Change toolkit for digital building permit

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1 Executive Summary

Municipalities face significant challenges in modernizing their building permit processes, which remain complex, highly regulated, and administratively burdensome. These processes involve multiple stakeholders, numerous procedural steps, and varying levels of digitalisation. Traditional workflows often suffer from inefficiencies due to manual data handling, fragmented communication, and inconsistent digital adoption, leading to delays, lack of transparency, and increased workloads for both applicants and municipal authorities. Many municipalities lack a structured method to assess their digital maturity and define a clear pathway for transformation, making it difficult to prioritize improvements and align digitalisation efforts with their existing resources and infrastructure.

The CHEK Virtual Assistant (VA) was developed as a scalable, AI-powered tool to assist municipalities in mapping their permitting processes, assessing digital maturity, and generating an actionable roadmap for digital transformation. The CHEK VA aims to help municipalities structure their existing processes, evaluate their digitalisation levels, and plan strategic improvements. Through chatbot-assisted process mapping, users receive guidance in structuring their workflows based on standardised best practices while maintaining flexibility for local adaptations. Once the process map is completed, the system automatically extracts key information and evaluates digital maturity levels against CHEK-defined benchmarks, ensuring an objective, data-driven assessment of the municipality's current capabilities.

Following the assessment, the CHEK VA automatically generates a tailored transformation roadmap, outlining the necessary steps for a municipality to reach its target digital maturity level. This roadmap aligns with predefined CHEK benchmarks, ensuring that recommendations are strategic, realistic, and actionable. The system also produces a structured report, summarizing the municipality's process structure, maturity assessment, and roadmap recommendations, providing clear insights for decision-making.

A fundamental aspect of the CHEK VA is its scalability, allowing it to be effectively adopted by municipalities of different sizes, regulatory frameworks, and digital readiness levels. Designed to be flexible and widely applicable, the tool ensures that municipalities can adapt it to their specific needs while maintaining a standardised approach to digitalisation. The chatbot guidance makes the tool accessible even to municipalities with limited digital expertise, reducing complexity and enhancing usability.

While the CHEK VA has been successfully developed and internally validated, it should be noted that full demonstration of the tool's capabilities in municipal contexts requires additional testing and refinement. The complexity of the system and the variability of municipal workflows mean that users may require guidance and support during initial adoption. The tool has undergone internal testing and preliminary evaluation with consortium municipalities (detailed in D1.5), which identified factors that hindered use at full potential, including the learning curve for BPMN process mapping and the assessment model. These findings indicate that while the CHEK VA represents a significant achievement in developing an AI-supported assessment tool, further testing and iterative improvements are necessary before it can be considered fully demonstrated as a standalone, independently usable solution.

Future developments, that will be exploited after the ending of CHEK project, might focus on further improving user experience and usability, possibly expanding the languages in which the user can interact with the assistant. Besides making the chatbot more intuitive, refining the benchmarking model, and exploring expansion beyond the building permit process. While the CHEK VA was developed specifically for building permits, its structured methodology could be applied to other regulatory processes, such as environmental permitting or urban planning approvals, further supporting municipalities in their broader digital transformation efforts.

By providing municipalities with a scalable, structured, and data-driven tool for assessing and improving their permitting processes, the CHEK VA represents a significant step toward digital transformation. It enables cities to transition from

manual, paper-based workflows to structured, strategic digitalisation, ensuring greater efficiency, transparency, and service delivery improvements while remaining adaptable to diverse municipal contexts and future advancements in digital governance.

2 Introduction

The digital transformation of municipal services has become a critical priority for cities and public administrations seeking to enhance efficiency, transparency, and accessibility. One of the most complex and resource-intensive processes within municipal governance is the building permit process, which involves multiple stakeholders, regulatory requirements, and decision-making steps. Traditional permitting workflows often suffer from inefficiencies due to manual processes, fragmented communication, and inconsistent digital adoption, leading to delays, increased administrative burden, and a lack of clarity for applicants and authorities alike.

The CHEK VA was developed as an AI-driven tool to support municipalities in assessing and improving their permitting process maturity through a structured and automated approach. By leveraging artificial intelligence, process mapping, and maturity model assessments, the CHEK VA provides municipalities with a comprehensive analysis of their current digital capabilities, by assessing the CHEK Maturity Model and summarizes the CHEK Roadmap with actions that can guide their digital transformation journey. CHEK MM and CHEK Roadmap were both developed on Task 1.2 and can be found on Deliverable D1.2[1].

The current document outlines the methodology, development, and implementation of the CHEK Virtual Assistant, detailing how it assists municipalities in evaluating their permitting workflows and assessing their digital maturity with the framework of CHEK MM The report covers the CHEK Virtual Assistant's development methodology, workflow, data collection, maturity assessment framework, integration of AI technologies, and final implementation phases. Internal testing on the use and content of the tool was carried within its development, while usability testing with external users (municipality technician) was done through out Task 1.4 and is available at Deliverable D1.5.

The Virtual Assistant is designed to support municipalities of varying sizes and digital readiness levels by offering a structured, data-driven approach to digitalisation. The goal of the CHEK VA is to support Municipalities in setting up their own strategy and implementation plan towards the digital transformation, by using the CHEK Maturity Model and the CHEK Roadmap as base for development of the tool. Initially, the CHEK VA was thought as a user-friendly web-based tool composed of assessment and target questionnaires, that could give the result of the maturity levels from the CHEK MM together with the CHEK Roadmap and a list of actions municipalities should follow to help on their digitalisation strategy.

However, the tool presented here expanded the scope delineated by the goals of CHEK project, as the emerging of assessable artificial intelligence and large language models became an innovative and tangible feature during the development of the project. This way, the CHEK VA presented as final result of Task 1.3 is an innovative solution to give the municipalities a tool where they can assess their digital maturity (based on CHEK MM) within an AI-based solution. The CHEK VA functionality includes process mapping, automated maturity assessments of the CHEK MM, creation of the CHEK Roadmaps, and automated reporting of all the previous steps; making it a valuable asset for municipalities aiming to refine their regulatory procedures and enhance service delivery.

By providing a scalable, user-friendly, and AI-powered solution, the CHEK VA represents a significant support in the digitalisation of permitting systems, enabling municipalities to transition from manual, paper-based processes to more efficient, digital workflows. This document serves as a comprehensive guide to understanding the design, implementation, and impact of the CHEK VA. Section 3 of this deliverable presents a literature review on the topics of virtual assistants, artificial intelligence and maturity models assessment. Section 4 presents the methodology used to

[1] Available at: CHEK_101058559_D1.2_Maturity-Model-and-Roadmap (https://chekdbp.eu/wp-content/uploads/2023/11/D1.2_CHEK_101058559_Maturity-Model-and-Roadmap_v1.0_Final.pdf)

develop and implement the CHEK VA. Section 5 details the phases of development of the CHEK VA. Section 6 presents the framework and implementation of the tool, focusing on the backend development. Section 6.3 presents the internal tests made before the publication of the tool. Section 7 shows a discussion and future steps for the tool. Finally, Section 8 concludes the deliverable.

2.1 Integration with WP1 Deliverables

Each deliverable in WP1 built upon the previous work, creating a comprehensive framework for understanding, assessing, and guiding the digital transformation of building permit processes. Figure 1 illustrates the relationships and dependencies between all WP1 deliverables.

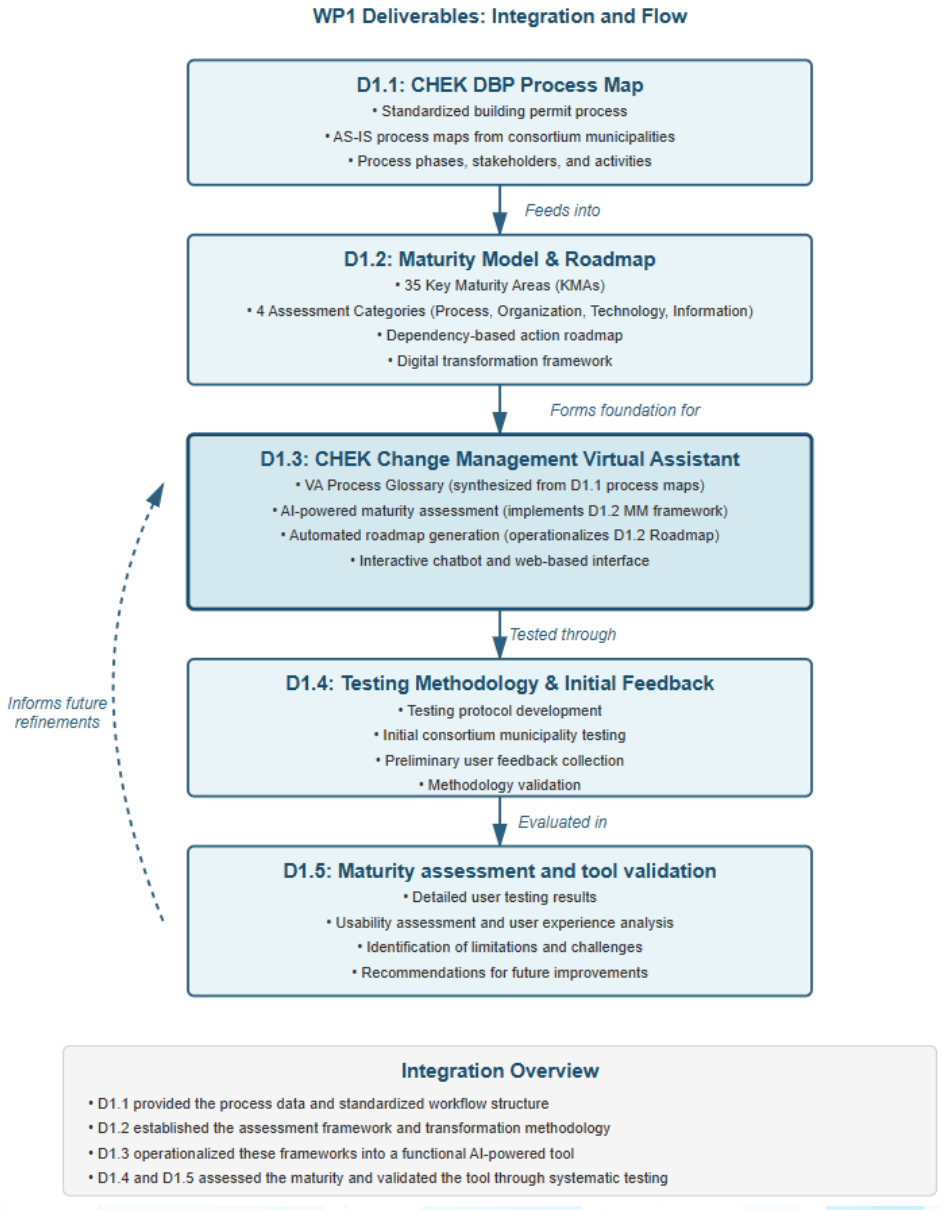

Figure 1 WP1 deliverables integration

D1.1 - CHEK DBP Process Map: Established the standardized building permit workflow and collected AS-IS process maps from consortium municipalities (Prague, Ascoli Piceno, Vila Nova de Gaia, Lisbon). These process maps provided the foundational data for understanding the diverse approaches to building permitting across European municipalities, identifying common phases, stakeholders, and activities that informed the development of the CHEK VA Process Glossary.

D1.2 - Maturity Model & Roadmap: Developed the CHEK DBP Maturity Model with 35 Key Maturity Areas across four categories (Process, Organization, Technology, Data) and defined a dependency-based roadmap for digital transformation. This deliverable provided the assessment framework and transformation guidance that the CHEK VA operationalises through AI-powered automation.

D1.3 - CHEK Virtual Assistant (current deliverable): Translates the conceptual frameworks from D1.1 and D1.2 into a functional, AI-powered tool. The CHEK VA Process Glossary synthesizes the process maps from D1.1 into standardized terminology, the maturity assessment module implements the evaluation framework from D1.2, and the roadmap generation feature automates the transformation planning defined in D1.2's roadmap.

D1.4 - Testing methodology & initial feedback: Established the testing protocol for evaluating the CHEK maturity model and maturity assessment and conducted initial testing with consortium municipalities. This deliverable documented the testing approach, data collection methods, and preliminary findings that informed final adjustments to the maturity assessment before final evaluation.

D1.5 – Final testing and maturity assessment results: Established the testing protocol for testing and validating the CHEK VA and conducted further maturity assessments with consortium municipalities. This deliverable documented the testing approach, data collection methods, and final maturity assessment results. The findings from D1.5 directly inform the discussion of limitations and future prospects presented in Section 7 of D1.3.

This sequential development approach ensured that each component of WP1 was grounded in validated research and real-world municipal needs, creating a comprehensive and integrated approach to supporting digital transformation of building permit processes.

3 State of the art

Chapter summary

This chapter explores the integration of maturity models, AI, and virtual assistants in the digital building permit process. It highlights the limitations of traditional maturity models, such as CMMI, in addressing the complexities of digital permitting and presents the CHEK DBP Maturity Model (CDBPMM) as a tailored solution. The chapter reviews existing maturity models, the role of automation, and the potential of AI-driven virtual assistants in streamlining maturity assessments. It also examines AI's impact on the Architecture, Engineering, Construction, and Operations (AECO) industry and e-governance, emphasizing the need for machine-readable regulatory frameworks. By integrating AI, natural language processing, and automated data collection, virtual assistants can enhance the efficiency, accuracy, and adaptability of digital permitting processes, providing municipalities with a structured roadmap for digital transformation.

3.1 Crossing domains

Building the CHEK VA for assessing maturity or the building permit process has required the integration of domains and the research extended to tackle all those topics - from mapping of the building permit process in the public administration, to automation and integration of AI and chatbots, as illustrated in Figure 2.

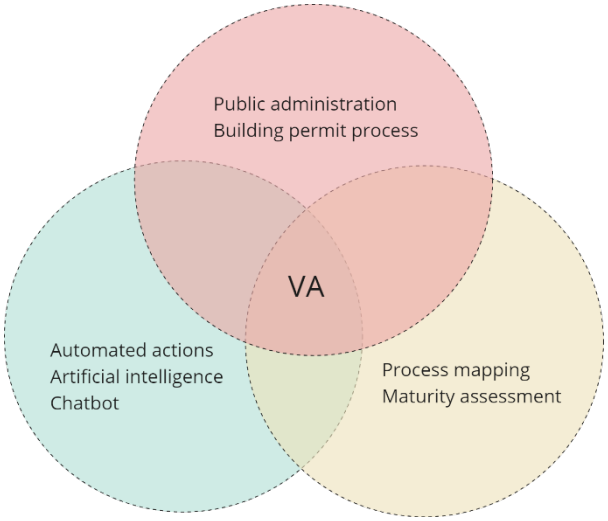

Figure 2 Crossing domains

3.2 Review of existing use of maturity models and maturity models for permitting

Maturity models have been widely applied to evaluate organizational capabilities and process effectiveness, with frameworks such as the Capability Maturity Model Integration (*CMMI for Development, Version 1.3*, 2010) (CMMI) serving as a cornerstone in many industries (Jia et al., 2011). As classified by Jia et al. (2011), existing maturity models generally fall into four categories:

1. Generally applicable MM,
2. Industry-specific MM,
3. Models addressing specific areas, and

4. Other variations.

Despite the broad application of these models, there remains a notable gap when it comes to processes such as building permit digitalisation. Traditional models have primarily focused on project management and software processes, while the critical and complex domain of digital permitting has been underexplored (Reis et al., 2017). This gap is addressed in the CHEK DBP Maturity Model (Ataide et al., 2023), which draws on several established models — including BIM and GIS maturity frameworks, the Capability Maturity Model Integration (CMMI) framework[2], and basic design principles (Poeppelbuss and Roeglinger, 2011) — to build a comprehensive model tailored for digital building permit (DBP) processes.

The CDBPMM is divided into four main categories — Process, Organisation, Technology, and Information — each broken down into multiple KMAs that are scored on a scale from Level 0 (non-existent) to Level 5 (optimised/automated). This practical approach demonstrates how maturity models can evolve from theoretical frameworks to tools that guide digital transformation in municipal building permitting procedures (CHEK DBP Maturity Model presented deliverable D1.2).

While many maturity models rely on manual, ad hoc data collection using spreadsheets and static questionnaires for assessing the maturity, some studies emphasize the critical role of employing automation techniques in both the design and deployment phases of maturity models (Proença, 2016; Wu et al., 2017). This collective body of research underscores the enduring importance of automation for enhancing the effectiveness and efficiency of maturity model development.

