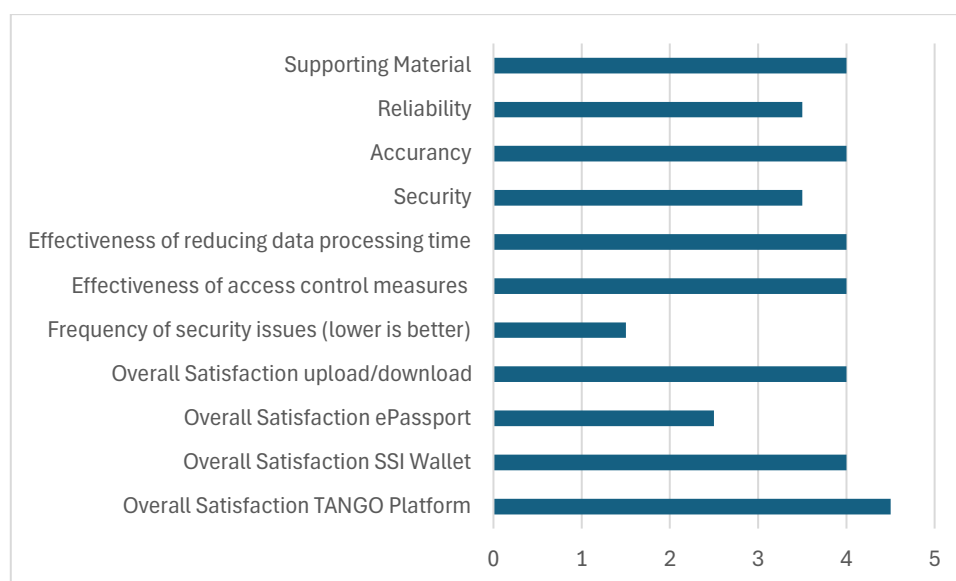


Figure 48: Smart Manufacturing Case 2 Evaluation results (Client)

Table 36: Smart Manufacturing Case 2 Net Promoter Scores (Client)

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)							50.00%		50.00%			7.00

5.7 Pilot 4 – Banking

5.7.1 Pilot Overview

The Banking Pilot explores the application of Federated Learning (FL) to anti-fraud detection in a multi-bank setting. Its objective is to leverage the collective intelligence of different financial institutions while maintaining the privacy and sovereignty of their customer data. By enabling banks to share model parameters rather than raw data, the pilot aims to build a robust global fraud detection model that adapts faster to emerging fraud patterns. This approach balances data protection, compliance with banking secrecy, and improved fraud prevention.

Led by ABI Lab with technical support from NTT Data and other TANGO partners, the pilot also seeks to build a community of banking stakeholders, engage end-users, and support future standardisation efforts in financial data governance.

5.7.2 Deployment environment/ Legacy systems integration

The pilot is deployed on NTT-owned Azure VMs. Core TANGO components relevant for the pilot—such as FLEviden, XAI—are installed on these environments. Hardware requirements include at least 4 vCPUs, 32 GB RAM, and 650 GB storage, with GPU resources recommended but not mandatory for ML components.

A VPN interconnection is established between each VMs, which represents separate banks' environments, enabling parameter exchange during FL training rounds. Legacy banking systems for transaction monitoring remain in place, with TANGO providing an overlay layer to enhance fraud detection capabilities. The integration strategy ensures minimal disruption while enabling new real-time anomaly detection services.

5.7.3 Legal / Ethical Issues

The Banking pilot did not entail any processing of personal data within the meaning of Article 4 (1) of the GDPR. Only anonymised and aggregated data were used throughout the pilot activities. As such, the data employed did not relate to identified or identifiable natural persons and consequently fell outside the material scope of the

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GDPR. In light of the above, there was no legal requirement to execute a DPA or obtain consent, as the regulatory obligations under the GDPR were not triggered.

Nevertheless, appropriate technical and organisational measures were maintained to ensure data integrity, quality and the ethical soundness of the pilot activities, in line with good data governance practices and the overarching principles of accountability and transparency.

5.7.4 Pilot Implementation & Testing scenarios

The pilot testing scenarios combine technical evaluation of the TANGO components with realistic fraud detection workflows:

- Onboarding and Identity Management – Each participant bank configures its FL node and authenticates via SSI credentials, ensuring only trusted entities contribute to the network.
- Local Model Training – Each bank trains an anti-fraud ML model using local transaction data stored securely on-premises. The models are tuned with hyperparameter optimization and validated locally.
- Federated Learning (FL) Aggregation – Model parameters (not raw data) are shared with a central TANGO node, which aggregates them into a global anti-fraud model. The process is repeated iteratively to improve accuracy and adapt to new fraud patterns.
- Model Evaluation and Comparison – The global FL model is compared against the local models on metrics such as accuracy, precision, and recall. Results show clear improvements of the federated approach over isolated training.
- Explainable AI (XAI) Testing – Using SHAP-based tools, banks test the interpretability of the FL model to understand how different transaction features (e.g., amount, country risk score, day-of-week) influence fraud predictions. This improves trust and transparency for compliance officers and auditors.

Operational Integration Scenario – The global model is integrated with existing bank fraud monitoring platforms, enhancing their rule-based systems with AI-driven anomaly detection. Transaction risks are flagged in real time, and fraud investigators can investigate via existing case management systems.

5.7.5 Evaluation results

The Banking Pilot evaluated the TANGO platform in the context of federated learning (FL) for fraud detection using sensitive data from multiple banks. The evaluation was conducted by NTT Data in collaboration with partners and took place across three sessions on July 24, August 4, and August 5, 2025. Participants operated from both physical PCs (Dell Latitude 5420) and Azure-hosted virtual machines, all running Ubuntu 22.04. This ensured secure, isolated, and high-compliance environments for handling sensitive financial data.

The pilot successfully encompassed all planned activities, including data preprocessing, parameter tuning, federated training, and performance evaluation using F1-score metrics. One of the pilot's most important accomplishments was the ability to quantitatively compare the local models with the federated model. Specifically, in the initial KPI evaluation, Bank 1 achieved an F1 score of 39%, Bank 2 reached 66%, while the federated model produced an F1 score of 76%. During a subsequent evaluation, conducted on a test dataset obtained by merging the two banking datasets, the results were as follows: Bank 1 achieved an F1 score of 66%, Bank 2 reached 57%, and the federated model produced an F1 score of 74%. In both the testing scenarios, we obtained a 8-10% improvement over the best-performing local model. This outcome exceeded the project's initial goal of a 5% improvement and clearly demonstrated the value of federated learning in cross-bank collaborative fraud detection without sharing raw data.

Despite its success, the pilot encountered notable challenges, particularly around privacy and security requirements. Implementers had to make careful architectural and technical trade-offs to arrive at a solution that met compliance, confidentiality, and performance standards. These challenges were ultimately resolved, and the result was a well-balanced, production-feasible implementation that respected both the legal boundaries and technical needs of financial institutions.

User feedback was resoundingly positive. All three participants agreed that the TANGO platform was easy to use, easy to learn, and intuitive, giving it the highest scores across categories. Additionally, no problems were encountered during the evaluation phase. The platform was described as stable, secure, and accurate, and no bugs or crashes were reported. Reliability, particularly during federated weight aggregation, was rated at the maximum level, and the TANGO platform's fraud detection capabilities were considered effective and sufficiently accurate by all evaluators.

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Moreover, all users reported a high degree of trust in the system's security features and access control mechanisms, both of which received perfect scores. No support or troubleshooting was required during the evaluation. Supporting materials were reported as easily available, reinforcing the platform's readiness for production environments.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 37: Banking Evaluation Results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use						Not applicable
Ease of Learning						Not applicable
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness						Not applicable
User Friendly						Not applicable
Supporting Material						Not applicable
Reliability						Not applicable
Accuracy						Not applicable
Effectiveness of centralized model				100.00%		4.00
Accuracy from detecting and preventing fraudulent transactions				100.00%		4.00
Reliability during the weights aggregation process						Not applicable
Effectiveness of access control measures						Not applicable
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)						Not applicable
Frequency of security issues (lower is better)						Not applicable
	Very	Insecure	Neutral	Secure	Very Secure	
Security						Not applicable

Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Federated learning / MLOps			66.67%	33.33%		3.33
XAI			66.67%	33.33%		3.33
TANGO Platform				33.33%		4.00

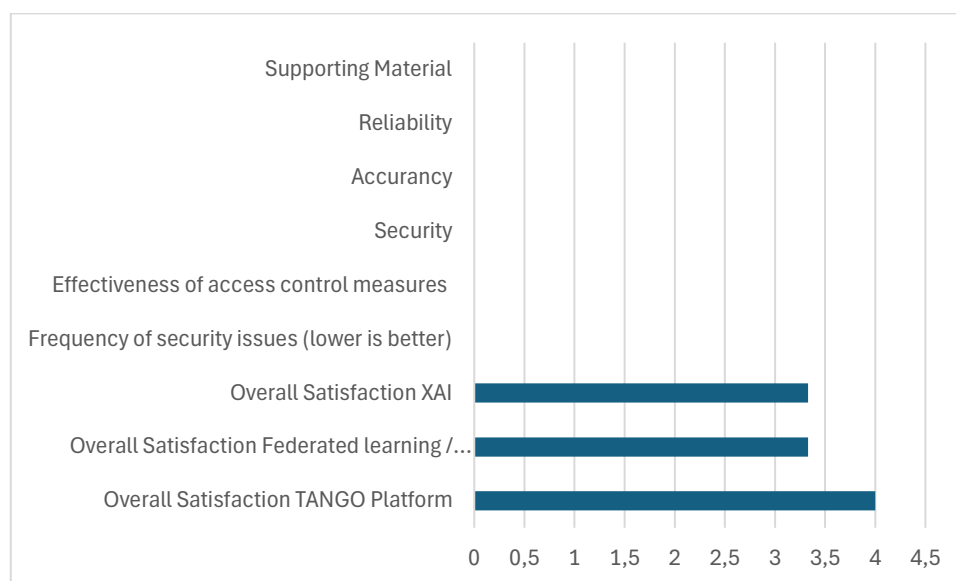


Figure 49: Banking Evaluation Results

Table 38: Banking Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)						33.3%			33.3%		33.3%	7.67

5.8 Pilot 5 - Public organisations

5.8.1 Pilot Overview

The Public Administration pilot, coordinated by VISAR with support from NORB and other TANGO partners, demonstrates how TANGO can strengthen trustworthy data governance in interactions between public sector organizations and citizens. The pilot aims to ensure that sensitive personal and administrative data can be shared across distributed systems in a legally compliant, privacy-preserving, and transparent way. The key objectives were to test TANGO's identity and consent management, secure storage via FIDES, and policy-based access control, while validating usability for citizens and government employees.

The setup for this specific pilot is based on three main nodes:

- one for the Employer (Node C),
- one for VisaRight (Node A), and
- one for the Immigration Authority (Node B).

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All those nodes are connected between them in a single p2p flat network, which is going to provide privacy, transparency, and traceability among them. This setup incorporates Norbloc's DRILL for secure data redundancy, DnAMS for decentralized access control and encryption, and the blockchain (Hyperledger Fabric) for maintaining a full audit trail of all ecosystem activity.

Together, these components ensure verified data can be exchanged safely, with full user consent and real-time compliance enforcement.

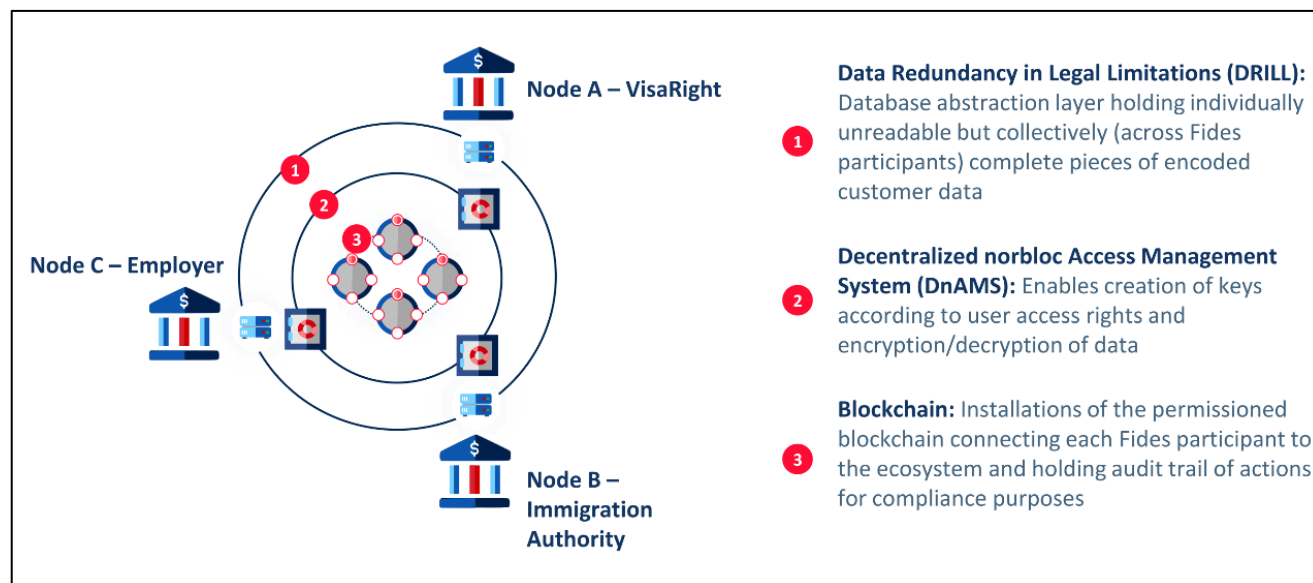


Figure 50: Fides setup for the Public Organizations pilot

5.8.2 Deployment environment/ Legacy systems integration

The pilot was deployed using FIDES, a TANGO component providing a legally compliant distributed backend (DRILL) for storing and managing public sector data. All pilot data were stored in this environment using FIDES' internal formats. A private Kubernetes cluster was set up for the pilot, hosting multiple FIDES nodes and providing APIs for secure access and queries.

Integration with legacy systems is achieved via the FIDES API, which allows data exchange with existing public administration databases while maintaining compliance. This enables government agencies to keep their existing workflows intact, while TANGO ensures that all access and processing follow GDPR-compliant audit trails and user consent requirements.

5.8.3 Legal / Ethical Issues

The Public Administration pilot case involves processing of personal data of citizens and employees involved in administrative workflows, including names, work titles, contact details, and signatures.

However, the actual pilot implementation did not involve any processing of personal data, as only synthetic data were used throughout its execution. Synthetic data, which are artificially generated and do not relate to any identified or identifiable natural person, do not fall within the definition of personal data under Article 4 (1) of the GDPR.

As a result, the use of such data lies outside the material scope of the GDPR. Consequently, there was no requirement to conclude a DPA or obtain data subject consent, as no data protection obligations under the GDPR were triggered.

Nonetheless, the use of synthetic data was carried out in accordance with high ethical and technical standards, ensuring the reliability, accuracy, and relevance of the data for the intended testing and evaluation purposes.

5.8.4 Pilot Implementation & Testing scenarios

The Public Organizations pilot took place online, with participants playing the various roles and demonstrating the platform's operation via shared screen. There were four participants directly involved, i.e. Employer,

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Employee (VISA applicant), public authority employee and VISAR employee, and additional participants observing the process.

The testing scenario is resented in the following table.

Table 39: Public Authorities pilot: VISA application through Fides

Scenario Step	Description	Components involved
Employer and Authority employees onboarding	VISAR acquires a professional user account on Fides. Employee, Employer and Authority employees acquire Fides user accounts.	Fides
Employer initiates visa application	Employer fills out the initial visa application with the applicant's details, completes their own profile, and submits it to VISAR.	Fides
Relocation Employee fills-in information	Relocation Employee verifies email and ID and completes individual details (marital status, degree).	Fides
VISAR Employee receives relocation case assignment	VR Employee gets the relocation case assigned. Monitors and verifies the Relocation Employee profile (indicated by checkmarks that signify the data has been confirmed by VISAR personnel). Prepares and submits completed Relocation Employee application. Relocation Employee gets notified that application was submitted by VISAR.	Fides
Authority Employee works on the case	Authority Employee (Federal Employment Agency, Immigration Office) receives notification about new application. Reviews available documents (checkmarks from VISAR employees confirm data verification, while Employer checkmarks indicate data entered by the Employer). Approves or rejects the application by selecting the relevant decision status and uploading the supporting document. If necessary, sends a request for additional documentation.	Fides
VISAR Employee finalizes the case	VISAR Employee sends final status confirmation to the Relocation Employee and to Employer and closes the relocation case in Fides. Informs Relocation Employee on the entry procedure to Germany.	Fides

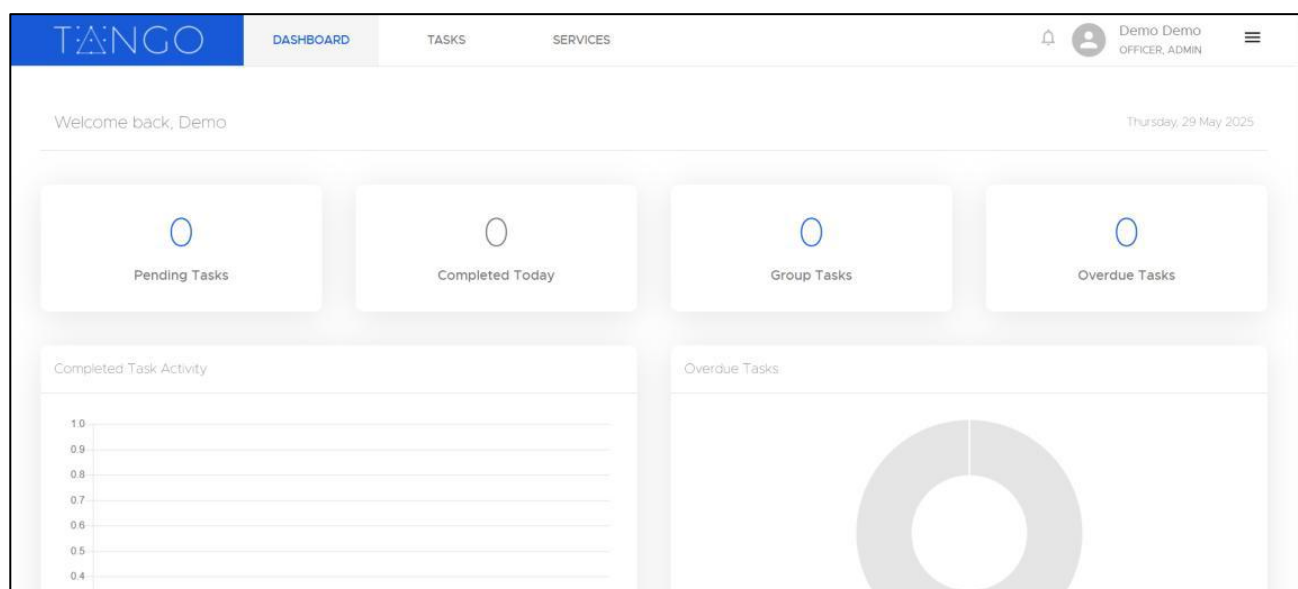


Figure 51: Public Organizations pilot: The Fides dashboard

5.8.5 Evaluation results

In order to evaluate this pilot, specific devices were used for implementing and evaluation, such as PCs and laptops which were running on Windows 10, Windows 11, macOS softwares. Evaluators provided all the necessary data about their devices and operating systems, in order to ensure that compatibility and user experience across platforms will be achieved.

Participants successfully completed all intended actions within the platform. Each evaluator not only performed their assigned role but often observed the entire process to better understand the complete journey of a visa application. Tasks ranged from filling in personal details and submitting documents to reviewing applications and issuing decisions. The end-to-end process was effectively demonstrated, confirming the platform's functionality and collaborative capabilities.

Regarding the evaluation results, the feedback was truly positive and optimistic. Users reported that they had successfully implemented their tasks and achieved their goals by using the platform. They also mentioned that the TANGO platform was truly efficient, intuitive, and well-structured, which helped them to enable smooth transitions between all the workflow stages. Moreover, despite the fact that most of the participants agreed that the platform worked as expected, there were several users, who noted that there is a lack of notifications at the end of the process. Those users expressed their desire for an update and to receive updates on the visa status after submission.

While most users did not experience major difficulties, some highlighted areas for improvement. The most commonly mentioned issues included insufficient data validation and lack of clarity in form instructions. For example, in some forms, users could enter non-numeric characters in numeric fields without receiving error messages, resulting in blank submissions. Several users felt that clearer instructions or in-system guidance would improve the experience, especially for first-time users. Moreover, no bugs identified during the process.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 40: Public Organisation Evaluation Results

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use			10%	90%		3.90
Ease of Learning		30%	60%	10%		3.80

	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness		30%	70%			3.70
User Friendly			40%	50%	10%	3.70
Supporting Material		10%	40%	50%		3.40
Reliability			30%	70%		3.70
Accuracy		10%	30%	50%	10%	3.60
Efficiency of the residence permit application			40%	50%	10%	3.70
Time reduction			40%	60%		3.60
Effectiveness of access control measures			30%	70%		3.70
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	70%	20%	10%			1.40
Frequency of security issues (lower is better)	90%		10%			1.20
	Very Insecure	Insecure	Neutral	Secure	Very Secure	
Security			20%	70%	10%	3.90
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
Overall Satisfaction			10%	80%	10%	4.00

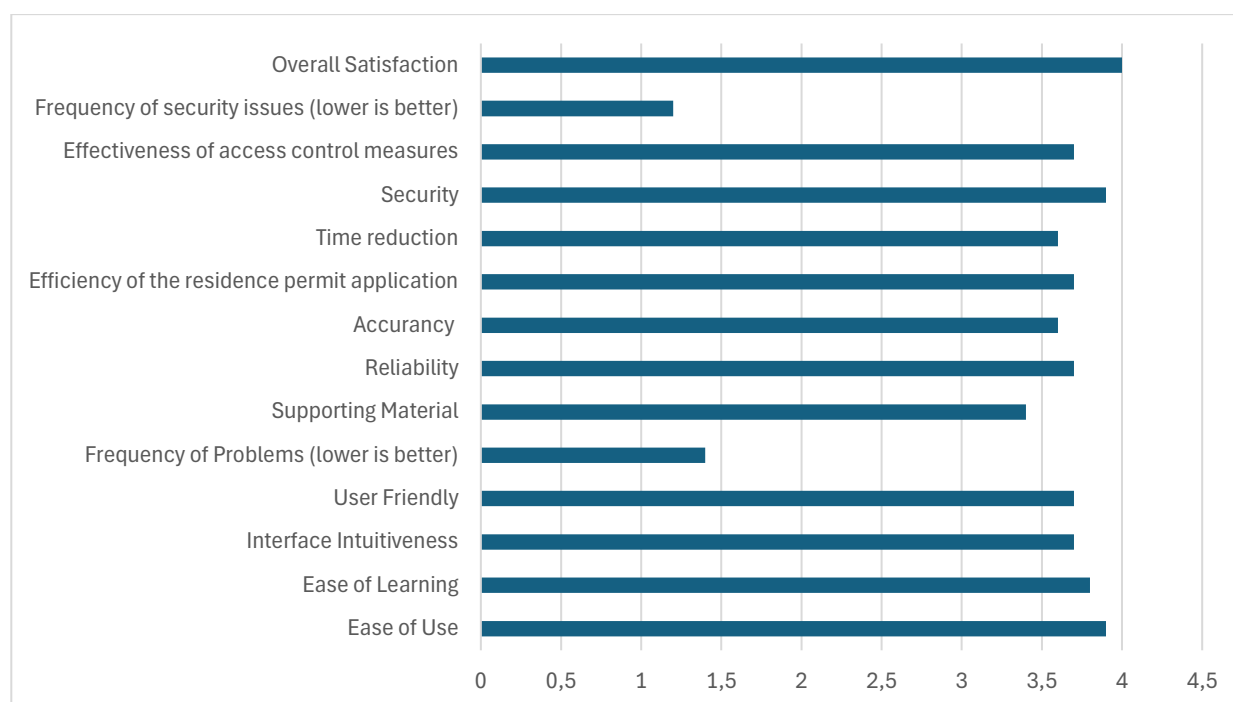


Figure 52: Public Organisation Evaluation Results

Table 41: Public Organisation Net Promoter Scores

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)							10%	40%	30%	20%		7.6

5.9 Pilot 6 – Retailers

5.9.1 Pilot Overview

The Retailers pilot, led by METRO, demonstrates how TANGO technologies can enhance data-driven decision-making in the retail sector while ensuring privacy, trust, and compliance. It focuses on empowering IT managers and business managers (marketing, sales, product) to securely analyze distributed retail data from different locations (Athens and Cyprus) using TANGO's identity, policy, and analytics components.

