Change toolkit for digital building permit

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Contents

1. Executive summary

The deliverable outlines the preliminary results of the first phase of testing in Work Package 1 (WP1) from the CHEK project, which aims to assess and improve the digital maturity of building permit processes in building authorities. The project addresses one critical challenge faced by municipalities: the lack of understanding and evaluating their digital maturity, which is necessary for enhancing digital transformation efforts. This issue is particularly significant in the context of building permit processes, where conventional workflows often hinder efficiency, transparency, and stakeholder engagement. The objective of the present work package is to develop a scalable and efficient assessment methodology that can be applied across different regions, considering their unique regulatory and cultural contexts.

To achieve this objective, WP1 has developed the CHEK DBP Process Map, the CHEK Digital Building Permit Maturity Model (CDBPMM) and the CHEK Roadmap to support municipalities in evaluating and advancing their digital maturity in building permit processes. Moreover, the assessment results and the model itself can be used as a basis for setting benchmarks against industry and public standards. The last version of the process map, maturity model and roadmap were peer-reviewed, as stated on the respective deliverables. The three outcomes were presented to members on CHEK consortium, CHEK community of practice, and other experts on related topics on digital building permit. The results for the CHEK Process Map, CHEK DBP Maturity Model and Roadmap can be found on previous deliverables D1.1 and D1.2.

The CHEK DBP Maturity Model exams the digital maturity across the four categories (process, organisation, information, technology) related to digital building permit process. The content on the CHEK DBP MM was thoroughly reviewed and the last version was approved by all parties involved in the process of making it. The present deliverable details the methodology used for testing this instrument across the four CHEK partner municipalities: Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague. The testing methodology is structured into four distinct phases, each applying a different approach to assess digital maturity: traditional expert-led assessment, VA-assisted assessment, independent VA assessment, and use case evaluation.

The preliminary findings of the first phase highlight low variations in digital maturity levels across the participating municipalities, particularly in the categories of Technology and Information. While Vila Nova de Gaia demonstrates relatively high digital maturity in Process, the other three municipalities show lower levels of digital maturity in all categories. The preliminary results reflect the maturity of the current situation of each municipality and provide insights into areas that require further development.

Future phases of testing will further validate the effectiveness of an AI-based assessment method, the CHEK Virtual Assistant (VA). The CHEK VA is under development from the efforts of WP1 and aims to provide a scalable and effective solution for the assessment of the CHEK DBP MM and help the municipalities on the evaluation of their current levels of maturity. Future testing work will be done by comparing the AI-based method against traditional methods, with Deliverable D1.5 providing the final outcomes. Ultimately, the CHEK project aims to facilitate the digital transformation of building permit processes in municipalities, promoting greater efficiency, transparency, and adaptability using advanced digital tools and methodologies.

2. Introduction

The digital transformation of local building authorities has become a critical priority across Europe as they strive to streamline services, improve transparency, and enhance citizen engagement. One of the key areas of focus has been the digitalisation of building permit processes, which traditionally involve complex, paper-based workflows and coordination across multiple stakeholders. The CHEK project[1] is part of a broader initiative to support municipalities in adopting digital solutions to manage these workflows more effectively. This deliverable presents the preliminary outcomes of the Work Package 1 - The DBP process and changing strategy, which assesses the digital maturity of four municipalities: Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague. The evaluation uses the CHEK DBP Maturity Model (Ataide et al., 2023), a structured framework that provides a detailed assessment across four key categories: Process, Organisation, Technology, and Information.

The CHEK DBP Maturity Model is a tool that allows municipalities to assess their digital maturity on the realm of the digital building permit process. The CHEK MM a divided in its 35 Key Maturity Areas (KMAs) across the four categories (process, organisation, information, technology) related to digital building permit process. The creation of the CHEK MM was detailed on deliverable D1.2 and its results derive from the careful research made on deliverable D1.1 that resulted on the CHEK DBP Process Map (Braholli et al., 2023). The levels of maturity and their evolution through the KMAs takes in consideration the ideal digitalised scenario of the CHEK DBP Process Map.

The primary objective of this deliverable is to validate the application of the CHEK DBP Maturity Model using both traditional expert-led assessments and an AI-driven tool, the CHEK Virtual Assistant (VA)[2]. This dual approach aims to establish a comprehensive understanding of each municipality's current digital maturity and to explore how AI-based methodologies can support the evaluation process. The traditional expert-led assessment provides a baseline, offering qualitative insights based on expert judgment and knowledge of the maturity model. On the other side, the CHEK VA uses by leveraging the use of Large Language Models (LLMs)[3] to deliver a possible more scalable and objective assessment. Discussions on future work related to the CHEK VA will be presented throughout this report.

This report covers several critical aspects of the task's testing and validation activities. The methodology adopted for this phase includes semi-structured interviews with municipal technicians and officers to gather qualitative data, which is then cross-referenced with the maturity model's criteria to determine each municipality's level of maturity in the four categories. The report discusses the findings from these initial assessments, providing insights into the strengths and areas for improvement for each municipality.

The deliverable also sets the stage for future testing phases, where the CHEK VA will be employed to conduct both assisted and independent maturity assessments. For the independent assessment, users will be presented with detail instructions on how to use the CHEK VA, and their structured feedback will be collected to provide user friendliness review. This structured testing approach will allow for a comprehensive comparison of results obtained through traditional methods and those derived from the AI-based method. The goal of the testing task is to demonstrate the value of the CHEK VA in providing an efficient, and possible less subjective means of evaluating digital maturity, which could potentially be scaled and adapted to different regions and organisational environments.

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[1] https://chekdbp.eu/
[2] CHEK Virtual Assistant is part of a parallel task T1.3 and will be presented at deliverable D1.3.
[3] OpenAI (OpenAI (2024). Available online: OpenAI Platform) models were used on the creation of the CHEK VA, the detail report will be presented in deliverable D1.3.

This deliverable presents the methodology of the testing, where the state of the art, detailed phases, scope, and data handling are outlined in the methodology presented on Section 3. Section 4 shows the preliminary results and validation from the first phase conducted with the four municipalities: Ascoli Piceno (Italy), Lisbon and Vila Nova de Gaia (Portugal), and Prague (Czech Republic). Section 5 discusses and interprets the findings of the preliminary phase. These findings will serve as the foundation for further testing and validation activities, culminating in Deliverable D1.5, which will present the final results and insights gained from the complete testing phases of WP1 of the CHEK project.

2.1. Scope

This deliverable is part of Task 1.4 – Testing, Validation, and Optimisation, which runs from M18 to M30 of CHEK project (Figure 1). The current deliverable (D1.4) provides preliminary outcomes from the testing phase in WP1. As such, the final results for all testing phases will be available at the conclusion of the work package. This report covers activities completed thus far in the CHEK project and WP1. The preliminary findings presented here are based on phase 1 testing, which includes results from interviews with the four municipalities and the traditional manual maturity assessment.

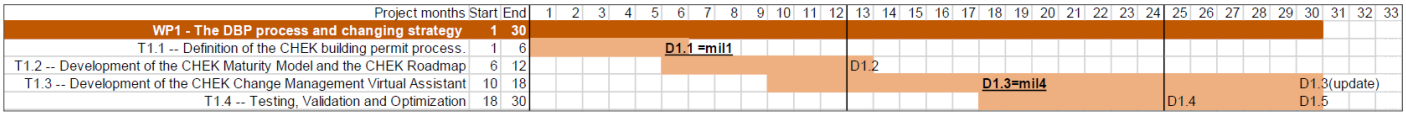

Figure 1 WP1 Timeline

Following phases of test will include a phase using the CHEK VA in an expert assisted assessment and a phase of self-assessment by municipality technician, followed by a structured questionnaire regarding the usability of the CHEK VA method. Results from testing with the CHEK VA, along with comparisons to the process maturity in the WP6 use cases, will be presented in deliverable D1.5 at the end of the work package activities. The description of the phases of testing and measurable results are described in Section 3.2.

3. Methodology

Chapter Summary
This chapter reviews existing literature on methods for testing and evaluating digital tools, focusing on those that support digital transformation in organisations. It introduces the CHEK Virtual Assistant (VA) as a tool for helping municipalities assess and improve their digital building permit processes using the CHEK DBP Maturity Model. The chapter outlines the methodology for testing the CHEK DBP MM across four municipalities (Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague), using both traditional expert-led assessments and the CHEK VA to compare results. The methodology of the testing will be conducted in four phases, each involving different approaches to assess the digital maturity of the municipalities. Data of the first phase of testing is collected through semi-structured interviews with municipal technicians, with responses analysed to determine maturity levels across several key areas. The results aim to provide insights into each municipality's digital maturity to help them to understand their current state, so can they successfully transition to a digital process.

3.1. Literature review and state of the art

In the rapidly evolving landscape of organisational development and process improvement, maturity assessment continues to be a crucial tool for evaluating and enhancing various aspects of an organisation's procedures. A maturity assessment in a general context is a systematic evaluation of an organization's or a process's current state of development or capability in relation to a set of predefined criteria. It helps determine how advanced or mature the organization or process is across various dimensions, such as efficiency, effectiveness, automation, innovation, and governance. The goal of a maturity assessment is to identify strengths, weaknesses, and areas for improvement to guide strategic planning and continuous development. Maturity assessments often use structured frameworks or models that categorize maturity levels and evaluate the organization or process against these levels. By doing so, organizations can prioritize efforts for improvement, track progress, and benchmark their capabilities against industry standards or competitors. (Wendler, 2012)

The concept of maturity assessment was first introduced by Watts Humphrey through the development of the Capability Maturity Model (CMM) in 1986. The model was initially designed for assessing the maturity of software development processes within organizations and providing a structured path for improvement. (Yildiz Technical University et al., 2022)

A maturity assessment in the context of the digital building permit process refers to a structured evaluation of how advanced and capable the current processes, technology, organization, and information management are in relation to the overall goal of digitalizing the building permit process. This assessment provides a clear understanding of where a municipality or organization stands in terms of its readiness to implement or improve digital solutions for processing building permits. It helps identify strengths, weaknesses, and areas for improvement to advance towards fully digital, efficient, and automated permit systems.

The topic of maturity assessment for the digital building permit process remains largely unexplored, with limited available references and scientific publications. While the maturity models have been widely used in fields like software development and organisational processes, there is a noticeable gap in research and practical frameworks specifically tailored to assessing the digital transformation of building permit processes. As municipalities and organisations increasingly seek to digitalise these processes, there is a growing need for tailored maturity assessment tools to guide the digitalisation efforts, but current literature does not yet comprehensively address this domain.

This report examines the state of the art in maturity assessment, focusing on three key areas: maturity assessment and analysis methods, evaluation methodologies for maturity assessment, and a literature-based argument for the choice of testing and evaluation methodologies. By exploring these aspects with an emphasis on recent developments, the aim is to provide a comprehensive and up-to-date overview of the current landscape of maturity assessment and justify the methodological choices in the context of assessing building permit processes across four municipalities.

Maturity assessment and analysis methods

While the foundations of maturity assessment were laid in the late 20th century with models like the Capability Maturity Model (CMM), recent years have seen significant advancements in both the conceptualisation and application of maturity models across various domains. One notable trend is the development of domain-specific maturity models. For instance, Proença and Borbinha (2016) proposed a maturity model for information governance, addressing the growing importance of data management in organisations. Their model emphasises the need for tailored approaches in assessing maturity in specialised areas of organisational function.

In the realm of digital transformation, which has become increasingly relevant for public sector organisations, Valdés et al. (2011) developed an e-Government Maturity Model. This model has been particularly influential in assessing the readiness and capability of government entities to provide digital services, a framework that could be relevant to studies of building permit processes such as CHEK's.

The concept of *agility* in maturity models has gained traction in recent years. Gren et al. (2015) proposed an agile maturity model that moves away from the traditional linear progression of maturity levels. Their model recognises that organisations might excel in certain agile practices while still developing others, allowing for a more nuanced assessment of organisational agility.

Analysis methods have also evolved significantly. The integration of big data analytics and artificial intelligence in maturity assessment has opened new avenues for more sophisticated and data-driven evaluations. Lichtenthaler, et al. (2020) explored the potential of AI-driven maturity assessments, highlighting how machine learning algorithms can process vast amounts of organisational data to provide more accurate and dynamic maturity evaluations.

Moreover, the rise of process mining techniques has revolutionised the way processes are analysed for maturity assessment. Aalst et al. (2011) demonstrated how process mining could be used to automatically discover, monitor, and improve real processes by extracting knowledge from event logs. This approach offers a more objective and data-centric method for assessing process maturity, potentially applicable to the analysis of building permit processes presented in this document.

Evaluating methodologies for maturity assessment

The evaluation of maturity assessment methodologies has itself matured, with researchers developing more rigorous and comprehensive approaches to validate these tools. Tarhan et al. (2016) conducted a systematic review of business process maturity models, providing a critical evaluation of their theoretical foundations and empirical validations. Their work highlighted the need for more rigorous validation of maturity models and proposed a framework for assessing the strength of empirical evidence supporting these models.

The concept of "fit for purpose" in maturity models has gained prominence. Poeppelbuss et al. (2011) emphasised the importance of aligning maturity models with specific organisational goals and contexts. They argued that the

effectiveness of a maturity model should be judged not just on its theoretical robustness but also on its ability to drive meaningful improvements in the assessed domain.

The usability and practical applicability of maturity models have also been subject to increased scrutiny. Lasrado et al. (2015) proposed a new approach for developing maturity models using set-theoretic methods. Their work aimed to address the limitations of traditional maturity models by providing a more flexible and context-sensitive assessment framework.

Maturity assessment testing methodology

In assessing the maturity of building permit processes across CHEK partner municipalities, methodological choices are informed by recent advancements in maturity assessment research and tailored to the specific context of public sector and building permit processes. A multi-dimensional assessment framework has been adopted, inspired by the work of Van Looy et al. (2012) on business process maturity, the methodology of Noardo and Malacarne (2021) on the digital building permit maturity model, and integration of process capabilities on the maturity model framework by Succar (2010). This approach allows evaluating not only the overall maturity of the permit process but also its constituent elements, such as technology utilisation, data quality, staff capability, and process standardisation. By examining these dimensions separately, a more nuanced understanding of each municipality's strengths and areas for improvement can be provided.

The methodology incorporates elements of agile maturity assessment, as proposed by Gren et al. (2015). This considers the potentially uneven development of different aspects of the permit process, recognising that a municipality might be advanced in one area while still developing in another.

Despite the testing methodology being supported merely by qualitative data, also quantitative metrics regarding some parts of the process are considered, drawing on the recommendations of Tarhan et al. (2016) for evidence-based maturity evaluations. This includes analysing processing times, return application rates and estimation rates of available resources to tackle change. The inclusion of such objective measures in the assessment of the maturity levels helps to mitigate the potential biases inherent in purely qualitative assessments and provides a more robust basis for comparison across building permit authorities.

Furthermore, the methodology emphasises stakeholder involvement throughout the assessment process, an approach supported by the findings of vom Brocke and Rosemann (2010). They highlight the importance of stakeholder engagement in ensuring the relevance and acceptance of maturity assessments. By involving both building authority staff and possible permit applicants in the evaluation, it is aimed to capture a comprehensive view of the process maturity from multiple perspectives.

In terms of data collection and analysis, the mapped processes from D1.1[4] were also considered during the creation of the maturity model. Aalst et al. (2011) considers the incorporation of process mining to automatically discover and analyse the actual processes being followed, providing an objective basis for our maturity assessment. This data-driven approach complements the qualitative assessments and helps to identify discrepancies between documented processes and actual practices.

[4] Available on: D1.1_CHEK_101058559_CHEK-DBP-process-map_V1.0-Final.pdf (chekdbp.eu)

The analysis framework incorporates both descriptive and prescriptive elements, as advocated by Poeppelbuss and Roeglinger (2011). While providing a clear description of the current maturity state for each municipality, also, actionable recommendations for improvement are provided. This dual focus ensures that our assessment not only evaluates the current and future state but also provides a roadmap[5] for future development, based on the CHEK tools and methods.

Lastly, the methodology is designed with scalability and replicability in mind, drawing on the principles outlined by Wendler (2012) for generalisable maturity models. The CHEK DBP Maturity Model (Ataide et al., 2023) is developed. It represents a framework that can be adapted to assess building permit processes in municipalities outside the CHEK context, but that can be used by different municipalities across different countries.

In conclusion, the choice of testing and evaluation methodologies for assessing the maturity of building permit processes is grounded in current literature on maturity assessment. By synthesising best practices from various contemporary maturity model approaches and adapting them to the specific context of municipal permit processes, a robust and comprehensive assessment framework is developed. This approach not only allows for an accurate evaluation of the current state but also provides valuable insights for process improvement and organisational development in the assessed municipalities.