3.3 Automated assistants and virtual technologies

Digital transformation is increasingly being driven by the adoption of virtual assistants and automated tools across various sectors, including construction and public administration. In these areas, virtual assistants have been designed to facilitate project management, streamline design processes, and enhance citizen services. For example, in the construction industry, Wang et al. (2022) developed a query-answering system that leverages natural language processing (NLP) to extract information from Building Information Models (BIM), achieving over 80% accuracy in early testing. Such systems demonstrate the potential of virtual assistants to support complex workflows by providing timely and accurate responses.

In public administration, virtual assistants have been deployed to improve service delivery and support administrative functions. Research by Safaei and Longo (2023) illustrates that while initial AI-driven models for generating policy-relevant documents have limitations, the scope for enhancement through integration with advanced NLP is substantial. Additional studies have similarly shown that chatbots can streamline access to geospatial data and automate routine tasks, thus alleviating administrative burdens (Morocho et al., 2022; van Noordt and Misuraca, 2019).

Despite these advancements, a dedicated virtual assistant specifically tailored for digital building permit processes has not yet been developed. The CHEK DBP Maturity Model deliverable underscores this gap by illustrating the necessity of linking KMAs with a corresponding set of actions and dependencies — information that is critical for developing a virtual change management assistant. By mapping dependencies among KMAs and creating a “waterfall” of actions required for maturity progression (Ataide et al., 2023), the deliverable provides a blueprint for a virtual assistant that can guide municipalities through digital transformation.

[2] Available at: CMMI Institute - CMMI (https://cmmiinstitute.com/cmmi)

3.4 AI Integration in AECO and E-Governance

The Architecture, Engineering, Construction, and Operations (AECO) industry is experiencing a profound transformation with the integration of AI technologies. Recent advances in natural language processing, computer vision, and machine learning are fostering innovative applications that improve efficiency, accuracy, and decision-making throughout the sector.

Early studies (Song et al., 2018; van Noordt and Misuraca, 2019; Wang and Issa, 2020) have shown that voice-enabled interactions with BIM software allow non-technical users to interact with complex design data through speech recognition (Shin et al., 2021), while remote access to building data models promotes more collaborative workflows (Elghaish et al., 2022). Additionally, automated inquiry systems have been instrumental in reducing decision-making bottlenecks by rapidly interpreting BIM data (Nabavi et al., 2023).

Beyond design and data access, AI plays a significant role in infrastructure management. Integrating IoT sensor data with machine learning supports real-time structural health monitoring and facilities management (Luckey et al., 2021). In construction, autonomous equipment and generative design algorithms are gradually reducing human error and enhancing productivity (Karan et al., 2021).

In the realm of public administration, AI is reshaping service delivery and organizational processes. Lu and Gao (2022) highlight how AI can optimize public sector operations, while Cortés-Cediel et al. (2023) provide evidence of AI-enabled chatbots enhancing citizen engagement. However, one of the most critical challenges remains the translation of building codes and regulations into machine-readable formats—a gap that is especially pronounced in the digital permitting domain (Song et al., 2018; Wu et al., 2023). The CHEK DBP Maturity Model deliverable addresses this challenge by embedding data quality, standardisation, and integration into its framework, thereby ensuring that the digital tools developed are robust and capable of handling regulatory complexities.

3.5 Virtual assistants for maturity model enhancement

The integration of AI-driven virtual assistants represents a promising solution to bridge the gap between traditional maturity models and the operational needs of digital permitting. Traditional frameworks like CMMI offer a solid foundation for process evaluation, but their practical application is often limited by outdated manual methods. AI-powered virtual assistants have the potential to automate the data collection, analysis, and reporting processes inherent in maturity model assessments, significantly reducing manual effort while enhancing accuracy and insight.

Key benefits of AI-enabled virtual assistants in maturity model assessments include:

- Automation and Efficiency: Automated data collection minimizes human input, accelerates the evaluation process, and reduces error margins (Proença, 2016; Wu et al., 2017). The CHEK DBP Maturity Model deliverable, with its detailed scoring and assessment framework, exemplifies how automation can be integrated to streamline the evaluation of complex processes.
- Enhanced Data Quality: Virtual assistants can consolidate data from multiple sources, providing a comprehensive, multidimensional view of an organization's digital capabilities. This aligns with the CDBPMM approach, which emphasizes structured data collection across 35 KMAs.
- Context-Aware Analysis: Advanced natural language processing allows virtual assistants to interpret and respond to complex, domain-specific queries—a feature critical for the variable nature of building permit processes. The CHEK deliverable's "waterfall of dependencies" between KMAs demonstrates how understanding contextual relationships is vital for maturity progression.

- Dynamic Reporting and Road mapping: Real-time feedback and dynamic reporting enable continuous monitoring and incremental process improvements. The integrated roadmap associated with the CHEK MM (Ataide et al., 2023) outlines a logical sequence of actions for municipalities to advance maturity, serving as an essential guide for developing a virtual assistant capable of supporting strategic decision-making.

Although prototype tools such as those developed by Krivograd and Fettke (2012) have demonstrated the feasibility of automated maturity assessments, their limited scope highlights the need for more advanced and configurable software solutions. The CHEK DBP Maturity Model deliverable illustrates this need by providing a detailed framework and roadmap that are intended to be operationalized through a "CHEK change management virtual assistant." This approach paves the way for a more comprehensive, digital solution that can adapt to the unique requirements of municipal permitting.

3.6 Discussion

In summary, while maturity models have provided a robust theoretical foundation for process evaluation, their application in digital building permitting has been hindered by reliance on outdated manual tools and the absence of dedicated digital frameworks. The CHEK DBP Maturity Model deliverable addresses this gap by offering a structured, detailed framework tailored to the unique challenges of digital permitting. By integrating established models like CMMI with specialized BIM, GIS, and organisational assessment frameworks, the CDBPMM provides a practical pathway for municipalities to assess and enhance their digital capabilities.

The deliverable's framework, which includes a comprehensive set of KMAs, a clear scoring system, and a dependency-based roadmap, demonstrates how traditional maturity models can evolve into dynamic, digitally enabled tools. Moreover, the integration of AI through virtual assistants represents a promising strategy to automate and enhance maturity model assessments, ensuring that data collection, analysis, and reporting become more efficient and context aware.

As the field of digital permitting continues to evolve, further research and development, guided by frameworks such as the CHEK DBP Maturity Model, will be essential. These advancements promise to bridge the gap between theoretical maturity models and the practical requirements of modern municipal governance, ultimately paving the way for smarter, more responsive public services.

4 Methodology

Chapter summary

The methodology followed an iterative approach to develop the capabilities of the CHEK Virtual Assistant. The framework for creating the CHEK VA used previous work from WP1 including the CHEK Maturity Model, CHEK DBP Process Map, and CHEK Roadmap. This provided detailed inputs on the as-is state of permitting capabilities and target maturity levels. Data analysis methods were then applied to map current capabilities to processes and identify maturity targets for each capability. Statistical analysis and AI algorithms translated these targets into specific actions that could be taken by municipalities to reach higher maturity. An extensive literature review compiled knowledge on existing permitting maturity models and automated assistants. Recent innovations in conversational AI and assessment algorithms were also analysed for applicability.

The development of the CHEK VA took several stages which were divided into 4 phases:

1 Data collections, analysis, and processing, including a literature research, collection of data sources, user requirement definition and definition of the CHEK VA goals.
2 Data integration and usage, that defined the CHEK VA workflow, define the module based on the workflow and defined the GUI design.
3 Development phase, that involved the modules implementation and carried internal tests.
4 Testing phase that was done in parallel with Task 1.4, and involved publishing the CHEK VA, testing with consortium users, collecting the results and deploying the software.

The workflow of the development stages is described in Figure 3, and the stages are detailed in other sections of this Deliverable.

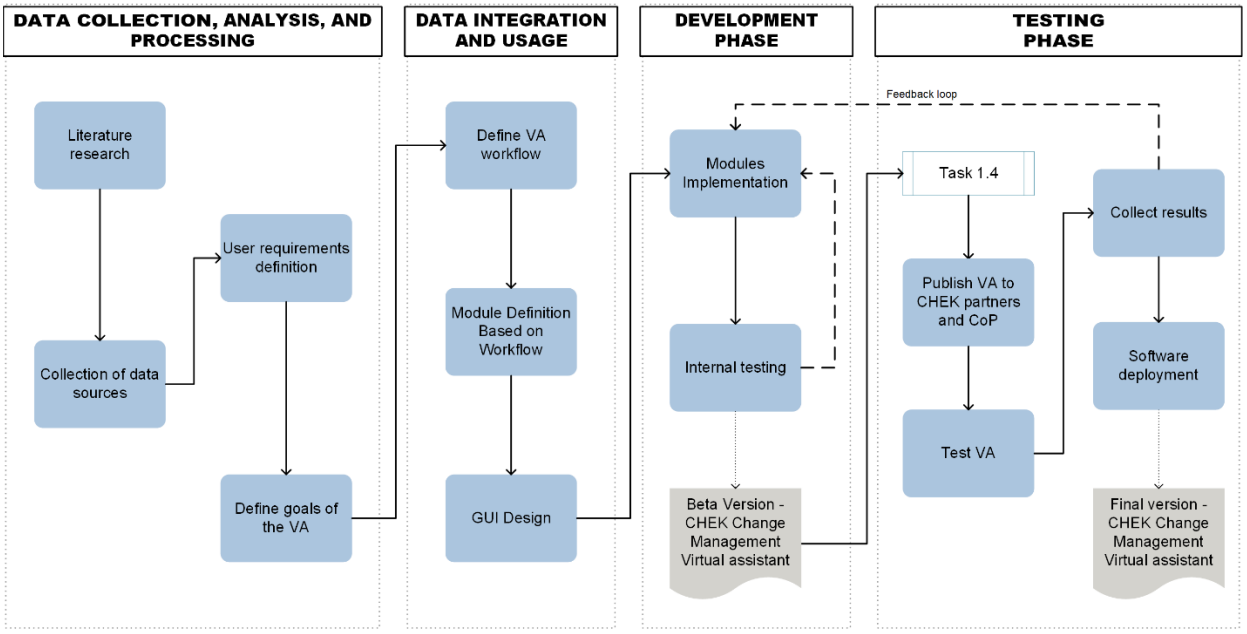

Figure 3 Methodology workflow

4.1 Goals of the Virtual Assistant

The CHEK Change Management Virtual Assistant was crafted to empower municipalities in their digital transformation journey, offering tailored support for the adoption of the CHEK toolkit. To achieve that, the CHEK VA was designed following three main goals that guided the methodology for creating the tool. They are:

1. **Understanding the Current Permitting Process:** Gain insights into the existing building permit procedures within the municipality.
2. **Assessing the DBP Maturity:** Evaluate the current state of permitting processes by employing the CHEK DBP Maturity Model. This step involves identifying strengths and pinpointing areas that require improvement.
3. **Generating a Roadmap and Action List:** Utilize the assessment outcomes and user expectations to create a tailored roadmap and a detailed list of actions, ensuring a targeted and effective transformation process.

4.2 Data collection for VA development

Comprehensive data collection and meticulous attention to user requirements are essential in the development of the VA. This section serves to outline the strategies employed to gather data and delineate user needs, both of which are fundamental pillars in the construction of an effective CHEK VA.

The integration of diverse data sources, including process maps, forms the backbone of the CHEK VA's functionality. These sources not only offer crucial insights into workflows but also aid in standardising data formats, ensuring seamless integration within the tool. Additionally, user requirements play a critical role in guiding the development trajectory, shaping both the functional capabilities and non-functional standards that underpin the CHEK VA's efficacy.

4.2.1 Data sources

The VA has different sources that build up to achieve all the expected results. Those sources were sometimes adapted to fit the format of the CHEK VA and standardise the data for the use in the tool. Each source created a database that was used to connect and train the AI. The purpose of the databases varies from the module on the CHEK VA, but they were connected to create a seamless workflow.

The sources of data used on the construction of the CHEK VA were: The CHEK DBP Process map, deliverable D1.1

- The building permit AS-IS process maps from the Consortium Municipalities, also presented on the deliverable D1.1
- The CHEK DPB Maturity model, deliverable D1.2.
- The CHEK Roadmap, deliverable D1.2
- User needs assessment
- CHEK objectives, KPIs, tools
- Literature

4.2.2 CHEK VA functional requirements

An effective virtual assistant depends on meeting key functional needs to deliver core value as well as important non-functional standards to ensure ease-of-use, security, and integration. The key requirements guiding the development of the virtual assistant comprise both functional needs centred on workflows and tasks, as well non-functional standards shaping broader system qualities.

Functional requirements:

- Multi-channel assessments - Conversational chatbots, interactive questionnaires, and other modes evaluate process maturity in context of each municipality.
- Process mapping - Visual diagramming empowers staff at all levels to map workflows, identify inefficiencies, and spotlight digitization opportunities.
- Personalized roadmaps - AI-powered recommendations guide municipalities through major process redesign milestones tailored to their resources and constraints.
- Progress tracking - Persistent storage of assessment responses and maps illustrates advancement over time.

Functional requirements define the primary workflows and tasks enabled by the assistant. Multi-channel digital assessments comprise conversational chatbots, interactive questionnaires, and other modes to evaluate process maturity while considering the municipal context. Visual process mapping functionality in BPMN supports capturing complex as-is workflows to feed the analysis and empowers staff at all levels to diagram workflows, spotlight inefficiencies, and identify digitisation opportunities. The assistant also persistently stores assessment and process maps to analyse progress over time. These capabilities directly target the assistant's objective to assess current states, outline improvement roadmaps, and track advancement.

Non-functional requirements:

- Usability - Intuitive navigation and contextual help allows users to obtain value, driving adoption.
- Security - Controls preserve sensitive municipal data integrity and privacy rights.

- Integration - APIs enable valuable data sharing with complementary CHEK tools.

Non-functional requirements are centred around usability through intuitive navigation, accessibility compliance for special needs, and security protections on potentially sensitive municipal data. Integration with other CHEK tools facilitates data sharing where required. The functional and non-functional requirements work together to build a broad virtual assistant serving municipalities of all sizes and capacities with their digital transitions.

4.3 Data analysis and processing

This section explores how the CHEK VA framework employs strategies for comprehensive data analysis and processing, crucial for guiding municipalities through digital transformations. With a focus on maturity model analysis, capability mapping, terminology refinement, and target setting. The goals include empowering municipalities to effectively utilise the CHEK toolkit and seamlessly transition to digital building permit processes, by understanding current procedures, assessing maturity levels, defining objectives, and generating customized roadmaps.

4.3.1 Analysing maturity model to identify capabilities

The first step in the data analysis process involved a detailed examination of the CHEK DBP Maturity Model to identify and categorize key capabilities, in order to find the best way to match all the categories and KMAs of the MM withing the CHEK VA's workflow. This analysis entailed an understanding of the breakdown of the 35 KMAs[3] across the four categories (Process, Organisation, Technology, and Data) to isolate specific capabilities found on the MM. By stipulating the definitions that articulate what each capability entails and how it manifests at different maturity levels from 0 to 5; also establishing relationships between capabilities to understand dependencies and prerequisites, while identifying capability indicators that could be measured through the CHEK VA's assessment process.

Each capability of the CHEK MM was transcribed to a text format[4] with its descriptions, maturity level definitions, and measurement criteria to ensure consistent evaluation across different municipalities. This systematic approach enabled the CHEK VA to provide detailed, multi-dimensional assessments of municipal capabilities rather than simplistic binary evaluations, creating a foundation for meaningful digital transformation guidance.

4.3.2 Mapping capabilities to process map actions

After identifying capabilities from the CHEK MM, the next crucial step involved mapping these capabilities to specific actions within the building permit process, since the process map actions drawn on the CHEK VA's interface should be analysed and categorised by its level of digital maturity. This mapping process began with analysing the standardised CHEK VA Process Glossary (see Section 4.3.3) to identify where and how each capability from the CHEK MM is applied within the building permit workflow. The actions of the CHEK VA Process Glossary were crossed with the capabilities found in the CHEK MM in a way that each capability is linked to relevant process steps in the BPMN maps, defining the digital maturity indicators for each process step that correspond to capability levels. Connections between process activities and the technological and organizational requirements needed to support them were also established, creating a holistic view of how capabilities manifest in practice.

[3] The structure of the CHEK MM is detailed on deliverable D1.2.
[4] The CHEK MM is available in an Excel format. The texts from the model were put in a .txt format to ease the data exchange and feeding of the data to the AI.

This mapping enabled the CHEK VA to translate abstract capability assessments (from the CHEK MM) into concrete process improvements (form the VA Process Glossary). By understanding how capabilities manifest in specific process actions, the CHEK VA can provide targeted recommendations that address the actual workflow challenges that municipalities face rather than generic improvement suggestions. The detailed connections between capabilities and process steps ensure that maturity assessments remain grounded in practical realities rather than theoretical ideals.