The pilot showcases TANGO's value in cross-branch data aggregation, privacy-preserving analytics, and secure onboarding of employees via ePassport and SSI Wallet. By embedding explainability and visualization into data analysis workflows, the pilot also contributes to increasing managers' trust in AI-driven insights and improving operational efficiency.

5.9.2 Deployment environment/ Legacy systems integration

The deployment is based on Linux servers/VMs hosted by METRO, with Kubernetes clusters supporting containerized TANGO components. Required infrastructure includes 4 vCPUs, 32 GB RAM, and ~1 TB storage, covering both system components and weekly retail datasets.

The pilot integrates with METRO's existing Oracle Databases (11gR2–19c), which store sales and operational data. As METRO does not provide direct APIs for security reasons, data is prepared by IT managers and placed in predefined secure locations for TANGO ingestion. A VPN connection links METRO's servers with the main TANGO Kubernetes cluster at INTRA, enabling synchronization of distributed services.

This setup ensures that METRO's legacy infrastructure remains operational while TANGO overlays secure data governance and analytics capabilities on top of existing systems.

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5.9.3 Legal / Ethical Issues

According to the Data Management & Ethics questionnaire, the pilot primarily processes non-personal, anonymized business data such as sales, product, and operational metrics. However, certain personal data (e.g., employee identifiers, passport data for onboarding) are temporarily processed during SSI identity onboarding.

In the Retailers pilot, personal data processing activities were carried out under the responsibility of METRO, which acted as the data controller. Given the involvement of multiple entities in the processing operations, a dedicated DPA was concluded in accordance with Article 28 of the GDPR. The DPA clearly defined the roles and responsibilities of the controller and the processors, ensuring compliance with applicable data protection obligations. METRO acted as Controller, while technical partners (e.g., ATOS, UMU, INTRA, EXUS) acted as Processors. Data were never transferred outside the EU/EEA, and all shared personal data were anonymized or pseudonymized when processed for evaluation.

To safeguard the rights and freedoms of participants, informed consent forms were prepared, distributed and duly signed prior to their participation in the pilot activities. These consent forms ensured that data subjects were adequately informed about the nature and purpose of the processing and that their participation was entirely voluntary and based on free and informed consent, as required by Articles 6 par. 1 (a) and 7 of the GDPR.

The data collected during the pilot have been aggregated and anonymised for the sole purpose of generating reports and evaluating the performance of the TANGO framework. Such data has not and will not be processed for any purposes beyond those explicitly stated in the consent documentation, in line with the principle of purpose limitation under Article 5 par 1 (b) GDPR. Anonymisation measures were implemented to ensure that individuals could no longer be identified, thereby eliminating the risk of re-identification.

All data have been securely stored on METRO's premises for the duration specified in the consent forms and will be permanently deleted upon the expiration of that period, in compliance with the data minimisation principle set out in Article 5 par. 1 (c) GDPR and the project's internal data retention policies.

5.9.4 Pilot Implementation & Testing scenarios

The TANGO pilot for Retailers took place at METRO premises in Athens, Greece, with the participation of the IT Manager and Commercial Managers from different levels representing the various roles. First the IT Manager performed the data preparation and triggered the data analysis. Afterwards, the Commercial Managers logged in to TANGO to view their respective reports.

The final testing scenarios involved two main personas: IT Managers and Commercial Managers (Sales, Marketing, Product) and demonstrated how TANGO ensures secure onboarding, privacy-preserving data flows, and trusted analytics within a real-world retail environment.

Table 42: Retail pilot: IT Manager scenario

Scenario Step	Description	Components involved
Employee onboarding (IT Manager)	Staff acquire a digital identity (ePassport) via a mobile app, stored in the SSI Wallet and verified by the SOUD. This identity is required to access TANGO services.	SOUD (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services.
Data Preparation	IT managers check data availability in Athens and Cyprus, extract datasets, and place them in secure locations. Existing files are removed to ensure clean ingestion. TANGO ensures that the person logged in is indeed the person typing and uploading the files.	UCBA
Data Analysis Trigger	IT managers log into TANGO via the UI and notify the EDAE component that new data are available. The system then processes the data, and results are returned via the dashboard.	SSI, SOUD PDP-PEP EDAE

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Scenario Step	Description	Components involved
		UI for getting access to various services.

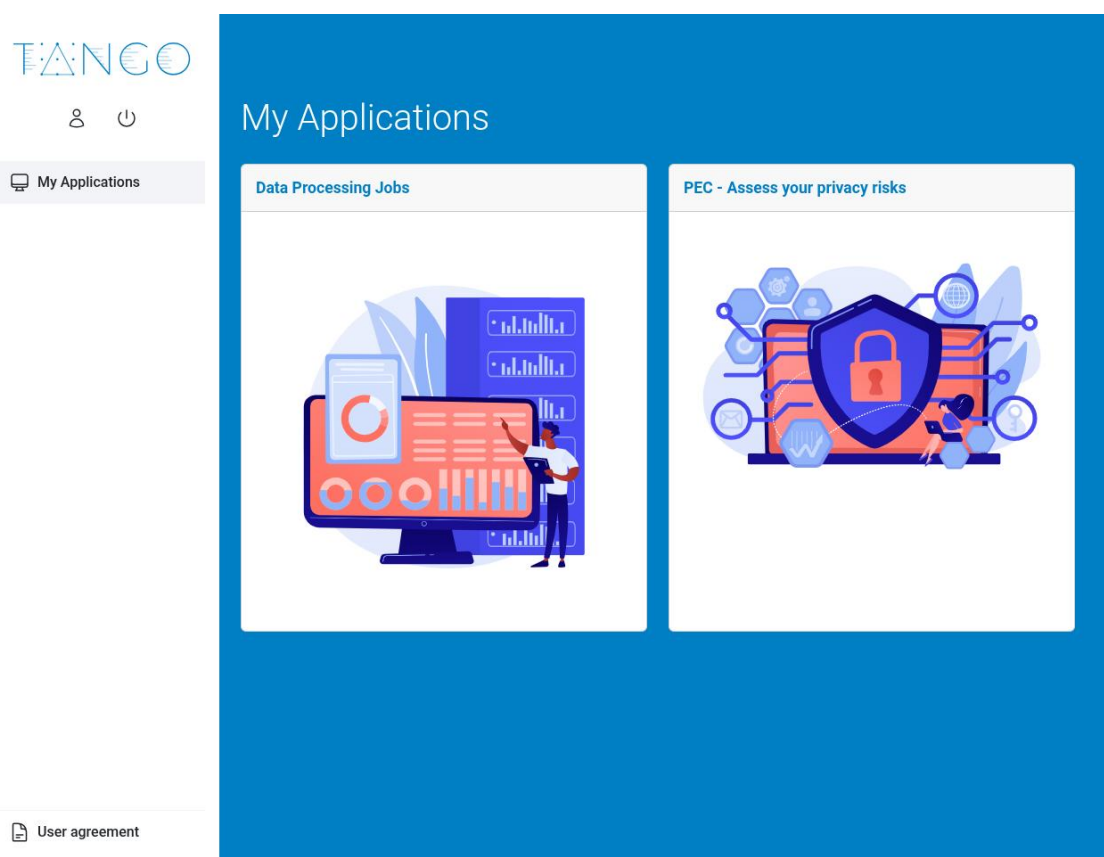


Figure 53: Retailers pilot: The IT Manager dashboard

Table 43: Retail pilot: Commercial Manager scenario

Scenario Step	Description	Components involved
Employee onboarding	Staff acquire a digital identity (ePassport) via a mobile app, stored in the SSI Wallet and verified by the SOUD. This identity is required to access TANGO services.	SOUD (ePassport) SSI Agent/Wallet UI for onboarding and getting access to various services.
Manager Data Requests	Business managers log into TANGO, select parameters for analysis, and request reports. Components such as VIS and EDAE generate results and visualizations, allowing managers to evaluate trends and support decisions.	SSI, SOUD PDP-PEP VIS UI for getting access to various services.

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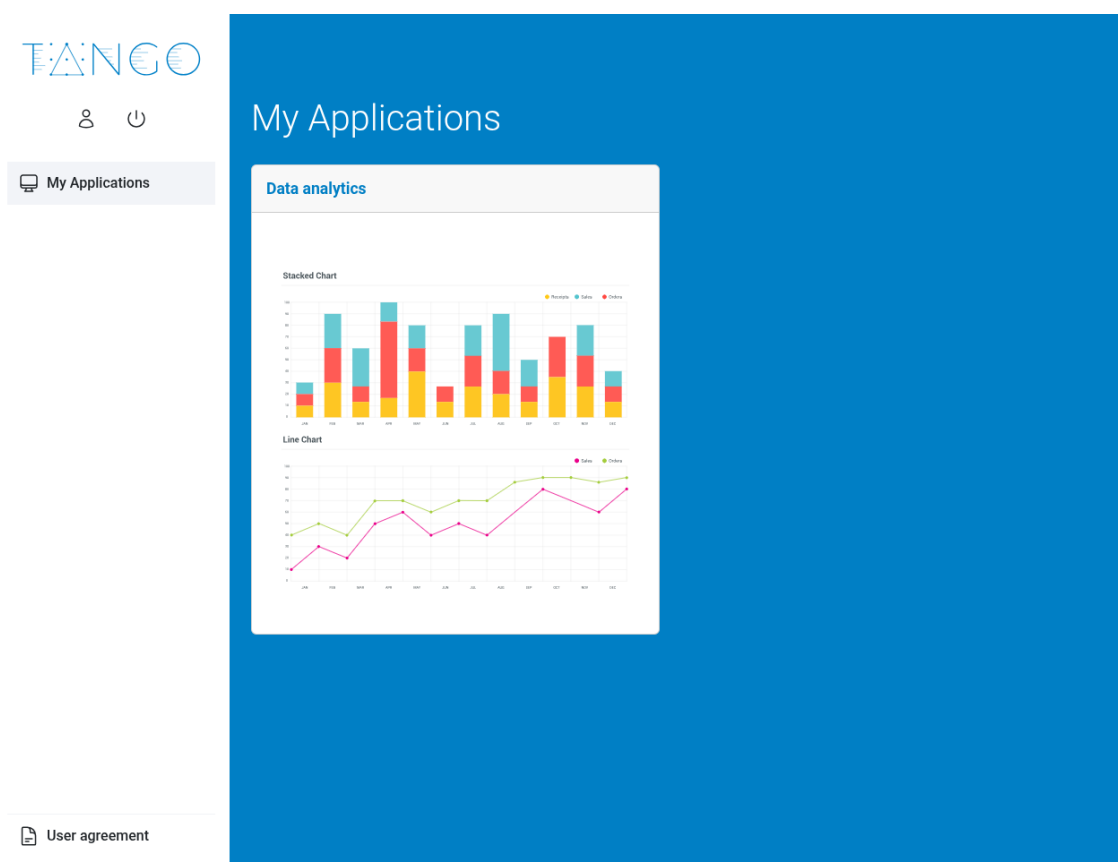


Figure 54: Retailers pilot: The Commercial Managers dashboard

5.9.5 Evaluation results

The Retail Pilot, led by METRO, aimed to assess the usability, stability, and performance of the TANGO platform from an IT & business manager's perspective within a retail enterprise environment. The evaluation was conducted on August 2025, using HP laptop running Windows 11, simulating a typical setup found in corporate retail IT operations. Moreover, they use also, smartphones with android software. Both stakeholder groups approached the system from different operational standpoints—technical and business-facing—but demonstrated a strong degree of alignment in their overall impressions. The responses to the first set of open-ended qualitative questions reveal shared sentiments around the usability of the platform and constructive suggestions for improvement.

IT Manager

During the pilot, the evaluator reported that all planned actions were completed, despite encountering a few initial issues with some components. These early challenges were attributed to environmental sensitivity, minor errors, and occasional stability issues. However, these were quickly resolved through system improvements. By the final testing phase, all modules functioned as expected, enabling a smooth and complete assessment of platform capabilities.

The core evaluation focused on verifying secure digital access, use of identity credentials (such as ePassports and SSI Wallets), and end-to-end system responsiveness. The platform's functionality was ultimately judged to be reliable, achieving its goals. No major bugs or weaknesses were identified during testing, and the user confirmed that they did not require external support at any point.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

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Table 44: Retailer Evaluation Results (IT Manager)

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				100.00%		4.00
Ease of Learning				100.00%		4.00
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness				100.00%		4.00
User Friendly				100.00%		4.00
Supporting Material			50.00%	50.00%		3.50
Reliability			50.00%	50.00%		3.50
Accuracy				100.00%		4.00
Effectiveness of reducing data processing time			50.00%	50.00%		3.50
Effectiveness of access control measures			50.00%	50.00%		3.50
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)			100.00%			3.00
Frequency of security issues (lower is better)		100.00%				2.00
	Very	Insecure	Neutral	Secure	Very Secure	
Security				100.00%		4.00
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
ePassport		50.00%	50.00%			2.50
SSI Wallet			50.00%	50.00%		3.50
Log in				100.00%		4.00
PEC				100.00%		4.00
UCBA		50.00%		50.00%		3.00

TANGO Platform				100.00%		4.00
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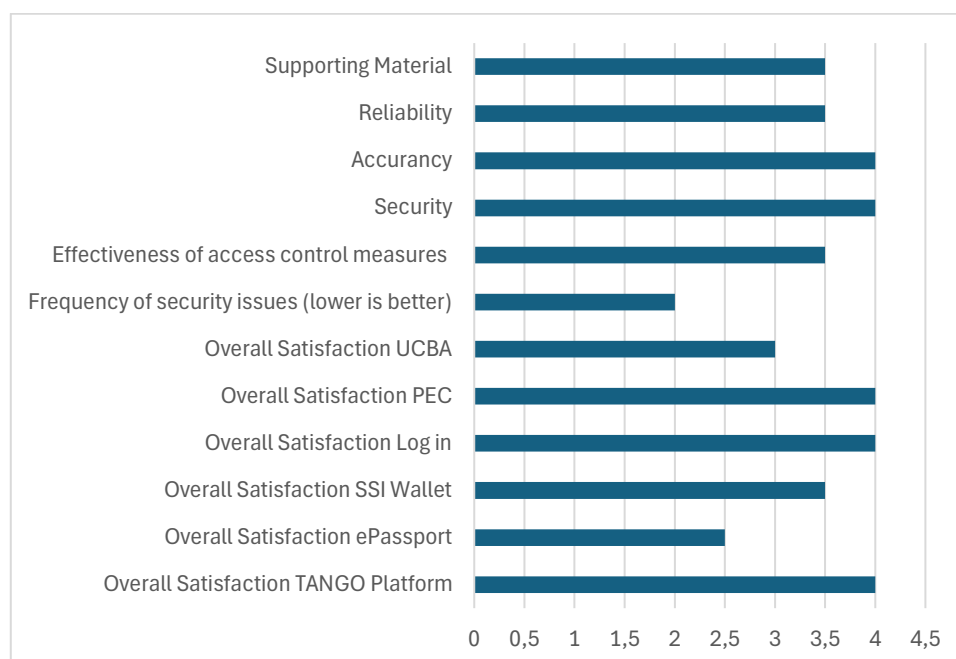


Figure 55: Retailer Evaluation Results (IT Manager)

Table 45: Retailer Net Promoter Scores (IT Manager)

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)							50.00%	50.00%				6.50

Business Manager

This report section focuses on the feedback collected from Business Managers involved in the Retail Pilot. Their role is particularly important, as they represent operational and strategic end users who rely on the platform to derive business insights, assess performance, and manage processes influenced by digital identity and data-driven decision-making. Business Managers (including Sales Manager, Marketing Manager and Product Manager) confirmed that they were able to successfully complete the tasks assigned during the evaluation scenarios. These tasks included interacting with the platform to generate and interpret business intelligence reports, navigate retail sales dashboards, and simulate user journeys such as comparing profitability across product categories and regions (e.g., Greece vs. Cyprus). The tools performed as expected and supported the use cases without technical obstacles. One user reported, “YES I MANAGED TO COMPLETE IT,” reinforcing the overall ease of execution.

Respondents highlighted the ability to produce clear visual outputs such as graphs and tables representing sales performance. These visualizations helped them identify category-specific profitability and regional trends, enabling more data-informed managerial decisions. The platform’s capacity to aggregate and present meaningful business metrics was seen as a key success of the pilot deployment. Moreover, all participants agreed that the pilot’s goals were achieved, particularly in providing decision-support tools that align with the operational needs of retail management. Several emphasized that the platform contributed to improved awareness of which product categories were underperforming and facilitated strategic reflection on resource allocation and sales optimization.

There were no major difficulties or frustrations reported during use. System stability, component responsiveness, and task completion flows were perceived as smooth and coherent. While no bugs or technical errors were

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encountered, some users recommended enhancements to increase interactivity and personalization of the output formats.

The following tables and figure, provide useful insights, regarding the rest of the questions from the evaluation questionnaire.

Table 46: Retailer Evaluation Results (Business Manager)

Category	VERY DIFFICULT	DIFFICULT	NEUTRAL	EASY	VERY EASY	Weighted Avg. (out of 5)
Ease of Use				100.00%		4.00
Ease of Learning				100.00%		4.00
	Not at all	Slightly	Moderately	Very	Extremely	
Interface Intuitiveness				100.00%		4.00
User Friendly			25.00%	75.00%		3.75
Supporting Material				100.00%		4.00
Reliability				100.00%		4.00
Accuracy				100.00%		4.00
Effectiveness of reducing data processing time			75.00%	25.00%		3.25
Effectiveness of access control measures			75.00%	25.00%		3.50
	Never	Rarely	Occasionally	Often	Very often	
Frequency of Problems (lower is better)	50.00%	25.00%		25.00%		2.00
Frequency of security issues (lower is better)	50.00%	25.00%		25.00%		2.00
	Very	Insecure	Neutral	Secure	Very Secure	
Security				100.00%		4.00
Overall Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	
ePassport		75.00%		25.00%		2.50
SSI Wallet				100.00%		4.00
Visualization & Reporting				100.00%		4.00

TANGO Platform				100.00%		4.00
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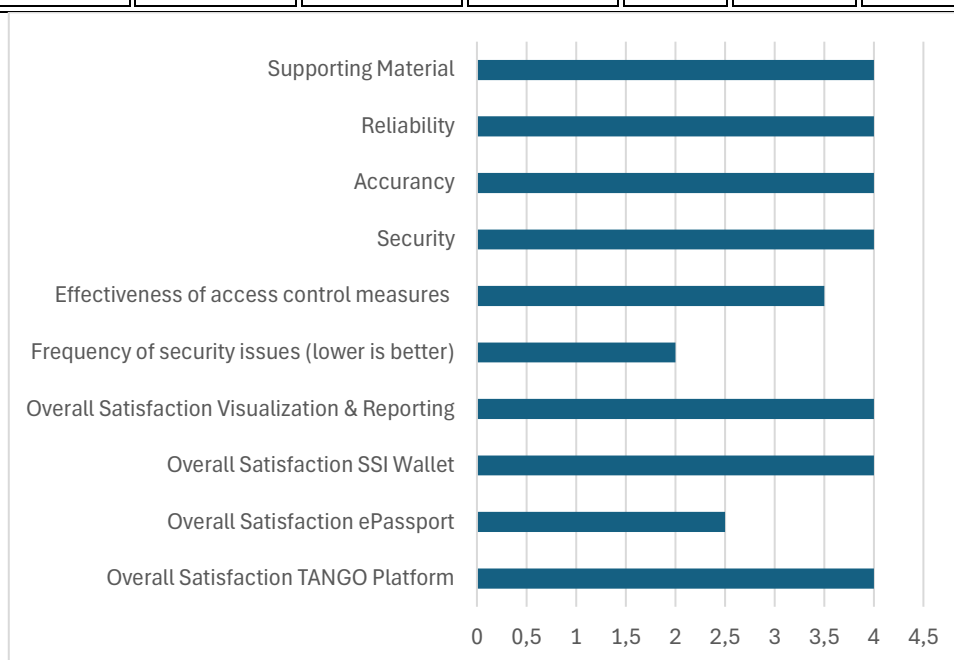


Figure 56: Retailer Evaluation Results (Business Manager)

Table 47: Retailer Net Promoter Scores (Business Manager)

	0	1	2	3	4	5	6	7	8	9	10	Weighted Avg. (out of 10)
Likelihood to Recommend (NPS 0–10)									75.00%	25.00%		8.25

6 Conclusions from TANGO pilot evaluation activities

The TANGO project's evaluation phase plays a significant role in understanding the platform's readiness, applicability, and perceived value across all pilot use cases and the corresponding industries. Therefore, this deliverable brings together insights from all pilot demonstrations and provides a consolidated and distinctive assessment of how well the components developed by TANGO delivered on expectations, usability, technical robustness, and strategic impact.

Cross-Pilot Completion and Participation

An important achievement that can be outlined is the completion of most pilot activities. Use case evaluations were carried out effectively by all participating stakeholders. Structured evaluations (as described in the methodology section) were undertaken using a standardized questionnaire and feedback form. This enabled consistent collection of both qualitative and quantitative data and helped the consortium to identify specific strengths and areas for improvement. In each use case, evaluators tested the relevant core TANGO functionalities according to specific scenarios. This approach demonstrates the platform's features and broad scalability across use cases with varying requirements.

User Profiles and Diversity

Another important aspect worth mentioning is the diversity of user personas and evaluators engaged in the pilot cases. Participants ranged from technical experts (e.g., data scientists, IT managers) to business users (e.g., hotel guests and public employees), providing a holistic view of user expectations. Despite the different levels of digital proficiency of users, the usability scores were consistently high, indicating that the TANGO platform was intuitive even for those with minimal previous experience on decentralized systems or advanced AI tools.

This inclusion of different roles also provided valuable feedback on how the platform operates when used by different types of users. For example, while developers appreciated the fine-grained control offered by TANGO's orchestration layer, business users emphasized the need for improved onboarding materials and UI intuitiveness.