3.2. Methodology and phases of testing

Following the work done during Tasks 1.1 and 1.2, and the resulting CHEK DBP Process Map[6] (Braholli et al., 2023), CHEK DBP Maturity Model[7], and CHEK Roadmap (Ataide et al., 2023), this deliverable aims to present the preliminary tests conducted on the outcomes of the previous tasks. These tests allow for the validation of the presented results and provide an overview of the KPIs that can be achieved through the project. To achieve these results, the current task was divided into two main goals:

1. evaluate the assessment of the maturity model using different methodologies.
2. evaluate the evolution of the maturity that can be achieved using CHEK tools.

The methodology for this task is based on comparing the results of different testing scenarios. Each scenario represents a phase of testing that uses the same data (the current building permit process of the municipalities) but is collected in a different manner. The four phases will use different methods for the collection of the data from the municipality (interview, VA assisted and VA independently), and the maturity results of each phase will be compared to understand the validation of different methods to assess maturity of an organisation. Each phase will be conducted with all four municipalities partnered with CHEK: Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague. Once all municipalities complete one phase, the process moves to the next phase, until all phases are completed for all municipalities. The methodology involves a structured approach that includes defining the testing criteria, establishing the test scenarios, executing the tests, and finally, analysing the results.

[5] Available on D1.2_CHEK_101058559_Maturity-Model-and-Roadmap_v1.0_Final.pdf (chekdbp.eu)
[6] Available on https://zenodo.org/record/7789035
[7] Available on https://zenodo.org/doi/10.5281/zenodo.10277474

Defining the testing criteria

Building on the results from previous tasks in WP1, the testing criteria were defined by selecting the most relevant aspects for evaluation during this phase. These criteria are focused on the needs of end-users of a digital building permit (DBP), particularly municipalities and applicants. As the digital maturity of municipalities remains a bottleneck in DBP implementation, the primary focus is on assessing their maturity and developing a scalable, reliable method to help municipalities assess their maturity and create effective implementation strategies.

The tests focus on comparing the results of maturity assessments using different methodologies. In particular, the CHEK Change Management Virtual Assistant (CHEK VA), to be presented in D1.3 (M30), will be evaluated for its ability to optimise maturity assessments compared to traditional expert-driven methods. Additionally, key performance indicators (KPIs) from this phase will be used to measure the impact of CHEK tools on the overall digital maturity of municipalities and Use Cases from WP6 (D1.5 – M30).

Defining the testing scenarios and conducting the tests

The testing scenarios are divided into four phases:

1. Maturity Model assessment of municipalities using the traditional method (Expert-led) – In this phase, the traditional method of assessing maturity will be conducted by an expert on the maturity model and digital building permit. This serves as a baseline for the comparison, establishing a benchmark for assessing how municipalities are performing in their current state of digital maturity. The expert will conduct a semi-structured interview with a set of questions that will give data necessary for a detailed assessment of the municipalities' maturity using conventional assessment techniques.
2. Maturity Model assessment of municipalities using the CHEK Virtual Assistant, assisted by an expert – In this phase, municipalities will provide input regarding their current processes, and the expert will use the CHEK VA to assess their maturity. The goal here is to evaluate how effectively the assistant can process the information provided by the municipalities and generate results that align with the traditional expert-led assessment. This phase will assess the efficiency and accuracy of the VA method when handled by a domain expert. The expert, using the municipalities' input, will conduct the maturity assessment through the CHEK VA. The results will be compared to the expert-led traditional method to evaluate the accuracy and efficiency of the assistant in supporting the maturity assessment process.
3. Maturity Model assessment of municipalities using the CHEK Virtual Assistant independently – his scenario will test the municipalities' maturity assessment independently using the CHEK VA without expert intervention. The goal is to compare the results from this independent VA-based assessment with those obtained in the expert-driven and VA-assisted phases, measuring how well the VA performs in a real-world, autonomous application by non-expert users and to gauge the VA's reliability when used autonomously by non-expert users.
4. Maturity Model assessment of Use Cases (Pre- and Post-CHEK) – This phase focuses on evaluating the maturity of the initial building permit process before the implementation of the CHEK tools and comparing it to the maturity after the CHEK toolkit processes are applied. The aim is to assess the improvement in digital maturity that results from using the CHEK tools, demonstrating their effectiveness in Use Cases from WP6.

The digital maturity of the processes involved in the Use Cases will be assessed after the implementation of the CHEK tools. Allowing the comparison of AS-IS vs. TO-BE scenario. This phase aims to measure the improvement in digital maturity facilitated by the CHEK toolkit.

Analysing the results

The results of the testing phase are expected after all 4 phases are concluded (to be shared on Deliverable D1.5). Once the tests are completed, those results will be analysed across several dimensions:

- Accuracy – The results of the VA-based assessments (both expert-assisted and independent) will be compared with the traditional expert-led assessments. This comparison will evaluate how well the VA replicates or improves upon the accuracy of the manual assessment process.
- Consistency of results – This will be measured by comparing the results across the four municipalities using both expert-led and VA-based methods. This comparison will analyse the degree to which the VA provides standardised and reliable outputs, both with and without expert input. The consistency will be determined by evaluating the variation between the results, ensuring that the VA can replicate expert judgments and reduce subjectivity across similar inputs.
- Scalability – It will be measured by the VA's ability to deliver accurate and reliable assessments across the four municipalities, producing consistent results both with and without expert input. Demonstrating the tool's capacity to scale and be applied across a broader range of municipalities and regulatory environments. This can confirm the VA's ability to maintain consistency and accuracy when deployed on a larger scale.
- Impact on digital maturity – The maturity of the initial situation of the building permit processes in the municipalities will be compared to the maturity achieved after the implementation of the CHEK tools. This KPI will measure the improvement in digital maturity facilitated by the use of the CHEK toolkit in simulated real-world scenarios.

3.3. Phase 1 - Expert-led assessment

The present deliverable presents the preliminary results of the testing phase of WP1, as explained in previous section 2.1. The methodology for each specific phase will be detailed when results of the corresponding phase are published (D1.4 for Phase 1 and D1.5 for Phases 2 to 4). For the current phase of expert-le assessment the methodology followed a data collection based on semi-structured interviews, the data analysis and processing by the interviewers, culminating on the result of Phase 1.

3.3.1. Data collection

The data collection for the Phase 1 of testing (Traditional Method - Expert-led Assessment) was carried by semi-structured interviews with municipalities technicians held over the course of April and May 2024. Each municipality followed one workshop with one expert from Fraunhofer Italia, in a total of 4 interviews. Each expert alone handled the

interviews of two municipalities (Expert 1: Ascoli and Prague; Expert 2: Lisbon and Gaia). The experts have high knowledge on the CHEK DBP MM and on digital building permit processes.

The interview workshops were online, with 2 hours each. The expert followed a set of 35 questions that were answered one by one by the technicians. The questions were prepared to allow the assessment of all the categories of the Maturity Model based on the respective answers. The 4 workshops followed the same structure, described on the following section.

3.3.1.1. Interview structure

Phase 1 - Testing the maturity assessment with the traditional method.

Introduction: Explain the interview structure and goals (10 min)

- Explain the structure of the interview
- Explain the goals of the interview
- Brief the participants on how to answer the questions

Semi-structured interview: Questions asked by topics (100 min)

- 35 questions in total + follow-up questions
- Make all the 35 during the interview. If it was answer before, the participants just must state that the question was already answered
- Some questions have a follow up question depending on the answer from the municipalities
- Typology of questions is mixed, yes/no questions, questions that can be answered with one word/short answer and open-end questions

Wrap up: Explain the next steps and dismiss all the participants (10 min)

- Explain the next steps (phases 2 and 3), after all interviews are completed
- Explain the sharing of results that will be done only after all steps are completed by all municipalities
- Answer questions by the participants
- Thank for their participation and close the interview

After workshop: Done only by the experts

- Process the interview results for each municipality
- Analyse the answers and cross with the CHEK DBP Maturity Model
- Define the maturity level for each Key Maturity Area (KMA) on the maturity model (available on an Excel format)
- Produce the report with the levels of maturity for each municipality
- Each assessment should be done by the same expert that made the interview

3.3.1.2. Interview questions

The 35 questions cover all four categories of the CHEK DBP Maturity Model and address specific Key Maturity Areas (KMAs). The questions are organised into 6 main topics to facilitate the interview process and avoid overlapping questions that address similar areas. This structure helps maintain focus during the interview and ensures clarity in the responses. While discussing each topic, participants were encouraged to provide additional context and information if necessary. Grouping the questions by topic also reduced confusion, repetition, and the possibility of contradictory answers.

Question topics:

- Process and standards
- Data management and standards
- Parties' integration and interaction
- Organisation and internal infrastructure
- Validation and checking
- Legislation

Process and standards

1. How is the building permit process currently documented and accessed within your municipality? Specifically, is there a formal or informal process map available to the public, and how detailed is it?
    - In your digital systems, how is the building permit process integrated and managed? Are all steps executed within this digital environment, and to what extent is the process automated for efficiency and constant improvement?
2. How is the municipality's current approach to setting standards, monitoring quality, and measuring performance within the building permit process? Specifically, are there defined quality plans, benchmarks, KPIs, and how regularly are these reviewed and updated for continuous improvement?
3. Does your municipality currently have guidelines or standards for the building permit process? How are these guidelines communicated to and followed by technicians and other stakeholders?
    - After the guidelines are used by applicants, do you get many inquiries about how the procedures should be done? How frequently are these guidelines reviewed and updated for alignment with quality improvements and regulations?
4. How are timelines and response times defined and communicated within the building permit process? The timelines of the whole process and of each step. What percentage of processes follow these timelines?
    - What measures are in place for monitoring, measuring, and optimising these timelines based on performance metrics and feedback?

Data management and standards

5. What level of standardisation exists in terms of data templates, formats, and documentation requirements across permit processes? Are these standardised practices widely accessible and used by all stakeholders?
    - How do you ensure continuous improvement in the use of standard data formats and documentation practices?
6. How is the municipality's approach to digital data management, specifically how data related to the building permit process is managed, shared, and accessed by different stakeholders? Additionally, are there advanced digital systems in place, like open API-based ecosystems or distributed data spaces, that facilitate collaboration among all stakeholders, including automated workflows?
    - Is anybody in the municipality aware of the entire process? Or each division is responsible only for the data related to that specific step of the process?
7. How does the municipality manage data storage and repository for the building permit process (from analogue systems to centralised digital repositories)? Please include any steps taken towards data governance, lifecycle management, and the integration of automated workflows within your data ecosystem.
8. What are the procedures for verifying procedural (administrative) data within your building permit process? Has this evolved from manual checks to fully automated verification against connected databases? What technologies are employed to facilitate this?
9. How does your municipality ensure that different digital data formats used in the building permit process are compatible with each other? Highlight any use of open formats or APIs to facilitate data exchange among various systems.
10. What is the current level of integration between building data and geospatial data in your municipality's processes? How are building and geospatial data visualised, georeferenced, and converted between each other?
    - What technologies or methodologies are employed to facilitate the integration of BIM and GIS data? Include any use of semantic mapping, automatic mapping, and real-time data communication.
11. How does your municipality ensure the alignment and comprehensive mapping between building data and geospatial data, and what advancements have been made towards automating these processes?
12. How does your municipality define and implement data standards and guidelines for the building permit process? Please describe the progression from initial guidelines to fully integrated standard-based, machine-readable data requirements, and any steps toward influencing industry standards.
13. How does your municipality ensure the quality of data within the building permit process? Describe your progression from initial informal quality control plans to the implementation of comprehensive quality plans with automated feedback mechanisms.

Parties' integration and interaction

14. How is the stakeholders' awareness of the building permit process steps and their responsibilities? Can you provide examples of how this awareness is facilitated or supported, such as through guidelines, checklists, or digital platforms?
    - Do all stakeholders have the guidelines and checklists for the process? Example applicants and agencies involved in the process.
15. How do stakeholders access information related to the building permit process? Are there different sources or a unified digital platform for this purpose?
    - Can stakeholders receive real-time updates or alerts on permit status? How interactive and personalised are these notifications?
16. How transparent is the information workflow of the building permit process to stakeholders? In the sense of the information that is being handled at each step pf the process. Do they have access to real-time tracking and are open to the applicants?
    - Are there collaborative features or platforms that allow stakeholders (to internal and external) to participate actively in the process and access detailed process metrics and documentation?
17. To what extent key stakeholders use digital data technologies in the building permit process? What percentage of stakeholders are using shared digital data effectively, and how integrated is this data across different steps in the process?
18. How has your municipality implemented digital submission and identification processes, including the use of electronic signatures and machine-readable formats? Please describe the extent to which these processes are automated and integrated with identity verification authorities.
19. What are the communication systems in place for internal and external stakeholders? Is there an evolution from analogue systems? Does the system integrate fully integrated digital tools that support live communication and automated updates?

Organisation and internal infrastructure

20. What percentage of your staff is actively involved in digital transformation initiatives, and how do they contribute to identifying and implementing digital solutions? Could you describe the extent of staff participation in training programs focused on modern technologies and the processes for sharing digital best practices within your organisation?
    - How is the acceptance of other staff members to enter in this digital transformation? What is the size of the building permit department?
21. How does higher management currently support and direct digital transformation efforts, such as the implementation of technologies like BIM and GIS?
    - Is there strategic planning and integration of digital innovations within organisational goals?

22. Can you outline your strategy for implementing a data ecosystem within your organisation? What stages have you reached in integrating digital tools and processes, such as BIM and GIS, and how do you foster a culture of innovation and continuous improvement in data practices?
23. How is the structure and level of dedication of your staff towards technologies like BIM and GIS? How many staff members are fully dedicated to these technologies?
24. How would you rate the proficiency and practical experience of your technicians in data technologies such as BIM and GIS? What percentage of your technicians regularly use these tools, and how many have pursued formal certifications or are considered experts?
25. What training and support structures are in place for employees working with digital and data technologies?
    - How many hours of training do employees receive annually, and how is this training integrated into your organisational strategies?
26. Evaluating the current state of your infrastructure's readiness to support digital permitting processes, what percentage of your infrastructure supports necessary digital tools (such as computer and networks that can host BIM/GIS software and others)?
    - How are continuous upgrades and enhancements managed? Are there any plans for upgrades to accommodate new technologies?

Validation and checking

27. How is your process for validating building data, such as dimensions and materials. Do you use any specific software or databases for this purpose?
28. How do you validate spatial data, like the location and environmental context of a building project? What tools or data sources are used?
29. How do you integrate detailed building information (like BIM models) with geospatial data? What challenges have you faced in this integration?
30. How do you use geospatial data to inform building data and models? Are there specific tools or workflows you employ for this purpose?
31. How does your municipality currently perform data inspection and visualisation? Please describe the progression from manual inspection to the use of advanced numerical simulations and immersive technologies like AR/VR for decision-making.
32. How does your municipality use digital tools for content analysis and regulation checking within the building permit process? Describe any automated systems in place for rule checking based on digital building data.

Legislation

33. How flexible is your legislative system in adapting to changes that facilitate digital transformation, such as simplifying rule interpretation and compliance checks? Are there any efforts made towards making regulations clearer and reducing subjective interpretation?

34. How is the current evolution of regulation formats in your municipality, from regulations in natural language to a database of machine-readable rules? Highlight any steps towards making regulations more structured, accessible, and integrated across platforms.
35. How are regulations made accessible to both internal and external stakeholders? In which format they available (from traditional formats to advanced, machine-readable formats)? Are there any tools or systems that support real-time updates, automated analysis, and compliance checks with regulations.

3.3.2. Data analysis and processing

The CHEK DBP Maturity Model consists of 35 KMAs, divided into four categories: Process, Organisation, Technology, and Information. Each KMA is evaluated on a scale of 0 to 5, where 0 represents no maturity, and 5 represents the highest level of maturity. The overall maturity for each category is determined by aggregating the maturity levels assigned to each KMA within that category.

The data collected from the interviews were analysed in detail for each municipality. The responses provided during the interviews were cross-referenced with the corresponding KMAs in the Maturity Model to determine the appropriate maturity levels. The experts processed the qualitative data by interpreting the interview content and assigning maturity levels based on how well the municipality's responses aligned with the criteria for each maturity level. This data processing provided a comprehensive picture of the municipality's current state of digital maturity in each category.

Each municipality's responses were evaluated by the same expert who conducted the interviews, the data was analysed after the interviews and crossed with the Key Maturity Areas of the CHEK DBP Maturity Model. The questions were formulated to allow for the answers to be easily related with the KMAs, being more straightforward to find a match on the levels. This approach was used to try to increase the consistency, even among the different experts, and ensured that the maturity levels assigned were aligned with the model's predefined criteria.

