DIPAS_analytics

AI-supported evaluation of citizen feedback in the digital participation process

Project duration: January 2023 to September 2025

Authors: Mateusz Lendzinski and Antonie Casper (BSW LP/SW), Bianca Lüders and Julien Hofer (LGV/B4)

Written on: 30 September 2025

Hamburg | Ministry of urban Development and Housing

Hamburg | Agency for Geoinformation and Surveying

hcu HafenCity Universität Hamburg | City Science Lab
A Cooperation with the MIT Media Lab

Abstract

The DIPAS_analytics project was initiated to expand the existing Digital Participation System DIPAS with a powerful evaluation and moderation component. The aim was to be able to evaluate the growing volume of participation contributions more quickly, more systematically and in a more resource-efficient manner in future, thereby further promoting digital participation in general. To achieve this, a digital toolbox based on modern natural language processing (NLP) methods was developed. During the project, the use of various NLP methods in combination with large language models (LLMs) was designed, tested and evaluated to reliably identify key statements, thematic focal points and recurring patterns in the participation data. The result is an open-source toolbox that can be integrated into the existing DIPAS system as an add-on. The benefits for the administration lie in an increase in efficiency in evaluation, a uniform and transparent presentation of results, and the possibility of flexibly transferring the developed tools to other areas of public administration.

Figure 1: Part of the project team from left to right: Michael Fischer, Bianca Lüders, Annika Weseloh, Antonie Casper, Anke Timmermann, Christa Becker, Christian Lamine, Julien Hofer, Mateusz Lendzinski

Table of Content

List of Figures

List of Abbreviations

B4	Urban Data Analytics (LGV / Geobasis Information)
BSW	Hamburg Ministry of Urban Development and Housing (Behörde für Stadtentwicklung und Wohnen)
BUKEA	Hamburg Ministry for Environment, Climate, Energy and Agriculture (Behörde für Umwelt, Klima, Energie und Agrarwirtschaft)
CSL	City Science Lab (HafenCity University Hamburg)
DIPAS	Digital Participation System (Hamburg)
FHH	Free and Hanseatic City of Hamburg
HIM	Hamburg Information Management (workflow-system)
HCU	HafenCity University Hamburg
AI	Artificial Intelligence
LGV	Hamburg Agency for Geoinformation and Surveying (Landesbetrieb Geoinformation und Vermessung)
LLM	Large Language Model
LP	Office for regional planning in the BSW (Amt für Landesplanung)
NLP	Natural Language Processing
OGC	Open Geospatial Consortium
PoC	Proof of Concept
PEV	Project Implementation Order (Projekteinsetzungsverfügung)
PV	Project Manager (Projektverantwortliche)
PWC	Project-Knowledge-Centre of the Financial Authority Hamburg (Projekt-Wissens-Center
SK/ITD	Hamburg Senate Chancellery, Department for IT and Digitalisation (Senatskanzlei Amt für IT und Digitalisierung)
SW	Stadtwerkstatt (BSW / LP)
UX/UI	User Experience / User Interface
Z4	Central Department for IT Management and Digitalisation of the BUKEA and BSW (Zentrale Abteilung für IT-Management und Digitalisierung)

1. Introduction

1.1 Project Context

The digitisation of informal citizen participation in Hamburg aims to create open and transparent administrative processes that actively involve citizens in urban development. The systematic integration of feedback from informal participation processes creates a continuous exchange between the administration and urban society, which makes planning more targeted and shapes the city as a ‘learning system’.

DIPAS is Hamburg's central digital participation tool, combining online participation and digital planning tables. It is mainly used for spatially related processes and enables citizens to anonymously locate, comment on and evaluate contributions on interactive maps. Since its development in 2016, over 130 DIPAS processes have been carried out, with the number of contributions received ranging from a few dozen to several thousand per process. This poses the challenge for the administration of efficiently evaluating these growing amounts of feedback.

1.2 Problem Statement

Particularly in participation processes with high participation, the responsible departments report considerable personnel expenses for moderation and evaluation. During the participation process, contributions and comments must be continuously checked for inappropriate or personal content. Once the participation process is complete, the manual analysis of the content for further planning is particularly time-consuming, as there are currently no standardised evaluation methods. The individual development of evaluation strategies ties up additional resources and makes manual evaluation prone to errors and difficult to scale. This represents an increasing burden for the implementation of informal participation processes.

1.3 Project Aim

To reduce the high personnel expenses involved in moderation and evaluation, the Stadtwerkstatt of the Ministry of Urban Development and Housing (BSW) and the Agency for Geoinformation and Surveying (LGV) launched the DIPAS_analytics research and development project and commissioned the CityScienceLab (CSL) at HafenCity University Hamburg to create a UX/UI design. The aim is to develop a ready-to-use and needs-based natural language processing toolbox (NLP toolbox) for DIPAS, which will also be made available to members of the DIPAS community after the end of the project and subsequently published as open source. The NLP-supported analysis tools are intended to significantly simplify the moderation and evaluation of large quantities of citizen contributions, thereby facilitating the use of digital participation systems. The uniform and transparent pre-structuring of the contributions enables a comprehensible and more objective evaluation. This strengthens the validity of the participation results and promotes their integration into urban planning. The focus lies on the user-friendly design of the tools as well as ensuring transparency and traceability throughout the entire analysis process.

1.4 Relevance

The DIPAS_analytics project supports the goals of Hamburg's digital strategy[1], by significantly increasing the information processing capacity of the DIPAS participation software, thereby promoting data-based urban development and user-centred administrative modernisation. With the development of modular, AI-supported and open-source-based analysis tools, Hamburg is strengthening its pioneering role in the field of digital citizen participation and innovative administrative applications. The conscious decision against proprietary providers and in favour of building up own expertise in the public sector contributes to digital sovereignty. Hamburg's nationwide recognition as a leading city in digital administration and citizen participation is further expanded and confirmed by DIPAS_analytics.[2]

The parties responsible for participation projects in Hamburg's district offices and planning offices, which evaluate DIPAS processes, benefit in particular. The modular NLP services can also be integrated into other systems via an interoperable and standardised interface (OGC Processes API). This enables other city departments and research institutions, as well as other local authorities nationwide, to benefit from the open-source approach. The tools developed also enable city-wide analysis of contributions from various processes to identify trends and focal points in urban development.

