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DIPAS – Towards an integrated GIS-based system for civic participation

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Abstract

In the course of a comprehensive digitisation campaign, the Free and Hanseatic City of Hamburg is planning to develop a GIS-based integrated system for informal civic participation. In order to achieve this, the system applies the uniform geodata infrastructure, GDI, whose development was spawned by the INSPIRE directive. Promoted by a widely comprehensive open data legislation, Hamburg holds a leading role in Germany regarding the extension of spatial data based services. The city is also a leading player in the development of new data and process standards in the field of urban planning and construction. Previously informal participation processes represented a gap in the digitisation field while at the same time sharply increasing in the urban planning processes of recent years. Based on modules for digital on-site participation and digital online participation, the BSW is cooperating with the HCU and LGV in order to develop a digital integrated participation system. This system is to be used for digitising space-related participation processes. Employing a high performance digital infrastructure the output from participation processes will be enhanced, thus extending the options for citizens to participate in the restructuring of urban spaces.

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Keywords: public participation; digital participation; citizen participation; smart urban governance; collaborative governance; urban democracy; urban governance; smart cities

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List of Acronyms

FHH	Free and Hanseatic City of Hamburg	GDI	Geodata Infrastructure
BSW	Administration for Urban Development and Housing	DIPAS	Digital Integrated Participation System
LGV	Agency for Geoinformatics and Survey	PPGIS	Public Participatory GIS
HCU	HafenCity University	GIS	Geoinformation System
PCAST	Presidents Council of Advisers on Science and Technology	API	Application Programming Interface
IBA	International Building Exhibition GmbH Hamburg	GUI	Graphical User Interface
CSL	City Science Lab (an Institute of the HCU)	EIP	European Innovation Partnership
MIT	Massachusetts Institute of Technology	WFS	Web File Service
IAP2	International Association for Public Participation	WMS	Web Map Service
TÖB	Agencies for Public Services	IFC	Industry Foundation Classes
XÖV	German Standard for Public Data Sets	BOP	Spatial Planning Online

1. Introduction

The FHH has set itself the goal to allow citizens to participate more intensely and regularly in spatially relevant planning procedures. An important impulse for this was sent out from protests against large infrastructure projects such as Stuttgart 21 in 2011. Throughout Germany these protest spawned a revival of the debate regarding civic participation already in the early stages of spatial plannings. In this type of resistance and the resulting delays for the realisation of large projects, important stakeholders recognised an eminent obstacle for the renewal of vital infrastructures [1]. In the wake of this, different institutions such as the German Conference of Cities [2], federal and regional ministries [3] [4], research institutions [5] and diverse foundations [6] publicised analyses, memorandums and guidelines on the topic of civic participation. Many municipalities and local councils in Germany reacted by introducing coordination centres for participation and by adoption of guidelines for civic participation. In 2012 the 'Urban Workshop' ('Stadtwerkstatt') was established within the Hamburg Administration for Urban Development and Housing as an agency for information and participation in the field of urban development [7]. Meanwhile 97 participation processes have been carried out in Hamburg between 2012 and 2016.

1.1. Aims and expected effects of additional civic participation

These measures are directed towards informing citizens about planning procedures at an earlier stage and offer more possibilities for public debate regarding the development of the respective projects. The political impetus behind these efforts is to improve planning procedures and make them easier to process again. But participation procedures come at a cost. According to a conclusion reached by Selle [8] the mediation process between the actors in a planning process is just as laborious as solving the technical problems entailed in planning. From the point of view of the public planning agents, the aims are mainly assigned to a qualitative enhancement of the planning process by broadening the planners' information base, increasing acceptance and relief for the formal planning procedure (less legal action, fewer objections) due to early disclosure and the resolution of conflicts of interest. In addition to this functional perspective of the administration, more extensive goals concerning the fortification of democratic institutions and procedures, respectively their acceptance and capacity for solving problems, come to the fore [9].

Representatives of planning science and comparative government share the view that a more intense civic participation in decision making processes can contribute to achieving performance and problem solving capacity for the entire democratic system [10]. Participatory methods applied in planning are usually perceived as a form of

urban governance [11] [12]. Such urban governance aims at a flattening of hierarchies in the relation between the state and society, and a shift towards heterarchical, networking modes of communication. According to Sinnig, *„the basic idea consists of improving the capacity for self-organisation in economic and social subsystems"*[13]. In the process citizens are transformed from recipients to 'co-producers' of social assets. In many municipalities and communities experiments are being carried out involving co-creative and cooperative procedures. Nevertheless, Geißel is correct in stating that *„co-governance procedures including citizens directly in decision making processes are hardly institutionalised at this point in time"* [14]. More often the lack of effectivity inherent in participation processes, or their exploitation as measures for generating acceptance are complained about [15]. Still the framework conditions for cooperative governance have improved substantially thanks to the development of modern digital communication tools and the proliferation of open data. Simultaneously the increasing complexity of planning, participation and decision making processes, require a development of instruments and methods for processing the surge of complexity contained in these open regulation processes. With regard of this aspect, within the smart city debate the term of 'smart urban governance' has arisen: "Smart city governance is about crafting new forms of human collaboration through the use of ICTs to obtain better outcomes and more open governance processes" [16]. A central question herein is how to merge social 'deliberative' processes and advanced technical means in a synergetic way, meaning how to connect the collaborative internet with collaborative planning and participation processes.

