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Street-Level Bureaucratic Responses to Government Technology:

Using a Systematic Review to Develop the Combined Framework of Technologist, Technology and User

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Abstract

This research employs a systematic review approach, guided by the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement (Page et al., 2021), to investigate the influence of government technologies on the operational practices and discretionary power of street-level bureaucrats (SLBs). The review spans literature from the fields of street-level bureaucracy (SLB), screen-level bureaucracy, and system-level bureaucracy (SYB) within public administration, culminating in the development and validation of the combined framework of Technologist, Technology, and User (TTU) to elucidate the interaction among them. By re-conceptualizing the concept of government technology, this research synthesizes empirical and theoretical works to formulate a discretionary framework with three lenses, exploring how discretion is impacted by various technological contexts.

The study argues that data professionals, such as system designers, should not be exclusively associated with system-level bureaucrats (SYBs). Instead, their roles are flexible and should be critically examined and defined within the bureaucratic forms of their respective organizations. In fact, the role of data professionals in SLB is to support and reinforce their organizations in transitioning to SYB. I argue that this transition from SLB to SYB is a contextual phenomenon, influenced by the type of public agencies (e.g., large-scale executive agencies) and various contextual factors affecting SLBs. While large-scale executive agencies may find it easier to transition to SYB, organizations that heavily rely on human judgment may find this shift challenging, if not impossible, to fully achieve.

The findings reveal that while information and communication technologies (ICT) and artificial intelligence (AI) can obscure and modify the discretionary actions of SLBs, these technologies do not entirely eliminate human judgment. Instead, new forms of discretion emerge with the use of emerging technologies. However, the transition from street-level to system-level bureaucracy remains largely theoretical, with limited empirical support. The thesis concludes by highlighting the complex and context-specific nature of technology's impact on public administration, providing insights into the evolving role of SLBs in an increasingly digitized environment. Additionally, it identifies nine themes to study the rearrangement of SLBs' work through the use of government technologies.

Keyword: Street-level bureaucracy, System-level bureaucracy, discretion, Government technologies, The combined framework of Technologist, Technology, and User

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Abbreviations

AI	Artificial Intelligence
AD	Artificial Discretion
ADTs	Algorithmic decision tools
AML	Anti-Money Laundering
AR	Augmented Reality
CIS	Client information systems
CTI	Cyber Threat Intelligence
CMS	Centers for Medicare and Medicaid Services
EU	European Union
GDPR	General Data Protection Regulation
GPS	General practitioners
IDS	Intrusion Detection System
ICT	Information and communication technology
ICTs	Information and communication technologies
IS	Information systems
JAWS	Job Access With Speech
MFA	Multi-Factor Authentication
NAV	Norwegian Labor and Welfare Administration
NVDA	Nonvisual Desktop Access
OECD	Organization for Economic Co-operation and Development
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SIEM	Security Information and Event Management
SLB	Street-Level Bureaucracy
SLBs	Street-Level Bureaucrat
SYB	System-Level Bureaucracy
SYBs	System-Level Bureaucrats
TTU	The combined framework of Technology, Technologists and Users
UNDP	The United Nations Development Programme
VR	Virtual Reality

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‘*Over the past five months, I changed my thesis topics twice due to unforeseen circumstances. Despite these challenges, I successfully completed it! I think this thesis can represent my commitment to pursue excellence and serves as a reminder to never be afraid of challenges throughout my life.*’

- Jinxiao

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'***I saw, I came, I conquered***'

- Fireball (Pitbull, 2014)

For Those Who Struggle In Their Own Spiritual World

-

You Are Welcome .

1 Introduction

1.1 Background and Motivation of Research

In recent years, the integration of technology in government operations has significantly transformed public administration. The advent of digital tools, artificial intelligence (AI), and other information and communication technologies (ICTs) has reshaped bureaucratic processes, enhancing efficiency and redefining the roles of public servants (Buffat, 2015; Busch & Henriksen, 2018; Young et al., 2019). This shift is part of a broader trend toward e-government, where digital technologies are used to improve service delivery, transparency, and citizen engagement. However, rapid technological advancements have also introduced complexities, particularly for street-level bureaucrats (SLBs)—frontline workers who interact directly with citizens and make discretionary decisions impacting public services.

Street-level bureaucrats, such as social workers and police officers, play a crucial role as they represent the primary interface between the government and citizens. They possess significant autonomy in their decision-making processes, which can profoundly impact individuals' lives and influence perceptions of government efficiency and fairness (Lipsky, 1980). However, Bovens and Zouridis (2002) argue that the rapid adoption of ICTs in the public sector is not creating more street-level bureaucracies (SLB). Instead, it is transforming these large-scale executive agencies away from structures reliant on street-level discretion. They suggested that in some areas, street-level bureaucrats have disappeared, replaced by system-level bureaucrats (SYBs), such as system designers, legal experts, and analysts who are the primary actors maintaining system operations (Bovens & Zouridis, 2002). This shift from SLB to system-level bureaucracy (SYB) has reshaped the academic debate in public administration, raising sub-topics such as the exercise of discretionary power and the implications of replacing street-level bureaucrats with technological systems.

Especially with the increased adoption of emerging technologies like AI, researchers especially center on the evolution of discretion and the transition from SLB to SYB. Current empirical evidence reveals that technologies have both enabling and curtailing effects on discretions (Buffat, 2015). Some scholars propose the concept of digital discretion, illustrating how digital technologies are replacing human discretion (Busch & Henriksen, 2018). This has led to the emergence of new forms of discretion, including Artificial Discretion (AD) and automated discretion (Young et al., 2019; Zouridis et al., 2020). These developments create new avenues for discussing the evolving relationship and the impact of new technologies on discretionary practices. However, what remains unclear is how these government technologies impact the work of SLBs and how their discretion is altered by the use of these technologies. Moreover, there is ongoing debate about whether human judgment will eventually be replaced entirely or if SLBs will themselves be replaced (Ammitzbøll Flügge et al., 2021; Buffat, 2015; J. Bullock et al., 2020; Busch, 2017; De Boer & Raaphorst, 2023; Giest & Grimmelikhuijsen, 2020; Hansen et al., 2018; Marienfeldt, 2024; Selten et al., 2023). Empirical research presents varied results on these questions. This research systematically reviewed them and provided valuable insights into the discussion in Chapter 4 of this thesis.

Furthermore, this thesis specifically focuses on understanding how government technology impacts SLBs' work and their discretionary practices. It explores the interactions among

technology, technologists, and users within public administration, aiming to develop a comprehensive framework—the combined framework of Technologists, Technology and Users — that encapsulates these interactions and their implications for public service delivery.

The research covers various aspects of government technology, including its conceptualization, categorization, and theoretical foundations, to provide a clear understanding of the types of technologies used in public administration and their specific functions. Categorizing these technologies allows for a better analysis of their impact on various administrative processes and outcomes. A well-defined conceptualization of government technology helps in identifying the potential implications associated with these technologies. Furthermore, it also enables systematic analysis of technology's impact on various aspects of use, such as efficiency, transparency, and accountability. This thesis contributes by offering a detailed conceptualization and categorization of government technology, which forms the basis for further empirical investigation. Such an understanding can guide future research and inform the development of policies and practices that leverage technology to enhance public service delivery. Of note, given the diversity of government technologies, this research does not aim to differentiate their specific impacts on SLBs. Instead, it uses a narrative approach to explore and integrate various technologies into different sections to understand their impact on different aspects, employing an inductive method.

The combined framework of Technologists, Technology and Users (TTU) is central to this research, exploring the intricate relationships between technology, technologists, and users in society. It posits that the interaction between these elements significantly influences the outcomes of technology integration in public or private sector operations. By examining these interactions, the TTU framework provides insights into how technology can be effectively implemented to enhance service delivery while addressing the challenges posed by technological advancements. For example, understanding technologists' perspectives can help design user-friendly systems that meet SLBs' needs. Similarly, analyzing how SLBs interact with technology can reveal areas where additional training or support might be needed. The development of the TTU framework is grounded in Giddens' theory of structure (1976, 1979, 1984), the structurational model of technology (Orlikowski, 1992), and the technology-in-practice theory (Orlikowski, 2000). Additionally, insights from Bailey and Barley (2020) are incorporated to enhance the framework's perspective. By using empirical evidence from a systematic review to validate this framework, it aims to bridge the gap between theoretical research and practical implementation, offering a comprehensive tool for analyzing the impact of technology on public administration.

The motivation for this research arises from the increasing reliance on technology in public administration and the corresponding need to understand its implications on bureaucratic discretion and service delivery. As governments worldwide adopt more sophisticated technologies, there is a pressing need to examine how these government technologies affect SLBs' decision-making processes, given their crucial role in policy implementation and public interaction. Moreover, this research addresses a gap in the literature concerning the nuanced effects of technology on SLBs' discretion and the broader implications for governance. While technology can possibly standardize procedures and reduce human error, it also risks constraining SLBs' flexibility and responsiveness. Understanding these dynamics is essential for designing technologies that support rather than hinder effective public service delivery.

1.2 Research Questions and Objectives

This research is guided by several key questions:

Main RQ: How do street-level bureaucrats rearrange their work around the use of government technologies?

- **Sub Q1:** What is the role of government technologies on the transition from street-level bureaucracy to system level bureaucracy?
- **Sub Q2:** How discretion is changed by using government technologies?
- **Sub Q3:** To what extent government technologies can replace human judgment within current research?
- **Sub Q4:** How do technologies, technologists and users interplay with each other within public context?

The objectives of this research are threefold. Firstly, it aims to understand how government technologies impact SLBs' work. Secondly, it seeks to understand how discretion evolves with the increased adoption of emerging technologies. Thirdly, it explores how the government can impact and potentially replace human judgment. In addition, to ensure readers clearly understand the context, this research will first introduce the discretionary discussion related to the sub-questions in the discussion section. Since this concept involves various factors in the rearrangement of SLBs' work. Following this, the rearrangement of SLBs' work will be examined. Finally, I will synthesize all the empirical evidence and findings into the TTU framework, completing the narrative.

With that, the structure of this thesis is designed to systematically explore the research questions and objectives outlined above. It is divided into several chapters: 1. Introduction: Provides the background, focus, scope, motivation, and significance of the research, along with an overview of the TTU framework and the research questions. 2. Theoretical Framework: Discusses the theoretical foundations of the TTU framework, including its formation and the key relationships between technology, technologists, and users. 3. Methodology: Describes the research design, including the strategies for identifying and screening relevant literature, the conceptualization and categorization of government technology, and the data analysis methods. 4. Findings and Discussion: Presents the results of the literature review and empirical analysis, highlighting the impact of technology on SLBs and the application of the TTU framework. 5. Conclusion: Summarizes the key findings, discusses the limitations of the study, and offers recommendations for future research and policy development.

By following this structure, the thesis ensures a coherent and comprehensive exploration of the research topic, providing valuable insights into the role of technology in public administration.

2 Theoretical Framework

2.1 Summary

The field of scientific inquiry is characterized by a diverse array of theories, each providing different perspectives and insights into complex topics. These theories, though diverse in their focus and application, collectively contribute to a comprehensive understanding of complex phenomena. Their importance lies in the distinct focal points they provide, enabling researchers to address different aspects of the same problem through varied lenses (See Appendix 8). This chapter delves into a range of theories, presenting a synthesis of their core concepts and illustrating their integration within the broader framework of Technology, Technologists, and Users (TTU). The structure of this chapter is constructed into two main sections: It first introduces the theoretical foundation of TTU, followed by the formation of the TTU framework. After that, the limitations and contributions of this framework are discussed in the end.

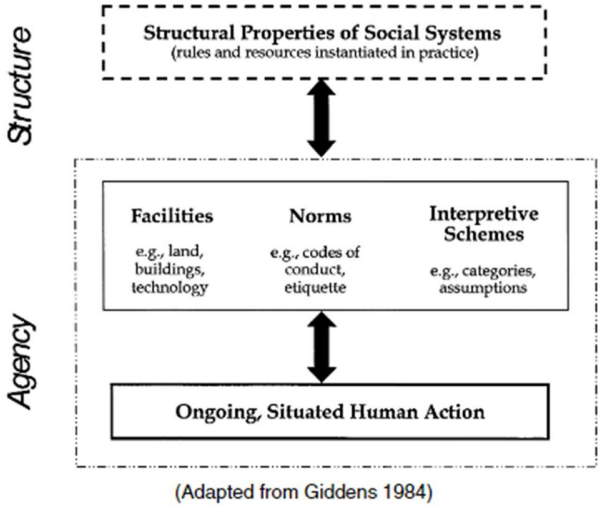
2.2 TTU Framework

2.2.1 Theoretical Foundation

Giddens (1979, 1984) introduced the concept of structure, which was also called structural properties of social systems, referring to the enacted rules and resources within social systems that moderate social interactions across three dimensions: *facilities, norms, and interpretive schemes*. In social life, structures will not be enacted by actors in isolation. Actors employ their accumulated knowledge from past experience and current situation and the facilities reliable to them, the norms that guide their experience (Giddens, 1979, 1986). As such, applying those factors enable actors to structure their current action, as seen in Figure 1. Through this process, they recursively instantiate and thereby reconstruct the rules and resources that build their social behavior.

Figure 1

Enactment of Structures in Practice



Note. Sources from Orlikowski, 2000, Page. 410.

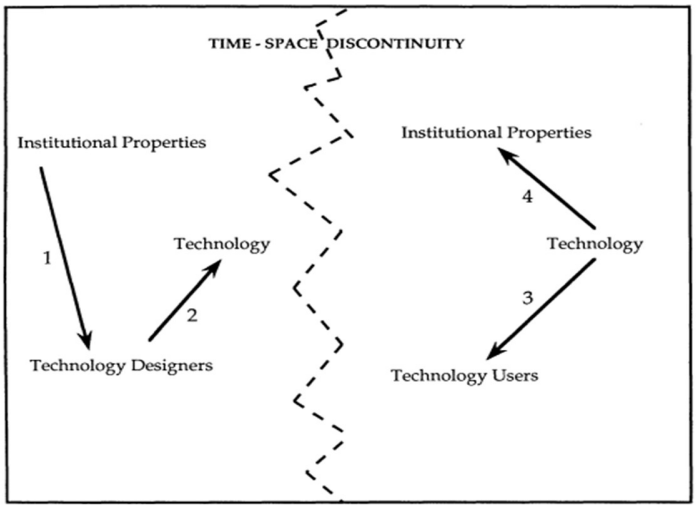
Building upon Giddens's structuration theory (1976, 1979, 1984), the structurational perspective offers a dynamic understanding rooted in continuous human activity. It enables the elucidation of the emergence and evolution of technologies and their usage. Orlikowski (1992) proposed a categorization of human interaction with technology into two modes: *design and use*. She pointed out:

> '[..]*Rather than positing design and use as disconnected moments or stages in a technology's lifecycle, the structurational model of technology posits artifacts as potentially modifiable throughout their existence. In attempting to understand technology as continually socially and physically constructed, it is useful to discriminate analytically between human action which affects technology and that which is affected by technology. I suggest that we recognize human interaction with technology as having two iterative modes: the design mode and the use mode.'* (Orlikowski 1992, p408)

While acknowledging the analytical convenience of this distinction, she noted the intricate interconnection between these modes in reality. Consequently, the underlying logic behind both design and use mode is similar to the relationship between technologists and technology (*Design mode*), as well as the relationship between users and technology (*Use mode*) separately. However, to comprehensively delineate the relationships among technology, technologists, and users, the combined framework of Technologist, Technology and User drew on a similar analytical approach. Nevertheless, although this theory explicitly considers both the design and usage modes, it fails to fully capture the dynamic interaction and relationship between technologists and users. This is because the theory emphasizes the discontinuities in time and space that separate both modes for analytical purposes, which weaken their interaction between technologists and users.

Figure 2

Traditional Models of Technology Design and Technology use (Discontinuous in Time and Space)



Note. Source from Orlikowski (1992)

Orlikowski (1992) identified a time-space discontinuity between the design and use of technology (see Figure 2), emphasizing the temporal scope. This dualistic view, which sees technology as either a fixed object or a product of human action, is influenced by the different temporal stages researchers focus on. Orlikowski argued that acknowledging this discontinuity helps explain the conceptual dualism prevalent in the literature (Orlikowski, 1992a, p. 407). However, this view also separates the interactions between users and technologists, leaving questions about their communication and interaction modes unresolved. With advancements in ICTs, improved logistics systems, and better production infrastructure, the gap between design and use is narrowing. Therefore, in the TTU framework, I aimed to integrate both technologists and users, as shown in Figure 4 and section 2.2.2.3. This research doesn't disregard the time-space discontinuity but argues that emerging technology, to some degrees, facilitates communication between technologists and users, thereby enhancing production development.

