Governance Design of Collaborative Intelligence for Public Policy and Services

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ABSTRACT

The existing literature presents an opportunity to address the governance challenge of collaborative intelligence for public policy and services. This paper seizes the opportunity by developing a governance framework for public value creation. This proposed framework builds on a novel conceptualization of collaborative intelligence that advances collaboration as the governance goal and treats technology-enabled platforms as central to collaboration. This framework draws from the scholarly foundation of collaborative governance that focuses on rules and addresses levels and dynamics. Moreover, this framework integrates both technological and administrative dimensions. The important advancements of this proposed framework lie both in treating AI as an actor in governance structures and processes and in understanding the interactions between technologies and rules. Another important contribution is to integrate various mechanisms of collaborative public service production into this unified governance framework for collaborative intelligence.

CCS CONCEPTS

• **Social and professional topics**; • **Computing / technology policy**; • **Government technology policy**;

KEYWORDS

Collaborative intelligence, governance, digital government, collaboration

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1 INTRODUCTION

The rise of artificial intelligence presents significant governance challenges to organizations for advancing public policy and services. These include governance design to address the challenge of involving artificial intelligence in making decisions that significantly impact the rights and welfare of members of society [10, 32, 45, 69]. Another salient challenge is to identify and implement governance principles and design structures and processes for addressing bias that can be introduced at various stages of the development and design of AI systems [12].

At the same time, opportunities exist for addressing these governance challenges regarding the integration of artificial intelligence in public services. The existing literature on the theory and practice of AI governance provides several avenues to address these challenges. The first is to approach governance from multiple and embedded levels of policy and legal frameworks [66]. The second is to take a cross-sector or collaborative approach to accountability and public value creation [37, 59]. Third is a process-orientation for understanding and assessing the interaction between artificial intelligence and public values [12]. Fourth is to build the micro foundation of the unique strengths and complementary collaboration between artificial intelligence and humans in the context of public organizations [8, 67].

Multiple conceptualizations exist for understanding human-AI collaboration. Hybrid intelligence brings humans and AI together by leveraging the complementary strengths of humans and AI [17]. Collective intelligence utilizes a collaborative organization-directed platform for people working together to achieve a common organizational goal [56]. Although these streams of studies and the diversity of conceptualizations offer significant insights independently, there is a missed opportunity to build a collaborative governance framework that integrates these insights for public value creation. This paper seizes the opportunity by offering a novel conceptualization that advances collaboration for public value creation as the governance goal and treats technology-enabled platforms as central to collaboration.

This paper proposes the term ”collaborative intelligence” as a more inclusive and integrative conceptualization that regards collaboration both as the goal and as the process, recognizes a diversity of actors (humans and machines), and covers a collection of collaborative mechanisms (e.g. platform and crowd-sourcing). The proposed framework builds on public governance and institutional design literature as the unifying intellectual foundation for the purpose of governance design for public services. Moreover, this framework explicitly addresses governance activities for collaboration between humans and AI across levels.

This paper achieves its goal of developing a governance framework by first introducing the conceptualization of collaborative intelligence as situated in the existing bodies of literature. It follows with the challenges facing the use and integration of AI in public service decision-making in the continuum and variety of human-AI collaboration. Next is the articulation of the proposed governance framework to address the governance challenges grounded in the

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literature on collaborative public governance and institutional design. This paper concludes with future research opportunities.

2 COLLABORATIVE INTELLIGENCE FOR PUBLIC POLICY AND SERVICES

This paper aims to develop a conceptualization of collaborative intelligence that promotes an effective design of collaboration across multiple intelligent actors for public value creation. It draws from the insights of AI governance, collective intelligence, collaborative governance, and actor network theory. The proposed conceptualization first recognizes multiple intelligences and treats both humans and AI as intelligent actors. A unifying conceptualization of human and artificial intelligences concerns intelligent capabilities, including sensing, learning, reasoning, communicating, and taking actions [61]. Another quality is to carry out these capabilities with foresight [49, 61]. Both humans and AI are intelligent actors as supported by the Actor Network Theory [28] which treats both human and machines as actors in a network to decide on and implement tasks. The notion of actors recognizes the ability of both humans and AI to make decisions and should be treated as actors of decisions. For instance, AI is responsible for information analysis to identify potential fraudulent activities, while humans draw from their field experiences in deciding on who to pursue [19]. Moreover, this paper further extends the conceptualization to organizations such as a governmental agency as an organizational actor and a network of computers as a collective actor.