3.3.3. Interview results

Upon completing the assessment, a report was generated for each municipality. Each report presents the final assessment, including a detailed justification for the assigned maturity levels. The summary includes a graphic representation of the municipality's maturity across the four main categories - Process, Organisation, Technology, and Information - enabling a clear comparison of their relative strengths and areas for improvement.

In addition to the summary graphics, the report explains the reasoning behind the maturity level assigned to the municipality. The expert's analysis considers the nuances of the municipalities' responses and how they align with the maturity criteria. The full Excel files containing the detailed assessment for each municipality can be found in Annex I (attached excel files) of this deliverable. On the Excel files is possible to see the full maturity model with all detailed KMAs scores, and the "Current Maturity" (in red) and "CHEK benchmark maturity" (in blue) graphics also shown in Section 4 (Figures 2 - 17).

4. Preliminary results and validation

Chapter Summary
This chapter presents the results of the first round of testing using the maturity model to assess the current state of the digital building permit process in the four municipalities participating in the CHEK project. FHI conducted initial interviews to gather information and assess the maturity of these processes. The maturity results are presented, analysed, and illustrated through graphs based on four maturity categories: process, information, technology, and organisation. This assessment will continue throughout the work package (WP1), with the goal of continuously improving and optimising the outcomes. Following the intermediate feedback phase (D1.4), the relevant key performance indicators (KPIs) will be re-evaluated (D1.5) to track progress and guide further optimisations.

4.1. Ascoli Piceno, Italy

4.1.1. Interview report

The relevant information for the maturity assessment of the building permit process for the municipality of Ascoli Piceno was collected during a two-hour meeting with two representatives of the building permit office. On May 14th, 2024, FHI conducted a semi-structured interview with questions addressing their current situation of processes, organisation, technology and information. The collected information was analysed by FHI to assess the overall maturity of the building permit process in the municipality of Ascoli Piceno.

The municipality's current digital maturity in managing building permits is relatively low, with substantial reliance on manual or semi-digital processes. However, there are significant opportunities for improvement by adopting comprehensive digital solutions, enhancing organisational responsiveness to digital needs, centralising information management, and upgrading technological infrastructure. These steps could lead to more streamlined, efficient, and transparent building permit processes. The municipality of Ascoli Piceno demonstrates openness and actual efforts to evolve the process and reach a higher maturity.

The municipality's building permit process shows significant challenges in terms of maturity, documentation, and digital integration. During the interview, it became apparent that while there is a digital platform in place for handling the submission of building permit requests, this platform lacks comprehensive automation and effective data management features. The current situation would be described better as an attempt to dematerialisation rather than a step towards digitalisation.

Currently, the municipality operates with a local digital platform that primarily guides applicants through the submission of building permits. This system provides basic prompts to ensure necessary information is filled out before progressing. However, the process is not automated beyond this initial stage, requiring manual intervention to upload and manage documents such as PDFs and technical drawings. The integration between the front-end submission process and back-office operations is virtually non-existent, necessitating manual communication through certified email (PEC) for approvals, feedback, and updates, which is both time-consuming and prone to errors.

One of the key limitations is the lack of a standardised documentation process. There is no comprehensive mapping or written documentation that outlines the end-to-end workflow for building permits. The lack of a unified guideline means the process is subject to individual interpretation, leading to inconsistencies in the handling of permits. The

system also does not support real-time data sharing with other stakeholders like fire departments or historical preservation agencies, which results in additional delays and potential discrepancies.

Moreover, there is no structured mechanism for monitoring and evaluating the quality and efficiency of the process. The only metric currently in place evaluates individual employee performance based on the number of permits processed, rather than focusing on the overall effectiveness of the workflow or service quality.

The interview highlighted a pressing need for greater digital integration and standardisation within the municipality's systems. While there is a national legislative framework guiding many aspects of the building permit process, local adaptations are still necessary. The municipality has no influence over these legislative processes and has limited capacity to provide feedback on their implementation. This inflexibility further complicates efforts to streamline and improve operations at the local level.

The data management standards are inconsistent, with documents often submitted in varying formats that are not compatible with the platform's requirements. This leads to inefficiencies and miscommunications, as documents must be manually verified and reformatted. In addition, the current system does not support interoperability with other municipal or external platforms, limiting the municipality's ability to manage and use data effectively.

Internally, there is a lack of dedicated resources for digital transformation. The digital transition team is shared across multiple departments and does not focus exclusively on improving the building permit process. Most changes and updates to the system require external support, which introduces delays and prevents timely adaptations to evolving requirements.

Despite these challenges, the municipality is actively participating in initiatives to evaluate and improve its digital capabilities, although the progress is slow, and the results are not yet evident. There is also an awareness of the importance of digitalisation, but concrete plans and resources for implementation are still lacking.

In conclusion, the municipality's building permit process is at an early stage of digital maturity. The process is heavily reliant on manual interventions, lacks a cohesive structure, and suffers from limited data integration and communication between stakeholders. Moving forward, the municipality would benefit from establishing clearer documentation, enhancing digital platforms to better integrate front- and back-office operations, and allocating more resources to support digital transformation initiatives.

4.1.2. Maturity assessment

Process

The process is partially digitised with initial submissions handled through a guided online platform. However, subsequent processes including reviews and approvals remain manual, relying on email communications (PEC) and manual uploads of documents.

The manual components of the process create bottlenecks, leading to delays and potential errors. The lack of full integration across all steps results in inefficiencies, and there is no automation beyond the initial submission, which limits the ability to scale and improve the service.

Fully digitising the entire process could substantially improve efficiency and accuracy. Implementing an end-to-end digital solution that includes automation of common tasks and integration between different platforms used by various departments could streamline operations and reduce turnaround times.

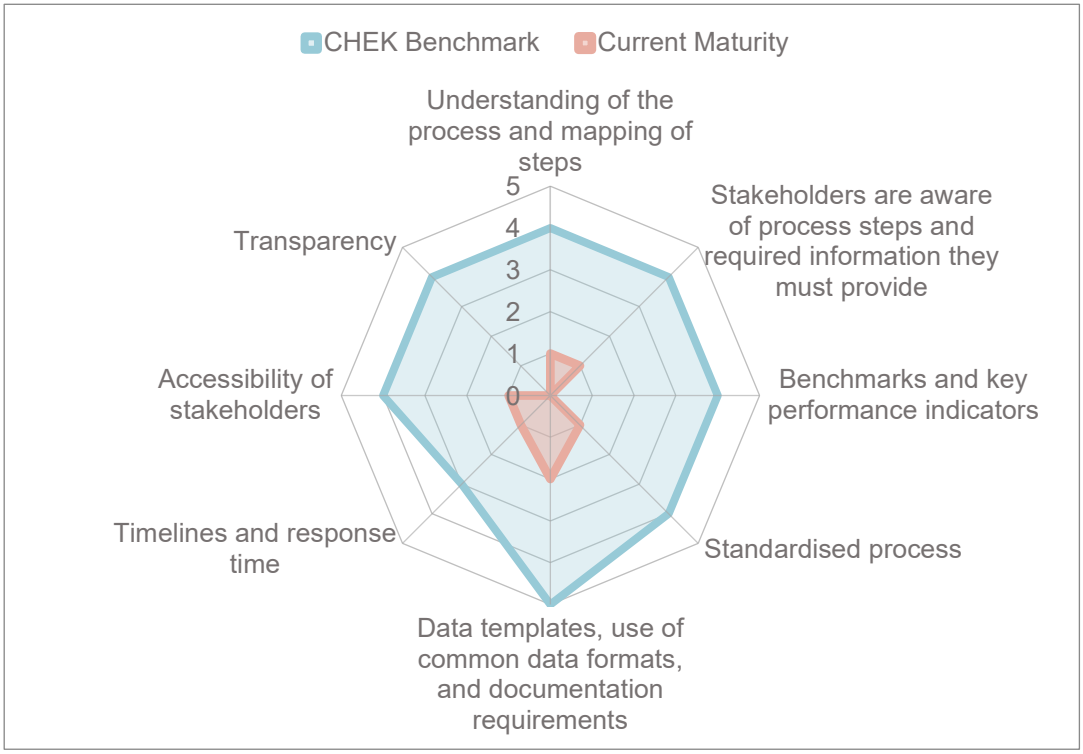

Figure 2 Process maturity of Ascoli Piceno

Organisation

The organisation structure is well-defined with clear roles and responsibilities. However, there is a reactive rather than proactive approach to digital innovation, relying heavily on directives from higher authorities rather than initiating local improvements.

The centralisation of digital initiatives could delay the adaptation of solutions that meet local specific needs. The absence of local digital leadership might slow down the adoption of new technologies.

Establishing a local digital transformation team could empower the municipality to address specific challenges more effectively. This team could focus on adapting and implementing digital solutions that are tailored to local needs, enhancing the responsiveness and effectiveness of the building permit process.

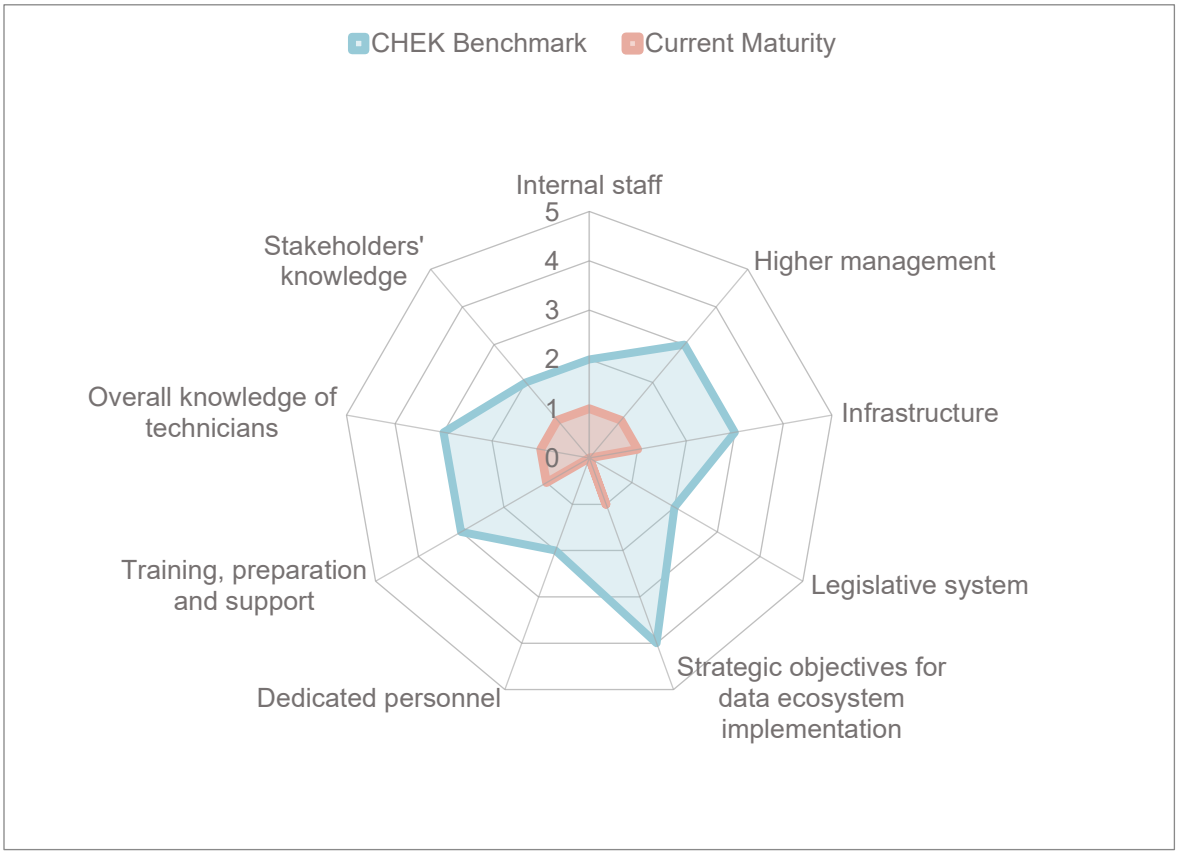

Figure 3 Organisation maturity of Ascoli Piceno

Technology

Technology usage is limited to basic digital communication tools such as email. There is a significant reliance on manual processes, and the existing technological infrastructure does not support comprehensive digital workflow management.

The current technological setup is inadequate for supporting a fully digital building permit process. There is a lack of advanced digital tools that could enhance data analysis, automate workflows, and integrate systems across the municipal operation.

Investing in modern IT infrastructure, including cloud services and specialised software for government services, could transform the building permit process. Implementing systems that support data integration, such as GIS and Building Information Modelling (BIM), could further enhance the efficiency and transparency of the process.

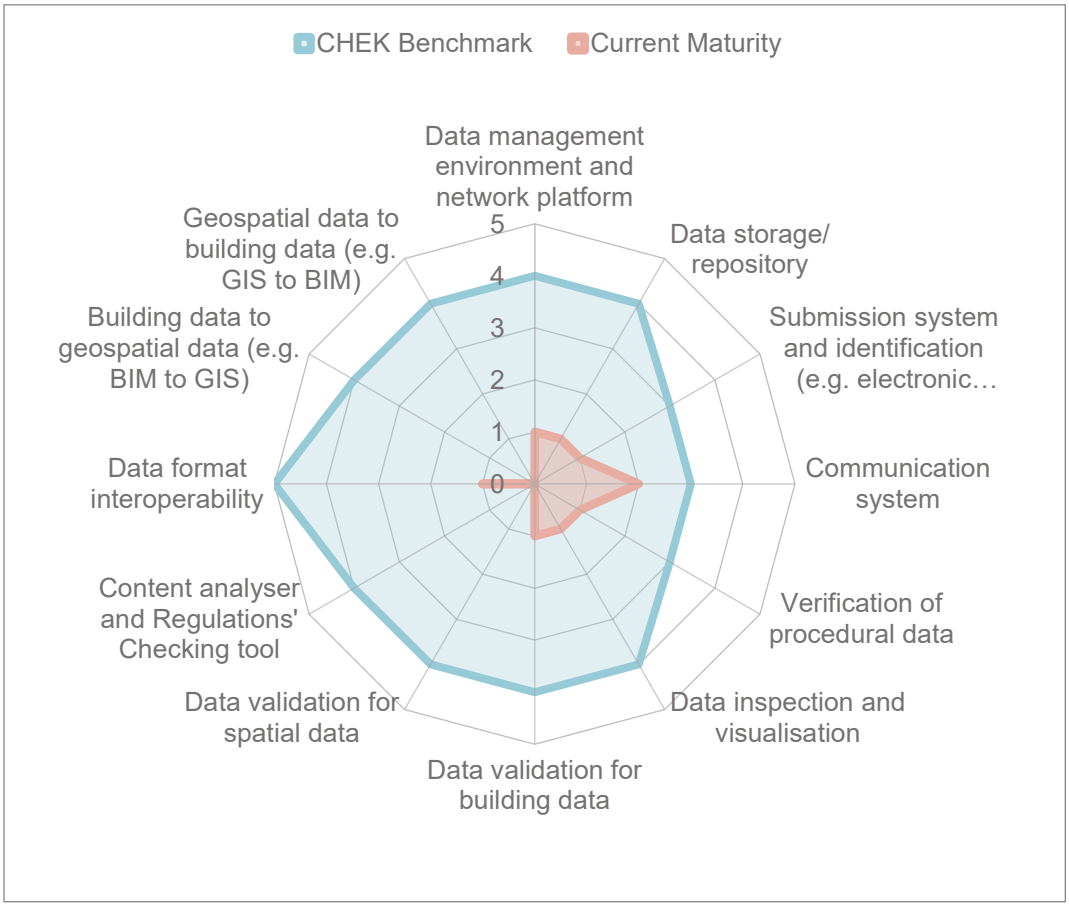

Figure 4 Technology maturity of Ascoli Piceno

Information

Information management is mixed, with initial applications being processed digitally but subsequent documentation managed manually. This dual system leads to disjointed information flows and storage.

The reliance on paper and manual processes for critical parts of the building permit applications complicates data management and retrieval, increasing the risk of errors and information loss.

Developing a unified digital document management system could centralise information storage and retrieval, making it easier to manage, access, and secure data. Such a system would also facilitate better communication and information sharing among all stakeholders.