4.3.3 Refining terminology and creating the CHEK VA Process Glossary

A critical component of the data analysis process was the standardisation of terminology across various aspects of the building permit process. Terms used across different municipal processes and regulatory frameworks were compiled, then harmonized to create a consistent vocabulary for the CHEK VA's interactions. Each term was defined to avoid ambiguity and ensure accurate assessments, while being categorized according to its relevance to process phases, stakeholders, and capability areas.

All the actions mapped from the different AS-IS process maps created in Task 1.1[5] were combined and the terms were standardised to facilitate the work of the AI in the backend of the CHEK VA. Those terms were sometimes rewritten in plain direct language, to facilitate the understanding of the AI. Since the terms are very specific to the actions within the process maps from Task 1.1, they were not found on the CHEK Glossary; however, the terms are integrated in CHEK Glossary, in a combined effort with WP5. The full CHEK VA Process Glossary available at the Annex II of this deliverable.

The resulting glossary serves as the foundation for the CHEK VA's natural language processing capabilities, enabling it to interpret user inputs accurately and provide contextually appropriate responses. This standardisation was essential for ensuring that the CHEK VA could effectively analyse processes from municipalities using different terminologies or procedural approaches. The glossary also facilitates communication between stakeholders by establishing a common language for discussing digital transformation initiatives, reducing misunderstandings and improving collaboration efficiency.

4.3.4 Translating targets into actions and defining the roadmap

The final step in the data analysis process involved translating maturity targets into actionable roadmaps. This translation process began with breaking down capability gaps into specific improvement actions that municipalities could implement. These actions were sequenced based on dependencies, resource requirements, and implementation complexity, creating logical pathways through the digital transformation journey. The defining of the relations and actions was initiated on Deliverable D1.2 within the work of the CHEK Roadmap[6].

From the list of actions created within the CHEK Roadmap, there was an effort to map each action to a CHEK tool. This list of actions and tools was peer reviews by CHEK consortium members and the final list is available on Annex I of this deliverable. The final CHEK Roadmap was used as input to the CHEK VA, in order to give the source for the creation of the roadmaps on the CHEK VA user's workflow.

[5] Deliverable available at: CHEK_101058559_D1.1_CHEK-DBP-process-map (https://chekdbp.eu/wp-content/uploads/2023/04/D1.1_CHEK_101058559_CHEK-DBP-process-map_V1.0-Final.pdf)
[6] Available at: CHEK_101058559_D1.2_Maturity-Model-and-Roadmap (https://chekdbp.eu/wp-content/uploads/2023/11/D1.2_CHEK_101058559_Maturity-Model-and-Roadmap_v1.0_Final.pdf)

4.4 Data integration and usage for the virtual assistant

The development of the CHEK VA[7] adhered to a methodical approach, employing a modular framework to address distinct goals, data sources, and expected outcomes. While the CHEK VA's workflow remains continuous, strategic milestones played an important role in the progress. This modular strategy optimised the development, allowing for the completion of each module before transitioning to the next, thereby expediting the process and mitigating inconsistencies.

Besides the software development into stages of implementation, preparatory steps were carefully executed to guide CHEK VA functions:

- **User Workflow Definition**: A complete definition of the user workflow was undertaken, delineating the main questions users should answer to guide the AI's starting point.
- **Stage Definition Based on Workflow**: Stages of implementation were clearly defined based on the established workflow, ensuring a systematic and cohesive approach.
- **GUI Design**: A Graphical User Interface (GUI) was crafted to comprehensively encompass all CHEK VA functions, enhancing user experience, understanding of the workflow, and easy identification of the module the user is working.

The user workflow served as a guiding blueprint for the AI's trajectory. Breaking down this comprehensive workflow into modules, each with distinct inputs, milestones, and expected outputs, provided a structured approach. The interface mock-up aimed to offer users a clear understanding of the modules while maintaining seamless continuity in the CHEK VA workflow. This interface design allows users to navigate and visualize the distinct expected outcomes of each module, providing a user-friendly experience. The initial frontend development set the foundation for subsequent modular backend implementation.

Post-implementation of each module, an internal testing phase, conducted within the software development team, reviewed functionalities, leading to adjustments as necessary. The successful conclusion of one module seamlessly paved the way for the next, adhering to a consistent iterative pattern. Upon the successful implementation of all modules, resulting in a satisfactory workflow, the tool will undergo on testing phase by external users, including Consortium municipalities and the Community of Practice, where applicable. This external testing phase aims to ensure the tool's effectiveness and user-friendliness, refining the CHEK VA based on valuable feedback from end-users. The testing phase, underlining both content and usability, will be comprehensively detailed in the subsequent task within Work Package 1 (WP1). Deliverables D1.4[8] and D1.5[9] have a dedicated focus on testing the tool, ensuring a thorough assessment of its functionality, effectiveness, and user-friendliness. This evaluative process ensures that the CHEK VA aligns with user needs and expectations.

[7] GitHub: GitHub - Fraunhofer-Italia-Research/CHEK: Change toolkit for digital building permit - Virtual Change Management Assistant (https://github.com/Fraunhofer-Italia-Research/CHEK)
[8] Available at: CHEK_101058559_D1.2_Maturity-Model-and-Roadmap (https://chekdbp.eu/wp-content/uploads/2023/11/D1.2_CHEK_101058559_Maturity-Model-and-Roadmap_v1.0_Final.pdf)
[9] The deliverable was done in parallel to this D1.3. It will be published on M30.

5 CHEK VA development

Chapter summary

The CHEK virtual assistant provides an interactive tool to assess maturity of permitting processes and generate tailored roadmaps to guide digital transformation. Advanced AI algorithms analyse municipal capabilities to produce personalised recommendations fitting needs and objectives.

5.1 CHEK virtual assistant workflow

The definition of the user workflow for the CHEK VA played a crucial role in shaping the implementation of the tool. With the goals of the CHEK VA - outlined in previous sections (1.1) - the software workflow was crafted to guide the AI along the path that users should follow to achieve these goals. Unlike traditional software architectures with closed workflows, the CHEK VA, while utilizing a chatbot with AI assistance, possesses specific goals to fulfil and a defined form of assistance. The user workflow significantly influenced the definition of implementation stages, specifying input and output for each step and anticipating possible user exits during the assistant's usage. The user interaction flow is designed around three key stages: Investigate, Assess, and Roadmap. This structured approach enables municipalities to gain deep insights into their current state, conduct thorough evaluations, and receive a transformation plan tailored to their specific needs according to what CHEK toolkit can provide. Clearly defined implementation steps play a crucial role in integrating data and components, ensuring transitions between process mapping, maturity model assessments, and road-mapping functions.

The first stage enables municipalities to outline their process, workflows, and methods, allowing the assistant to capture this information and customize all subsequent functions to their specific context. During the Assess stage, the assistant systematically evaluates process maturity across KMAs. In the Roadmap stage, AI models use the assessment data to generate digital transformation strategies. The conversational nature of the virtual assistant allows users to navigate between stages or exit and re-engage as needed, while the underlying framework ensures smooth transitions behind the scenes.

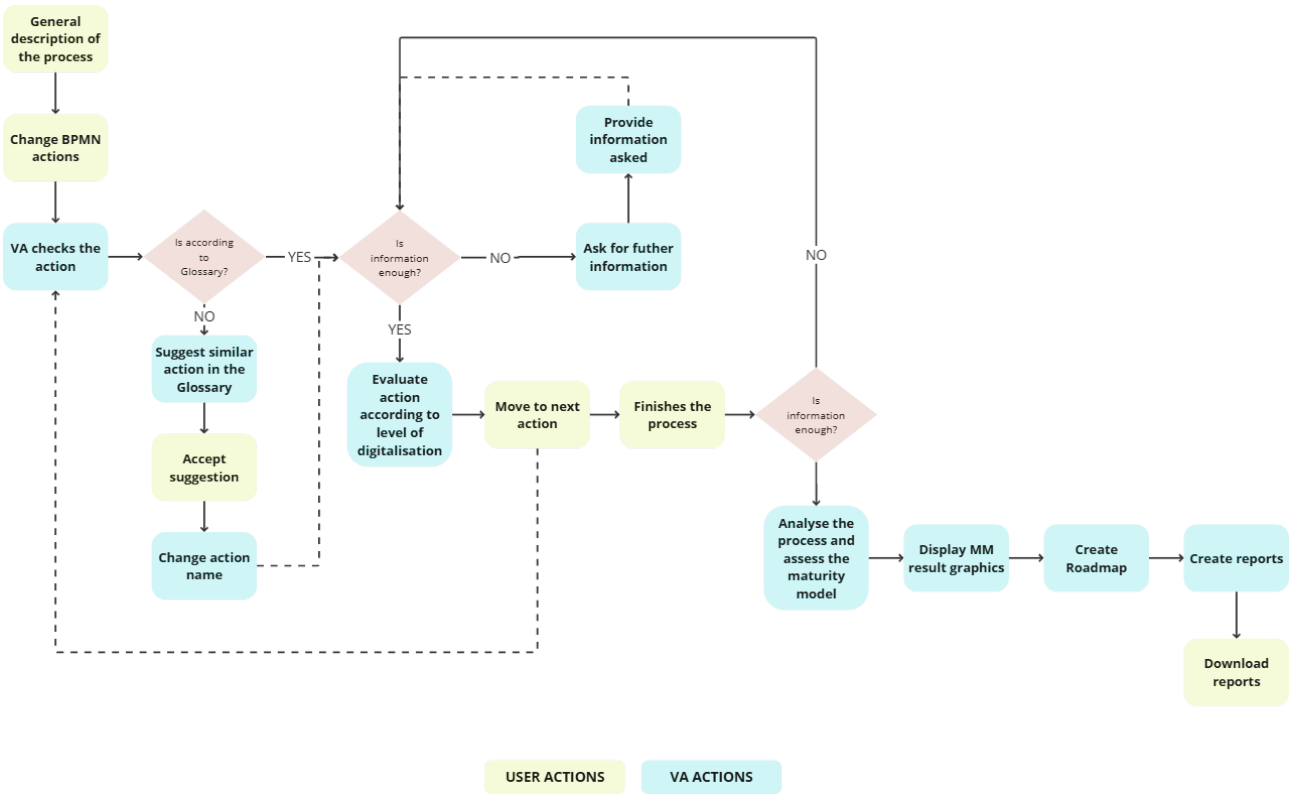

Figure 4 VA's user basic workflow

5.2 Implementation stages

The CHEK Change Management Virtual Assistant is conceived with four different stages that require different input from the user and provide different outcomes: As-is process map, Maturity Model assessment, CHEK Roadmap, and Creating reports. The implementation of the CHEK VA follows a structured sequence of milestones across each of these distinct phases. This sequential approach is essential due to the interdependencies between the steps, with each phase building upon the outcomes of its predecessor. Consequently, each stage was executed and implemented separately, with its commencement determined by the successful completion of the previous results.

These stages not only represent the development of the tool but also mirror the user's journey within the assistant. To achieve the final expected outcome, users must progress sequentially through all four steps, meeting key milestones before advancing. Despite these variations, the entire workflow is interconnected to support the assistant's overall objectives.

The five components are outlined below, detailing their required inputs, expected outputs, and key milestones.

- **Stage 1** – AS-IS Process map
  Input: Information from the user's municipality
  Milestone: Completion of a comprehensive analysis of a current permitting process, identifying key procedural aspects and methods.
  Output: As-is process map with current levels of digitalisation in BPMN format

- **Stage 2** – Maturity Model assessment
  Input: As-is process map with current levels of digitalisation
  Milestone: Assessment of the maturity model with graphic representation of the results
  Output: 4 spider graphics for maturity model's categories (Process, Organisation, Technology, Data)

- **Stage 3** – Building Roadmap
  Input: Current and desirable levels of Maturity
  Milestone: Define the roadmap for achieving the desirable levels of Maturity and provide an action plan for achieving those
  Output: CHEK Roadmap

- **Stage 4** – Creating reports
  Input: As-is process map with current levels of digitalisation; Maturity model's assessment; Roadmap and action plan
  Milestone: Report with the analysis and results on an exportable format
  Output: Exported files in pdf

This phased approach ensures the effective integration of insights, assessment results, objectives, and the transformation roadmap, an essential milestone that provides municipalities with a holistic and user-friendly way to navigate digital transformation. Additionally, user progress and achievements are continuously monitored to confirm successful stage completion. This enables smooth advancement through the workflow, enhancing engagement and supporting the efficient adoption of the CHEK digital building permit process.

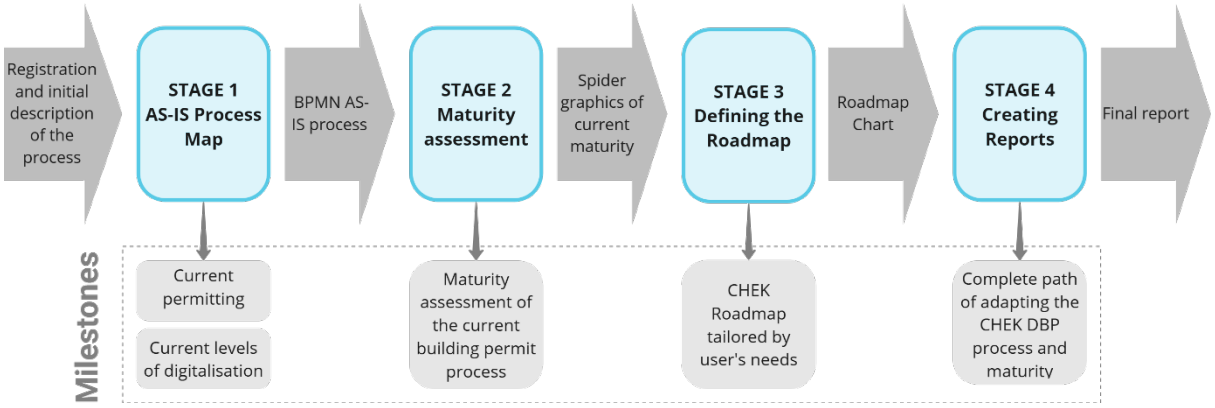

Figure 5 Schema of VA's workflow steps

5.2.1 **Stage 1:** Process mapping

5.2.1.1 From Process Maps to CHEK VA Process Glossary

The first milestone to be achieved on the CHEK VA was the completion of a comprehensive analysis of current permitting processes, identifying key procedural aspects and methods. To enable standardisation of the data and future processing, building permit process maps in BPMN format were utilized.

The as-is process maps of the partner municipalities, collected in Task 1.1[10], were broken down into discrete steps and synthesized into a unified Process Glossary. This glossary encompassed all the steps found across the various process maps of partner municipalities, enabling each element to be described in a standardised manner. Furthermore, each glossary term was classified to represent one specific activity in a BPMN process notation.

The CHEK VA Process Glossary (Figure 6) was imperative for training the Virtual Assistant's AI to accommodate diverse procedural inputs and map them onto normalized process flows. By "speaking the same language" across municipalities, the AI can make effective maturity evaluations and customization recommendations relying on a common activity lexicon.

	Task name	Task type	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
1	City regulatory information	Event	Regulatory information available at authority's office to collect in person.	Regulatory information available in pdf and can be sended via email.	Regulatory information available on the official webpage in pdf format and can be downloaded.	Regulatin information accessible online. 2D map available and the information associated to the zoning can be downloaded	3D city map accessible and the regulation information available to download in XML or JSON (city gml)	3D city map accessible and the rulesets can be imported from the plot directly to the design software
2	City planning information	Event	Regulatory information available at authority's office to collect in person.	City plans available in pdf and can be sended via email.	City plans available on the official webpage in pdf format and can be downloaded.	Regulatin information accessible online. 2D map available and the information associated to the zoning can be downloaded	3D city map accessible and available to download in XML or JSON (city gml)	3D city map accessible and available link directly to the design software

Figure 6 Glossary terms

The CHEK VA Process Glossary[11] contains various activities commonly executed during a building permit process. These were categorized by:

- Process phase in which they occur: Pre-Application, Application Submission, Sufficiency Review, Distribution and Coordination, Detailed Review and re-submission, Public Consultation, Final Review and Decision, Permit Issuance
- Actor responsible for carrying the activity: Applicant, Building Authority, Third Parties, Public
- Type of BPMN element they represent: Task, Event, Message, Gateway, Data
- The relation with the maturity KMAs and levels of the maturity model [12]

The creation of a CHEK VA Process Glossary with standardised language and terms was a crucial first step of the implementation of the CHEK VA, facilitating analysis of diverse as-is process maps and enabling future data processing and integration with the CHEK VA. The Process Glossary established a common dictionary to describe key elements across multiple building permit procedures.