According to the Structurational Model of Technology (Orlikowski, 1992b), human agents encompass technology designers, users, and decision-makers. However, within the TTU framework, the term "*human agents*" lacks specificity due to its broad scope. Thus, technologists and users are delineated as distinct entities but collectively represent the 'human agents'. This facilitates a more comprehensive elucidation of the dynamic relationships among technology, technologists, and users. I chose not to employ the term "designer" specifically within the TTU framework; instead, I utilized "*technologist*" to encompass this role. Due to its broader nature, a technologist can seamlessly adopt the responsibilities of a designer, proving versatile across a range of research scenarios.

It is essential to note that users may also function as designers (Rosson et al., 1988). For example, someone can both use SQL and design certain software. Particularly, both users and technologists operate across two layers, namely managers and regular users. This distinction is made explicitly to account for the varied impacts of institutional properties[1] on different roles within organizations. For instance, organizational managers wield power and possess their own ideological perspectives, which can influence their subordinates. Furthermore, the effects of institutional properties on managers versus employees may significantly differ.

Moreover, Orlikowski (2000) further expanded this perspective by introducing a practice-oriented interpretation of the recursive interaction among actors, technologies, and social action. This lens posits that through consistent engagement with a specific technology and its functionalities across various contexts, users enact rules and resources that guide their ongoing interactions with the technology. This interaction, termed 'technologies-in-practice' by Orlikowski, is recursive, with users shaping the technology's structure through recurrent practices, thereby influencing their use of the technology. She pointed out:

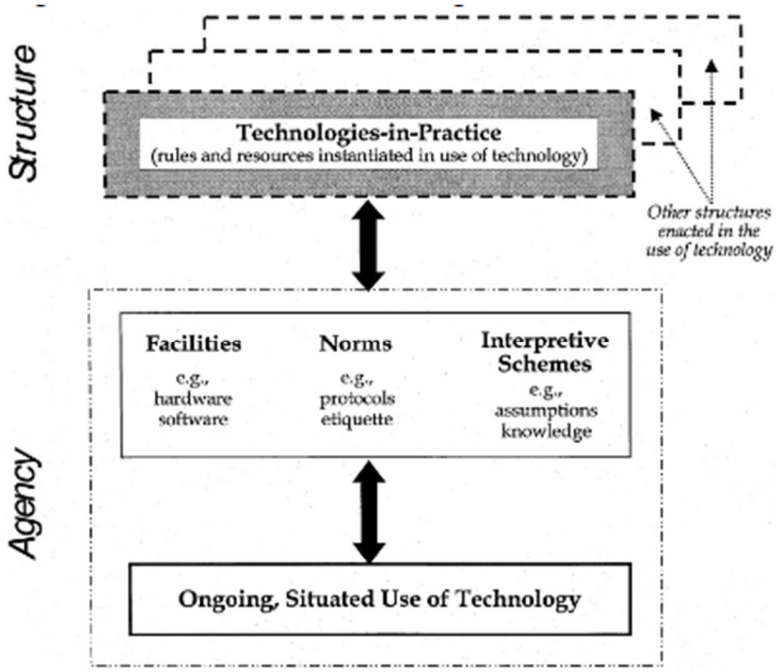
> '*Users also draw on their knowledge of and experiences with the institutional contexts in which they live and work, and the social and cultural conventions*

[1] Note that the definition of institutional properties within the TTU framework aligns with Orlikowski's structurational model of technology (1992), where she categorized those properties into two distinct groups. These institutional properties include organizational dimensions such as structural arrangements, business strategies, ideology, culture, control mechanisms, standard operating procedures, division of labor, expertise, and communication patterns. Furthermore, they encompass environmental pressures, including government regulation, competitive forces, vendor strategies, professional norms, the level of knowledge about technology, and socio-economic conditions.

associated with participating in such contexts. In this way, people's use of technology becomes structured by these experiences, knowledge, meanings, habits, power relations, norms, and the technological artifacts at hand. [...]over time, people constitute and reconstitute a structure of technology use, that is, they enact a distinctive technology-inpractice. (2000, p410).'

Figure 3

Enactment of Technologies-in-Practice



Note. Figure 3 demonstrates that people's recurrent and situated use of technology concurrently enacts multiple structures alongside a technology-in-practice. Sources from Orlikowski, 2000, Page. 410.

For that reason, users leverage their understanding and familiarity with the institutional environments where they operate, along with the social and cultural norms prevalent in those settings, to inform their use of technology. This process imbues their interactions with technology with the accumulated experiences, knowledge, interpretations, behaviors, power dynamics, and established norms, alongside the specific technological tools available (Orlikowski & Gash, 1994). Consequently, this structuring of technology is being used to enact a set of rules and resources that shapes subsequent interactions with the technology. As actors continue to engage with the technology over time, they continuously shape and reshape this structure, thereby creating a distinct structure of technology use (see Fig. 3).

Users can actively choose how to use or interact with technology according to their understanding and experience. They might use technology in ways that are not expected by the designers or technologists. Also, users may also choose to ignore using technology that is available. In the latter case, structures can not be enacted. For example, if people use a software (e.g. Whatsapp) only twice a year or people just generally ignore it. Then this process is not engaging with any recurrent

practice[2]. Thus, no rules and resources are enacted, even though this software exists and is available. Yet this case can be changed, sometimes dramatically, when users use this technology for their purpose or are motivated by some internal or external reasons, forming a habitual use practice. In this case, a particular technology-in-practice is enacted. As it is implicated in a recurrent social practice and thus rules and resources are enacted with this technology.

According to Orlikowski (1994, 2000), technologies-in-practice can be and are changed, given that actors undergo changes in various domains such as power, motivation, knowledge, time etc. These changes occur through the same process by which all social structures undergo transformation via human action. Individuals can intentionally modify the properties of their technology, thus affecting their interactions with it and potentially changing how they use their technologies in practice. As individuals implement these modified technologies-in-practice, they also impact the facilities, norms, and interpretive frameworks associated with their use of the technology, as depicted by the bidirectional arrows in Figure 3.

Moreover, through users' recurrent and contextually situated actions, they use previously enacted structures within the technologies-in-practice and other structures. In doing so, they contribute to the reconstitution of these structures, whether intentionally or unintentionally. This reconstitution process can manifest in two distinct forms: *reinforcement*, characterized by the repetition of existing structures without significant alterations, and *transformation*, wherein individuals enact modified structures. These modifications can vary in magnitude, ranging from minor adjustments to substantial revisions.

In the following section, I will analyze the formation of the TTU framework and the general overview of this tool will be presented. The validation analysis and framework test is presented in the discussion part.

2.2.2 The Formation of TTU Framework

Building on the perspectives and lens provided above (Giddens, 1976, 1979, 1986; Orlikowski, 1992b, 2000), I summarized and further proposed three dynamic relationships among the technologist, user, and technology regarding the enactment of the technology's structure, as illustrated in Fig 4. These relationships are integrated into a triangular model, with each interaction being mutual. Ultimately, structures emerge as actors engage with a specific technology repeatedly. The logic and legitimacy of this framework draw from Giddens' theory of structure (1976, 1979, 1984), Structurational model of technology (Orlikowski, 1992) and technology-in-practice theory (Orlikowski, 2000). Additionally, to enhance the framework's perspective, insights from Bailey & Barley (2020) are incorporated.

Bailey & Barley (2020) proposed an updated timeline for the trajectory of technology. They argued that conventional research typically commences with technology design and progresses to its utilization. Expanding on this notion, they extend the timeline in both directions, i.e. left and right. By emphasizing the use of technology, variations in such usage, and the resulting impacts on work,

[2] In the sense that users use a specific technology in a habitual and regular way. The process of using this technology is recursive.

workers, and organizations, they aim to address all four discussed issues[3]. To achieve this, they advocate broadening their focus to include both the design phase and an extended timeline. Inspired by this approach, I attempt to integrate additional perspectives and elements—such as power, institutions, and ideology—into this framework. Consequently, the design and use procedure of technology become integrated within this framework, offering a comprehensive tool for analyzing the dynamic relationships within technology.

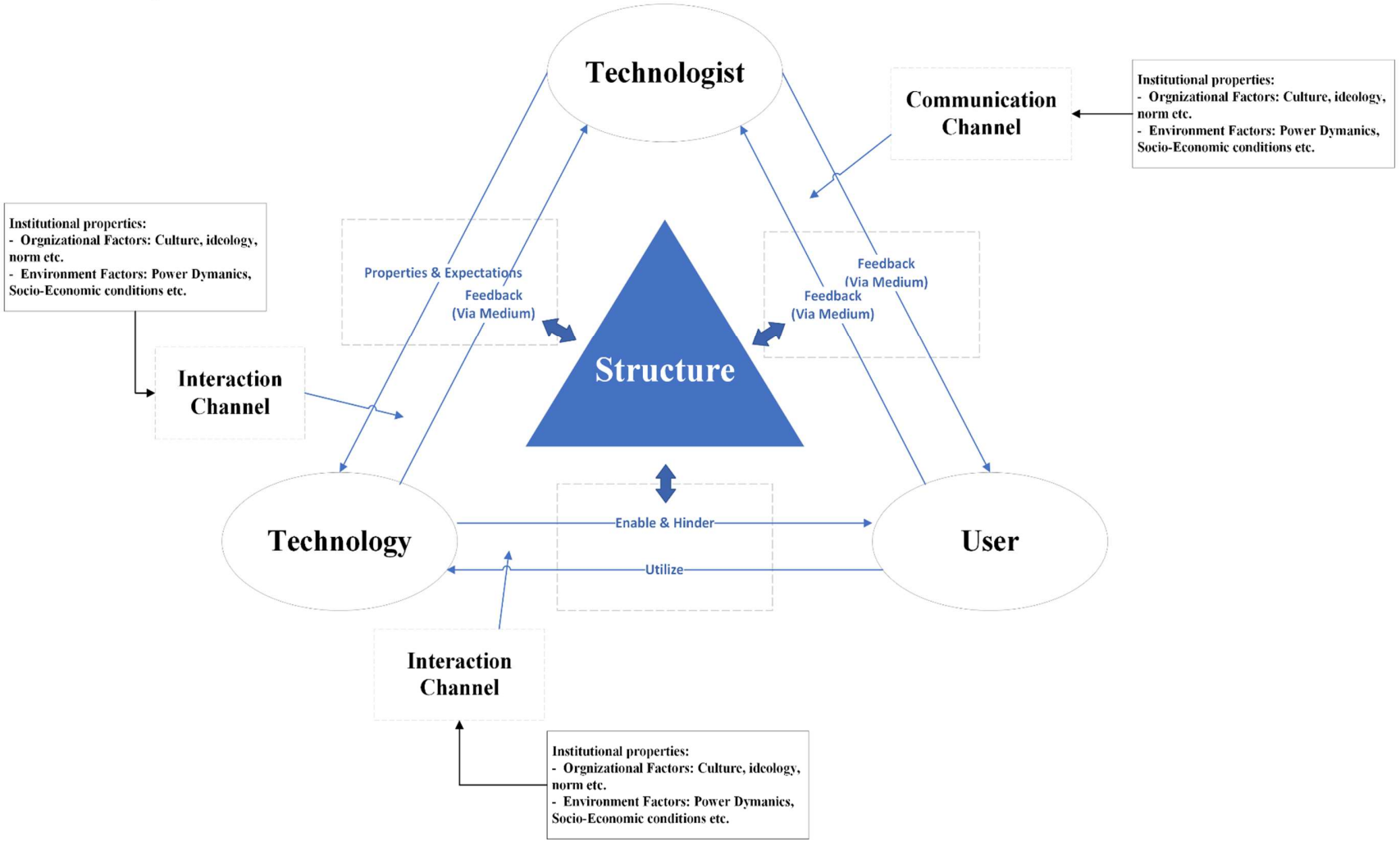
Similar to the Structurational Model of Technology (Orlikowski, 1992) and social theory (1979, 1984), this framework also incorporates their foundational principles concerning technology, particularly focusing on the concepts of *the Duality of technology* and *Interpretive flexibility*. The duality of technology underscores that it is both shaped and utilized by human action, serving as a tool for accomplishing various tasks. Meanwhile, interpretive flexibility illustrates the dynamic interaction between humans and technology, which is influenced by factors such as the material composition of the artifact, attributes of human agents, and contextual elements.

Before delving into the framework, it is important to distinguish between two key concepts: *Scope* and *Role*. Scope refers to 'what is defined as comprising technology,' while role refers to 'how the interaction between technology and organizations is understood.' This distinction is made to build upon prior conceptualizations of technology (see Orlikowski, 1992). While various research discusses the differences in scope and role, this section does not extensively explore those differences as it is not the primary focus here. Instead, these discussions provide a foundation for reflecting on the concept of technology and contribute to the development of a new conceptualization of technology. Orlikowski drew on structuration theory to reconceptualize the concept of technology and proposed the Structurational model of technology. This research aligns with Orlikowski's conceptualization of technology (1992). Consequently, scope will be limited to material artifacts: various configurations of hardware and software.

[3] Scholars have overlooked 4 important issues that are crucial for understanding how these technologies might impact society and the future of work: variation, power, ideology, and institutions

Figure 4

The Overview of TTU Framework



Note. Source from author

This limitation stems from Orlikowski's attempt to distinguish between the material nature of technology and human activities involved in designing or using those artifacts. Decoupling artifacts from human action helps in conceptualizing material artifacts as inherently social outcomes of human action. Moreover, this approach enhances the framing of the role of technology.

Moreover, the concept of Structuration is defined as a social process involving the dynamic interplay between human actors and the structural elements within organizations. This theory acknowledges that human actions are influenced and, in turn, shaped, by these structures, which are influenced by past actions. Applying this theory can enhance our understanding of how organizational structures manifest through the repeated use of specific technologies by human agents. In addition, Giddens' (1984) framework allows researchers to recognize technology as a medium of social practices, inherently presenting both constraining and enabling implications. The dominant implication depends on various factors, including the intentions of designers and implementers, the institutional context in which technology operates, and the autonomy and capabilities of individual users. Additionally, it helps clarify how organizational structure can either facilitate or impede the actions of human agents. Essentially, this theory serves as a foundational pillar for the TTU framework.

Of note, this research tests the TTU framework by collecting empirical evidence through a systematic review. Most of the data comes from the public sector, focusing on public administration, which introduces some empirical limitations. However, this does not imply that the framework cannot be applied to the private sector or other fields. The relationship from technology to users and technologists has been extensively researched in organizational science fields. Initially, most theories were developed within the private sector, but they are increasingly applied to study technological use in the public sector, demonstrating their broad applicability.

Therefore, public contexts are well compatible. Nevertheless, this does not mean to eliminate distinctions between the public and private sectors; rather, it raises interesting points for discussion such as organizational value, institutional properties, and resources. This framework recognizes those differences. Yet, in order to expand the scope of using this framework, I kept the main properties of the framework formulation at an abstract level. For example, agents from both public and private sectors might be impacted by organizational context. This can be categorized into such as '*Institutional properties & environments*'. Following this logic, the final framework (See Fig. 4) will present a clear categorization for researchers to study technology.

However, this does not imply that each element is all-encompassing. In the sense that researchers can not incorporate anything into 'Institutional properties'. To distinguish these differences, I also provide additional relevant definitions. This approach enables scholars to break down research boundaries between disciplines. Thus, the framework serves as a tool for researchers to better understand the dynamic interplay of technology between technologists and users, addressing intricate problems that arise from their interaction.

2.2.2.1 Relationship One: Technology - User

Technology serves as the medium through which human action is mediated, as users engage with it, shaping their activity (Orlikowski, 1992). When users select a specific technology, they

inherently determine their methods of interaction with it. This decision is guided by their knowledge and experiences within particular contexts, such as institutional settings, or the prevailing social and cultural norms in their work or living environment. As a result, their use of technology is influenced by a variety of factors, including available resources, established norms, interpretive frameworks, experiences, and power dynamics (See Giddens, 1979; Gash, 1994; Orlikowski, 2000). This is because when users engage with technology (whether through design, appropriation, modification, or resistance), they are impacted by the institutional properties of their environment. They draw upon existing knowledge, resources, and norms to carry out their tasks. Often, these influences remain unarticulated or are only briefly acknowledged by human agents (Giddens 1984) and are referred to here as the institutional conditions of interaction with technology.

