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Implementing Agile Data Workflows to Unlock Climate-Resilient Urban Planning

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Abstract: Cities around the world are facing the implications of a changing climate as an increasingly pressing issue. The negative effects of climate change are already being felt today. Therefore, adaptation to these changes is a mission that every city must master. Leading practices worldwide demonstrate various urban efforts on climate change adaptation (CCA) which are already underway. Above all, the integration of climate data, remote sensing, and in situ data is key to a successful and measurable adaptation strategy. Furthermore, these data can act as a timely decision support tool for municipalities to develop an adaptation strategy, decide which actions to prioritize, and gain the necessary buy-in from local policymakers. The implementation of agile data workflows can facilitate the integration of climate data into climate-resilient urban planning. Due to local specificities, (supra)national, regional, and municipal policies and (by) laws, as well as geographic and related climatic differences worldwide, there is no single path to climate-resilient urban planning. Agile data workflows can support interdepartmental collaboration and, therefore, need to be integrated into existing management processes and government structures. Agile management, which has its origins in software development, can be a way to break down traditional management practices, such as static waterfall models and sluggish stage-gate processes, and enable an increased level of flexibility and agility required when urgent. This paper presents the findings of an empirical case study conducted in cooperation with the City of Constance in southern Germany, which is pursuing a transdisciplinary and trans-sectoral co-development approach to make management processes more agile in the context of climate change adaptation. The aim is to present a possible way of integrating climate data into CCA planning by changing the management approach and implementing a toolbox for low-threshold access to climate data. The city administration, in collaboration with the University of Applied Sciences Constance, the Climate Service Center Germany (GERICS), and the University of Stuttgart, developed a co-creative and participatory project, CoKLIMAx, with the objective of integrating climate data into administrative processes in the form of a toolbox. One key element of CoKLIMAx is the involvement of the population, the city administration, and political decision-makers through targeted communication and regular feedback loops among all involved departments and stakeholder groups. Based on the results of a survey of 72 administrative staff members and a literature review on agile management in municipalities and city administrations, recommendations on a workflow and communication structure for cross-departmental strategies for resilient urban planning in the City of Constance were developed.

Keywords: climate change; climate resilience; climate policies and strategies; urban adaptation to global climate change; data analytics; agile administration; digital transformation

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1. Introduction

The urgency for implementing climate-resilient urban planning has become increasingly apparent as numerous cities—administrations as well as inhabitants—worldwide grapple with the severe impacts of climate change [1,2].

Due to their high-risk geographical locations and high population densities, coastal cities, which constitute over 90% of all urban areas, are particularly susceptible to the consequences of rising sea levels, coastal flooding, heat waves, and freshwater scarcity [3]. Urban areas that are not directly on the coast but along the course of a river are also exposed to higher risk. According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the damage from river flow overtopping is projected to increase threefold with global warming of 1.5 °C, fourfold with 2.0 °C, and sixfold with a 3.0 °C temperature increase [4]. As global temperatures continue to rise, urban planners and policymakers must prioritize adaptive strategies to mitigate the adverse effects of climate change and build (climate) resilience in their communities. The development of sustainable infrastructure, green spaces, and efficient resource management systems is crucial to ensure the well-being and safety of inhabitants in an increasingly changing climate. Nevertheless, these vulnerable urban areas provide urgent and compelling opportunities for implementing strategies to mitigate and adapt to the effects of climate change [1].

Investigations conducted within the CoKLIMAx project of the City of Constance highlight a tripartite gap regarding efficient and resilient urban climate change adaptation planning. The subsequent sections provide an overview of the three main challenges: the legal framework, interdepartmental and stakeholder communication, and the scientific database.

The first challenge is the respective legal framework. Local decision-makers are pivotal in implementing climate-resilient urban planning, given their firsthand knowledge of their cities' needs and their position at the forefront of climate change impacts [5]. Furthermore, they are optimally situated to catalyze change [6]. Nevertheless, local decision-makers are constrained by national and local regulations, policies, and politics [5–7]. Since the study area is located in the state of Baden-Wurttemberg, the following specific remarks refer to this federal state and can differ from the others. Germany is divided into 16 federal states ruled under the organizational principle of federalism. Therefore, governmental power and the performance of governmental functions are matters of the 16 federal states, which function under their own laws, regulations, and administrative framework unless the Basic Law permits otherwise [8]. As a result of the federal structure, the overall system can become inert because, as the number of actors increase, the veto possibilities increase and the diversity of interests can get out of hand, leading to a greater need for negotiation, compromise, and time. Each state uses individual approaches to project implementation or decision-making, leading to ambiguities, problems, and, in the worst case, failure to achieve overall national and macro-governance objectives [9]. With regard to climate projections in planning processes, "the strictly regulated German planning system makes the use (. . .) difficult because they do not fulfil the formal expectations about the nature of the information they provide" [10] (p. 432).

In 2013, the state of Baden-Wurttemberg announced its first climate protection and adaptation law, which was officially amended 10 years later, on 7 February 2023. The main goal is to achieve climate neutrality by 2040 [11]. Paragraph 15 clearly lays out the state-wide climate adaptation strategy beginning in 2023. Thereafter, the state shall adopt a strategy that includes relevant measures based on the provided adaptation report published in 2015 [12].

The second challenge to achieving effective climate change adaptation measures within municipal administrations is efficient and trustful interdepartmental communication [13]. A lack of communication among relevant departments can lead to slower adaptation and, ultimately, to maladaptation, where the implementation of measures is intended to promote adaptation but, due to erroneous decisions (e.g. neglecting biodiversity or autonomous adaptation), exacerbate vulnerability instead of enhancing adaptive capacity [7,14]. Ill-conceived planning not only squanders valuable resources, such as time and money but may also

render societies more susceptible to climate change impacts [6,15]. To mitigate the risk of maladaptation, it is imperative to establish clear metrics for evaluating the effectiveness and efficiency of adaptation measures. This entails continuous reporting, reassessment, and data utilization [6,16]. A study by Lehmann et al. (2015) highlights that adaptation planning is still understood and perceived as an environmental rather than a socio-environmental and economic issue, and thus, it is not properly integrated into sectoral and societal procedures and understandings. To mitigate the risk of maladaptation, it is imperative to establish workflows for data implementation and interdepartmental communication [17].

The third major challenge revolves around the integration and implementation of climate data and climate projection data within urban adaptation planning. As shown by Lorenz et al. (2016), the lack of a solid scientific database and unfamiliarity with globally accessible climate data significantly contribute to the slow progress in local climate change adaptation planning and decision-making [10]. The IPCC report of 2022 underscores the necessity for incorporating climate data, tools, and services at the local level equipping decision-makers, policymakers, administrators, and local authorities with the necessary tools for informed decision-making [16,18].

The new EU strategy for climate change adaptation introduces the idea of making climate information available to individuals from various disciplines and societal structures. This approach acknowledges the urgency to collect climate-related data and make them available to foster a holistic understanding of climate change [19]. In 2020, the Baden-Wurttemberg Ministry of the Environment, Climate and Energy Management published their state Monitoring Report on the Adaptation Strategy to Climate Change. The report highlighted the insufficiency of reliable climate data to further develop climate models and conduct analyses of climate impacts, which are leading to reliable and sustainable planning measures for climate adaptation [20]. Furthermore, the report underlines the findings of the 2021 data strategy published by the German Federal Government, affirming the limited availability of municipal Open Data portals emphasizing the necessity for improvement towards a democratizing data availability and production at the source [21]. In terms of data utilization improvement, Germany advocates for a shift in their data usage approach. For decades, the German climate adaptation planning processes have predominantly relied on climate function and planning recommendation maps that primarily focus on present and past climate data rather than climate projections [22].

The current realities surrounding climate data utilization, coupled with the absence of interdepartmental communication and national/local governance structures, result in the neglect and ignorance of integrating climate adaptation topics into municipal management processes. Moreover, due to the hierarchical structures inherent in municipal administrations in Germany (monocratic administrative organization), work follows the classical waterfall project management approach [23]. Yet, the COVID-19 pandemic highlighted that bureaucracies, in times of destabilization and crisis, can respond swiftly and adapt to fast-changing requirements, regulations, and contextual situations, often applying agile governance [24].

"Agile governance is in essence a method, translated for broader management application, to respond to changing needs and desires of the public" [24] (p. 5). In recent years, a marked shift has occurred in the working culture within public administrations. The traditional approach of individual responsibilities and isolated "silos" has given way to a more collaborative team-based approach. This transformation towards agility involves a continuous process of adaptation and change, where solutions are devised to tackle a set of challenges. The approach is iterative, with unexpected outcomes being evaluated and adjustments being made to continually improve the overall process [25]. Unlike the New Public Management model, agile administration does not solely rely on business-oriented metrics. Instead, it emphasizes the reassessment of standardized processes, particularly in less-structured administrative tasks. A crucial aspect of this transformation is the redirection of communication, transitioning from hierarchical, top-down communication to a more horizontal, interdepartmental, and problem-oriented exchange among colleagues and

departments [26]. Crises situations further underscore the necessity for these translations and adaptability into agile decision-making and cross-sectoral collaborative processes [24]. Morisio et al. (2020) emphasize that "Traditional Organizations Cannot Cope with New Demands" [27] (p. 13). Especially in time-critical projects, traditional project management methods encounter limitations, and the integration of flexibility and simultaneous reduction of bureaucracy present a major hurdle [27]. Agility and adaptability assure a functional bureaucracy that is even more relevant during times of uncertainty and volatility, facilitating swift shifts in priorities, adaptation to altering realities and the prompt implementation of new policies and measures. Furthermore, it ensures compliance with these policies and enhances communication with the public. Ever since, agile management has expanded beyond software development, including governmental transformation projects and organizational development [28].