These intelligent actors have respective strengths and weaknesses in the context of public services and governance for public value creation. Bullock et al. [9] use complexity and uncertainty as the two dimensions to define task characteristics for comparing the strengths of humans and machines. Complexity refers to the level at which a task deviates from the standard procedure, and uncertainty means the degree to which the task cannot be predicted and analyzed. Humans are more competent to tackle complex tasks than machines, but AI agents process uncertainty better than public employees. In other words, human agents dominate in highly complex and uncertain tasks, but machine intelligence outperforms in simple and straightforward work. In addition, AI leads the collaboration in public services with high uncertainty and low complexity, while human agents can maintain more power in completing missions with low uncertainty and high complexity [9]. Humans are good at tackling tasks that require more discretion [15]. Moreover, human agents can develop strategies to improve socially- and service-oriented values in collaborating with AI even if their traditional discretion has been replaced by machines [6].

The proposed conceptualization of collaborative intelligence regards collaboration as both the goal and the process. The goal of collaboration is to achieve a result that is better than the work of a single type of actors, either humans or AI. Moreover, collaborative intelligence is about the collaborative mechanisms that make collaboration productive. For public service and governance, there has been a growth in the variety and sophistication of digital platforms to engage citizens to participate in public policy and engage in public service production [34, 40].

Similarly, there has been growth in policy, organizational, and institutional arrangements to foster human-AI collaboration for public policy and service [19, 37]. More broadly, the coproduction in digital transformation in the public sector includes co-planning (stakeholder participation for national digital transformation strategies), codesign (user stories, prototypes, and workshops), co-management (public-private partnership, contracting out), co-delivery (data entry, provision of services), and co-assessment (forums for evaluation) [53].

This paper extends the public governance literature in public administration to explicitly address the role of digital technologies and platforms in collaboration between human intelligence and artificial intelligence. The studies of digital transformation [20, 53] inform the governance design. Digital transformation requires consideration of cultural, organizational, structural, and relational aspects of changes in the public sector [20, 35]. Moreover, coproduction in digital transformation creates economic, administrative, citizen, and democratic values [53].

The research on collaborative digital platforms further introduces integrated governance and technology design. Governments leverage the functions of digital platforms for public services [27]. Digital government platforms are increasingly recognized as critical public governance and service components. Noveck [40] argues that decisions made by public institutions would be more legitimate and effective if the decision-making process involved internal and external expertise through advanced technologies, known as crowd-sourcing. To enhance the governance of digital and platform government, Noveck [40] proposes a further understanding of who participates, what type of incentives and motivations the participants have, and what institutions are designed as the guiding principles of digital platform governance.

Furthermore, Liu [30] reveals three components of digital and platform government governance: alignment, motivation, and evaluation. On alignment, Liu [30] stresses the importance of aligning policy goals with crowd-sourcing initiatives and matching crowd-sourcing tasks with participants' skills. On motivation, it is critical to create incentives for participation and quality of contribution [30]. Finally, on evaluation, it is important to design a peer review process and establish a reputation system to build trust for the governance of the digital and platform government.

3 BENEFITS AND CHALLENGES OF COLLABORATIVE INTELLIGENCE FOR PUBLIC POLICY AND SERVICES

The opportunities for collaborative intelligence come from the complementary role that human and AI actors play by leveraging their respective strengths to compensate for their respective weaknesses. Humans' strengths lie in understanding complexity and dealing with uncertainty [9]. However, humans are limited in gathering and processing a large amount of data and information with accuracy. On the other hand, AI is superior in gathering and analyzing big data with precision. Nonetheless, AI is constrained by the data and its ability to solve complex and uncertain problems. Working together, humans and AI can produce significant results [17, 26].

The collaboration of humans and AI has seen positive impacts in several public service areas [64]. In governmental operations, there

is an increase in the capabilities of gathering and analyzing a large amount of data for fraud detection, resource planning, customer services, work productivity, etc [19]. The most recent development and application of ChatGPT can provide digital knowledge and writing assistance that is comprehensive and personalized.

The benefits of collaborative intelligence also come from platform-based coproduction and co-creation between citizens and governments. Noveck [41] first notes that new technology facilitates collaboration and enables collective action to resolve complex problems. She emphasizes the importance of designing a transparent process to exchange information between the government and the public through the rise of social media. Most importantly, policy experts selected by government officials might not be knowledgeable about all aspects of the policy needs. Therefore, new technology allowing crowd-sourcing and open peer review can help the government be more informed about policy decisions [41].