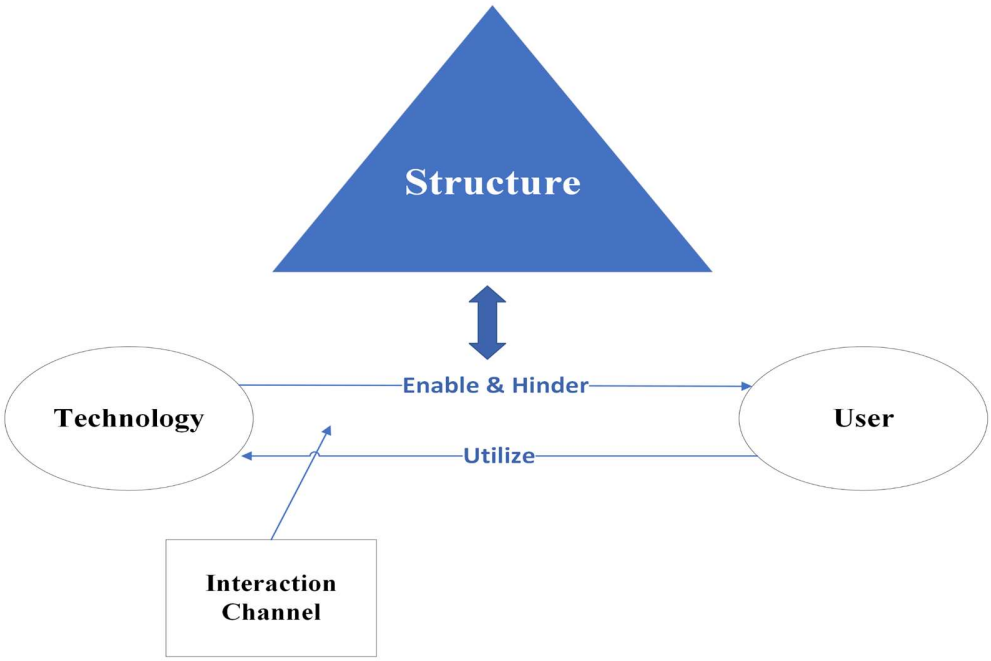
Users appropriate technology by attributing shared meanings to it, thereby influencing their adoption of the interpretive schemes, facilities, and norms embedded within the technology, which subsequently guide their task execution. Additionally, through the regular actions of knowledgeable and reflective individuals, interaction patterns become established as standardized practices within organizations. Over time, the habitual use of these practices becomes institutionalized, shaping the structural characteristics of organizations (Orlikowski, 1992). It is important to note that human action is situational action, molded by the organizational environment. Human agents are influenced by the institutional properties of their surroundings, drawing upon existing knowledge, resources, and norms to fulfill their tasks (Orlikowski, 1991). These processes lead to the enactment of a set of rules and resources in practice, subsequently shaping and defining future technology uses.

Through consistent engagement with technology in their daily routines, users gradually establish and adapt a structure for its usage, thereby, forming a distinct technology-in-practice (Orlikowski, 2000). Hence, the relationship between technology and users is symbiotic, wherein users utilize technology as a medium of social practices (see Giddens, 1984) to achieve their objectives. However, occasional use of certain technologies, such as once or twice a year, does not lead to the enactment of structures. In such cases, while users may employ the technology for their purposes, they do not engage in the recurrent social practices necessary for structure enactment (see Giddens, 1979). It is only through recurrent social engagement with technology that structures are formed, indicating users' integration of the technology into their habitual routines. Without such recurrent engagement, the establishment of structures becomes unattainable, as it relies on the rules and resources embedded in social practices.[4]

[4] This situation can be changed (sometimes dramatically). Orlikowski (2000) gave an example that if a tax preparation software is generally ignored by users for most of the year, this is not implicated in any recurrent practice, therefore, no rules and resources are enacted with this technology. However, this case changes very fast in certain periods, e.g. when users are motivated by the tax filing deadline to use this software repeatedly. Hence, it enacts a particular technology-in-practice.

Figure 5

The Relationship between Technology and User



Note. Source from author

Particularly, when users engage with technology, it can either '*enable*' or '*hinder*'[5] their work experience (see Fig. 5), as technology doesn't always exclusively facilitate users in a positive manner. Despite designers and technologists designing properties for technology with the aim of improving user experience, the actual utilization of these properties isn't predetermined; it depends on the specific actions users take in each instance (Orlikowski, 2000).

The use of technology by individuals not only directly impacts local conditions, with both intended and unintended consequences (Orlikowski, 1992), but also has broader, indirect effects on the institutional environment. For instance, the widespread adoption of social media platforms has directly influenced communication patterns within communities and indirectly affected political discourse and policymaking processes, thereby shaping the institutional landscape of democracy. Moreover, when users deviate from the intended use of the technology, they can undermine and sometimes transform the embedded rules and resources, as well as the institutional context and strategic objectives of the technology's creators, sponsors, and implementers.

Numerous studies have demonstrated that users often utilize technologies in ways not foreseen by designers. Whether due to error or intent, users frequently disregard, modify, or find workarounds for the inherent technological properties (Arni & Schiprowski, 2015; Barnes et al., 2015; Breit et al., 2021; Busch & Eikebrokk, 2019; Giest & Raaphorst, 2018; Huuskonen & Vakkari, 2013; Vogl

[5] Orlikowski (1991) argued that technology cannot determine social practice, however, it can only condition social practice. Also, technology in conditioning socal practices, is both facilitating and constraining. It does not only constrain or only enable, but rather does both.

et al., 2020). Additionally, users commonly augment or adjust these properties (such as by installing new software, peripherals, or adding data), actively shaping or customizing the technology to suit their specific needs or interests..

The consistent use of these practices becomes institutionalized by time, shaping the structural properties of organizations. These structural or institutionalized properties are used by humans in their ongoing interactions, further reinforcing the institutionalized properties through their usage. This concept, known as *the duality of structure*, as conceptualized by Giddens, resolves the dichotomy between the objective, structural features of organizations and the subjective, knowledgeable actions of human agents (Giddens, 1986; Orlikowski, 1992a). The duality of structure helps this research to identify how human agents use technology to form the structure and further assist me to formulate the TTU framework. By drawing on this lens, we are able to see if technologies reinforce the institutional properties. This is crucial to analyze the use of technology within organizations.

2.2.2.2 Relationship Two: Technologists - Technology

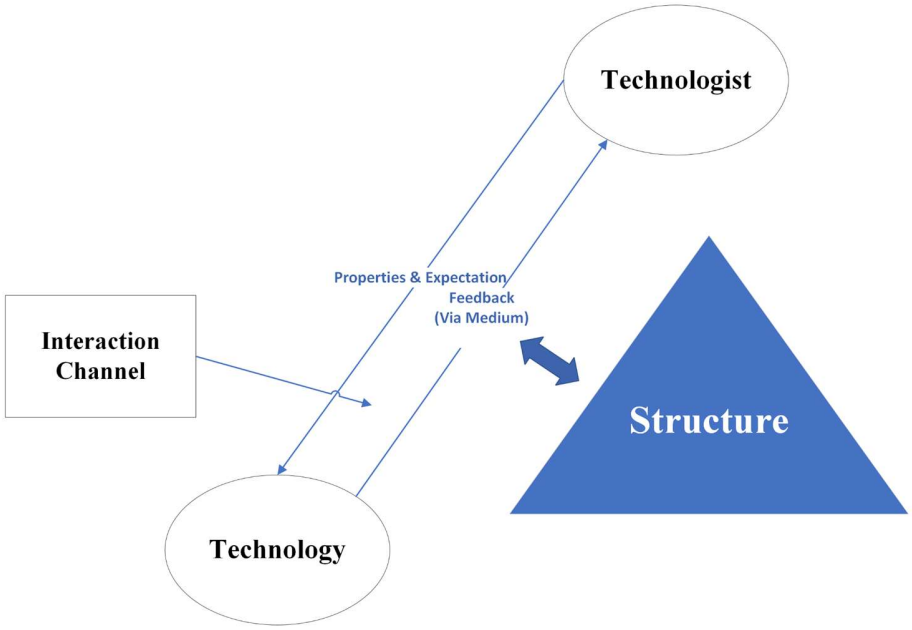
Technology, as a human artifact, is brought into existence through creative human action and sustained through ongoing maintenance and adaptation (Giddens, 1979; Orlikowski, 1992a). When technologists design and develop a specific technology, they incorporate certain interpretive schemes (rules reflecting knowledge of the work being automated), facilities (resources to accomplish that work), and norms (rules defining the organizationally sanctioned way of executing that work). In essence, they imbue it with distinct technological properties, functionalities, and anticipated outcomes (see Fig 6). Concurrently, technology can provide feedback through various mediums[6], such as user interactions. This interaction constitutes the second relationship in the model, termed the 'interaction channel'.

It is noteworthy that technologists can establish structures through the interaction channel, but they often rely on another technology, referred to as a 'medium', to assist them in creating new technologies. This medium technology functions as a tool for technologists to engage in a recurring social practice. Essentially, technologists become users of the medium technology, aligning with the same logic as the first relationship (Technology-User). For example, programmers utilize SQL (as the medium) to develop new software, embedding technological properties and expectations into the code. By incorporating SQL into their daily workflows, they establish a recurring social practice. Through this process, a set of rules and resources is enacted using SQL, ultimately leading to the establishment of structures.

[6] This medium has different meanings in different contexts. From the relation between technologists to technology, it refers to a technology that can help technologists to form their recurrent social practice. However, from the relation between users to technology, medium refers to users that can give feedback to technologists by using the technology.

Figure 6

The Relationship between Technologist and Technology



Note. Source from author

In essence, technology is both the result of human action and possesses structural properties. It is physically constructed by actors within a specific social context, while its social construction is influenced by the meanings attached to it and the features emphasized and utilized by these actors (Orlikowski, 1992a). However, once developed and implemented, technology often becomes reified and institutionalized, appearing to be a part of the objective, structural properties of the organization, thereby losing its connection with the human agents that constructed it or imbued it with meaning.

However, it is crucial to recognize that structures cannot be directly enacted by technologists without utilizing medium technology. This is because technologists cannot establish a recurring social practice without the integration of medium technologies, which is essential for facilitating the formation of technology-in-practice. Additionally, the initiation of rules and resources necessary for structural enactment will also be hindered, thereby impeding the shaping of structures. For example, programmers utilize SQL to develop specific software, with SQL serving as a medium tool to facilitate their recurring practice. Without SQL, they are unable to establish a set of rules and resources required to enact structure. However, programmers have the flexibility to employ other software as well. The crucial aspect is whether the technology aids in establishing a recurrent practice, as this serves as the central precondition for enacting technology-in-practice.

At the same time, technology can also ‘provide’ feedback to technologists in a special way. Technology itself, to a great extent, lacks autonomy, thereby, it does not possess the ability to communicate directly with technologists. However, the role of users is highlighted in this case, in the sense technology can relay feedback to technologists through user input (another type of medium). Thus, users serve as the medium, moderating the relationship between technology and

technologists. For instance, caseworkers in the Public Employment Services field use algorithms in their daily tasks and gather action resources from their recurring experiences (Hansen et al., 2018). If technologists seek to enhance technology, they must solicit input, such as feedback, from users who regularly employ algorithms. Although technology cannot articulate words, it can convey feedback through users' practical engagement with it.

The ongoing actions of human agents, habitually relying on a technology, lead to its objectification and institutionalization. Therefore, if technologists were to modify the technology - either physically or interpretively - every time they used it, it would not acquire the stability and taken-for-granted nature essential for institutionalization. However, constantly evolving interactions with technology would compromise many of the advantages derived from using technology to perform tasks, such as considering the use of decision support systems in healthcare. These systems can greatly enhance the efficiency of diagnosing and treating patients by providing doctors with quick access to patient data and medical knowledge. Even so, if healthcare professionals continuously adapt their interactions with these systems without standardizing processes, the benefits might be undermined. Just as we do not need to rethink how we use a telephone, elevator, or typewriter every time we interact with them, decision support systems should ideally operate reliably without frequent adjustments. Nevertheless, there are scenarios where unreflective use of such technology is inappropriate. For instance, blindly following recommendations from decision support systems without critical evaluation can lead to misdiagnosis or ineffective treatments, demonstrating the necessity for ongoing scrutiny and thoughtful application of these tools.

Human action imbues technology with meaning through its utilization. Once technology is created, it will be deployed in organizations, but it remains inert and ineffective unless it is assigned meaning and manipulated - either directly or indirectly - by humans. On its own, technology holds little significance; it does not play a meaningful role in human affairs until it is employed for productive or symbolic purposes, thereby exerting influence. It is only through the appropriation of technology by human actions, whether for productive or symbolic ends, that it assumes a significant role and exerts influence.

2.2.2.3 Relationship three: User - Technologist

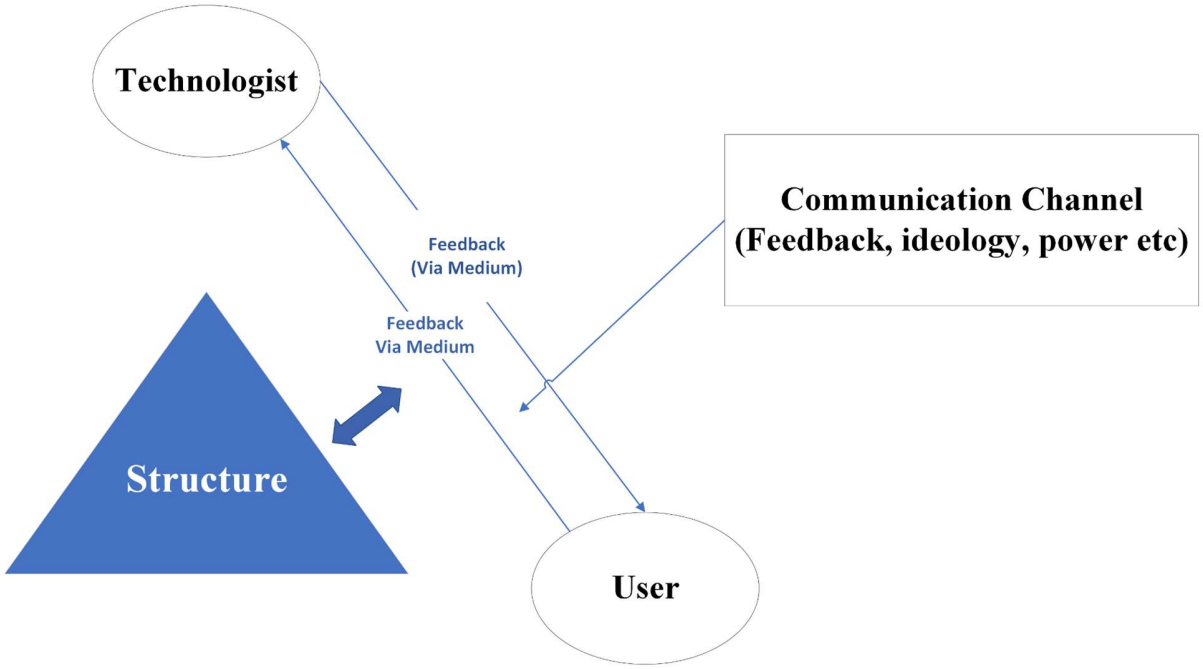
The current relationship between users and technologists is understudied in the public administration field. In this section, I tried to extend this framework by drawing on the knowledge from the field of sociology and design science. Some assumptions are enacted in this part and will be explained in the discussion section (see section 4.4) by empirical data derived from reviewed literature. Of note, in the previous two relationships involving TTU, I used inductive methods to establish connections, which are straightforward to form with abundant data. However, the relationship between users and technologists has received little research attention. Therefore, I made some Hypothesis and employed an exploratory approach to test this relationship.

The relationship between users and technologists is mutual, as depicted in Fig. 7. In general, users provide feedback to technologists based on their experiences with the technology to form a communication mechanism. Similarly, technologists can engage with users, for example, by seeking feedback. This interaction between technologists and users is termed the '*communication channel*'. Primarily, this channel facilitates discussions on enhancing the technology's usability. Following these thoughts, we can build the first and second hypothesis:

H1: When users give feedback to technologists, they are co-designing a specific technology. The co-design might enhance product development but it is not necessarily being perceived positively.

Figure 7

The Relationship between Technologist and user



Note. Source from author

Fundamental elements of social interaction, such as power and norms, are highly interdependent and inseparable in practice (Giddens, 1976, p. 104). Thus, through the communication channel, structures can also be enacted when both actors in this channel communicate via a specific technology and utilize this technology habitually. The underlying logic mirrors that of the relationship between *technologists and technology*. As previously mentioned, structures cannot be enacted directly by actors without engagement with technology. Therefore, the role of medium technology is emphasized once again. Therefore, when both technologists and users employ a specific technology (e.g.WhatsApp, Skype) to interact with each other regularly, they can enact a set of rules and resources that contribute to shaping a particular structure of technology use. However, during the communication process, how both actors perceived the technology is crucial to understand:

H2: When technologists communicate with users, they tend to perceive the technology in very different ways. The understanding toward technology is based on their background, including personal expertise, culture and organization context.

It is important to recognize that technologists are not the sole actors capable of crafting or modifying technological properties. Users also possess the ability to indirectly influence the creation or modification of certain technologies and their properties. This influence is mediated by

various factors, including feedback, ideology, power dynamics, and institutional context, when users engage with technologists in the communication channel (see Bailey & Barley, 2020). For instance, users can actively engage with technologists, providing feedback to modify certain properties to better suit their needs and improve the technology. However, what remains unclear is:

> **H3:** Users will modify the parameters of technologies to their advantage and even use the technologies in an unintended way from technologists' perspective.