Climate change, understood as one of the most pressing, acute, and cascading crisis situations, calls for the rapid adaptation of bureaucracy and policy at various levels. Adaptation to climate change is a time-critical socio-political, economic, and administrative endeavor necessitating flexible and rapid action [29]. To align with the goals of the 2015 Paris Agreement (COP21), which aims to limit global warming to 1.5 °C and adapt to existing impacts, a critical reflection and change of administrative structures are imperative [30]. The IPCC, as well as the United Nations Environment Programme (UNEP Adaptation Gap Report (2022)), identify the need for systemic change to face the challenges of CCA [16,31]. The current fragmentation of political governance, coupled with a lack of institutionalization, presents challenges for current municipal urban CCA planning [29]. The emergence of CCA as a new focus area for municipalities is not surprising, considering the various impacts and challenges that climate change poses for administrations and individuals on various scales. Nevertheless, it is crucial to address these issues comprehensively, as highlighted by Bruns and Fünfgeld (2021) [32]. With climate change already affecting various aspects of public services, local municipal departments are required to collect data and convert them into actionable information regarding climate risks and the selection of appropriate measures [33]. Ideally, citizens, businesses, various levels of government, and local administrations collaboratively determine normative stances on acceptable, equitable future risks and desirable objectives regarding risk reduction for all [34]. "Climate change adaptation requires long-term planning and forward-looking decision-making that marries scientific diagnoses and technical innovation with social organization and political debate around competing value systems. It requires building in experimentation, iterative learning, and the capacity to shift practices and policy positions considering new findings" [35] (p. 107).

Such deliberative processes require being informed by scientific and quantitative data to avoid maladaptation and identify pathways for a resilient future. Climate impacts manifest diversely depending on regional and local conditions as well as contextual vulnerabilities, thereby requiring CCA strategies to be designed at a local level [36]. Hence, municipal administrations play a pivotal role in data collection, information processing, strategy development, facilitation of participatory and deliberative processes, and implementation of measures. Adopting agile approaches to municipal CCA management in collaboration with new data holds promise in jointly establishing data-handling practices and work processes towards a holistic, interdepartmental, and encompassing stakeholder concept.

Agile management has its origins in software development [27,28,37]. In 2001, 17 experts crafted a manifesto on agile management based on the following principles:

- "Individuals and interactions are more important than processes and tools
- A software that works well is more important than extensive documentation
- The cooperation with project stakeholders is more important than contract negotiations
- Responding to change is more important than sticking to a rigid plan" [38]

For public administrations, an agile framework must address the specific needs of individual departments while providing a holistic view of the organization. The goal is to improve efficiency, adaptability, and communication throughout the organization

by implementing digital administrative processes, information, and data flows. Agile structures allow rapid process adaptation through recurrent solution elicitation. Elements of agile management include a willingness to experiment, make mistakes, and engage in early and regular feedback with relevant stakeholders and the public [37]. The essence of agile management transcends traditional delineations of responsibilities and subject areas. Current experiences highlight that flexible, interdepartmental communication and cross-departmental agile work are possible when responsible employees from relevant offices regularly convene to exchange ideas, share and co-create knowledge, and collaborate within their expertise [39]. The development and integration of CCA into municipal operations is a continuous and developing process. To address evolving community needs and preferences, the involved departments must exhibit adaptability. As updated data, such as the information given within the Intergovernmental Panel on Climate Change (IPCC) reports, becomes accessible, city administrations should revise their CCA strategy to prevent maladaptation due to outdated information. [40]. Agile administrations are not yet widespread in Europe and worldwide. The only well-documented case of Ängelholm, a Swedish city, implemented agile administrative management in 2015. Yet, traditional administrative approaches have not been completely replaced; instead, the two forms, agile and traditional administrative approaches, complement each other [41]. The decision to embrace a conservative or agile approach is based on careful consideration of which one will yield the optimal solution for the existing problem. When the administration cannot resolve a citizen's issue through conservative means, when the level of service provided is inadequate, or when projects face time constraints (such as threats to public safety), the agile approach is preferred [42]. Regarding agile administrative management and CCA, current academic and practice literature highlights the urgent need for enhancing adaptation measure planning by integrating climate data into agile management processes grounded in local and supra-regional legal frameworks [20,35,40]. This paper connects the findings of the empirical approach conducted within the CoKLIMAx project with the knowledge about the opportunities of agile management in order to develop an agile workflow for the City of Constance, where the three main challenges regarding climate change adaptation planning are tackled.

2. Materials and Methods

2.1. The City of Constance and the CoKLIMAx Project

Constance, the largest city on Lake Constance in Southern Germany, is home to over 87,000 people [43]. As a regional center within the state of Baden-Wurttemberg and border city to Switzerland, it holds significant supra-regional significance (Figure 1).

As the first city in Germany to announce a climate emergency, the authorities signed a declaration on 2 May 2019, laying the cornerstone to bundle social, political, cultural, and economic aspects within urban society to counter climate change impacts and prepare for the future. This resolution emphasized the urgency and necessity of holistic adaptation to forthcoming climate changes, providing the political and legal frame for fast and prioritized administration and decision-making [44]. On 25 November 2021, the City Council further solidified its commitment to sustainable practices by adopting the Constance Climate Protection Strategy, paving the way to achieve maximal climate neutrality by 2035 [45]. A further step towards sustainable urban development and planning occurred on 19 July 2022, with the establishment of a dedicated climate office under the direct leadership of the Mayor [46].

As a parallel progression, the Department of Urban Planning and Environment is developing a catalog of measures for future climate change adaptation for both private and public spaces. This catalog is expected to be completed by 2024, contingent upon the renewal of climate function maps, which were first crafted as part of an initial climate analysis in 2015. Furthermore, a comprehensive vulnerability analysis for the entire urban area is currently in preparation [47].

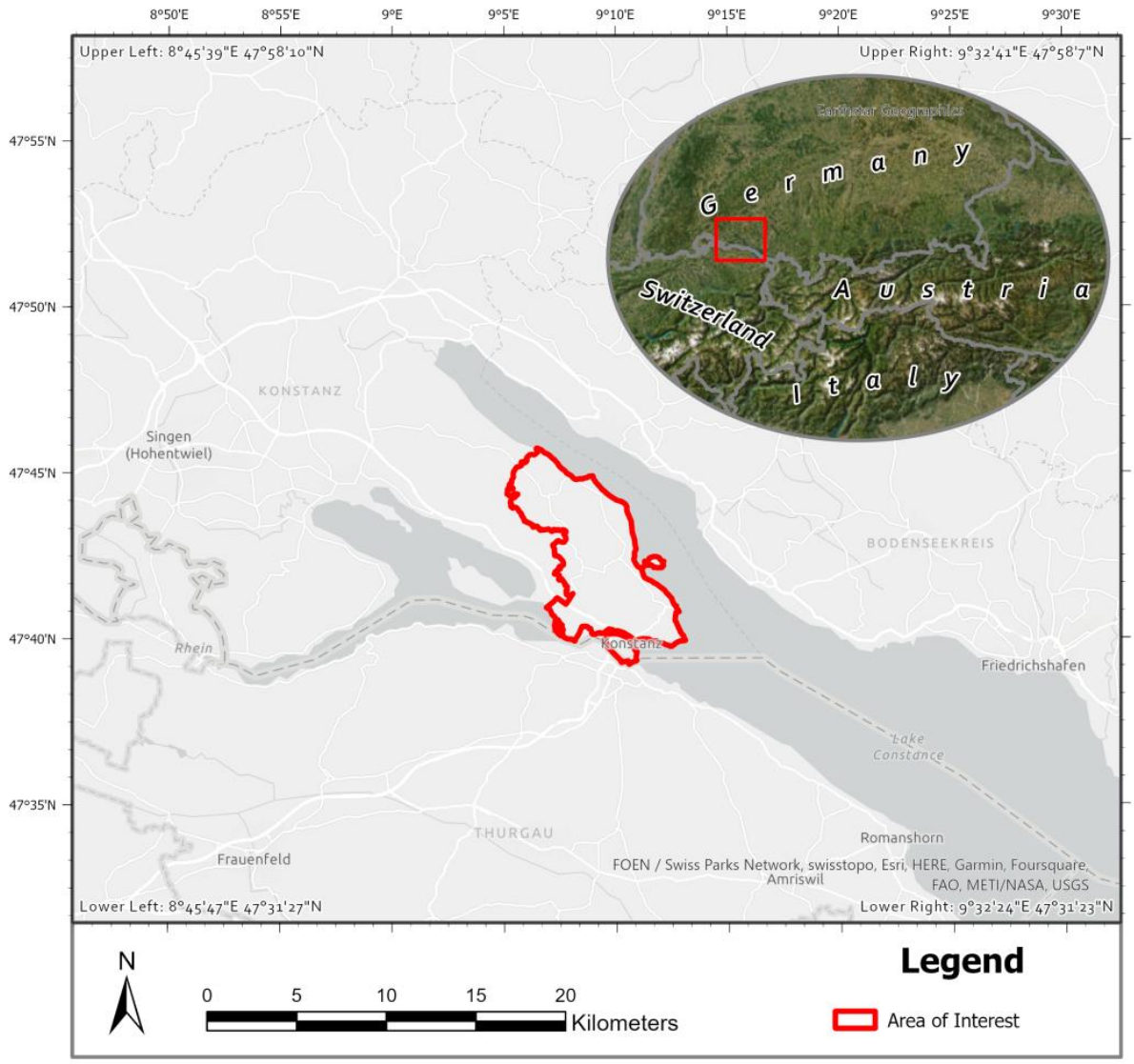

Figure 1. location of the City of Constance.