Citizen service information systems such as 311 can also benefit from collaborative intelligence [50]. By reporting issues, citizens help local governments sense the problems experienced by citizens on the ground. By asking for information, citizens assist governments in identifying the most critical information services. In doing so, citizens play the dual roles of customers and partners [58]. AI can be deployed for its natural language processing capability to provide on-demand targeted responses to inquiries. Moreover, public innovation can be enhanced through better digital and platform government governance by engaging different social and political actors in collaborative processes addressing differences [60]. The processes of constructive managing differences are critical for public innovation because they help identify problems and simulate solutions to facilitate innovation.

However, there are risks and dangers in the rise of algorithmic governance with the deployment of AI for public governance and services. Some government use of AI, internally created by the collaboration between AI and government employees, can threaten personal autonomy by nudging citizens to behave in the way that enhances government control [38]. Information asymmetry can further erode the ability of regular citizens to respond or challenge algorithmic or AI-based decisions [10, 45].

Moreover, the use of AI in public governance can increase the risk of administrative evil [68]. Such risks arise from technology instructability, automation bias, and domination of technological rationality. The risks further increase when there is a lack of consideration of social and democratic values, insufficient testing of AI-enabled solutions, and an overreliance on quantitative and machine-readable data.

The use of AI can result in discrimination against certain social groups [65]. Digital inequality has been a long-standing challenge since the advancement and use of digital technologies by government [21, 45]. The deployment of artificial intelligence, in some instances, has further resulted in discrimination in the areas of policing and hiring practices.

4 A GOVERNANCE FRAMEWORK OF COLLABORATIVE INTELLIGENCE FOR PUBLIC POLICY AND SERVICES

This proposed framework takes a sociotechnical system perspective with an explicit focus on digital technologies and intelligent characteristics for collaboration. The goal is governance design informed primarily by the collaborative governance framework [18] and the studies of institutional analysis and development [42, 52]. The context is public governance and services that span from citizen participation in public policy to government provision of services.

This framework, as depicted in Figure 1, has the following components. First are the design principles for the governance of collaborative intelligence. Design principles are essential for effective governance. Moreover, it will discuss mechanisms for integration. The second component is the consideration of levels. Levels are an important consideration for understanding the effectiveness of network governance [47, 48]. Such networks can include both human actors and AI ones. The distinction between levels is important [25] and can serve as an analytical frame to identify and leverage governance design opportunities. The third component is the conceptualization and development of governance as a configuration of rules for behaviors and interactions. A rule-based analytical approach can provide more specific governance recommendations as advanced by scholars working on institutional analysis and development [51] and institutional grammar [22] for the development of collaborative intelligence.

Moreover, this framework addresses the interactions of these components by describing the governing mechanisms in the sociotechnical system for achieving the public governance and service results of collaborative intelligence. These interactions integrate levels and rules by engaging actions such as principled engagement, shared motivation, and capacity for joint action [18]. Moreover, the incorporation of the sociotechnical system perspective addresses the dynamics of these areas of activities. The feedback loops from governance results to governance design and activities are essential considerations for the framework [23, 57].

4.1 Design Principles

The first principle is to use public values to guide the governance framework. This principle aligns with the context of public governance and services and addresses the need to serve public interests. Advancing public interests requires articulation and inclusion of public values. These values for digital governance can include societal values such as equity, justice, fairness, and impartiality; service-oriented ones such as efficiency, effectiveness, and transparency; and duty-oriented ones such as democratic governance and accountability [4]. Moreover, the guidance of public values also implies the understanding of the interactions between public values and governing activities. A productive way to understand such interactions is to examine the process of the collaboration between humans and AI to study how public values are first introduced for the AI system design, then codified into the goals of AI systems, followed by the actual implementation of AI systems, and concluded with an evaluation of the public value implications for various stakeholders [12].