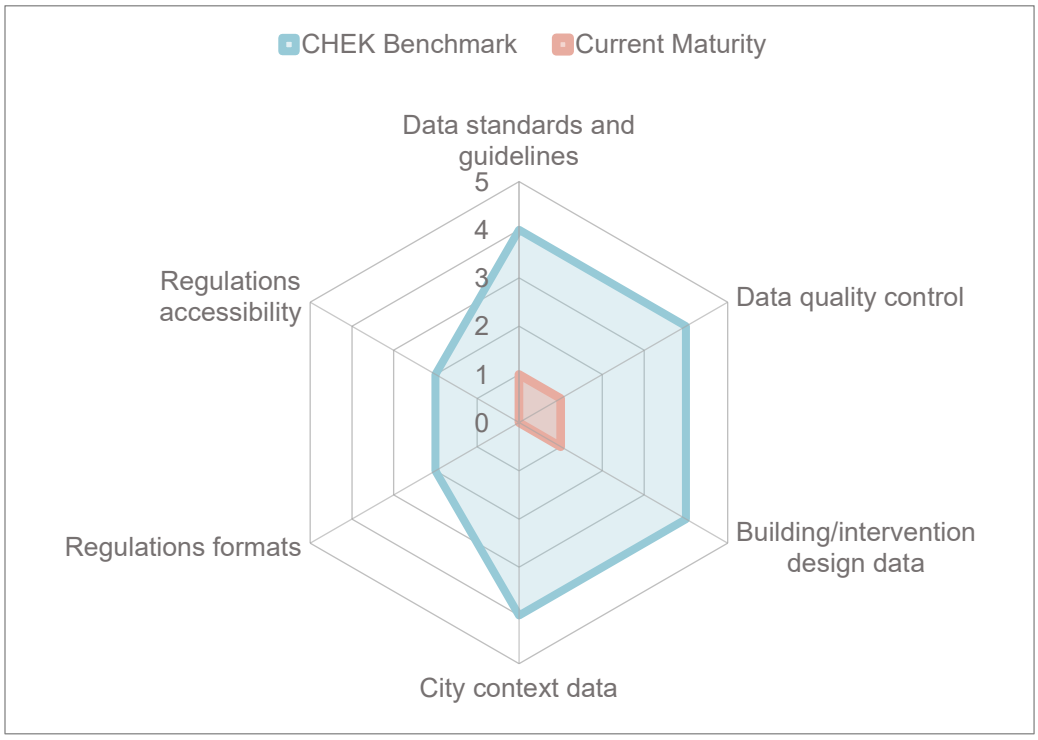

Figure 5 Information maturity of Ascoli Piceno

4.2. Lisbon, Portugal

4.2.1. Interview report

The workshop conducted on April 10th, 2024, to assess the Lisbon maturity on Digital Building Permit process provided insightful discussions on several fronts. Over the course of two hours, the 35 questions were posed, which helped to uncover various aspects of the current status of the municipality and the digital transformation efforts.

The municipality maintains basic workflow diagrams for the building permit procedures, which are documented internally but not shared widely within the municipal departments or with the public. This lack of shared documentation creates a bottleneck in the process by impeding access and transparency.

Digital systems to manage the building permit process have been established, but they display scattered and non-linear integration. There is an ongoing effort to map and insert procedural data into a dedicated portal, although full automation and optimisation of the process are still forthcoming. Although the municipality has begun to track Key Performance Indicators (KPIs) to monitor efficiency and quality, the absence of a seamless information workflow holds back the full utilisation of these metrics, and consequently the improvement of processes based on the measures.

Internal guidelines are available within the departments, yet there is no effective mechanism to communicate these externally to designers or building owners. The regulatory landscape that guides these internal guidelines is in constant evolution. The nature of constant change of the regulations complicates the maintenance of consistent and current

practices. There are teams inside the municipality dedicated to improving processes and workflows, however the changes are usually disrupted by the constant change of the regulatory system.

The defined timelines for the building permit process are set by the legislation. However, they are frequently unmet. Analyses to understand and mitigate delays are in progress, but the optimisations have not been fully implemented yet. The absence of a comprehensive measurement of the global timeline and frequent process interruptions add further complexity to timely project executions.

Data management within the municipality showcases some standardisation of formats and templates as stipulated by legislation. Issues predominantly arise from the data quality provided by applicants, which often fails to meet the required standards. "Loja Lisboa Online" is the platform for application submission and geographic referencing, the initial digitalisation of the process by accepting digital documents rather than paper was enforced by the COVID pandemic in 2020. Even though there is an initial effort towards digitalising processes, there is still a significant gap in comprehensive data integration and sharing across different municipal departments.

Awareness of the building permit process varies significantly among stakeholders. Key municipal agencies are well-informed about their roles and responsibilities, whereas external applicants struggle with the regulatory complexities due to varied rules across different zones. The system currently does not support real-time updates or facilitate active participation from external stakeholders, indicating a need for enhanced communication and engagement mechanisms.

The workshop revealed that while Lisbon Municipality is making strides towards transforming its building permit process into a fully digital system, several areas require attention to achieve a streamlined, efficient, and user-friendly process. The discussions pointed towards a need for better documentation, enhanced stakeholder communication, and more robust digital tools to support the ongoing transformation efforts. These elements are crucial for the municipality to reach its digital transformation goals effectively.

4.2.2. Maturity assessment

Process

The process maturity of the municipality of Lisbon, according to the CHEK DBP MM is low. Ranging from level 0 to 1. The municipality shows early efforts to improve the digitalisation and automation of the process; however, still lacks more advanced techniques for reaching a higher level.

The process is mapped, but not formalised and shared internally or externally. The municipality is still on the transition to monitoring the whole workflow with a digital platform. Thus, there are defined KPIs, but not official measure and usable results. The same happens with timelines, where they are defined but not officially measured and mostly not followed. Accessibility of external stakeholders is limited, resulting in a low level of transparency.

The municipality uses standards on the process and documents, but they are mostly for internal use. Technicians usually have guidelines to aid on their part of the process, the documents used have templates to be followed. However, applicants must rely only on the legislation that is often complex and unclear, and this causes many errors from their part.

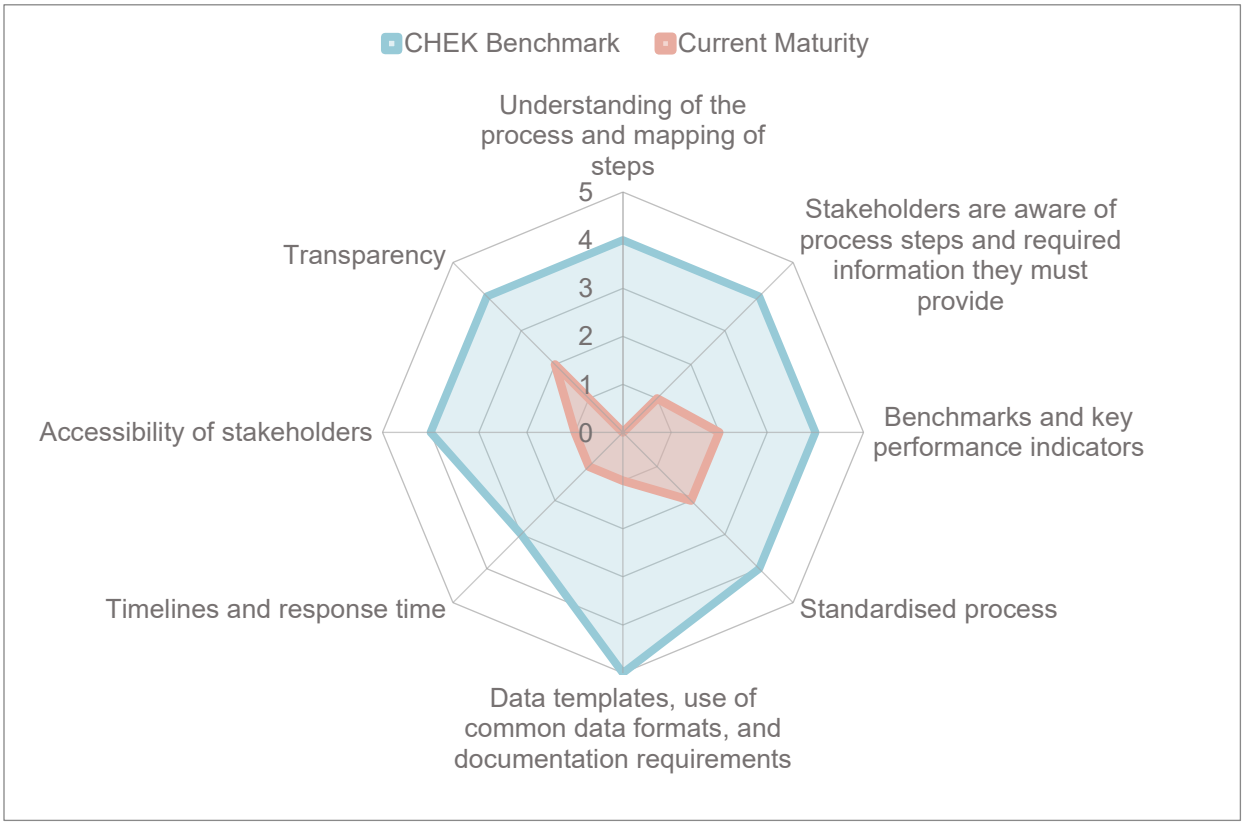

Figure 6 Process maturity of Lisbon

Organisation

The assessment of the municipality's digital transformation in the building permit process highlights a strategic effort to enhance digital maturity across various KMAs. The evaluation shows a low level of maturity, ranging between level 0 and 1.

Starting with internal staff, the municipality currently exhibits a low level of openness to digitalisation among staff, with only a minority actively participating in identifying digital needs and benefits. Higher management currently shows basic support for digital transformation, with most of the efforts for a digital transformation coming from a bottom-up approach. The infrastructure necessary to support the digital permitting process is partially in place but lacks the capability to fully support all required software and tools when changing from a 2d to a 3d based process.

Strategic objectives for data ecosystem implementation are at a nascent stage, lacking a comprehensive implementation strategy with limited integration of processes and standardised practices. Dedicated personnel for digital technologies are limited, with less than 5% working on new technologies. Overall, knowledge of technicians show room for improvement. Currently, only a minority of technicians and stakeholders are well-versed in using digital data effectively.

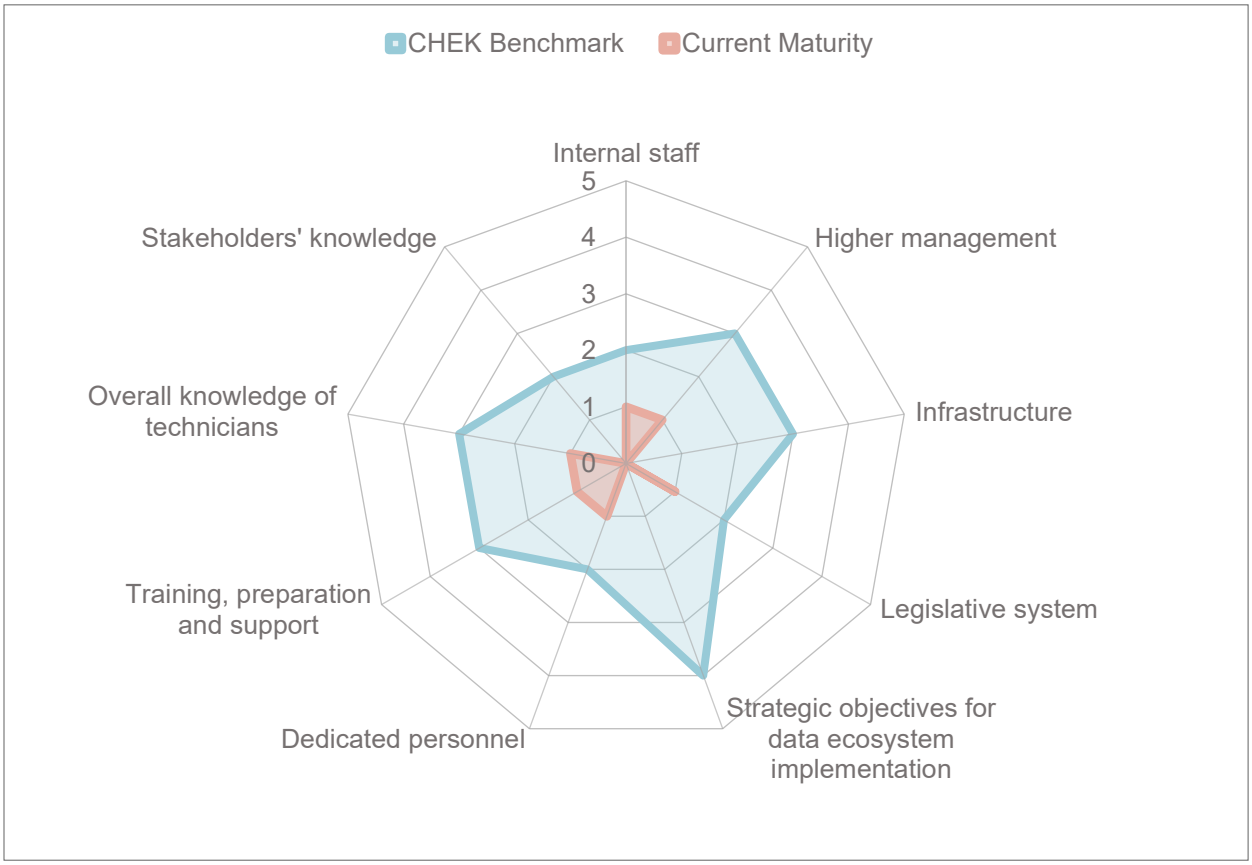

Figure 7 Organisation maturity of Lisbon

Technology

The assessment of the technology category data reveals varying levels of maturity across the different KMAs. While the municipality counts with a good managing platform, there are still very feel other aspects that have more advanced digitalisation. Most of the process it is on the first stage of digitalisation using mostly digital documents without any metadata that could be reused on other steps of the process.

In the realm of data management environments and network platforms, the municipality has developed a modular platform. Although internal data is well-managed and accessible throughout the organisation, integration with external stakeholder data is not yet realised. For data storage and repository, the municipality maintains a centralised repository that serves ongoing and archived processes, accessible by internal staff but lacking comprehensive data governance and advanced features like automated backups and lifecycle management.

The submission system is in its nascent stage with digital document submission capabilities that do not yet support machine-readable formats or advanced digital signing. Similarly, the processes for verifying procedural data and inspecting data are primarily manual, supplemented by basic digital visualisation tools. This setup indicates a foundational digital environment that still relies significantly on manual input and verification.

Data validation and interoperability formats show a slightly better integration, using open formats and some digital verification methods, though they are basically for 2D drawings and documents. Overall, the municipality has made initial steps towards a digital transformation but must focus on enhancing automation, integration, and comprehensive digital governance to progress to higher levels of digital maturity.

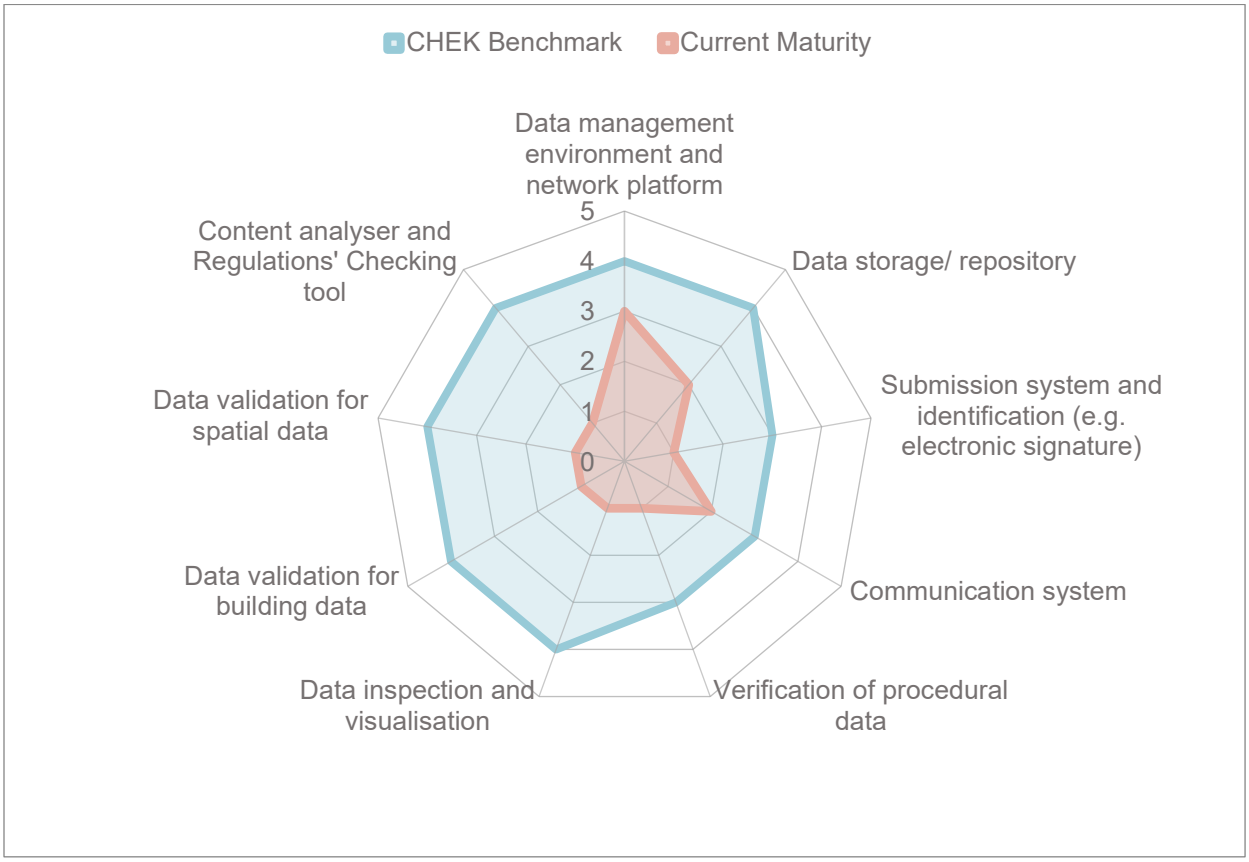

Figure 8 Technology maturity of Lisbon

Information

The maturity model assessment for the municipality's information maturity reveals very low stage in the adoption and integration of digital data across the key areas. Considering the only recent digitalisation of documents to a digital-based visualisation and analysis, the municipality still needs to implement digital data use in mostly all steps of the process.