The overarching goal of the CoKLIMAx project is to enable public administrators to utilize different strands of CCA relevant data and information (e.g., Copernicus data products [48] and in situ measurements) in a cross-departmental collaborative fashion. This endeavor involves developing and testing novel data management strategies and procedures [49]. A central ambition is to develop an Advanced Municipal Climate Data Store (AMCDS) toolbox, facilitating climate-resilient urban planning based on reliable climate data [50].

Simple and intuitive manageability is of high importance to all stakeholders, including administrators and the public [49,50]. Special attention is given to designing and implementing agile data workflows that effectively integrate climate data into relevant administrative processes, improving communication between different city departments and functions, as well as with citizens, and providing a robust foundation for decision-making within the city/City Council. As part of the overarching goal to improve CCA planning and data utilization, this study aims to investigate and identify communication structures within the city administration. This meticulous exploration is a crucial initial step towards tailoring the toolbox to stakeholder requirements.

2.2. Qualitative Methods

We conducted a qualitative semi-structured survey including relevant stakeholders from the City of Constance administration. To ensure a comprehensive and well-coordinated effort, the rollout of the stakeholder survey was meticulously planned by the project management, aiming to establish trust as well as common understanding and goals with the City of Constance administration. Furthermore, to ensure a representative output, sensitive preparation increased the questionnaire response rate. Prior communication with the city ensured that relevant departments were well-informed and engaged. The questionnaire was tailored to align with the organizational structure and requirements for future effective CAA work planning.

A pre-selected number of staff members across different departments were identified, all working on issues in the context of climate change and protection, geoinformation, as well as urban planning and development. A total of 72 administrative employees participated in the survey between May and July 2022. The survey results were analyzed using bivariate statistical methods, allowing the identification of correlations between individual questions and providing better insights into administrative management and governance structures. The stakeholder survey and its analysis served as the basis for the elaboration and development of an agile data workflow, with the long-term goal of establishing a sustainable and interdepartmental climate data management structure.

The objective of the survey was twofold: (a) identifying the respective departments and relevant stakeholders to be integrated into an agile workflow for CCA, and (b) gaining a better understanding and insights on the following questions:

1. Is climate data utilized in your field of work?
2. Would you like to employ climate data within your area of expertise?
3. Which departments should be more engaged in communication concerning adaptation to climate change impacts?
4. Which processes or areas of urban planning could benefit from processed information on climate and expected future climate changes?

To achieve the surveys' overall objective, it was organized into nine thematic sections: (1) work field and expertise, (2) need for and field of action, (3) climate adaptation measures, (4) implementation challenges, (5) communication flow(s), (6) work with climate data, (7) obtaining climate data, (8) planning processes, and (9) digital transformation. The structure of the survey, the questions, and answer options are shown in Appendix **??**, Table A1. The questionnaire was collaboratively developed in partnership with the City of Constance administration and experts from the Climate Service Center (GERICS), who provided support in the preparation of the questionnaire based on their long-standing expertise and experience in climate data integration within municipal administration workflows [51]. The survey was designed to collect both general and specific information from participants. General information included their departmental affiliations and experience with climate adaptation. Specific and detailed questions aimed to gain a better understanding regarding how climate data is currently used in their daily work and within their respective departments. Additionally, the survey sought insights into the existing workflows of CCA and identified the aspects of their current and future work that would benefit most from climate data integration. Sub-sections were created for specific areas to ensure comprehensive responses, targeting a filtered group of respondents with specialized knowledge. This approach aimed to obtain well-informed answers and gain a deeper overall understanding of the topics. Multiple-select questions were predominantly used in the survey, allowing respondents to choose from a range of options for matters such as climate adaptation measures and the desire for improved inter-departmental communication. Matrix questions (multiple Likert scale questions) were utilized to capture participants' personal opinions. Additionally, the survey included opportunities for free-text responses, encouraging participants to share their personal or professional thoughts on specific aspects of climate data implementation and utilization. This facilitated the exploration of distinct willingness and

opinions on the value of climate data, providing essential insights to pinpoint the most suitable entry points for its implementation.

Upon completing the nine sections of the survey, participants were invited to engage in a "conversation", a term deliberately chosen instead of "expert interviews", in order to foster inclusivity and create a welcoming environment for all stakeholders to participate, regardless of their expertise in CCA and data handling. Following the survey, the research proceeded with 10 in-depth "conversations", which were thoroughly evaluated by Harrs et al. (submitted) [52]. The primary focus of this paper is to identify an appropriate workflow for communication involving all relevant departments and incorporating climate data integration. In particular, sections 5 (communication flows), 8 (planning processes), and 9 (digital transformation) were central areas of interest. The remaining sections were considered as additional information, and the results were used where applicable.

3. Results

The largest group of survey participants consists of employees from the Department of Urban Planning and Environment (UE), followed by the waste disposal company (WM). The distribution of participants does not reflect the size proportions of individual offices, which is considered in later interpretations.

In order to identify the relevance of climate data at the municipal administration level, the survey included a question about which processes or areas of urban planning could benefit from processed information regarding climate and expected future climate changes (Figure 2).

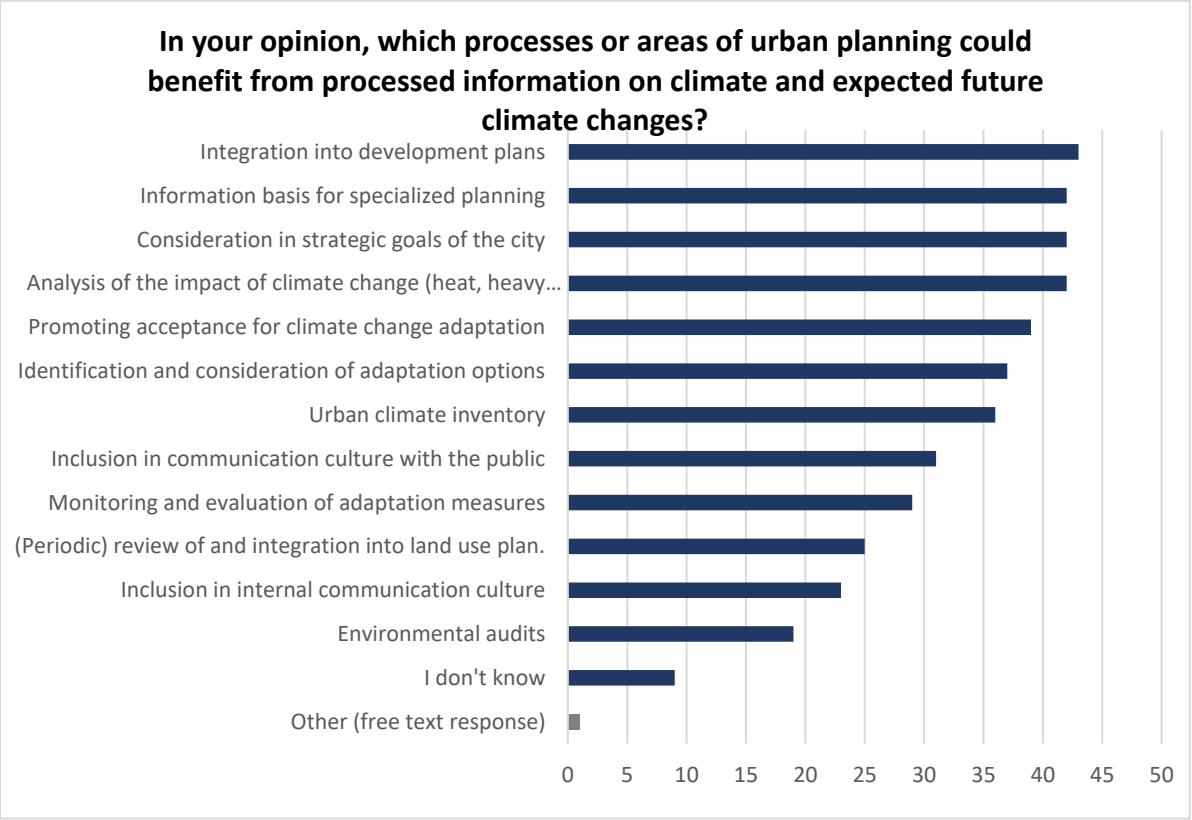

Figure 2. Processes/areas of urban planning that would benefit from climate data, Section 8 [52].

The answers show four areas as particularly benefiting: integration into development plans (43 mentions), analysis of the impact of climate change (42 mentions), consideration of climate data in strategic goals of the city (42 mentions), and climate data as information bases for specialized planning (42 mentions).