[1] Promoting digital participation through the further expansion of DIPAS is one of the goals of Hamburg's digital strategy. (Digitalstrategie für Hamburg, FHH 2025, S.71)

[2] In the Germany 2024 Digitalisation Index, Hamburg once again ranked first among the federal states, particularly due to its strategic digital policy, a high number of digital administrative services and the consistent implementation of the Online Access Act (OZG). In the Smart City Index of the digital association Bitkom, Hamburg has been ranked among the top cities for several years, currently in second place behind Munich, partly due to the consistent public development and provision of digital participation tools such as DIPAS. Hamburg is also regularly rated as a leader in digital administration in the Bitkom State Index. DIPAS_analytics makes a concrete contribution to strengthening this profile through its high level of technical and methodological innovation.

2. Project Planning and Methodology

2.1 Approach

The planning and implementation of DIPAS_analytics followed a clearly structured, agile process model. From the beginning, emphasis was placed on designing the development in iterative cycles and testing it regularly to take user requirements into account as best as possible and to be able to respond flexibly to new findings. The project structure was designed to identify both technical and organisational challenges at an early stage and address them in a targeted manner.

2.2 Milestones

Several key milestones were defined during the project to ensure transparency regarding progress and the achievement of objectives. An initial analysis and definition phase, during which the foundations were laid, and the project implementation order (PEV) was drawn up, was followed by the development of the first prototypes. These were tested and further developed in close consultation with the partner institutions and future users. Then, the final modules went into piloting and were subsequently released as open-source software in 2026. The individual phases were each characterised by clearly documented work packages and regular coordination with the steering committee and the teams involved.

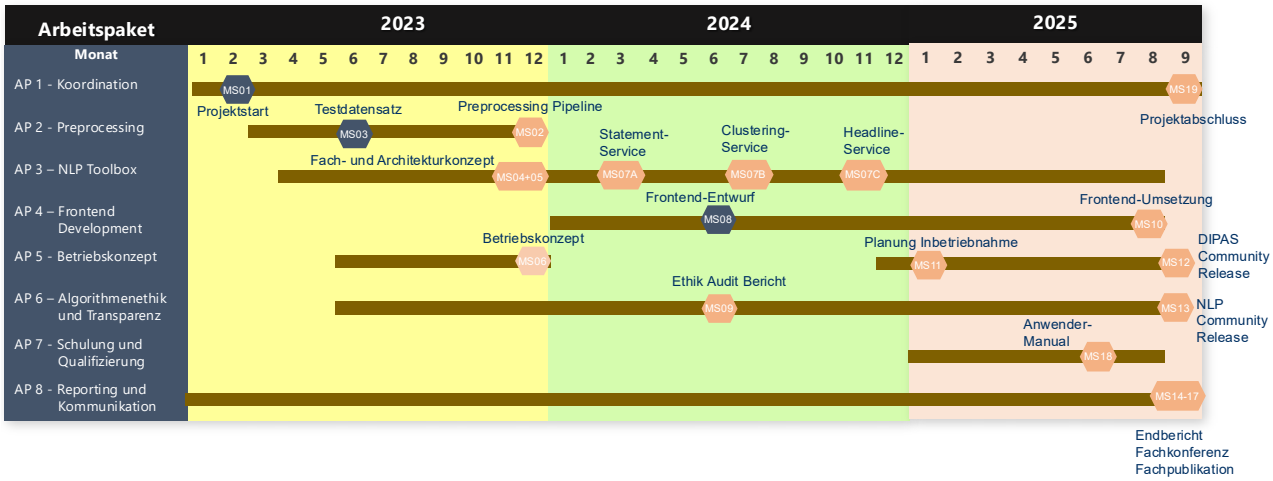

Figure 2: Project progression including work packages (AP) and milestones (figure only available in German)

2.3 Resources

Resource planning involved close cooperation between the central partner institutions: the Stadtwerkstatt of the Ministry for Urban Development and Housing (BSW) took on technical management and requirements management, while the Agency for Geoinformation and Surveying (LGV) was responsible for the technical development and implementation of the NLP algorithms and their integration into the DIPAS infrastructure. The CityScienceLab (CSL) at HCU developed the UX/UI design and participated in the proof of concept for the overall city analysis. The Central Office Z4 of BUKEA supported project coordination and reporting.

The team was supplemented by external partners, in particular Dataport in the areas of infrastructure consulting and software development. The project was also temporarily supported by an external consultant from Capgemini.

The methodological foundation and further development of the NLP services was also supported by close cooperation with research institutions such as the University of Hamburg (WISTS Socio-Technical System Design), the University of Hildesheim (Information Systems and Business Modelling) and Heinrich Heine University Düsseldorf (CIMT Citizen Involvement in Mobility Transition Project). Accompanying scientific research and through the supervision of final theses, the latest findings from AI and NLP research were incorporated directly into development, further enhancing the quality of the solutions.

The LGV had powerful hardware resources at its disposal for the development and operation of the AI-supported analysis tools. These included a dedicated AI server with modern GPUs, which enabled the processing of large amounts of data and the local operation and use of LLMs with up to 70 billion parameters. The data sources included both existing DIPAS process data and specially created training data sets, which were systematically prepared and documented during the project.

Quality assurance was ensured through structured project management, which monitored compliance with the defined work packages and milestones. Coordination with the steering committee and the involvement of external expertise ensured that both the functional and technical requirements were met and that the project results were implemented in a comprehensible and high-quality manner.

The project duration was extended twice during the project: first by six months to integrate powerful large language models (LLMs) and then by a further three months until the end of September 2025 due to the increased effort required for frontend development. Both extensions were communicated transparently and contributed significantly to ensuring the connectivity and quality of the project results.

3. Project Results

3.1 Technical Concept

The conceptual development of DIPAS_analytics is based on requirement analyses, data evaluations and research results. The classification of the main statements into the content types ‘suggestions’, “assessments” and ‘questions’ is based on findings from the empirical analysis of DIPAS contributions and on scientific models from the field of argument mining (cf. Liebeck et al., 2016[3]). These types were identified as particularly relevant for planning-related evaluation, as they reflect the central forms of citizen feedback and enable structured, comprehensible aggregation. The interviews conducted and an analysis of around 30,000 contributions showed that individual citizen contributions often contain several different topics despite being assigned to categories, and that the existing categories are too broad for systematic evaluation. The recurring content types mentioned above proved to be central to the planning-relevant structuring of the data. Based on this, the technical concept for DIPAS_analytics was developed, which describes two modules:

The ‘DIPAS_analytics Live-Dashboard’ is used by project managers for daily monitoring and, if necessary, moderation of citizen contributions. Its features make it possible to get a quick overview even with large amounts of contributions and to intervene in cases of netiquette violations (which fortunately occur very rarely in DIPAS). In addition to a wide range of up-to-date statistical information on the process, the Live-Dashboard displays a list of contributions that AI has classified as worthy of review for various reasons. This applies, for example, to the detection of text elements that are likely to contain personal data. In such cases, the relevant information (usually names or telephone numbers) can manually be removed, and a note is left in the contribution.