Conversely, there are instances where users, particularly those in managerial positions within institutions, hold significant power and authority over technology design. In such cases, users (managers) dictate the appearance and functionalities of the technology, shifting the decision-making power away from technologists. Consequently, technologists may have limited discretion in designing functionalities according to their own ideas.

Moreover, ideology plays a crucial role in shaping the modification of technological properties. Those involved in designing technologies often operate from specific ideological perspectives. For example, AI designers may prioritize technical considerations over social implications, reflecting a cultural bias towards technological advancement over social concerns. This ideological stance influences the design choices made by technologists and further shapes the properties of the technology being developed (Bailey & Barley, 2020).

> **H4:** The design and optimization of technology will be impacted by power dynamics, institutional properties, ideologies within the organization.

2.2.2.4 Contribution and Limitation of TTU Framework

The TTU model offers a comprehensive framework for understanding the intricate dynamics between technologists, users, and technology in the development and implementation processes. Drawing on insights from scholars such as Giddens, Orlikowski, Bailey & Barley, the model further proposes three main subjects and relationships, addressing critical questions surrounding technology's lifecycle.

Firstly, the model elucidates how technologies are designed and implemented, shedding light on the intricate process of technological development. Secondly, it delves into the interactions between technologists and users, highlighting the feedback loop that shapes technology refinement. Thirdly, it explores how users engage with and utilize technologies, illustrating the impact of user interactions on technology usage patterns. Moreover, central to the model is the concept of structure enactment, wherein the recurrent engagement of actors with technology leads to the establishment of structures. This conceptual framework provides valuable insights into how technology shapes and is shaped by human interactions and practices, offering a nuanced understanding of the socio-technical landscape.

While the TTU model offers a framework for understanding technology dynamics, it has its limitations. One significant constraint is the need for empirical validation. Although the model draws on existing literature and theoretical foundations, empirical data is crucial to substantiate its claims and validate its applicability in real-world contexts. Furthermore, while evidence supporting the model's premises can be found in existing literature, empirical validation through rigorous research is essential to ensure its reliability and validity. Additionally, the model's generalizability across diverse contexts and settings may require further exploration and refinement.

3 Methodology

The objective of this chapter is to provide a comprehensive overview of strategy and method for examining the research questions by using the PRSMA method. Details are presented to ensure transparency and rigor. The following sections will outline the six main elements of the research methodology: research paradigm, design, data collection, analysis, validity methods, and limitations.

3.1 Research Paradigm

The philosophical underpinnings guiding qualitative research are termed 'paradigms', a concept coined by (Kuhn, 1994) and elaborated upon by various scholars. These paradigms encompass personal beliefs or ideas that influence a particular field, often interchangeably referred to as worldviews (Creswell & Creswell, 2018). Creswell & Creswell (2018) emphasized the necessity for qualitative researchers to explicitly acknowledge these personal views in their research process, or at least be conscious of them. Recognizing this, and seeking to enhance understanding of academic research, it becomes imperative to establish a clear paradigm. Such clarity informs our adoption of interpretive or theoretical frameworks, shaping our methodologies and designs, thereby influencing the methods employed and the data collected. A well-defined paradigm thus serves as a guiding principle, facilitating the successful completion of our research endeavors.

Denzin and Lincoln (2018) assert that, within qualitative research, there exists a range of paradigms, each characterized by its fundamental beliefs and specific practical considerations, such as the aim of inquiry, the nature of knowledge, and methods for knowledge accumulation. These paradigms, rooted in personal beliefs, guide the application of theory in qualitative research and the selection of appropriate methodologies for data collection (Denzin & Lincoln, 2018). According to Lincoln et al. (2011), qualitative researchers may opt for one of four philosophical orientations: postpositivism, critical theory, constructivism, or participatory[7] (Lincoln & Guba, 2011). Additionally, paradigms are shaped by four core beliefs: ontology, epistemology, axiology, and rhetoric, as identified by Creswell and Poth (2018). This research, in line with constructivist principles, emphasizes the importance of understanding how individuals construct meaning in their social contexts.

This research aims to qualitatively explore the influence of technology on SLBs' work. It is important to clarify that constructivist beliefs will serve as the guiding framework for this study. Constructivist beliefs highlight the diversity of individual perspectives, asserting that research aims to uncover these varied viewpoints. Therefore, constructivists prioritize close engagement with participants, often conducting research in real-world contexts to gather data. They also transparently address their own values and biases within their studies. Furthermore, constructivists regard participants as experts in the research process and rely on their insights to shape the key themes of the study. Consequently, the research methodology adopts an inductive approach, building from the bottom up to develop codes, themes, and perspectives characteristic of qualitative inquiry (Creswell & Creswell Báez, 2021). Accordingly, this research conducted systematic review, gathering data and evidence from diverse sources. The nature of this research

[7] Except for four main types of philosophy, there are more schools of thinking, e.g., pragmatism, realism and others (Creswell & Creswell Báez, 2021).

is to utilize various points of view from research that were conducted in the real world and have extensive engagement with individuals. In this light, this research closely aligns with the constructivist perspective.

Furthermore, this research retains its exploratory and inductive nature, reflecting the limited existing knowledge in this specific field. The current literature offers limited insights into conceptual frameworks or hypotheses, highlighting the necessity for a broad and open-ended investigation. Such a knowledge base is not conducive to the development of good theoretical statements, and any new empirical research is likely to take on the characteristics of "exploratory" research (Yin, 2009, p. 37).

Thus, this research examines the impact of government technology on SLBs as well as SYBs. However, through the reviewed process, I found that most literature studying government technology and its impact on SLBs is centering on cases: emerging technologies such as AI, and algorithms. This increased the difficulties of this research. While emerging technologies are increasingly researched in recent years, especially in the field of public administration, most of them highlighted the societal implication, value as well as governance (Anthopoulos & Reddick, 2016; Janssen & Kuk, 2016; Young et al., 2019). What remains unclear is how those technologies impact street-level bureaucrats. Hence, in order to deepen the understanding of this area, an exploratory approach is optimal to study this topic. In light of this, this research employed a general inductive approach for qualitative data analysis. The aim is to convert substantial raw data into summary findings. Also, it helps to establish clear connections between research objectives and the findings, ultimately developing a model or theory (Thomas, 2006). In this way, the TTU framework was formed in the end by using this inductive approach.

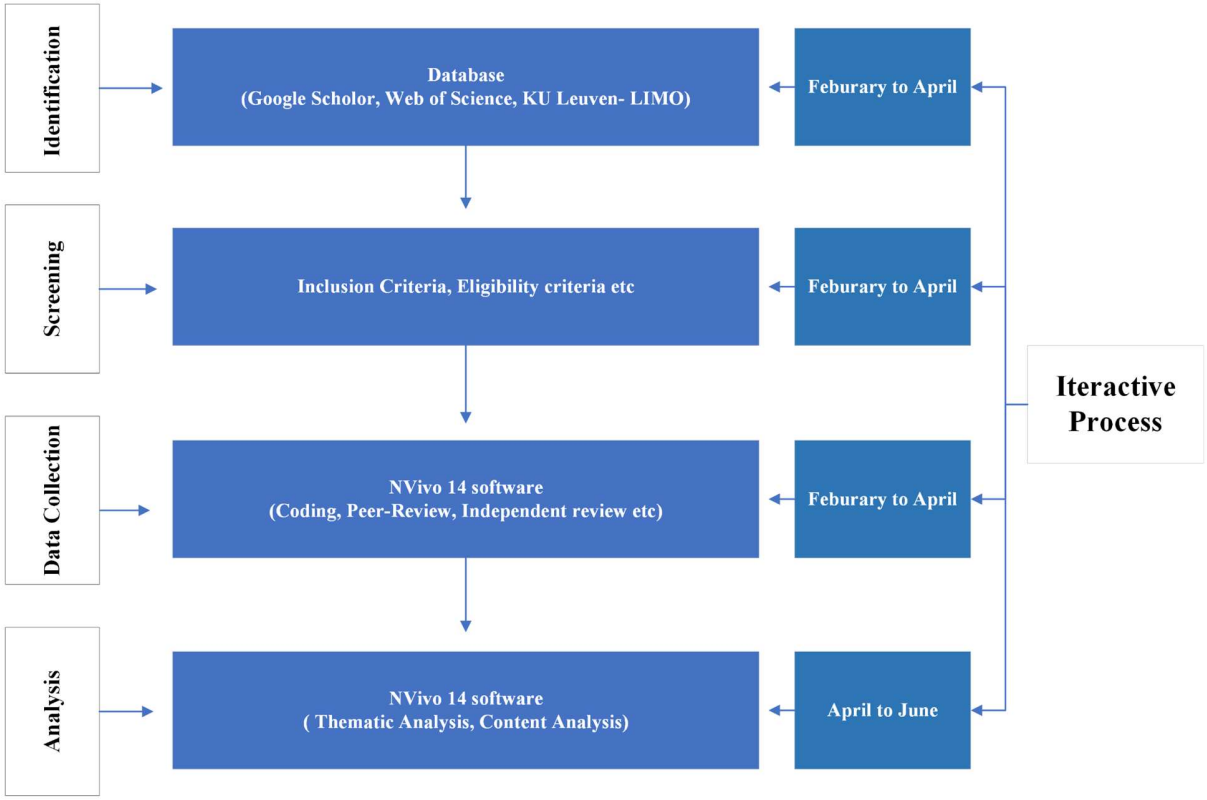
3.2 Research Design

3.2.1 Strategy of Identification and Screening

The exploration of SLBs and its integration with emerging technologies has been a prevalent focus in academia, especially the transitioning relationship from SLB to SYB. However, the impact of these technologies on SLBs' work remains relatively underexplored in the current literature (Buffat, 2015; Marienfeldt, 2024; Selten et al., 2023). To gain insight into the methodologies and inquiries around these central themes, I conducted a systematic literature review, employing the PRISMA method (Liberati et al., 2009) as a guide. Adhering to the PRISMA statement (Page et al., 2021), this methodology ensures a thorough, rigorous, and transparent process. Initially, I identified keywords and sources, proceeded to screen the results for eligibility, and made informed decisions regarding source inclusion. This work will also employ peer-review as one of search criteria, which has been validated practically by empirical evidence (Liberati et al., 2009).

Figure 8

The Design Logic of Literature Review



Note. Every process iterates, undergoing discussion with the supervisor, until achieving consensus at each step. Besides, picture source from author.

Moreover, this research review serves two primary objectives. Firstly, it seeks to comprehensively examine the implications of technology on street-level bureaucrats' working practices. Of note, the working practice in this research refers to two main themes, i.e., workflows and working routines.

Secondly, I will try to use the empirical evidence of this review to validate the TTU framework proposed for this study. The original focus of this research is confined to ‘the impact of algorithms, also called data models, on individuals’ working routine’. However, this might not be enough to validate the framework. The central idea of the TTU framework is to provide a tool to study the dynamics among technologies, technologists and users. Based on this point, I further extended the scope of the subject of research from ‘algorithms’ to ‘government technologies’.

The research design includes both data collection and analysis methodologies. Rather than strictly compartmentalizing each section, I have chosen a narrative approach to elucidate how data from the literature was processed, ensuring a comprehensive systematic review with my reflective insights. This approach offers two key advantages: it fosters transparency and rigor of my research, in line with the PRISMA statement's principles as well as visions, and it provides some guidance for early-stage researchers that could potentially draw on experiences from this research. As a result, every step in this research will be clearly and comprehensively articulated.

Prior to delving into the systematic literature review, this section provides a brief overview of the review design (as depicted in Fig. 8) to enhance clarity in understanding the review's structure. This facilitates readers in comprehensively and systematically grasping the current state of research on government technology implemented within the public sector. The specific analysis is presented as follows.

Three filters are utilized in this review process. Firstly, filters based on the year of publication are excluded from the search process. Given that the concept of street-level bureaucracy originated in 1969 and has since been extensively studied. Moreover, with the significant impact of emerging technologies, certain aspects of street-level bureaucracy have evolved over time, leading to the emergence of new concepts such as screen-level bureaucracy and system-level bureaucracy (Bovens & Zouridis, 2002). Considering those new conceptualizations, I chose to disregard publication years to ensure a comprehensive review of the literature and better understand my research question. The specific search results are detailed in the Appendix 1, 2, 3. Secondly, English language and the availability of full text format is required to ensure a comparability as well as the transparency of this research. Thirdly, the overall content should be related to the Public administration and e-Government field, particularly street-level, screen-level and system-level bureaucracy.

Additionally, the initial screening process relied on three indicators: the title of the text, the abstract, and the keywords. Along with the keyword and the research field the relevance for this thesis was determined to gauge relevance to the research questions. Following the removal of duplicates and articles that did not meet these criteria, this search yielded an initial dataset of 299 references, forming the foundation of this review. Employing this method, I excluded 164 articles that did not align with the inclusion criteria. Initially, a pilot experiment was conducted by screening 100 records, followed by discussions with colleagues to resolve inconsistencies and reach a consensus. With that, the transparency and comprehensibility of the screening process could be guaranteed. Subsequently, I proceeded independently with the screening process, applying the two aforementioned filters.

Table 1

Main Database for Review

Database	Coverage
Google Scholar	1950-present[8]
Web of Science	1900-present[9]
KU Leuven - LIMO	*

Note. * indicates nonspecific data from the official website.

In terms of databases for literature review, I chose Web of Science and Google Scholar as my main databases (see Table 1) because of their broad coverage across multiple disciplines (de Winter et al., 2014). Additionally, I used Limo, KU Leuven's digital library[10], which offers access to various mediums such as printed and electronic books, journals, databases, and digital documents. This additional resource provides supplementary literature information. From February to April, I set up a database and conducted a search process using predefined terms and Boolean operators, as shown in Table 2 and 3. This initial search yielded over 100,000 hits. Throughout the search process, I utilized truncation as a technique to broaden the scope of results, encompassing various word endings and spellings. For example, employing "bureaucra*" would encompass terms such as "bureaucracy," "bureaucracies," "bureaucrat," and "bureaucrats." This method facilitated the retrieval of comprehensive results. The clear explanation is presented as follows.

Table 2

Stage One - Pre-defined Terms for Searching Process

Number	Pre-defined Terms	Preliminary Retrieve
1	Government technolog* AND (Street-level bureaucra* OR System-level bureaucra*)	18,100
2	Government technolog* AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)) AND (Working routines OR Behaviors OR Workflow)	14,900
3	（Technolog* OR Design*) AND Use* AND (Interaction between technologists and users) OR (Interaction between designers and users) AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	15,300
4	(Designers AND users) OR (Technologists AND Users) And (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	16400

[8] https://scholar.google.com/intl/en/scholar/help.html#coverage

[9] https://clarivate.libguides.com/librarianresources/coverage

[10] Author's university digital library (database)

5	(Feedback mechanism OR Feedbacks) AND (Technologists AND Users) AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	10400
6	(Open data OR Big data OR Machine learning algorithms OR AI OR Artificial intelligence OR Blockchain) AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*) AND (Working routines OR Behaviors OR workflow)	1360
		SUM: 76,460

Note. Truncation symbols = *, (AND, OR = Boolean operators), The retrieval number displayed in the table represents the combined number of results retrieved from Google Scholar, Web of Science, and LIMO.

Table 3

Stage Two - Pre-defined Terms for Searching Process

Number	Pre-defined Terms	Preliminary Retrieve
1	Governement technolo* AND Street-level bureaucra*	38,100
2	Governement technolo* AND System-level bureaucra*	18,000
3	Governement technolo* AND Screen-level bureaucra*	484
4	(Technolog* OR Design*) AND Use* AND Street-level bureaucra*	17,800
5	(Technolog* OR Design*) AND Use* AND Screen-level bureaucra*	463
6	(Technolog* OR Design*) AND Use* AND System-level bureaucra*	17,400
		SUM: 92,247

Note. Truncation symbols = *, (AND, OR = Boolean operators)

The systematic review comprises three stages, each serving a distinct purpose. The primary objective is to ensure a comprehensive coverage of relevant literature, thereby enhancing the rigor and transparency of the review process. During the stage one, meticulous and intricate predefined terms were employed to identify all related literature within the defined scope. Specifically, this stage tried to integrate all potential keywords of relevant literature into pre-defined terms, aiming to yield more relevant results to address the research questions. Hence, the logic of predefined terms follows a progression from the general to the specific level. For example, I began my search using a broad term like 'Government technology,' then narrowed down to specific technologies such as 'AI' or 'Blockchain.' In this light, it can craft different layers of results, covering most of potential results.