Goal Achievement and Platform Functionality

Based on the pilots' evaluation reports, all respondents confirmed that they were able to complete their pilot tasks and achieve their goals, apart from the RIAS pilot where persistent technical issues related to the smartwatches were faced. This is one of the most important findings of the evaluation, as it confirms the technical viability of this digital platform across all tested industries. Whether the task involved downloading mobility maps, verifying fraud-detection models via federated learning, or analyzing production data using MLOps, the TANGO components performed as expected.

The platform's core functionalities—security, access control, and information accuracy—received exceptionally high ratings from all evaluators, with most users assigning top scores. An additional important issue is the fact that TANGO platform managed to ensure baseline robustness in compliance-sensitive domains, such as finance and public administration.

User Satisfaction Metrics

To assess user satisfaction, throughout the entire process of evaluation, quantitative analysis was conducted using weighted averages and Likert scales metrics. The results revealed that overall user satisfaction was high across all evaluation categories. Categories such as ease of use, learnability, and intuitiveness received average scores above 3.5 on a 5-point scale. Satisfaction levels remained strong, suggesting that users saw significant value in the platform and believed that any issues encountered were resolvable, rather than fundamental flaws. The above statement is further supported by their willingness to recommend this platform, as indicated by Net Promoter Scores (NPS), ranging from 7.0 to 10.0.

System Stability and Issue Frequency

System stability was another key area evaluated in the pilots. Most users reported encountering no major problems such as crashes, data loss, or unrecoverable errors. In cases where issues did arise, such as during the initial stages of the Retail and Manufacturing pilots, these were attributed to the internal environment constraints and dependencies, incomplete setup, or edge-case configurations. These issues were resolved during the evaluation process and did not prevent the completion of tasks.

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The “Frequency of Issues” metric was measured on a scale where lower scores represent fewer problems. This metric consistently fell within the optimal range, with several pilots achieving the lowest (best) score. This suggests that the platform demonstrated production-grade stability in most environments tested, even under heterogeneous conditions involving different devices, operating systems, and connectivity constraints.

Security and Trust in the Platform

A recurring outcome of the evaluation was the confidence users expressed in TANGO’s security architecture. Across all pilots, no security issues were reported, and the perceived effectiveness of access controls was consistently rated at the highest level. This is especially significant in domains such as Banking, where federated models needed to be trained without compromising sensitive financial data, and in Public Services, where citizen privacy is a paramount concern.

The platform’s transparent governance models and explainability features also contributed to user trust. For example, in the Smart Manufacturing pilot, users utilized the XAI module to evaluate model fairness and detect potential bias, boosting confidence in AI decision-making.

Information Accuracy and Output Quality

Another area with strong positive feedback was the accuracy and reliability of platform outputs. Evaluators confirmed that the models behaved as designed and expected, and that the platform analytics were consistent with verified facts. This was especially critical in data-centric pilots like Manufacturing and Banking, where participants used AI tools to process and interpret large datasets.

In the Banking pilot, for example, the federated model outperformed individual bank models, providing a 10% improvement in F1-score over the best local baseline. This not only demonstrated the power of collaborative learning without data sharing but also validated TANGO’s ability to manage model convergence, weight aggregation, and synchronization across distributed nodes.

Support Materials and Help Requirements

The availability of support materials such as user guides, examples, and tutorials received mixed reviews. While some pilots (notably Autonomous Vehicles and Banking) found everything they needed to complete the evaluation independently, other users—especially in more technical setups—requested clearer documentation and better onboarding flows.

This feedback suggests that while the platform is functionally robust, the user enablement layer can be improved, particularly for developers working with custom AI models or integrating multiple components. Automated wizards, walkthroughs, and interactive UI guides could support users and facilitate deployment.

Despite these limitations, it is worth noting that only one user reported the need for external help, justifying the platform’s general usability, even in complex scenarios.

Strategic Impact and Adoption Readiness

Perhaps the most compelling insight from the evaluation is the platform’s readiness for adoption. Multiple pilots indicated that they intended to continue using the TANGO components beyond the project timeline. Features like MLOps pipelines, secure access control, and explainable AI were not seen as experimental, but rather as valuable tools ready for production use.

Moreover, pilots from regulated domains (e.g., Banking, Public Services) explicitly stated that the platform helped reduce legal and compliance risk by minimizing the need to centralize personal data. The integration of privacy-by-design principles makes TANGO a highly aligned solution for data governance in the EU’s evolving digital landscape.

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7 References

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Annexes

Annex 1 - Hospitality Pilot User Guide

ONBOARDING AND REGISTRATION INSTRUCTIONS

Prerequisites:

- An android device (smartphone or tablet) with NFC
- A passport
- A laptop (for parallel testing of the platform)

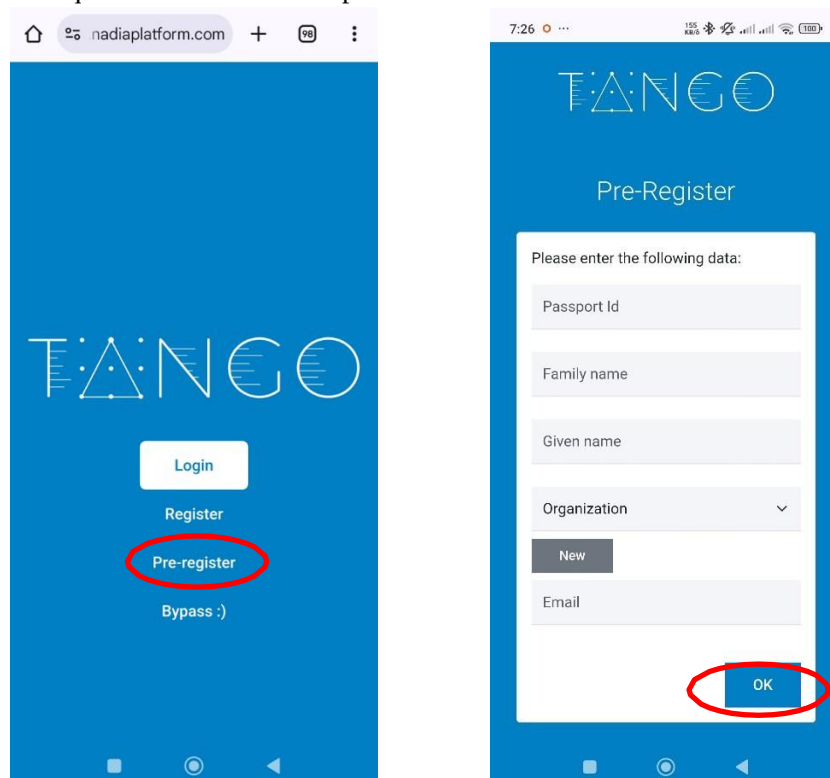
PREPARATORY ACTIONS

Step 1. Completing the consent forms.

1. Complete and sign the consent form that has been sent in the previous days. You can find it at the Owncloud here: <https://newrepository.atosresearch.eu/index.php/f/1387665>.
2. Upload it to this directory of the Owncloud: <https://newrepository.atosresearch.eu/index.php/apps/files/?dir=/TANGO/Work%20package%20WP7/Pilot%20Consent%20Forms/Pilot%201%20-%20Smart%20hospitality/Signed%20consent%20formsCfileid=1387074>

Step 2. Pre-registration

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/>.
2. Click “Pre-register”.
3. Complete the required information and press OK.

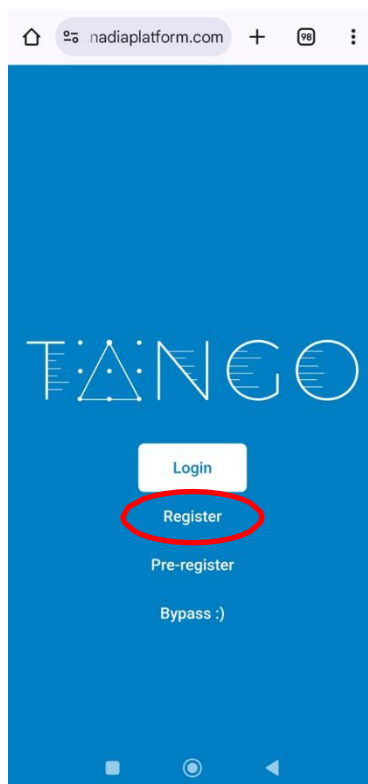


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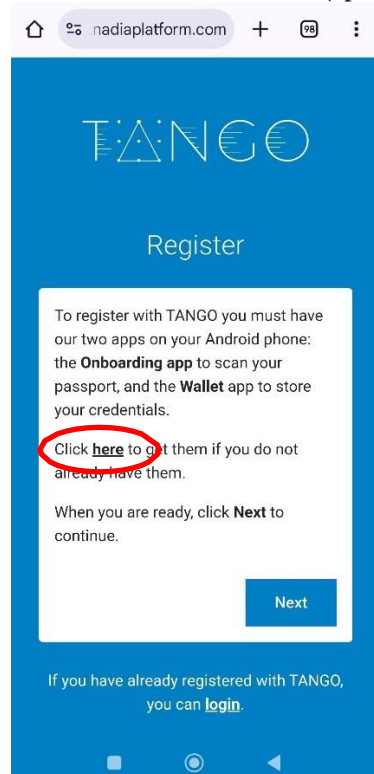
USER ONBOARDING (SSI WALLET s ePASSPORT)

Step 3. SSI Wallet s ePassport apps installation

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/>.
2. Click “Register”.

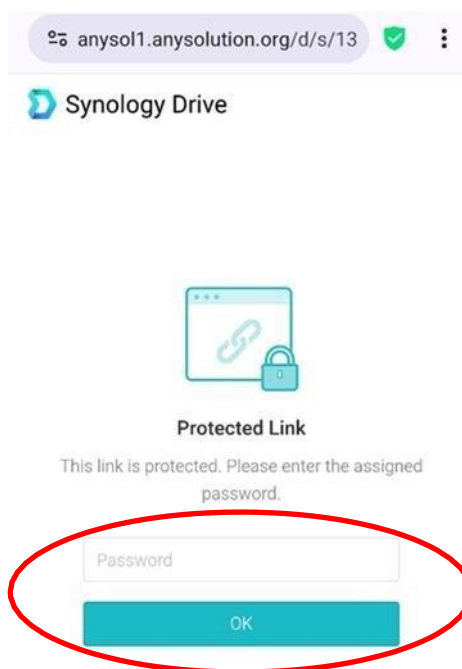


3. You have to install the SSI Wallet and the ePassport apps on your android device (NFC-enabled smartphone or tablet). Click “here” to be directed to the download page of the installation files (apk files) - Synology Drive (AnySolution).

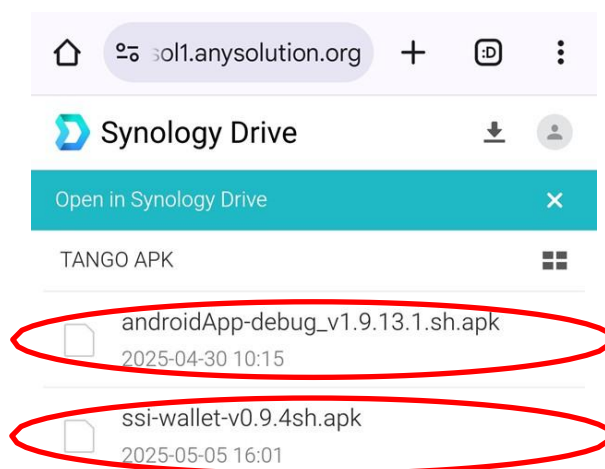


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4. Enter the Password: **Tango2025%** and press “OK”.



5. You will be directed to the page with the apk files:
- ePassport:** androidApp-debug_v1.9.13.1.sh.apk
 - SSI Wallet:** ssi-wallet-v0.9.4sh.apk
6. Tap on each apk file and install the applications on your android device. Make sure you have enabled permissions to install apps from third party providers. If you do not know how to install apk files on an android device you can visit: <https://www.lifewire.com/install-apk-on-android-4177185>.



Step 4. SSI Wallet sign-up

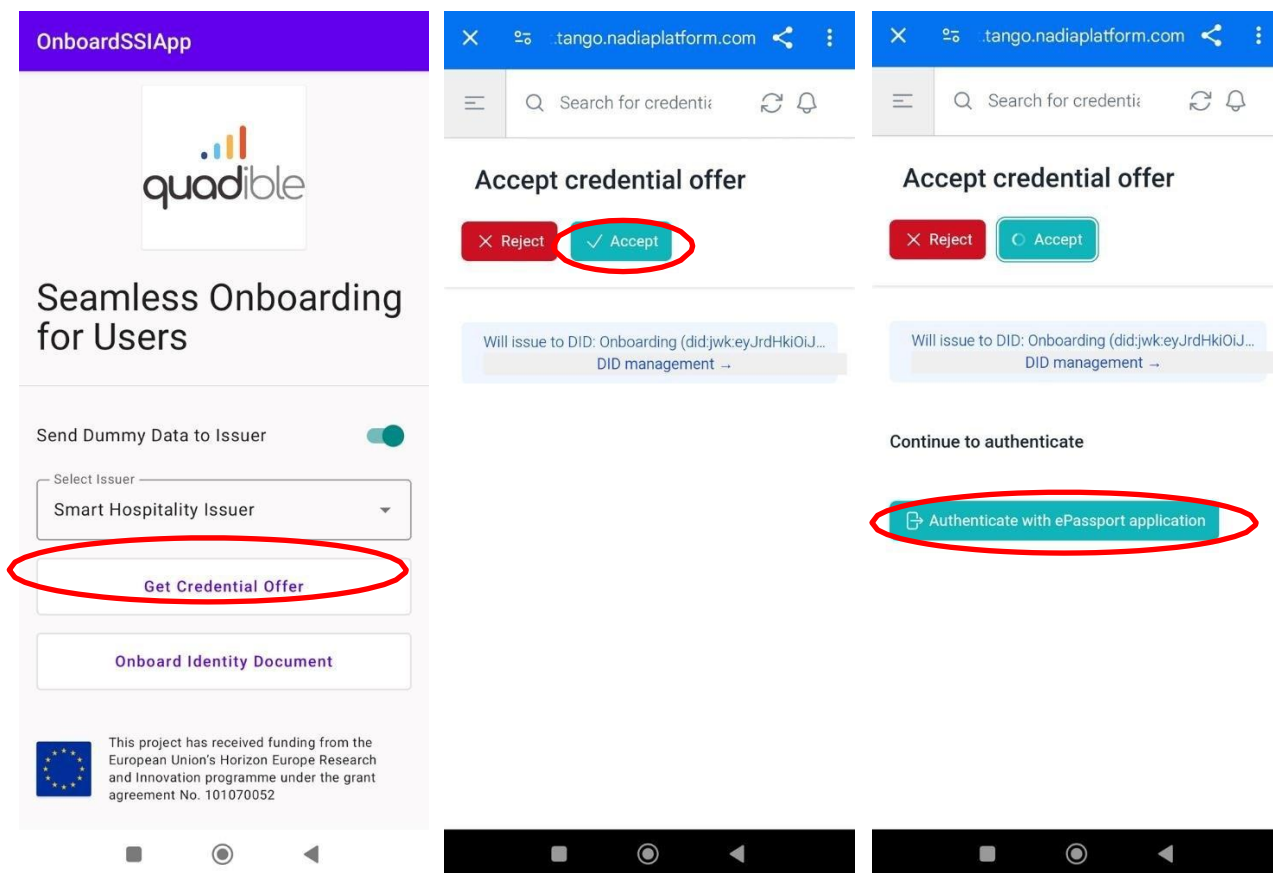
- Open the SSI wallet (from android launcher) and create an account (Sign-up - email + password).

Note: Installing the SSI wallet on an android device is necessary for the integration with the ePassport application. Otherwise, accessing the wallet at <https://ssi-wallet.tango.nadiaplatform.com> works equally well, with the same account.

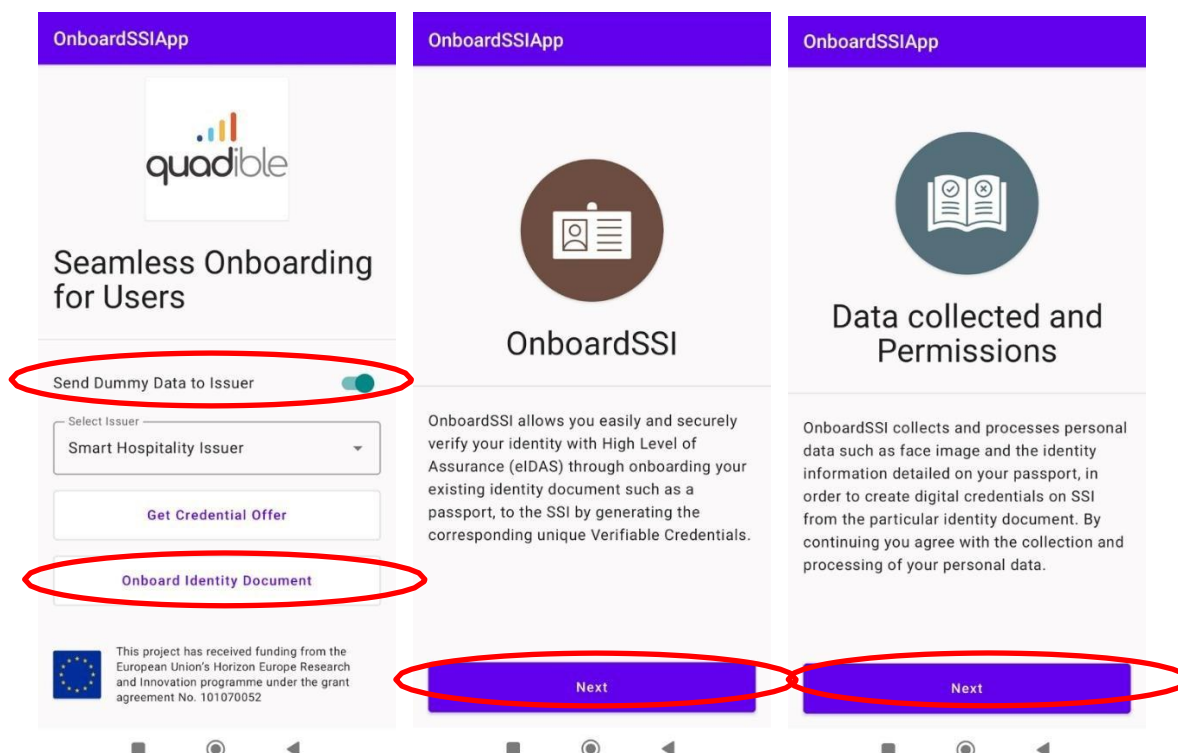
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Step 5. Onboarding process (SSI Wallet s ePassport)

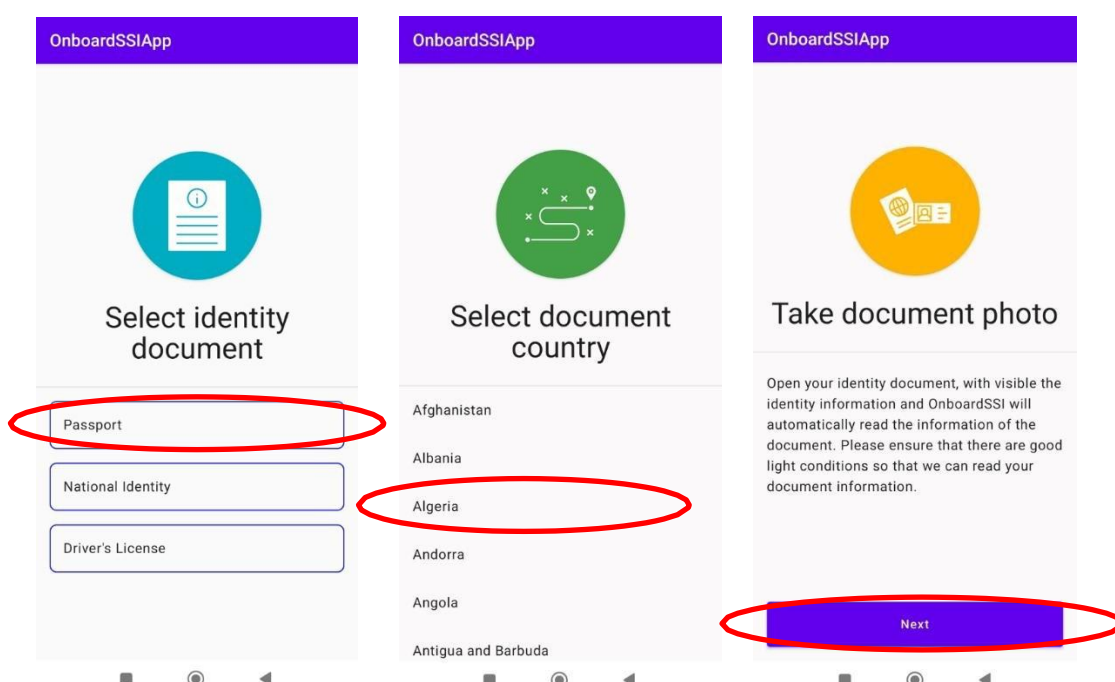
1. Launch ePassport app.
2. Click “Get Credential Offer”. The SSI wallet should open automatically.
3. Click “Accept” at the “Accept credential offer” screen.
4. A button “Authenticate with ePassport application” should appear. Click “Authenticate with ePassport application”.
5. You will be forwarded to the ePassport application.



6. On the ePassport application click “Onboard Identity Document” and run through the steps:
 - a. Disable the option “Send dummy data to issuer”.
 - b. Read through the description of the app. Click “Next”.
 - c. Read through the description of the data collected by the app. Click “Next”.