In the module ‘DIPAS_analytics Insights’, the free texts of the citizens' contributions are broken down into individual key statements. These key statements are methodically pre-structured by labelling them according to their content type – for example, as a suggestion, assessment or question – and then assigning them to the thematic categories of the respective participation process. Spatial references from the contributions are retained and displayed on a map so that the connection between content and location remains clear. Similar statements are automatically grouped into aspects, which are given short and understandable titles. A statistics-view provides additional aggregated key figures and diagrams. The results can be filtered, sorted, combined with geodata and exported for further processing. A key innovation lies in the technical ability to cross-reference the text-based analysis results directly in the user interface with official geodata. This function bridges the gap between citizen-generated knowledge and the Urban Data Platform Hamburg. By embedding participation results in the geospatial context of the city, contributions can be spatially validated, assigned to existing infrastructures and linked to specialist data. This not only increases the ability to interpret citizen feedback but also enables interdisciplinary analyses – such as linking local suggestions with transport, environmental or socio-demographic data sets.

[3] Liebeck, Matthias; Esau, Katharina; Conrad, Stefan (2016): What to Do with an Airport? Mining Arguments in the German Online Participation Project Tempelhofer Feld. In: Proceedings of the 3rd Workshop on Argument Mining, pages 144–153.

3.2 NLP-Services and Orchestrator

In the DIPAS_analytics project, eight independent and interoperable NLP services were developed to implement the technical concept, which are provided via an OGC Processes API-compliant interface. These services enable the automated analysis and structuring of citizen contributions: The service ‘Key Message Extraction’ identifies the most important statements and their type, ‘Key Message Offset’ recognises which part of a citizen contribution a main statement is based on, ‘Statement Labelling’ classifies the underlying sentences, and the ‘Category Classifier’ assigns main statements to thematic categories. The ‘Cluster Number Estimator’ estimates how many groups the contributions should be grouped into. With 'Clustering' and 'Title Generation', the contributions are grouped, and the resulting groups are given descriptive titles. In addition, the ‘Named Entity Recognition Service’ recognises personal data in the contribution texts and thus supports moderation in ensuring the anonymity of the contributions (see figure 3). The services are modular in design and connected via processors in the Orchestrator to form clear analysis pipelines (see figure 4).

A key project outcome is the integration of large language models (LLMs) into four of the eight services. Technological developments and the associated higher expectations of users made it necessary to use powerful generative AI. Working with LLMs enabled significantly better contribution analysis but also required a new architecture and infrastructure. An operating concept was developed jointly with Dataport and IONOS to provide scalable and flexible hosting solutions for the AI-supported processes.

The selection of open-source models was approached pragmatically and transparently: First, the respective ‘model cards’ were examined – i.e. the origin and composition of the training data, coverage of the German language, and licensing aspects. Since DIPAS processes German-language contributions (the proportion of foreign-language contributions is less than 1%), language was a key criterion. In addition, the number of parameters was weighed up, as this can have a significant impact on both the computing effort and the quality. In practical tests such as categorisation, mixture-of-expert models (Mixtral-7b) and LlaMa-based models (Llama3.1-8b, Llama-3.1-70b) were applied and evaluated with the help of a provided evaluation dataset. The recognised benchmarks and leaderboards, particularly the European LLM Leaderboard, were used as a further basis. During the implementation of the individual services, special attention was paid to ensuring that the language models could be exchanged. In principle, it is recommended to carry out an evaluation during such an exchange.

The benefit lies in the automated, consistent and scalable evaluation of large amounts of text, which reduces the administrative burden and increases the quality of the analysis. The open architecture allows for easy expansion and reuse of the services in other administrative contexts and makes the FHH a pioneer in the use of generative AI in citizen participation.