1.2. Modernisation potentials in participation procedures achieved by digitisation

The key role of the Internet in distributing information to citizens is beyond question. The value and the widely spread applications of consultative Internet participation have, for instance, been described in the 'Guidelines for Online Consultations' by the Bertelsmann Foundation [17]. The tools for visualizing and simulating urban spaces have improved significantly within the last years, up to interactive 3D tools that can integrate GIS Data and urban designs like the CITYPLANNER from Agency9 [18] [19]. Yet these instruments and methods are still a far cry from co-governance. Beside the numerous methodical and political preconditions required to increase the effectiveness of participation processes, the existing technical solutions lack a connection between online and on-site methods and instruments. Moreover the Internet-based participation platforms do currently not exhaustively exploit the enormous available data inventories that the public administration commands. The digital integrated participation process presented hereafter is an approach to supporting complex participation processes online and on-site applying modern digital methods. An essential element of this is the exploitation of the data and knowledge bases available through the public administration as well as the seamless integration into public data infrastructures and digitised administration processes. The public data inventories are fast-growing, and grow even faster, when monolithic expert procedures are opened and citizens, civic organisations and institutions are also able to enter information into the system. Like many other European cities Hamburg works on the construction of an 'urban platform', for which the European Innovation Partnership (EIP) has developed this working definition: "An 'Urban Platform' is the implemented realization of a logical architecture/content/design that brings together (integrates) data flows within and across city systems and exploits modern technologies (sensors, cloud services, mobile devices, analytics, social media etc.) providing the building blocks that enable cities to rapidly shift from fragmented operations to include predictive effective operations, and novel ways of engaging and serving city stakeholders in order to transform, in a way that is tangible and measurable, outcomes at local level (e.g. increase energy efficiency, reduce traffic congestion and emissions, create (digital) innovation ecosystems, efficient city operations for administrations and services)" [20]. The urban platform enables citizens and public or private institutions of the city alike to access urban data and applications. This approach aims at generating new knowledge by making available, combining and analysing existing data from different sources. In this manner private and public services are intended to be improved or newly developed, infrastructures are sought to be utilised more efficiently, and innovations are to be promoted. At the beginning of 2016 the US 'Presidents Council of Advisers on Science and

Technology' (PCAST) presented a report named 'Technology and the Future of Cities' [17]. In this report the establishment of a national 'city web' plays a central role. The most important function of the city web is the creation of a comprehensive platform for urban innovation. According to PCAST there exists a great convergence of interests among individuals, organisations and the public authorities regarding the development of smart service innovations. Here civic organisations such as 'Code for America' articulate themselves as a part of a new bottom-up movement, engaging in development solutions directed toward common welfare. These efforts do not only expose urban problems to technology, they also expose technology to urban problems, hence initiating the development of new socially and economically useful services. Such initiatives have also been started in Hamburg, creating new services and applications on external platforms using the data from the transparency portal. And, as EIP puts it: "Further, in the future, data will be to a greater extent generated by individual citizens and this too (with due consideration to privacy and a strong trust framework) can be considered city data". In order to merge data generated by citizens with the urban data inventories, adequate channels need to be created. Strategically the aim is to let citizens participate in the development of urban products and services in order to strengthen their active and creative role in the establishment and reproduction of urban spaces for living.