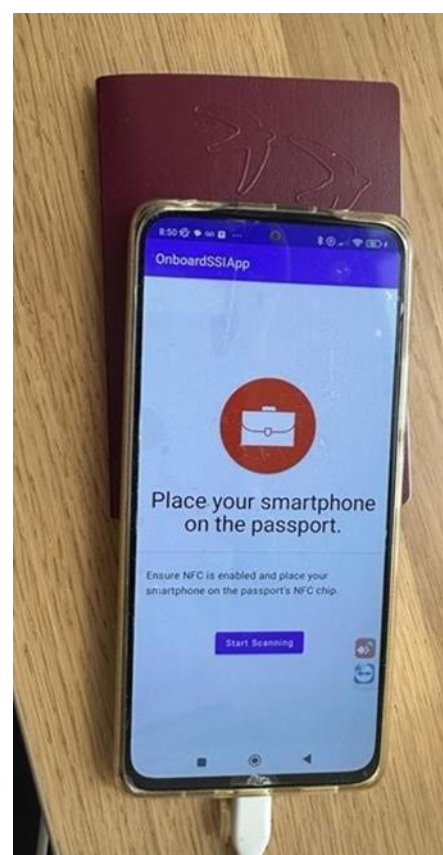


7. Choose “Passport” at the Select Identity Document screen.
8. Scroll and select (tap on) the country from which the identity document was issued (e.g. Greece, Spain, etc.).
9. Choose “Next” at the “Take document photo” screen. *To take the photo you will be prompted to grant the appropriate permissions in the android device. Enable permissions for the camera.*

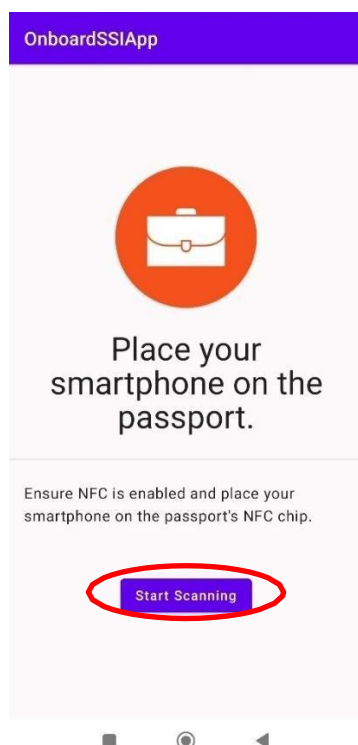


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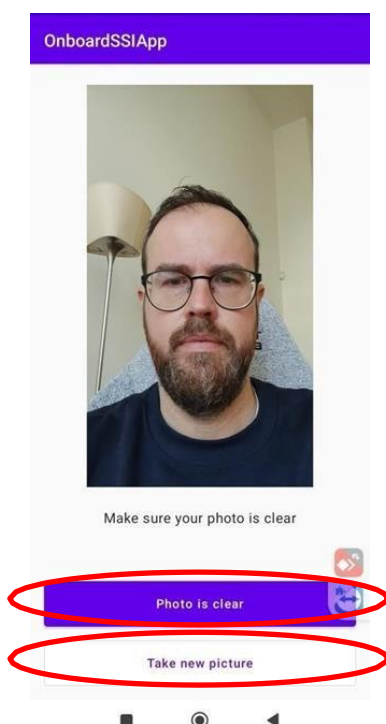
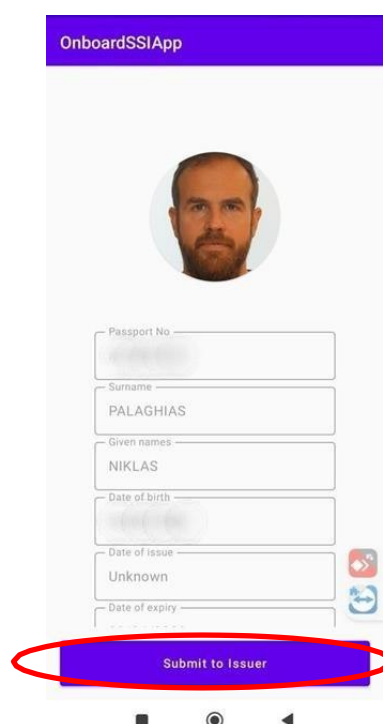
10. Now you can take a photo of the identity document. *A few important points:*
 - a. Make sure you are in a well-lit environment.
 - b. Try to centre the rectangle as shown at the image.
 - c. It will automatically capture an image once the passport is detected.
 - d. Try to hold it still, to get a clear picture and make sure that the numbers are visible.
11. Verify that the information is visible and that the image is not blurry.
 - a. If the info is blurry, tap on “Take new picture”.
 - b. If the info is visible, tap on “Photo is clear”
12. Place the device on the passport as shown on the image.
 - a. Make sure the NFC reader is enabled on your device.
 - b. The passport NFC tag is on the back cover.
 - c. You will here a short sound when the NFC tag is accessed by the device.
13. Wait for 5 seconds and do not move the device.



14. Tap on “Start Scanning” and wait. If it successfully scans, after 5-10 seconds it will show the next screen.
15. Place your face inside the oval. It will detect your face and take an image.



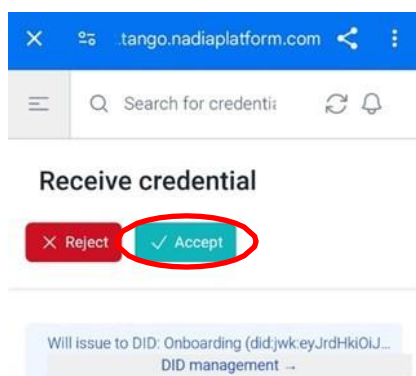
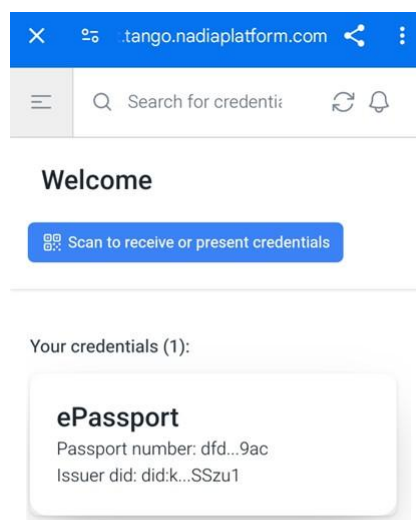
16. Verify that the facial image is visible and that the image is not blurry.
 - a. If the info is blurry, tap on “Take new picture”.
 - b. If the info is visible, tap on “Photo is clear”.
17. *The system has performed identity verification and showcases the facial image of the person and the information from the passport.*
18. At the end click “Submit to Issuer”. You should be forwarded to the SSI wallet.



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19. Click “Accept”.

20. You have received an ePassport verifiable credential.

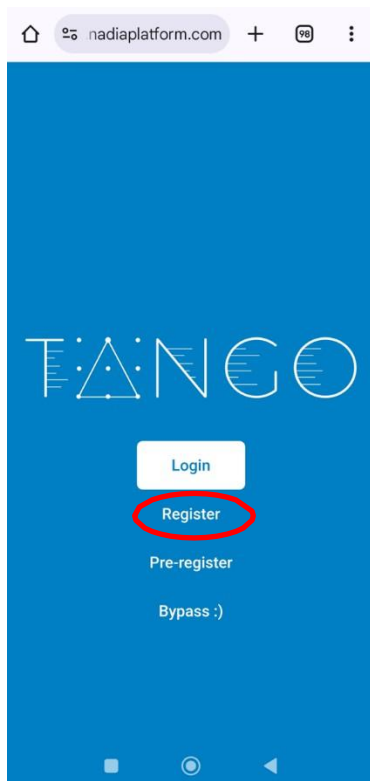
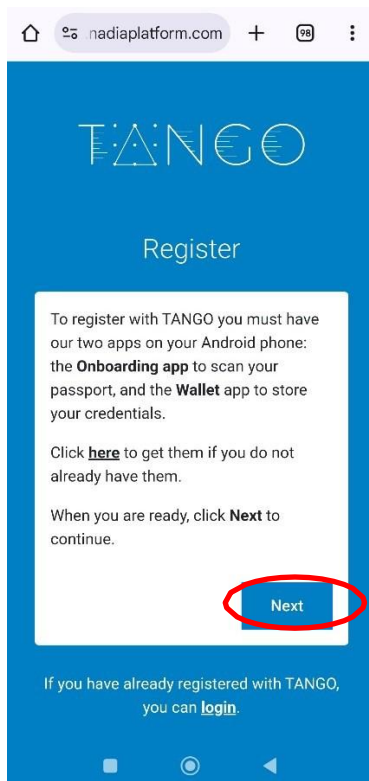
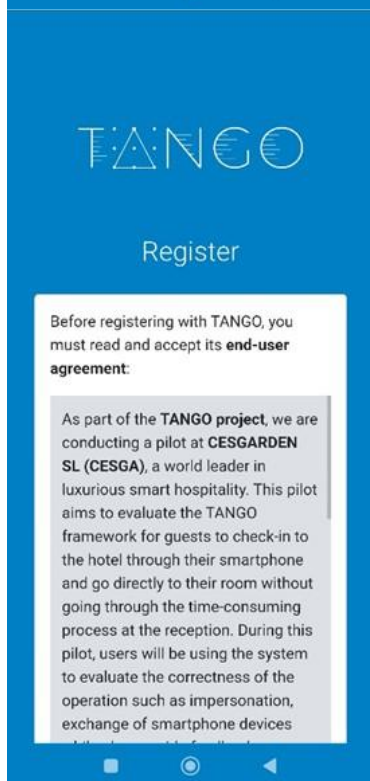


TANGO REGISTRATION PROCESS

Step 6. Obtaining customer/employee credential

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/>.
2. Click “Register”.
3. Run through steps.
 - a. Click “Next”.
 - b. Scroll down and read through the end-user agreement.
 - c. Check the “Accept the above terms” checkbox.
 - d. Click “Next”.

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TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

out to them via an email, should you have any questions regarding your personal data, in the following email address: legalint@diadikasia.gr.

2. Purpose of Data Collection

We are collecting your personal data within the hotel to:

- Evaluate the TANGO framework for check-in to the hotel through your smartphone while going directly to your room



TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

- directly to your room without going through the time-consuming process at the reception,
- Evaluate the correctness of the operation such as impersonation, exchange of smartphone devices,
- Provide us feedback regarding your satisfaction and your overall experience with the TANGO framework.

With your assistance and participation, according to your



TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

participation, according to your designated contribution, we will be able to test and implement the TANGO framework through its projected function during the check-in process.

3. Data Collected

We would like to inform you that we will be processing the following personal data:

1. Name
2. Surname
3. Passport Number, date and



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TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

Your data will be processed according to the following three-phase approach:

- **Onboarding process:**

Before connecting to TANGO, you must get your TANGO identity. To do that, the process of onboarding you into TANGO starts by scanning your passport in a dedicated app, downloaded by you on your respective mobile phone. After scanning the passport with

TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

scanning the passport with the app, your required personal data will be sent to the SSI wallet and identity components located in the server of the pilot. You will then get your TANGO identity in order to use it to login to the system. The TANGO UI provides access to a QR code to allow your authentication and authorization via the Mobile wallet into the system.

TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

wallet into the system.

- **Tourist Check-in process:**

You will log in with your TANGO credentials by scanning a QR code in the TANGO dashboard and by using the identity components for authorization and authentication. The PAT Tool complements the personal data from the user to check-in via a form and copy this information for the hotel receptionist in

TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

the hotel receptionist in order to update the hotel system.

- **Final process:** Sensor data is used to generate statistical reports for managers and the hotel.

Your personal data will be removed from the TANGO pilot after the completion of the evaluation, expected in May 2025.

5. Legal Basis for Processing

TANGO

Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

5. Legal Basis for Processing

Your personal data will be processed according to the relevant legal provisions. The legal basis for the processing of your personal data during the pilot is your consent relating to Article 6 paragraph 1 sentence 1a of the General Data Protection Regulation.

Please note that you have the right to withdraw your consent at any time, without any

TANGO

Register

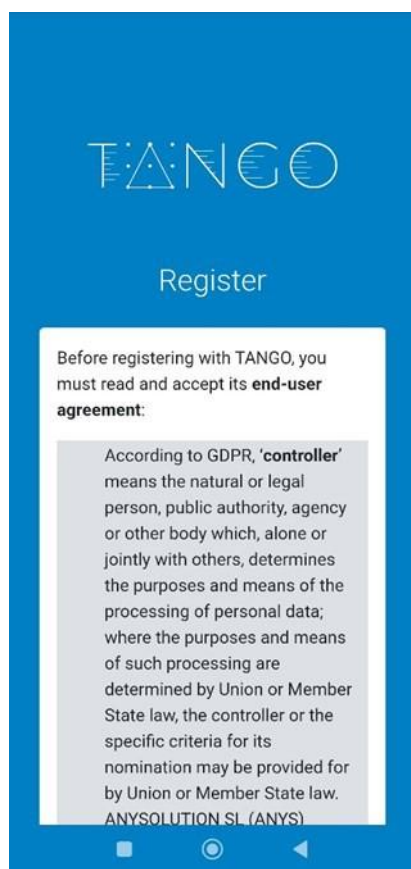
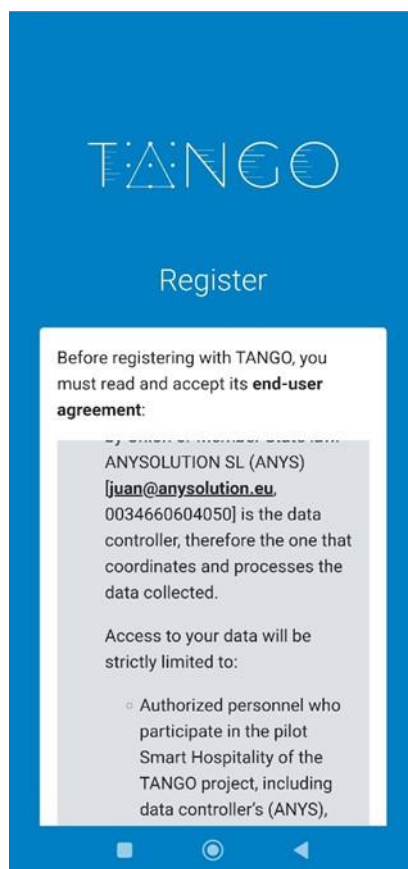
Before registering with TANGO, you must read and accept its **end-user agreement**:

at any time, without any negative consequences. If you choose to withdraw consent, this will not affect the lawfulness of any data processing that has already taken place before your withdrawal. You can contact legalint@diadikasias.gr to revoke consent.

6. Data controllers - Access to Personal Data

According to GDPR, 'controller'

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Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

8. Your Rights

As a result of the data processing operations, according to the General Data Protection Regulation ("GDPR"), the data subject – participant to the pilot can exercise at any time the following rights, when applies:

- **Right to be informed** regarding anything that is related to the processing of personal data,



Register

Before registering with TANGO, you must read and accept its **end-user agreement**:

personal data,

- **Right of access** to the personal data and any other information related to the data processing activities,
- **Right to rectification** of inaccurate personal data or completion of incomplete personal data,
- **Right to erasure (right to be forgotten)**, according to which the data subject could achieve the deletion of his/her personal data under certain conditions,

Before registering with TANGO, you must read and accept its **end-user agreement**:

certain conditions,

- **Right to restriction of processing** of the personal data under certain conditions,
- **Right to data portability**, according to which the data subject can receive the personal data concerning him/her, which had been provided to a controller, in a structured, commonly used and machine-readable format and transmit them to another controller without hindrance from the controller to which the personal data had been previously provided,
- **Right to object** at any time to processing of personal data concerning him/her,
- **Right to object** to the automated individual decision-making, including profiling.
- **Right of filling a complaint**

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to processing of personal data concerning him/her,

- **Right to object** to the automated individual decision-making, including profiling.
- **Right of filling a complaint** to the competent national supervisory authority.
- **Withdrawal from the provided consent** at any time freely.

In case you wish to exercise your forementioned rights, please contact the designated legal partner of TANGO project, "Diadikasia Business Consulting Symvouloi Epicheiriseon AE", via an email in the following email address: legalint@diadikasia.gr.

☐ I accept the above terms

Back Next

If you have already registered with TANGO, you can [login](#).

to processing of personal data concerning him/her,

- **Right to object** to the automated individual decision-making, including profiling.
- **Right of filling a complaint** to the competent national supervisory authority.
- **Withdrawal from the provided consent** at any time freely.

In case you wish to exercise your forementioned rights, please contact the designated legal partner of TANGO project, "Diadikasia Business Consulting Symvouloi Epicheiriseon AE", via an email in the following email address: legalint@diadikasia.gr.

☒ I accept the above terms

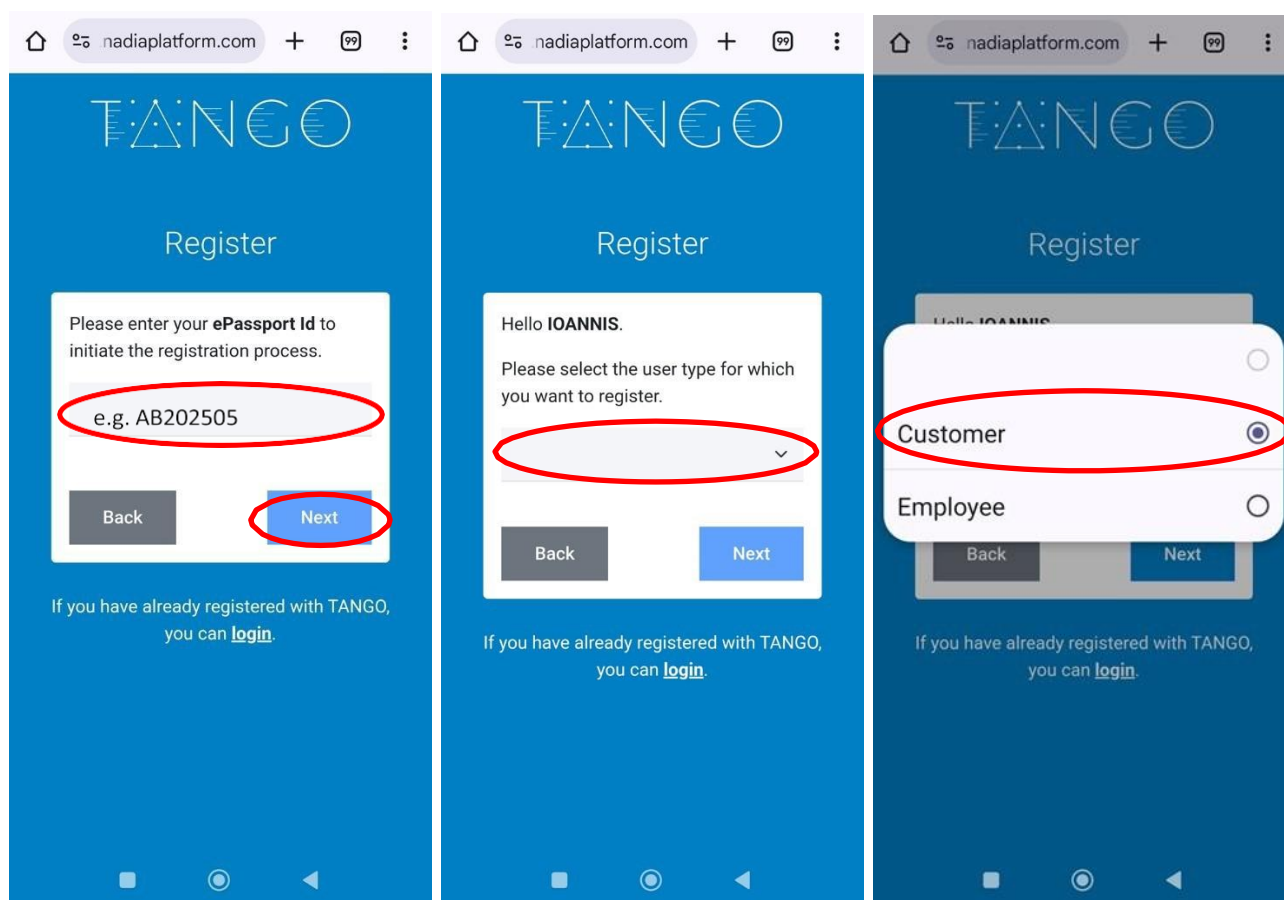
Back Next

If you have already registered with TANGO, you can [login](#).

4. Under "Please enter your ePassport Id to initiate the registration process." enter your passport ID

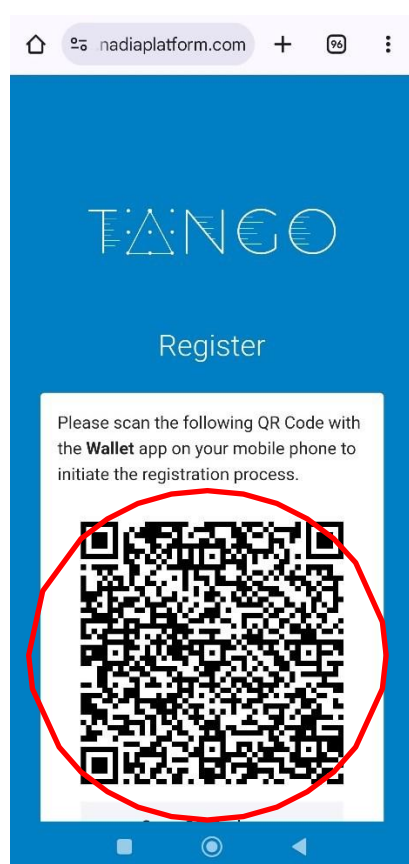
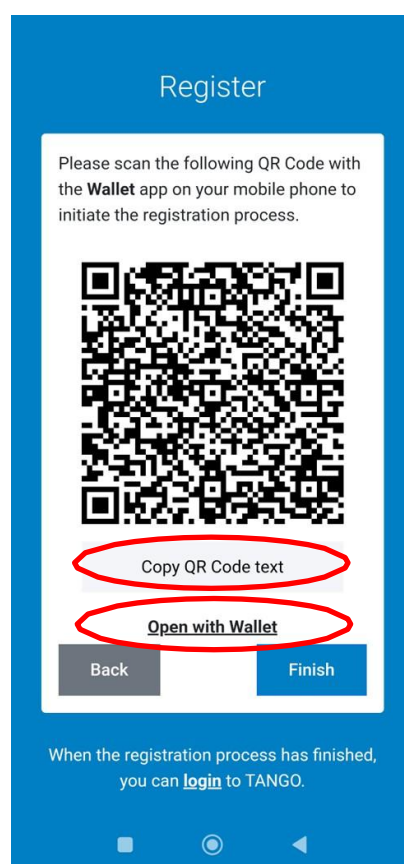
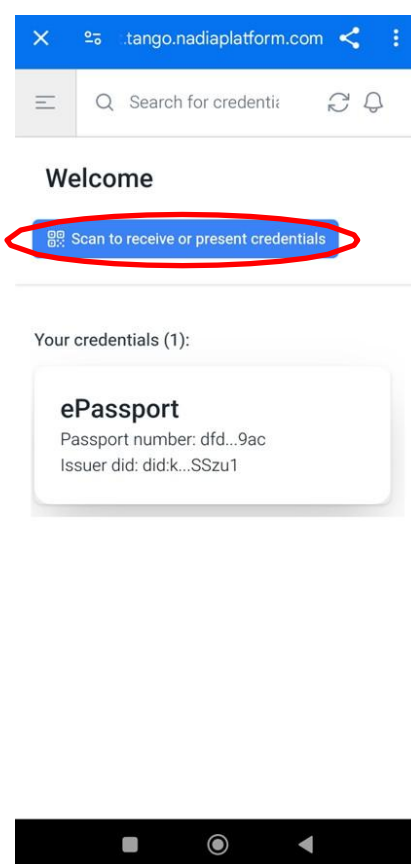
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- and click “Next”.
- Pick “Customer”.