Modular and interoperable NLP-Services in DIPAS_analytics

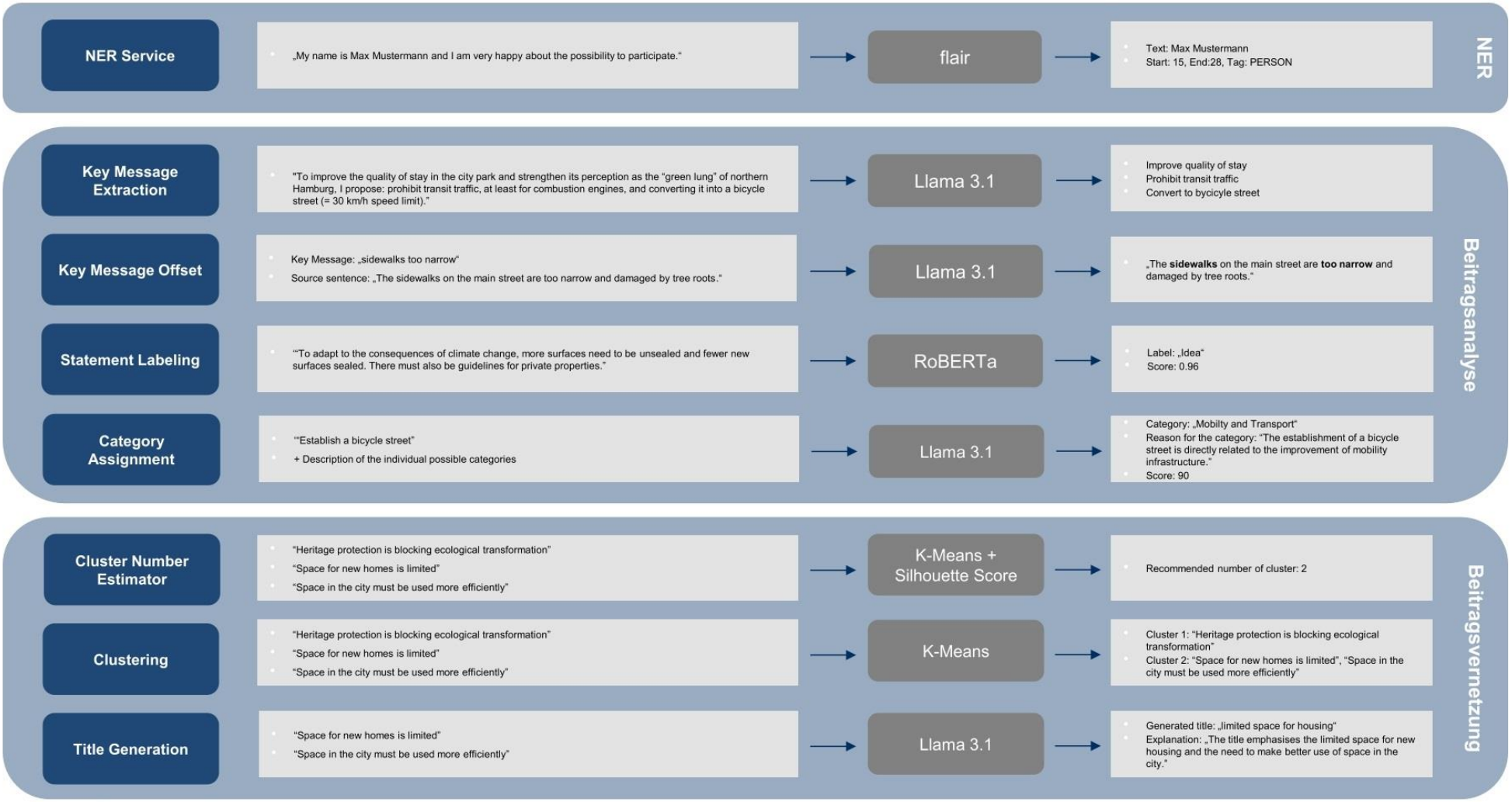

Figure 3: Overview of the eight NLP-Services

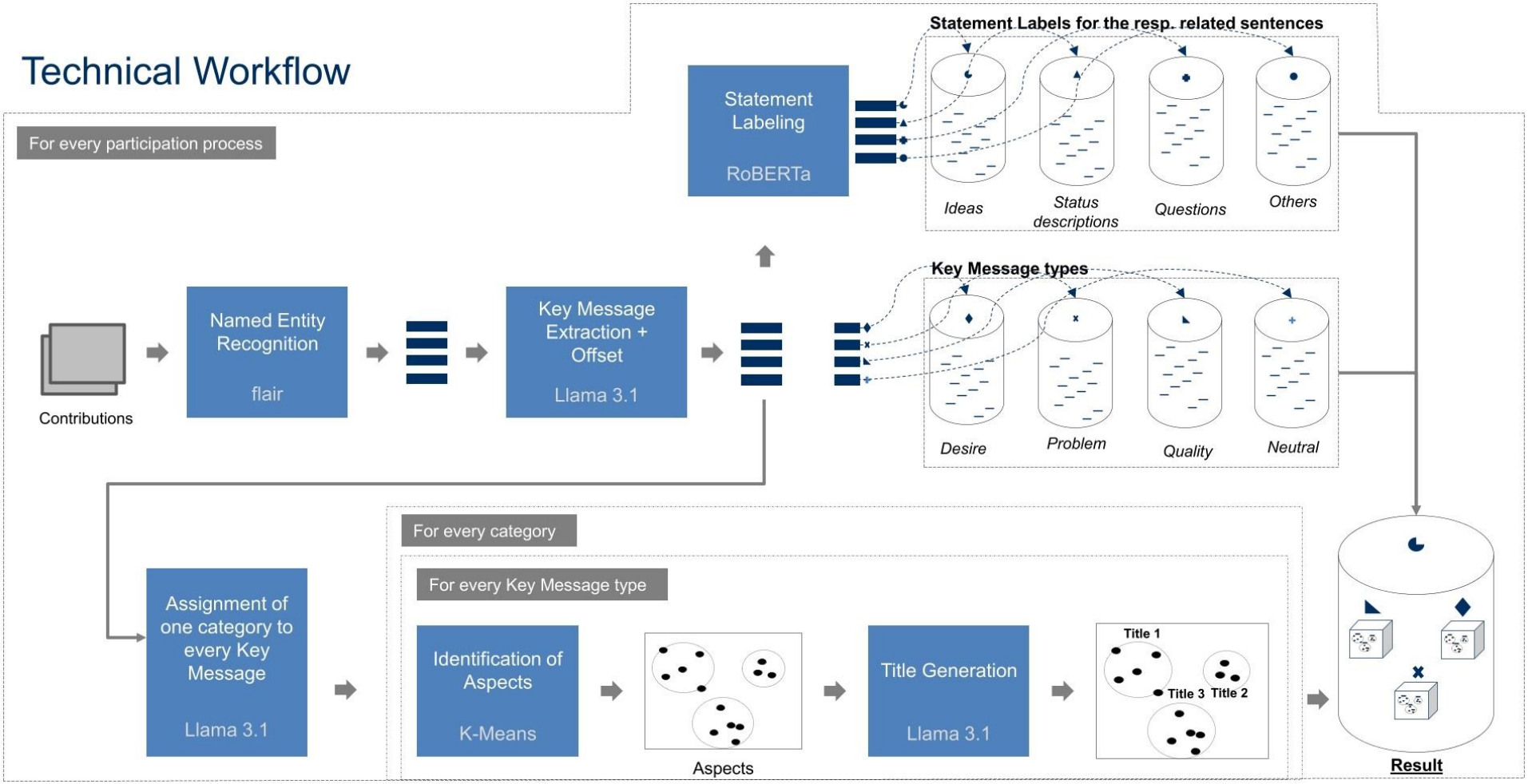

Figure 4: System architecture of the NLP-Toolbox

3.3 UX/UI-Design

The CityScienceLab (CSL) at HafenCity University developed the UX/UI design for the two central user interfaces: the Live-Dashboard and Insights. Their creation was based on the double diamond methodology and was iteratively improved in several usability tests and stakeholder workshops.

The results are a design manual, a design brief report and a Figma file with all UI components and user flows. The design features dynamic navigation, clear map visualisations and flexible export functions. Extensive filter and search functions support the analysis. According to the CSL, the requirements for digital accessibility in accordance with the relevant regulations were considered as far as possible during the development of the UX/UI design. The design was approved by the steering committee and served as the basis for frontend development by LGV from the beginning of 2025.