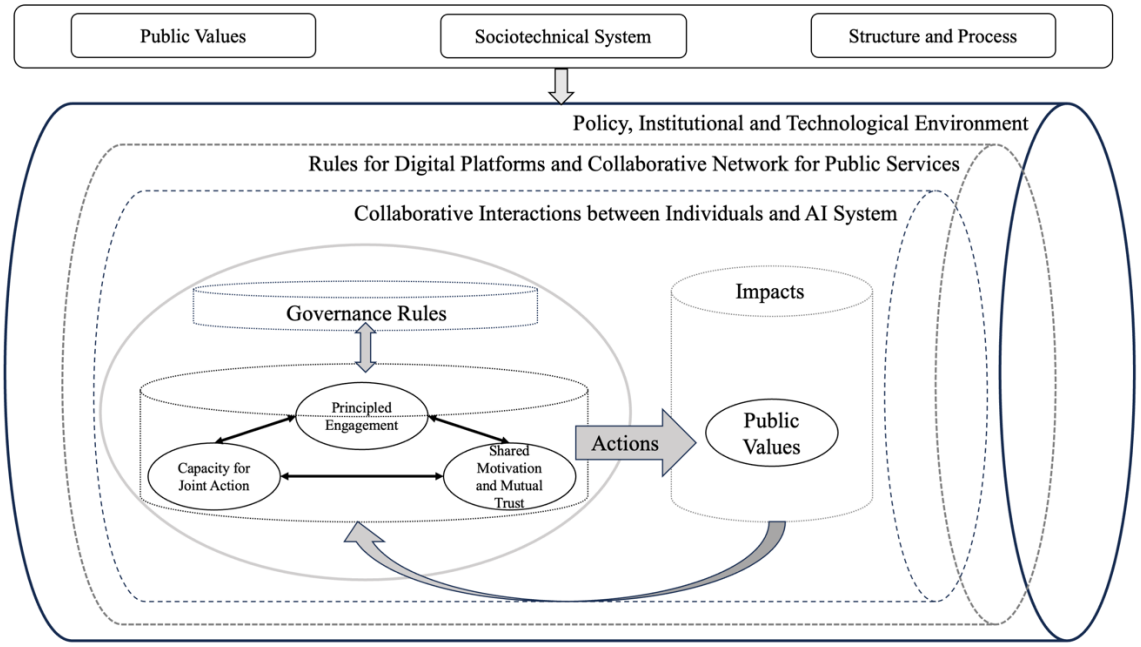

Figure 1: A multi-level principle-guided governance framework for public policy and services

The second design principle is to explicitly model and design a sociotechnical system by recognizing both the distinctive characteristics of a social system and a technical one and the interactions between both systems to form a holistic sociotechnical system. The social one mainly involves the social interactions between humans to coordinate among themselves to create shared understanding and accomplish collective tasks. The technical one consists of the use of data and various technologies. The primary focus is the digital format of these data and technologies. The holistic attribute of the sociotechnical system comes from the networked interactions and couplings of humans and computers. For instance, a distributed computing environment requires the integration of computer networks and human networks [54]. Moreover, a sociotechnical system is a dynamic one that includes feedback loops between various inputs, conditions, and outputs. A feedback loop can reinforce a condition or balance it in a complex web of many feedback loops. Identifying key dynamics and feedback loops helps evaluate and identify policy solutions [23]. The proposed framework will follow a similar approach to identifying governance solutions.

The third principle is to design collaborative structures and processes to leverage the characteristics and strengths of different actors and focus on their complementarity. Humans are social beings with emotional attributes. Governance of collaborative intelligence can design rules and processes to enhance social connections and attend to emotional motivators. Humans are also the primary actors who embody public values. Humans can design collaborative rules to ensure the consideration and infusion of public values into collaboration. Collaborative processes can explicitly draw on the strengths of AI systems in information processing and analysis. The recent development in the natural language processing capability of generative AI provides additional communication capabilities between humans and information systems.

4.2 Levels

The proposed governance framework explicitly addresses levels. The distinction between levels is important for the study of public policy and governance [25, 39] and for digital platforms [34]. The proposed framework follows the categorization of levels by Jilke et al. [25] to include macro, meso, and micro levels. The focus at each level is the policies and rules that govern the behaviors of various entities. The goal is to conduct institutional design [42, 43].

At the macro level, the digital governance of collaborative intelligence pertains to the broad policy and institutional environment as well as the technological one. This is usually at the level of a nation or a union of nations that has its own legal and policy framework on the collaboration between AI and humans as well as on citizen-government collaboration utilizing digital platforms. In the United States, examples of such a framework are the Executive Order of the Biden Administration titled "Executive Order on the Safe, Secure and Trustworthy Development and Use of Artificial Intelligence" on the specific requirements for federal agencies and the general statements in the AI Bill of Rights. The technological environment also shapes the strengths of AI in relation to humans as well as the ways in which AI and humans can collaborate. The fast development of generative AI, such as ChatGPT demonstrates the capability of generative AI in leveraging all publicly available digital content and the ability to communicate in human-like prose writing.