2. Methodical approach of DIPAS

The design of the participation system is derived from the levels of participation outlined by the 'International Association for Public Participation' based on the 'Ladder of Participation' originally developed by Sherry Arnstein in 1969 [22].
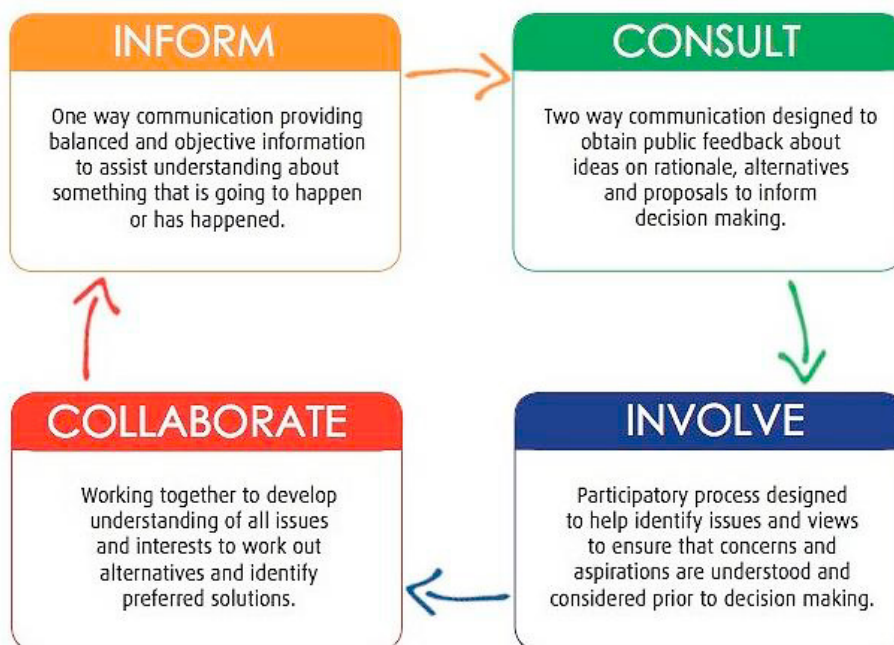
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Fig. 1: IAP2 Spectrum of Public Participation

2.1. Requirements for a system for information, consultation and involvement

The basic requirement for a digital participation system is a comprehensible and reliable presentation of information. Public data, documents and plans must be comprehensively available, and spatial data, plans, planning alternatives, designs and simulations must be visualized. In practice this can be solved by employing geodata-based Web map services and Web file services built on top of the geodata infrastructure established for the implementation of the European INSPIRE directive [23].

The core feature of the system lies in the creation of a high quality digital feedback channel leading to the institutions responsible for the planning. Based on comprehensive and accurate information, citizens must be able to voice their thoughts, criticism, ideas and comments in connection with planning projects of all kinds. Such Internet-based solutions are best described by the term Public Participatory GIS. The special feature of DIPAS is the requirement that feedback needs to be collectable in digital form by an integrated system both online and on-site. The feedback harvested online and on-site must be synchronised and parallelised in the system. In principle the system must be designed such as to be open to all subjects, i.e. it must be capable of processing information, consultation and collaboration for diverse locations and problems in order to be usable by many different authorities and public institutions. Evaluation and analysis tools must enable fast and systematic analysis and further processing of harvested information for both responsible planners and citizens. The quality and information depth of the civic participation, so far usually practised in workshops and events using 'plan and paper', is enhanced by the availability of exact digital representations of maps and specialised spatial data. At the same time the processing of feedback is facilitated as it is collected in digital and geo-referenced form.

In participation processes, in the initial phase typically information is provided with regard to the object of the procedure, followed by an extensive collection of ideas and contributions. Methodically this is tantamount to a consultation of the public. The feedback is analysed and condensed, whereupon it is communicated back to the public online and through events. The evaluations yield a first overview of the participants' opinions and can be used, for instance, in order to prioritise questions on the agenda of a planning procedure: which topics are important? What does the feedback concentrate on? Where do needs and demands become visible? Where are fields of problems and conflicts to be identified? The contributions made by citizens are usually characterised by a broad and heterogeneous range of topics. In order for participation to unfold its effect, a thorough treatment of the collected information is essential. So far this has been a time-consuming operation requiring expert resources. A critical requirement for the efficiency of a digital participation system is thus the capacity to meaningfully restructure the complexity of the contributions, often several hundred, in order to facilitate evaluation. Furthermore, functions for statistical evaluation and algorithm-based interconnections reaching all the way to automated analysis of text information need to be developed and implemented. The development of such evaluation functions and reporting modules are designed to deliver as precise and transparent information as possible in order to enable downstream planning and decision making processes. When a consultation has been carried out in such a manner as to effectively influence the agenda and the priorities of a planning procedure, then participation has reached the level of involvement.

2.2. Requirements for a co-creation and collaboration system

A more difficult problem to solve is the digitally supported co-creation and collaboration process. Previously this has taken place nearly exclusively within the framework of special formats such as real labs, planning cells, Charette procedures etc. Digital platforms can provide good support for the retrieval and processing of information, yet this has so far only been assessed and put into effect through personal communication [20]. Hence there only exist experimental approaches to multi-phase, Internet-supported participation processes aiming at producing complex results. Trénel et al. expressed the notion already in 2003 that "the participating citizens value the qualities of the Internet for consultations especially when the disadvantages of computer based communication are compensated by alternating with face to face sessions" [21], or, as Petrin pointed out, "online without nonline is insufficient" [22].

As suitable technical tools and methodical formats for digital work processes with heterogeneous groups are rare, there still remains substantial research and development work to be done in order to yield functional tools and formats. Among other things the DIPAS project seeks to develop system functions for supporting collaborative and co-creative workshop processes, as well as precisely gauged digitally supported workshop formats in order to embed them in the later phases of the multi-stage participation process.