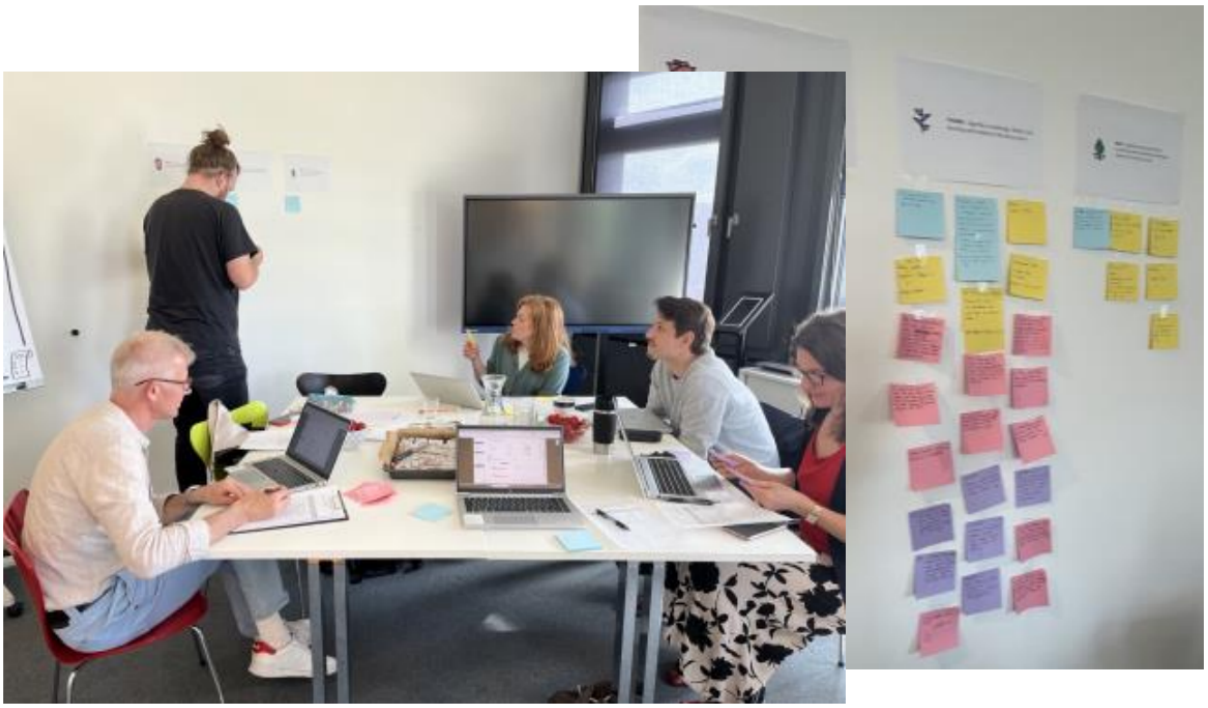

Figure 5: Stakeholder-Workshop - ©Mahta Nikoufar

3.4 Development of two Frontends

The technical implementation of the concept was carried out in addition to the production of the backend components (see 3.2) through the development of two frontends: The DIPAS_analytics Live-Dashboard enables daily monitoring of ongoing participation processes. It shows the development of contributions over time, the distribution by category and contribution type, and automatically identifies content that requires moderation, such as personal data. Contributions with a high response rate or controversial content are highlighted so that the project manager can respond in a targeted manner.

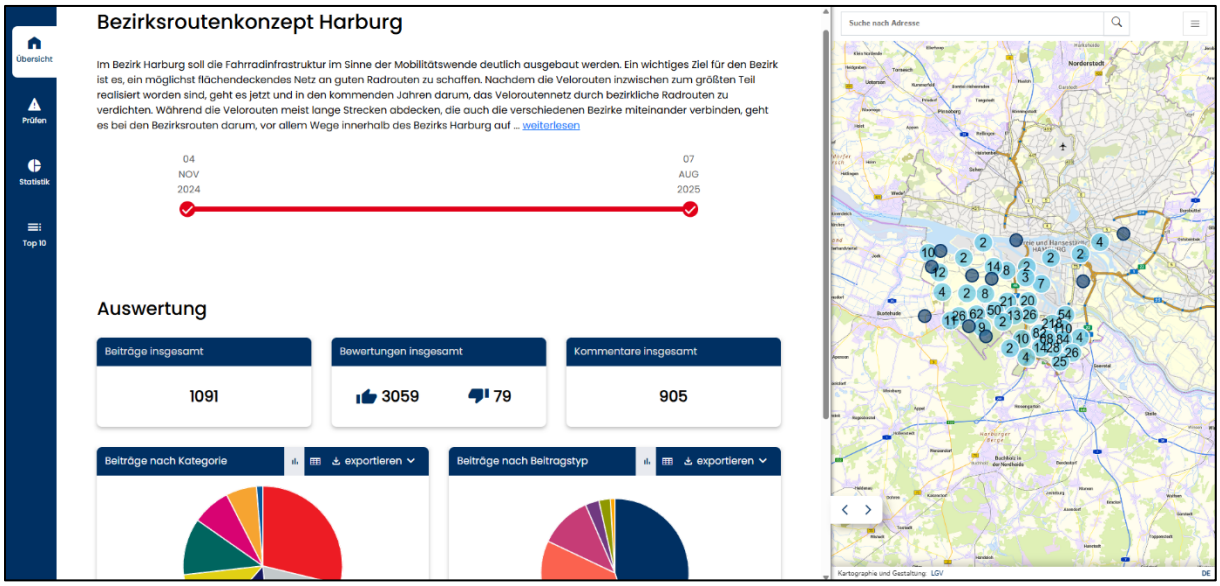

Figure 6: DIPAS_analytics Live-Dashboard Frontend (figure only available in German)

The second frontend, DIPAS_analytics Insights, supports the analysis and evaluation of completed participation processes. It structures large amounts of free text, extracts key statements, organises them thematically and spatially, and enables manual editing, filtering and exporting of the results. Via the integrated Masterportal[4], all freely available urban geodata from the Urban Data Platform can be displayed and directly combined with the technical findings from the contribution analysis. The geodata can be easily retrieved and visualised; contributions can be converted into heat maps, for example, so that spatial relationships and focal points can be quickly identified. In addition, a statistics view provides aggregated key figures and diagrams for quantitative evaluation. Both tools can be integrated into the DIPAS system as plug-ins and expand the possibilities for participation evaluation with interactive, customisable analysis functions.