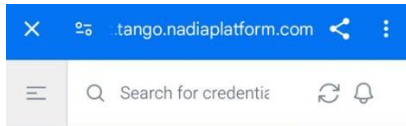
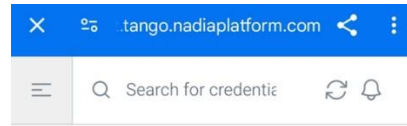
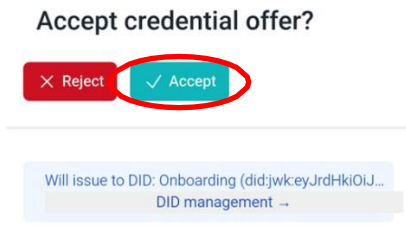
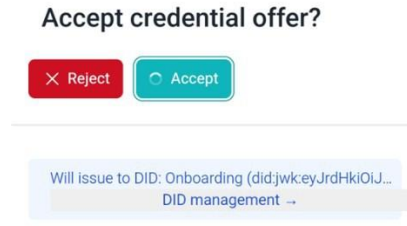


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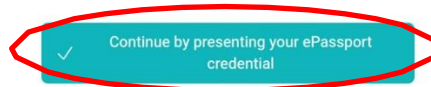
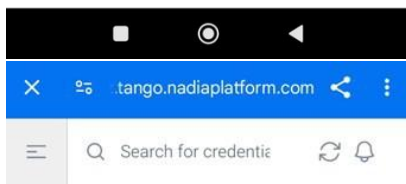
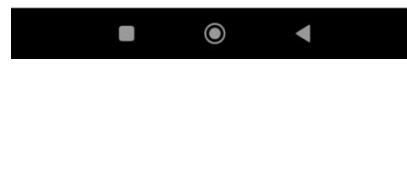
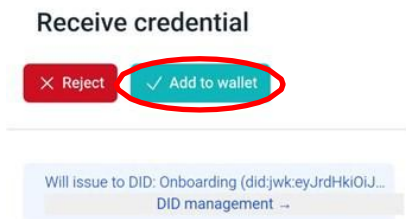
6. You should see the QR code.
7. At the end of this screen, you can see two options:
 - a. Copy QR Code text.
 - b. Open with Wallet.
8. You can proceed in two ways:
 - a. When you have the QR code in another device:
 - i. Open the SSI Wallet.
 - ii. Click “Scan to receive or present credentials” at its front screen.
 - iii. Scan the QR code.
 - b. When you have the QR code in the same device:
 - i. Click Copy QR Code text.
 - ii. Or directly tap on “Open with Wallet” option.
9. Click “Accept” to receive the credential offer.
10. Click “Continue by presenting your ePassport credential”.
11. Click “Add to wallet” to receive a customer credential offer.
12. Your (Customer) credentials are now at your SSI Wallet.

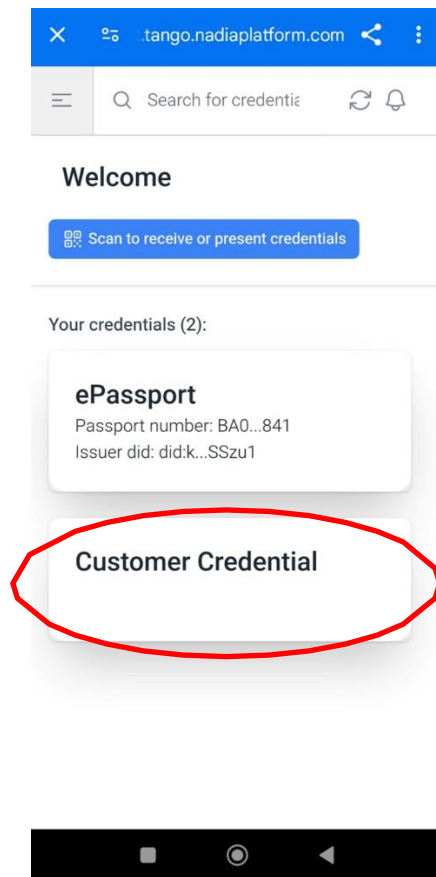


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Continue to authenticate

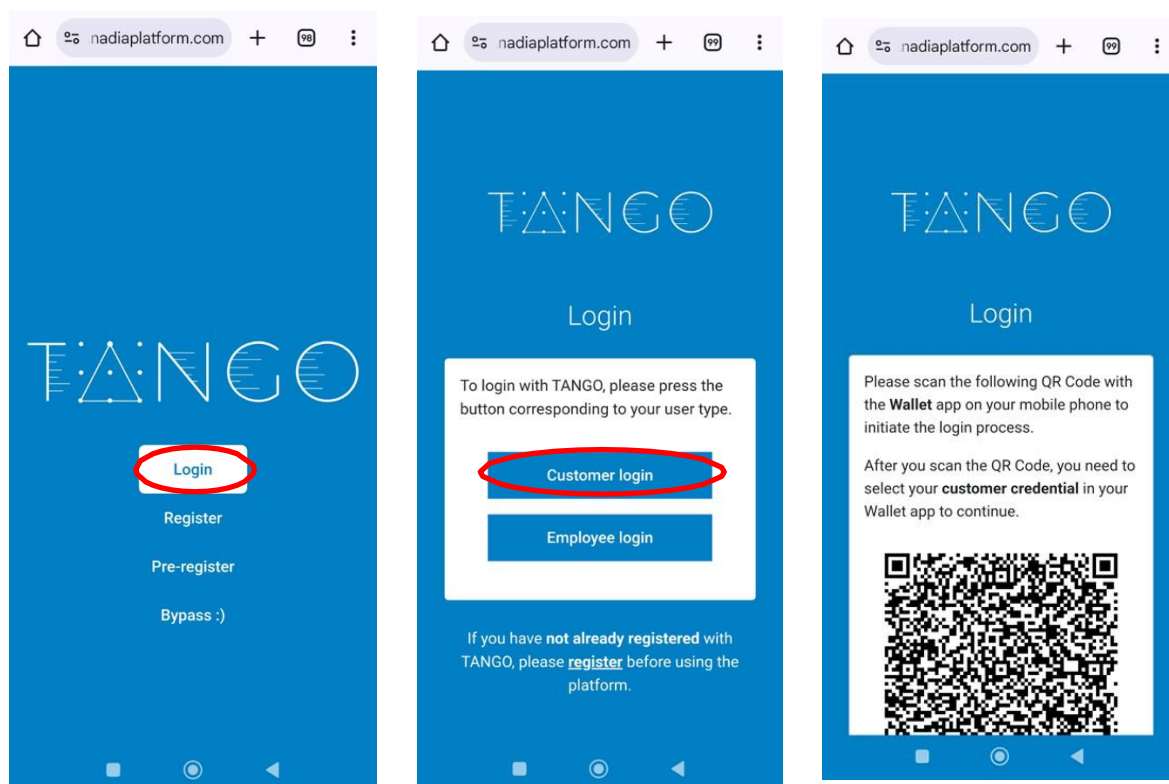




TANGO DASHBOARD LOG IN PROCESS

Step 7. Logging into TANGO dashboard using customer credentials

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/>.
2. Click “Login”.
3. Click “Customer login”.
4. *You should see the QR code.*
5. *At the end of this screen, you can see two options:*
 - a. *Copy QR Code text.*
 - b. *Open with Wallet.*
6. You can proceed in two ways:
 - a. When you have the QR code in another device:
 - i. Open the SSI Wallet.
 - ii. Click “Scan to receive or present credentials” at its front screen.
 - iii. Scan the QR code.
 - b. When you have the QR code in the same device:
 - i. Click Copy QR Code text.
 - ii. Or directly tap on “Open with Wallet” option.
7. *The SSI Wallet will open automatically.*
8. After signing in (if you have not selected to stay signed-in), in the SSI Wallet front page, click on the required credentials (Customer credentials) and click “Accept”.
9. *It will show a screen that the presentation of the credentials has been successful. Press OK. You will be redirected to the SSI Wallet’s first page.*
10. Go back to your browser. *You have successfully logged in to the TANGO dashboard and you can see the available applications on the Dashboard screen. On the Dashboard you can also see the menu button and its options when pressed (e.g. My applications, User agreement, etc.).*



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initiate the login process.

After you scan the QR Code, you need to select your **customer credential** in your Wallet app to continue.



Copy QR Code text

Open with Wallet

Please wait for the login process to complete...

If you have **not already** registered with TANGO, please **register** before using the platform.

Sign in to your SSI wallet

Or sign up for your SSI wallet !

Connect with web3 Connect with OIDC

Or continue with

Email address

Password

Sign in

Remember me Forgot your password?

To provide the functionality of this application, verifiable credentials are stored on a server. Verifiable credentials may

verifier.tango.nadiaplatform.com

Reject Accept

Presentation

Select credentials to present:

Selected: 1

☐ ePassport

Passport number: BA0...841

Issuer did: did:k...SSzu1

ID:

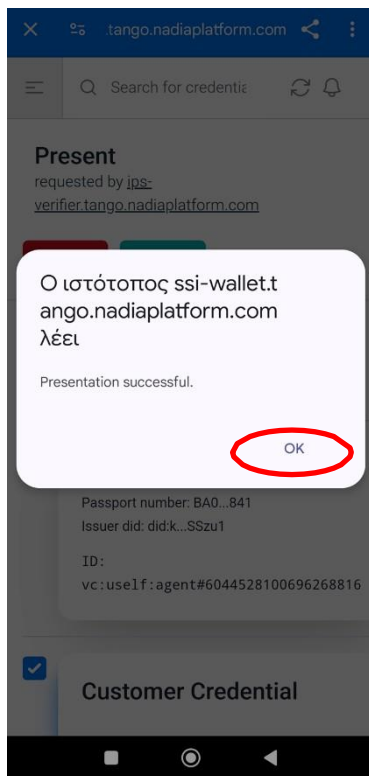
vc:userf:agent#6044528100696268816

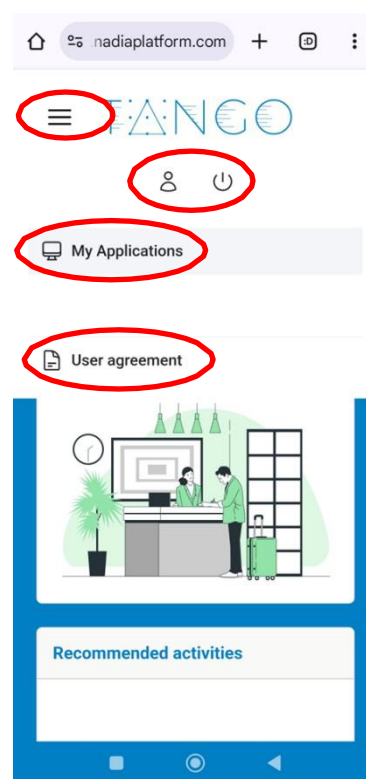
☒ Customer Credential

ID:

vc:userf:agent#5561857423061774733

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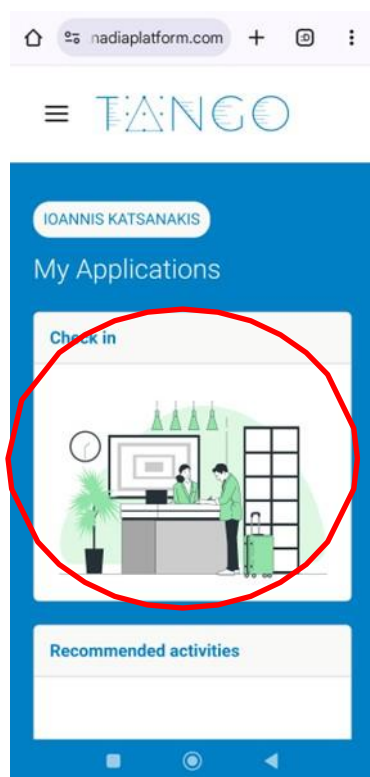
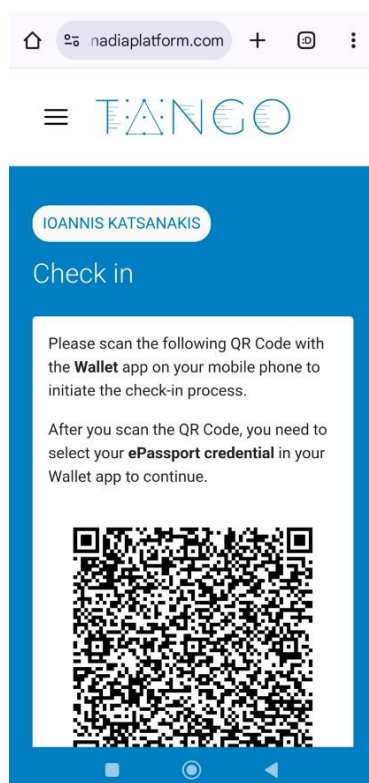
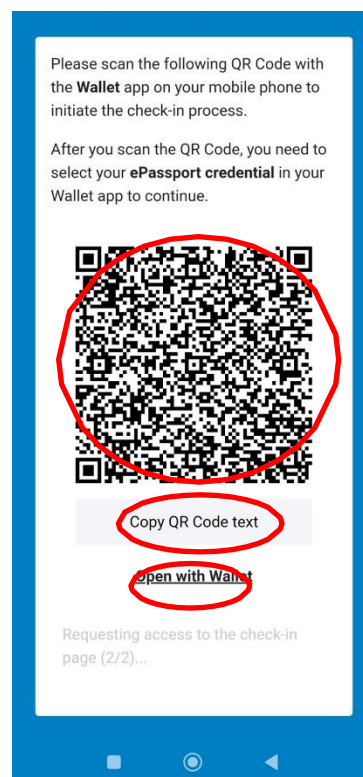
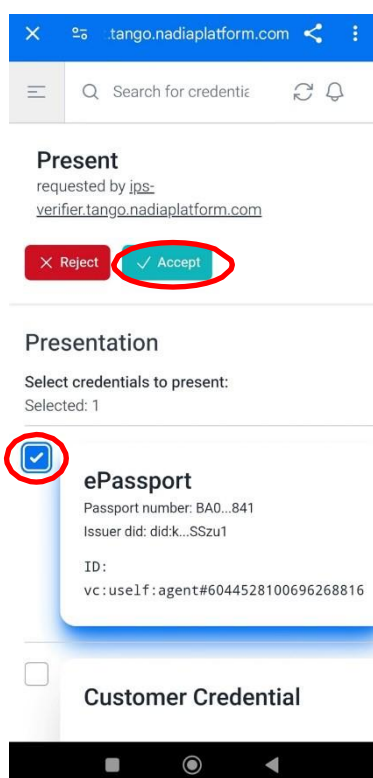
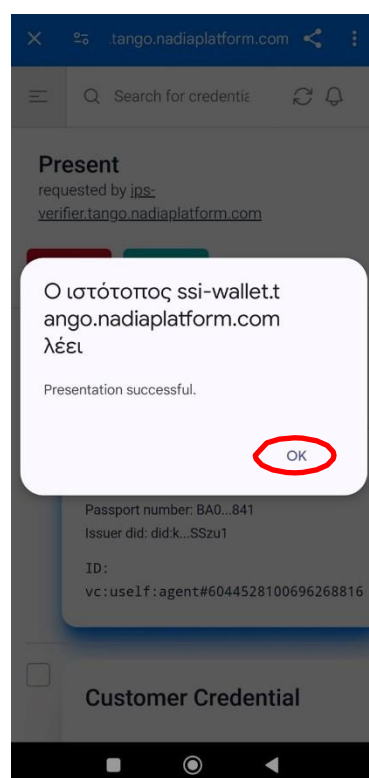
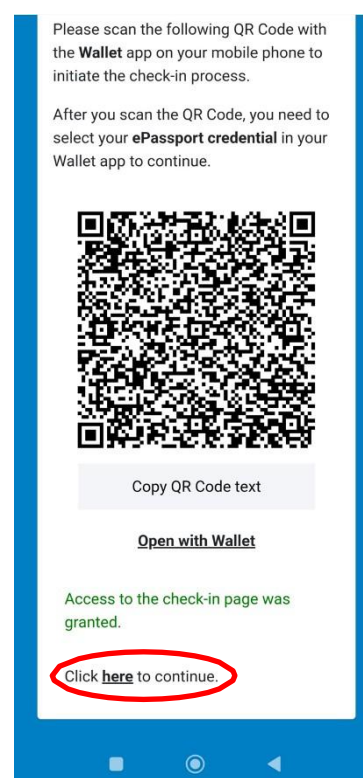
HOTEL CHECK-IN PROCESS

Step 8. Using the PAT tool for check-in process

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/> and click “Login”.
2. Follow the instructions of Step 7 (3-10).
3. Click on “Check-in” option.
4. *You should see the QR code.*
5. *At the end of this screen, you can see two options:*
 - a. *Copy QR Code text.*
 - b. *Open with Wallet.*

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6. You can proceed in two ways:
 - a. When you have the QR code in another device:
 - i. Open the SSI Wallet.
 - ii. Click “Scan to receive or present credentials” at its front screen.
 - iii. Scan the QR code.
 - b. When you have the QR code in the same device:
 - i. Click Copy QR Code text.
 - ii. Or directly tap on “Open with Wallet” option.
7. *The SSI Wallet will open automatically.*
8. After signing in (if you have not selected to stay signed-in), in the SSI Wallet front page, click on the required credentials (ePassport credentials) and click “Accept”.
9. *It will show a screen that the presentation of the credentials has been successful. Press OK. You will be redirected to the SSI Wallet’s first page.*
10. Go back to your browser.
11. Press “here” option. *You have successfully redirected to the TANGO PAT application and you can complete the rest of the check-in data.*
12. *After completing your check-in data press “Submit”.*



A screenshot of a mobile application's "Enter Your Details" form. The background is white. At the top, the title "Enter Your Details" is in a dark grey sans-serif font. Below it, the section "Mandatory Data - Information" is underlined. The form contains several input fields: "Gender" (empty), "First name" (containing "IOANNIS"), "Last name" (containing "KATSANAKIS"), "Address" (empty), "ZIP Code" (empty), "City" (empty), and "Country" (empty). To the right of the "Country" field are two blue buttons: one with a speech bubble icon and another labeled "Submit". At the bottom of the screen, there are three small, dark grey icons: a square, a circle, and a triangle.A screenshot of a mobile application's "Enter Your Details" form. The background is white. At the top, the title "Enter Your Details" is in a dark grey sans-serif font. Below it, the section "Mandatory Data - Processing Clarification" is underlined. The form contains several input fields: "Country" (empty), "Date of birth" (empty), "Phone" (empty), "Email" (containing "ikatsana@unipi.gr"), and "Nationality" (empty). To the right of the "Nationality" field are two blue buttons: one with a speech bubble icon and another labeled "Submit". At the bottom of the screen, there are three small, dark grey icons: a square, a circle, and a triangle.

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latform.com:32494

Enter Your Details

RECEPTIONIST

MANAGER

The purposes for which the hotel staff members would like to access your data above:

check-in

check-out

The actions that the hotel staff will be able to perform on your above data are listed below:

read

delete

Your personal data will be stored for the following duration:

12 months

Your personal data will only be accessible from the within the following areas:

Submit

latform.com:32494

Enter Your Details

MANAGER

The purposes for which the hotel staff members would like to access your data above:

check-in

check-out

The actions that the hotel staff will be able to perform on your above data are listed below:

read

delete

Your personal data will be stored for the following duration:

12 months

Your personal data will only be accessible from the within the following areas:

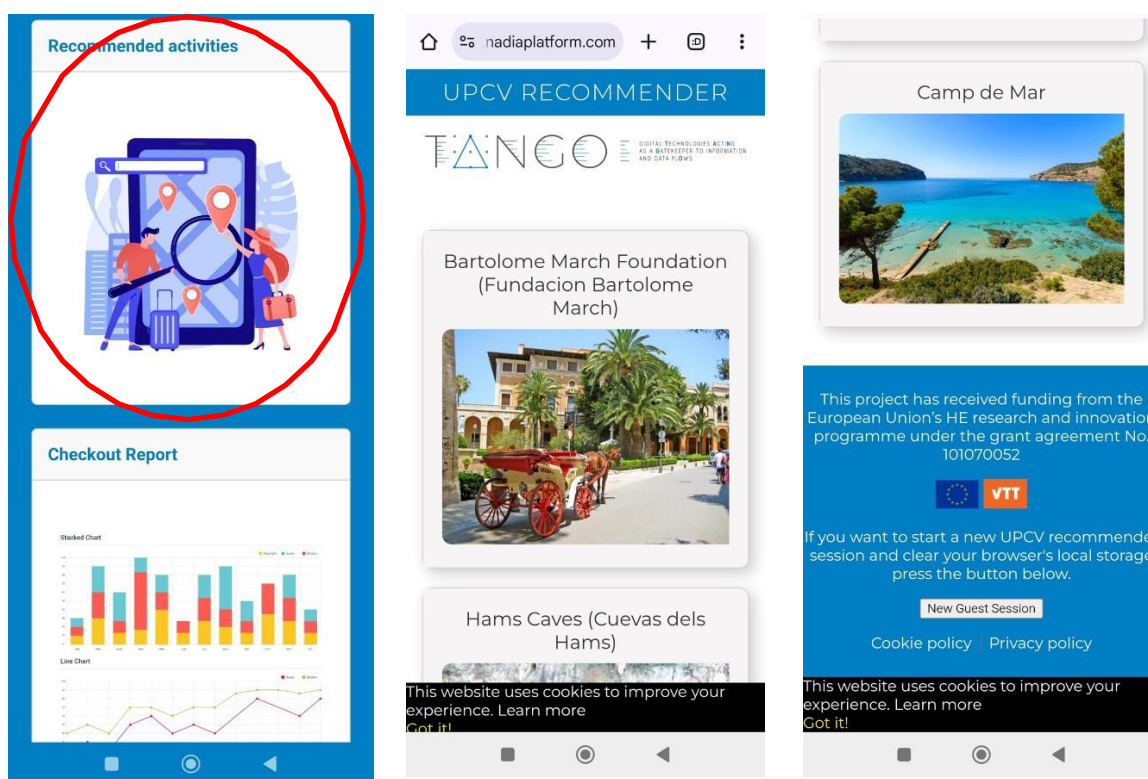
Spain

Submit

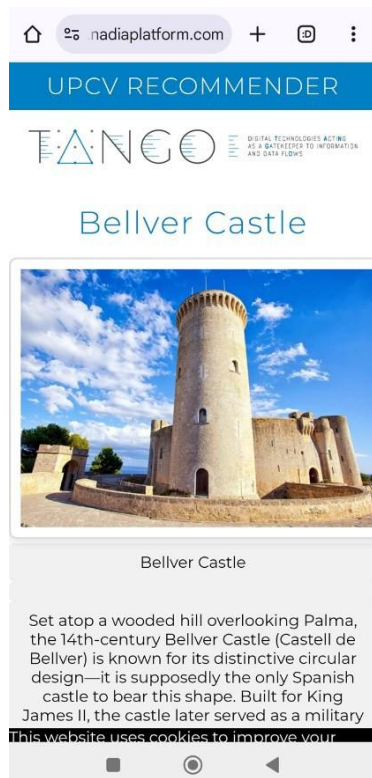
USE OF OTHER TANGO DASHBOARD APPLICATIONS

Step 9. Using the Recommender tool (Recommended activities)

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/> and click “Login”.
2. Follow the instructions of Step 7 (3-10).
3. Click on “Recommender” option. *You will be redirected to the Recommender page.*
4. Tap on one of the activities that are presented, and you are interested in. *The description of this activity will open at the top of the list, and the other activities will be shown as additional activities that the user might be interested in.*
5. Choose another activity that you are interested in.
6. Proceed with the previous step for 6-7 activities.