The municipality has yet to establish formal guidelines or specifications for data standards, which are essential for creating a structured and efficient digital workflow. In terms of data quality control, while there is an acknowledgment of the importance of data integrity, the efforts are informal lack robust measurement and monitoring systems. Additionally, the current use of analogue data (2D drawings without any metadata) in building data shows a considerable reliance on traditional methods, with only initial steps toward digital transformation focused on visualisation in a digital environment.

Moreover, regulatory information is primarily managed in natural language and accessed through static means, such as paper or PDF formats. Overall, the municipality's approach to integrating digital technologies in the building permit process is still in the preliminary stages, requiring substantial enhancements in data handling, quality control, and regulatory management to achieve a higher level of digital maturity.

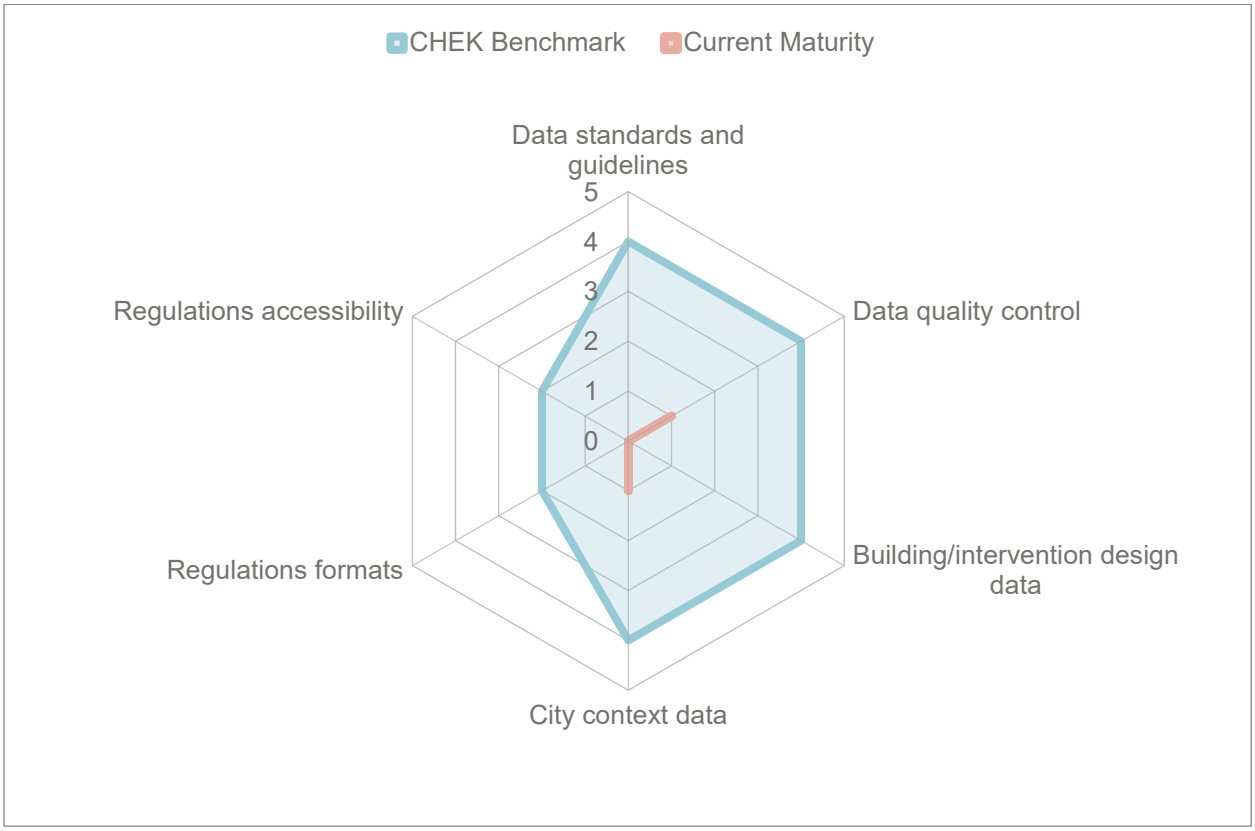

Figure 9 Information maturity of Lisbon

4.3. Vila Nova de Gaia, Portugal

4.3.1. Interview report

The workshop aimed to assess the municipality's level of maturity for the shift to a digital building permit process. The interview was done on May 8th, 2024, and revealed a well-structured approach that is thoroughly documented and adheres to ISO 9001 standards. The administrative processes and workflows between departments are heavily digitalised and automated, streamlining operations and ensuring compliance with established procedures. Employees have ready access to all necessary documentation, guided by clear KPIs for each process step, which helps maintain a consistent approach to managing the process.

Key Performance Indicators (KPIs) are in place for each step and are measured automatically via their internal platform, providing accurate tracking of process efficiency and effectiveness. Technicians have access to a dashboard displaying general stats, which aids in identifying and improving process aspects that may lag or require attention.

Internally, the municipality enforces stringent guidelines that all employees must follow to guarantee the quality of their work, which is a requirement for maintaining ISO certification. These guidelines are periodically reviewed and updated, considering both internal feedback and the constantly updated regulatory requirements. Despite this detailed internal standardisation, there are gaps in how applicants understand and follow their part on the process, sometimes resulting in incorrect or incomplete submissions. To mitigate this issue, the municipality has developed targeted informational materials and instructional videos aimed at improving external compliance and reducing submission errors.

Timelines for the building permit process are clearly defined for each step and align with national laws. However, adhering to these timelines, especially the general ones set by the law, proves challenging as they are not comprehensively measured and mostly not followed. The timelines for each step are set and direct the deadlines for the departments to finish with their part of the process, however there is no continuity on those deadlines the full timeline is often stretched. Recent adjustments have been made to integrate these timelines into the broader KPIs, facilitating better tracking and enforcement.

Data related to the building permit process are standardised and templates are used for internal documents, extending to the naming, and filing system within the digital platform, which automatically changes according to predefined codes to ensure data consistency and security. The municipality operates four main platforms that integrate various aspects of the process such as submission, document management, georeferencing, and data storage. All tools are interconnected via APIs that promote a seamless and semi-automatic workflow. A secure API-accessible database stores all internal documents, protected against unauthorised access or modification. This level of security ensures that the data remains intact and continuously updated without being compromised by external software errors.

Despite the overarching automation, manual checks are still necessary for procedural data such as registry or identity numbers against national or professional databases. Most design professionals and owners provide the numbers during the application process, however there is yet not a link with national platforms to check details and authenticity. The same for georeferencing of plots that has some automation when generating reports related to that parcel of land; however, the verification still needs to be done manually.

Even though there is a high level of automation and standardisation on the administrative tasks (meaning that the workflow among departments and technicians is all managed on a digital environment without much human input needed), the projects are still handed and verified on a traditional 2D method, with optional 3D submission as additional visualisation. Various formats are accepted, including PDF and DXF, besides IFC models on the applicant's choice. The models are used mostly for visualisation of the project. Although geospatial data is integrated into internal city maps, showing detailed layers of plot-related information, this data is not shared publicly due to the lack of standardised IFC models.

Communication with external agencies is regulated nationally, conducted via a national platform that manages all requests from all country municipalities. When the georeferencing is updated in the municipality system, there is an automatic report generated that lists to the agencies that should be consulted. If the project is according to the rules the technician confirms if there is the need of that consultancy. In case yes, the process is uploaded in this national platform to make the consultancy of the defined entity.

Nonetheless, real-time communication with the municipality is limited, with applicants typically having access to data on their process only after and official decision has been made. Despite this structured approach, real-time interaction with the company is limited and applicants should schedule in-person meeting if they desire to make inquires before applying or after the first decision. On the submission platform there is the possibility to visualise the department and the technician analysing the project at each step, but the platform only allows that. Ther is not possibility to contact the municipality or receiving notifications on the progression. Only when a decision is available, the applicant receives a SMS on their phone.

Even though the company shows a high maturity on the automation and data management, there is not a department or team dedicated to implement BIM in the process. About 10 out of 120 staff members involved in the building permit process are directly engaged in digital transformation efforts (not only BIM and GIS), with only three fully dedicated to this task. The higher management supports these initiatives but faces frequent challenges due to budget constraints, affecting the pace and extent of implementation.

Efforts to simplify construction legislation into a single code are underway on national and municipal level, aiming to facilitate easier compliance and interpretation. There are discussions to simplify the legislation on different fronts, but the municipality is active in giving consultancy for creating more machine-readable friendly legislation.

The municipality also ensures that all the legislation related to building permit (national and municipal) is accessible online. They recently launched a simulator that helps the applicant to understand which legislation is applied in their case. The user goes through a series of questions where they chose the case related to their project and this will identify where they can find the specific information regarding taxes and legislation.

In summary, the workshop revealed that Vila nova de Gaia building permit process showcases a high degree of process digitalisation and regulatory compliance, nonetheless it continues to face challenges in timeline adherence, stakeholder communication, and transparency.

4.3.2. Maturity assessment

Process

The municipality's process maturity highlights a well-developed understanding of procedural steps, along with effective benchmarks for quality and standardised processes. The municipality show a high level of maturity on the digital process, having good practices and focus on innovation and efficient solutions.

The processes within the municipality are extensively documented and integrated into a digital environment that supports comprehensive management of both technical and administrative tasks. Stakeholders are well-informed about their roles and responsibilities, with process steps and required documentation clearly communicated through digital platforms, which aid in reducing ambiguity and enhancing participation.

Regarding the benchmarks and key performance indicators, the municipality has effectively integrated these into their systems with proactive monitoring and quality control mechanisms in place. These benchmarks are not only defined but are actively measured and monitored, with feedback loops that supports in refining and adhering to regulations and standards.

However, the areas of data templates and transparency indicate a need for broader application and more inclusive sharing practices. There are ongoing improvements to data templates and common data formats within the municipality, yet these enhancements are predominantly internal and not expanded to applicants. External stakeholders do not have access to these standardised data formats, and critical building information modelling (BIM) standards have not been universally applied. In terms of transparency, while real-time updates are available, the information regarding the process is only shared post-completion, which may not fully support stakeholder engagement throughout the process. Thus, the municipality exhibits a high level of digital integration and communication within its internal operations, but improvements in external data sharing and process transparency could enhance overall stakeholder interaction and efficacy.

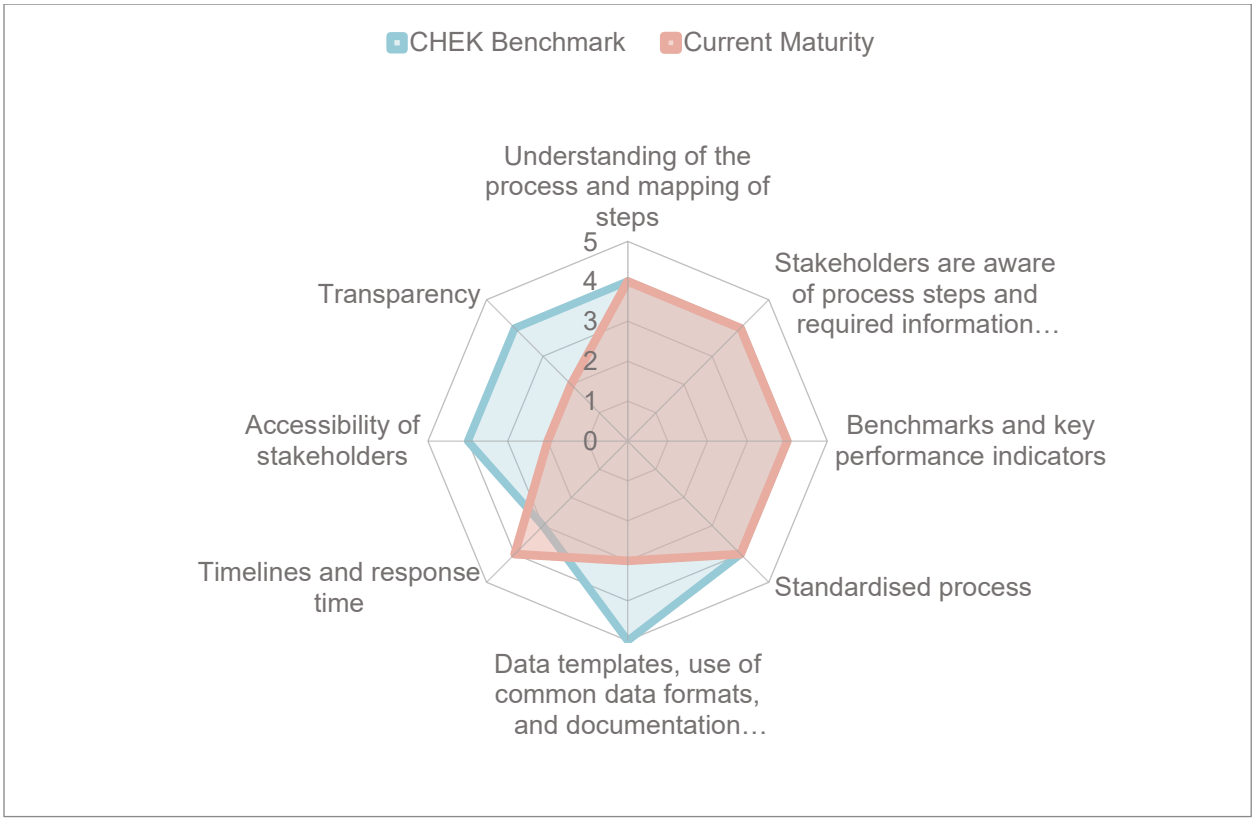

Figure 10 Process maturity of Vila Nova de Gaia

Organisation

The municipality's digital building permit process reveals varied levels of maturity across different internal components and stakeholders, according to the latest assessment.

Regarding Internal staff, the majority recognise the importance of digital transformation. Although there is some initial resistance, the municipality employees show good response to new processes and technologies. Few members of the staff have begun to engage in cross-functional teams to identify and discuss digital technology opportunities. This stage reflects an environment where digitalisation is acknowledged and beginning to take shape, yet cohesive adoption and integration across all staff members are still developing.

Infrastructure support within the municipality is progressively capable of handling required software essential for digital permitting processes, including a significant portion, but not all, of the necessary hardware and software installations. The strategic objectives for data ecosystem implementation display a preliminary alignment with an emerging understanding and initial integration of technological advancements and process improvements, although milestones and concrete plans are not yet established.

The utilisation of digital data is evident, although the integration across different stakeholders and the comprehensive use of these technologies within the process appear to be limited. This shows a scenario where there is recognition and partial adoption of necessary digital technologies and strategies, but the full potential of these integrations into the daily workflows and broader strategic objectives has not yet achieved high realisation.