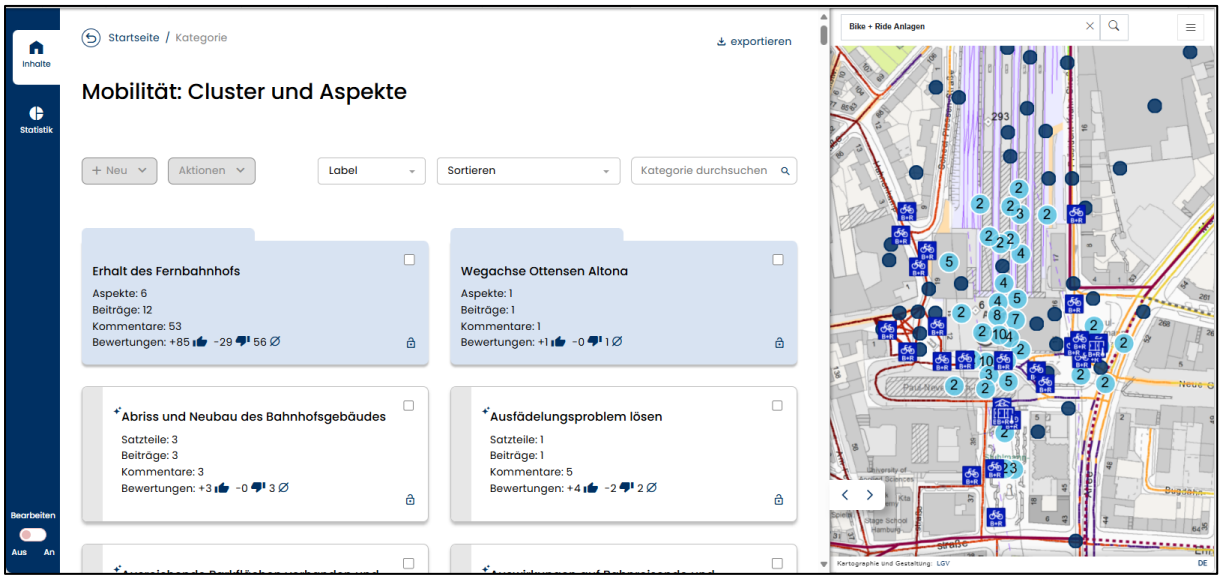

Figure 7: DIPAS_analytics Insights frontend (figure only available in German)

[4] The Masterportal is an open source platform provided by the City of Hamburg for the provision and visualisation of geodata. It serves as the technical basis for numerous urban applications and also enables interfaces to participation and evaluation systems such as DIPAS_analytics. See: https://www.masterportal.org/en/

3.5 PoC City-wide Analysis

A technical proof of concept (PoC) demonstrated that DIPAS_analytics is also suitable for city-wide and cross-process evaluations. To this end, contributions from five different processes were bundled and analysed automatically. Manual harmonisation of the categories was necessary, as automated assignment does not yet operate reliably. The analysis showed that an automated data pipeline is needed to merge the various procedures for evaluation. In addition, a new attribute ‘procedure’ is necessary for clear assignment, as well as the ability to perform multiple independent evaluation runs. It also became apparent that the introduction of a new role for cross-procedural evaluations is recommended in the DIPAS role concept. Further development of DIPAS_analytics in this direction would make it possible in future to identify trends and focal points in urban development over several years and participation processes, which would strengthen citizen participation at the city-wide level.

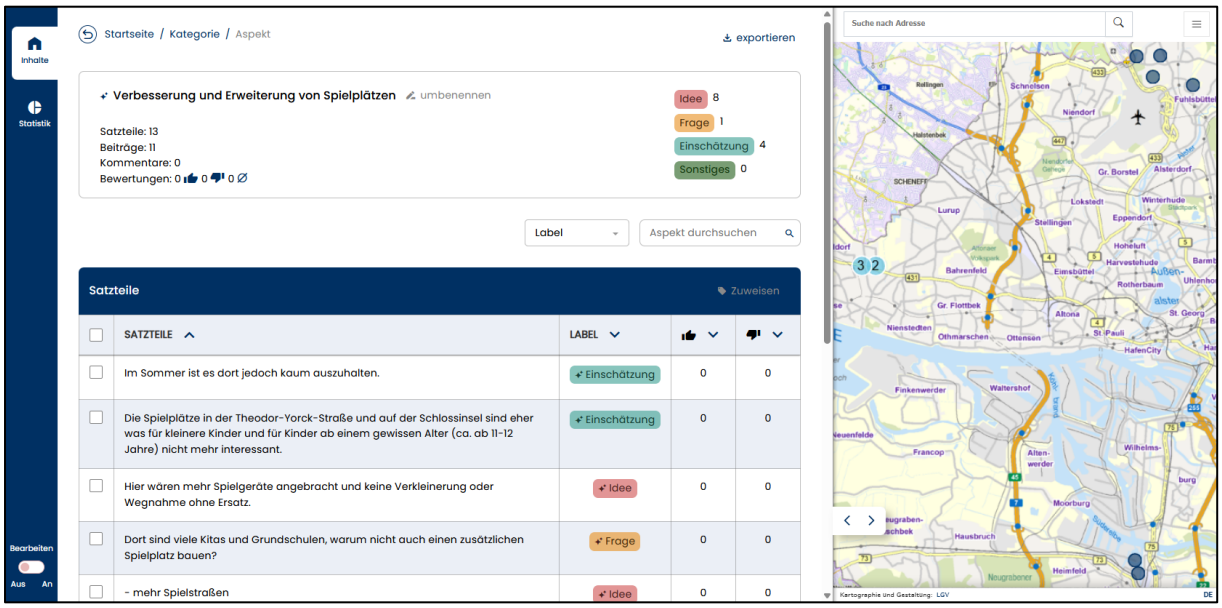

Figure 8: PoC – Cross-process Analysis (figure only available in German)

3.6 Ethics Audit and Risk Analysis

Already in the first year of the project, one focus was on familiarising ourselves with the topics of AI ethics, the European AI Act and the specific risks of generative AI models. To this end, workshops on digital ethics were held, including with the NExT Community, and a data ethics check for DIPAS_analytics was completed in cooperation with the Senate Chancellery, Department for IT and Digitalisation (SK/ITD). In addition, an audit scheme for the EU AI Act was developed, also in collaboration with the Senate Chancellery.

In the area of ethics and risk analysis, an audit was conducted by the Finnish start-up Saidot, which emphasised particularly the importance of transparency, communication and governance with a ‘lifecycle perspective’. It became clear that while AI enables efficiency gains, it also brings new tasks and challenges, especially given the still recent regulatory framework.