The Process Glossary was used to then rebuild the as-is maps of the consortium municipalities, plus one other map that englobes all the glossary steps. These five BPMN process maps were fed to the AI to train it for the creation of customised process maps, depending on the different inputs of the users, but sticking to the glossary standardised format. The 5 process maps can be found in BPMN format in Annex III of this deliverable[13].

[10] Available at: CHEK_101058559_D1.1_CHEK-DBP-process-map (https://chekdbp.eu/wp-content/uploads/2023/04/D1.1_CHEK_101058559_CHEK-DBP-process-map_V1.0-Final.pdf)
[11] Terms from VA Process were added to the CHEK Glossary.
[12] Available at: CHEK_101058559_D1.2_Maturity-Model-and-Roadmap (https://chekdbp.eu/wp-content/uploads/2023/11/D1.2_CHEK_101058559_Maturity-Model-and-Roadmap_v1.0_Final.pdf)
[13] The process maps can be open using BPMN tools such as bpmn.io (https://bpmn.io/).

5.2.1.2 *Levelling activities on the CHEK VA Process Glossary*

After defining glossary for processes steps, the subsequent phase involved establishing a grading scale to enhance the data collection process for an accurate assessment the building permit process. Each process step was assigned a grading system ranging from 0 to 5. In this scale, 0 denoted a fully analogue approach, while 5 indicated a completely automated and digitized method. For instance, the activity "Initial Design Drafting" could be rated as Grade 0 with 2D printed drawings, Grade 1 using CAD software, Grade 2 with a BIM model in authoring software, Grade 3 incorporating BIM model templates from building authorities, Grade 4 involving the use of IFC model, and Grade 5 utilizing a live-updated IFC model on a cloud-based platform. The grading of these steps within the CHEK VA Process Glossary followed an evolution of technologies and methods that are pointing to the evolution of the levels in the CHEK MM, facilitating the relation to be crossed from the process actions to the maturity model.

A detailed description for each grade was provided for all activities listed in the CHEK VA Process Glossary, outlining the methods by which each activity could be executed in the building permit process. The grading system is visually represented in the Virtual Assistant through a colour scheme applied to each BPMN element. This comprehensive grading system enables a thorough analysis of the as-is process map, integrating the level of digitalisation.

5.2.2 **Stage 2:** Maturity Model Assessment

The second milestone within the CHEK VA entails the assessment of the CHEK DBP Maturity Model, utilizing the data acquired from the initial module; that resulted on the as-is process map, formulated in BPMN format, and generated from the Process Glossary. The map encapsulates each building permit process step along with corresponding scores, portraying the current levels of digitalisation within the municipality's workflow. The activities and scores assigned to each step offer a nuanced view of the municipality's existing state in terms of the building permit process. This information, which encompasses the current levels of digitalisation, serves as input for the AI-driven analysis of the municipality's existing state.

The CHEK DBP Maturity Model was structured as a comprehensive database, encompassing the 35 KMAs, classified into the 4 categories (Process, Organisation, Technology, and Data). For each KMA, a brief yet comprehensive description outlines the aspects being measured, accompanied by the 6 distinctive levels of maturity.

This structured list of 35 KMAs, along with their respective levels, serves as a reference for comparing the municipality's status derived from the BPMN maps. This comparative analysis enables the AI to assign scores to each KMA, subsequently utilized to generate spider graphics for the 4 individual Maturity Model categories. These graphics visually represent the municipality's standing across different KMAs, offering a nuanced and insightful depiction of its digital maturity in the context of the CHEK framework.

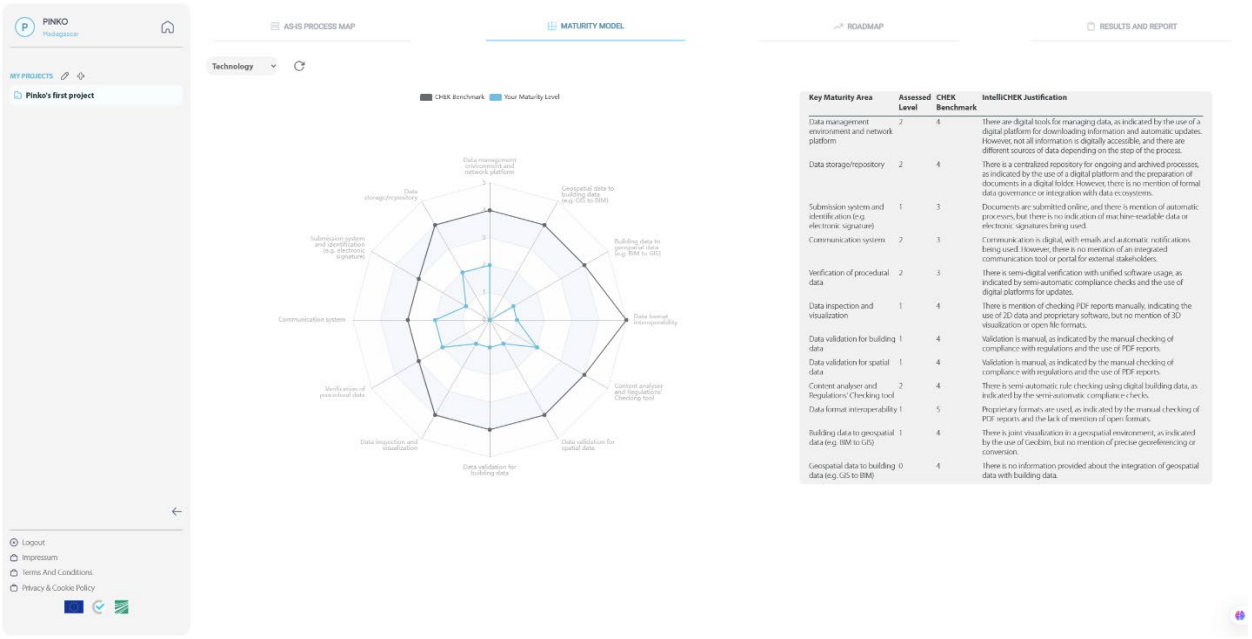

Figure 7 Radar graphs of MM assessment

5.2.3 **Stage 3:** Generation of the roadmap

Once the assessment of the MM was completed, with the corresponding desired maturity defined by CHEK benchmarks. It is possible to define a roadmap that enables the achievement of this goals. Therefore, stage 3 of the CHEK VA is crafted to formulate the roadmap for the digital transformation of the building permit process within the municipality. The implementation of this module commences with defining the current maturity level, determining the desired level of maturity, and outlining the necessary actions to transition from the current state to the desired level.

The actions were predefined as a result of Deliverable D1.2. The final roadmap is presented in the form of a Gantt where the actions are listed with an estimated recommended time needed to complete each action. The list of actions is fixed by the levels of maturity a municipality needs to achieve in order to get to the final desirable level of maturity. The resources and time are variable and will change according to the inputs given by the CHEK VA user.

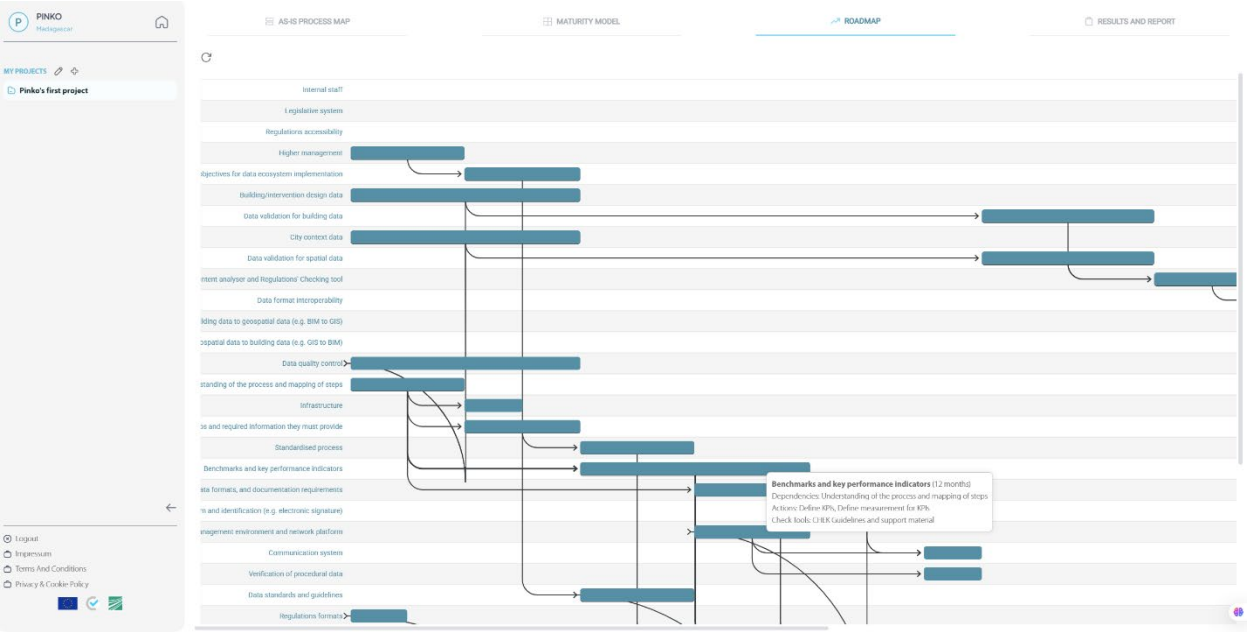

Figure 8 Roadmap output

5.2.4 **Stage 4:** Exporting the results

At the final stage of the CHEK VA workflow, a comprehensive report is automatically generated, providing municipalities with a structured summary of their maturity assessment and roadmap. This report serves as a formal document that municipalities can use for decision-making, planning, and stakeholder communication.

The report includes a detailed breakdown of the building permit process, assessment results, and a roadmap for digital transformation. The key sections are:

1. Introduction
   - Overview of the building permit process and its key stakeholders.
   - Explanation of the purpose of the report and its relevance to the municipality's digital transformation.

2. Process Description
   - A step-by-step breakdown of the current building permit process involving the Applicant, Building Authority, Public, and Third Parties.
   - Responsibilities of each stakeholder at different stages of the process.
   - Analysis of workflows, including data collection, application submission, compliance checks, public notifications, and final approval.

3. Maturity Model Assessment
   - Detailed assessment of the municipality's maturity levels across four key areas: Process, Organization, Technology, and Data.
   - Explanation of strengths and areas for improvement based on the assessment results.
   - List of actions recommended for improving maturity in each category.

4. Target Maturity Level & Roadmap
   - Description of the desired digital transformation goals for the municipality.
   - A list of required improvements to reach the target maturity level, structured into actionable steps.
   - The roadmap and action plan, outlining key milestones, timeframes, and necessary resources.

5. Conclusion & Next Steps
   - Summary of key findings from the assessment.
   - Recommendations on how municipalities can proceed with implementation.
   - Guidance on monitoring progress and ensuring effective adoption of digital permitting solutions.

6 Export Formats

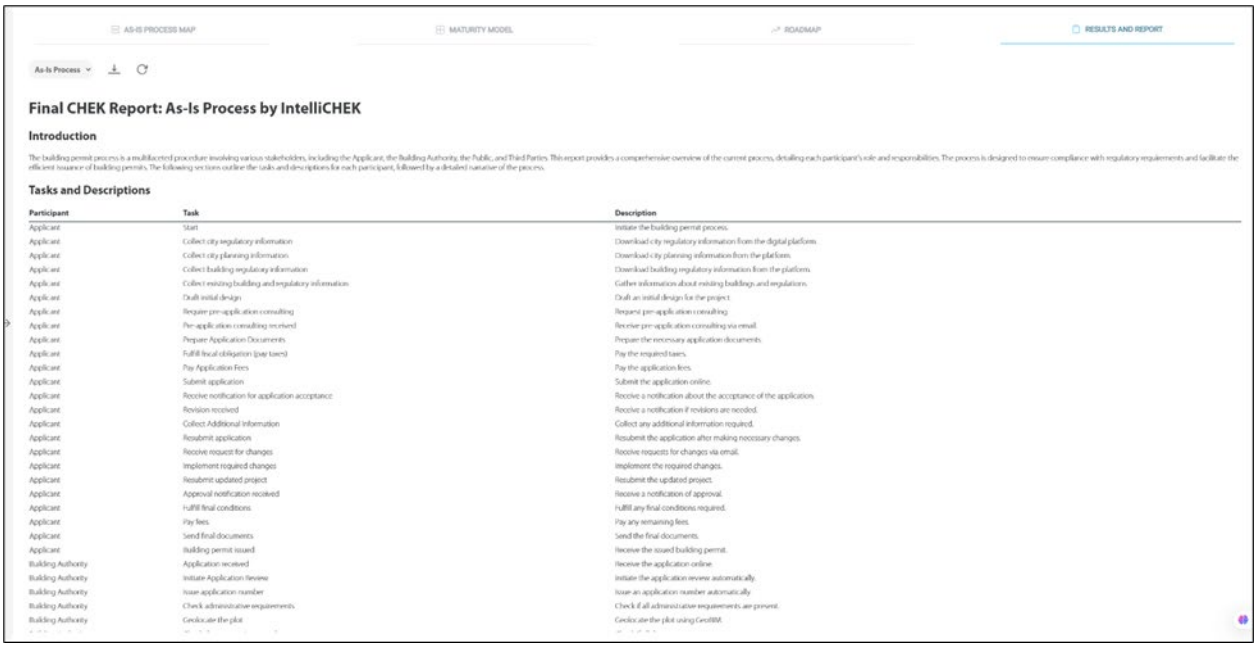

Figure 9 Final report view

The report is automatically generated in pdf format to ensure ease of access and distribution. Once generated, the report is final and cannot be customized by the user. It serves as an official output of the CHEK Virtual Assistant, ensuring standardisation and consistency across different assessments. By providing a structured, actionable, and well-documented assessment, the CHEK VA enables municipalities to make informed decisions and effectively plan their digital transformation journey.[14]

[14] The detailed test results are documented in Deliverable 1.5, along with the original output files, which are included as attachments.

6 Tool implementation and deployment

Chapter summary

This chapter introduces the CHEK Virtual Assistant, a smart tool designed to improve user interaction and efficiency. It uses advanced technology for smooth communication, secure data handling, and automated tasks. With a user-friendly interface, it helps users access information, generate reports, and visualize data easily.

6.1 Integration of Advanced Technologies in CHEK VA Development

The incorporation of sophisticated technologies and innovative methods has led to the development of a highly advanced virtual assistant. This tool is specifically designed to address evolving technical, regulatory, and data security requirements within the European Union (EU). Given the strict EU regulations on data privacy—such as the requirement for cookie consent and restrictions on personal data collection—this web application is built to ensure compliance. It does not collect personal data, store passwords, or process user information in a way that would compromise privacy. From a legal standpoint, the application aligns with European laws but is not intended for market distribution. Instead, it remains a safe tool for internal use without causing harm.

The system's architecture includes a FastAPI backend, PostgreSQL database, and the IntelliCHEK library, along with the integration of advanced language models such as ChatGPT-4 and Langchain. The application interacts with OpenAI's API, and as per OpenAI's agreement, all API calls are protected and not used for any model training or learning processes. Additionally, OpenAI has stated that user data is not retained for training purposes, ensuring that no personal information is stored or processed beyond the scope of each request. This reinforces the application's strong commitment to privacy, security, and compliance with EU regulations.

This section describes its complex architecture and features, emphasizing crucial elements like the FastAPI backend, PostgreSQL database, IntelliCHEK library, and the use of progressive language models including ChatGPT-4 and Langchain.

Backend Architecture:

1. **Containerization with Docker:**
   We have adopted a containerized approach using Docker[15] to enhance efficiency and scalability. This approach involves compartmentalizing the FastAPI backend into separate containers, creating a modular structure that simplifies management and boosts system performance. The containers communicate via a shared network, facilitating seamless operations.
2. **PostgreSQL Database Infrastructure:**
   Our PostgreSQL database[16] is pivotal in managing data. It is optimized to store and process crucial information effectively. The database schema is designed to support the FastAPI backend, ensuring rapid performance and response times.
3. **FastAPI Backend Implementation:**
   The virtual assistant leverages the robust capabilities of the FastAPI backend (https://fastapi.tiangolo.com/). This backend is the foundation of user interaction, with thoroughly documented API endpoints using Swagger

[15] Available at: https://www.docker.com/.
[16] Available at: https://www.postgresql.org/

(https://swagger.io/). This documentation is a key resource for developers and users, detailing functionalities, request-response patterns, and essential parameters. The backend is further strengthened with advanced middleware and authentication mechanisms.

4. **Security and Data Protection:**
   Security protocols guard communication between Docker containers. Access to external APIs, including OpenAI, is controlled via API keys. Our PostgreSQL database employs encryption and strict access controls for data security, safeguarding against potential threats.