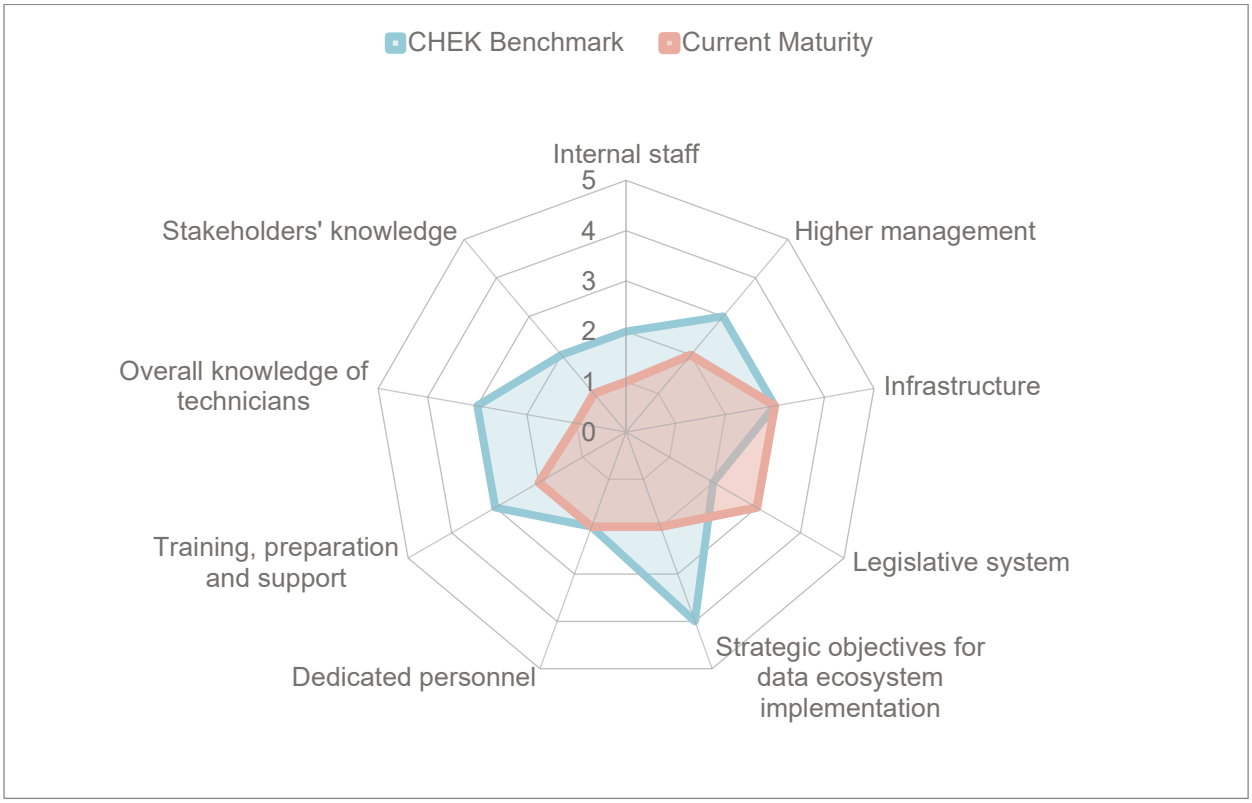

Figure 11 Organisation maturity of Vila Nova de Gaia

Technology

The municipality's digital building permit process displays a moderate to advanced level of maturity across several key technological categories, particularly in data management and storage. The data management environment and network platform within the municipality includes various platforms operating through APIs. While the municipality has successfully implemented a system where staff can access and manage data comprehensively, the access for external stakeholders is not yet fully integrated, there is still need of human input for verifying and validating data.

In terms of storage/repository, the municipality has effectively centralised its data repository systems that support both ongoing and archived processes, adhering to structured data governance protocols. The submission system and identification similarly show development in digital processes, such as the automatic checking of digital signatures.

For data inspection and visualisation, the municipality has developed capabilities for producing 2D deliverables and has unofficial 3D models, but lacks a standard, official protocol for 3D data. Data validation for building and spatial data also indicates a blend of manual processes supplemented by some level of automation in data checking, which shows a transitional phase towards more advanced digital validation methods.

The areas of data format interoperability and the conversion of building to geospatial data (and vice versa) reveal a reliance on open formats, although the integration of comprehensive 3D data and BIM systems is not yet achieved, since the BIM use is still unofficial. These aspects underscore a partial integration of modern data technologies, with significant advancements in certain areas but not uniformly across all dimensions of the digital building permit process.

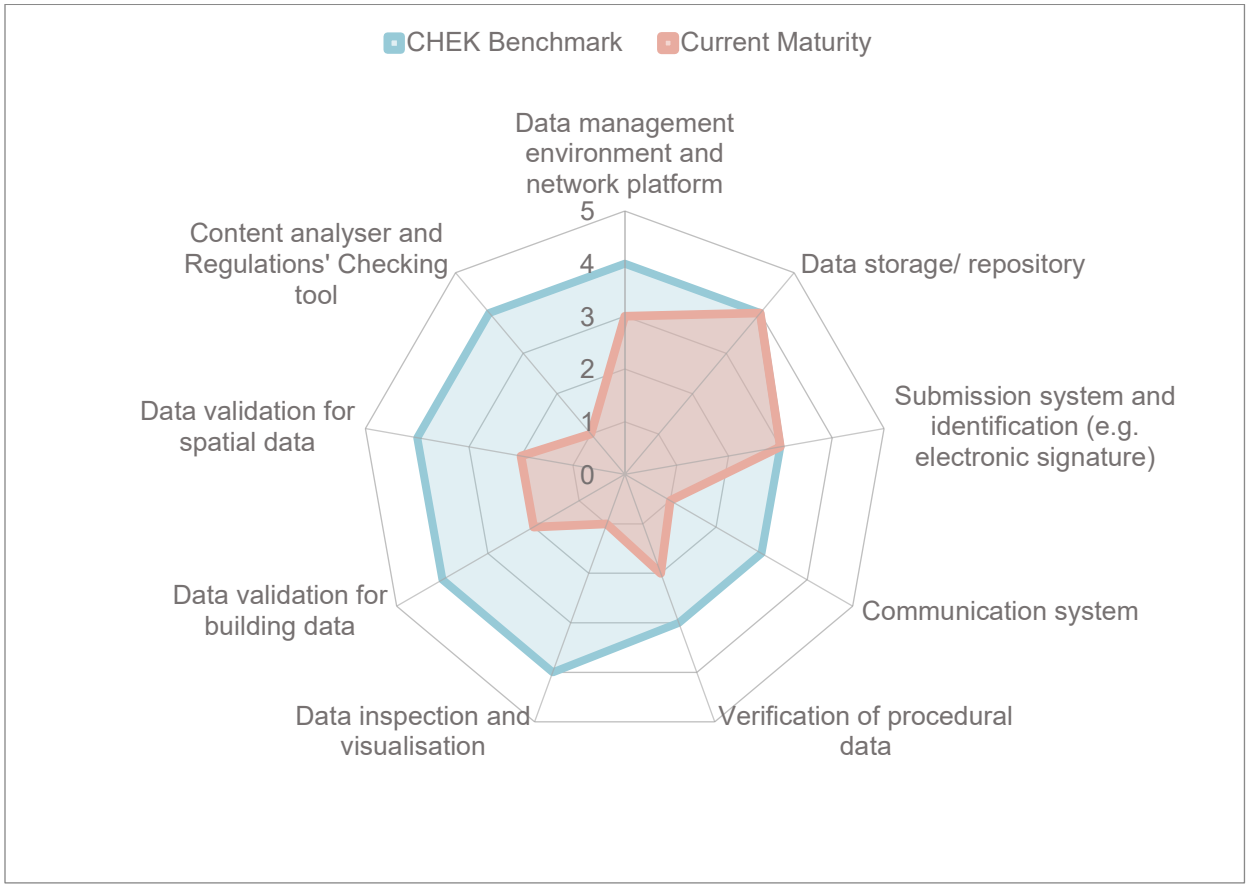

Figure 12 Technology maturity of Vila Nova de Gaia

Information

The assessment of information maturity shows a relatively low maturity for the data usage, but high maturity on quality and processes related to this data. Even though processes and standards are highly mature in the municipality, the

usage of 3D data is still limited. There is also a high discrepancy between GIS and BIM use. There the first is advanced and with good solutions, but the second is almost inexistent.

The municipality has established standard-based data requirements that include basic guidelines for data standardisation, such as training manuals and delivery standards. However, these have not yet evolved into a system where organisational standards are fully aligned with industry standards, mainly due to the lack of use of digital data on many steps of the process.

In the area of data quality control, the municipality has moved beyond informal plans and now has comprehensive quality plans that ensure accuracy and consistency. These plans are tightly integrated with data validation workflows, with automated reporting on adherence and anomalies, suggesting a high level of maturity in maintaining and monitoring data integrity.

Regarding building and city context data, the municipality uses basic 2D mapping and has begun integrating BIM and GIS data. However, the use of BIM data is unofficial, and while there is a city model populated with data, it is restricted to internal use and lacks standardised building models.

Lastly, in the domains of regulations formats and accessibility, the municipality is at the initial stages. The regulations are predominantly in natural language that requires interpretation, and accessibility is limited to paper or PDF formats. Although, the accessibility to the codes and regulations is made easier by the online platform and online tools developed by the municipality to assist on the application of a building permit.

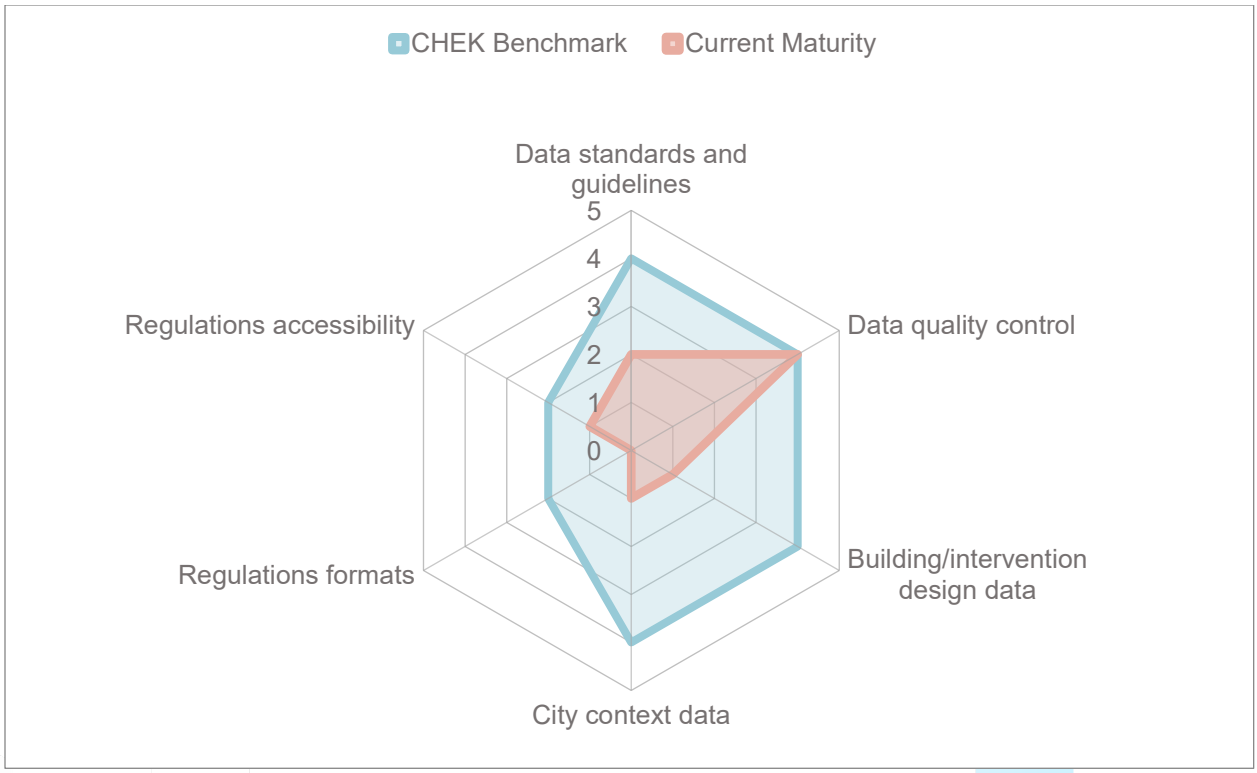

Figure 13 Information maturity of Vila Nova de Gaia

4.4. Prague, Czech Republic

4.4.1. Interview report

The relevant information for the maturity assessment of the building permit process in the municipality of Prague was collected during a two-hour meeting with two representatives of the Institute of Planning and Development of Prague. On May 6th, 2024, FHI conducted a semi-structured interview with questions addressing their current situation of processes, organisation, technology and information. The collected information was analysed by FHI to assess the overall maturity of the building permit process in the municipality of Prague.

The current digital maturity of the process in handling building permits is relatively low across all areas, heavily reliant on manual processes and paper-based documentation. There are plans in place for significant digital transformation with the implementation of a new building act and digital platform, which, if executed well, could elevate the digital maturity substantially. However, as of the information provided in the interview, these changes are prospective, and their successful implementation is yet to be seen. The organisation and its stakeholders appear to be in a transitional phase, waiting for state-led initiatives to materialize.

The municipality's building permit process is currently undergoing a significant transformation, driven by a nationwide initiative to implement a fully digital building permit system starting in July 2024. At present, the process is almost entirely manual and paper-based, which leads to inefficiencies and delays. The current system is not automated, and there is no integration between digital and physical documentation. This reliance on manual operations results in frequent delays and makes the permit approval process complex and time-consuming, particularly for projects that require approvals from multiple stakeholders.

The existing process follows a standardised procedure defined at the national level. The municipality has no autonomy to alter or adapt this procedure to local needs, as it must adhere strictly to the national guidelines and regulations. This centralised approach limits the municipality's role to that of an administrative executor rather than a proactive agent in improving or modifying the process. Although the current building permit process is well-documented in terms of the national framework, the actual implementation at the municipality level varies depending on the complexity and location of each building project.

The transition to a digital building permit system, mandated to take effect in July 2024, is expected to address some of these inefficiencies by enabling electronic submission of applications and digital workflows for document management. However, there are concerns about the readiness and acceptance of this new system. The municipality has not been actively involved in the development or customisation of the digital platform and will only begin training and adaptation efforts once the system is officially launched. This has created a sense of apprehension among staff members, who feel inadequately informed and unprepared for the impending changes.

Currently, the verification and validation of permit applications are performed manually by municipal officers. The process includes checking paper-based submissions for compliance with various standards and regulations. Applicants must manually deliver all required documents to the relevant authorities, which adds another layer of complexity and delays. In some cases, the processing time for building permits can extend to several years, particularly for projects requiring multiple consultations and approvals. Although the national regulation stipulates a 60-day processing time, this is rarely met due to the need to consult with numerous external stakeholders.

The municipality does use some geospatial data for assessing land use and zoning compliance, but this is not integrated with the building permit application system. The use of digital tools such as GIS is limited to visual inspections rather than automated rule-checking or validation. Additionally, there is no mechanism for stakeholders to view or interact with the status of a building permit application in real-time, resulting in a lack of transparency and coordination between parties.

Despite these challenges, the municipality is hopeful that the upcoming digital system will streamline operations by introducing digital signatures, electronic submissions, and automated document workflows. However, the success of this transition largely depends on the effectiveness of the national government's implementation and the extent to which the municipality's staff can be trained and adapted to the new system.

In summary, the municipality's building permit process is currently at a low level of digital maturity, characterised by manual procedures, limited data integration, and an overreliance on paper documentation. The impending transition to a national digital building permit system represents a significant opportunity to improve efficiency, transparency, and compliance, but also poses challenges related to staff training, infrastructure readiness, and system adoption.

4.4.2. Maturity assessment

Process

The building permit process is largely manual and paper-based, with some digital elements primarily in form submission. The process documentation exists in a generic form on a national website, suggesting some level of standardisation. However, the process customisation at the municipal level is negotiated case-by-case, indicating a lack of streamlined digital processes. The impending changes, with a new building act effective from July 2024, hint at potential improvements but are yet to be implemented.

The lack of automation and reliance on paper-based methods lead to inefficiencies and potential errors. The process adaptation to individual cases, while flexible, can be seen as a lack of standardisation that could otherwise streamline operations.

The planned digital transformation, including the implementation of a new building act, presents an opportunity to standardise and automate processes. Embracing digital tools for workflow management and integrating these with existing digital documentation could reduce processing times and increase transparency.