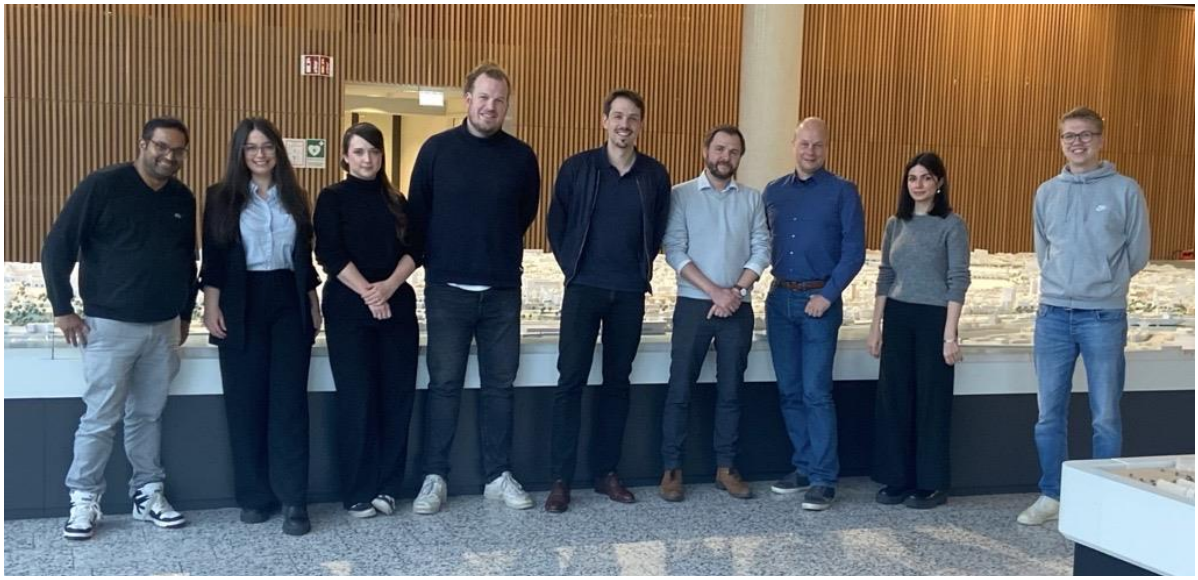

Figure 9: Ethics-Audit with Saidot - © BSW

Technically, risks such as hallucinations by LLMs, bias and algorithmic misclassifications were identified and addressed through targeted mitigation measures. The analysis according to the EU AI Act showed that DIPAS_analytics is to be classified as a system with 'limited risk', which means a transparency obligation towards users: they must be informed that the results are AI-based and may potentially contain errors.

3.7 Preparation of User-oriented Training Materials

Separate user manuals have been developed for the two main components, DIPAS_analytics Insights and Live-Dashboard. They provide a systematic introduction to AI-supported evaluation, explain key concepts and working steps, and make the technical processes transparent. The manuals are practical in nature and serve both as training materials for new users and as a basis during ongoing use. Additional publications are being produced to make the project results accessible to the scientific community, experts and the user community.

3.8 Expert and Final Conference

As a tangible conclusion to the project, a full-day expert conference was held in Hamburg on 15 September 2025[5]. The aim was to present the key project results, discuss them in a collegial peer review and reflect on the methodology. Representatives from administration, research and the specialist public were invited. The focus was on the two core tools, Live-Dashboard and Insights, and their possible applications. Thematic deep dives into NLP services, prompt engineering, LLM integration, requirements analysis and implementation management of AI products, as well as georeferencing from texts, promoted exchange among participants from the fields of development, application and research. The conference served as a kick-off for the dissemination and further development of the project results and contributed to the networking of the expert community. The day's program concluded with a

[5] Conference website: https://www.dipas.org/en/analytics/expertconference2025

keynote talk by Sir Michael Batty (University College London), who linked his perspective on digital twins and AI in cities to overarching issues of data-based urban development.

Figure 10: Project presentation by Mateusz Lendzinski at the final conference - © Angela Pfeiffer

4. Achievement of Objectives

All the objectives defined in the project implementation decision (PEV) were achieved in the project. The work packages were adapted and implemented on schedule or after consultation with the steering committee. The integration of powerful large language models (LLMs) and the methodological advancement of the analysis processes expanded the originally planned functionalities and improved the quality of the evaluation. The development of the preprocessing pipeline was streamlined due to changes in technology: many classic processing steps were replaced by the capabilities of the LLMs, so that the technical focus increasingly shifted to their integration and control as well as prompt engineering.

The technical implementation went beyond prototype status: instead of the three originally planned, eight independent NLP services were implemented and connected by an orchestrator to form flexible analysis pipelines. The toolbox has a modular and open design, so that it can be further developed and used beyond DIPAS for other administrative contexts. The operating concept was finalised in collaboration with Dataport, and the foundations for productive use were laid.

Individual goals, such as the provision of a general DIPAS training data set, could not be fully implemented during the project period, as the immediate need was lower and licensing issues still had to be clarified. However, the preparatory work for this has been completed and technical implementation is planned for the end of 2025.

DIPAS_analytics will first be trialed in practical use within the DIPAS user community and further improved based on the newly gained insights. In 2026, the software, including all services, orchestrators and both frontends, is planned to be made available open source to everyone on bitbucket and OpenCode.

The assumptions regarding economic efficiency, in particular the potential for increasing efficiency in evaluation, have been confirmed by experts but have not yet been empirically validated, as productive commissioning was not part of the project. A significant reduction in resource use and an improvement in evaluation quality is expected. However, this can only be proven after the planned evaluation. This qualitative evaluation is planned to take place no later than 24 months after the end of the project in order to record the actual effects on evaluation duration, costs and analysis quality.

Overall, the project goal – the development of an operational, user-centered and future-proof NLP toolbox for DIPAS – was fully achieved, laying the foundation for flexible further development and transferability to other administrative areas.

5. Discussion

5.1 Evaluation of the Achievement of Objectives

From the perspective of the departments implementing the project, the results achieved in the DIPAS_analytics project can be considered very successful and forward-looking overall. The technical components developed – in particular the modular NLP services and user-friendly frontends – significantly exceed the original expectations in terms of functionality and flexibility. The integration of powerful large language models has noticeably improved the quality and scalability of the evaluation and underlined the innovative nature of the project. Close coordination with users and consistent quality assurance have contributed to the practicality and compatibility of the solutions. Overall, DIPAS_analytics forms a solid basis for further development and reuse in other administrative contexts and strengthens Hamburg's role as a pioneer in digital citizen participation.

5.2 Strengths and Weaknesses

One of the project's key strengths is the consistent involvement of the customer: regular feedback and the provision of resources for collaboration have significantly enhanced the quality of the results and the practical suitability of the tools. The agile approach, iterative development and continuous professional exchange within the team enabled flexible adaptation to new requirements and technological developments. Close networking with city-wide digitalisation players such as SK/ITD proved essential for taking city-wide aspects into account.