2.3. Consideration for the requirements of special target groups

A topic often treated in research is the social selectivity of participation processes [23]. The participants are usually selected by means of self-selection: those interested in the subject and in participating in the talks will turn up. These are mostly persons with higher education, they tend to be older, the majority are men. Inhabitants with a migration background, the age group of the under-thirties, women, young families and the elderly are under-represented. Online participation procedures hardly influence this unbalanced situation. Although it is simple for all to participate from home, not all groups of the population take advantage of this option equally. Studies show a relatively high interest from younger people for online procedures [24], but the actual distribution of users is difficult to determine, as no such data is collected in most of the processes. A 'digital divide' persists along the lines of age, income and education. The higher the education and income, the more frequently the online possibilities are used, also at a higher age. The lower education and income are, the rarer the online possibilities are taken advantage of, especially with growing age [25]. When developing tools and methods for digitised participation, such segregation effects need to be taken into account, and counter-strategies need to be developed.

3. Actors and system environment

The basis for developing a digital participation system is to be found in open data. For Hamburg the central elements are the transparency portal, the geodata infrastructure and the portals and applications built on top of these. Continually relevant are new developments within the standardisation of building and planning procedures in the wake of the proliferation of XÖV standards. In practice the development of DIPAS on one hand relies on the experience and findings of the 'finding places' project carried out by the CityScienceLab of the HafenCity University in cooperation with the MIT Media Lab 2016 [26], on the other hand it is based on a digital participation tool developed by the BSW and the LGV.

3.1. CSL CityScope

The CSL CityScope was created for the Finding Places Project. This 'crowdfinding' participation process was initiated by the mayor of Hamburg against the backdrop of a sudden, high increase in demand for suitable locations for refugee shelters in 2016, and the distinct reluctance of many citizens towards such shelters. The CSL conducted this process using an adapted 'CityScope' simulation system, which was initially developed by the MIT MediaLab 'Changing Places' group. The system blends hardware, software and human interface design together with Hamburg's existing geodata infrastructure. CSL CityScope proved to be a very effective tool for supporting planning workshops with citizen involvement. The system allows for quick display and easy retrieval of a wide variety of urban data, and provides effective support when laymen wish to lead a qualified and productive discussion with planning experts. Yet CityScope is permanently located at the HCU and designed for the use in workshops, not online.
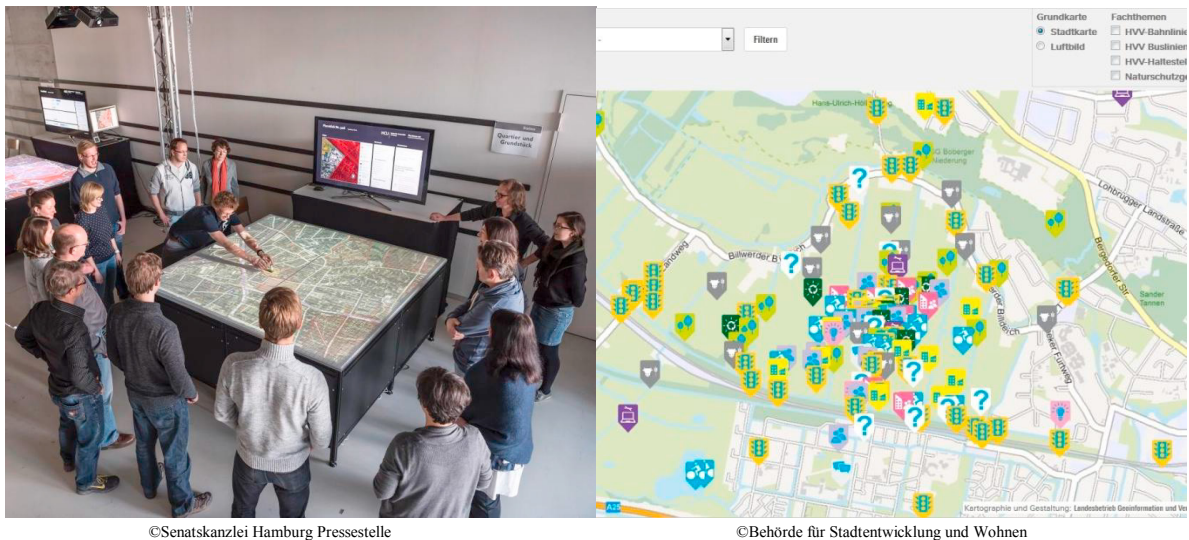
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Fig. 2: (a) HCU City Scope for 'Finding Places' (b) BSW/LGV Online Participation Tool for the IBA Development Project 'Oberbillwerder'