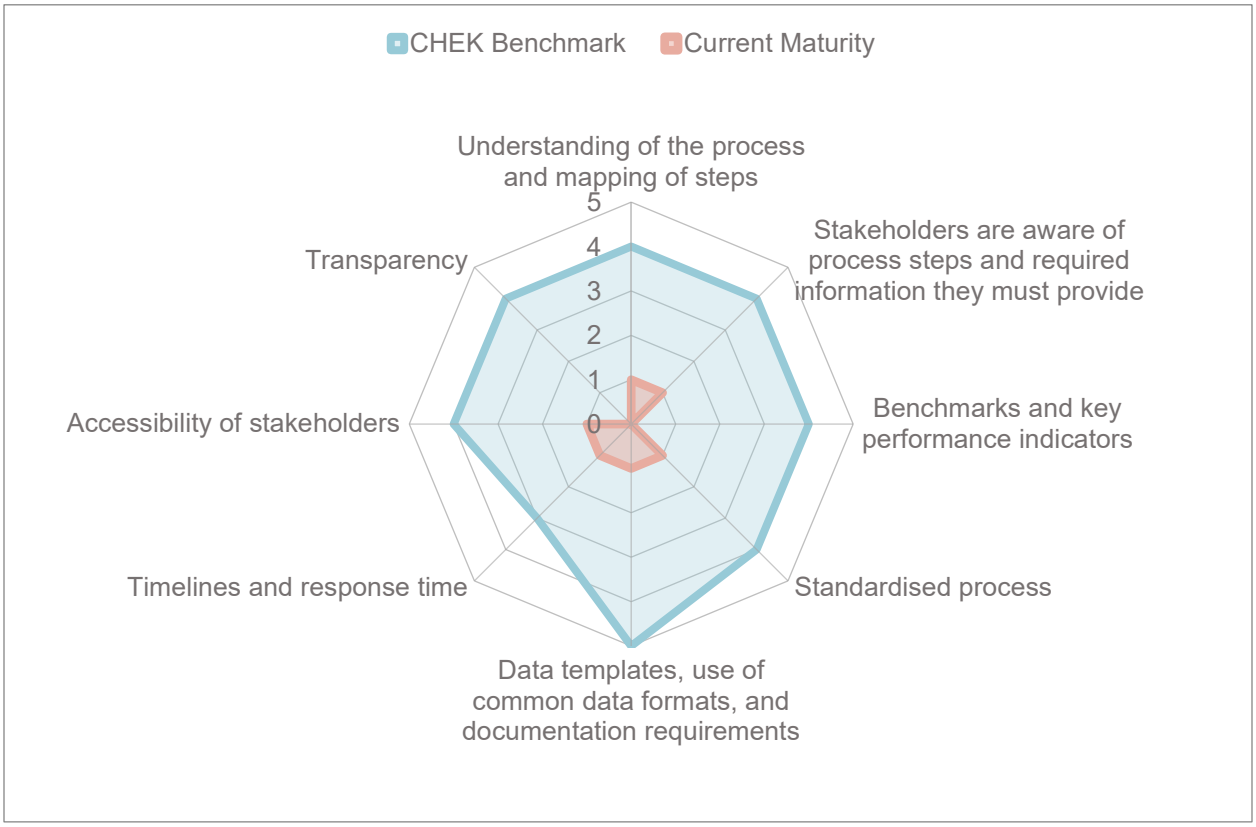

Figure 14 Process maturity of Prague

Organisation

The municipality has a formal role in the building permit process as mandated by the state, suggesting a clear organisational structure. However, there is a noted lack of proactive involvement in the digital transformation from the municipality's side, with changes being centrally driven. This indicates some organisational preparedness but limited autonomy in driving improvements.

The centralisation of process changes and digital initiatives may lead to delays and a lack of alignment with local needs. The municipality's reactive stance to digital transformation indicates a potential gap in digital leadership and strategy at the local level.

Developing a local digital strategy that complements national directives could empower the municipality. Training and development programs to enhance digital literacy and leadership within local departments could foster a more proactive approach to digital transformation.

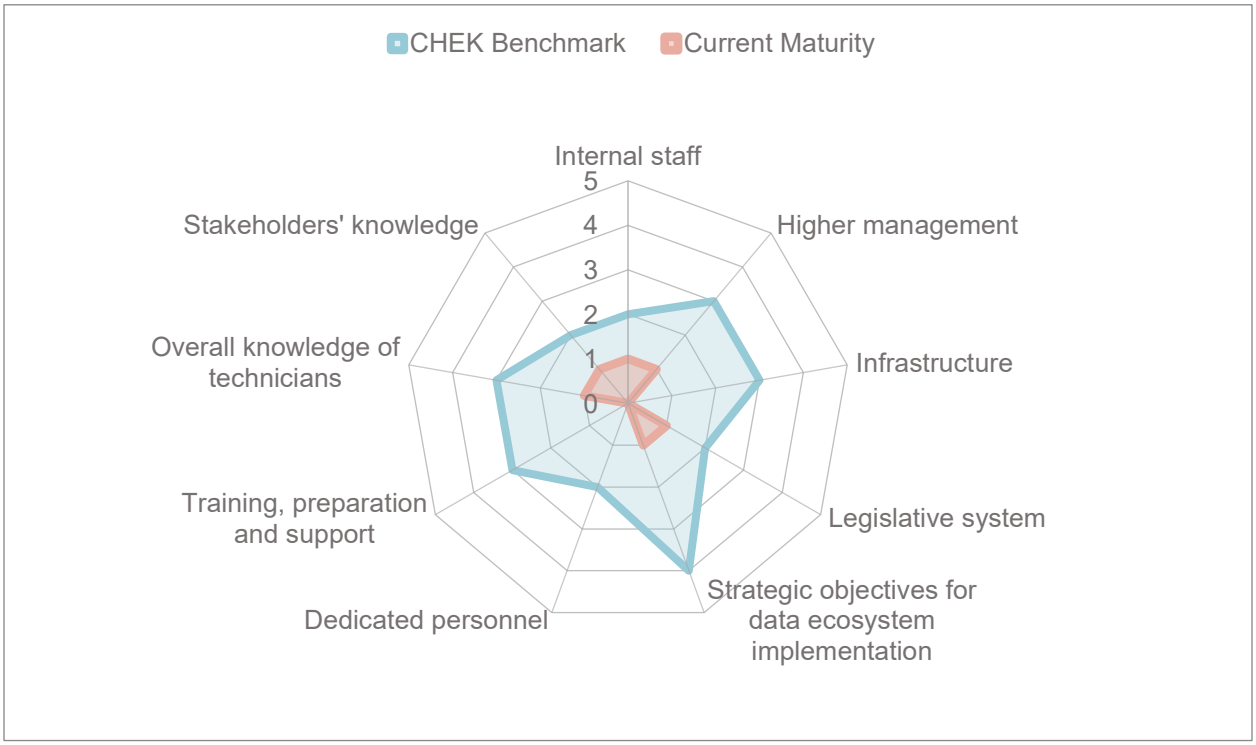

Figure 15 Organisation maturity of Prague

Technology

The technology in use is predominantly for basic digital communication (such as email), with no integrated digital tools for process management or data handling specific to building permits. The reliance on paper documents is high, and while there is a mention of a future digital platform that could centralise and digitise the process, as of now, the technological infrastructure is not aligned with a high level of digital maturity.

The existing technological infrastructure is insufficient to support a comprehensive digital transformation. The lack of advanced tools for data analysis, process automation, and digital interaction between departments and with the public is a significant hindrance.

Investing in a robust IT infrastructure that supports cloud-based services, mobile applications, and secure online platforms could be transformative. Additionally, adopting technologies such as GIS for spatial data integration and BIM for detailed project visualisation would not only improve the accuracy and efficiency of the permit process but also enhance stakeholder engagement and compliance.

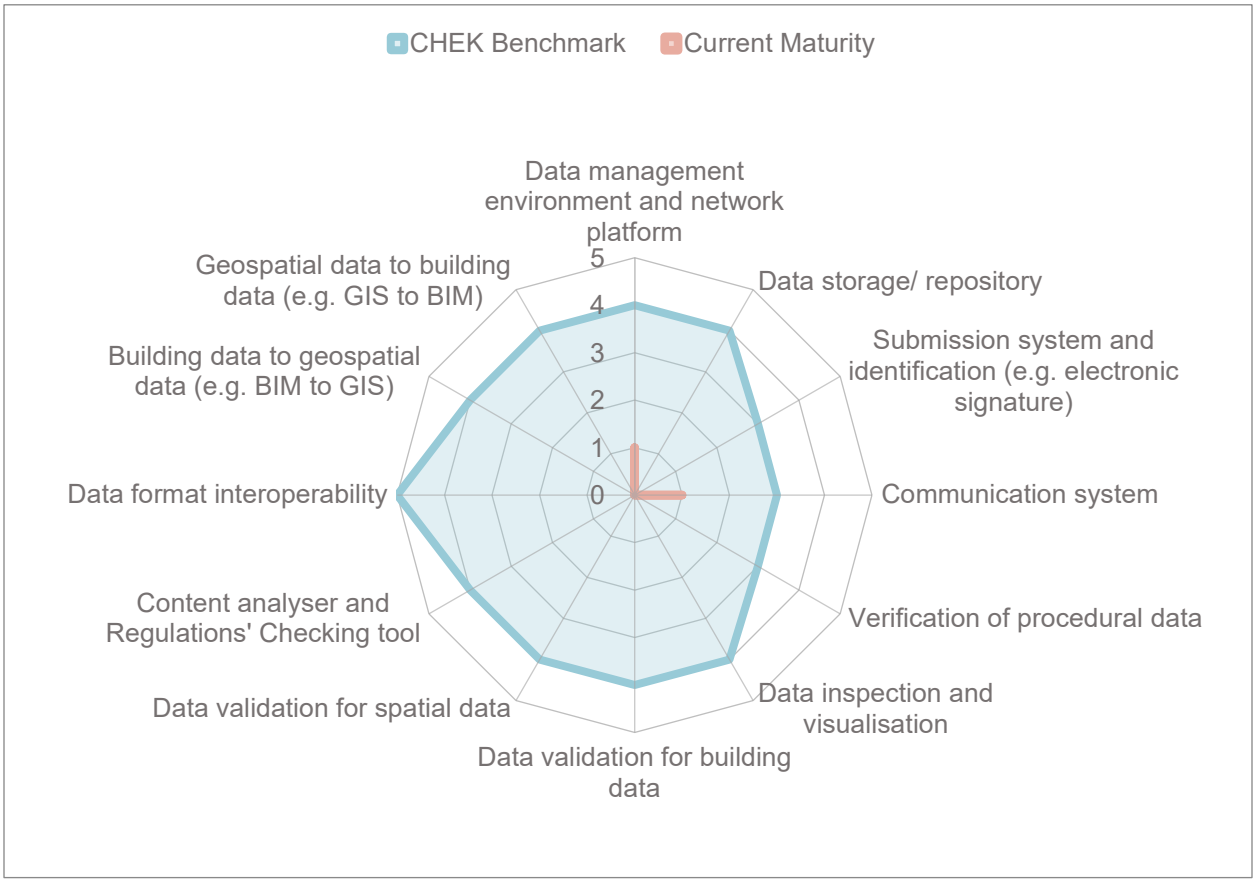

Figure 16 Technology maturity of Prague

Information

Currently, most documentation is handled in paper format, with electronic submissions limited to initial applications and not extending to full project documentations. Information sharing between departments and with external bodies (like fire departments) is also manual, which hinders efficient information flow. There is a plan to transition to a fully digital process by July, which could enhance the information handling significantly if implemented successfully.

The manual transfer and storage of documents not only slow down the process but also increase the risk of errors and information loss. The current system's limited capability for information sharing between stakeholders further complicates the process.

The shift to a fully digital platform as planned could revolutionise information management in the municipality. Implementing an integrated digital document management system that encompasses all aspects of the building permit process, including submissions, reviews, and approvals, could enhance efficiency and security.

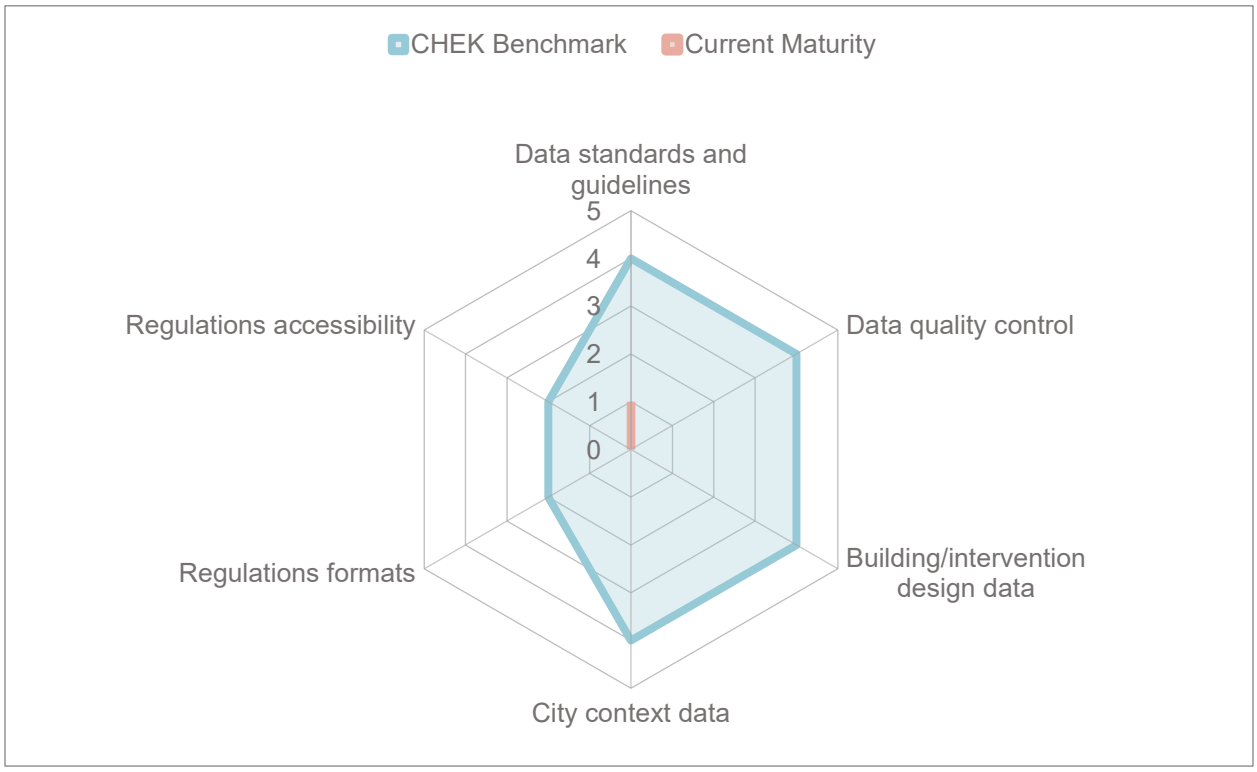

Figure 17 Information maturity of Prague

5. Discussion and future progress

Chapter summary
This chapter presents the preliminary results of the first phase of testing, which assessed the digital maturity of four municipalities: Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague, across four categories—Process, Organisation, Technology, and Information. The findings show that while Vila Nova de Gaia have higher maturity on categories of Process and Organisation, the other municipalities have relatively low digital maturity overall, particularly in Technology and Information for all municipalities, including Gaia. The chapter also discusses the subjectivity involved in assessing maturity and the efforts made to standardise results through structured interviews. Future testing phases will incorporate the CHEK Virtual Assistant (VA) to evaluate an AI-based methodology for assessing maturity models, aiming for a scalable and less subjective approach. The next deliverables, D1.3 (update) and D1.5 (both scheduled to M30), will provide further insights into the development and results of the VA testing phases.

5.1. Discussion of preliminary results

The first phase of testing provides an overview of the current digital maturity of the four processes that are object of study to the CHEK project: Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague. The results reflect the AS-IS situation of each municipality in terms of the digitalisation of their building permit processes. The maturity assessment was conducted across four categories: Process, Organisation, Technology, and Information based on the CHEK maturity model developed in WP2. The assessment offers a comprehensive view of how municipalities are advancing in their digital transformation.

The goal of the testing phase is not to compare municipalities directly, as each operates in their unique regulatory and cultural context. Instead, the aim is to provide interim feedback on the content of the CHEK DBP Maturity Model through the expert-led interview method. Additionally, the testing will explore new alternative assessment methods that attempts to increase the objectivity and support self-assessment. The results provide valuable insights into the digital maturity of each municipality, offering a clear view of their current capabilities and highlighting areas that need further development.

The assigned maturity levels vary according to the current processes reported by the municipal technicians during the interviews. The overall maturity of three processes (Ascoli, Lisbon, and Prague - Figure 18, Figure 19, and Figure 21) can be considered low, except for the one of Vila Nova de Gaia (Figure 20). However, there is some consistency in the results, as the levels for Process and Organisation are generally higher than those for Technology and Information across all municipalities.

It is also important to consider the subjective factor when assessing maturity. The interviews were conducted by two different experts: Expert 1 interviewed Prague and Ascoli, and Expert 2 interviewed Lisbon and Gaia. Although both experts possess a high level of knowledge about the Maturity Model and digital building permit process, there is always a degree of subjectivity in human decision-making during such assessments. The interviews followed a structured questionnaire, and the data was processed as objectively as possible to minimise any potential biases. Each technician will analyse the other two municipalities on the Phase 2 of testing (Expert 1: Lisbon and Gaia, Expert 2: Prague and Ascoli) and by the end of the two phases the data from both will be compared with the Phase 1 to improve the objectivity of both phases of testing.

Figures 18 – 21 illustrate the overall results of the maturity for the entire process of each municipality. Each graphic shows the level of maturity for each KMA of the maturity model. For the extended name of the KMA refer to the maturity model in APPENDIX 01.