Good communication between relevant concerning departments is an important prerequisite for enhancing administrative processes' agility [37]. Figure 3 shows how offices rate their communication with other offices and within their own. In this context, the red cross symbolizes the desire for significantly more communication and the orange arrow for somewhat more communication. If a field contains a green check mark, communication is considered sufficient. If no need is seen for communication with another office, the space is left blank.

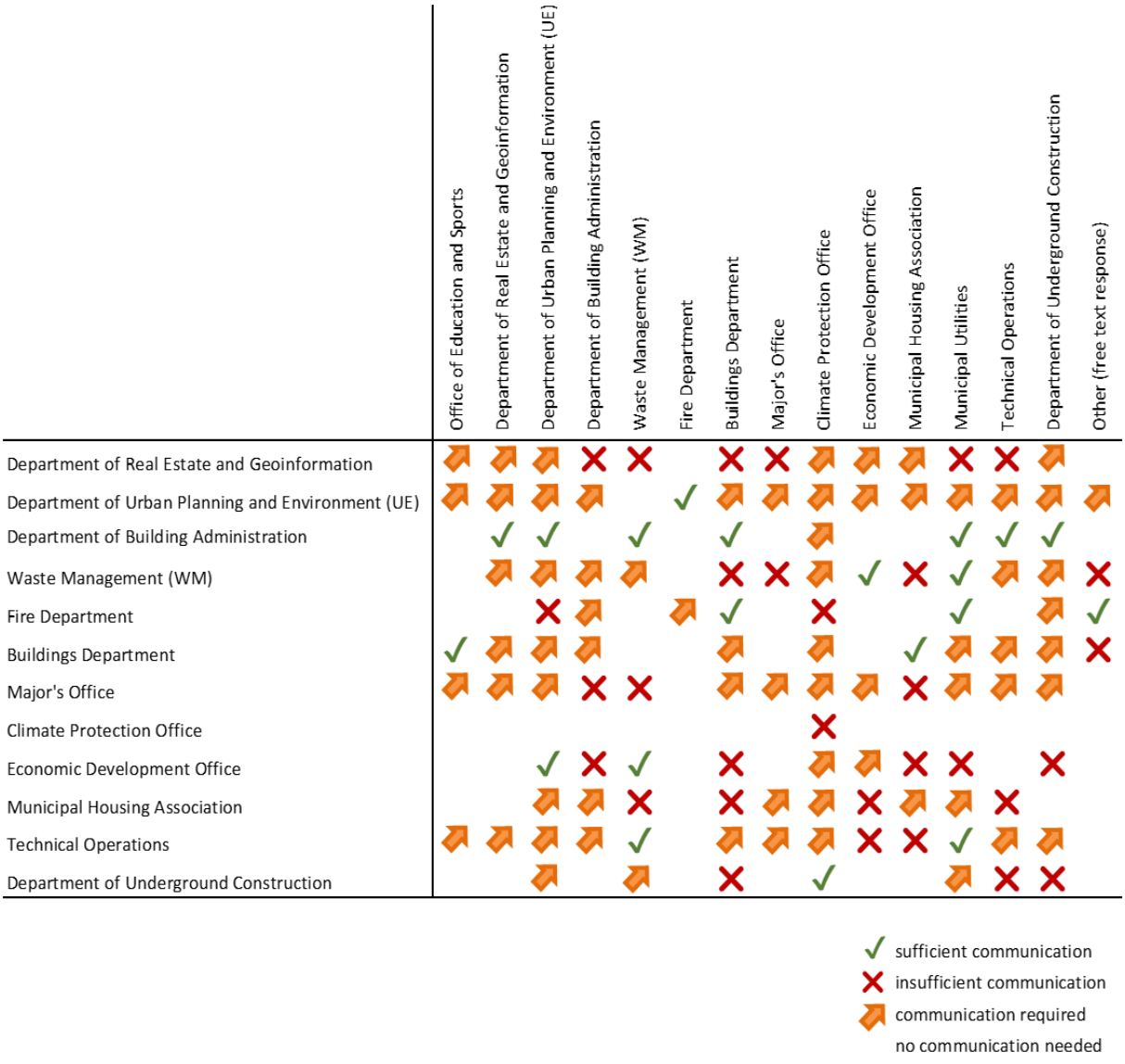

Figure 3. Communication between different departments, Section 5.

The foremost priority involves enhancing communication with the Buildings Department, the Municipal Housing Association, the Department of Underground Construction, the Department of Building Administration, and the Climate Protection Office. Notably, no office considers internal communication within their own department to be satisfactory.

For effective integration of climate data into administrative processes in the future, understanding which offices are already working with climate data is vital. Presently, less than a third of the city employees surveyed are currently using climate data. Among those not yet working with climate data, there is a noted interest in adopting it in the future. The Department for Urban Planning and Environment should be highlighted here, which shows an above-average interest in working with climate data compared to other departments.

As we learned from the survey results, climate data currently employed in the city administration primarily consists of observational data and climate model data. Some participants mentioned using climate projection data. The participants state that the climate data they use is obtained from external experts and scientific sources, e.g., studies, data portals, or research articles. However, the specific sources were not further specified in the survey. Further, a few participants stated that it is planned to increase the work with climate model data in the future.

Looking at the topic area of digitalization and data integration into existing administrative processes and digital workflows reveals that participants identify several major challenges. These include a lack of know-how among employees, the increase in the volume of work due to digitalization as additional work, and increased resource requirements or too high investment costs (Figure 4). These observations are consistent with the latest findings from the IPCC report [53].

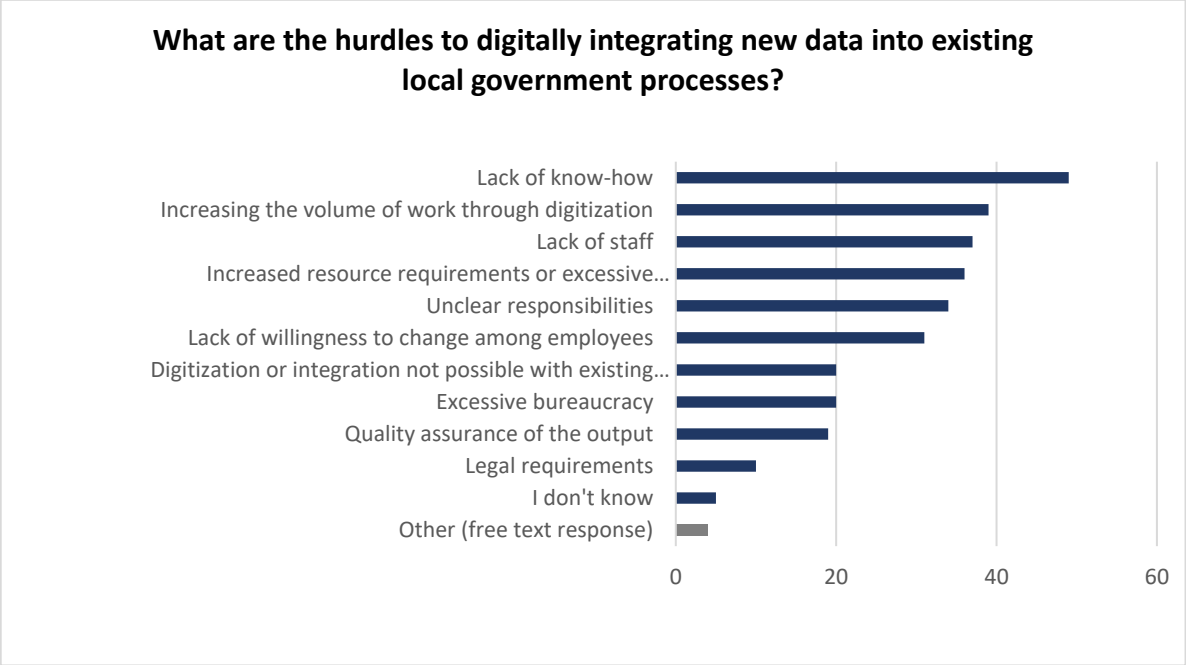

Figure 4. Hurdles in integrating data into existing processes [52].

Considering the above-mentioned concerns of the stakeholders and the preceding research, an exemplary agile workflow for the integration of climate data into the administrative process of urban land use planning was created using the example of the City of Constance (Figure 5). The abbreviations stand for UE = Department of Urban Planning and Environment, TBA = Department of Underground Construction, and HBA = Buildings Department.

The departments and offices that need to be strongly involved in communication, according to the survey results (Figure 3), are a central part of multiple steps within the agile data workflow. While the gray boxes represent constant feedback loops among involved parties about actions taken, arrows represent the direction of communication, with double-sided arrows denoting constant exchange during a certain phase. Light blue boxes contain established procedures of the binding urban land use planning prescribed by the building code, substantiated by the petrol boxes containing the respective paragraphs. These legally binding parts of the building code present multiple possibilities for the integration of the AMCDS toolbox.