The IntelliCHEK Library:

The IntelliCHEK library, an in-house development, is integral to the project. It enhances the virtual assistant's AI-driven processes and intelligent checks. The library introduces tailored functionalities to meet our operational needs, including:

1. **Integration of Large Language Models (LLMs):**
   Combining ChatGPT-4[17] and LangChain[18] provides a powerful language processing foundation. ChatGPT-4 is used for various tasks, from understanding natural language to generating human-like responses. LangChain is pivotal in managing language data processing, enhancing interaction efficiency with language models.
2. **Utilizing Large Language Models:**
   LLMs are extensively used for diverse applications. These range from direct communications with OpenAI using API keys to employing Retrieval-Augmented Generation (RAG) systems that utilize local data for advanced language processing. This versatile approach allows adaptation to various scenarios and optimizes resource usage.
3. **RAG Systems:**
   Retrieval-Augmented Generation (RAG) systems represent a significant enhancement in language model operations. These systems use locally stored data to improve language understanding and response generation. By integrating our PostgreSQL database with advanced language models, we have created a context-aware virtual assistant capable of addressing a broad spectrum of user queries and commands[19].

6.2 Development of graphical web user interface (front-end)

The design of the graphical mock-up for web User Interface (UI) was done with Figma[20], which is a commercial software for the creation of UI designs and mock-ups. Leveraging the designs created in Figma the actual implementation of the graphical web UI was realized with the free and open source JavaScript framework Vue.js (Evan You, 2014). The free and open source build tool Vite (Evan You and Vite Contributors, 2019) was used for the deployment. The tool is open to register by any user. During the registration, new users need to accept the terms and condition of the tool, so they are aware that the data they input will be used for research purposes.

[17] gpt-4-1106-preview Available at: https://chat.openai.com/
[18] Available at: https://python.langchain.com/docs/get_started/introduction
[19] Available https://arxiv.org/abs/2005.11401, accessed on 16.01.2024.
[20] Available at: Figma: The Collaborative Interface Design Tool (https://www.figma.com/)

The web UI[21] consists of the following components:

- User login and registration
- Welcome page where logged users can create new projects
- Sidebar for the navigation of the tool
- Project page

The project page component is the main part of the web UI and the component that the user is expected to spend most time on. A project page consists of the following subcomponents:

- AI-Chat
- Process map editor, realized with BPMN-js (bpmn.io, 2023)
- Radar chart viewer for visualization of maturity assessment results (Li et al., 2018)
- Gantt chart viewer for visualization of road map results (implemented based on Google Charts)
- Final report section where the user can view the automatically created report

The functionalities of the above-listed components heavily rely on the communication with the back end. Every input and query the user does through the web UI is sent to the backend as a request via API-calls. These requests are processed in the backend and the required information is sent back to the web UI. The user request can furthermore trigger execution of task like the automatic maturity assessment or the automatic report creation in the backend.

6.3 Validation and implementation of CHEK VA

The implementation and validation of the CHEK VA followed a structured and iterative process to ensure functionality, usability, and accuracy. Each component underwent systematic validation through internal assessments and pilot evaluations with the internal development team. This section describes the implementation of key components, including process maps, glossary, maturity assessment, roadmap, and overall system integration. The figures on this section represent only the interface of the tool, not having any relevant data or information. Detail data of testing and results made by real users is shared on deliverable D1.5.

[21] Available at: CHEK Virtual-Assistant (https://chek.fraunhofer.app/login)

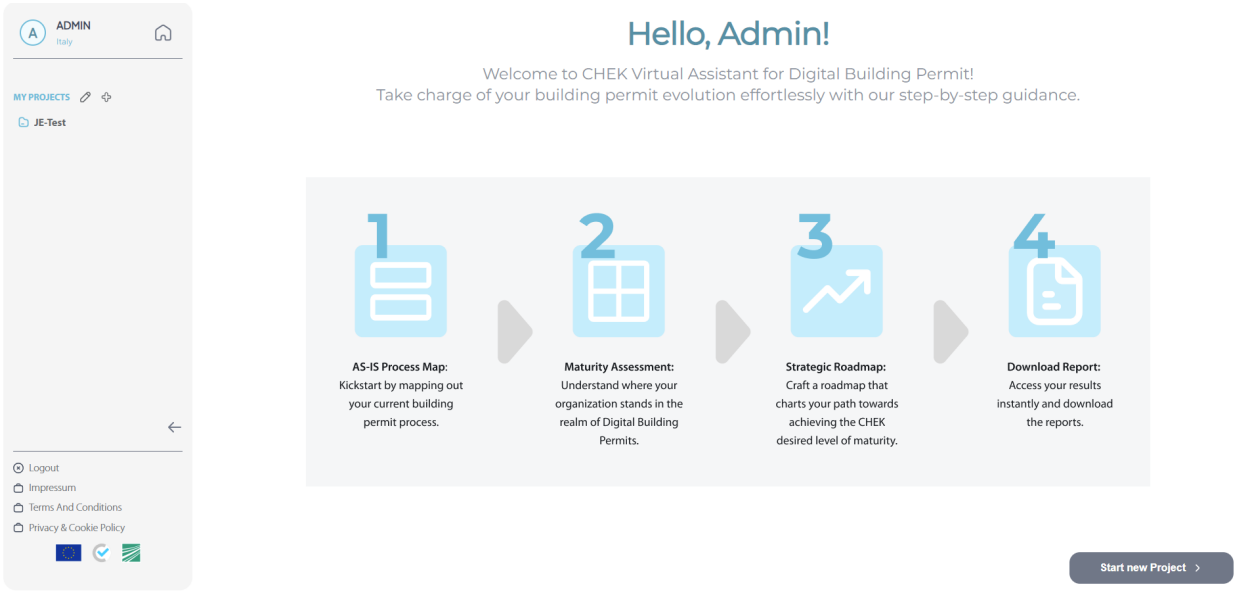

Figure 10 User's homepage

6.3.1 Process Map Implementation

The process map component is drawing tool, where the users can manipulate and draw their as-is building permit process. The implementation of the process mapping component began by gathering as-is workflows from consortium municipalities and standardising them using BPMN notation. The process maps were developed to reflect real-world municipal permitting procedures while maintaining a format adaptable for digitalisation.

Once the process maps were structured, a general template was assembled and integrated into the Virtual Assistant. This initial template process map is a generic representation of a digital building permit, not representing any real process. The template process map serves as a guide to users so they can modify the actions according to their own process. The users should manipulate the process map using the BPMN tool integrated with the VA by adding, deleting or modifying actions and events whiting the map.

The users manually do their process while the AI reads the content of the actions that are being created or modified. The AI was trained to analyse each action, assigning digitalisation levels to each process step. Internal validation ensured the accuracy of the AI-driven assistance in heling the users to name their actions and evaluating the digitalisation of each action; while pilot testing with municipalities validated its applicability, results of this testing is shared on D1.5.

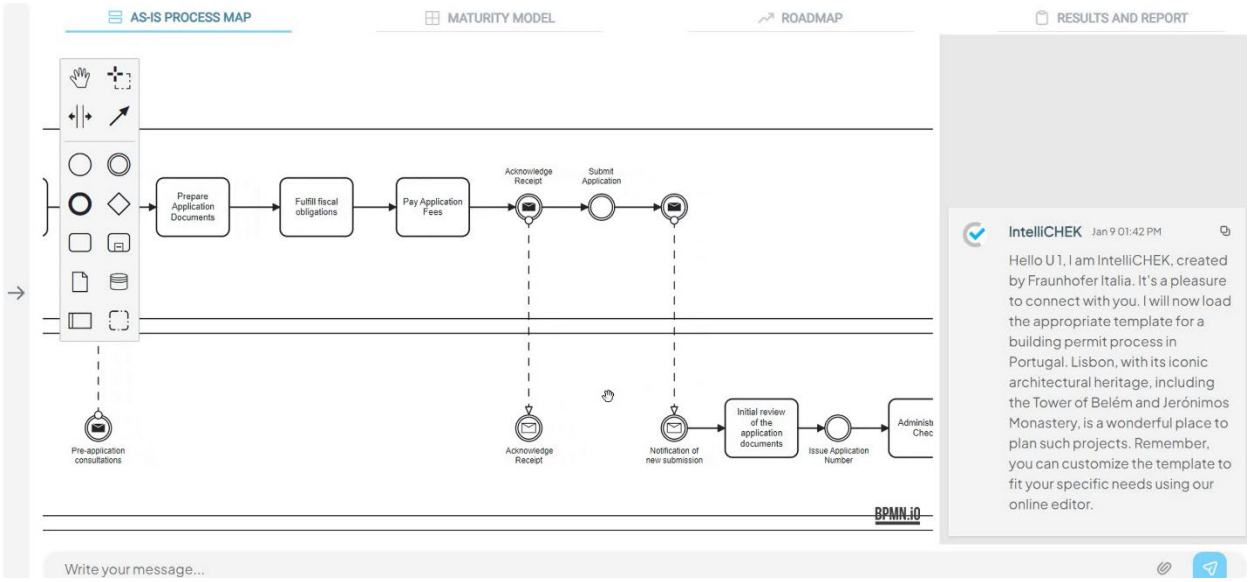

Figure 11 BPMN Process map

The CHEK VA Process Glossary played a crucial role in standardising terminology across municipal workflows. Its development involved collecting and synthesising process-related terms from the as-is maps of the 4 municipalities and categorising them according to process phases, actors, BPMN elements, and digitalisation levels. This ensured that all activities within the process maps were consistently defined and named.

During integration, the CHEK VA Process Glossary was embedded into the Virtual Assistant's database, serving as a reference for process map generation and to facilitate the AI-driven maturity assessments. This allowed the system to automatically classify user inputs according to predefined terms, ensuring consistency across different municipalities. Internal testing confirmed that the AI correctly applied glossary terms during process analysis, while municipal testing validated that the standardised vocabulary improved process accuracy. The results demonstrated that the glossary effectively reduced ambiguity in process mapping actions and enabled the Virtual Assistant to function across diverse municipal workflows without inconsistencies.

6.3.2 Maturity Assessment Implementation

The implementation of the maturity assessment module focused on evaluating municipalities' levels of digitalisation and providing targeted recommendations for improvement. The CHEK Maturity Model is structured around 35 KMAs, divided into four categories: Process, Organization, Technology, and Data. Each KMA having six levels of maturity, ranging from fully analogue to fully automated digital processes (Level 0 to Level5).

The CHEK VA system was designed to analyse user-provided process maps and assign maturity scores based on the predefined KMAs. AI-driven logic compared municipal workflows against the CHEK MM criteria, identifying gaps and areas for improvement. Internal testing ensured that the CHEK VA's assessment correctly classified digital maturity levels. The internal validation confirmed that the maturity assessment by the AI provided structured and actionable insights, which can help municipalities to identify their current digital capabilities and necessary steps for improvement.

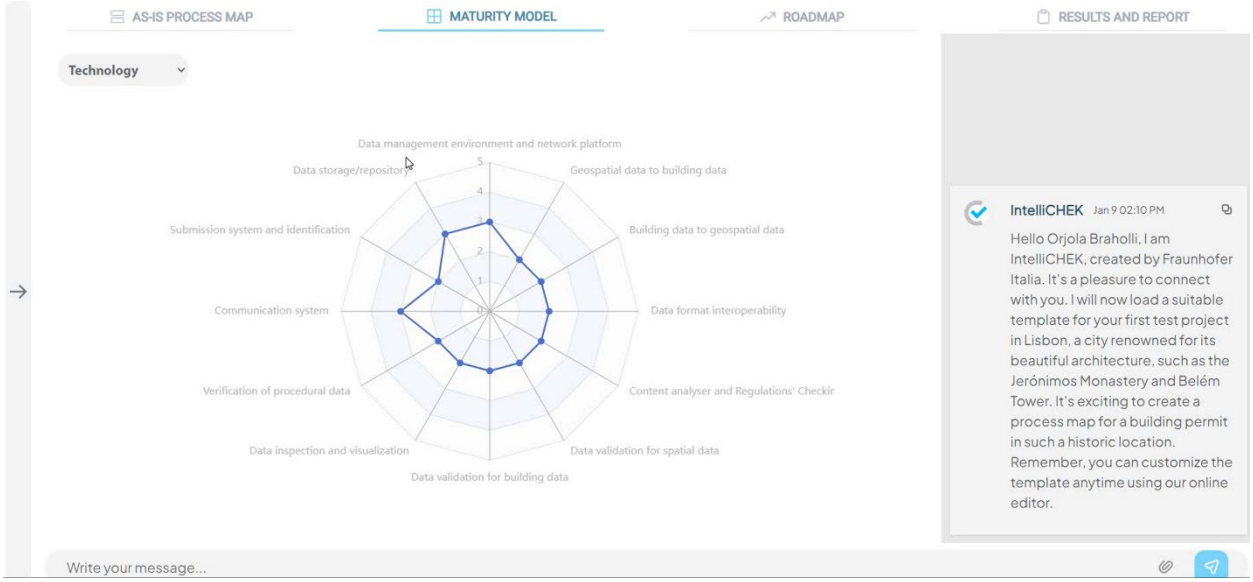

Figure 12 Result of MM assessment

6.3.3 Roadmap Implementation

The roadmap module was developed to support municipalities in transitioning to higher maturity levels through structured guidance. The first stage of implementation involved defining a framework that linked the results of the maturity assessment to a set of predefined improvement actions. The Virtual Assistant uses the AI to compare the current and target maturity levels (defined by CHEK benchmarks) and generate a roadmap outlining the necessary steps for digital transformation[22].

This roadmap included a list of actions (that is defined by the available CHEK tools for each topic), structured into a Gantt graphic that can guided municipalities through the transformation process. Validation focused on ensuring that the AI accurately translated maturity gaps into the defined CHEK Roadmap steps. The Gantt graphic represents the dependencies between the actions, meaning that one action must be completed to allow the beginning of the others. A time dimension is not specified, since this can vary from one municipality to other, depending on their economic and cultural background. The VA does not offer an option to adjust time or resources, because is understood that the AI is not yet able to do that kind of analysis. The CHEK Roadmap in the CHEK VA is a list of actions based on CHEK toolkit that can help municipalities when they set their own digital transformation, by giving initial guidance of what tools could be implemented.

6.3.4 System Integration

The final stage of implementation focused on integrating all components into a fully functional virtual assistant. The backend of the system was developed using FastAPI, supported by a PostgreSQL database to store process data, maturity assessments, and roadmap (see Section 6.1). The system architecture was designed to be scalable, using Docker containerization to enable smooth deployment and maintenance.

[22] The CHEK benchmarks and list of actions were defined on Deliverable D1.2 with the review of other consortium members. The full Roadmap is available on Annex I.

Natural Language Processing (NLP) capabilities were integrated through ChatGPT-4 and LangChain, allowing the VA to process user queries and generate intelligent recommendations. Retrieval-Augmented Generation (RAG) techniques were applied to improve AI accuracy by referencing structured municipal data during interactions. On the front-end, Vue.js was used to create an interactive user interface, integrating BPMN-js for process visualization and Gantt charts for roadmap display.

The integration process underwent multiple phases of testing. Unit testing validated the individual functionalities of process mapping, glossary application, maturity assessment, and roadmap generation. Integration testing ensured smooth communication between these components, while end-to-end testing confirmed that the functioned as a cohesive system.

The internal validation and implementation of the CHEK VA followed a structured methodology to ensure reliability, accuracy, and usability. Each module — process mapping, glossary standardisation, maturity assessment, and roadmap generation — was systematically validated to ensure that the tool could be effectively used by users. The fully validated and integrated system is deployed and publicly available, offering municipalities a practical and data-driven approach to achieving higher levels of digital maturity. The final tests of the CHEK VA with real users were made in a methodological and structured way, considering usability of the tool and content generated by the AI. These tests are part of Task 1.4 and available, with all the results, on deliverable D1.5.

6.3.5 Training materials and platform integration

Training materials and user support

Recognizing that the CHEK VA requires user guidance for effective adoption, comprehensive training materials have been developed and made publicly available:

- **User manual**: A detailed user manual is available in the CHEK Wiki[23], providing step-by-step instructions for each stage of the CHEK VA's workflow, explanations of key concepts and useful glossary terms[24].
- **Demonstration videos**: Video tutorials demonstrating the CHEK VA's functionality are available on the CHEK YouTube channel[25], including walkthrough examples of process mapping, maturity assessment interpretation, and roadmap generation.
- **Open-source access**: The complete CHEK VA codebase, supporting data, and documentation are openly available in the FHI's GitHub repository and published as dataset in Zenodo[26], enabling users and developers to access all technical resources and contribute improvements.

Platform Integration Considerations

The CHEK Virtual Assistant operates as a standalone web application separate from the main CHEK DBP platform. This architectural decision was made because the CHEK VA serves as a pre-DBP assessment tool, it helps municipalities understand their current state and plan their digital transformation journey before they implement the actual digital building permit process supported by the CHEK DBP platform.