3.2 Online Participation Tool

The online participation tool was developed by the City Workshop of the BSW in cooperation with the LGV between 2014 and 2016 as a geodata-based social web application allowing citizens to enter suggestions, questions and criticism online regarding urban planning projects. It is programmed in open source software Drupal and functions as a web application in the geodata master portal of the FHH. Geodata layers relevant for the respective planning project can be applied as required. The tool aims at providing a simple-to-use standardised utility for online participation for the seven districts of Hamburg. Therefore it is designed to be easily integrated into the information environment of the respective project agency (websites belonging to districts, authorities or external users). On a map of the project area, citizens can enter contributions regarding different project-specifically defined subject categories and define them as suggestion, idea, lead or criticism. Moreover, secondary links can be indicated, and explanatory documents and images can be uploaded. Other users have the option to comment on contributions and to assess them. In addition the tool also provides the option to carry out simple surveys. For users the tool offers diverse evaluation and data export functions. In the last 12 month the tool was used to upgrade 6 participation processes with an online component, several more are under preparation.

3.3 Technical and data-related conditions

Thanks to the Freedom of Information Act, the data collected by official agencies are basically accessible to the public, save clearly defined exceptions for the protection of personal data, classified business and commercial information owned by enterprises as well as security-relevant data. During recent years this legislation has been further developed on the level of the German federal states. In the process Hamburg took on a leading role in 2012, when a transparency act was passed setting the standards throughout the republic regarding the treatment of data collected by the public administration.

3.3.1 Transparency portal, master portal geo-online

Subsequently a transparency portal was released in Hamburg in 2014 making more than 2,500 datasets available to the public. The LGV feeds data from 57 digitised business processes into the transparency portal, where this and other data can be cartographically represented by 387 Web map services. At the same time approximately 80 different applications are available offering functions for the analysis and aggregation of data for diverse

applications. The fundament for all applications are the WMS and WFS services of the geodata infrastructure Hamburg. The development of these services and applications is directed by the LGV that operates the master portal 'geo-online', which is also applied as the geoscience client for the transparency portal.
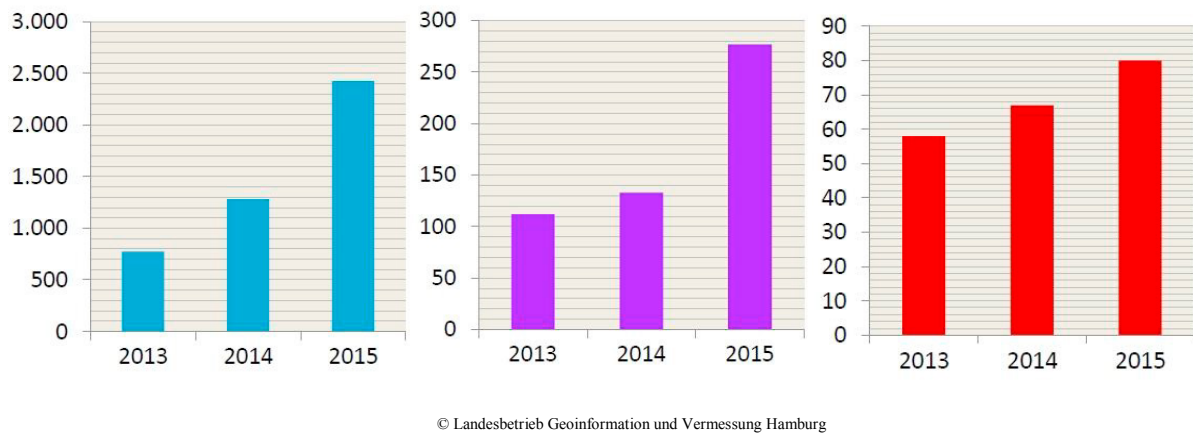