At the meso level, governance designs are about the rules for digital platforms that foster collaboration between an organization and individuals or a collaborative network of organizations

and technical entities for public service. Digital platforms can foster collaboration between government agencies and individual citizens/residents to produce public services [29]. There are governance arrangements that foster collaboration between citizens and government by utilizing digital platforms. For example, Peer to Patent case taps into the public service motivation of citizens for public service production [29, 41] facilitated by digital platforms. Another type of coproduction of public service is the resident information services as gathered and disseminated by 311 systems. These platforms can also help with the generation of policy ideas, such as those seen in the UK's My2050. These governance arrangements address the collective action of individuals in the coproduction of public policy and service.

The technological advancements at the meso level are the development of applications and information systems that significantly increase the ease of collaboration across a diversity of skills and conditions for the production of public service and the generation of public policy ideas. Moreover, the aggregation and sharing of information have been significantly streamlined. For instance, such streamlining is evident in sophisticated citizen service systems run by local governments. In addition, the development of AI chatbots combined much improved natural language processing capability to understand and respond to human service queries. For producing publicly funded computing resources, the advancement in technology allows the integration of software and hardware as well as humans for providing advanced computing resources to researchers [13].

At the micro level, it is the design of collaborative interactions between individuals and a specific AI system. This involves the specification of the role that humans play in collaborating with AI systems. Such collaboration should take advantage of the respective strengths and capabilities of human and AI actors. Building on the automation literature, the involvement of humans can vary depending on the stages [44]. Moreover, the question of authority and corresponding accountability is important in structuring collaboration. An AI system for fraudulent activity investigation is particularly productive in analyzing a large amount of textual data. At the same time, humans can provide a "bag of words" based on their investigatory experiences that flag potentially fraudulent activities [19]. What the AI system offers is recommendations. The final decision authority still lies in the human investigators, recognizing the accompanying accountability.

4.3 Rules as Governance Structure

This proposed design framework adapts pertinent rules of institutional design [42, 43, 51] to model the governance structure of a socio-technical system for collaborative intelligence. First, participant rules prescribe who can participate in various positions and decisions. For an AI-enabled system for public information service, a participant rule can require someone to be a registered local resident or citizen to contribute to the system. Second, position rules specify the positions that participants can take in the governance structure. At the meso level, one position can be policymakers, who decide whether to adopt a certain AI system for a particular digital government platform to be used. At the micro level is the position of the AI system developer. Such a position provides the system developer with an official role in participating in the governance decisions.

The third type is authority rules, which prescribe a set of decisions attached to a position. For instance, a software developer typically has the authority to make technical decisions on the choice of the AI development environment. Public service professionals have the authority to make decisions on whether to follow the recommendations of an AI system. The policymakers can decide on what the core public values are advanced. The question of authority is particularly salient in public service organizations, as accountability usually follows authority.

The fourth type is information rules, which prescribe what information is available to each position and decision. For instance, an information rule can allow city council members to have full access to the AI system development history and system specifications for making the decision on city-wide adoption of the system. Information rules are salient for the collaboration between humans and AI systems at the micro level. At the meso level, the development of explainable AI can assist in not only making information available but also more understandable [3].

The payoff rules specify how benefits and costs are allocated to a participant in a specific position. For instance, a citizen may benefit from a digital government platform to contribute and receive city information services such as a 311 system. A public manager may benefit from making an AI system more transparent to gain the trust and support of citizens. There could be costs of facility, time, and resources for the operation of a digital government platform. The costs can be borne by taxpayers. Some of the costs could be borne by the users of the system.

The typology and the specifics of rules help model the governance structure and assess the governance outcomes [22, 43]. The governance structure includes the specifics of each type of rules and their configuration. Rule configuration is important to understanding the governance structure and its impact on outcomes [42]. Moreover, attention will be paid to the rules-in-use, which reflect practice better than the rules in the book. Rules-in-use structure the actual behavior of the participants taking on various positions and making decisions.

4.4 Governance Activities and Mechanisms

The embeddedness of levels is a key design consideration of governance activities and mechanisms. The system context should be commensurate with the scope of the investigation. For the interest in public governance and service, the broad system context needs to capture the national context that includes core public values, type of administrative systems, technological capabilities, economy, and demographics [55]. The meso-level governance of interorganizational networks and digital government platforms is embedded in this broader sociotechnical context. Such embeddedness recognizes the important influence of values as well as administrative, technological, and economic factors at the system context level on prescribing and constraining the boundary of possibilities for institutional design at the meso level. The micro-level governance design is further conditioned and structured by the rules at both the meso and the macro levels. A digital government platform for coproduction of public service prescribes the respective roles of

citizens and governments. These meso-level rules govern the design of collaborative interactions between humans and AI systems.