[23] CHEK VA user's guide: CHEK Virtual Assistant tutorial | CHEK DBP Wiki
[24] CHEK process glossary: CHEK Process glossary | CHEK DBP Wiki
[25] CHEK VA demonstration video: CHEK – Change management virtual assistant tool
[26] CHEK VA open source: https://doi.org/10.5281/zenodo.17236331

The CHEK VA's function is fundamentally different from the CHEK DBP platform's role:

- The CHEK DBP platform provides the infrastructure and tools for operating a digital building permit process, including BIM model validation, automated compliance checking, and workflow management.
- The CHEK Virtual Assistant helps municipalities assess their readiness and plan their path toward implementing such a system.

This separation ensures that municipalities can use the CHEK VA for strategic planning and maturity assessment without requiring access to or knowledge of the full CHEK DBP platform. Once municipalities complete their assessment and develop their roadmap using the CHEK VA, they can then proceed to implement the actual digital permitting tools recommended in their roadmap, including the CHEK platform where appropriate.

Despite being architecturally separate, the VA is referenced in the CHEK informative booklet (D7.5) and is disseminated alongside other CHEK tools as part of the comprehensive CHEK toolkit. This ensures that municipalities are aware of the CHEK VA's role in their digital transformation journey while understanding that it serves a distinct, preparatory function compared to the operational tools provided by the main CHEK DBP platform.

6.3.6 Municipal testing

The CHEK VA underwent testing with consortium municipalities as part of Task 1.4, with detailed results documented in Deliverable D1.5. This testing phase included representatives from the partner municipalities (Prague, Ascoli Piceno, Vila Nova de Gaia and Lisbon), who evaluated both the tool's usability and the quality of outputs generated. The testing revealed valuable insights regarding the process and maturity results, the clarity of chatbot guidance and the practical applicability of generated roadmaps, which informed the identification of areas requiring further development discussed in Section 7.

7 Discussion and prospects

The CHEK VA has been successfully developed as a structured tool for municipalities to map their permitting processes, assess their digital maturity, and generate a transformation roadmap. However, it is important to distinguish between the tool's development and its full demonstration. While the CHEK VA's core functionality has been implemented and internally validated, the testing phase revealed that the tool's complexity requires user support and guidance for effective adoption. The AI-driven features, including the chatbot-assisted process mapping and automated assessment, show promising capabilities, but require further testing to validate their robustness across diverse municipal contexts.

Testing conducted as part of Task 1.4 (detailed in D1.5) indicated that users found certain aspects challenging, particularly the BPMN process mapping interface and understanding how to structure their workflows according to the CHEK VA Process Glossary. While the chatbot provides guidance, user feedback suggested that additional training materials, interactive tutorials, and potentially human support during initial use would significantly improve the user experience. These findings demonstrate that while the tool has been developed and its fundamental approach validated, achieving Objective 1 of WP1 should be understood as the creation of a functional prototype that requires further refinement rather than a fully demonstrated, production-ready solution.

7.1.1 Discussion

One of the key achievements of the CHEK VA is its ability to support municipalities in understanding and structuring their own permitting workflows. The process mapping component is a human-driven task, where users manually construct their municipal workflows with the assistance of the chatbot, which provides explanations, relevant terminology, and guidance based on the agreed CHEK glossary. This ensures that municipalities maintain a consistent methodology while still maintaining flexibility in representing their specific workflows.

Once the process mapping is completed, the AI automatically extracts information from the mapped process, combining it with user-provided answers to conduct a comprehensive digital maturity assessment. The AI-driven analysis evaluates how digitalized each process step is, categorizing the municipality's digital maturity based on the CHEK maturity benchmarks. This automation eliminates the need for manual evaluations, ensuring objective, data-driven insights into the municipality's current capabilities.

Another significant feature is the automatic roadmap generation, which provides clear, structured recommendations for municipalities to achieve their target digital maturity level. The roadmap is based entirely on CHEK's predefined benchmarks, ensuring that the recommendations align with the project's strategic objectives and best practices for digital permitting.

During testing, one of the main challenges observed was the variability in municipal workflows. While the CHEK VA provides a standardized structure for process mapping, the differences in local regulations, administrative procedures, and existing digital infrastructures mean that municipalities interpret and construct their process maps in different ways. This variability, while allowing flexibility, can impact the accuracy of maturity assessments if the process maps are not structured correctly. Additional user training or enhanced chatbot guidance could help ensure that process maps are consistently formatted, improving the reliability of AI-driven assessments.

Another challenge identified was user adoption and engagement. While the chatbot-assisted process mapping aims to make the workflow intuitive and user-friendly for most of the users. Providing clearer onboarding materials, interactive

tutorials, and real-time chatbot explanations could further facilitate the user experience and reduce the learning curve for municipal staff[27].

Unlike other digital tools that focus on automating the permitting process itself or integrating with external systems, the CHEK VA was intentionally designed as a self-contained assessment tool. It does not integrate with other municipal software, permitting platforms, or external APIs, ensuring broad applicability across different administrative environments without requiring technical adaptations. This approach makes the CHEK VA accessible to municipalities regardless of their existing digital infrastructure but also means that its primary function remains strategic assessment and planning, rather than real-time process automation.

It also important to mention that while AI-driven virtual assistants provide significant benefits in guiding users through structured workflows, they are not entirely free from the phenomenon of "hallucination"—where an AI generates incorrect or misleading information. Although hallucinations cannot be entirely prevented, the CHEK VA is designed to minimize their occurrence by ensuring that the AI always operates within a well-defined context. The system provides the AI with structured, relevant information at each step, avoiding reliance on fragmented short-term memory chains that could lead to inconsistencies. Additionally, the CHEK VA follows a controlled workflow with predefined inputs and outputs, reducing the chances of unverified or misleading responses. However, as with human decision-making, absolute accuracy cannot be guaranteed. Recognizing this, the system incorporates mechanisms to verify critical outputs and ensures that users remain aware of the potential limitations of AI-generated responses.

7.1.2 Limitations and Requirements for Further Testing

The development and preliminary testing of the CHEK VA have identified several areas requiring further investigation before the tool can be considered fully demonstrated:

User independence and support Requirements: Current testing indicates that users cannot operate the CHEK VA intuitively and without guidance. The complexity of BPMN process mapping, combined with the need to understand the CHEK VA Process Glossary and maturity model concepts, creates a learning curve that necessitates support materials or assisted onboarding. Future work should focus on developing comprehensive training resources, including video tutorials, step-by-step guides, and potentially live support during initial adoption phases.

Chatbot reliability and response quality: While the AI-powered chatbot provides contextual guidance, further testing is needed to ensure it consistently delivers accurate, helpful responses across the full range of user queries and municipal contexts. The current implementation minimizes AI hallucinations through structured prompts and controlled workflows, but edge cases and unexpected user inputs require additional validation. A more extensive testing phase with diverse municipal users would help identify scenarios where chatbot responses need refinement.

Roadmap clarity and customization: Feedback from testing highlighted concerns about the roadmap's practicality, particularly regarding task duration estimates. The current implementation provides a dependency-based action sequence without customizable timeframes or resource allocations, as the AI is not yet capable of accurately estimating these variables based on municipal-specific constraints. Users noted that the roadmap would be more actionable if it could be tailored to reflect their specific resources, budget constraints, and organizational capacity. Future versions could explore methods for incorporating user-provided parameters to generate more realistic, customized implementation timelines.

[27] A video demonstrating the VA in use is provided on: CHEK VA - Demonstration video.mp4 (https://chekdbp.eu/wp-content/uploads/2025/03/CHEK-VA-Demonstration-video.mp4).

Scalability across municipal contexts: While the CHEK VA was designed to be scalable across different municipal sizes and regulatory frameworks, testing has been limited to a small number of consortium municipalities. Broader testing with municipalities of varying digital maturity levels, administrative structures, and regulatory environments is necessary to validate the tool's adaptability and identify context-specific challenges that may require additional customization options.

Integration with municipal workflows: The CHEK VA operates as a standalone assessment tool, which ensures broad applicability but also means it does not integrate with existing municipal software systems. Testing revealed that users would benefit from clearer guidance on how to incorporate CHEK VA outputs into their existing planning and decision-making processes. Future development could explore options for data export in formats compatible with common municipal planning tools or provide templates for translating VA recommendations into internal strategic documents.

These limitations do not diminish the value of the CHEK VA as a prototype and proof-of-concept. Rather, they represent natural stages in the development of complex AI-powered tools and provide clear directions for future refinement. The tool successfully demonstrates the feasibility of using AI to support municipal digital transformation assessment, while also highlighting the importance of iterative development and extensive user testing in achieving production-ready solutions.

7.1.3 Prospects

One of the most critical future prospects is the scalability of the CHEK Virtual Assistant. Ensuring that the tool can be easily adopted by municipalities of different sizes, regulatory frameworks, and digital readiness levels will be essential for its long-term success. Further development could focus on making the CHEK VA more adaptable to diverse municipal structures, allowing flexibility in maturity assessment criteria while maintaining standardised methodology.

Usability optimization, based on users' feedback, must also be a key focus in future iterations. Enhancing the intuitiveness of the chatbot's guidance, improving interface design, and providing interactive explanations could help make the process mapping and assessment stages more seamless and accessible. Future updates may introduce real-time feedback mechanisms that help users correct errors or refine their process maps before proceeding to the maturity assessment stage.

Another important prospect is exploring the adaptability of the CHEK VA beyond building permits. The methodology used, structured process mapping, AI-powered assessment, and automated roadmap generation, could potentially be applied to other municipal workflows that require digital transformation planning. Examples could include environmental permit processing, urban planning approvals, public service optimization, or other regulatory procedures. However, adapting the CHEK VA for other use cases would require further testing, validation, and customization to ensure that the assessment model accurately reflects different process structures and maturity benchmarks.

While external system integration was not a priority in this version of the CHEK VA, future improvements could explore options for data export and compatibility with existing municipal planning tools. Even without direct API integration, allowing municipalities to export structured reports in various formats (e.g., CSV, JSON, or interactive dashboards) could enhance practical usability for long-term digital strategy planning.

8 Conclusion

The development of the CHEK VA represents a significant step forward in creating tools for the digital transformation of municipal permitting processes. By leveraging AI-driven process mapping, automated maturity assessments, and personalized digital roadmaps, the tool provides municipalities with a structured approach to understanding their current capabilities and planning improvements. However, it is important to emphasize that while the CHEK VA has been successfully developed and its core functionality validated, it has not yet been fully demonstrated as a production-ready, independently usable solution. The complexity of the system, combined with feedback from preliminary testing (detailed in D1.5), indicates that further testing, refinement, and user support mechanisms are necessary before the tool can achieve widespread, independent adoption by municipalities.

One of the key achievements of the project is the integration of structured process data with AI-powered assessments, allowing municipalities to transition from manual, fragmented workflows to standardised and optimized digital processes. The CHEK VA's process mapping module ensures that municipalities can visualize their current as-is permitting workflows, while the maturity assessment framework provides a clear understanding of their digital capabilities across process, organization, technology, and data categories. The roadmap generation feature translates these insights into a practical implementation plan, outlining specific actions required to achieve higher levels of digital maturity.

The system integration phase successfully combined natural language processing, automated data processing, and interactive UI components, ensuring that the CHEK VA is both intuitive and effective for municipal users. The testing and validation process, conducted in collaboration with municipal stakeholders, confirmed that the CHEK VA aligns with real-world permitting challenges and provides meaningful, context-specific recommendations.

The findings from the development and testing phases highlight the importance of structured digitalisation strategies in improving municipal services. The project demonstrated that municipalities, regardless of their current level of digital readiness, can benefit from standardised process models, AI-driven insights, and structured transformation roadmaps. Furthermore, the integration of automated assessments and intelligent recommendations reduces the administrative burden on municipalities while enhancing decision-making and long-term planning.

Looking ahead, the CHEK VA provides a foundation for future advancements in digital permitting and e-governance. Potential enhancements could include expanded AI capabilities, refinements based on feedback collected from municipalities, and further testing with more municipal users. Aiming at providing, in the future, a more accurate assessment of time and resources required for each proposed action, ultimately supporting broader adoption across municipalities operating in different regulatory environments. Additionally, as technological advancements in AI, automation, and smart governance continue to evolve, the CHEK VA can serve as a scalable model for other areas of public administration, supporting governments in their ongoing efforts toward digital transformation.

In conclusion, the CHEK VA has demonstrated its value as an AI-powered tool for improving municipal permitting processes, offering a structured, data-driven approach to enhancing efficiency, transparency, and digital governance. Its successful implementation highlights the potential of AI and digital maturity models in transforming municipal services, setting a precedent for the broader adoption of intelligent automation in public administration.

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9.1 List of Figures

Annex I The CHEK Roadmap

CHEK Roadmap

Period Highlight: 1 | Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

KMA	ACTION #	DEPENDS ON			ACTIVITY	CHEK TOOLS	AVAILABLE MATERIAL	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
1.1.1	1				Implement platform for tracking processes, connect all internal systems to the platform and allow time tracking.	BIM Server Center		1	1	0	0	0%
1.1.2	2	1			Create a detailed process map with steps of the process, using the CHEK VA. Make the process map public available.	CHEK Virtual Assistant		2	1	0	0	0%
1.2.3	3	1			Define KPIs to be achieved.	CHEK Guidelines and support material		2	1	0	0	0%
1.2.3	4	3			Set up measurements of KPI's on the management platform	CHEK Guidelines and support material		3	1	0	0	0%
1.2.4	5	2			Create guidelines for each step of the process (use CHEK guidelines as references). Make guidelines available for internal and external stakeholders. Control the privacy of external guidelines.	CHEK Guidelines and support material		3	1	0	0	0%
1.2.5	6	1			Implement the use of BIMserver.centre to manage project models.	CHEK Guidelines and support material		2	1	0	0	0%
1.2.5	7	6			Use APIs to connect BIMserver.centre to municipality's platform.	CHEK Guidelines and support material		3	1	0	0	0%
1.2.5	8	6			Require IFC and GIS as data exchange files on the process. Follow CHEK guidelines for data structure and implementation.	CHEK Guidelines and support material		3	1	0	0	0%
1.3.6	9	11			Communicate timelines for all steps of the process. Start monitoring and reporting the timelines of the processes managed on the platform.	CHEK Guidelines and support material		6	1	0	0	0%
1.3.7	10	4	5	8	Implement data sharing on BIMserver.centre. Include stakeholders and manage their permissions inside the platform.	BIM Server Center		4	1	0	0	0%
1.3.8	11	10			Connect BIMserver.centre to stakeholder's platforms with the APIs	BIM Server Center		5	1	0	0	0%
2.4.9	12				Make online basic trainings available for staff members. The training should cover what is data technology, what are the advantages and how to implement. Require minimum participation of 50% of staff.	CHEK training package		1	1	0	0	0%
2.4.10	13	2			Create strategic plan for implementing the digital process. Use CHEK tools to support the decision making. Use the CHEK VA to create an initial roadmap and the adjust according to available resources.	Municipality's domain		3	1	0	0	0%
2.4.11	14	1			Make an assessment of the hardware and software used on the steps of the process, defining the current situation of the infrastructure.	Municipality's domain		2	1	0	0	0%
2.4.11	15	13	14		Create a list of software needed for each step of the digital process. And the hardware/software requirements for them.	Municipality's domain		4	1	0	0	0%
2.4.11	16	15			Update the hardware and software of the organization based on the specifications needed.	Municipality's domain		5	1	0	0	0%
2.4.12	17				Evaluate and understand the legislation specific to building permit. Identify the similar rules that are translated by CHEK project.	CHEK Regulation Tool		1	1	0	0	0%
2.5.13	18	13			Update vision and strategic plan to include digital processes and data technology. Share the vision and goals with the whole institution.	Municipality's domain		4	1	0	0	0%
2.5.14	19	18			Create a small dedicated team of 3-5 staff member with good knowledge in BIM or GIS, to be leading the implementation of the digital process ion the institution.	Municipality's domain		5	1	0	0	0%
2.5.15	20	19			Provide training to dedicated implementation group staff on BIM/GIS. Use CHEK training packages for support.	CHEK training package		6	1	0	0	0%
2.6.16	21	20			Provide certifications and participation in conferences for staff members working directly with the digital permit process implementation.	CHEK training package		7	1	0	0	0%
2.6.17	22	20			Make online trainings and booklets available for stakeholders. Use CHEK Training packages for support.	CHEK training package		7	1	0	0	0%
3.7.18	23	26			Implement use of BIMserver.centre for managing the building and urban data (carried on the IFC models) on the correspondent steps of the process	BIM Server Center		4	1	0	0	0%
3.7.18	24	26			Distribute the access for external stakeholders that are part of the process, adjust user permissions to control the privacy of the data.	BIM Server Center		4	1	0	0	0%
3.7.19	25	23			Connect BIMserver.centre to municipality's storage repository through APIs. Configure automatic backups.	BIM Server Center		5	1	0	0	0%
3.7.20	26	6			Integrate IFC signature tool for validate submission of models. Connect to BIMserver.centre through API.	BIM Server Center and IFC Signature		3	1	0	0	0%
3.7.21	27	23			Use a web portal to communicate between stakeholders. Integrate portal with the internal municipality's communication system. Set automatic notification to all parties involved.	BIM Server Center		5	1	0	0	0%