Moreover, the advent of Information and Communication Technology (ICT) has profoundly transformed the organizational dynamics of large public agencies. In response to this, Bovens and Zouridis (2002) contended that in certain domains, street-level bureaucrats have transitioned into screen-level bureaucrats and system-level bureaucrats, assuming roles such as system analysts and software designers. Building upon this perspective, I incorporate the concept of screen-level and system-level bureaucracy to ensure comprehensive coverage of relevant aspects pertaining to street-level bureaucracy. Thus, I employed the defined term (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*) to broaden the focus from street-level to system-level bureaucracy.

Consequently, I have chosen the keyword: "government technolog* AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)". This combination encompass 18 variations, i.e. Government technology(ies), Government technologist(s), street-level bureaucracy(ies), street-level bureaucrat(s), Screen-level bureaucracy(ies), Screen-level bureaucrat(s) , street-level bureaucrat(s), system-level bureaucracy(ies) and system-level bureaucrat(s). This formulation represents a straightforward permutation and combination, for instance, it could encompass, for instance, "government technology(ies) AND street-level bureaucracy(ies)" or "government technologist(s) AND street-level bureaucracy(ies)". Thus, this combination maintains its broadest nature, avoiding specific contextual limitations (e.g., public services, human agents, workflows). Using this term for search purposes, it retrieves approximately 20,000 results across two primary databases.

Moreover, I expanded the search parameters by including the keywords "working routine", "workflow' and "behaviors", collectively representing working practice. Given their semantic similarity, I chose to differentiate among them using the logical operator OR. Consequently, this combination introduces 19 primary keywords: government technology(ies), government technologist(s), street-level bureaucracy(ies), street-level bureaucrat(s), screen-level bureaucracy(ies), screen-level bureaucrat(s), street-level bureaucrat(s), system-level bureaucracy(ies), and working routines, behaviors and workflow. This yields 14,900 hits.

Terms No. 3 and No. 4 in Table 2 are tailored to validate the TTU framework proposed in this research. The primary objective of employing this combination aims to validate assumptions derived from the relationship between users and technologists, as depicted in Fig 4. However, this doesn't imply that other search terms cannot contribute to validating this point. Instead, using specific keyword combinations enhances the comprehensive understanding of this relationship. Moreover, since technologists are akin to designers in language semantics, both terms are distinguished using the operator OR to ensure clarity. Consequently, interactions between these actors should also be differentiated. Additionally, the premise should revolve around street-level bureaucracy, screen-level bureaucracy and system-level bureaucracy.

Emerging technologies like Artificial Intelligence (AI) and Machine Learning algorithms have been integrated into the public sector and related research topics have been conducted increasingly due to the growing tendency. Some research showed that their introduction has significantly altered the characteristics of SLBs, including their discretion and behaviors (Ammitzbøll Flügge et al., 2021; Buffat, 2015; Busch & Henriksen, 2018). Building on this foundation, I developed a specialized keyword combination to incorporate AI, machine learning algorithms, and blockchain into the research process. Note that while other government technologies are essential, strategically

supplementing these popular technologies can enhance search results, making them more accurate and comprehensive.

Note that while attempting to include additional elements in the keywords, it becomes apparent that not every element can be logically combined. Such indiscriminate merging of keywords could result in ambiguous search results, as the database would indiscriminately weigh each term, leading to irrelevant findings and increasing the workload for researchers. Therefore, all the keyword combinations were carefully crafted through a process of reflection and trade-offs, guided by my iterative deliberation. Moreover, navigating through a lengthy list of permutations proves futile in the context of this systematic review. The aim of these keyword combinations is to optimize search outcomes aligned with the research questions, rather than stacking keywords without purpose. Employing such symbol combinations minimizes search redundancy and enhances efficiency.

However, it is worth acknowledging that this approach demands a certain level of expertise and may pose challenges for beginners. Throughout this process, I also encountered numerous similar challenges. Therefore, seeking guidance from experienced researchers could serve as a valuable strategy to enhance the eligibility of the search process. Following their advice ensures greater conciseness and validity. For instance, terms like "Government technolog* AND street-level bureaucra*" might be insufficient, while a more comprehensive expression like "Government technolog* AND (street-level bureaucra* OR system-level bureaucra*)" offers succinctness. However, it is crucial to acknowledge that such complexity might confuse scholars.

Transitioning to the second stage, simpler defined terms are utilized to uncover potential oversights from the initial search, as search engines may not capture all results due to their operational mechanisms (Rovira et al., 2021). Consequently, the use of more generic and straightforward terms in this stage mitigates the risk of omitting essential articles from the review. Following the completion of the initial review stage, I undertake a secondary assessment (Stage Two) using simplified criteria to ensure the inclusion of potentially overlooked, but essential literature related to this research. Despite encountering numerous instances of duplicated literature in the search results, additional eligible literature remains within the scope of the review. Consequently, this stage serves to supplement critical articles that might otherwise be disregarded. Specific pre-defined terms are outlined in Table 3.

After the initial two rounds of searching and screening, 332 results were obtained, predominantly focused on AI related topics, which, from my perspective, do not fully align with the intended scope of government technology. On the other hand, it indicates a growing emphasis within public administrative and e-Government academia on AI-related topics. Therefore, these results presented bias, since the search engine could not entirely capture the specific keywords I had in mind. Meaning that it seemed to prioritize the popularity of certain subsets of government technology. To address this bias, I initiated the third-stage search. The objective of this step is to find a clear definition of government technology. Based on this definition, I will try to incorporate more technologies that have been used in the public sector and categorize them from various sources. For instance, based on a certain definition of government technology, I might find that open data platforms fit with the scope of definition. But given that there are many platforms such as e-government platforms and information portals etc. Hence, they can be categorized into the ‘platform or Portal technology’. In this light, I can draw on the term ‘platform’ by using the

Boolean operators. By following this logic, the next section explores the concept and cases of Government technology.

3.2.1 The Conceptualization of Government Technology

However, I encountered a challenge in finding an appropriate definition of government technology during the search process. The broad scope of the term made it difficult to pinpoint its exact meaning. I was thinking whether my research could contribute to clarifying and conceptualizing this concept. Instead of solely focusing on AI-related research. Thereby, I sought to explore diverse definitions of government technology for a more comprehensive understanding. This led me to revisit the term '*government technology*' in the two main databases.

Nevertheless, I barely found clear definitions of Government technology and categories from academic literature, which complicated the research process. To address this issue, I turned to seeking definitions from various international organizations such as the United Nations, World Bank, and UNDP for insights, as shown in Appendix 9. I first analyzed four documents from these organizations using content analysis techniques to understand how they define and categorize government technology. From their official documents, several key factors emerged.

The first document offers a clear definition of government technology and highlights several government technology programs implemented at the EU level. However, the cases presented focused on programs like GovTech Polska, GovTech Lab Lithuania, and the National Digital Research Center (Ireland), rather than specific technologies such as AI or cloud technology. Consequently, information is limited to a conceptual level, although some general categories can still be inferred, as will be summarized in Appendix 5. In contrast, the second document lacks a specific definition of government technology. Instead, it provides a synthesis of various perspectives on technological governance, emphasizing the role and impact of emerging technologies like AI. Despite the absence of a defined term, the analysis reveals specific types of government technology, which is listed further in Appendix 5.

The third document offers an explicit definition of government technology and enumerates specific technologies listed in its agenda, many of which are disruptive. It also outlines the focus areas of government technology and introduces related concepts such as the GovTech Global Partnership. Lastly, the fourth document from the OECD primarily addresses digital technologies such as ICT and open data concerning government technology. It also emphasizes the role of emerging technologies like AI in facilitating digital transformation.

In summary, four documents offer detailed guidance on governing technology, introducing concepts such as user-centric, emerging, and disruptive technologies to illustrate the application of government technology. They collectively emphasize the crucial role of AI in the digital transformation of government while also highlighting the necessity for new legal and governance frameworks to accommodate the use of emerging technologies like AI. This underscores the significance of AI's implications in current public sectors, a conclusion supported by the findings of the initial review process, which predominantly focused on the application of AI in the public sector to the exclusion of other government technologies. Therefore, this underscores the importance of establishing an accurate definition of government technology.

As depicted in Appendix 6, two distinct concepts of government technology emerge. However, neither of these definitions fully aligned with my research context, a conclusion reached after discussions with my supervisor. Although I acknowledged the competitiveness of these definitions, I chose to explore further by using the term '*Definition of government technology* OR *government technology*' to search in Web of Science and Google Scholar, yielding 1868 openly accessible articles. I then refined the search results by evaluating the title, keywords, and abstract of each article. Despite this effort, the initial screening revealed recurring keywords such as E-government, ICT technology, and technology adoption, yet failed to yield a definitive definition of government technology. Reflecting on this, I argued that there remains a gap in establishing a precise definition for government technology.

In light of this situation, I have expanded the search scope beyond academic articles. Instead, I have included 14 official or business websites (often called gray literature), as detailed in Appendix 2. The rationale behind this decision stems from the fact that existing information sources offer limited insights into this definition. Therefore, these websites serve as valuable supplements to gain further understanding of government technology definitions. Analyzing these definitions allows us to identify key factors and refine our understanding accordingly.

Appendix 7 presents an analysis of the core themes and elements defining government technology across various sources. Those elements reveal that the majority of definitions revolve around four primary themes (i.e., Entities, tools, characteristics, and objectives), each supported by multiple elements. Notably, all definitions consistently emphasize two key themes: the involved entity (governments or public sectors) and the objectives (enhancing efficiency, streamlining processes, etc.). Particularly, the focus of most definitions lies on the objectives of government technology, where the majority of elements are concentrated. This indicates a prevalent tendency to depict the anticipated outcomes of government technology rather than providing an in-depth understanding of the concept itself. Consequently, I further propose a refined definition of government technology synthesized from these themes and elements as follows:

> Government technology refers to the strategic integration of emerging and innovative technological tools within the public entities, public sectors etc,. It encompasses a range of categorized tools designed to fulfill specific purposes and objectives[11], facilitating the use of digital products and services to enhance administrative efficiency, operational effectiveness, and the provision of public services. This field is marked by its dynamic evolution and the collaborative integration of public sector expertise with innovative solutions from the private sector.

This definition aims to offer a comprehensive understanding of government technology without becoming overly specific or general. By leveraging emerging and innovative technological tools, it allows for the categorization of various types of government technologies pertinent to this research. The objective is to broaden the search parameters beyond AI-related subjects. In this case, this definition effectively focuses the scope of inquiry, aligning with the research objectives. It is worth mentioning that although alternative definitions are available in official sources, they

[11] E.g. Citizen-centric, accessible etc..

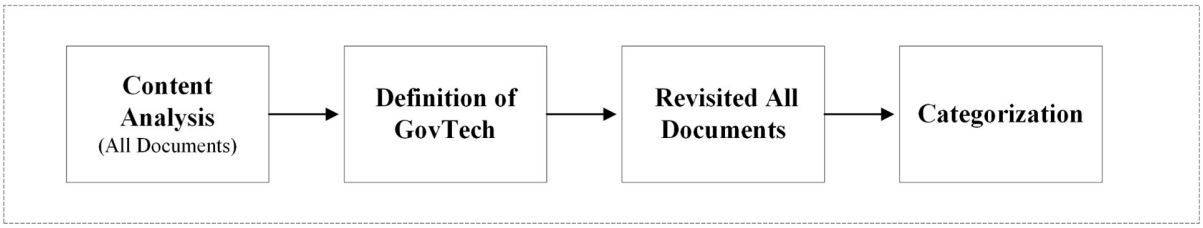
were not chosen due to either their overly broad or narrow focus, which would have constrained their relevance to my research goals.

3.2.2 The Categorization of Government Technology

As described, content analysis was used to analyze and understand the definition of government technology. By breaking down the main themes from various definitions, I developed a new conceptualization of government technology. Based on this definition, I revisited all documents from both academic sources and gray literature, then extracted and categorized the cases from these documents and presented them in Appendix 5.

Figure 9

Refining The Process of Defining and Categorizing Technologies



Note. Source from author

Appendix 5 aims to provide a clear categorization of government technologies, offering readers an understanding of the technical classification. Categories are structured across three layers: layer one represents the broadest scope and layers two and three progressively narrow down into more specific classifications. Additionally, cases provided in the table are included to authenticate and reinforce the legitimacy of the categorization. The table illustrates a notable concentration of digital technologies, with only a minority comprising non-digital ones. This highlights the predominant usage of digital technology within public entities, particularly emerging technologies. Thus, the categorization aligns well with the European Commission's definition and signifies a refined classification process.

Note that the data presented in this table is drawn from limited sources. Consequently, while the examples provided offer insights into government technology, they may not encompass the entirety of the field. Utilizing an inductive approach, I then generalized these examples based on their respective category properties, gradually reaching a more abstract level. Therefore, subsequent searches will concentrate on layers two and three, rather than relying solely on the initial examples. This strategy accounts for the extensive scope of government technologies, with certain areas such as AI and Blockchain undergoing increasing research. By remaining at the middle levels (two and three), the table effectively filters out unnecessary results while still providing comprehensive coverage.

Moreover, it is important to acknowledge the overlap in categorization. For example, in Layer three, I defined a set of technologies as platform and portal technologies and listed them as communication and interaction technologies because their main feature is providing a space for citizen interaction and communication. Although current analytics technologies, such as AI, can

also offer interaction functions, I did not classify them under communication and interaction technologies to ensure each level's primary function (e.g. analyzing data) is clear. Categorizing them this way ensures that each level has a distinct characterization. However, there is a clear boundary between tangible and digital technologies, which may provide useful hints for further research.

Table 4

Stage Three - Pre-defined Terms for searching process

Number	Pre-defined Terms	Preliminary Retrieve
1	(Platform OR Portal OR System Technolog*) AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	18,100
2	Emerging Technology AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	18,000
3	Data Analytics Technolog* AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	18,500
4	Virtual Technolog* AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	20,600
5	(Communication OR Interaction Technolog* AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	17,900
6	(Regulatory OR Compliance Technolog*) AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	22,100
7	(Accessibility OR Inclusion Technolog*) AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	17,100
8	Tangible Technolog* AND (Street-level bureaucra* OR Screen-level bureaucra* OR System-level bureaucra*)	9,340
		SUM:141,640

Note. Truncation symbols = *, (AND, OR = Boolean operators)

The third round of search incorporates terms derived from the categorization of government technology (see Table 4). After removing duplicate results, this search and screening process yielded 33 outcomes, as shown in Appendix 3. Of these, 19 met the inclusion criteria upon further screening. The general method for using the predefined terms was the same as in the first and second rounds (see Section 3.2.1), so I will not elaborate further on how these terms were created.

Table 5

Summary of Number of Literature

Process	Number of literature
Screen literature from database	299
- Exclusion based on criterias	259
Addition (forward and backward search)	19
Total literature reviewed	59

3.3 Data Analysis and Validation

In terms of data analysis, this research conducts a thematic qualitative analysis method with inductive nature, guided by Creswell and Creswell Báez (2021). Cording is to transcribe raw data and make sense of them (Creswell and Creswell Báez, 2021). In this research, coding is supported by NVivo 14 software. Besides, The coding process consists of 8 steps, including 1. setting up a transcript, 2. reading through each text and comprehending the general ideas, 3. coding each text, 4. listing all of the codes, 5. Grouping and removing duplicated codes, 6.writing a theme passage, 7. Creating a conceptual map and 8. Develop a narrative story to tie all themes (Creswell & Creswell Báez, 2021, p. 164).

Following these steps, I began the coding process using two parallel strategies: open coding and pre-defining the meaning of codes and matching them with the text. For example, in the open coding section, I first read and comprehend a text, then summarized possible central phenomena, and converted them into potential codes. The following sentence is extracted from research on the impact of technology on judges: The judges use keywords such as 'no restrictions' and 'exercise discretion' to describe how they react to IT. Based on the whole context, I inferred that technology might have a very limited impact on judges' discretion. Thus, I coded this sentence as 'Unrestricted discretion.'

> '*The chief judge elaborates: "As far as I can see, IT has not in any way limited a judge's ability to exercise discretion … The judge has a greater opportunity to obtain information with a better basis for his or her decision. But there are no restrictions in the judge's ability to exercise discretion'* (Busch, 2017).

Moreover, in the latter case, I established certain codes before beginning the coding process. The starting point was a coding frame derived from the research question and existing literature. For example, my research question explores how technology impacts the work of street-level bureaucrats. Based on the literature and my understanding in this field, technology may enhance or hinder 'efficiency' of their work. Therefore, 'efficiency' was pre-defined as technology enhancing street-level bureaucrats' work, such as improving responsiveness to users. Following this rationale, other codes emerged, including 'transparency', 'accountability', 'drawbacks', and others. After completing the first round of coding, a second round of coding is conducted to further refine the existing codes, and to summarize and generalize until themes emerge. In addition, the results of the coding process are interpreted using the TTU framework. This research has two

primary objectives. First, it aims to answer the research question by reviewing the current relevant literature. Second, it seeks to validate and refine the TTU framework proposed, drawing on empirical data collected from the literature review.