The levels also imply the relative magnitude of effort for change as well as trade-offs. The macro-level institutions require the most effort for change as they are related to the changes that Ostrom characterizes as constitutional-level change. Such change usually requires a significant modification to the constitutions of the collective. The meso-level change such as the change in collaborative arrangement between government and citizens utilizing a digital platform, is relatively easier than those at the constitutional level. At the micro level, government agency managers and AI system developers can make changes within their scope of responsibilities.

The focus of the proposed framework is governance design on the meso level while considering the constraints and conditions at the macro level and the implications of governance at the meso level for activities at the micro level. Moreover, the proposed framework conceptualizes activities and dynamics by organizing around the three areas of activities as proposed by Emerson et al. [18] in their work on an integrative framework for collaborative governance, namely principled engagement, shared motivation, and capacity for joint action. The governance activities and mechanisms are also informed by the literature on network governance and digital government platforms.

4.4.1 Principled Engagement. Principled engagement, as proposed by this framework, builds on the principles suggested by Emerson et al. [18], expands to the inclusive incorporation of public values and recognition of AI systems as an actor, and addresses the characteristics of information and technologies. More specifically, the guiding principles for engagement are open and civil communication and discourse, representation of stakeholder interests, and incorporation of stakeholder perspectives and knowledge [2, 7].

These principles align with several key public value considerations for the effective design of digital platforms for collaboration between government, humans, and AI systems [12]. Such engagement can promote equity in participation. A salient digital participation challenge facing underserved communities is access to broadband services. Accessibility and usability challenges can be barriers to effective collaboration via digital government platforms [36]. The implementation of collaborative platforms needs to consider and implement an in-person supporting mechanism for utilizing digital platforms. Such equity in participation can be supported mainly by participant rule that allows for the participation of key stakeholder groups at a particular phase of collaboration. For instance, the participation of the stakeholders impacted by an AI system is considered important for achieving equity in participation. Information rules allowing for the sharing of information to under-represented stakeholder groups can further strengthen equity.

Engagement needs to explicitly consider AI systems as an actor for collaborative intelligence and engage them accordingly. As stated previously, AI can complement human actors in conducting analysis of big data and identifying emerging patterns. Such engagement can be supported by participant rules to allow for an explicit role for AI systems and then governed by authority rules to delineate their decision-making authority.

Transparency in engagement is particularly important for including AI systems. Transparency is one of the primary concerns for collaborating with AI systems [15]. How and why a particular conclusion is reached by an AI system are difficult to ascertain. For public policy and service, there is a need to actively design and implement transparency measures to ensure a reasonable understanding of how and why for meaningful participation.

A digital government platform typically embodies a multitude of public values and engagement approaches. Several civic engagement projects implemented in the public sector demonstrate core values like human dignity, digital equity, transparency, accountability, and democracy. For instance, Philadelphia's Change by Us platform empowered citizens to voice ideas to improve their neighborhoods, reinforcing human dignity and democratic participation [1]. In New York, the Big Ideas challenge exemplified transparency and accountability by inviting citizens to submit online ideas for applications to improve civic services [1]. Additionally, Helsinki's initiative illustrates digital equity and transparency, where Code for Europe fellows created an app to catalog public museum art, and citizens contributed by tagging uncatalogued art images [1]. These open calls for ideas promoted equitable participation through digital platforms and upheld democratic values by involving citizens directly in the service provision or policymaking.

4.4.2 Shared Motivation and Mutual Trust. The cultivation of shared motivation and mutual trust is an important governance activity for collaborative intelligence. Articulation of shared values is an essential source of shared motivation. For collaborative arrangements for public service, the shared motivation for improving our society is productive. Public service motivation can explain the energy and commitments of public service professionals [46]. Such motivation can be a unifying force to bring various groups of participants together for the creation and advancement of a common goal. Such shared motivation is the basis for the creation of mutual understanding, shared commitment, and mutual trust.

For digital platforms facilitating collaboration among citizens themselves and citizens with a public-sector organization, there are various mechanisms for creating shared motivation and mutual trust. Citizens commonly evaluate and improve public policy or public service ideas through voting or commenting, as seen in platforms like Open Government Dialogue. This method is crucial for refining outcomes, controlling content quality, and predicting preferences [31]. A transparent, fair aggregation process of citizens' input in policy idea generation and evaluation is essential to the generation of trust [31]. Such a process should also respect and value participant contributions for the generation of mutual trust.