One challenge was the high cost of manually labelling data, which was necessary for the development and evaluation of the AI models. This showed that this process must be considered early on in personnel planning and that sufficient resources must be allocated to avoid delays. The ethical evaluation of algorithms is also a constantly evolving field that should be addressed with appropriate resources and expertise right from the start of the project. The complexity of backend and frontend development made it clear that a clear separation of the development phases in terms of time and a detailed briefing for the teams involved improve the efficiency and quality of implementation and minimise the coordination effort between the teams.

5.3 Lessons Learned for Future Projects

The project has brought about numerous learning effects for future projects in the field of AI and administrative digitalisation. A key point is the realisation that it is necessary to plan development periods generously, especially at the beginning, to enable structured and high-quality implementation. Experience has shown that comprehensive briefing is essential for complex projects to create a common understanding of concepts and terms. In this case, it took about two weeks to explain the concepts and key terms for frontend development to the development teams and to establish a common understanding. The sequence of backend and frontend development should be clearly separated so that interfaces and APIs can be tested and integrated in advance. Continuous UX/UI design support throughout the frontend development process is recommended to minimise the need for coordination and friction losses.

A key learning outcome of the DIPAS_analytics project concerns prompt engineering and dealing with bias when using LLMs. The targeted design and ongoing optimisation of operational instructions are crucial for the quality and consistency of AI results. For successful implementation, a clearly structured workflow with manageable sub-steps is recommended, in which the model takes on individual tasks and the intermediate results are always checked by humans. Precisely defined input and output values are essential to enable targeted prompt engineering. Developing effective prompts is an iterative process in which input and output must be regularly reviewed and adjusted.
Controlling bias is particularly important, as LLMs are trained on large data sets from the internet and can therefore adopt the prejudices they contain. The wording of the prompts can also influence the response behavior. The project therefore used targeted testing procedures and systematic model evaluation under human supervision to identify and address potential biases at an early stage. The findings were directly incorporated into the further adaptation of the prompts and the selection of suitable model configurations. Overall, it became clear that a conscious and methodologically sound approach to prompt engineering and bias is crucial for the trustworthiness and quality of AI-based evaluations.

A coordinated operating concept developed early on in collaboration with the IT service provider is necessary for the subsequent operation of AI solutions. This ensures that the necessary technical and human resources can be made available in good time. Ethical assessment and compliance with regulatory requirements should be considered an integral part of the project from the start.

During the project, it became clear that the use of open-source AI and LLMs offers considerable advantages over proprietary solutions. The opportunity to not only conceptualise modern tools in an administrative context, but also to implement them in practice, was seen as a significant opportunity by all those involved. However, the selection and integration of LLMs requires a comprehensive understanding of the possibilities, limitations and risks, as well as a clear definition of the intended use. Compared to classic, rule-based or purely statistical approaches, the generative models enabled a significantly more powerful and flexible contribution analysis, especially in the automated extraction of key statements and the categorisation of texts.

Selecting a suitable language model is complex and depends on various criteria, including modality, open-source status, hosting options, and industry-specific requirements. The project chose the AI Model Hub from IONOS, which offers a limited range of models that are suitable for the use case. The costs for using the LLMs are very low due to the short texts in the NLP services and amount to around €10 per complete participation process.

6. Outlook

The completion of DIPAS_analytics provides a solid technical and methodological basis for the further development of digital citizen participation in Hamburg and beyond. In the coming years, several concrete tasks and development opportunities will arise that will further exploit the potential of the system and open up new fields of application.

A key objective is to extend the analysis functions to comments. The aim here is to examine and implement a prototype for classifying and evaluating comments as approving, disapproving or supplementary reactions.

The modular NLP components also offer the possibility of supporting the input of contributions themselves, for example through automatic georeferencing from texts.

The city-wide evaluation, as already tested in a PoC within the project, is particularly relevant from a strategic perspective: the analysis of cross-procedural topics and trends based on collected participation data can help to identify priorities and developments in urban development from the citizens' perspective over longer periods of time.

With the planned introduction of a CC BY-NC-ND licence[6] for participation contributions by the end of 2025, a legally secure training data set can be made available in the future, which can be used for further developments in the field of NLP and AI.

The user interfaces will also be further tested and optimised after initial practical experience to continuously improve usability and acceptance. The next steps are to pilot the developed services internally within the Stadtwerkstatt and then gradually test them in real-world scenarios – also in collaboration with the DIPAS user community.

For the sustainable evaluation and optimisation of the tools, it is recommended that random comparisons between human and machine evaluation are carried out in future. Qualitative differences and the time required for manual versus AI-supported processes should be documented to allow for a well-founded assessment of the effectiveness and practical benefits of the services.

Overall, DIPAS_analytics is designed in such a way that further development and transferability to other administrative contexts are possible at any time. Possible applications include, for example, the processing of letters from citizens or objections to planning

[6] creative commons license with the need for attribution (BY) and no permission to use it commercially (NC – noncommercial) or create derivates (ND – no derivates) https://creativecommons.org/licenses/by-nc-nd/4.0/

processes. Responsibility for the further implementation of DIPAS_analytics in the context of downstream measures or follow-up projects and for evaluation lies with the Stadtwerkstatt.

7. Conclusion

DIPAS_analytics expands the DIPAS digital participation system with a powerful, AI-supported evaluation component. The project was a response to the sharp increase in demand for automated and valid analysis methods, which became particularly apparent with the rise of digital participation processes and the challenges posed by the COVID-19 pandemic. The development of eight modular NLP services, the integration of large language models and the implementation of user-friendly frontends fundamentally simplify the monitoring and evaluation of citizen contributions and should noticeably reduce the administrative burden when implementing participation processes.

The consistent integration of open-source technologies and methodological development – for example, through the integration of LLMs and the systematic consideration of ethical and legal requirements – underline Hamburg's role as a pioneer in the field of data-based urban development and digital sovereignty. The project results are not only applicable to Hamburg, but also to other municipalities and administrative areas, and offer a flexible basis for future innovations.

The sustainable embedding and evaluation of the solutions in real-world operation will be evaluated within 24 months.

In conclusion, it can be said that the DIPAS_analytics project has fully achieved its objectives and exceeded them in several aspects. A robust technical and methodological foundation has been created that enables the use of modern AI technologies in digital citizen participation and strengthens Hamburg's position as an innovative and digitally sovereign city administration.