Moreover, The validity of this research is carefully considered. In qualitative research, validity ensures that the findings are accurate rather than merely plausible. For this research, I utilize the reviewers' lens (also known as the readers' lens) to achieve validity. This approach relies on reviewers perceiving the qualitative account as accurate. Therefore, conducting an external audit is necessary to provide an objective review of the study's accuracy. Additionally, peer debriefing (or peer review) will be employed as a strategy. This involves having someone familiar with the research or the central phenomenon being explored review the project. Such peers can offer support, challenge assumptions, and help refine the study. These reviewers, who may be fellow students or researchers, can ask critical questions and provide valuable insights, much like the study's participants (Creswell & Creswell Báez, 2021, pp. 201–202).

Note that the coding book is attached in the Appendix 10.

3.5 Limitations

This research aims to provide significant insights into the impact of government technologies on street-level bureaucrats through a comprehensive literature review. However, several limitations must be acknowledged to contextualize the findings and guide future research. These limitations arise from methodological choices, data collection processes, and the inherent constraints of qualitative research.

One primary limitation is the scope and generalizability of the findings. The broad nature of conceptualizing 'Government technology' to understand its impact on street-level bureaucrats may introduce bias. Additionally, the qualitative methods employed, while rich in contextual detail, are often subject to researcher bias and subjectivity.

The interpretation of qualitative data relies heavily on the researcher's perspective, which can introduce biases despite efforts to maintain objectivity. The use of thematic analysis, although systematic, still requires subjective judgments in code development and theme identification. The data collection process also presents certain limitations. The sample size, though adequate for qualitative analysis, may not capture the full diversity of experiences and perspectives of street-level bureaucrats using government technologies. Moreover, while the study proposes and utilizes the TTU framework, its empirical validation remains a challenge. Although grounded in existing literature, the framework requires further empirical testing across different contexts to ensure its robustness and applicability.

Ensuring the external validity and reliability of qualitative findings is inherently challenging. While the study relies on peer debriefing and external audits to enhance validity, these measures cannot entirely eliminate the subjectivity involved in qualitative research. Therefore, the study's findings, while insightful, should be interpreted with caution, considering potential variability in other contexts and settings.

In conclusion, this research provides valuable insights into the interplay between government technologies and street-level bureaucrats. However, the aforementioned limitations highlight areas for cautious interpretation and further investigation. Addressing these limitations in future research will be crucial for developing a more comprehensive and generalizable understanding of the impact of government technologies on public administration practices.

4 Findings and Discussion

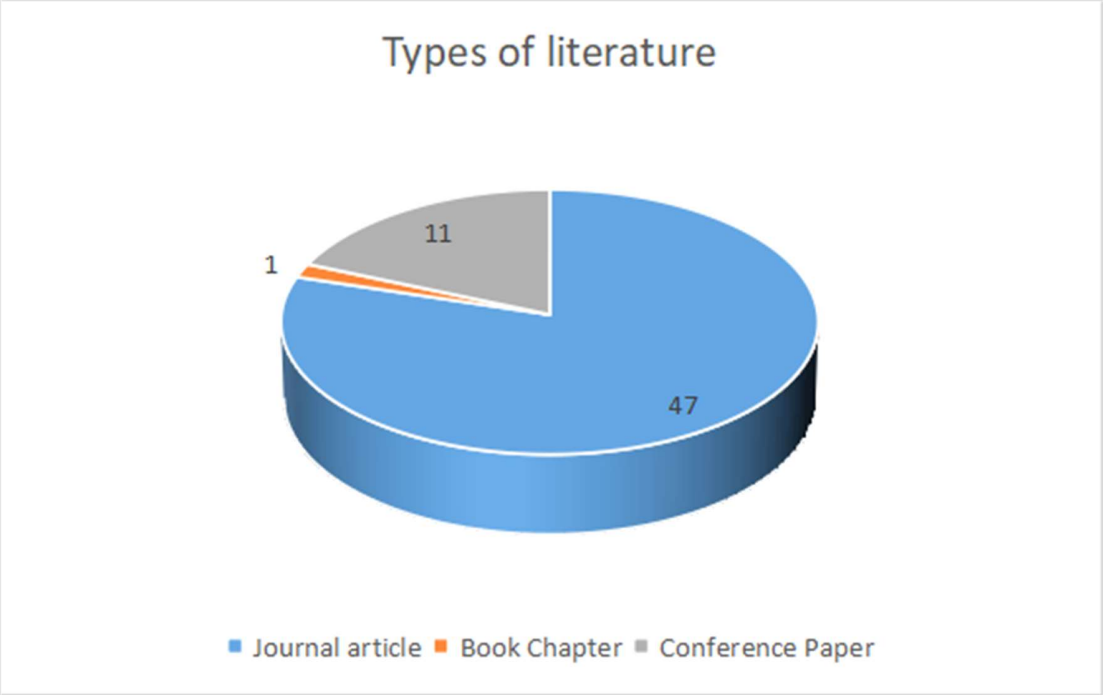
4.1 Overview of Reviewed Literature

This section provides a clear overview of the review literature, including the type of literature, research objects, publication years, methodologies, and main themes. A detailed analysis is presented as follows:

As shown in Fig. 10. Out of 59 literature included by this review, 80% are journal articles, 19% are conference papers. 1% is the book of chapters.

Figure 10

Type of Literature



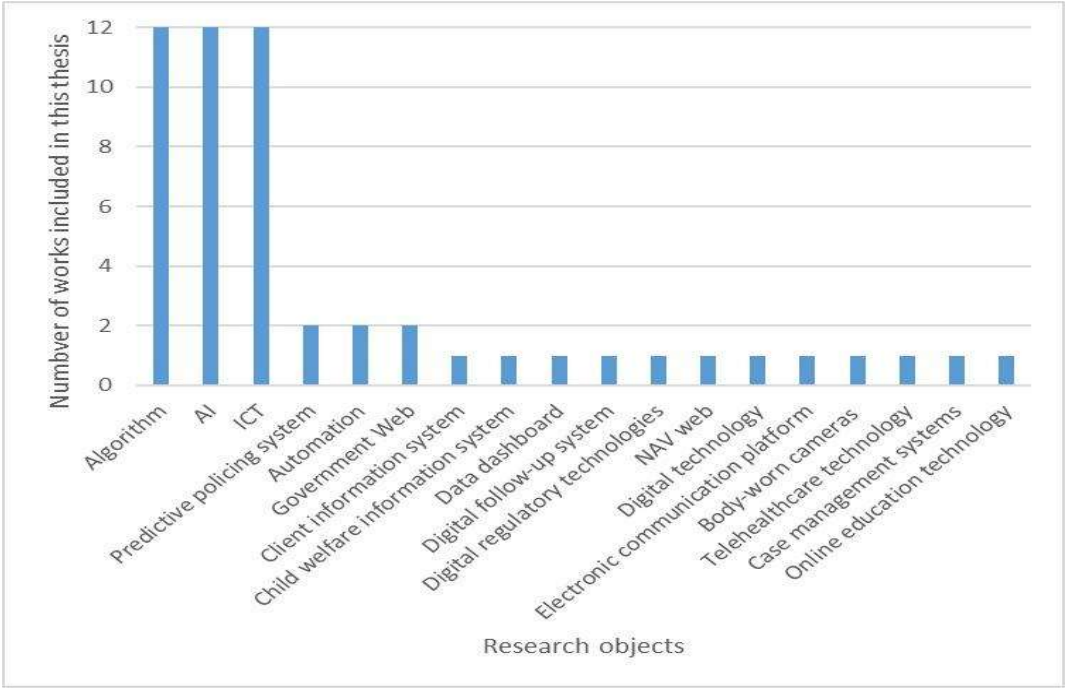
Note. Source from author

The main themes of the reviewed literature are presented in Fig. 11. Discretion is the most frequently studied topic (40%). The transitioning relationship from SLB to SYB comprises 10% of the reviewed literature (Discretion was also discussed within this topic but was not included into 'discretion' category). The process investigation constitutes 5% of selected literature, examining how technologies influence SLBs' work. In addition, Digital discretion (3%) and artificial (1%) were also explored from this research. I aimed not to include both topics into 'discretion', since the conceptualization was changed and separating both topics helps clarify the landscape. Of note, the essence of both topics, rigorously, are being part of 'discretion'. The rest of the themes are clustered in the following topics: Organizational pattern (1%), administrative burden and exclusion (3%), buffering strategies (1%), digital coping (1%), digital cages (1%), user's perceptions (1%), fairness and accountability (3%), automation bias (1%), behavior, policy

alienation (1%), transparency (1%), human judgment (1%)t, political legitimacy (1%), responsible design (1%), technological impact (1%), organizational coordination (1%), and street-level algorithms (1%).

Figure 11

Research Objects of research



Note. Source from author

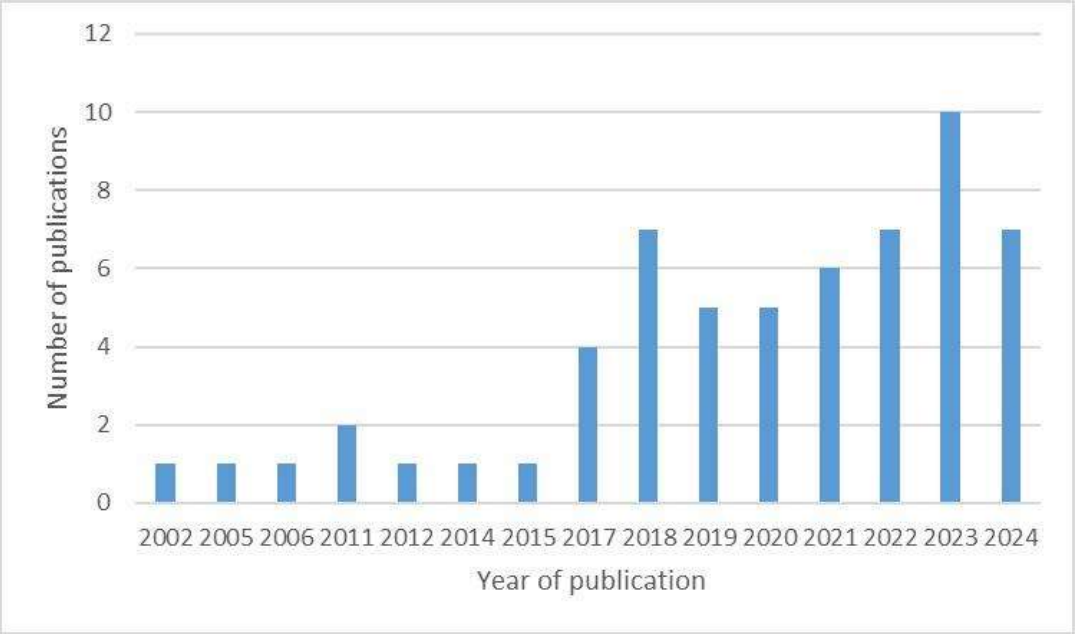
Based on the conceptualization of government technology, as noted in section 3.2.2, I further conducted a third round of screening (details presented in section 3.2). Therefore, the results showed that the topic of AI and algorithms constitute 20% of reviewed literature, collectively representing 40% of the research objects. I did not merge both topics together, as the definition and conceptualization of each literature regarding AI and algorithms might present a subtle difference. Therefore, I attend to categorize them according to the main contents of those research. For instance, if a paper discusses the impact of AI on SLBs, I will list the research object of this research as AI, even though this paper mentioned algorithms as well. This is mainly based on the main content of the research. Following this logic, ICT, as an umbrella term, also accounts for 20% of the reviewed literature. Additionally, the remaining technologies are listed as follows: government platform (5%), Automation (3%), predictive (3%), client information system (1%), child welfare information system (1%), data dashboard (1%), digital regulatory technologies (1%), body-worn cameras (1%), telehealthcare technology (1%), case management systems (1%), online education technology (1%), digital technology (1%).

From the data provided, it is evident that the current use of government technologies by SLBs are mainly referring to the use of AI and algorithms. When I conducted the searching process for this review, I barely found any other government technology in stage one and two. This made me

confused that can AI just represent government technologies? I think the answer is 'No'. Accordingly, this searching result shows a trend (might, arguably, also be called a research bias), as AI was given too much attention and spotlight nowaday, so that other applications of government technologies might be glossed over and under-researched. We might ask - are those technologies not interesting enough? Or is the AI or algorithms more intriguing to research? The answer is unknown and subtle. Therefore, a call on researching beyond AI in the public sector is necessary, in the sense that researchers should give more attention to other innovative government technologies.

Figure 12

The Year of Publication

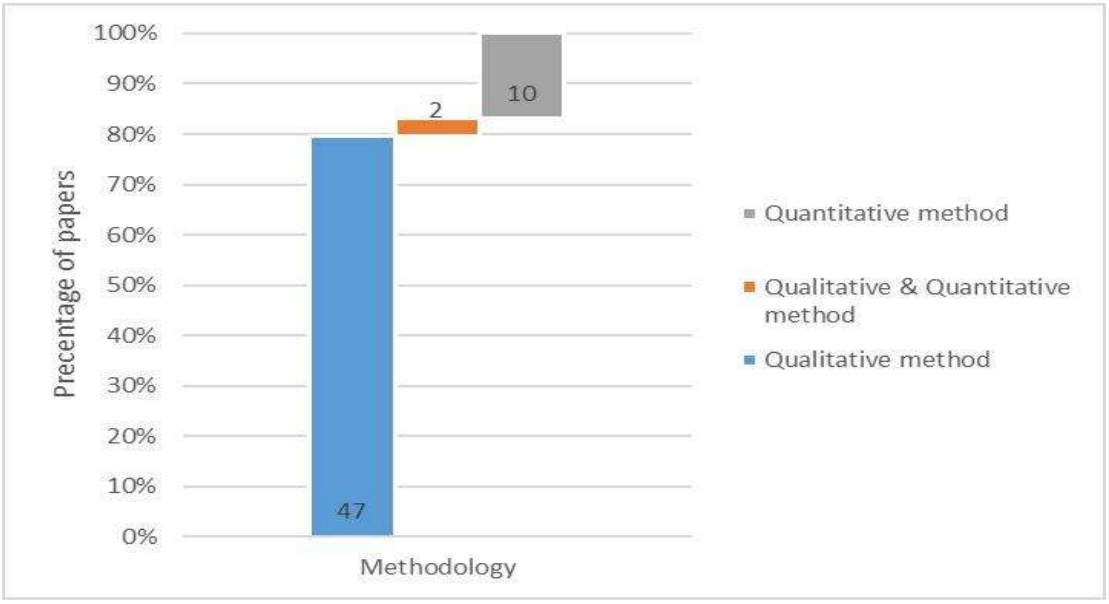


Note. Source from author

Most reviewed research was published between 2000 and 2024 (see Fig. 12). Studies on the relationship between street-level bureaucrats and technology have shown a spurt of publication in the last five years. This suggests a crucial point: scholars are paying more attention in this field, with the growing digital capacity of the government and increasing use of emerging technologies in the public sector. In addition, the majority of research is published in excellent peer-reviewed journals, including (but not limited) Public Administration Review, Government Information Quarterly, Information Polity etc. Besides, conference papers, published in the proceedings of the Hawaii International Conference on System Science (HICSS) and the proceedings of Electronic Government (21st IFIP WG 8.5 International Conference), are further included. Therefore, the quality of journals can be largely guaranteed. Also, gray literature is excluded during the review process.

Figure 13

Methodology Overview - 1

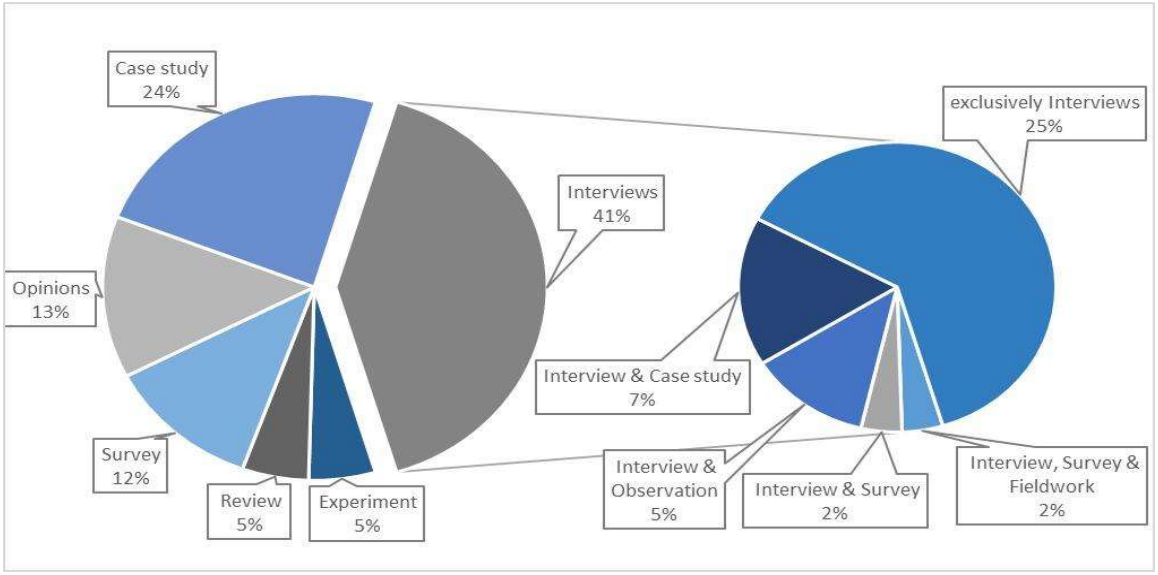


Note. Source from author

Among all the reviewed literature, 22% is conceptual, while 78% is empirical. Specifically, research using qualitative methods accounts for around 80% of the studies, about 17% use quantitative methods, and only 3% use a mixed-methods approach that combines both qualitative and quantitative methods (see Figure 13).