PERIODS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

KMA	ACTION #	DEPENDS ON			ACTIVITY	CHEK TOOLS	AVAILABLE MATERIAL	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE	PERIODS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
3.8.22	**28**	23			**Identify and implement all the procedural (adminstrative) information that are in the process and use CHEK IDS to check it.**	CHEK IDS		5	1	0	0	**0%**	
3.8.23	**29**	23			**Implement the use of VC Map CHEK or CYPE tools for visualisation and inspection of the IFC and GIS models.**	BIM Server Center or VC Map + VC Map CHEK plugin		5	1	0	0	**0%**	
3.8.24	**30**	29	38		**Implement the use of BIMserver.centre Validation or Verify 3D for the data validation of IFC models according to CHEK IFC.**	BIM Server Center Validation and Verify 3D		10	1	0	0	**0%**	
3.8.25	**31**	29	39		**Implement use of data validation on VC Map and/or BIMserver.centre for basic GIS data.**	CHEK GIS standard		10	1	0	0	**0%**	
3.8.26	**32**	30	31	42	**Implement the use of Cype Urban or Verify 3D for the rule checking of IFC models.**	CYPE Urban		11	1	0	0	**0%**	
3.9.27	**33**	32			**Connect rule checking software to BIMserver.centre through the available APIs.**	CHEK IDS		12	1	0	0	**0%**	
3.9.28	**34**	33			**Implement the use of BIM to CityGML on the corresponding steps of the process. Make the Revit plugin available for designers and other stakeholders.**	BIM to CityGML or Plugin CityJSON to Revit		13	1	0	0	**0%**	
3.9.29	**35**	33			**Implement the use of CityGML to IFC on the corresponding steps of the process.**	CityGML to IFC		13	1	0	0	**0%**	
4.10.30	**36**		18		**Implement the use of CHEK IFC as data structure for the models.**	CHEK IDS		5	1	0	0	**0%**	
4.10.31	**37**	38	39		**Use of CHEK guidelines and reports to create the municipality's plan of quality control. Make guidelines easily available for all stakeholders.**	CHEK Guidelines and support material		10	1	0	0	**0%**	
4.11.32	**38**	42			**Use CHEK IFC to create MVD and/or IDS specific for the municipality's process.**	CHEK IDS		9	1	0	0	**0%**	
4.11.33	**39**	42			**Use CHEK GIS standards to adjust for municipality's steps on the process.**	CHEK IDS		9	1	0	0	**0%**	
4.12.34	**40**	17	36		**Assess all rules that might be translated to machine readable format and are not on the CHEK repository of rules.**	CHEK Guidelines and support material		6	1	0	0	**0%**	
4.12.34	**41**	40			**Translate rules using the CHEK rules configurator.**	CHEK Regulation Tool		7	1	0	0	**0%**	
4.12.35	**42**	41			**Access CHEK repository of rules to create the rulesets according to municipality's specific process.**	CHEK Guidelines and support material		8	1	0	0	**0%**	

Annex II The CHEK process glossary

Column1	Task name	Task type	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	UID	Column2
1	City regulatory information	Event	Regulatory information available at authority's office to collect in person.	Regulatory information available in pdf and can be sended via email.	Regulatory information available on the official webpage in pdf format and can be downloaded.	Regulatin information accessible online. 2D map available and the information associated to the zoning can be downloaded	3D city map accessible and the regulation information available to download in XML or JSON (city gml)	3D city map accessible and the rulesets can be imported from the plot directly to the design software	1.1.E	City regulatory information has the UID 1.1.E and is in the POOL MUNICIPALITY with the Element Type Event.
2	City planning information	Event	Regulatory information available at authority's office to collect in person.	City plans available in pdf and can be sended via email.	City plans available on the official webpage in pdf format and can be downloaded.	Regulatin information accessible online. 2D map available and the information associated to the zoning can be downloaded	3D city map accessible and available to download in XML or JSON (city gml)	3D city map accessible and available link directly to the design software	1.2.E	City planning information has the UID 1.2.E and is in the POOL MUNICIPALITY with the Element Type Event.
3	Building regulatory information	Event	Regulatory information available at authority's office to collect in person.	Email request for pdf of building regulatory documents	Access of webpage and download of pdf building regulatory documents	Access of online database and download regulatory documents	Access of online centralised database and download regulatory information in IDS	Access of online centralised database and link directly into design software to import IDS	1.3.E	Building regulatory information has the UID 1.3.E and is in the POOL MUNICIPALITY with the Element Type Event.
4	Pre-application consulting request received	Event	In-person meeting at authority's office	Pre-consultations with email exchanges	Online request of pre-consultation by uploading documents at webportal	Pre-consultation of model uploaded at a cloud-based platform	Automatic analysis of model-checkig with rulesets from authority	Automatic analysis of model-checkig at authority's dedicated platform	1.4.E	Pre-application consulting request received has the UID 1.4.E and is in the POOL MUNICIPALITY with the Element Type Event.
5	Provide pre-application consulting	Task	In-person meeting at authority's office	Pre-consultations with email exchanges	Online request of pre-consultation by uploading documents at webportal	Pre-consultation of model uploaded at a cloud-based platform	Automatic analysis of model-checkig with rulesets from authority	Automatic analysis of model-checkig at authority's dedicated platform	1.5.T	Provide pre-application consulting has the UID 1.5.T and is in the POOL MUNICIPALITY with the Element Type Task.
6	Application received	Event	In-person or mail submission of physical documnets	Email submission with attachments	Online submission at webportal with filling of forms and update of documents	Submission of models, form filling, and digital documents with automated verification of documents	Submission of models with automatic extraction data for filing forms	Submission of models with automatic extraction and validation of data	1.6.E	Application received has the UID 1.6.E and is in the POOL MUNICIPALITY with the Element Type Event.
7	Initiate Application Review	Task	Manual verification of printed documents using a checklist	Manual verification of CAD and PDF documents using a checklist	Manual verification of BIM models using a checklist	Compliance checking software implementation for BIM Models	Implementation of Automated Compliance Checking for BIM Models	Real-Time Cloud-Based Monitoring for Compliance of BIM Models	1.7.T	Initiate Application Review has the UID 1.7.T and is in the POOL MUNICIPALITY with the Element Type Task.
8	Issue application number	Task	Manually Assigned Application Number	Digital Issuance and emailed application number	Digital issuance with online access	Automated number assignment platform notification	Automated number assignment with dashboard	Instantaneous digital numbering with cloud integration	1.8.T	Issue application number has the UID 1.8.T and is in the POOL MUNICIPALITY with the Element Type Task.

9	Check administrative requirements	Task	Manual Review of Physical Administrative Documents	Utilization of Computerized Administrative Checklists	Basic Digital Tracking System for Administrative Verification	Automated Tracking of Administrative Document	Real-Time Cloud-Based Administrative Document Tracking and Verification	AI-Driven Automated Administrative Document Compliance and Verification System	1.9.T	Check administrative requirements has the UID 1.9.T and is in the POOL MUNICIPALITY with the Element Type Task.
10	Geolocate the plot	Task	Geolocate plot on a physical map	Manual geolocation of plot on 2D map	Geolocate plot on map with GIS data	Manual geolocation of BIM model	Automatic geolocation of BIM model	Real-Time Cloud-Based geolocation of models	1.10.T	Geolocate the plot has the UID 1.10.T and is in the POOL MUNICIPALITY with the Element Type Task.
11	Check documentation completenes	Task	Manual check of physical documents for completion	Document checklist on computer	Use of basic digital document tracking	Automated tracking of document submission	Real-Time Cloud-Based Document Tracking and Verification	AI-Driven Automated Document Compliance and Verification System	1.11.T	Check documentation completenes has the UID 1.11.T and is in the POOL MUNICIPALITY with the Element Type Task.
12	Return application for revision	Task	Hand-delivered or mailed notice for revisions	Email notification with revision notes	System-generated email with revision notes	Automated notification system with revision notes	Immediate digital messaging with revision guidance	Real-time interactive revision platform	1.12.T	Return application for revision has the UID 1.12.T and is in the POOL MUNICIPALITY with the Element Type Task.
13	Accept application	Task	Manual application acceptance	Digital acceptance via email	Online application acceptance	Automated acceptance with tracking	Real-time acceptance with notifications	AI-driven acceptance with instant feedback	1.13.T	Accept application has the UID 1.13.T and is in the POOL MUNICIPALITY with the Element Type Task.
14	Notify acceptance	Task	Physical ledger communication log	Communication logs in digital files	Database entry for communications	CRM system tracking communication	Unified communication logging platform	Integrated Communication Analytics Dashboard	1.14.T	Notify acceptance has the UID 1.14.T and is in the POOL MUNICIPALITY with the Element Type Task.
15	Application Status updated	Event	Manual ledger updates	Spreadsheet updates	Digital dashboard updates	Real-time status updates via software	Integrated project management system updates	Immediate status synchronization in a cloud system	1.15.E	Application Status updated has the UID 1.15.E and is in the POOL MUNICIPALITY with the Element Type Event.
16	Assign responsible technician for the process	Task	Paper documents handover	Use of internal email system	Centralized document management system	Automated distribution to relevant departments	Permission Modifications for Assigned Technicians in Shared Data Environment	AI-Enabled Document Routing with Instant Status Integration	1.16.T	Assign responsible technician for the process has the UID 1.16.T and is in the POOL MUNICIPALITY with the Element Type Task.
17	Assign internal evaluators	Task	Physical inter-office mail to distribute documents	Use of internal email system	Centralized document management system	Automated distribution to relevant departments	Permission Modifications for Assigned Technicians in Shared Data Environment	AI-Enabled Document Routing with Instant Status Integration	1.17.T	Assign internal evaluators has the UID 1.17.T and is in the POOL MUNICIPALITY with the Element Type Task.
18	Require external evaluation	Task	Mailing documents to external agencies	Emailing digital documents	Update documents at online submission portals for external agencies access	Integrated external consultation systems	Real-time collaboration platforms	Blockchain-verified inter-agency platform	1.18.T	Require external evaluation has the UID 1.18.T and is in the POOL MUNICIPALITY with the Element Type Task.

19	Receive external evaluation report	Task	In-Person Decision-Making and Sign-Off on External Agency Approvals	Email Communication for External Agency Decision	System-Generated Email with External Agency Decision Details	Automated Notification System for External Agency Decision	Automatic statuss aproval in cloud-based platform with notification	Automated approval through live collaboration system	1.19.T	Receive external evaluation report has the UID 1.19.T and is in the POOL MUNICIPALITY with the Element Type Task.
20	Require changes	Task	Physical ledger communication log	Communication logs in digital files	Database entry for communications	CRM system tracking communication	Unified communication logging platform	Integrated Communication Analytics Dashboard	1.20.T	Require changes has the UID 1.20.T and is in the POOL MUNICIPALITY with the Element Type Task.
21	Receive updated project	Task	Physical document resubmission	Email resubmission of CAD/PDFs	Online portal resubmission	Model and digital document resubmission with automated verification	Automated data extraction from models	Automated data extraction and validation	1.21.T	Receive updated project has the UID 1.21.T and is in the POOL MUNICIPALITY with the Element Type Task.
22	Changes accepted	Event	Manual acceptance of changes	Email confirmation	Digital tracking of accepted changes	Automated acceptance with notification	Real-time cloud-based acceptance	AI-driven validation and acceptance	1.22.E	Changes accepted has the UID 1.22.E and is in the POOL MUNICIPALITY with the Element Type Event.
23	No project changes required	Event	Manual confirmation of no changes	Email notification	Digital tracking of no changes	Automated confirmation with notification	Real-time cloud-based confirmation	AI-driven validation of no changes required	1.23.E	No project changes required has the UID 1.23.E and is in the POOL MUNICIPALITY with the Element Type Event.
24	Check compliance with urban regulation	Task	Review physical zoning maps	Digital maps with CAD software	Interactive GIS systems for zoning	Compliance Checking Software Implementation for GIS data	Implementation of Automated Compliance Checking for GIS data	Real-Time Cloud-Based Monitoring for Compliance of GIS data	1.24.T	Check compliance with urban regulation has the UID 1.24.T and is in the POOL MUNICIPALITY with the Element Type Task.
25	Check compliance with building regulation	Task	Manual Verification of Printed Documents Using a Checklist	Manual Verification of CAD and PDF Documents Using a Checklist	Manual Verification of BIM Models Using a Checklist	Compliance Checking Software Implementation for BIM Models	Implementation of Automated Compliance Checking for BIM Models	Real-Time Cloud-Based Monitoring for Compliance of BIM Models	1.25.T	Check compliance with building regulation has the UID 1.25.T and is in the POOL MUNICIPALITY with the Element Type Task.
26	Check structural project compliance	Task	Manual Verification of Printed Documents Using a Checklist	Manual Verification of CAD and PDF Documents Using a Checklist	Manual Verification of BIM Models Using a Checklist	Compliance Checking Software Implementation for BIM Models	Implementation of Automated Compliance Checking for BIM Models	Real-Time Cloud-Based Monitoring for Compliance of BIM Models	1.26.T	Check structural project compliance has the UID 1.26.T and is in the POOL MUNICIPALITY with the Element Type Task.
27	Check compliance with fire and safety regulation	Task	Manual Verification of Printed Documents Using a Checklist	Manual Verification of CAD and PDF Documents Using a Checklist	Manual Verification of BIM Models Using a Checklist	Compliance Checking Software Implementation for BIM Models	Implementation of Automated Compliance Checking for BIM Models	Real-Time Cloud-Based Monitoring for Compliance of BIM Models	1.27.T	Check compliance with fire and safety regulation has the UID 1.27.T and is in the POOL MUNICIPALITY with the Element Type Task.
28	Require changes	Task	Manual request for changes	Email notification	Digital tracking of required changes	Automated notification with details	Real-time cloud-based change request	AI-driven change request with guidance	1.28.T	Require changes has the UID 1.28.T and is in the POOL MUNICIPALITY with the Element Type Task.