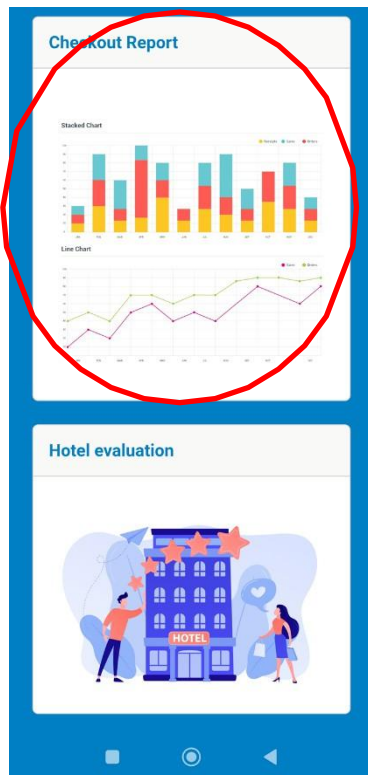
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Step 10. Using the Visualization and Reporting tool (Checkout Report)

1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/> and click “Login”.
2. Follow the instructions of Step 7 (3-10).
3. Click on “Checkout Report” option. *You will be redirected to the Visualization and Reporting tool.*
4. Choose your room number from the drop list if you are staying at one of the four test rooms. Otherwise, choose the “Other” option.
5. Choose the start and end date of your stay at the hotel. For testing reasons, please insert as start date: 05/05/2025 and end date: 06/05/2025.
6. Click on the “GENERATE REPORT” option. *The report will be generated in the same window.*

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Smart Hospitality Pilot Traveller Report Dashboard

Room Number

Date From

Date To

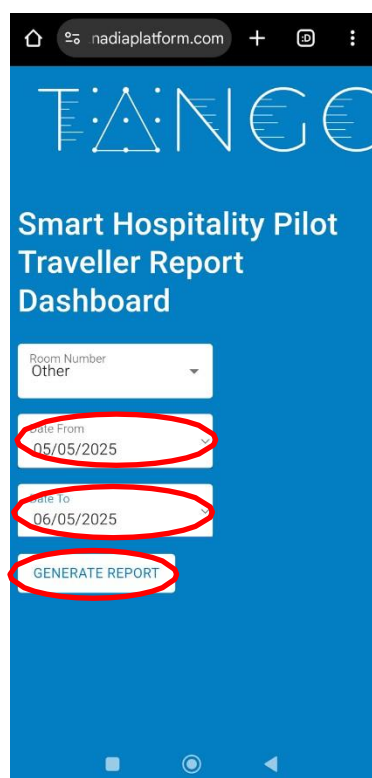
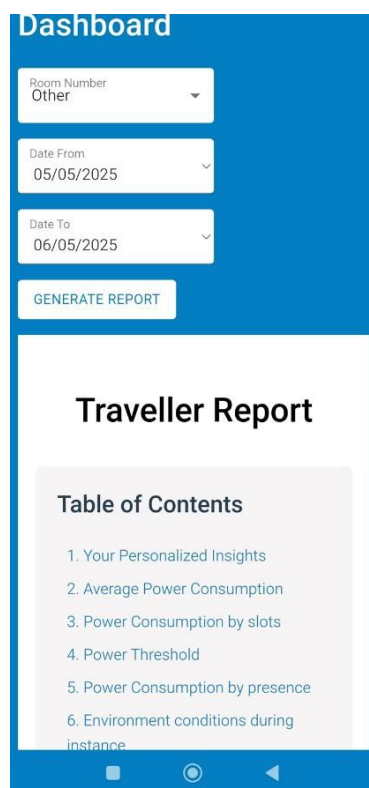
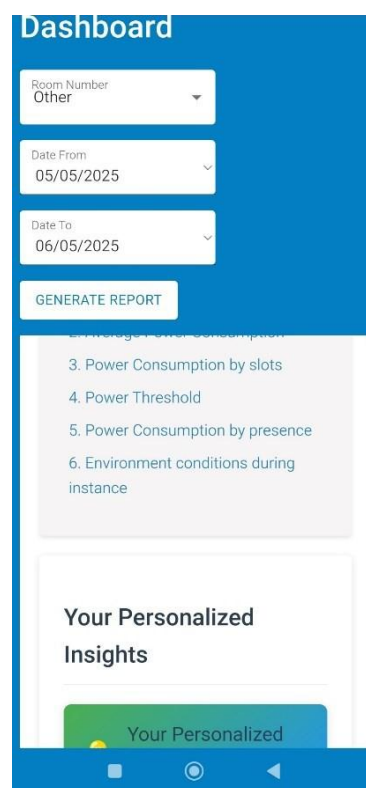
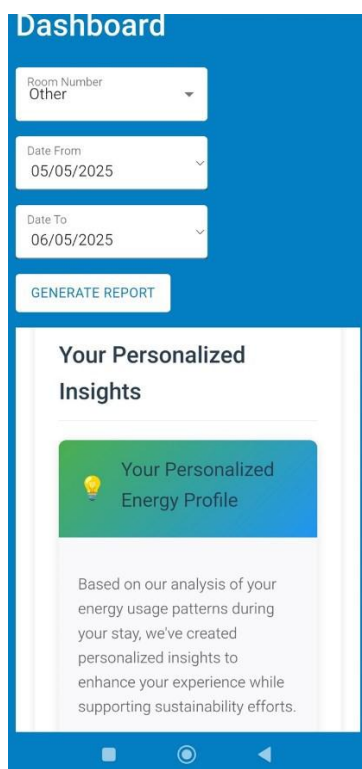
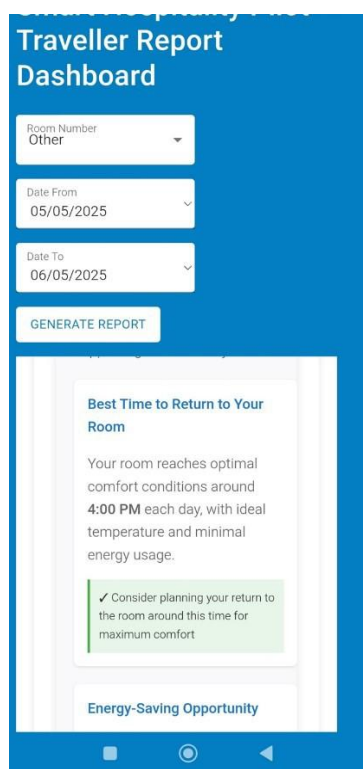
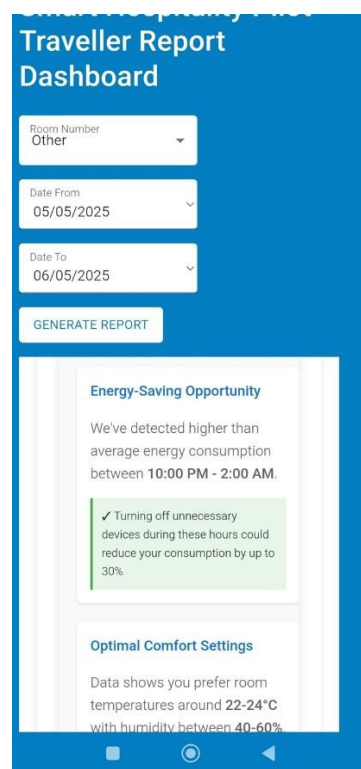
GENERATE REPORT

Smart Hospitality Pilot Traveller Report Dashboard

Room Number

Select Room

- 3103
- 3104
- 3203
- 3204
- Other



Traveller Report Dashboard

Room Number
Other

Date From
05/05/2025

Date To
06/05/2025

GENERATE REPORT

Optimal Comfort Settings

Data shows you prefer room temperatures around 22-24°C with humidity between 40-60%.

✓ Setting AC to 23°C when in the room maintains comfort while optimizing energy use.

Your Potential Impact

By following these personalized recommendations, you

Traveller Report Dashboard

Room Number
Other

Date From
05/05/2025

Date To
06/05/2025

GENERATE REPORT

Your Potential Impact

By following these personalized recommendations, you could:

- Reduce your vacation's carbon footprint by approximately 5-10%
- Help the hotel save enough energy to power 30+ room-nights annually
- Contribute to water

Traveller Report Dashboard

Room Number
Other

Date From
05/05/2025

Date To
06/05/2025

GENERATE REPORT

- Contribute to water conservation efforts through optimized climate control

Power Average Consumption When You're In vs. Out

Traveller Report Dashboard

Room Number
Other

Date From
05/05/2025

Date To
06/05/2025

GENERATE REPORT

Power Average Consumption When You're In vs. Out

Consumption Insight:

We measured how much Power is used when the room is empty versus when someone is inside. Here's what we found during your stay:



Traveller Report Dashboard

Room Number
Other

Date From
05/05/2025

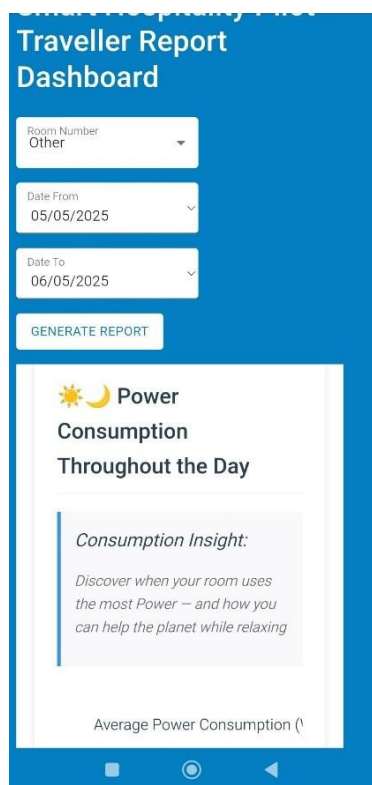
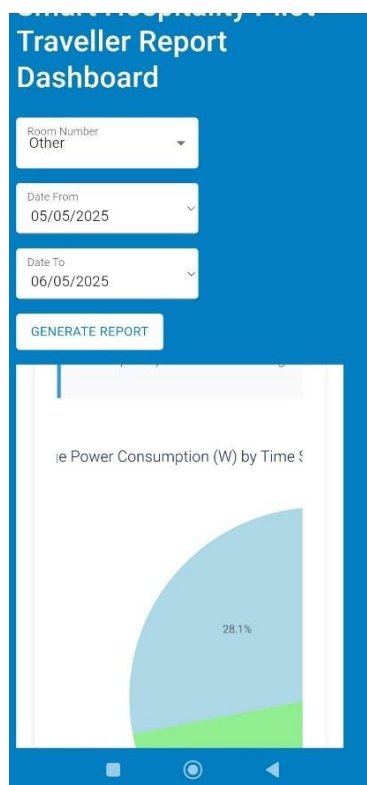
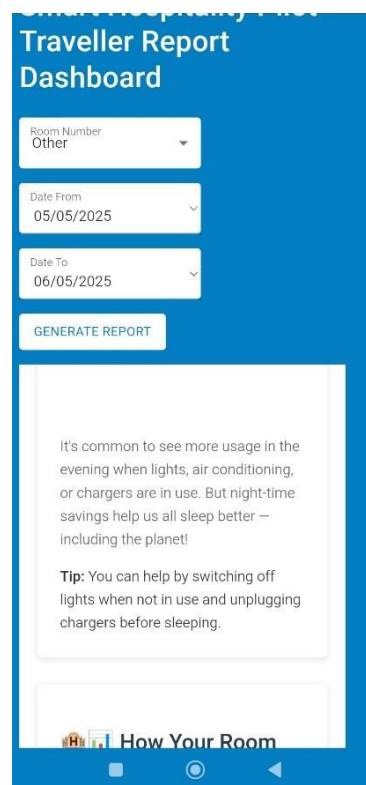
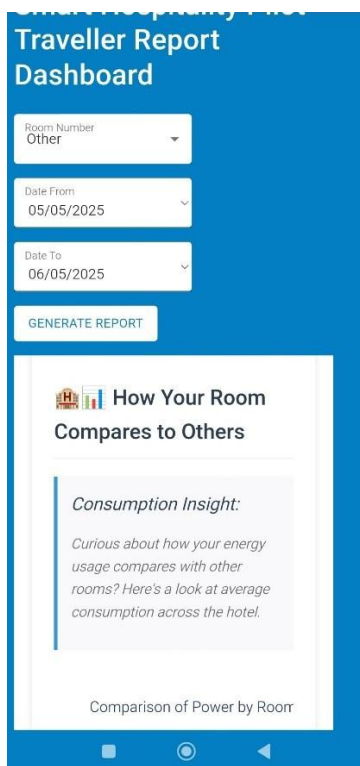
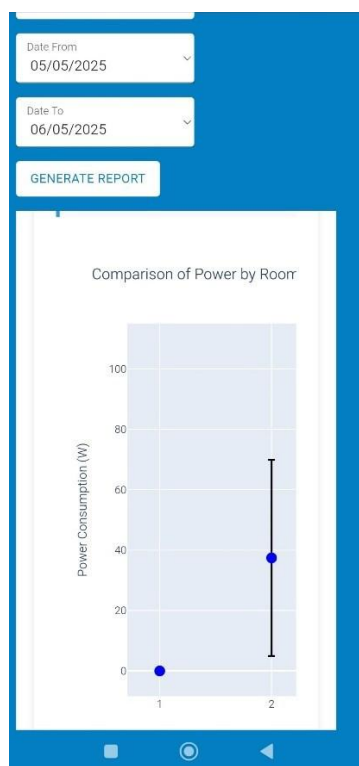
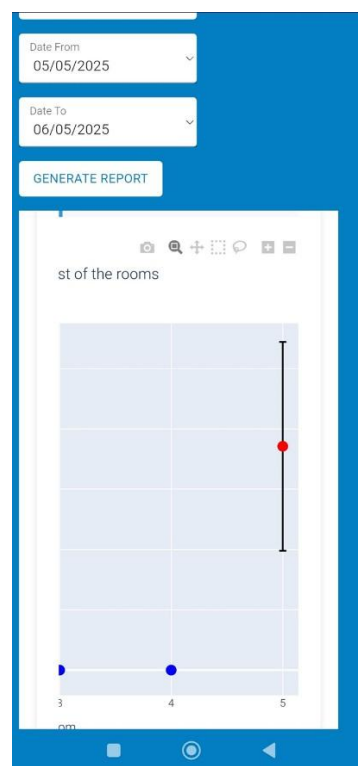
Date To
06/05/2025

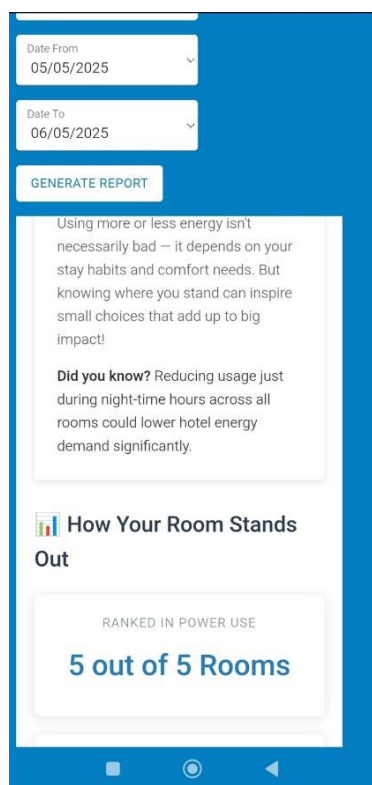
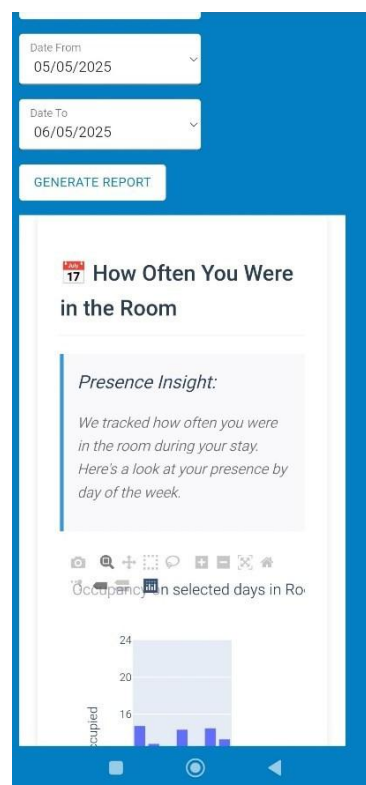
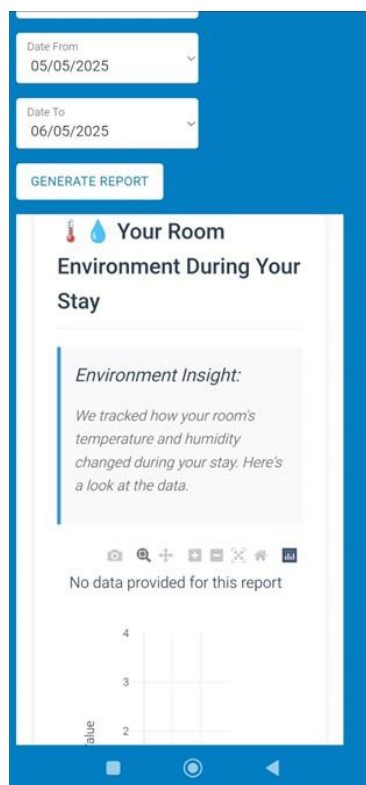
GENERATE REPORT

By turning off lights or devices before leaving the room, you help reduce waste significantly.

Tip: Try unplugging unused devices when you're out. Every small action adds up!

Power Consumption Throughout the Day





Step 11. Using the Hotel Evaluation tool

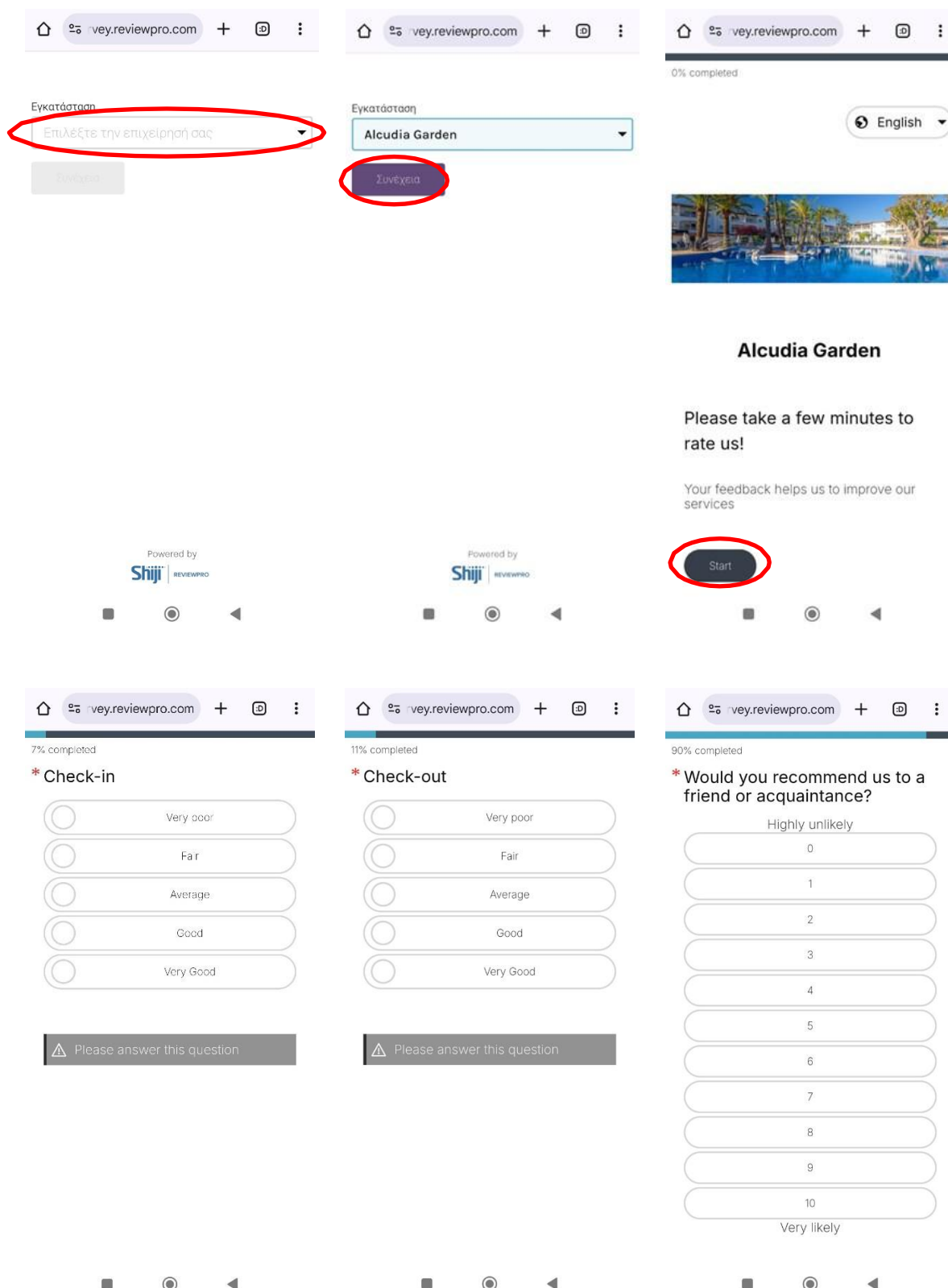
1. Go to the TANGO dashboard: <https://ui-frontend.tango.nadiaplatform.com/> and click “Login”.
2. Follow the instructions of Step 7 (3-10).
3. Click on “Hotel evaluation” option.

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4. From the dropdown list select the hotel you would like to evaluate and press “Continue”.
5. Press “Start” to be directed to the questions of the hotel evaluation.

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6. Answer each question by tapping on the desired answer and the next question will load at your screen.
7. Answer all the questions (*some of the questions are presented at the next print screens*).
8. Complete your contact details (optional).
9. Tap on “Send survey” to complete the hotel evaluation.



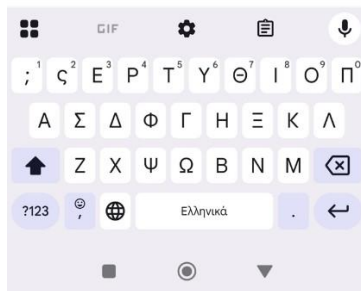
The screenshots show the survey app interface. The first screen displays the 'Εγκατάσταση' (Installation) section with a dropdown menu for 'Επιλέξτε την επιχείρησή σας' (Select your business) and a 'Συνέχεια' (Continue) button. The second screen shows the 'Alcudia Garden' hotel selection screen with a 'Start' button. The third screen shows the 'Check-in' and 'Check-out' rating screens with a 'Please answer this question' prompt.

vey.reviewpro.com + ⓘ ⋮

97% completed

Help us improve with your comments and suggestions!

Next



vey.reviewpro.com + ⓘ ⋮

100% completed

Contact details

First name(s)

Surname

Email address

Room number

Day of arrival

yyyy-MM-dd

Day of departure

yyyy-MM-dd

vey.reviewpro.com + ⓘ ⋮

100% completed

Email address

Room number

Day of arrival

yyyy-MM-dd

Day of departure

yyyy-MM-dd

Send Survey

Powered by
Shiji REVIEWPRO

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Annex 2 - Public Organizations Pilot User Guide

This guide was created to walk you through the full process of creating and managing a visa application using the Fides platform. Whether you are an employer, a VisaRight officer, or a reviewer at the Immigration Authority, this checklist shows exactly what happens and what you need to do at each step - clearly and simply.