Figure 14

Methodology Overview - 2

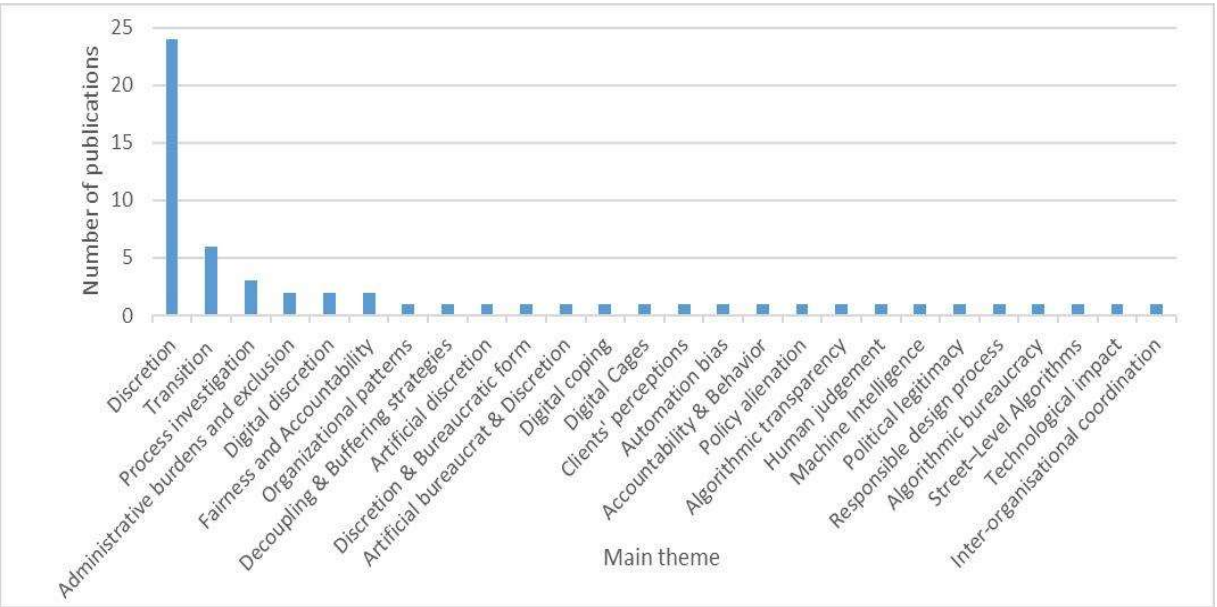


Note. Source from author

As can be seen in Fig. 14, 25% of the research conducted interviews for empirical data collection. Additionally, 5% used both interviews and observation, while 7% combined interviews with case studies. Surveys were used in 12% of the studies, and 5% employed experimental methods. Review papers made up 5% of the research, and 3% used a mixed method combining surveys and interviews. Finally, 14% of the research was entirely conceptual.

Figure 15

Main theme of Reviewed Literature



Note. Source from author

Accordingly, we can see most topics researching SLB and underscore the concept of 'discretion', reflecting its central role in studying the impact of technology on SLBs. Moreover, investigating the transition from SLB to SYB is also a growing trend in this field. The rest of themes also mirror a tendency where scholars are starting to move beyond the studying of discretion. Instead, their focus appears to be on two key areas: the behavior of SLBs (e.g., administrative burden, perception, human judgment, etc.) and technological properties (e.g., automation bias, digital cage, design, etc.).

4.2 Navigating Discretion: The Double-Edged Sword of Technology in Bureaucracy

4.2.1 Discretionary Power: Moving Towards Diversity?

In section 4.2.1, I aim to present the main evolution of the discretionary form and its classification to answer the Sub question 2 in this research. Following this, a brief conclusion is provided. Based on these findings, the section also summarizes a framework that includes three lenses for studying discretion. This framework is supplemented by empirical evidence, illustrating how scholars have examined the impact of technology on discretion.

1. A glimpse of discretionary augment

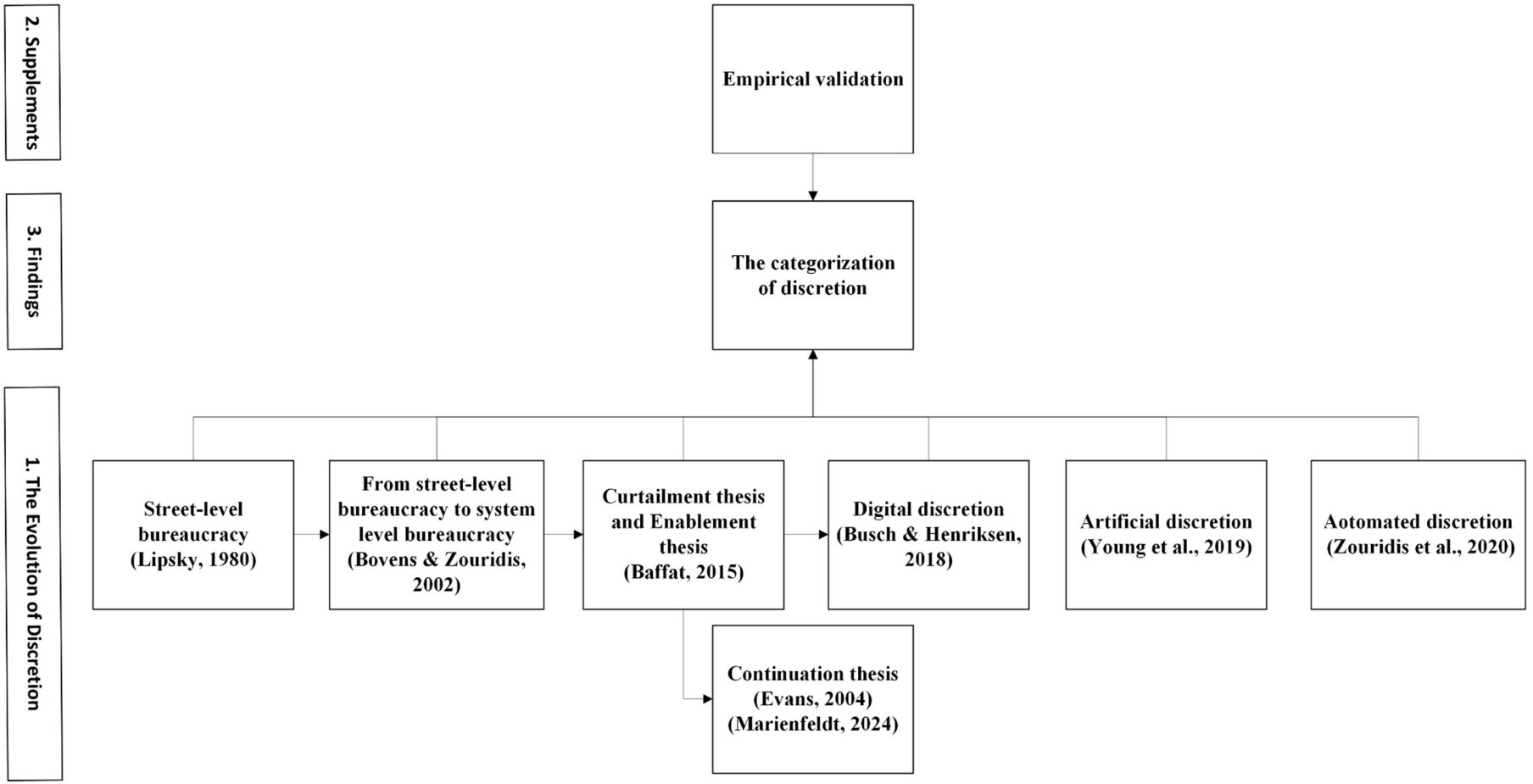
After the street-level bureaucracy was coined, discretion was always being put in the central stage in academia (Buffat, 2015; Busch & Henriksen, 2018; Evans & Hupe, 2020). Traditionally, SLB refers to the public public services organizations, including police, welfare department etc, where frontline workers, also defined as street-level bureaucrats, interact directly with the public and have significant discretion over the distribution of public sanctions or the distribution of benefit (Lipsky, 2010, p. xi)). Based on the Lipsky, three clear main characteristics of SLBs emerge: substantial services requests, exclusive control over the public services and huge discretion on their work (Alshallaqi, 2024; Arnold, 2015; Giest & Raaphorst, 2018, p. 201; Hupe & Buffat, 2014).

The reasons behind such discretionary power and practice can be explained by several factors. Firstly, the public sector generally lacks sufficient resources. For instance, to check each individual tax return, tax agencies require a huge number of frontline workers to handle those work. The requirements in reality are usually far more beyond the capacities of those agencies (Zouridis et al., 2020). Consequently, SLBs often have very limited time and energy to perform their duties. In addition, SLBs, as policy implementers, also have ample space for professional discretion within organizations. For example, even for the same rule or regulation, different SLBs will have different interpretations. This leads them to interpret policies with vague objectives based on their own understanding, expertise, and experience. In this case, professionalism is essential to guide the work of SLBs, giving them considerable leeway to interpret and implement policies according to their own perceptions. That is why SLB has been described as a professional bureaucracy (Mintzberg, 1993). Furthermore, the challenges of management, work conditions, client complexity, and human nature also contribute to the extensive discretionary practices of SLBs (Lipsky, 2010).

However, with the introduction and implementation of information and communication technologies (ICTs) in the public sector, public organizations began transforming into a movement known as 'Digital-Era Governance.' This transformation involves integrating new functions into government operations and continuously digitizing administrative processes (Dunleavy, 2005). This shift profoundly impacts the relationship between governments and citizens and advances the development of e-government. According to Bovens and Zouridis (2002), the rapid adoption of ICTs is transforming the organizational structures of many large

Figure 16

The Logic of Section 4.2.1



Note. Source from author

executive public agencies, originally referring to street-level bureaucracy. Specifically, they argue that SLBs have disappeared in some areas, suggesting that these agencies have shifted to Screen-Level Bureaucracy, and even SYB, where system designers, legal experts, and analysts are the primary actors maintaining system operations[12] (Bovens & Zouridis, 2002).

With the new conceptualization of SYB, questions emerged regarding how discretion changed during such transition. This issue became a central topic of academic debate and received significant attention in the twenty years when it was published, particularly as emerging technologies like AI, blockchain, and big data gain traction in the public sector. This further exacerbates how discretion is impacted in the transition from SLB to SYB and what technologies have done to discretion. The starting point of debates might, arguably, start from a well cited statement from Lipsky:

> *'The essence of street-level bureaucracies is that they require people to make decisions about other people. Street-level bureaucrats have discretion because the nature of service provision calls for human judgment that cannot be programmed and for which machines cannot substitute'* (Lipsky, 1980, p. 161).

While Lipsky's statement acknowledges the importance of SLBs' judgment in dealing with frontline work, the debate with regard to if human judgment can be fully automated is still ongoing in academia. However, the impact of emerging technologies goes beyond simply replacing human decision-making. The rise of concepts like "digital-era governance" and "System-Level Bureaucracy" highlights this complexity. Therefore, a crucial question remains: how will ICT affect the discretionary practices of SLBs? Bovens and Zouridis (2002) argue that computerization transforms both SLBs and legal frameworks, leading to a shift towards "Screen-Level Bureaucracy". This means some parts of the SLBs' tasks are programmed into software, turning their work into a more routine process. The interaction between SLBs and citizens becomes limited, often confined to screen-based communication. Additionally, citizen data is collected through standardized electronic forms, processed by automated systems using pre-defined rules. This significantly reduces the scope for SLB discretion as decisions are embedded in the system design, leaving them to merely 'accept' or 'reject' system-generated recommendations (Bovens & Zouridis, 2002).

In System-Level Bureaucracy, Information and Communication Technology plays a pivotal role in organizational operations. Bovens and Zouridis noted,

> '*It is not only used to register and store data, as in the early days of automation, but also to execute and control the whole production process. Routine cases are handled without human interference. Expert systems have replaced professional workers. Apart from the occasional public information officer and the help desk staff, there are no other street-level bureaucrats as Lipsky defines them*' (Bovens & Zouridis, 2002, p. 180)

[12] In this research, transition refers to the transition from Street-Level Bureaucracy to System-Level Bureaucracy.

This transition implies that SLBs will ultimately be phased out as their agencies move from Screen-Level Bureaucracy to SYB. Therefore, the discretionary power traditionally held by SLBs will be completely eliminated and finally transferred to SYBs, typically system designers and legal experts. These individuals will impact the actual implementation of policies by converting legal frameworks into information systems and algorithms (Bovens & Zouridis, 2002, p. 180). This shift allows SYBs to exercise discretion in a manner that is not transparent, usually referring to 'Black Box'. However, unlike SLBs, who are the policy enforcers (Lipsky, 1980, pp. 13–14), SYBs essentially become the policy makers themselves. Zouridis (2020) argued that discretion does not stem from scarcity and ambiguous standards in system-level bureaucracies but is instead operationalized through standardized parameters in IT systems and the use of software to manage administrative processes.

2. 'Cuiltment' and 'Enablement' thesis

Following the discretionary debate, Buffet (2015) argued that with the extensive utilization of ICTs in the public sector, governments are shifting to a more digital form, that is what is usually called e-government. Based on this background, he asserted two main arguments regarding discretion have been developed. One of which is named curtailment thesis that had been addressed already. This type of thesis highlights the frontline policy discretion is decreasing and even disappearing. In addition, the second argument he maintained is the emergence of the enablement thesis, underscoring how technologies provide additional resources for frontline workers and citizens. This research has gotten a lot of attention in academia and was well cited in recent years. One important contribution of this research is that it provides a lens to categorize discretion with few empirical results in terms of how ICT impacts SLBs' discretion at that moment. The starting point of the curtailment thesis was the development of ICT that challenged the SLBs' capacity of control information (Snellen et al., 1998). The argument from Bovens and Zouridis (2002) further reinforces this stream of research. Since human judgment was, partially or fully, replaced by predefined algorithms. In this case, SLBs no longer make decisions, instead, software will help them finish the decisions. As Bovens and Zouridis (2002) pointed out

> *'The process of issuing is carried out—virtually from beginning to end—by computer systems'* (Bovens and Zouridis, 2002, p. 180).

Therefore, this augment elaborates on the fact that street-level discretion is decreasing with the increasing role of ICT (Buffet, 2015). According to Bovens and Zouridis's observation of screen-level bureaucracy and system-level bureaucracy, we can capture two trends here where the discretion was either shifting or decreasing. This seems to point out that technology has an impact on curtailing discretion to some degree (Buffet, 2015). However, Buffet argued that technological determinism is implied, and the power of ICT is over evaluated. Moreover, the definition of discretion among those arguments is too narrowed. And the curtailing effect also has evident empirical limitations (Buffet, 2015).

With that, He also captured an alternative direction to study discretion in this research and proposed the 'enablement' theses. This type of empirical research suggests technology is not suppressed on the SLBs and is still used by SLBs in their daily activities. In other words, technologies can not fully determine SLBs' discretion. Instead, new technologies are only a contextual element that impacts on discretion. Also, it underscores the various effects of ICT and emphasizes how both frontline agents and citizens use technologies as action resources. As he asserted:

> *'Analytically speaking, this means that technology (and its use) is only one of the factors influencing the discretion of frontline agents and that a variety of non-technological factors shape it as well. This is why no unilateral effects of technology can be assumed'* (Buffat, 2015, pp. 156–157).