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Fig. 3: Datasets, services and applications in the transparency portal of the municipality of Hamburg
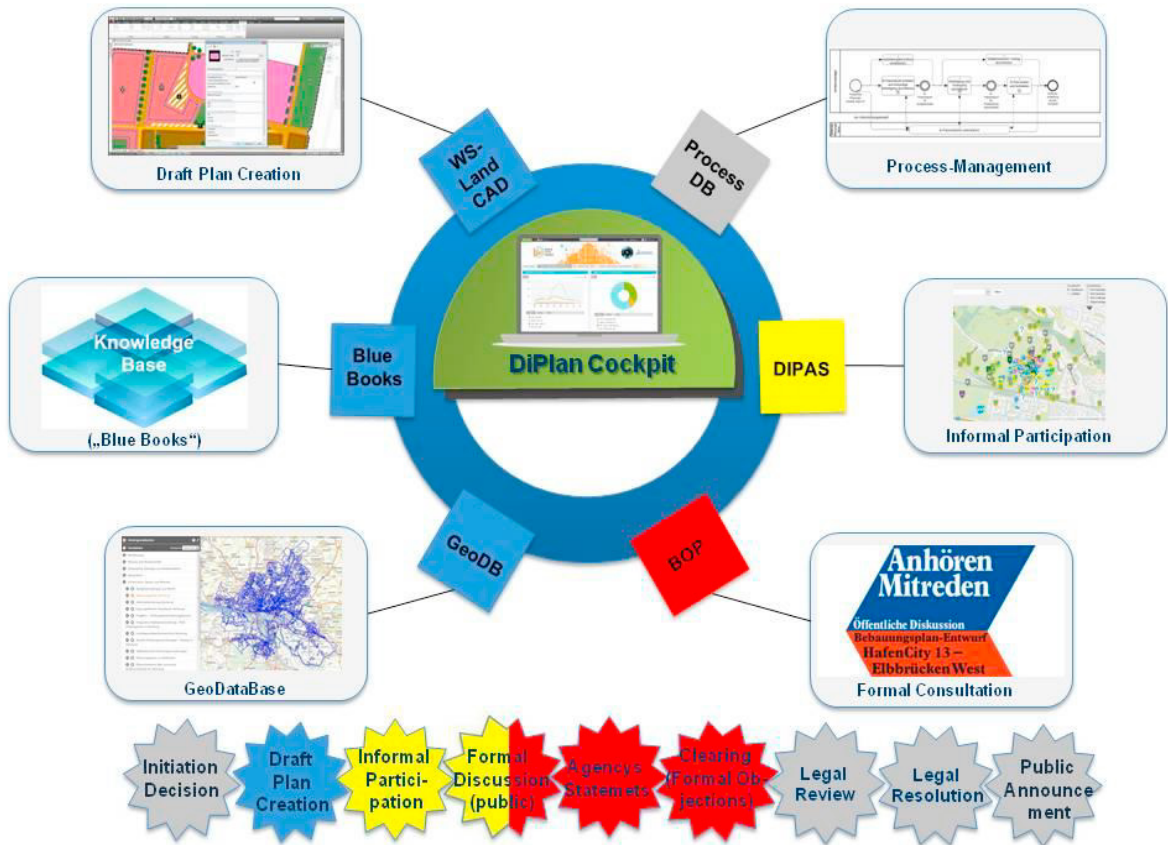
3.3.2 XÖV standards, XPlanung, XBau

The introduction of new, unified data formats in the planning sector is an important precondition for the development of a digital planning system. Upon appointment by the Federal Construction Secretary Conference, Hamburg is supervising the development of the standards XPlanung and XBau, which belong to the family of the XÖV data standards set out by the German public authorities. With Xplanung, representations and terms of planning documentation belonging to the urban land use planning and spatial regulations are described semantically in a data model. One characteristic of the format is the geo-referenced registration of the spatial regulations with an option for connecting attributes to the geometries based on urban building law. This enables a differentiated recording of specific functions and the assignment of textual determinations to the respective spatial geometries. Thus plans established by means of XPlanung can be digitally analysed and visualised. The existing building stock, the frameworks set by the development plan and the cubatures of planned buildings can, for instance, be visually superimposed in three dimensions. The XPlanung-compliant registration of applicable planning regulations in Hamburg will supposedly be concluded by 2017. New development plans must now already be established in the XPlanung format. The XBau format aims at standardising data exchange in the building licensing process. Employing XBau information, documents and digital layouts can be exchanged on a standardised basis in the shape of IFC files so that also individual building projects can be visualised through digital systems, and interactively processed. For the future, investigations are in progress within the framework of DIPAS in order to determine whether the formulation of an XÖV standard for participation (XPart) might be an option. The aim of such a quest would be to be able to standardise and automate the downstream processing of fundamental process data and products, respectively to make them available to the public through transparency portals.

3.3.3 DiPlanung and online development planning (BOP)

The FHH project DiPlanung is aimed at creating a digitised process chain on the basis of XPlanung und XBau reaching from the digitised creation of development plans to the digitised licensing of individual building projects. The entire process from the decision to establish a development plan to the public announcement is to be reflected by a digitised process. The essential information regarding the state of the process, adjustment processes, events and next steps of action are to be visualised in a Web-based cockpit. For this, the system will integrate existing modules

of the digital planning infrastructure, respectively automate the data exchange between these systems. It will be a challenge to establish interfaces for the transition from informal participation with DIPAS to formal participation using the system Online Development Planning (BOP), which is already being used for so-called TÖB (Public Issues Agencies) participation as well as public announcements. As can be seen in the diagram, BOP and DIPAS are modules of DiPlanung.

Fig. 4: DiPlanung system diagram

4. DIPAS system design and development

DIPAS is a combination of the online participation tool with digital planning tables yielding an integrated, seamless digital system for informal participation. Priority issues that need to be resolved for production include the development of a mobile digital presence system (workshop tool) as well as its systemic interconnection with a further developed online tool. The construction of the system is to be carried out in several steps. At first a promptly realisable basic functionality for use in the responsible departments and districts is to be defined and created. On top of this system a stepwise extension of functionalities is to be realised in accordance with the experience gained through it.