Credentials for all nodes: Username: demo Password: Demo123\$

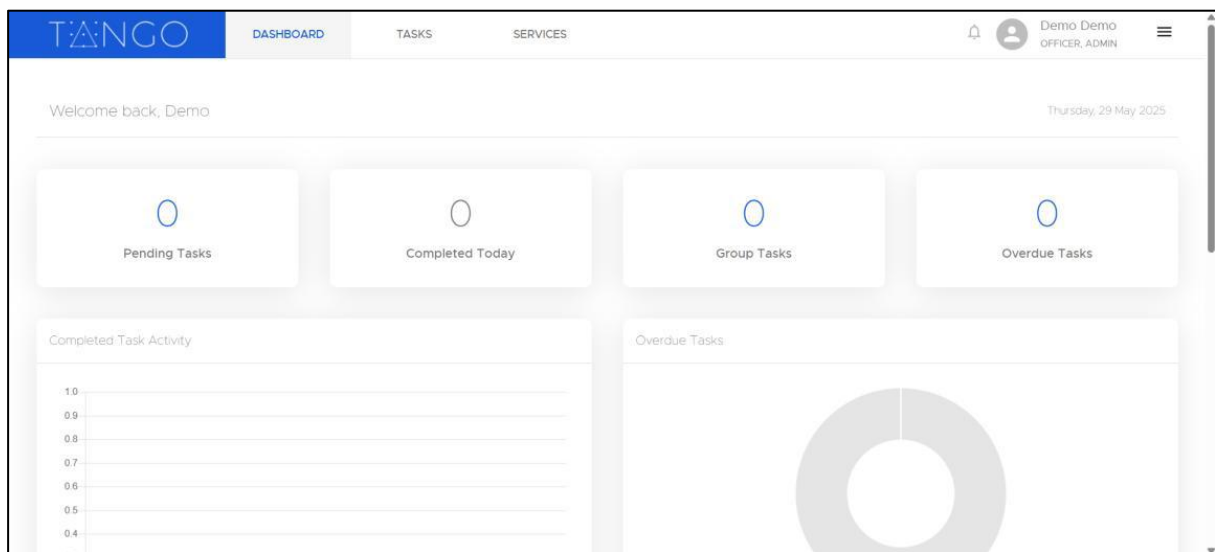
Actors:

- Applicant - natural person that is a potential employee of the Employer and needs visa to Germany to start the employment.
- Employer - a company that wants to hire the Applicant. Employer uses Fides multi-tenancy Tango node for employers (tango-c.norbloc.com).
- VisaRight - a company that facilitates visa application process. Has its own dedicated Fides node (tango-a.norbloc.com).
- Immigration Authority - a government entity that makes visa decisions. Has its own dedicated Fides node (tango-b.norbloc.com).

I) Employer creates initial application and sends it to VisaRight via Fides

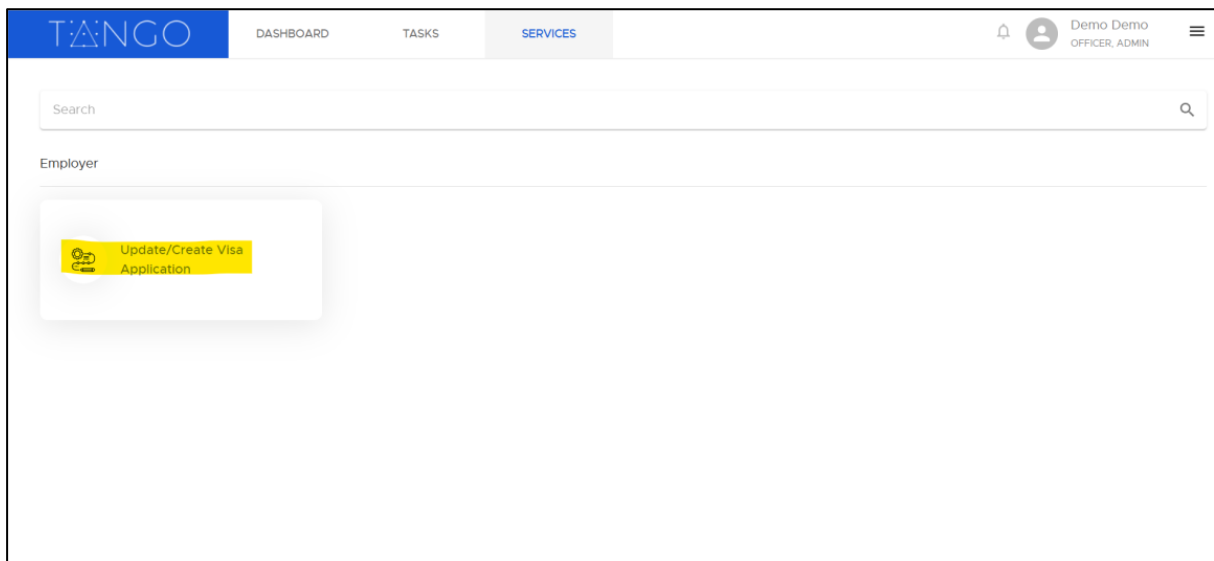
1. Employer initiates Application through Employer Portal.

Once you as the user log in to the platform, you are automatically directed to the Dashboard tab, while the Tasks and Services tabs are visible and clickable.

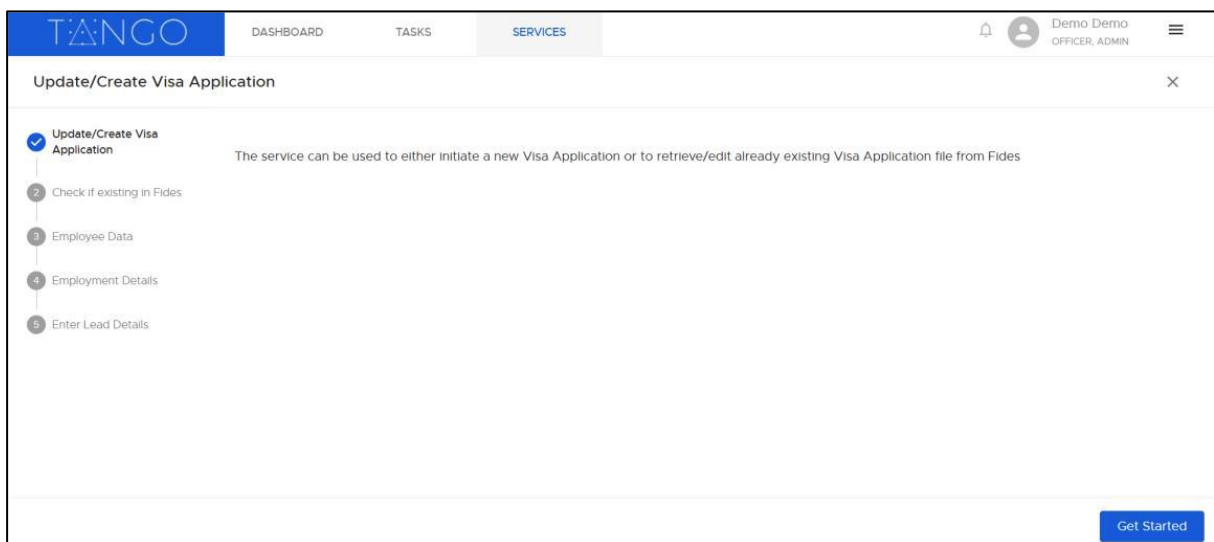


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2. Click to the Services tab and click on Update/Create Visa Application.

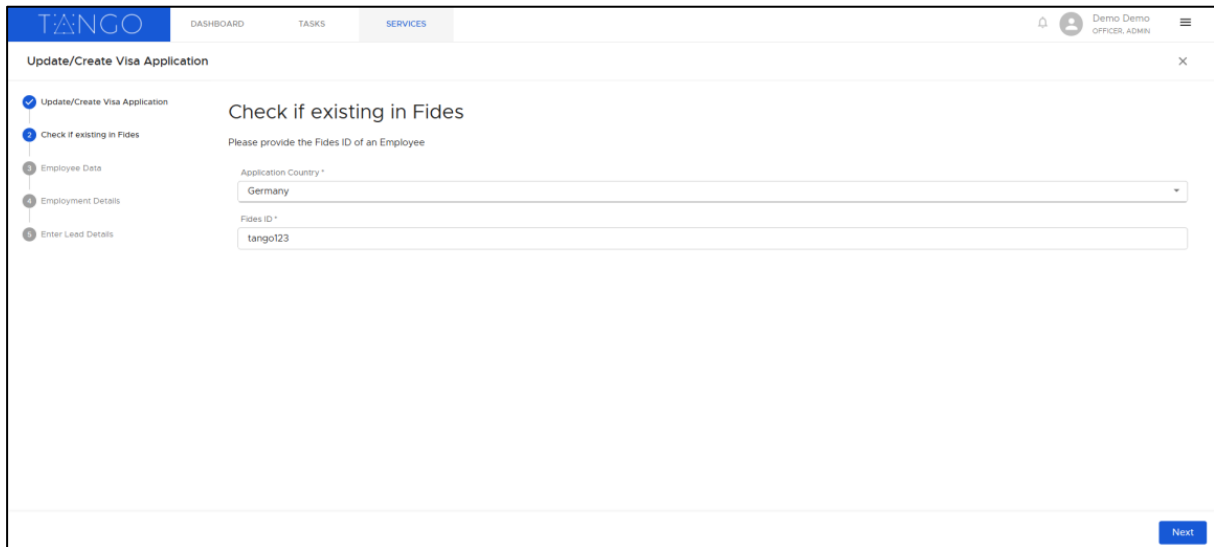


3. Go to Get Started at the right below in order to initiate the Visa application process.

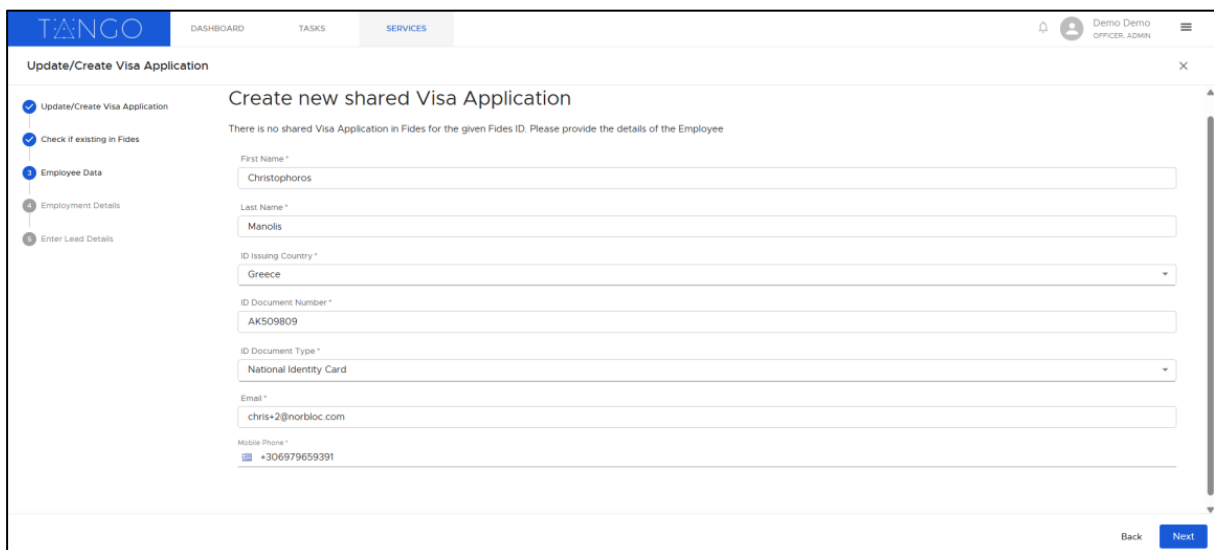


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4. Choose the Application Country and then you can enter the "Fides ID" to check if there is already a file with that ID. "Fides ID" can be anything, this is just a string to identify the Application in Fides - it must be unique.

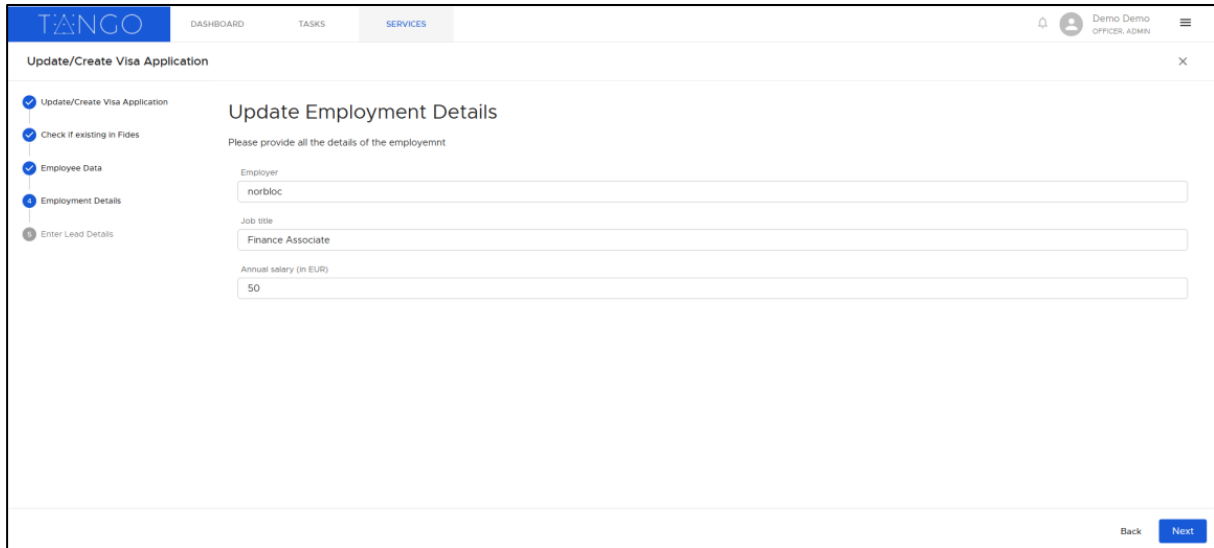


5. At this point, enter the personal details of the applicant (e.g. name, email, document info). Put in a real email where you can receive emails. Remember the data you put in, especially Applicant Document Type, Number and Country, as these are the data that Applicant will have to enter to confirm their identity.



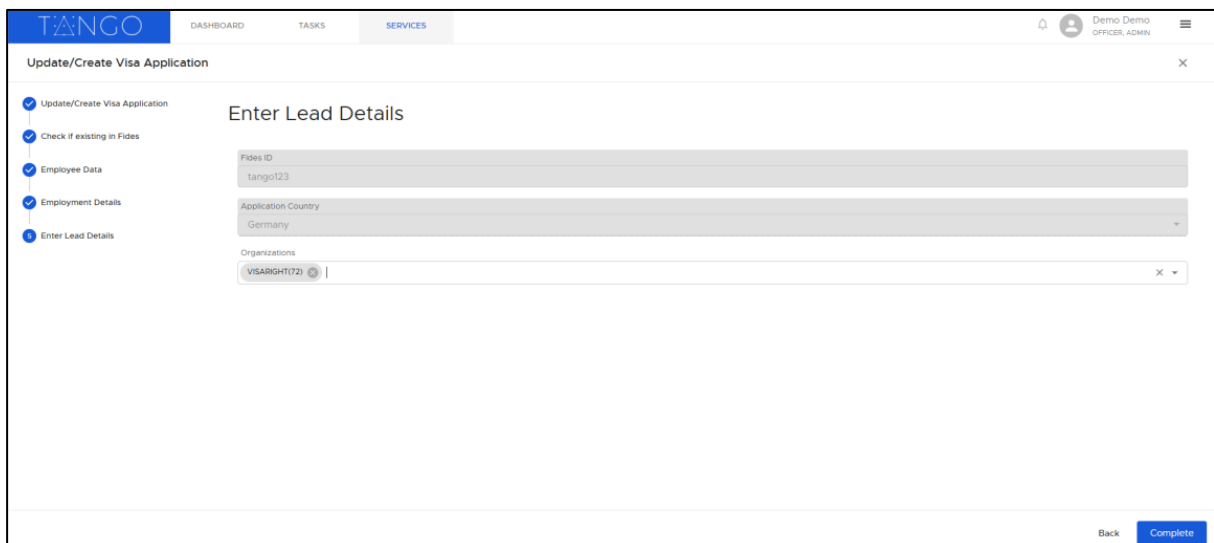
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6. If you pressed Next, you are now directed to the employment details (e.g. employer name, job title and annual salary), which you fill accordingly.



The screenshot shows the 'Update/Create Visa Application' interface. On the left, a sidebar lists the steps: 'Update/Create Visa Application' (checked), 'Check if existing in Fides' (checked), 'Employee Data' (checked), 'Employment Details' (active), and 'Enter Lead Details'. The main area is titled 'Update Employment Details' and contains a form with the following fields: 'Employer' (text input with 'norbloc'), 'Job title' (text input with 'Finance Associate'), and 'Annual salary (in EUR)' (text input with '50'). At the bottom right, there are 'Back' and 'Next' buttons.

7. In this final step, the Fides ID and Application Country fields will already be pre-filled based on the information entered earlier. The Applicable Organization is set to VisaRight by default (this is currently the only available option). Once everything looks correct, click Complete to finalize and send the application



The screenshot shows the 'Update/Create Visa Application' interface at the 'Enter Lead Details' step. The sidebar on the left shows the same steps as before, with 'Enter Lead Details' now active. The main area is titled 'Enter Lead Details' and contains a form with the following fields: 'Fides ID' (text input with 'tango123'), 'Application Country' (dropdown menu with 'Germany' selected), and 'Organizations' (text input with 'VISARIGHT(72)' selected). At the bottom right, there are 'Back' and 'Complete' buttons.

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II) VisaRight reviews the application from Employer and invites the Applicant (potential employee) to fill in missing details.

- Once you have logged in the VisaRight Fides node (VisaRight Portal) go to Tasks, find and click at the left the correct Application (Incoming Application: <tango123>)

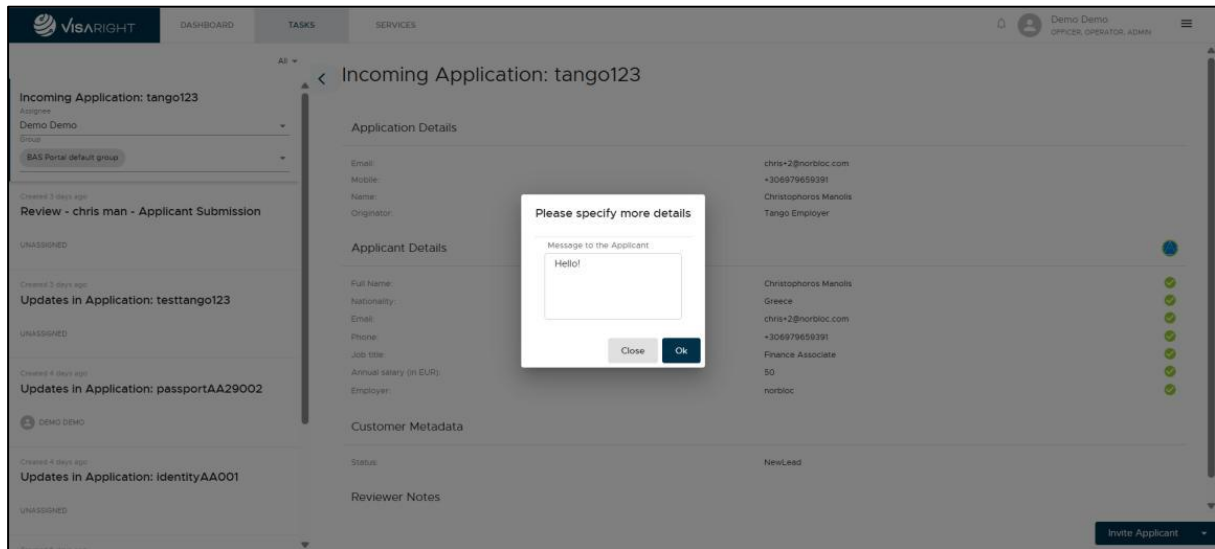


- You can now open the application and review the data. Also, you as the user are able to see the green verification stamp next to the Employer-submitted data. Hover the mouse over the green check marks - observe the verification stamp with clear indication of who and when the data is verified.

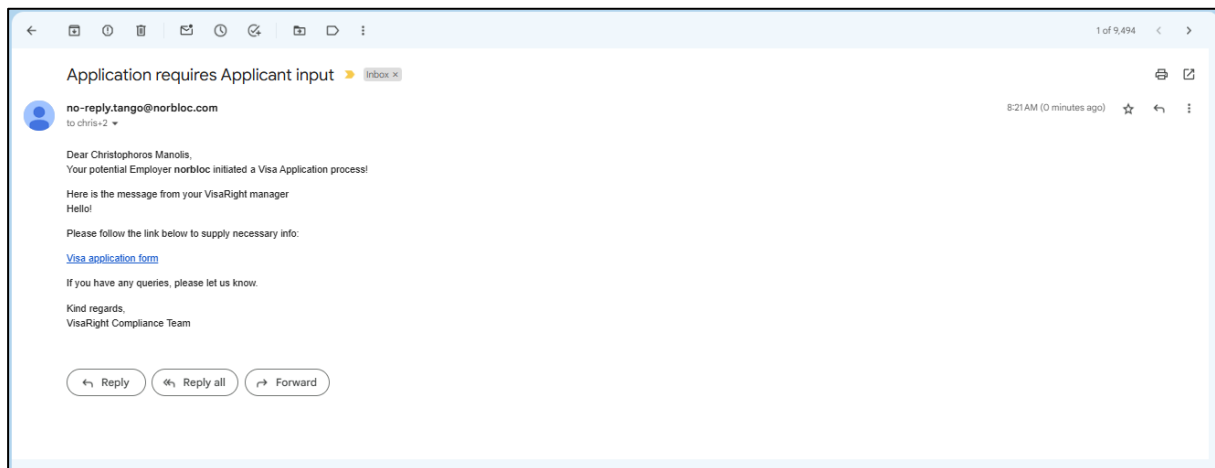


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3. Once the application has been reviewed and everything appears correct, click the Invite Applicant button at the bottom right to proceed. You also have the option to include a custom message, in case you need to request additional information or clarifications from the applicant.



4. The applicant receives the link to his email address.



5. Important: Open the link in a new Incognito window (or in a separate browser). Reason: VisaRight Officer dashboard and VisaRight Customer app both have the same domain ("tango-a.norbloc.com"), therefore they share the same cookies.

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6. As an Applicant, enter CORRECT document type, number and country. They MUST be the same as supplied by Employer - this is to confirm Applicant identity.

VisARIGHT

Applicant Details

First Name
Christophoros

Last Name
Manolis

ID Issuing Country
Greece

ID Document Number
AK509809

ID Document Type
National Identity Card

Category ID
tango123

A Unique Identifier for the Applying Entity

Next

7. If the identity matches, the form will open with all Employer-supplied fields pre-filled. The Applicant should now fill in the remaining fields and click Next.