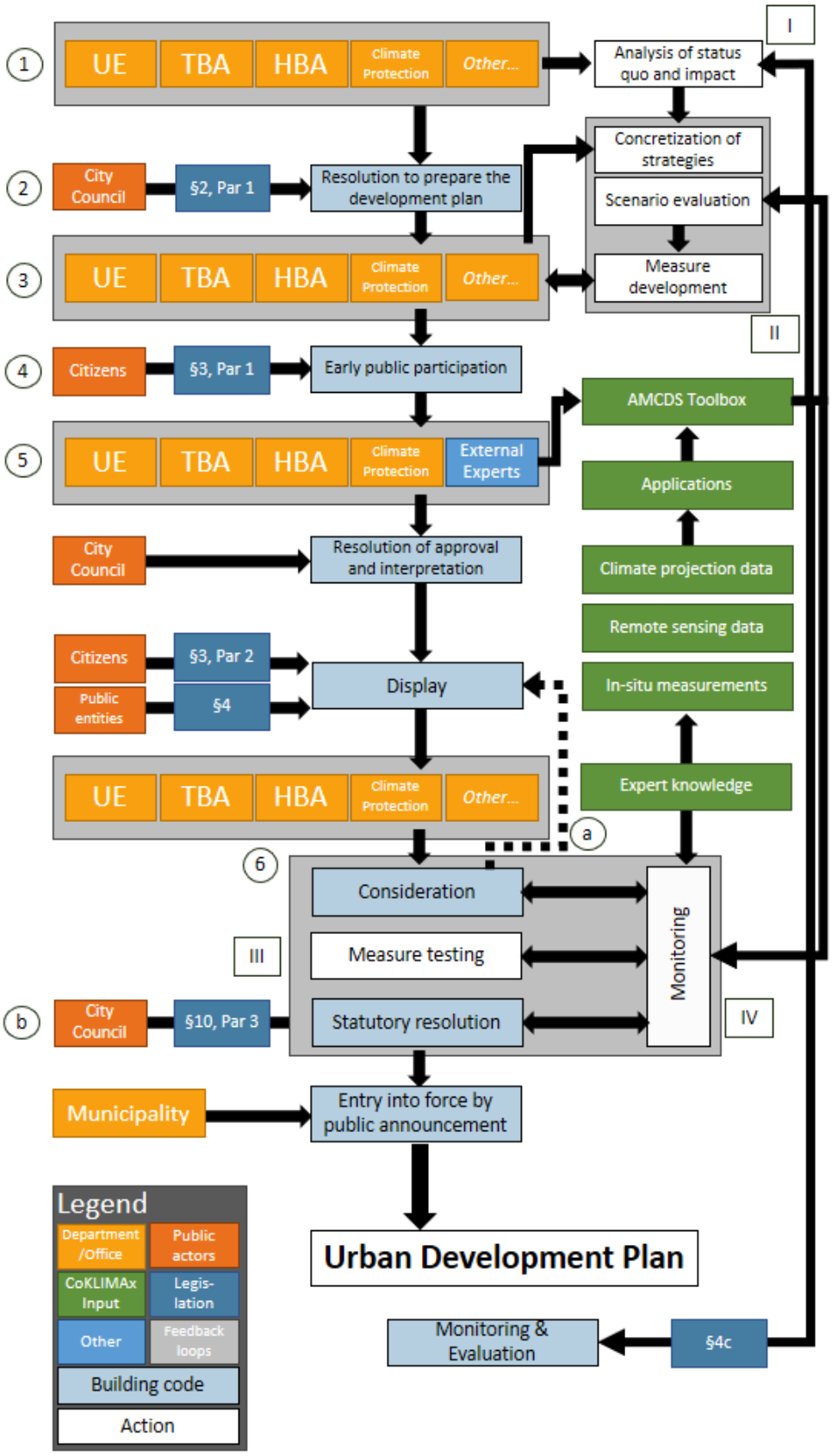

Figure 5. Agile data workflow for the implementation of an Urban Development Plan.

The building code serves as the foundation for all construction projects in Germany [54]. It consists of four chapters. The first chapter outlines the basics of urban land use planning, starting with general regulations, to the instrument of the preparatory urban land use plan (land use plan), to the binding urban land use plan (development plan), and to the cooperation with private parties. In this workflow, the first chapter of the building code is considered. The following six consecutive steps are required for the final approval of the development plan: (1) preparation of the development plan, (2) after approval of the City Council (the City Council as a voluntary body decides on the individual steps [54,55]), the city municipality starts with the implementation, (3) early public participation through public display of the plan and the possibility to comment on the plan, (4) engagement of external experts for environmental, noise protection report and others (5). Considering early public comments, the City Council decides the resolution of approval and interpretation, followed by a second display for citizens and public interest entities. If serious changes arise from balance consideration, it is necessary to revise and repeat the application (6a, dotted arrow). If no serious changes are necessary, the City Council decides to establish the development plan through statutory resolution (6b). Reaching the stage of statutory resolution leads to the approval of the final development plan entering into force through a public announcement by the City of Constance administration. Within the proposed workflow, the resources within the AMCDS toolbox could be involved in all these stages, supporting all stakeholders ranging from the municipality and City Council to citizens, public entities, and external experts. The toolbox could support everything from initial public information using climate data about local environments and the planned changes to demonstrating and evaluating the impact of planned measures during the final stages.

Based on the survey analysis, four main processes (Actions) benefiting most from climate data utilization and integration have been identified (see Figure 2): (I) analysis of status quo and impact, (II) measure development, (III) measure adaptation/testing, and (IV) monitoring and evaluation. In the proposed agile data workflow, the AMCDS toolbox is integrated in a way to support all these processes with data-driven information and applications.

An urban development plan entered into force requires continued legally bound monitoring and evaluation. These processes can provide feedback data to the AMCDS toolbox, enabling data experts to assess and refine the execution of the development plan. The reciprocal data flow would lead to continued improvement regarding the reliability of data comparison and future predictions for the city. This process necessitates either training and dedication from existing municipal employees or constant monitoring from AMCDS toolbox scientists. The feasibility of establishing such a process is discussed in the following section.

Since the proposed workflow relies on the participation of the whole city, broad support from citizens and elected political representatives, the City Council, is needed. Gaining acceptance and support for urban projects and achieving timely results is only feasible through the engagement of all parties involved [10,17].

4. Discussion

As elaborated in the introduction and confirmed through the survey conducted within the City of Constance administration, the implementation of climate data in urban planning processes faces three challenges: legal frameworks, communication, and scientific database [7]. Firstly, national and local regulations hinder the use of climate data in existing planning processes [10]. Secondly, a lack of structure and agility within city governance poses obstacles to integrating climate data into existing established processes [1,10,16]. The lack of communication between involved departments can lead to maladaptation and must be avoided [7,14]. Thirdly, at this point in time, very little climate data is incorporated into urban planning processes [10,19,20]. Actively adapting to climate change has only recently gained attention at the local governance level, and processes and procedures have yet to be established to give this issue the attention and importance it requires. The

inter- and intradepartmental communication deficit (Figure 3) is regarded as a structural problem. Interdepartmental thinking and collaboration, which is a prerequisite for the successful implementation of the cross-cutting challenge of CCA, has not yet arrived in the classical waterfall structure of the city administrations. Realizing these connections and adapting administrative structures is an ongoing learning process requiring the willingness of administrative staff to change.

It is crucial to recognize that mitigation and adaptation are not mutually exclusive but rather complementary aspects of climate protection [7]. While early mitigation efforts can help prevent damage and adverse impacts, adapting to the irreversible changes that have already transpired remains essential [6,56]. By striking a balance between mitigation and adaptation, urban planners and policymakers can more effectively address the multifaceted challenges of climate change and promote sustainable, resilient communities.

The case study within the City of Constance, including the administrative staff survey analysis and the literature review, reveals that climate change adaptation at the municipal level is not purely a technical issue but also a socio-political one. In this context, benefits for stakeholders need to be promoted when proposing the implementation of climate adaptation measures to public actors. Within existing law, three municipal structures are key stakeholders in this process: (a) the City Council, responsible for commissioning administration and deciding on financial and human resources; (b) municipal employees who prioritize and implement measures; and (c) citizens, who support the measures as the foundation of society. By encouraging the "city government to be an integrating force, fostering communications and mutually beneficial partnerships among experts and stakeholders at multiple levels" [6] (p. 23), and integrating climate data into planning and decision-making, the long-term goal of a climate-resilient city can be achieved, and maladaptation can be avoided [6,7,16]. One example of this integrated approach is the shift to green/sustainable mobility. While this shift lowers greenhouse gas emissions in urban environments, it directly benefits stakeholders by mitigating health risks through poor air quality within the city. [57]. By combining the shift to green/sustainable mobility with the use of data for intelligent traffic control, further benefits, such as reduced commute times or less traffic congestion, can be created for urban society [58,59].

In the City of Constance, the City Council comprises 40 elected citizens who volunteer for this role. Therefore, no professional politicians are members of the City Council [60]. A legislative term lasts five years [55]. However, climate change adaptation measures might take a longer time to show direct effects, are not directly visible (e.g., installing storage sewers in the sewer system), or, at first glance, are associated with restrictions on citizens, as experienced in other cities worldwide (e.g., nature-based solutions in Remiseparken in Copenhagen (Denmark), Rotterdam (Netherlands) and New York City (USA), where lowered sports fields serve as retention areas during heavy rainfall events [61,62]). For these reasons, adaptation to climate change does not enjoy excessive popularity among politicians as well as among citizens. However, according to the survey, the greatest challenge in integrating climate data is still seen at the administrative level.