Trust in the government systems can foster trust in e-services [5]. The general trust in government plays an important role in the determination of trust in government AI systems [63]. Building trust in government AI systems requires the consideration of AI system qualities and openness. Governing activities such as the participatory design in AI chatbots have shown promise in addressing the deficiency in the trust of indigenous people in the U.S. government [62]. A more open participant rule can support trust building. Moreover, an authority rule that empowers historically marginalized stakeholder can also support trust building. Having the representative of tribal nations to chair AI system design

meeting is perceived to earn more trust from the tribal members [62].

Transparency can enhance trusting relationships between governments and citizens [24]. Digital government platforms to engage citizens/residents have emphasized the importance of transparency in the aggregation of their opinions and preferences [31]. Information rules can codify who can receive what information to ensure transparency to various stakeholder groups. Transparency is considered one of the most critical factors for a trusting relationship between humans and AI when AI systems can make independent information utilization and analysis decisions. For public policy and service decisions, providing transparency in the involvement of AI in decision-making and the line of authority is important not only for the public managers involved but also for the general public.

4.4.3 Capacity for Joint Action. At the meso level, the capacity for joint action includes the technical and administrative capacity. There are activities and mechanisms that support capacity building. There are several areas of technical capacity for digital government networks and platforms. First is the need to address disparate data standards to ensure quality and a service-oriented view of information and service [14, 16]. Second is the capability for collaborative communication and coordination [13]. A shared information and communication infrastructure helps with information-sharing and coordination. A common communication platform with knowledge management capability helps coordinate the computing and human resources available via a distributed network. Government-citizen collaborative platforms typically have a technical infrastructure that allows access and collaboration, such as in the case of 311 systems [11]. For cross-sector collaboration, the underlying information architecture of a platform is essential, shaping how various stakeholders, including government, businesses, civil society, and citizens, interact [34]. The next area of technical capability is the feedback to participants of the networks and platforms about their use and contributions to the network or platform. A sophisticated platform typically allows for a personalized participant view.

Leadership and management play a critical role in growing administrative capability for managing digital governance networks or platforms [14]. Such administrative capacity allows for the alignment of collaborative interactions to the goals of public policy and services. Collaborative public managers can engage in the activation of key network member organizations to ensure certain capacity [33]. Mobilization is another main area of activity that helps address the interdependence among members of policy and service networks [33] and fosters joint innovation [60]. For digital government platforms, administrative capacity for structuring and implementing tasks to facilitate individual participation is important. In a citizen-facing crowd-sourcing platform, a structured approach to matching tasks with crowd members' specific skills and interests enhances effectiveness [30]. For example, the Peer to Patent project [41] structures the review as a five-step process with clear instructions available on the project website.

At the micro level, joint action refers to the collaboration between humans and AI to complement each other. The technical capacity for joint action requires a technical infrastructure that allows for effective communication and collaboration. Such a technical infrastructure needs to have several qualities. First is clear documentation of the data utilized and the respective roles of humans and AI in data input. Such documentation is important to address potential biases in the data that are a central concern for public service. Second is the specification of the technical capabilities of AI systems. AI systems vary significantly in capabilities. Some AI systems focus on natural language processing. Some are specific about computer visions. Knowing the specific capability that AI brings to the public service task is crucial for designing and implementing appropriate collaboration. Technical capacity for collaboration also includes the communication between AI and humans in the predictive framework models specified by humans and the AI's communication with humans about the process and results of reasoning and learning.

The administrative aspect of collaboration between humans and AI can be modeled after the process of information acquisition, information analysis, decision, and action selection, and then action implementation, as suggested by the work on automation [44]. Humans and AI can collaborate on each of the steps depending on their relative strengths. For instance, humans can help acquire qualitative data from humans and convert them into digital format. AI systems such as ChatGPT can gather publicly available digital data. Humans can provide value-based guidance for decision and action selection, while AI can help explore and rank various decisions and their consequences. One focus should be on explainable AI (XAI) for collaboration at various stages of the process.

4.4.4 Dynamics and Feedback Loop. The three aforementioned areas of activities interlock with one another to form various dynamics. Principled engagement can provide guidance for the key values to advance in developing capacity for joint actions. For instance, principled engagement can promote openness and transparency to help build joint capacity to address bias and digital inequity. Principled engagement can foster the creation and sustainability of shared motivation and mutual trust. An increased level of trust allows for a more involved engagement of the participants. For public service, a unifying and anchored motivation is the public service contribution to our society. Such shared motivation helps activate and mobilize resources for building capacity for joint action. Given the resource interdependence between actors both at the meso (network) and micro levels, such shared motivation and mutual trust can increase the contribution of various actors to the collective benefits.