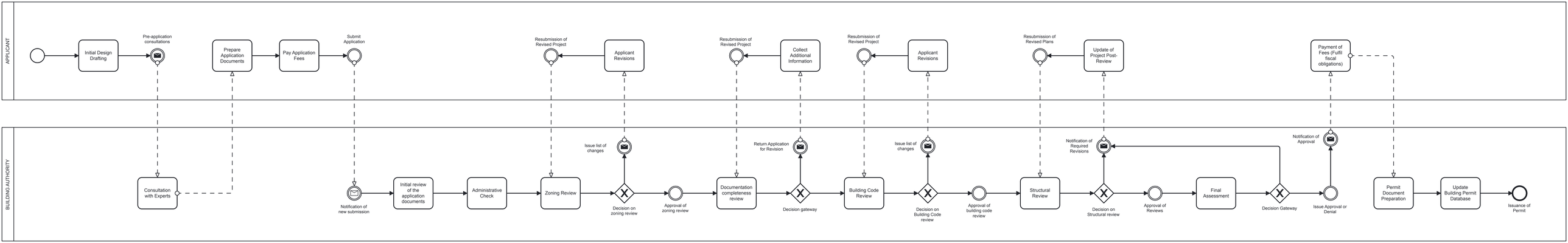
29	Receive updated project	Task	Physical document resubmission	Email resubmission of CAD/PDFs	Online portal resubmission	Model and digital document resubmission with automated verification	Automated data extraction from models	Automated data extraction and validation	1.29.T	Receive updated project has the UID 1.29.T and is in the POOL MUNICIPALITY with the Element Type Task.
30	Check compliance with energy efficiency standards	Task	Manual Verification of Printed Documents Using a Checklist	Manual Verification of CAD and PDF Documents Using a Checklist	Manual Verification of BIM Models Using a Checklist	Compliance Checking Software Implementation for BIM Models	Building energy simulation	Energy simulation integrated with the city model energy information	1.30.T	Check compliance with energy efficiency standards has the UID 1.30.T and is in the POOL MUNICIPALITY with the Element Type Task.
31	Check compliance with natural disaster regulation	Task	Manual Verification of Printed Documents Using a Checklist	Manual Verification of CAD and PDF Documents Using a Checklist	Manual Verification of BIM Models Using a Checklist	Compliance Checking Software Implementation for BIM Models	Building natural disaster simulation	Natural disaster simulation integrated with the city model information	1.31.T	Check compliance with natural disaster regulation has the UID 1.31.T and is in the POOL MUNICIPALITY with the Element Type Task.
32	Require changes	Task	Hand-delivered or mailed revision requests	Email notifications	System-generated emails with feedback	Automated feedback messaging system	AI-based notification system with action items	Immediate digital communication with AI guidance	1.32.T	Require changes has the UID 1.32.T and is in the POOL MUNICIPALITY with the Element Type Task.
33	Approve compliance checks	Task	Manual signature on printed document	Digital scanned document with signature and stamp	Digital signatures and seal on electronic document	E-approval system with digital seals	Smart contract execution for approvals/denials through digital platforms	Immediate digital distribution of decision and blockchain recording in an integrated ecosystem	1.33.T	Approve compliance checks has the UID 1.33.T and is in the POOL MUNICIPALITY with the Element Type Task.
34	All compliance checks approved	Event	Manual compliance check approval	Email confirmation	Digital tracking of compliance	Automated compliance approval	Real-time cloud-based compliance approval	AI-driven compliance monitoring and approval	1.34.E	All compliance checks approved has the UID 1.34.E and is in the POOL MUNICIPALITY with the Element Type Event.
35	Public notification	Event	Post physical notices in local newspapers and on-site	Send out mailers to local residents	Publish on local authority's website	Use social media for wider notification	Automated notification systems across multiple digital platforms	AI-driven targeted community engagement platforms	1.35.E	Public notification has the UID 1.35.E and is in the POOL MUNICIPALITY with the Element Type Event.
36	Receive public feedback	Task	Receive written letters and feedback forms	Collect feedback via email	Use online survey tools for feedback collection	Automated feedback collection systems	Advanced analytics for feedback analysis	AI semantic analysis of public sentiment	1.36.T	Receive public feedback has the UID 1.36.T and is in the POOL MUNICIPALITY with the Element Type Task.
37	Evaluate public feedback	Task	Deliberation meetings to consider feedback	Internal review of feedback documents	Collaborative digital platforms for decision-making	Use of decision-support software	AI-driven predictive impact analysis of feedback	Machine learning for optimization of decision outcomes	1.37.T	Evaluate public feedback has the UID 1.37.T and is in the POOL MUNICIPALITY with the Element Type Task.

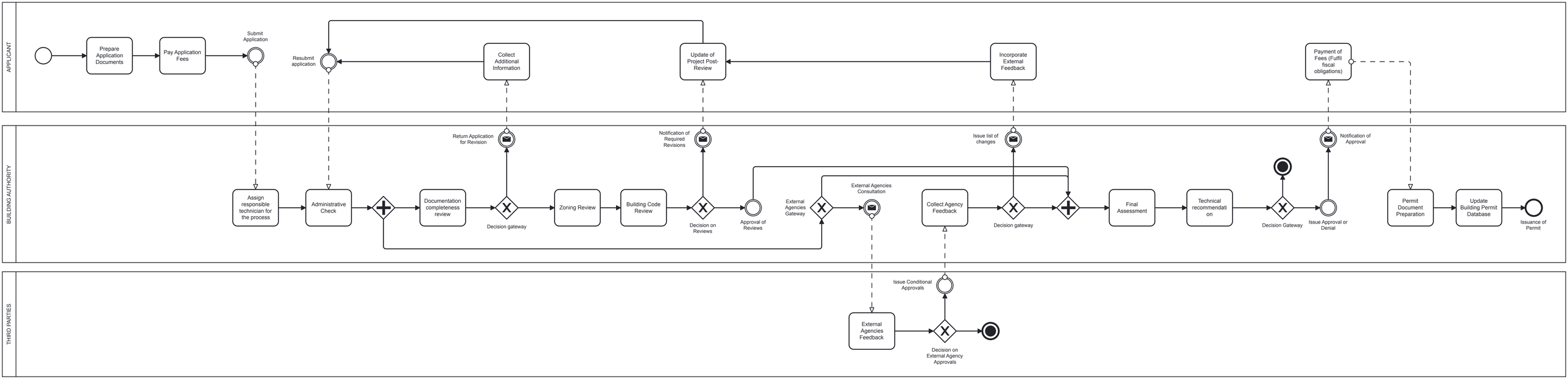
38	Share public feedback	Task	Manual signature on printed document	Digital scanned document with signature and stamp	Digital signatures and seal on electronic document	E-approval system with digital seals	Smart contract execution for approvals/denials through digital platforms	Immediate digital distribution of decision and blockchain recording in an integrated ecosystem	1.38.T	Share public feedback has the UID 1.38.T and is in the POOL MUNICIPALITY with the Element Type Task.
39	Approval notification sent	Event	Mailed letter of decision	Email notification	System-generated email with decision	Automated email and SMS notification	Push notifications through digital platforms	AI-powered communication system with follow-up actions in an integrated ecosystem	1.39.E	Approval notification sent has the UID 1.39.E and is in the POOL MUNICIPALITY with the Element Type Event.
40	Changes accepted	Event							1.40.E	Changes accepted has the UID 1.40.E and is in the POOL MUNICIPALITY with the Element Type Event.
41	Building permit approved	Event	Mailed letter	Email notification with digital attachment	Email notification and in dedicated platform download of the notice	Automated email and SMS notification	Push notification through digital platforms	Real-time alerts on applicant's digital dashboard in an integrated ecosystem	1.41.E	Building permit approved has the UID 1.41.E and is in the POOL MUNICIPALITY with the Element Type Event.
42	Building permit denied	Event	Mailed letter	Email notification with digital attachment	Email notification and in dedicated platform download of the notice	Automated email and SMS notification	Push notification through digital platforms	Real-time alerts on applicant's digital dashboard in an integrated ecosystem	1.42.E	Building permit denied has the UID 1.42.E and is in the POOL MUNICIPALITY with the Element Type Event.
43	Final Assessment	Task	Manual final assessment	Digital compilation of assessments	Assessment software usage	Centralized digital review dashboard	Automated compliance and review platform	AI-supported comprehensive evaluation system	1.43.T	Final Assessment has the UID 1.43.T and is in the POOL MUNICIPALITY with the Element Type Task.
44	Receive final documents	Task	Physical document reception	Email receipt of final documents	Online portal document reception	Automated document tracking	Real-time cloud-based document reception	AI-driven document verification	1.44.T	Receive final documents has the UID 1.44.T and is in the POOL MUNICIPALITY with the Element Type Task.
45	Permit Document Preparation	Task	Printed and manually signed permit document	Scanned signature and stamp on digital document	Digital template filling and PDF generation	Automated document creation	AI-powered document customization and generation	Smart system for instant digital permit issuance	1.45.T	Permit Document Preparation has the UID 1.45.T and is in the POOL MUNICIPALITY with the Element Type Task.
46	Update Building Permit Database	Task	Manual ledger entry of decision	Digital entry in spreadsheet	Database update with new permit status	Cloud-based permit management system	Real-time update through digital platforms	Update in blockchain database for immutable record-keeping in an integrated ecosystem	1.46.T	Update Building Permit Database has the UID 1.46.T and is in the POOL MUNICIPALITY with the Element Type Task.

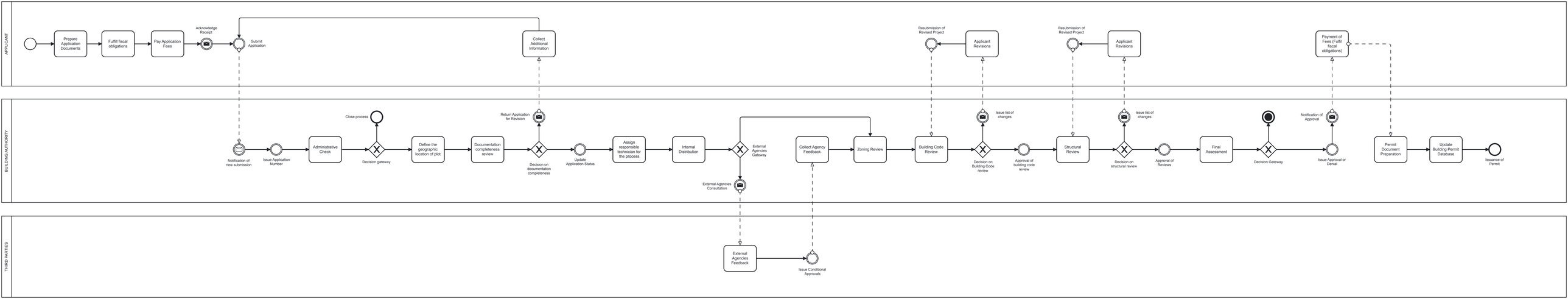
47	Issue building permit	Task	Manual signing, printed, and handover of the permit document	Email with digital attachment of scanned document with signature and stamp	Email notification and in dedicated platform to download permit with electronic signature and seal	E-permit issuance with digital credentials	Secured e-permit with smart contracts	Immediate digital distribution and blockchain recording of e-permit in an integrated ecosystem	1.47.T	Issue building permit has the UID 1.47.T and is in the POOL MUNICIPALITY with the Element Type Task.
48	End	Event	Manual process closure	Digital confirmation of closure	Automated process completion	Real-time process monitoring	Integrated project management system closure	AI-driven process completion and archiving	1.48.E	End has the UID 1.48.E and is in the POOL MUNICIPALITY with the Element Type Event.

Annex III Process maps

- AS_IS_CR_Prague
- AS_IS_IT_Ascoli
- AS_IS_PT_GAIA
- AS_IS_PT_Lisbon
- VA_Template


APPLICANT
Initial Design Drafting
Pre-application consultations
Prepare Application Documents
Pay Application Fees
Submit Application
Resubmission of Revised Project
Applicant Revisions
Resubmission of Revised Project
Collect Additional Information
Resubmission of Revised Project
Applicant Revisions
Resubmission of Revised Plans
Update of Project Post-Review
Payment of Fees (Fulfil fiscal obligations)
BUILDING AUTHORITY
Consultation with Experts
Notification of new submission
Initial review of the application documents
Administrative Check
Zoning Review
Issue list of changes
Decision on zoning review
Approval of zoning review
Documentation completeness review
Return Application for Revision
Decision gateway
Building Code Review
Issue list of changes
Decision on Building Code review
Approval of building code review
Structural Review
Notification of Required Revisions
Decision on Structural review
Approval of Reviews
Final Assessment
Decision Gateway
Notification of Approval
Issue Approval or Denial
Permit Document Preparation
Update Building Permit Database
Issuance of Permit


APPLICANT
Prepare Application Documents
Pay Application Fees
Submit Application
Resubmit application
Collect Additional Information
Update of Project Post-Review
Incorporate External Feedback
Payment of Fees (Fulfil fiscal obligations)
BUILDING AUTHORITY
Assign responsible technician for the process
Administrative Check
Documentation completeness review
Return Application for Revision
Decision gateway
Zoning Review
Building Code Review
Notification of Required Revisions
Decision on Reviews
Approval of Reviews
External Agencies Gateway
External Agencies Consultation
Collect Agency Feedback
Issue list of changes
Decision gateway
Final Assessment
Technical recommendation
Decision Gateway
Issue Approval or Denial
Notification of Approval
Permit Document Preparation
Update Building Permit Database
Issuance of Permit
THIRD PARTIES
External Agencies Feedback
Issue Conditional Approvals
Decision on External Agency Approvals


APPLICANT
Prepare Application Documents
Fulfill fiscal obligations
Pay Application Fees
Acknowledge Receipt
Submit Application
Collect Additional Information
Resubmission of Revised Project
Applicant Revisions
Resubmission of Revised Project
Applicant Revisions
Payment of Fees (Fulfil fiscal obligations)
BUILDING AUTHORITY
Notification of new submission
Issue Application Number
Administrative Check
Close process
Decision gateway
Define the geographic location of plot
Documentation completeness review
Return Application for Revision
Decision on documentation completeness
Update Application Status
Assign responsible technician for the process
Internal Distribution
External Agencies Gateway
External Agencies Consultation
Collect Agency Feedback
Zoning Review
Building Code Review
Issue list of changes
Decision on Building Code review
Approval of building code review
Structural Review
Issue list of changes
Decision on structural review
Approval of Reviews
Final Assessment
Decision Gateway
Notification of Approval
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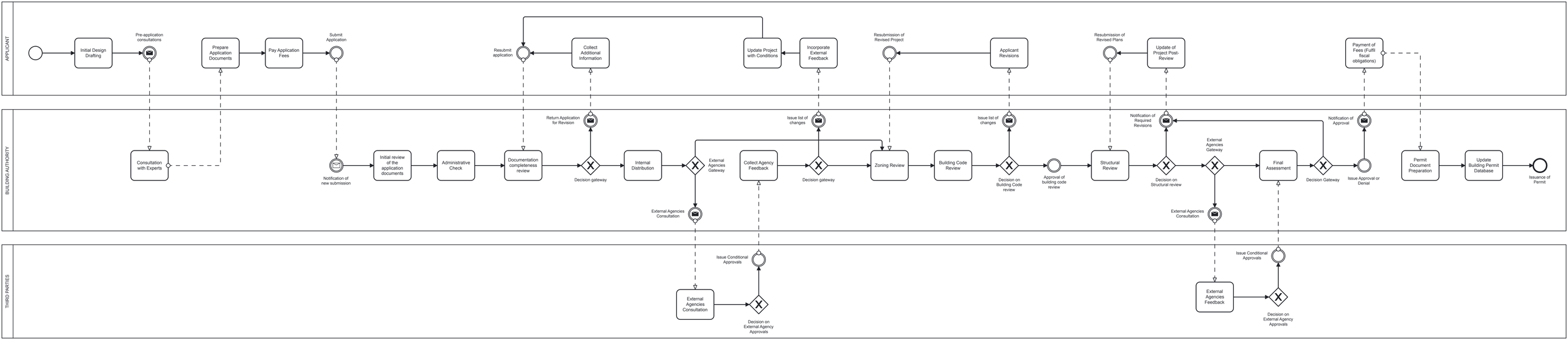
Permit Document Preparation
Update Building Permit Database
Issuance of Permit
THIRD PARTIES
External Agencies Feedback
Issue Conditional Approvals


APPLICANT
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THIRD PARTIES
Initial Design Drafting
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Prepare Application Documents
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Collect Additional Information
Update Project with Conditions
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Notification of Required Revisions
Decision on Structural review
External Agencies Gateway
External Agencies Consultation
Final Assessment
Notification of Approval
Decision Gateway
Issue Approval or Denial
Permit Document Preparation
Update Building Permit Database
Issuance of Permit
External Agencies Consultation
Issue Conditional Approvals
Decision on External Agency Approvals
External Agencies Feedback
Issue Conditional Approvals
Decision on External Agency Approvals


APPLICANT
BUILDING AUTHORITY
THIRD PARTIES
PUBLIC
Start
Collect city regulatory information
Collect city planning information
Collect building regulatory information
ollect existing building and regulatory information
Draft initial design
Require pre-application consulting
Pre-application consulting received
Prepare Application Documents
Fulfill fiscal obligation (pay taxes)
Pay Application Fees
Submit application
Revision received
Collect Additional Information
Resubmit application
Receive notification for application acceptance
Receive request for changes
Implement required changes
Resubmit updated project
Public feedback received
Approval notification received
Fulfill final conditions
Pay fees
Send final documents
Building permit issued
City regulatory information
City planning information
Building regulatory information
Pre-application consulting request received
Provide pre-application consulting
Application received
Initiate Application Review
Issue application number
Check administrative requirements
Geolcate the plot
Check documentation completenes
Is the documentation complete?
Return application for revision
Yes
No
Accept application
Notify acceptance
Application Status updated
Assign responsible technician for the process
Assign internal evaluators
Is external evaluation needed
Require external evaluation
Receive external evaluation report
Are changes required?
Require changes
No project changes required
Receive updated project
Are changes accepted?
Changes accepted
Check compliance with regulations
Check compliance with fire and safety regulation
Check structural project compliance
Check compliance with building regulation
Check compliance with urban regulation
Are all checks compliant?
Check compliance withe regulations
Check compliance with energy efficiency standards
Check compliance with natural disaster regulation
Approve compliance checks
All compliance checks approved
Public notification
Receive public feedback
Evaluate public feedback
Share public feedback
Final Assessment
Building permit denied
Is the building permit approved?
Building permit approved
Approval notification sent
Receive final documents
Permit Document Preparation
Issue building permit
Update Building Permit Database
End
Request for external evaluation received
Evaluate project
Send external evaluation
Public notified
Is there public feedback?
Send public feedback