Based on the survey results and research, it is concluded that the agile data workflow and the AMCDS toolbox have theoretical feasibility. However, a major challenge lies in establishing the longevity of such a digital tool [63]. As pointed out in Figure 4, a lack of know-how poses the main hurdle to integrating new data into existing local government processes. With the help of an intuitive AMCDS toolbox, comprehensive training, constant revision, and further development, these hurdles can be overcome. Another way for continuation would be supervision by the scientists who provided the toolbox. However, this approach presents systematic challenges since after the CoKLIMAx project concludes, maintaining personnel structures would be necessary to provide well-founded support. On the other hand, this approach offers the opportunity to react to changes and make adjustments at short notice. A good example of continuation is Victoria state in Australia, where the implementation and continual evaluation of a Heatwave Plan is conducted in close collaboration with residents by the local council [64,65].

One of the next steps is to present the developed and proposed exemplary agile data workflow (Figure 5) to selected administrative staff in participatory and co-creative workshops. Feedback received will be revised and integrated into an adjusted workflow. In addition, conducted expert interviews will provide more in-depth information and additions for the ideation phase [52]. After approval of the workflow from administrative staff and co-creative development of the toolbox, the workflow will be integrated into the urban development plan implementation process.

In all the above considerations and analyses, it should be kept in mind that the proposed workflow is a possible solution for the City of Constance. A transferability to other municipalities in the state of Baden-Wurttemberg is possible under consideration of given local structures and context. Striving for transferability of the integration of climate data into municipal governance structures to the whole of Germany requires a case-by-case examination of various legal standards and binding codes, such as state building codes (LBO) that vary within the 16 federated states in Germany [66]. It should also be taken into account that the financial resources available to municipalities vary greatly, both globally and within Germany [53,67].

5. Conclusions

Climate change adaptation transcends national boundaries to become a global challenge. Due to climatic, geographic, political, and structural differences, thoughtful approaches tailored to local circumstances are essential [16,31,53,68]. Based on the presented findings, we conclude that agile workflow approaches have the potential to support sustainable and effective CCA planning at the municipal level. However, it becomes evident that these approaches must be well-integrated within existing governance structures and legal/political framings. In addition, the most impactful changes to governance structures arise when co-developed directly with municipal authorities, ensuring comprehensive integration of all relevant municipal departments and stakeholders.

Furthermore, the findings highlight that CCA planning and implementation are not solely administrative processes; they constitute holistic citizen-oriented activities. Therefore, integrating citizen science and participatory approaches support a successful transformation from administration to implementation of CCA.

To avoid maladaptation and ensure the effectiveness of climate adaptation measures, local decision-makers need a reliable system based on climate data in place to facilitate the transition towards informed climate-resilient urban planning. This system should further provide a framework for progress measuring and scenario predictions [16,61]. Empowering local decision-makers, the municipality, and citizens by providing necessary tools and resources, agile data workflows have great potential to unlock climate resilience in urban areas.

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Appendix A

Table A1. Structure of the survey.

Thematic Section	Question
(1) Background/Experience	Q1: In which office (or staff unit or company) of the city do you work? Department of Urban Planning and Environment (UE) Waste Department Department of Real Estate and Geoinformation Buildings Department Major's Office Technical Operations Fire Department Municipal Housing Association Department of Underground Construction Department of Building Administration Climate Protection Office Economic Development Office Office of Education and Sports Municipal Utilities Other (free text response)
	Q2: How many years have you been professionally involved in the topic of adaptation to the consequences of climate change? Yes, more than one year Yes, less than one year No experience
(2) Areas of action for CCA/need for action	Q3: In your opinion, is there a need for municipal action regarding adaptation to the consequences of climate change (e.g., heavy rain, heat waves, etc.)? Yes No
	Q3a (if answer to Q3 is "yes"): In your opinion, is there a need for municipal action regarding adaptation to the consequences of climate change (e.g., heavy rain, heat waves, etc.)? Very high need for action High need for action Rather little need for action Little need for action

Table A1. *Cont.*

Thematic Section	Question
	Q4: In which fields of action of adaptation to the consequences of climate change do you see your professional tasks most likely? (multiple choice) Spatial, regional, and urban land use planning Human health Water balance, water management Soil Agricultural production areas Forestry and forest management Biodiversity Energy management Traffic and transport infrastructure Industry and commerce Tourism industry Civil protection I do not deal professionally with adaptation to climate change Other (free text response)
(3) CCA measures	Q5: Which climate adaptation measures in cities do you know? (multiple choice) Green roofs Greening of facades Increasing the green volume in urban spaces (e.g., parks, lawns, etc.) Preservation and protection of cold air production areas and corridors Green corridors Multifunctional use of green and open spaces Unsealing of surfaces Preservation and creation of water retention areas Technical flood protection systems Adapted stormwater management (to heavy rainfall events) (e.g., infiltration troughs, infiltration trenches, etc.) Use of light-colored surface materials Climate-adapted (new) construction Climate-adapted renovation Creation of shaded areas (trees, structural sun protection) Planting of climate-adapted tree species Providing information on heat events and associated health risks within urban areas I also know of. . . (free text response)
	Q6: Do you know of climate adaptation measures (e.g., from question 5) that have already been implemented in Constance? Which adaptation measures are these? Yes No
	Q6a (if answer to Q6 is "Yes"): Which adaptation measures do you know are already being implemented in Constance? (free text response)
(4) Challenges of Implementation	Q7: At which of the level(s) below do you see the greatest challenges to incorporating climate adaptation measures into urban planning? Administration Municipal council City population Civil society (e.g., clubs, associations) I don't know Others (e.g., municipal subsidiaries)
	Q7a (if answer to Q7 was not "I don't know"): Please briefly describe the challenge(s) at the level you chose in Q7

Table A1. *Cont.*

Thematic Section	Question
(5) Communication structure	Q8: With which offices or departments do you or your department communicate regarding climate-relevant urban planning? (multiple choice) Office of Education and Sports Department of Real Estate and Geoinformation Department of Urban Planning and Environment (UE) Department of Building Administration Waste Management (WM) Fire Department Buildings Department Major's Office Climate Protection Office Economic Development Office Municipal Housing Association Municipal Utilities Technical Operations Department of Underground Construction There is no communication regarding climate-related urban planning Other (free text response)
	Q9: Which offices should be more involved in communication regarding adaptation to climate change impacts? (multiple choice)
	Q10: With which offices do you communicate about climate data? (multiple choice) State Parliament of Baden-Württemberg State Institute for the Environment Baden-Württemberg Freiburg Regional Council District Office Constance With no institution Other (free text response)
	Q10a (If selection in Q10 is not "With no institution"): Who is your contact person in the selected institution?
(6) Work with climate data	Q11: Do you work with climate data in your field of work? Yes No
	Q12 (If answer to Q11 is "No"): Would you like to work with climate data in your field of work? Yes No
	Q12.1 (If answer to Q12 is "Yes"): What specifically would you use climate data for? (free text response)
	Q12a: (If answer to Q11 is "Yes") Which climate data do you work with? (multiple choice) Observational data (data recorded at the earth's surface, e.g., with weather stations or ground sensors, usually small measurement networks from several points in a city) Climate model data in general Reanalysis data (historically consistent data created by merging historical observational data and the use of climate model data) Climate projection data (data produced on the basis of climate models or model ensembles for near or distant future scenarios) Satellite data (Earth surface data acquired through remote sensing methodology that are prepared and made available for various purposes through the use of various processing steps) Crowdsourcing (climate data collected by private individuals, usually for a specific purpose such as measuring pollutants on traffic routes) Other (free text response)

Table A1. *Cont.*

Thematic Section	Question
	Q12b (If answer to Q12 is "Yes"): Are you planning to work with the following (or further) climate data in the future? (multiple choice) Observational data Climate model data in general Reanalysis data Climate projection data Satellite data Crowdsourcing Other (free text response) No
	Q12c (If answer to Q12 is "Yes"): Do you consider future expected climate change information in your field of work? Yes No
	Q12c.1 (If answer to Q12c is "Yes"): What kind of information is involved? (free text response)
	Q12d (If answer to Q12c is "No"): Would you like to work with future expected climate change information in your field of work? Yes No
(7) Gathering climate data	Q13: Where do you generally obtain data and information for decision making? (multiple choice) External experts Scientific sources (e.g., studies, data portals, online articles, etc.) Expert reports Non-scientific online articles Colleagues Empirical knowledge Personal expertise Own data sets Surveys or public participation Other (free text response)
	Q14: Do you collect climate data yourself in your area of work? Yes No
	Q15 (If answer to Q14 is "Yes"): What climate data do you collect? (free text response)
(8) Planning processes challenges of handling climate data	Q16: In your opinion, which processes or areas of urban planning could benefit from processed information on climate and expected future climate changes? (multiple choice) Urban climate analysis Analysis of the impact of climate change (heat, heavy rain, etc.) Consideration in strategic goals of the city Information basis for specialized planning Environmental audits Identification and consideration of adaptation options (Periodic) review of integration into land use plan. Integration into development plans Inclusion in internal communication culture Inclusion in communication culture with the public Promoting acceptance for climate change adaptation Monitoring and evaluation of adaptation measures Other (free text response) I don't know