Action can be taken to drive dynamics [18]. The enactment of supporting rules can enable all three areas of activity for collaboration. These include participant, decision, information, authority, and other rules that can support collaboration across organizations and individuals. Openness in information sharing and standardization of data for interoperability are productive [14, 34]. Achieving compliance with rules at the macro and meso levels is one of the essential actions to connect the three areas of activity to impact. In addition, enacting payoff rules in favor of individuals and groups contributing to the network or platforms can facilitate productive dynamics leading to impact.

These actions lead to impacts. An articulation of the impacts is critical for focused effort. Governance of collaborative intelligence

for public policy and service has the normative goal of public value creation. These public values include those for society as a whole, such as social equity and societal accountability and those for public service, such as responsiveness, efficiency, and transparency [4]. Taking a process perspective in a dynamic system to understand the role of public values is important. Attention should be given to how these values have been introduced, codified, and implemented to lead to their impacts [12].

A system dynamic perspective highlights the importance of feedback loops [23]. A reinforcing feedback loop identifies a circular of actions and impacts that reinforce a particular result. This could be about the positive impact of the involvement of marginalized populations to gain mutual understanding and trust. A balancing loop is one that reduces a certain impact. This could be a collection of governing activities that reduce bias in data. Advancement of technology and changes in technical capabilities are important inputs of these feedback loops. The user-friendly task organization and support are helpful, such as those in digital government platforms facilitating citizen contribution to public service.

An understanding of the feedback loop assists with the adaptation of the governance structure and processes. The adaptation of rules can take place at various levels [18]. At the macro system context level, these adaptations can be the initiation and implementation of national policy changes. These changes are relatively more challenging and time-consuming and subject to various political, economic, and social factors. At the meso network and platform level, these adaptations are more within the influence of the public service managers who wish to design and implement rules to achieve public policy and service goals. These adaptations can be about having an AI governance board that has a wide representation of various stakeholder groups rather than just the government. Another example is the change in transparency requirements to ensure the data, goals, and involvement of AI in public decision-making are understandable by the general public.

5 CONCLUSIONS AND FUTURE RESEARCH OPPORTUNITIES

This paper develops a conceptual framework for the governance of collaborative intelligence for public policy and services. The goal is to advance governance design for public value creation. This framework builds on the scholarly foundation of collaborative governance that focuses on rules and addresses levels and dynamics. Moreover, this framework integrates both technological and administrative dimensions. The important advancement lies both in treating AI as an actor in governance structure and process and in the understanding of the interactions between technologies and rules. Another important contribution is to integrate various mechanisms of collaborative public service production, such as digital government platforms for crowd-sourcing, into this unified governance framework for collaborative intelligence.

The proposed framework provides a further specification on the role of public values and the type of rules. Public values are the outcomes of the governance of collaborative intelligence for public policy and service. A broader frame of public values goes beyond service-oriented public values to include society-oriented ones [4]. Governance design for collaborative intelligence can introduce, codify, implement, and produce these values [12]. The typology of rules offers a more analytical approach to identifying and designing a specific type of rule for impact, such as participant rule to include marginalized stakeholders for equity. The typology of rules can offer the specifics for governance and allow for tracing the impact of a particular type of rule.

Moreover, the proposed framework places emphasis on governance actions and system dynamics in the context of levels. The three areas of activity are principled engagement, shared motivation and mutual trust, and technical and administrative capacity for joint action, adapted from the areas of collaborative dynamics as proposed by Emerson and Nabatchi [18] with an enhanced focus on digital technology and artificial intelligence. The proposed framework distinguishes between reinforcing and balancing feedback loops and models feedback to identify governance design and implementation opportunities.

Future research opportunities include development in the following areas. The first is to study specific cases to help refine and update the framework. These cases can show how a specific collaboration dynamic takes place and its impact on the public value outcomes. A rich collection of cases should feature a diversity of contexts and dynamics. The second is to have more specifications on the rules and, more importantly, rule configuration. The work on formalizing these rules and conducting computational analysis [22] is particularly helpful. At the same time, more empirical work needs to be done on the rules in practice to enhance our understanding of the dynamics. Lastly, a productive area of development is to examine the co-evolution of humans and AI in the fast development of AI capabilities. The fast development of both generic and specific AI offers research opportunities for evolving collaboration between humans and AI and identifying some enduring governance mechanisms for public value creation.

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