4.1. Basic development stage

In its basic version, DIPAS is intended to serve as a digital, interactive support system, accompanying consultations regarding urban plannings over the course of participation procedures, competitions and committee sessions. Technically this will be solved by means of an adaptation of the GUI of the online tool for use with interactive devices such as touch tables, which can comfortably display maps and geo-referenced 2D data. This includes spatial data all the way to the level of individual plots as well as all legal fundamentals regarding urban planning regulations (equally so in Finding Places).

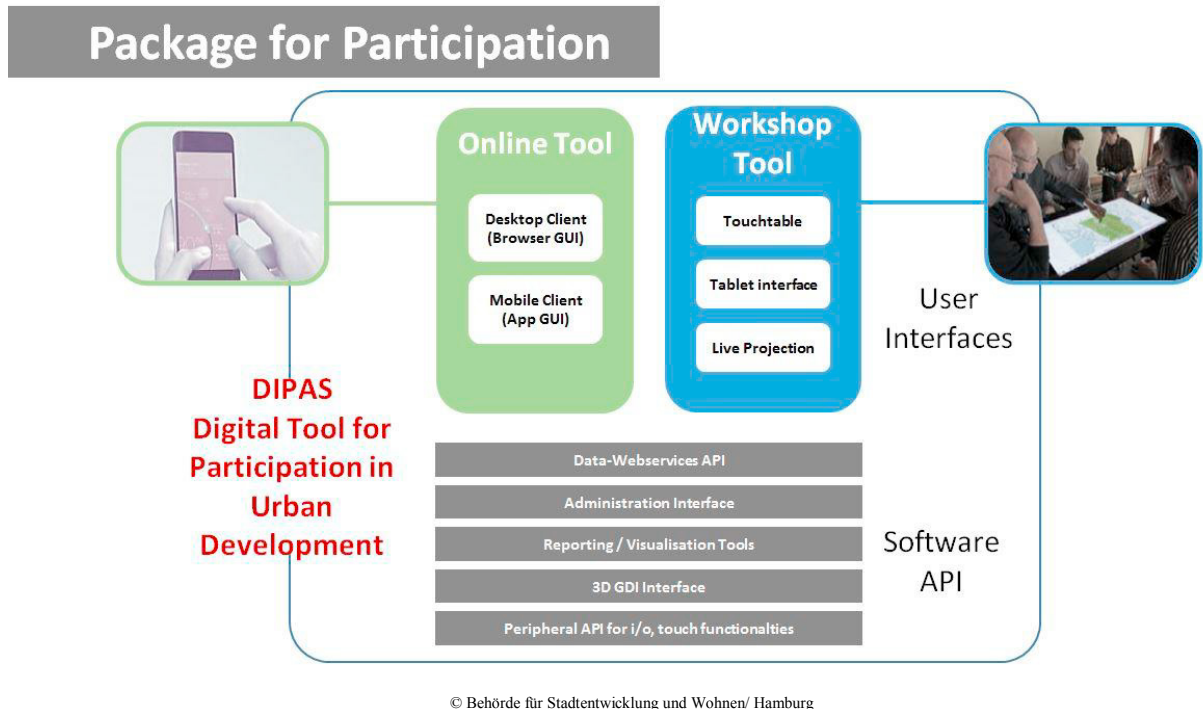© Behörde für Stadtentwicklung und Wohnen/ Hamburg
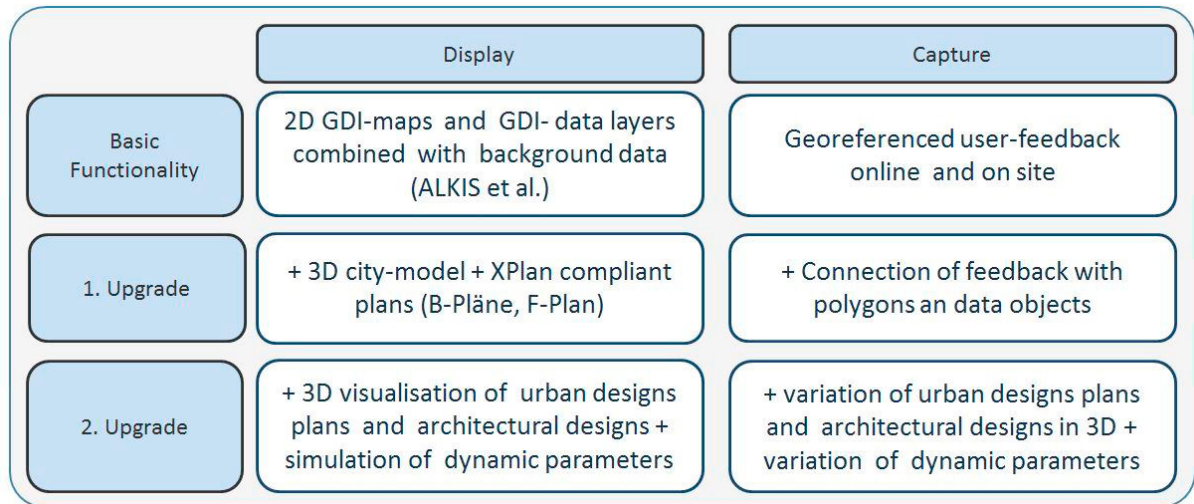
Fig. 5: DIPAS system design