Table A1. *Cont.*

Thematic Section	Question
	Q17: Please tell us to what extent you agree with the following statements. answer matrix: Do not agree at all rather disagree rather agree fully agree I don't know Statements: The importance of reliable climate data in urban planning processes is steadily increasing It is difficult to obtain reliable climate data Assessing the quality of climate data is difficult It is difficult to process climate data The analysis of climate data is difficult Integrating climate data into existing work and planning processes is difficult My work would benefit from a tool that provides processed information on climate and future expected climate changes The integration of reliable climate data has no influence on the consideration processes in urban planning.
	Q18: What other data or information could you use to better implement climate adaptation measures in your area of work?
(9) Digital transformation	Q19: How high do you rate the readiness for digital transformation? answer matrix: Very low Low High Very high I do not know answers: For me personally. . . In my department in general. . . With political decision-makers. . .
	Q20: What hurdles are there to the digital integration of new data into existing processes in local government? (multiple choice) Lack of willingness to change among employees Increase in work volume due to digitization as additional work Increased resource requirements or excessive investment costs Quality assurance of output Lack of dedicated staff Lack of know-how Digitization or integration not possible with existing software concepts Too much bureaucracy Unclear responsibilities and roles Legal requirements I do not know Other (free text response)

References

1. UNEP. Around the World Cities Race to Adapt to a Changing Climate. Available online: https://www.unep.org/news-and-stories/story/around-world-cities-race-adapt-changing-climate (accessed on 20 February 2023).
2. Boland, B.; Farhad, N.; Charchenko, E.; Garg, S.; Knupfer, S.; Huxley, R.; Sahdev, S. Focused Adaptation: A Strategic Approach to Climate Adaptation in Cities. 2021. Available online: https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/how%20cities%20can%20adapt%20to%20climate%20change/focused-adaptation-a-strategic-approach-to-climate-adaptation-in-cities-vf.pdf (accessed on 31 March 2023).

3. Boland, B.; Sahdev, S.; Charchenko, E.; Knupfer, S. How Cities Can Adapt to Climate Change: Research Identifies 15 Proven Ways that Urban Areas around the World Can Adapt to Climate Risk. Available online: https://www.mckinsey.com/capabilities/sustainability/our-insights/how-cities-can-adapt-to-climate-change (accessed on 21 February 2023).
4. Bednar-Friedl, B.; Biesbroek, R.; Schmidt, D.N. *IPCC Sixth Assessment Report (AR6): Climate Change 2022—Impacts, Adaptation and Vulnerability: Regional Factsheet Europe*; IPCC: Intergovernmental Panel on Climate Change: Paris, France, 2022.
5. Moloney, S.; Fünfgeld, H. Emergent Processes of Adaptive Capacity Building: Local Government Climate Change Alliances and Networks in Melbourne. *Urban Clim.* **2015**, *14*, 30–40. [CrossRef]
6. Lee, M.; Willmott, E.; Le Courtois, A.; Baker Gallegos, J.; Datta, N. *Guide to Climate Change Adaptation in Cities*; World Bank: Washington, DC, USA, 2011.
7. Pörtner, H.-O.; Roberts, D.C.; Poloczanska, E.S.; Mintenbeck, K.; Tignor, M.; Alegría, A.; Craig, M.; Langsdorf, S.; Löschke, S.; Möller, V.; et al. IPCC: Summary for Policymakers. In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*; IPCC: Paris, France, 2022.
8. Bundesfinanzministerium. Föderalismus. Available online: https://www.bundesfinanzministerium.de/Content/DE/Glossareintraege/F/009_Foederalismus.html?view=renderHelp (accessed on 27 June 2023).
9. Flaskühler, C.A. Föderale Klimaschutzgesetzgebung in Deutschland im Lichte des wohlgeordneten Rechts. Ph.D. Thesis, Nomos Verlag, Baden-Baden, Germany, 2018.
10. Lorenz, S.; Dessai, S.; Forster, P.M.; Paavola, J. Adaptation planning and the use of climate change projections in local government in England and Germany. *Reg. Environ. Change* **2017**, *17*, 425–435. [CrossRef]
11. Baden-Württemberg.de. Klimaschutz- und Klimawandelanpassungsgesetz Baden-Württemberg. Available online: https://um.baden-wuerttemberg.de/de/klima/klimaschutz-in-bw/klimaschutz-und-klimawandelanpassungsgesetz-baden-wuerttemberg (accessed on 26 June 2023).
12. *Klimaschutz- und Klimawandelanpassungsgesetz Baden-Württemberg (KlimaG BW)*; Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg: Stuttgart, Germany, 2023.
13. Hasse, J.; Willen, L. Umfrage Wirkung der Deutschen Anpassungsstrategie (DAS) für die Kommunen: Teilbericht. 2019. Available online: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-01-21_cc_01-2019_umfrage-das.pdf (accessed on 28 June 2023).
14. Magnan, A.; Mainguy, G. Avoiding Maladaptation to Climate Change: Towards Guiding Principles. 2014. Available online: https://journals.openedition.org/sapiens/1680 (accessed on 25 March 2023).
15. Schipper, E.L.F. Maladaptation: When Adaptation to Climate Change Goes Very Wrong. *One Earth* **2020**, *3*, 409–414. [CrossRef]
16. Pörtner, H.-O.; Roberts, D.C.; Adams, H.; Adelekan, I.; Adler, C.; Adrian, R.; Aldunce, P.; Ali, E.; Begum, R.A.; Bednar-Friedl, B.; et al. *IPCC: Technical Summary*; IPCC: Paris, France, 2022.
17. Lehmann, P.; Brenck, M.; Gebhardt, O.E.A. Barriers and opportunities for urban adaptation planning: Analytical framework and evidence from cities in Latin America and Germany. *Mitig. Adapt. Strateg. Glob. Change* **2015**, *20*, 75–97. [CrossRef]
18. Dale, M. Climate Information to Inform UK Decision Making. Available online: https://www.ukclimateresilience.org/projects/climate-information-to-inform-uk-decision-making/ (accessed on 31 March 2023).
19. European Commission. *Eine neue EU-Strategie für die Anpassung an den Klimawandel*; European Commission: Brussels, Belgium, 2021.
20. LUBW. Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg. In *Monitoringbericht 2020 zur Anpassung an den Klimawandel in Baden-Württemberg*; Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg: Stuttgart, Germany, 2020.
21. Bundesregierung. Datenstrategie der Bundesregierung: Eine Innovationsstrategie für Gesellschaftlichen Fortschritt und Nachhaltiges Wachstum. 2021. Available online: https://www.bundesregierung.de/resource/blob/992814/1845634/f073096a398e59573c7526feaadd43c4/datenstrategie-der-bundesregierung-download-bpa-data.pdf?download=1 (accessed on 19 June 2023).
22. Liam Heaphy. Modelling and Translating Future Urban Climate for Policy. Ph.D. Thesis, School of Environment, Education and Development, Manchester, UK, 2014.
23. Fliedner, O.; Haller, A. Grundwissen Kommunalpolitik: 14. Kommunalverwaltung. 2017. Available online: https://library.fes.de/pdf-files/akademie/kommunal/13890/13890-14.pdf (accessed on 30 May 2023).
24. Janssen, M.; van der Voort, H. Agile and adaptive governance in crisis response: Lessons from the COVID-19 pandemic. *Int. J. Inf. Manage.* **2020**, *55*, 102180. [CrossRef] [PubMed]
25. Michl, T., Steinbrecher, W. (Eds.) *Wozu Kann Unsere Gesellschaft eine "Agile Verwaltung" Brauchen?*; Springer: Berlin/Heidelberg, Germany, 2018.
26. Rölle, D. Agile Verwaltung. In *Handbuch Digitalisierung in Staat und Verwaltung*; Springer Fachmedien: Berlin/Heidelberg, 2020; pp. 1–11. [CrossRef]
27. Morisio, M.; Torchiano, M.; Jedlitschka, A. *Proceedings of the Product-Focused Software Process Improvement: 21st International Conference, PROFES 2020, Turin, Italy, 25–27 November 2020*; Springer: Cham, Switzerland, 2020; ISBN 978-3-030-64147-4.
28. Kuster, J.; Bachmann, C.; Hubmann, M.; Lippmann, R.; Schneider, P. *Project Management Handbook: Agile—Traditionalhybrid*; Springer-Verlag: Berlin, Germany, 2023; ISBN 978-3-662-66210-6.
29. Göpfert, C.; Wamsler, C.; Lang, W. Institutionalizing climate change mitigation and adaptation through city advisory committees: Lessons learned and policy futures. *City Environ. Interact.* **2019**, *1*, 100004. [CrossRef]