VisARIGHT

Individual Details

Applicant Details

Full Name
Christophoros Manolis

Gender
Male

Nationality
Greece

Date of Birth
18/09/1998

Email
chris+2@norbloc.com

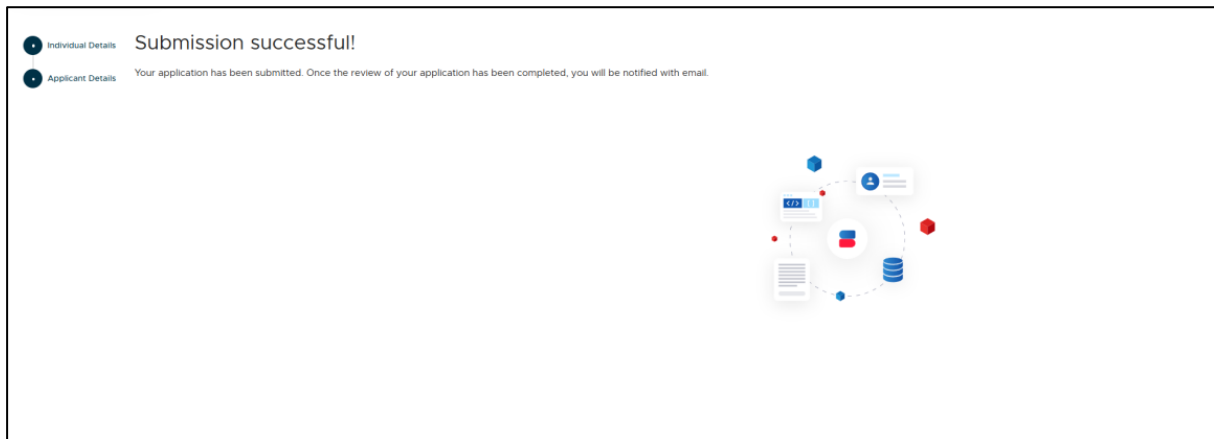
Phone
+306979659391

Purpose of Stay
Employment

Travel Doc No
AK509809

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8. You should see the message confirming that the submission of the personal data is successful.



III) VisaRight reviews full application with data from both the Employer and Applicant (potential employee), submits it to Immigration Authority.

1. On the VisaRight portal (VisaRight Portal), go to the Tasks tab. Tasks do not refresh automatically, so make sure to manually refresh the list. Look for the application labeled: "Review - [First Name] [Last Name] – Applicant Submission». This is the version completed by the applicant and ready for final review.



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2. Open the application and review all the information provided. Green verification stamps indicate data originally submitted and confirmed by the Employer. Yellow highlights show newly added or updated fields provided by the Applicant. If everything looks correct, you as a VisaRight Customer Manager can send the application to the Immigration Authority by clicking at the bottom right the respective button.

Review - Christophoros Manolis - Applicant Submission

Assignee: Demo Demo
Group: Demo

Created 3 days ago
Review - chris man - Applicant Submission
UNASSIGNED

Created 3 days ago
Updates in Application: testtango123
UNASSIGNED

Created 4 days ago
Updates in Application: passportAA29002
DEMO DEMO

Created 4 days ago
Updates in Application: identityAA001
UNASSIGNED

I understand that my data will be shared according to the [Privacy policy](#). No

First Name: Christophoros
Last Name: Manolis
ID Issuing Country: Greece
ID Document Number: AK509809
ID Document Type: National Identity Card

ID Documents

No Jumbo data

Individual Details

Full Name: Christophoros Manolis
Gender: Male
Nationality: Greece
Date of Birth: 18/09/1998
Email: chris+2@norbloc.com
Phone: +306979659391
Purpose of Stay: Employment
Travel Doc No: AK509809
Marital Status: Single
Job title: Finance Associate
Annual salary (in EUR): 50
Degree: Master
Employer: norbloc

Checklist

PEP Screening report for Christophoros Manolis is **CLEAR**
Verified by pep

Placeholder Manual Check

Send Application

Review - Christophoros Manolis - Applicant Submission

Assignee: Demo Demo
Group: Demo

Created 3 days ago
Review - chris man - Applicant Submission
UNASSIGNED

Created 3 days ago
Updates in Application: testtango123
UNASSIGNED

Created 4 days ago
Updates in Application: passportAA29002
DEMO DEMO

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Checklist

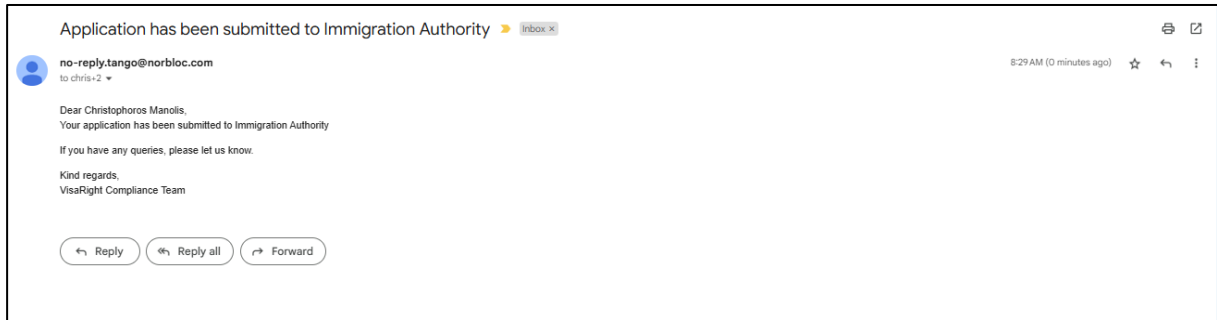
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Verified by pep

Placeholder Manual Check

Send Application

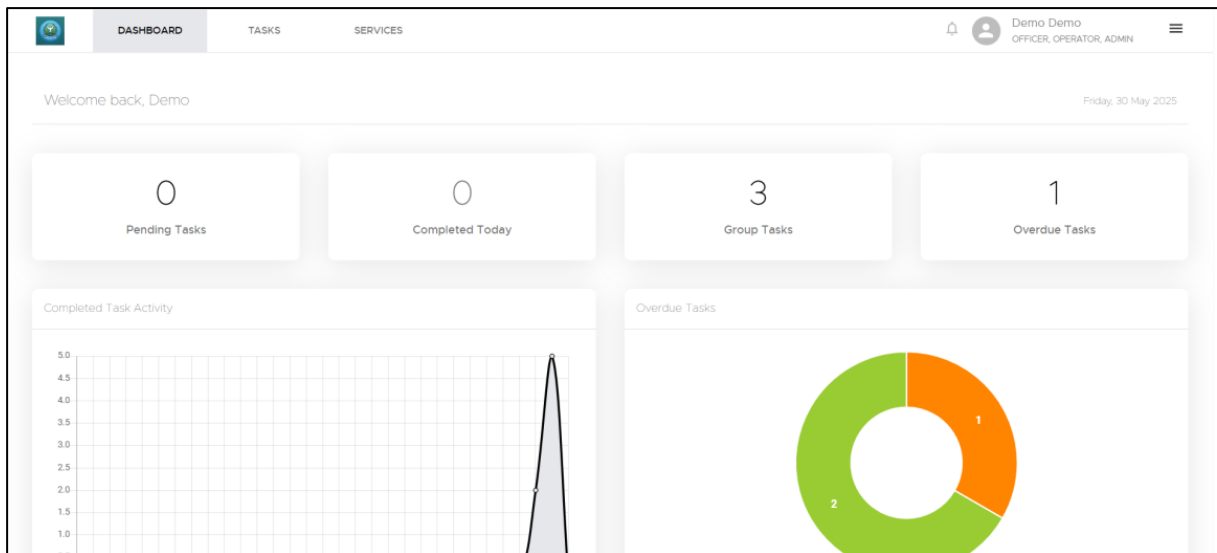
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	Version:	1.0	Status:
			Final

3. Now, the applicant has received a notification email that the application has been submitted to the Immigration Authority.



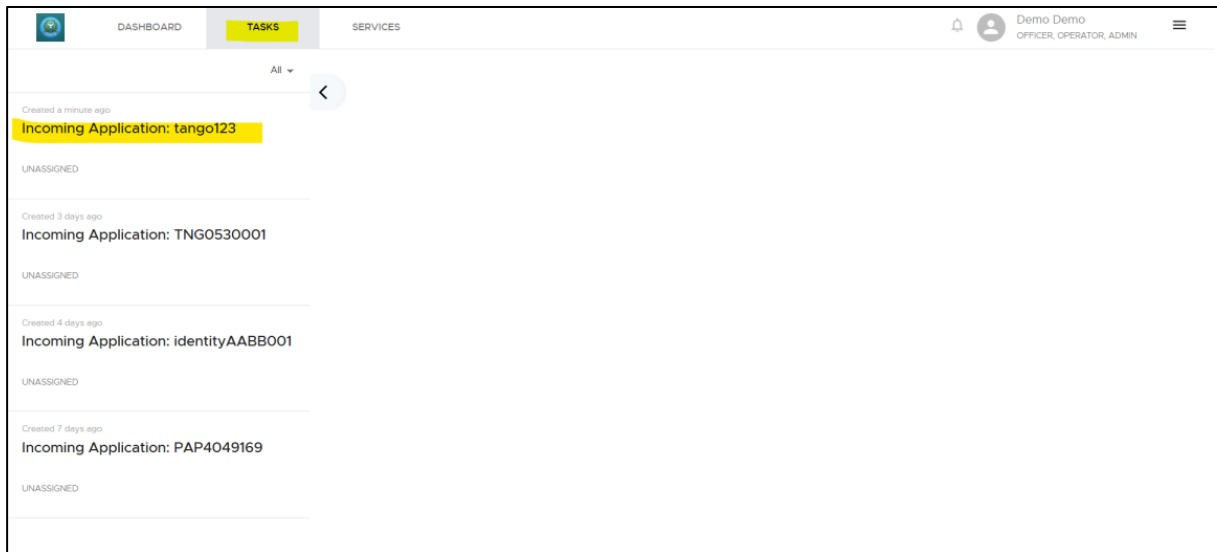
IV) The Immigration Authority reviews the application and makes a decision. The decision is delivered back to VisaRight via Fides.

1. The user logs in to the Immigration Authority Fides node (Immigration Authority Portal)

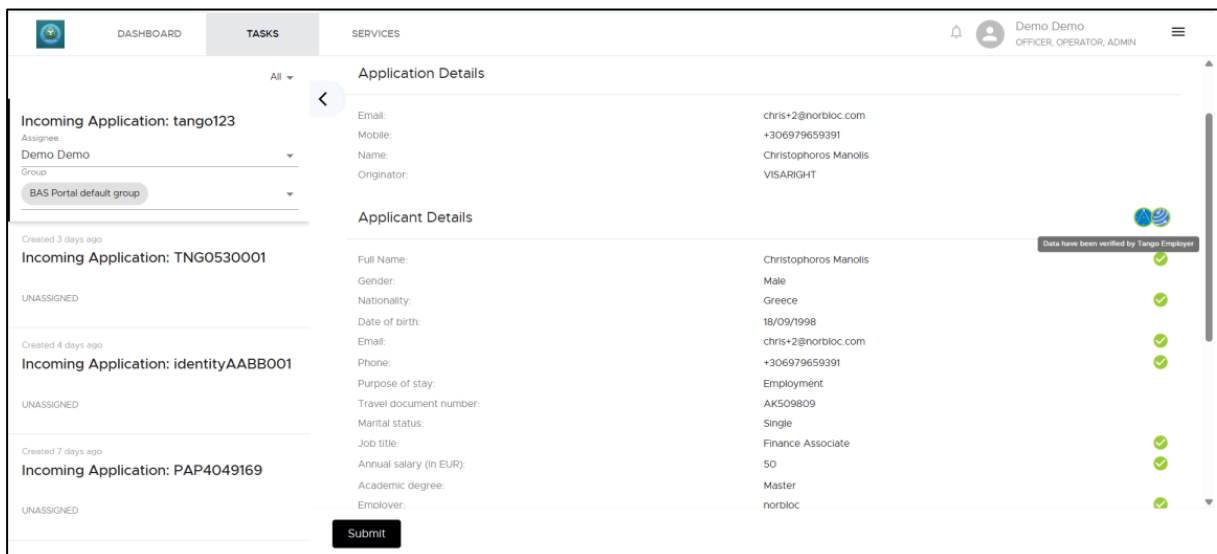


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2. At the Tasks tab, find the correct Application (Incoming Application: <tango123>) and click on it.



3. You, as an Immigration Authority Officer, can open the application and review all the submitted data. Green verification stamps indicate fields that have been confirmed by both VisaRight and the Employer, ensuring data integrity across sources.



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Application Details

Email: chris+2@norbloc.com
 Mobile: +306979659391
 Name: Christophoros Manolis
 Originator: VISARIGHT

Applicant Details

Full Name: Christophoros Manolis
 Gender: Male
 Nationality: Greece
 Date of birth: 18/09/1998
 Email: chris+2@norbloc.com
 Phone: +306979659391
 Purpose of stay: Employment
 Travel document number: AK509809
 Marital status: Single
 Job title: Finance Associate
 Annual salary (in EUR): 50
 Academic degree: Master
 Employer: norbloc

Submit

4. Enter the decision details into the application: set the Visa Decision field to either Yes or No, and upload a supporting document (this can be any file relevant to the decision). Click Submit to finalize the entry. The new data will be recorded in Fides and made available to authorized parties.

Customer Metadata

Status: NewLead

Authority decision

Visa Decision: Yes

Supporting document

[norbloc.pdf](#) X

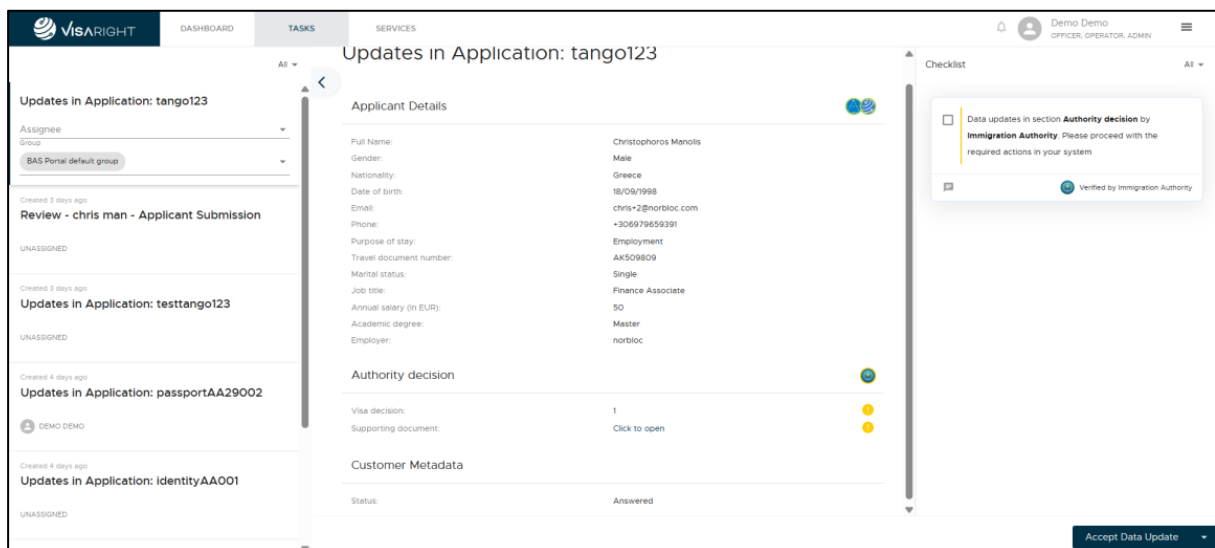
Submit

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5. Now, back to the VisaRight Fides node (VisaRight Portal), go to Tasks (or refresh Tasks, they do not refresh automatically), find the correct Application (Updates in Application: <tango123>).



6. The user reviews the updates in the application. Newly added fields, such as "Visa Decision" and "Supporting Document" will be highlighted in yellow to indicate recent changes.



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7. Final step: Click Accept Data Update.

The screenshot displays the VisARight TANGO Fides platform interface. The top navigation bar includes 'DASHBOARD', 'TASKS', and 'SERVICES'. The main header shows 'Updates in Application: tango123'. The left sidebar lists several application updates, including 'Review - chris man - Applicant Submission' and 'Updates in Application: testtango123'. The central panel displays 'Applicant Details' for Christophoros Manolis, including personal information, contact details, and employment status. Below this, the 'Authority decision' section shows a 'Visa decision' of '1' and a 'Supporting document' link. The 'Customer Metadata' section shows a 'Status' of 'Answered'. On the right, a 'Checklist' section indicates that data updates in the 'Authority decision' section have been verified by the Immigration Authority. At the bottom right, a green button labeled 'Accept Data Update' is visible.

That's it! You just completed the full visa application journey using the TANGO Fides platform - from employer onboarding to final authority review.

Annex 3 – Evaluation Questionnaire Samples

Samples of the questionnaires used during the component and pilot case evaluation are included below.

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Hospitality Pilot Evaluation

A. Evaluation Overview

*** A.1. Partner performing the evaluation**
(e.g. VISAR, IDIADA, etc.)

*** A.2. Evaluation dates**
(Enter specific date or date range)

Start date

Date



End Date

Date



A.3. Which device did you use for testing the TANGO platform?
(Please specify your device specifications)

Device type:
(e.g. PC, tablet, smartphone)

Device model:
(e.g. Xiaomi 14T Pro, Galaxy A52s 5G)

Operating system:
(e.g. Windows, Android, iOS)

Operating system version/edition:
(e.g. Windows 11 Pro, Android 13, iOS 17.3)



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B. Evaluation (Part 1)

B.1. Evaluation activities performed

(Please describe if you managed to complete all actions in the pilot during the evaluation)

B.2. Main evaluation outcomes

B.2.1. Please describe the main outcomes of the evaluation.

B.2.2. Did the TANGO platform function as expected?

B.2.3. Did you manage to achieve the goal?

B.2.4. Did you experience any difficulties or frustrations?

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Please feel free to include any screenshots, images, diagrams, or other visual elements that help illustrate the main outcomes of your evaluation. Only one file can be uploaded.

(*Note: Only PDF, DOC, DOCX, PNG, JPG, JPEG, GIF files are supported*)

Choose File

No file chosen

B.3. Suggestions for TANGO platform improvement

B.3.1. Please provide any suggestions to help improve the TANGO platform.

B.3.2. Did you identify any bugs, weaknesses, or areas of improvement?

67%

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C. Evaluation (Part 2)

* C.1. How easy is it to use the TANGO platform?

Very difficult	Difficult	Neutral	Easy	Very easy
☐	☐	☐	☐	☐

* C.2. How easy was it to learn how to use the TANGO platform?

Very difficult	Difficult	Neutral	Easy	Very easy
☐	☐	☐	☐	☐

* C.3. How intuitive do you find the TANGO platform's interface?

Not at all intuitive	Slightly intuitive	Moderately intuitive	Very intuitive	Extremely intuitive
☐	☐	☐	☐	☐

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*** C.4. How user-friendly is the TANGO platform overall?**

Not at all user-friendly	Slightly user-friendly	Moderately user-friendly	Very user-friendly	Extremely user-friendly
☐	☐	☐	☐	☐

*** C.5. How often do you encounter problems (e.g. crashing, non-response, etc.) when using the TANGO platform?**

Never	Rarely	Occasionally	Often	Very often
☐	☐	☐	☐	☐

*** C.6. Are the supporting materials for the TANGO platform easily available?**

Not at all available	Slightly available	Moderately available	Very available	Extremely available
☐	☐	☐	☐	☐

*** C.7. Did you need any help or support for the TANGO platform?**

- ☐ Yes
- ☐ No

*** C.8. How reliable do you find the TANGO platform?**

Not at all reliable	Slightly reliable	Moderately reliable	Very reliable	Extremely reliable
☐	☐	☐	☐	☐

*** C.9. How accurate is the information provided by the TANGO platform?**

Not at all accurate	Slightly accurate	Moderately accurate	Very accurate	Extremely accurate
☐	☐	☐	☐	☐

*** C.10. How secure do you feel using the TANGO platform?**

Very insecure	Insecure	Neutral	Secure	Very secure
☐	☐	☐	☐	☐

*** C.11. How effective are the TANGO platform's access control measures?**

Not at all effective	Slightly effective	Moderately effective	Very effective	Extremely effective
☐	☐	☐	☐	☐

* C.12. How often do you encounter security issues when using the TANGO platform?

Never	Rarely	Occasionally	Often	Very often
☐	☐	☐	☐	☐

* C.13. How likely are you to recommend the TANGO platform to colleagues/others?
(0–10 Net Promoter Score)

0 - Not at all likely	1	2	3	4	5 - Neutral	6	7	8	9	10 - Extremely likely
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

* C.14. Overall, how satisfied are you with the TANGO platform?

Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
☐	☐	☐	☐	☐

* C.15. How satisfied are you with the features of the TANGO platform?

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
ePassport	☐	☐	☐	☐	☐
SSI Wallet	☐	☐	☐	☐	☐
Check-in	☐	☐	☐	☐	☐
Recommender	☐	☐	☐	☐	☐
Visualization & Reporting	☐	☐	☐	☐	☐
Hotel evaluation	☐	☐	☐	☐	☐

100%

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Done

Component Evaluation [ePassport] (Smart Hospitality Pilot)

A. Evaluation Overview

*** A.1. Partner performing the evaluation**
(e.g. VISAR, IDIADA, etc.)

*** A.2. Evaluation dates**
(Enter specific date or date range)

Start date

Date



End Date

Date



A.3. Which device did you use for testing the component?
(Please specify your device specifications)

Device type:
(e.g. PC, tablet, smartphone)

Device model:
(e.g. Xiaomi 14T Pro, Galaxy A52s 5G)

Operating system:
(e.g. Windows, Android, iOS)

Operating system version/edition:
(e.g. Windows 11 Pro, Android 13, iOS 17.3)



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B. Evaluation (Part 1)

B.1. Main evaluation outcomes

B.1.1. Please describe the main outcomes of the evaluation.

Did you experience any of the following situations?

- 1. Seamless onboarding is achieved and the verification is performed correctly for a 'correct' user.*
- 2. Onboarding should fail and the component should detect that a passport does not match a given user, if someone uses an incorrect passport.*

B.1.2. Did the component function as expected?

B.1.3. Did you manage to successfully verify your identity and view the final summary page that showcases the details of the passport?

B.1.4. Did you experience any difficulties or frustrations?

Please feel free to include any screenshots, images, diagrams, or other visual elements that help illustrate the main outcomes of your evaluation. Only one file can be uploaded.

(Note: Only PDF, DOC, DOCX, PNG, JPG, JPEG, GIF files are supported)

Choose File

No file chosen

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B.2. Suggestions for component improvement

B.2.1. Please provide any suggestions to the component leader to help them improve the component.

B.2.2. Did you identify any bugs, weaknesses, or areas of improvement?


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C. Evaluation (Part 2)

* C.1. How easy is it to use the specific component?

Very difficult	Difficult	Neutral	Easy	Very easy
☐	☐	☐	☐	☐

* C.2. How easy was it to learn how to use the specific component?

Very difficult	Difficult	Neutral	Easy	Very easy
☐	☐	☐	☐	☐

* C.3. How intuitive do you find the specific component's interface?

Not at all intuitive	Slightly intuitive	Moderately intuitive	Very intuitive	Extremely intuitive
☐	☐	☐	☐	☐

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* C.4. How often do you encounter problems (e.g. crashing, non-response, etc.) when using the specific component?

Never	Rarely	Occasionally	Often	Very often
☐	☐	☐	☐	☐

* C.5. How reliable do you find the specific component?

Not at all reliable	Slightly reliable	Moderately reliable	Very reliable	Extremely reliable
☐	☐	☐	☐	☐

* C.6. How likely are you to recommend the specific component to colleagues/others?
(0–10 Net Promoter Score)

0 - Not at all likely	1	2	3	4	5 - Neutral	6	7	8	9	10 - Extremely likely
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

* C.7. Overall, how satisfied are you with the specific component?

Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
☐	☐	☐	☐	☐



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