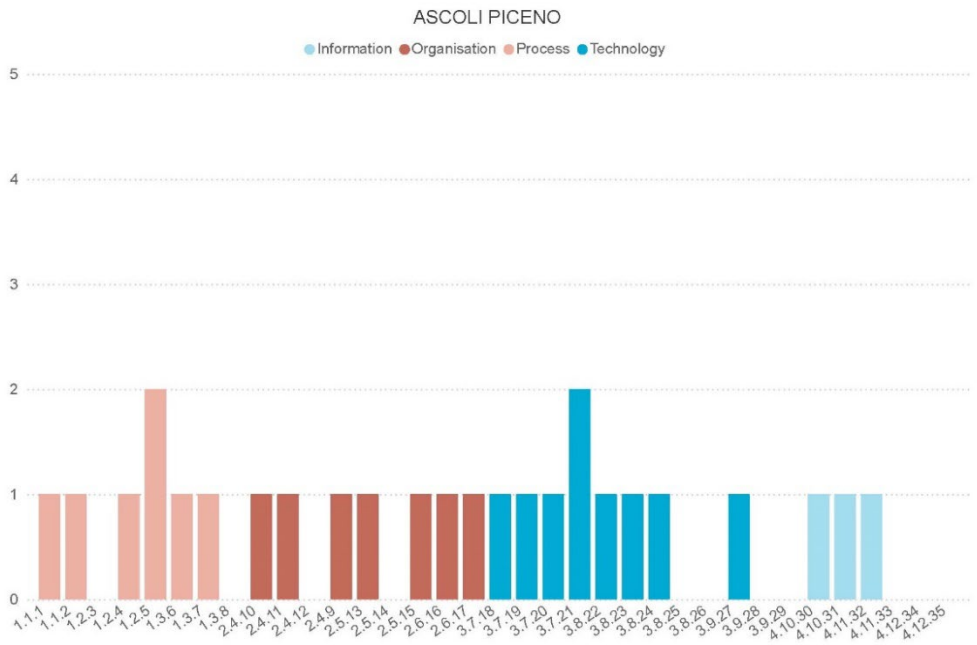

Figure 18 Overall maturity of Ascoli Piceno

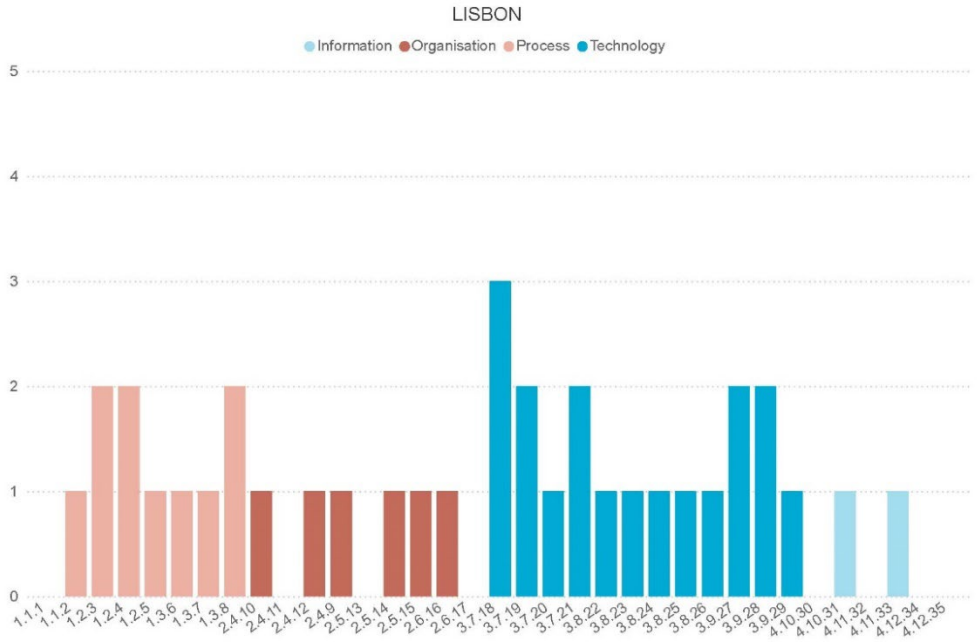

Figure 19 Overall maturity of Lisbon

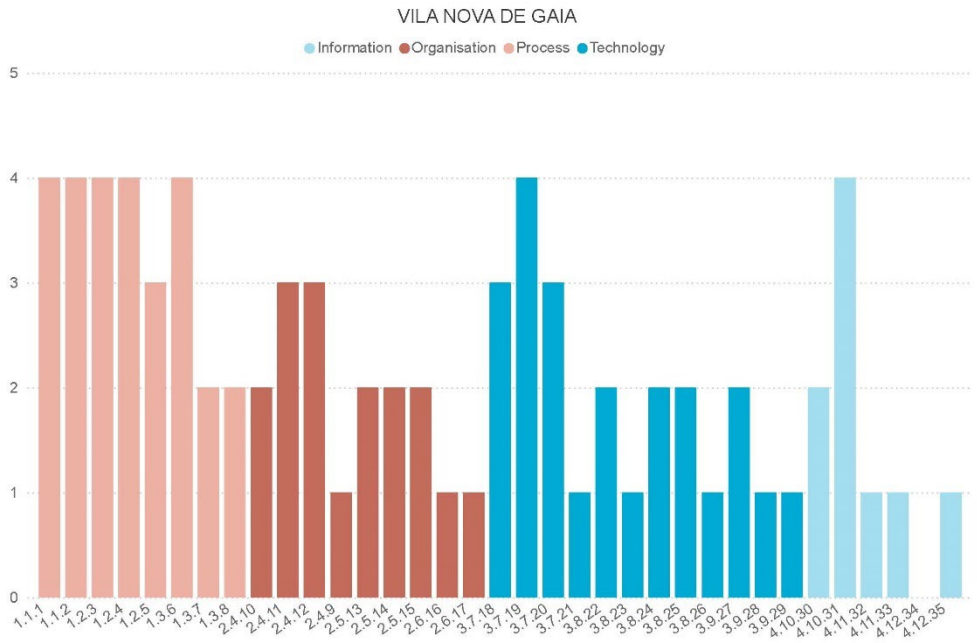

Figure 20 Overall maturity of Vila Nova de Gaia

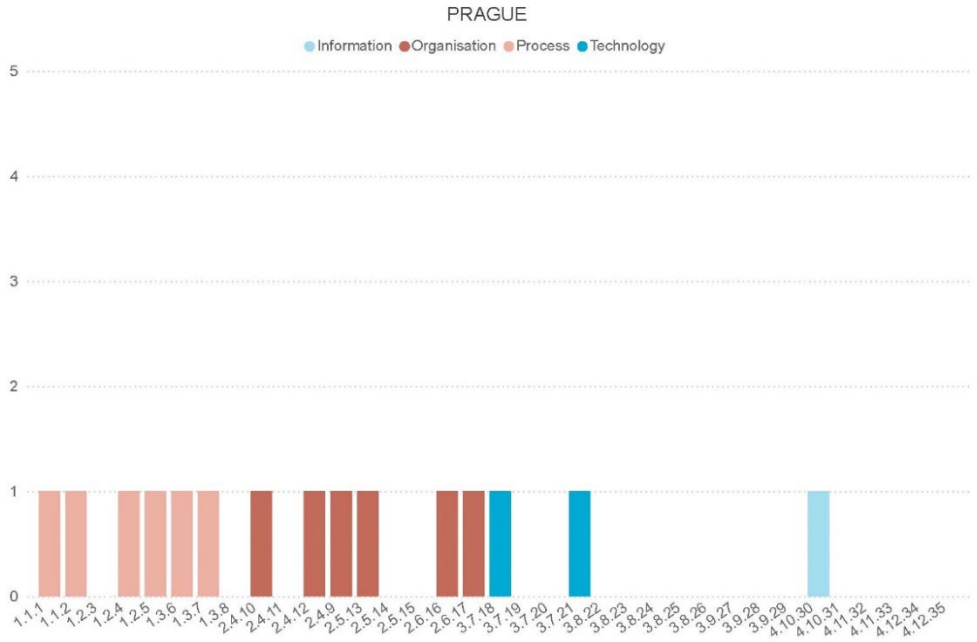

Figure 21 Overall maturity of Prague

6. Conclusion

The assessment of digital maturity in building permit processes for the processes of four CHEK partner municipalities - Ascoli Piceno, Lisbon, Vila Nova de Gaia, and Prague - reveals a diverse landscape of digital transformation progress. The study used the CHEK Digital Building Permit Maturity Model (CDBPMM) to evaluate and benchmark the digital capabilities of each municipality across four key dimensions: Process, Organisation, Technology, and Information. This analysis offers a comprehensive understanding of the current digital maturity levels, identifies existing challenges, and highlights areas for potential improvement.

The results indicate significant variability in digital maturity among the analysed municipalities. Vila Nova de Gaia demonstrated a relatively high level of digital maturity, especially in process automation and information management, while the other municipalities - Ascoli Piceno, Lisbon, and Prague - exhibited lower maturity levels, with heavy reliance on manual processes and limited digital integration.

On the process analysis, Vila Nova de Gaia stood out with a well-structured and automated process supported by digital tools, whereas the other municipalities showed a fragmented process landscape with varying degrees of digitalisation. Common issues included the lack of comprehensive process documentation and end-to-end digital workflows.

Organisational maturity varied, with some municipalities showing strong internal structures and staff engagement in digital initiatives. However, a lack of dedicated resources and digital leadership was a recurring theme, indicating the need for a more proactive approach to digital transformation.

The technological dimension revealed the most significant gaps. Most municipalities lack the necessary infrastructure and tools to support advanced digital processes, such as Building Information Modelling (BIM) and Geographical Information Systems (GIS). Technological upgrades, particularly in IT infrastructure, data integration, and automation, are crucial for achieving higher maturity.

Information management practices were generally weak, with challenges in data standardisation, quality control, and real-time information sharing. The integration of digital data, especially 3D data and standardized formats, was identified as a key area for improvement.

The assessments were conducted through semi-structured interviews with municipal technicians, using a traditional expert-led approach. Despite efforts to standardise the process, there remains a degree of subjectivity in evaluating maturity levels. This subjectivity was mitigated by following a structured methodology and ensuring consistency in data processing.

In summary, the main challenges in the building permit processes include heavy reliance on manual processes, limited automation, disconnected workflows, inconsistent data standards, frequent regulatory changes, and inadequate real-time communication with external stakeholders. Additionally, the lack of comprehensive BIM and GIS integration and insufficient staff preparedness for digital transitions reduce overall efficiency.

To address these issues, the most important recommendations are to implement fully automated, end-to-end digital platforms for data management and processing, standardise data formats and workflows for consistency, and establish dedicated digital transformation teams to drive local improvements. Enhancing communication channels to provide real-time updates to applicants and stakeholders, alongside comprehensive staff training on digital tools and systems, is crucial to achieving streamlined, efficient, and transparent building permit processes.

6.1. Future progress

Future testing phases will involve the CHEK Virtual Assistant (VA), designed to reduce subjectivity and enhance the scalability of the digital maturity assessment. The CHEK VA is expected to simplify the evaluation process and provide more objective results, which can be applied across a broader range of municipalities and regulatory contexts. The development of the CHEK VA runs parallel to the activities reported in this deliverable. The assistant aims to implement an innovative methodology for assessing maturity models using an AI-based approach. The use of the AI method has the intention to make the assessments of maturity models more efficient, by allowing non-expert users to easily assess the maturity of their DBP process without an expert to assist in the assessment, and consequently increasing the scalability of the tool.

The CHEK VA leverages Large Language Models to cross-reference the results provided by the user through a chatbot interface (Figure 22) with the levels of maturity from the CHEK DBP MM. The expected outcome is a scalable and less subjective method for assessing maturity models, with the next phases of testing providing the comparison with the traditional method.

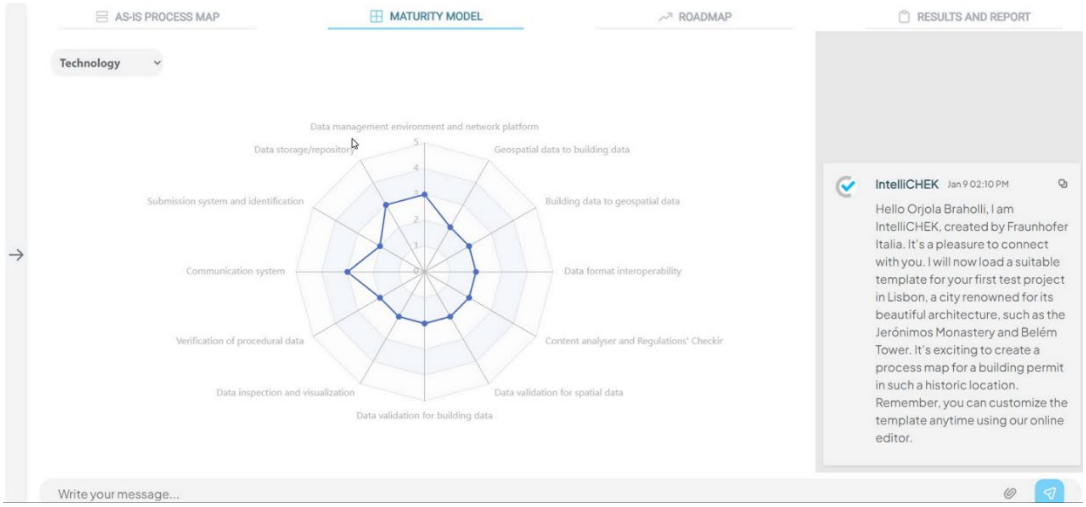

Figure 22 CHEK VA Interface

Future work for the testing phase will include completing Phase 2 – the Maturity Model assessment of municipalities using the CHEK VA, assisted by an expert – and Phase 3 – the Maturity Model assessment of municipalities using the CHEK VA independently, both with all four municipalities. In the intention to obtain comparable results across different methodologies for assessing the Maturity Model. At the end of the self-assessment, users will answer a structured questionnaire regarding the usability of the assistant.

In parallel, phase 4 – Maturity Model assessment of Use Cases (Post-CHEK Project) – will assess the four use cases from WP6 and compare the ideal future scenario expected from the CHEK toolkit with the current maturity scenario presented in this deliverable.

The detailed development plan and methodology of the CHEK VA will be described in Deliverable D1.3 (update), which is due in March 2025, including a full description of the user workflow and the backend connections made by the tool. The next steps for Task 1.4 involve continuing with the testing phases using the CHEK VA. The results of these tests will be shared in Deliverable D1.5, also due in March 2025.

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7.1. List of figures

7.2. List of used abbreviations

AECO	Architecture, Engineering, Construction, and Operations
AI	Artificial Intelligence
BIM	Building Information Modelling
BP	Building Permit
CDBPMM	CHEK DBP Maturity Model
DBP	Digital Building Permit
DoA	Description of the Action
EC	European Commission
EU	European Union
GA	Grant Agreement
GIS	Geographic Information System
KMA	Key Maturity Area
KPI	Key Performance Indicator
LLM	Large Language Model
VA	CHEK Virtual Assistant
WP	Work Package

APPENDIX 01 – KMAs of the CHEK DBP Maturity Model

PROCESS	1.1.1 Understanding of the process and mapping of steps
	1.1.2 Stakeholders are aware of process steps and required information they must provide
	1.2.3 Benchmarks and key performance indicators
	1.2.4 Standardised process
	1.2.5 Data templates, use of common data formats, and documentation requirements
	1.3.6 Timelines and response time
	1.3.7 Accessibility of stakeholders
	1.3.8 Transparency
ORGANISATION	2.4.9 Internal staff
	2.4.10 Higher management
	2.4.11 Infrastructure
	2.4.12 Legislative system
	2.5.13 Strategic objectives for data ecosystem implementation
	2.5.14 Dedicated personnel
	2.5.15 Training, preparation and support
	2.6.16 Overall knowledge of technicians
	2.6.17 Stakeholders' knowledge
TECHNOLOGY	3.7.18 Data management environment and network platform
	3.7.19 Data storage/ repository
	3.7.20 Submission system and identification (eg. electronic signature)
	3.7.21 Communication system
	3.8.22 Verification of procedural data
	3.8.23 Data inspection and visualisation
	3.8.24 Data validation for building data
	3.8.25 Data validation for spatial data
	3.8.26 Content analyser and Regulations' Checking tool
	3.9.27 Data format interoperability
	3.9.28 Building data to spatial data (eg. BIM to GIS)
	3.9.29 Spatial data to building data (eg. GIS to BIM)
INFORMATION	4.10.30 Data standards and guidelines
	4.10.31 Data quality control
	4.11.32 Building/intervention design data
	4.11.33 City context data
	4.12.34 Regulations formats
	4.12.35 Regulations accessibility