30. Rat der Europäischen Union. Pariser Klimaschutzübereinkommen: Die EU-Mitgliedstaaten Unterstützen Nachdrücklich das Übereinkommen von Paris und Dessen Ziel, die Erderwärmung Innerhalb Sicherer Grenzen zu halten. Die EU Wird bis 2050 Klimaneutral Sein. Available online: https://www.consilium.europa.eu/de/policies/climate-change/paris-agreement/ (accessed on 13 March 2023).
31. United Nations Environment Programme. *Adaptation Gap Report 2022: Too Little, Too Slow: Climate Adaptation Failure Puts World at Risk*; Online Annexes: Nairobi, Kenya, 2022. Available online: https://www.unep.org/adaptation-gap-report-2022 (accessed on 15 June 2023).
32. Bruns, A.; Fünfgeld, H. Universalisierung und Entpolitisierung von Klimawandelanpassung?: Kritische Perspektiven auf die anwendungsorientierte Klimawandelanpassungsforschung. *Standort* **2021**, *45*, 233–238. [CrossRef]
33. Bender, S.; Cortekar, J.; Groth, M.; Sieck, K. Why There Is More to Adaptation Than Creating a Strategy. In *Handbook of Climate Services*; Springer: Berlin/Heidelberg, Germany, 2020; pp. 67–83. [CrossRef]
34. Fünfgeld, H.; Schmid, B. Justice in climate change adaptation planning: Conceptual perspectives on emergent praxis. *Geogr. Helv.* **2020**, *75*, 437–449. [CrossRef]
35. Taylor, A.; Cartwright, A.; Sutherland, C. Institutional Pathways for Local Climate Adaptation: A Comparison of Three South African Municipalities. 2014. Available online: https://www.africancentreforcities.net/wp-content/uploads/2014/06/FocalesN18_GB_WEB.pdf (accessed on 15 June 2023).
36. Archer, D.; Almansi, F.; DiGregorio, M.; Roberts, D.; Sharma, D.; Syam, D. Moving towards inclusive urban adaptation: Approaches to integrating community-based adaptation to climate change at city and national scale. *Clim. Dev.* **2014**, *6*, 345–356. [CrossRef]
37. Klenk, T., Nullmeier, F., Wewer, G. (Eds.) *Handbuch Digitalisierung in Staat und Verwaltung*; Springer Fachmedien Wiesbaden: Wiesbaden, Germany, 2020; ISBN 9783658236694.
38. Beedle, M.; van Bennekum, A.; Cockburn, A.; Cunningham, W.; Hunt, A.; Jeffries, R.; Kern, J.; Marick, B.; Matrin, R.C.; Schwaber, K.; et al. Manifesto for Agile Software Development. Available online: https://agilemanifesto.org/ (accessed on 1 April 2023).
39. BearingPoint. Fünf Hebel für eine agile Verwaltung: White Paper. 2013. Available online: https://www.bearingpoint.com/de-de/unser-erfolg/insights/fuenf-hebel-fuer-eine-agile-verwaltung/ (accessed on 16 June 2023).
40. Chastain, C.; Ferguson, J.; Gundernatch, S.; Kondracki, E.; Levy, J.; Tran, L. *Climate Change Adaptation: A Framework for the City of Philadelphia*; Columbia University: New York, NY, USA, 2011.
41. Bartonitz, M., Lévesque, V., Michl, T., Steinbrecher, W., Vonhof, C., Wagner, L. (Eds.) *Agile Verwaltung: Wie der Ffentliche Dienst aus der Gegenwart die Zukunft*; 1. Aufl. 2018; GABLER: Wiesbaden, Germany, 2018; ISBN 9783662576991.
42. Hofert, S. *Case Studies for Agile Working and Thinking. Hofert (Hg.) 2022—The Agile mindsetHofert*; Springer: Berlin/Heidelberg, Germany, 2022; pp. 197–216.
43. Stadt Konstanz, Amt für Digitalisierung und IT. Einwohnerentwicklung 2022: Deutlicher Bevölkerungszuwachs in der Stadt Konstanz, Statistik-Info 1/2023. 2023. Available online: https://www.konstanz.de/leben+in+konstanz/statistik (accessed on 29 June 2023).
44. Stadt Konstanz. Klimanotstand: Als Öffentlichkeitswirksames Signal, Parallel zu Städten wie Basel, Los Angeles, Vancouver oder London, Hat die Stadt Konstanz am 2. Mai 2019 den Klimanotstand Ausgerufen. Available online: https://www.konstanz.de/stadtwandel/konzepte+und+chronologie/klimanotstand (accessed on 9 June 2023).
45. Stadt Konstanz. Konstanzer Klimaschutzstrategie. Available online: https://www.konstanz.de/stadtwandel/konzepte+und+chronologie/klimaschutzstrategie (accessed on 1 April 2023).
46. Thöni, A. Beschlussvorlage ö—2022-2413: Ansiedlung des Themas Klimaschutz in der Verwaltung—Ergebnis des Prüfauftrages, Bildung eines Dezernats für Klimaschutz. Available online: https://www.konstanz.sitzung-online.de/public/vo020?VOLFDNR=1008849&refresh=false&TOLFDNR=1034357 (accessed on 30 March 2023).
47. Treß, W. *Maßnahmen der Stadt Konstanz zur Klimawandelanpassung*, oral report. 9 March 2023.
48. Copernicus. Europe's Eyes on Earth: Looking at Our Planet and Its Environment for the Benefit of Europe's Citizens. Available online: https://www.copernicus.eu/en (accessed on 28 June 2023).
49. Amt für Stadtplanung und Umwelt der Stadt Konstanz; CoKLIMAx; Über CoKLIMAx. Available online: https://maps.coklimax.net/portal/apps/sites/#/coklimax/pages/ueber-coklimax (accessed on 10 June 2023).
50. Bühler, M.M.; Sebald, C.; Rechid, D.; Baier, E.; Michalski, A.; Rothstein, B.; Nübel, K.; Metzner, M.; Schwieger, V.; Harrs, J.-A.; et al. Application of Copernicus Data for Climate-Relevant Urban Planning Using the Example of Water, Heat, and Vegetation. *Remote Sens.* **2021**, *13*, 3634. [CrossRef]
51. Cortekar, J.; Bender, S.; Brune, M.; Groth, M. Why climate change adaptation in cities needs customised and flexible climate services. *Clim. Serv.* **2016**, *4*, 42–51. [CrossRef]
52. Harrs, J.; Reinhart, V.; Vögt, V.; Scheib, P.; Tewes, T.; Pohl, T. Integrating climate information into municipal services: An empirical analysis of climate change adaptation in the city of Constance. 2023, jan-albrecht.harrs@hereon.de, Climate Service Center Germany (GERICS), Helmholtz-Zentrum Hereon, 20095 Hamburg, Germany. *manuscriptsubmitted*.
53. Dodman, D.; Hayward, B.; Pelling, M.; Castan Broto, V.; Chow, W.; Chu, E.; Dawson, R.; Khirfan, L.; McPhearson, T.; Prakash, A.; et al. *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change: Cities, Settlements and Key Infrastructure*; IPCC: Paris, France, 2022.
54. *Baugesetzbuch: Bau-GB*; Epubli: Berlin, Germany, 2023.

55. *Gemeindeordnung für Baden-Württemberg*; Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg: Stuttgart, Germany, 2000.
56. ICLEI-Local Governments for Sustainability. *The Mitigation-Adaptation Connection: Milestones, Synergies and Contradictions*; ICLEI: Freiburg, Germany, 2010.
57. Almatar, K.M. Towards sustainable green mobility in the future of Saudi Arabia cities: Implication for reducing carbon emissions and increasing renewable energy capacity. *Heliyon* **2023**, *9*, e13977. [CrossRef] [PubMed]
58. Mohammed Almatar, K. Traffic congestion patterns in the urban road network: (Dammam metropolitan area). *Ain Shams Eng. J.* **2023**, *14*, 101886. [CrossRef]
59. Almatar, K.M. Transit-Oriented Development in Saudi Arabia: Riyadh as a Case Study. *Sustainability* **2022**, *14*, 16129. [CrossRef]
60. *Geschäftsordnung für den Gemeinderat der Stadt Konstanz*; Versandantiquariat Petra Gros GmbH & Co. KG: Koblenz, Germany, 2022.
61. Badaoui, N.; Coppola, F.; van Dijk Castañeda, J.; Farhad, N.; Ikert, A.; Jay, L.; Riaño, D.; Redondo, A.; Riberio, P.; Sadouni, I.; et al. *Integrating Climate Adaptation: A Toolkit for Urban Planners and Adaptation Practitioners*; Global Platform for Sustainable Cities: Washington, DC, USA, 2020.
62. Nielsen, C.N.; Munk, T.S. In Good Company: How New York City and Copenhagen Deliver Climate Adaption—Together: Few Cities Are Capable of Fighting Climate Change. NYC and Copenhagen Offer Unique Examples that Work in Their Own Ways. Available online: https://ramboll.com/media/rgr/how-ny-city-and-copenhagen-deliver-climate-adaption (accessed on 3 July 2023).
63. Verburg, P.H.; Neumann, K.; Nol, L. Challenges in using land use and land cover data for global change studies. *Glob. Change Biol.* **2011**, *17*, 974–989. [CrossRef]
64. Environmental Health Unit Rural; Regional Health and Aged Care Services Division; Victorian Government Department of Human Services Melbourne Victoria Australia. Heatwave Planning Guide: Development of Heatwave Plans in Local Councils in Victoria. 2009. Available online: https://content.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/p/planning-guide{-}{-}-pdf.pdf (accessed on 29 June 2023).
65. State of Victoria, Department of Health. Heatwave Plan Review Tool. 2011. Available online: https://content.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/1/1110015_heatwave_plan_review_web{-}{-}-pdf.pdf (accessed on 31 March 2023).
66. Hippel, A.M. *von. Brandschutztechnische Anforderungen an Bauteile: Landesbauordnungen im Vergleich*; Landesbauordnungen im Vergleich; Springer: Berlin/Heidelberg, Germany, 2022.
67. Löffler, G. *Analysis of the State of Local Finance in Intermediary Cities*; United Cities and Local Governments: Barcelona, Spain, 2016.
68. Benmarhnia, T.; Schwarz, L.; Nori-Sarma, A.; Bell, M.L. Quantifying the impact of changing the threshold of New York City heat emergency plan in reducing heat-related illnesses. *Environ. Res. Lett.* **2019**, *14*, 114006. [CrossRef]