The entry of geo-referenced contributions is processed on-site using tablets that are connected to the touch tables as display units via WLAN. The System can be applied in the entire city area or for defined parts thereof.

4.2. First upgrade: integration of XPlanGML plans and urban development designs

The first upgrade will integrate a 3D surface/construction model in the system in addition to the 2D map views. Supported by a 3D visualised polygonal structure model, building heights, visual axes, open spaces and street sections can be visualised. Furthermore, plans produced in the XPlanung format can be visualised and evaluated, and visualisation of urbanistic designs will be enabled employing the workshop tool. Additionally the results of urban development competitions can be retrieved from participating architectural offices and integrated in the digital 3D city model of the FHH by transformation to the CityGML file format. Entered amounts will be directly linkable to data objects in the plan design.

4.3. Second upgrade: Variation of urbanistic designs and simulations

The second upgrade aims at interactive variation of target conditions, i.e. planning and configuration designs such as layout plans, urban development plans and construction designs. The option to vary planning and object designs on-site in workshops is to be enabled by variation of individual objects directly in the digital plan or by importing preprocessed positioning variants for buildings, route planning, parks etc. with a view to enabling integral geo-referenced 3D visualisation of planned structures and infrastructures in the 3D building model. In further development hikes dynamic parameters simulations and variations of dynamic parameters such as noise, wind or traffic will be enabled.

Basic Functionality	**Display**	**Capture**
	2D GDI-maps and GDI- data layers combined with background data (ALKIS et al.)	Georeferenced user-feedback online and on site
1. Upgrade	+ 3D city-model + XPlan compliant plans (B-Pläne, F-Plan)	+ Connection of feedback with polygons an data objects
2. Upgrade	+ 3D visualisation of urban designs plans and architectural designs + simulation of dynamic parameters	+ variation of urban designs plans and architectural designs in 3D + variation of dynamic parameters

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Fig. 6: DIPAS functionalities

5. Procedure and Implementation

The technological platform for the first stage of DIPAS is set. After the adaption of the desktop client for touch tables, a series of iterative development and testing will be conducted.

Testing will take place in planning workshops in cooperation with citizens and particularly interested professionals, such as planning students and the coding community.

These workshops shall be carried out parallel to real life planning processes, and will deal with the plannings and problems involved in them. A strong focus will lie on the usability of the workshop tool's GUI, as the shift from the traditional method using plan and paper to touch surfaces, layer technology and tangibles represents a challenge to planners and participants. The technical side faces challenges too, for instance regarding the visualisation of the 3D city model via the Internet, or plans, designs and simulations that must be resolved in order to achieve the goal of informed feedback. Eventually work methods and workshop formats must be developed enabling the required concentrated communication of information and feedback.

In order to optimise the design of the system a detailed evaluation of the workshops will document and analyse the interaction of participants, questions, obstacles and experiences of achievement.

The resulting application will be capable of displaying most relevant planning and urban data, yet also enable citizens to convey their wishes, demands and ideas, thus becoming co-creators of their urban environment. It is planned to equip the seven Hamburg district authorities with the DIPAS system for use during participation

processes, stakeholder discussions and planning competitions. Furthermore, specialized authorities, companies and agencies are invited to apply DIPAS for their planning processes. The system will hopefully proliferate due to co-operations throughout the metropolitan region and nation-wide institutions.

6. Conclusion

DIPAS is a system solution, designed to fulfil a certain function within a highly developed, digitised and regulated procedure chain. It can also be seen as an interactive interface to an urban platform. Basically such a system can also represent an effective tool for supporting space-related planning and decision making processes in the background using far less input data, for instance in developing countries. DIPAS is based on open data and will be open source, as is the master portal of the LGV (https://bitbucket.org/lgv-g12/lgv). The data from all results of participation procedures will be openly accessible. Transparency regarding procedures, actors, results and decision are the aim, as well as the application of the knowledge of the multitude in order to reach better results and decisions. Planning and decision processes find acceptance when they are carried out transparently and are adjusted to the situation. Effective participation leads to affirmation in democratic processes, as an experience of personal involvement in a participation process becomes an experience of success.

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