3. Continuation - a new way looking at discretion

Followed by 'enablement' and 'curtailment', 'continuation theses' was also pointed out by scholars (Evans, 2004; Marienfeldt, 2024). This concept was originally derived from the social work area (Evans, 2004). This type of research mainly argues that actively using digital technologies can bring changes to SLBs and those changes were deemed as resistance to the demands of these tools and their underlying policy goals (Marienfeldt, 2024, pp. 6–7). In addition, it also underscores that SLBs are trying to retain their professional judgment to make decisions for cases, instead of solely following the official procedures. While technologies, arguably, in most cases are able to improve SLBs' casework by providing more information, limited resources, complicated human relationships and social reality create tensions for SLBs. In this light, those SLBs might 'alter' rules to match with their deviant behavior (Alshallaqi, 2024; Busch et al., 2018). Some cases included breaking and ignoring rules, altering rules to fulfill their purposes as well as using strategies to get social support. As Marienfeldt (2024) mentioned:

> '*Coping can be both client-oriented or justified by frontline workers' needs and constitutes a strategy to retain some discretion despite the challenges and constraints imposed by the digital tools'* (Marienfeldt, 2024, p. 7).

4. Digital discretion - gradually replacing human discretion

Busch and Henriksen (2018) conducted a systematic review on ICT and discretion in the street-level, introducing the concept of 'digital discretion' to describe the impact of ICT on discretion. They define digital discretion as the use of computerized routines and analyses to impact or replace human judgment (Busch & Henriksen, 2018, p. 4). Thus, their research theoretically supports the perspective of 'curtailment' argument as a continuation. Furthermore, inspired by Bovens and Zouridis (2002), Busch and Henriksen examined the influence of ICT over the past twenty years and noted its rapid development. They suggest that digital discretion closely aligns with the transition from SLB to SYB., as they mentioned:

> '*Digital discretion emphasizes the shift from viewing discretion as the street-level bureaucrats' intellectual process to a situation where ICT replaces parts of, or the full intellectual discretionary process'* (Busch & Henriksen, 2018, p. 4).

Two reasons were given to illustrate the significance of digital discretion. First of which is that ICT can bridge the gap between 'policy as written' and policy implementation by influencing the actions of SLBs. Second, digital discretion enables the efficiency of the decision-making process by e.g. partially or fully automated decision process to save SLBs' amount of time, which highlights the usability of this concept. Following Buffat's research (2015), they draw on the concept of 'curtailment' and 'enablement', suggesting that ICT has both effects on street-level discretion. Based on their empirical findings, they pinpoint 10 contextual factors, being categorized into four levels of analysis, to explain the digital discretion in the SLB. This is to say, when considering the diffusion and impact of digital discretion on SLBs, the contextual elements such as consideration

of leadership in macro-level and the degree of SLBs' professionalism are crucial to take into account. In this sense, technologies are not the only factor to determine discretion. Instead, contextual factors play a significant role in understanding the impact of ICT on digital discretion. Furthermore, with the increasing application of ICT, the range of SLB is further narrowed, transitioning into what they called digital bureaucracies - essentially, similar to screen-level bureaucracies and system-level bureaucracies, featured by bureaucrats using computers to handle their work. Based on their investigation, they argue that digital discretion can reinforce both ethical and democratic values in public services, but diminished value in terms of professional and relational aspects.

5. Artificial Intelligence - curtailing discretion further by AI

Interestingly, Young et al., (2019) observed a trend where artificial intelligence (AI) has the potential to influence discretion. Based on that, they further introduced the concept of 'Artificial Discretion (AD)', a conceptual framework, to investigate how AI impacts on public managers' decision-making process and how they exercise it. The central idea of AD is that by providing a framework, public managers can decide to properly execute the applications of AI to reinforce or replace human judgment within public organizations. This framework comprises four criteria, i.e. effectiveness, efficiency, equity, manageability and political feasibility, aiming to compare with human discretion. Authors argue AD provides an opportunity to tackle general deficiencies within governments, which includes inaccurate prediction, inconsistent quality of discretion, discretion bias, corruption and workforce.

In addition, they asserted whether AI is appropriate for specific tasks is contingent on the factors such as task complexity, quality and availability of data etc. In other words, the potential use of AD for administrative tasks align closely with those contextual factors. Therefore, this research is similar to that of Busch and Henriksen (2018) and could be considered a continuation. This similarity is validated by the fact that they draw on the two key tasks dimension, i.e., the level of discretion and the level of analysis (Busch & Henriksen, 2018). In essence, both dimensions are interrelated, when analyzing the AD in a real situation. For instance, simple tasks can be handled by a caseworker through using their expertise and discretion. However, as the complexity of administrative tasks increases, stakeholders need to negotiate, which restricts and interlinks discretion. Thereby, those cases highlight the importance of contextual factors in analyzing the discretion.

Accordingly, Young et al., (2019) divided the level of analysis into three layers-Micro, Meso and Macro-to explain how to understand artificial discretion in different situations. As a new form of discretion arising from the increasing use of AI tools, artificial discretion requires understanding and comparing how these emerging technologies influence the work of street-level bureaucrats compared to human discretion. Ultimately, they argue that AI can enhance administrative discretion in three ways: increasing scalability, decreasing cost, and improving quality (Young et al., 2019).

6. Automated Discretion

Zouridis et al., (2020) reflected on the development from SLB to SYB, suggesting that street-level discretion is transitioning to system-level discretion. Some indications of new development in this research field indicate that a new form of discretion has been created, which could be arguably called 'automated discretion'. But in this research, authors did not give a clear definition in this

new discretionary form (De Boer & Raaphorst, 2023). Instead, they captured some changes in the public organizations and called on to further rethink constitutional and democratic embeddedness and the foundation of IT-driven large-scale bureaucracies (Zouridis et al., 2020).

In their research, the analysis is still limited to large 'production agencies' (Wilson, 2000). This is largely consistent with Bovens and Zouridis' research (2002), which also focused on large executive agencies while excluding professions such as teachers, health workers, and judges, as claimed in both researches. An interesting point is whether some other changes have been caused outside of that specified range in the two decades. And in those excluded SLBs, has there been any indication that they've been converted to SYB? They observed some signs in terms of discretionary shift, but still, there seems no indication to show the nature of those organizations has been transitioned to system-level.

Zouridis et al. (2020) argued that SYB has been further expanded and the role of SYBs has been emphasized. Against the backdrop of addressing the failures of initial large-scale systems in SYB, the authors observe a rise in a new bottom-up software development approach, where a group of 'creative' software developers has been given the autonomy to refine the current applications and they discuss how to improve software regularly with management and reach agreements ultimately. In this case, those software engineers do not have formal decision-making power, however, they have substantial discretion to application development.

Moreover, data analysts are also mentioned in this article, they analyze the data in the system, finding patterns based on collected data and further come up with suggestions. Dutch Tax and Customs Administration is a typical case where data analysts utilized large volumes of data from all taxpayers to find various patterns, in order to find possible fraud and common errors. With that process, data analysts hold considerable discretionary power in their work. Therefore, it is evident that discretionary powers have shifted from frontline workers to IT developers. The authors raise concerns about regulating this new form of discretion. They argue that with this shift, the discretion exercised in making individual decisions related to public administration is likely to disappear in the long run. As evidence, they cite the example of tax assessments in the Netherlands. In short, both cases not only support the transition from SLB to SYB, but also further validate cutiling effect of technologies (Buffat, 2015).

Table 6

The Evolution of Discretionary Form

Discretionary forms	Empirical research
Discretion →Digital discretion → Artificial discretion → Automated discretion → [...]	(Alshallaqi, 2024; J. Bullock et al., 2020; J. B. Bullock, 2019; Busch, 2017; Busch & Henriksen, 2018; Busuioc, 2021; De Boer & Raaphorst, 2023; Gordon et al., 2024; Marienfeldt, 2024; Ranerup & Henriksen, 2022; Y. Wang & Pan, 2024; Young et al., 2019)

Note. Summarized by author

7. Conclusion

Accordingly, from the overview of the evolution of discretion provided above, we can identify three key points. First, with the increasing introduction and implementation of new government technologies in the public sector, the impact of these technologies on SLBs' discretion remains a central debate (Busch & Henriksen, 2018; Zouridis et al., 2020). This debate has provoked various research perspectives on discretionary power, as summarized in the next section (see Table 7).

Secondly, the transition from SLB to SYB is the key hint of learning discretion. This relationship not only underscores the changes of organizational nature, but also emphasizes how the role of SLBs and their discretionary power are changed. This is because ICT is a key driver behind this transition (Bovens & Zouridis, 2002). Research has shown technologies, particularly automation, AI, can, to great extent, curtail SLBs' discretionary practice (see Table 7), even those SLBs can use coping strategies to escape or resist using those digital tools, as it always does (Breit et al., 2021). But, we can observe the trend has been shaped: SBLs' discretion is hugely limited in the two decades after the conceptualization of SYB. The overall scope of SLB is shrinking, while SYB is expanded. This drives the discretionary power shifting from SLBs to SYBs, which was noted by Zouridis et al. (2020): '[...] *IT leads to a loss of discretion in making individual decisions, as the discretionary power shifts to the development of the software*.' They even predict that individual decisions in terms of public administration are, in the long run, to disappear' (Zouridis et al., 2020, p. 326).

Thirdly, from this review, I have observed that the evolution of research on discretionary powers is progressive and complementary, despite some debates. Meaning that there is a positive correlation between the types of discretion (e.g. digital discretion, artificial discretion etc) and the types of technology (automation, AI, digital tools etc). This is to say as new technologies are applied, new forms of discretion (e.g. digital discretion, artificial discretion) emerge with the engagement of human agents. I argue that as emerging technologies continue to develop, more forms of discretion will arise in the future. Studying these new patterns of discretion will require integrating data technologies, fostering interactions between software engineers and management, and conducting more in-depth empirical studies of administrative relationships (Zouridis et al., 2020).

4.2.2 Analyzing Discretion Through Three Lenses

In this section, the findings combine with empirical evidence mentioned in section 4.2.1. Based on the existing reviewed literature, I further categorize how current scholars are studying the impact of technologies on discretion (See Table 7). Arguably, this can be seen as a framework.

1. Context oriented lens

In table 7, discretion was inductively categorized into three lenses and each layer contains several topics derived from existing literature. Regarding the first lens, which I termed it as 'context oriented lens'. In this group of research, they held a common argument: context matters and discretion is influenced by various contextual factors beyond just technology. Authors who support this lens highlight that technology is not the sole factor that can impact discretion. Instead, technology might serve as a tool and coexist with other factors and impact with each other. Discretionary power is a result caused by the combined influence of environmental factors. As preliminarily presented in section 4.2.1, in Buffat's research (2015), he has systematically categorized and analyzed the 'curtailment' and 'enablement' thesis. Especially, the 'enablement' thesis underscores that technologies, as a contextual factor that work in conjunction with other factors to impact discretion. He pointed out that '*[...] They [curtailment authors] consider new technologies as only one contextual factor among others shaping discretion, focus their attention on various effects of ICT and highlight how both frontline agents and citizens use technologies as action resources* (Buffat, 2015, p. 154).'

On top of that, the continuation thesis, originating from sociology, highlights the response of SLBs toward digital tools. Most research in this field underscores the deviant behavior when SLBs use digital technologies, focusing on the SLBs' personal qualities, such as their perception of technologies, knowledge limitations, which align with the 'micro level' context in Busch and Henriksen's research (2018). However, those personal factors, in reality, combined with other contextual factors, result in the exercise of discretion together. For example, front-line workers use their discretion to respond to policy alienation, which can enhance or undermine policy implementation (Tucker et al., 2022). Besides, social workers and doctors might modify the properties of technologies using some strategies for their purpose to expand their discretion (Huuskonen & Vakkari, 2013).

Moreover, while AI technologies can provide suggestions to police officers, those officers might not blindly trust suggestions offered by AI technology. Instead, they follow AI's advice, only if it aligns with their judgements (Selten et al., 2023). Busch (2017) studies a court case, arguing that technology does not unilaterally influence street-level discretion. Its impact is moderated by contextual elements such as social workers' knowledge, case complexity, and the need for face-to-face contact. This highlights the importance of contextual factors (Busch, 2017). Thus, the discretion of SLBs is influenced by a combination of factors, including personal judgment and specific purposes. Notably, the impact of technologies on discretion in the continuation thesis is usually indirect and subtle, and discretion might not always be evident in certain cases.

Another perspective to view discretion is from Marienfeldt (2024). In her research, she divided digital tools into three categories, based on the role and locus of technologies, i.e., Supportive (common database, archive), leading (case management systems) and divisive (automated decision-making system). However, it seems like the boundaries between those technologies are quite

blurred without a further description. Nevertheless, she compared various organizational contexts and observed the impact of those digital tools on street level decisions. She argued that there is a tendency that rigid system designs reduce discretionary power in service-oriented organizations (De Boer & Raaphorst, 2023). If digital technologies are used for information gathering and decision support, discretion is rather limited. While in regulation-oriented organizations digital tools enable professional judgment through a more comprehensive information base (Marienfeldt, 2024). Her observation provides a perspective to investigate the discretion based on organization context.

Interestingly, Alshallaqui (2022) uses a socio-materiality perspective to understand the interplay between street-level discretion and digitization, and its implications for street-level work. This research reveals that subordinate-supervisor relationships shape how SLBs exercise discretion, and that the introduction of technologies reconfigures these relationships. Alshallaqui argues that street-level and system-level discretion shape each other through a dialectic relationship, rather than displacing each other. The research acknowledges that the enablement and curtailment thesis provide a framework to view street-level discretion. However, the author contends that enablement and curtailment are not mutually exclusive. Instead, the author asserts that the enablement versus curtailment framing falls short of adequately accounting for the multifaceted relationship between street-level work and digitization (Alshallaqi, 2024).

In conclusion, the context-oriented lens reveals that discretion is influenced by a complex interplay of contextual factors, rather than solely by technology. This perspective emphasizes that technology coexists with other factors to shape discretionary power, as illustrated in Buffat's categorization of the curtailment and enablement theses. The continuation thesis highlights the role of personal qualities and contextual elements in the exercise of discretion, noting that technology's impact is often indirect and subtle. Additionally, Alshallaqui's socio-materiality perspective demonstrates that street-level and system-level discretion are mutually inclusive.

Table 7

The Categorization of Discretion (Discretionary framework)

Lens	topics	Functionalities	Empirical Validations
Context oriented lens	Contextual factor (Discretion)	Moderation	(Buffat, 2015; Busch, 2017; Peters et al., 2021)
	Enablement, Curtailment & Continuation	Co-exist: Enablement & Curtailment	(Alshallaqi, 2024)
		Enablement	(Alshallaqi, 2024; Aviram et al., 2024; Bao et al., 2024; Buffat, 2015; Gordon et al., 2024; Marienfeldt, 2024; Meijer et al., 2021a; Peiris et al., 2011; Selten et al., 2023)
		Curtailment	(Alshallaqi, 2024; Aviram et al., 2024; Busch, 2017; Busch & Eikebrokk, 2019; Busch & Henriksen, 2018; De Boer & Raaphorst, 2023; Marienfeldt, 2024; Marston, 2006; I. T. M. Snellen et al., 1998; Wang et al., 2024; Zouridis et al., 2020; Reddick, 2005; Wastell et al., 2010; Saxena & Guha, 2024; B. Bullock, 2019; Meijer et al., 2020; Young et al., 2019; B. Bullock et al., 2020; Breit et al., 2020; Wang & Pan, 2023; Ranerup et al., 2020;)
		Continuation	(De Boer & Raaphorst, 2023; Evans, 2020; Evans & Hupe, 2020; Marienfeldt, 2024; Huuskonen & Vakkari, 2013)
	Organizational context	Regulation-oriented & Service - Oriented	(Bovens & Zouridis, 2002; Marienfeldt, 2024; I. Snellen, 2002; I. T. M. Snellen et al., 1998)

Task oriented lens	Social complexity	Low & High	(Buffat, 2015; J. Bullock et al., 2020; J. B. Bullock, 2019;)
	Decision complexity	Low & High	(Busch, 2017)
	Degree of discretion required	Low & High	(Young et al., 2019)
	Task complexity	Low & High	(J. Bullock et al., 2020; J. B. Bullock, 2019)
	Task types	Determinist & nondeterministic	(Young et al., 2019)
	Risk & Uncertainty	Low & High	(The author, J. B. Bullock, 2019)
Structure oriented lens	Bottom-up & Up-down	Weak & Strong	(Busch & Eikebrokk, 2019)
	Hierarchical & Non-hierarchical	Weak & Strong	(Evans, 2004; Giest & Raaphorst, 2018)
	Bureaucratic form	Low & High	(Buffat, 2015; Bovens & Zouridis)

Note. Summarized by the author.

2. Task oriented lens

This lens is mainly unfolded by the properties of tasks (i.e., types, complexities etc), arguing that different properties of tasks might impact on the discretion of street-level bureaucrats by using technologies. The central idea revolves around whether SLBs' tasks can be automated or replaced by emerging technologies and how different properties of tasks can influence SLBs' discretion. If so, their discretionary space might be further squeezed by those tasks by using technologies. With that reason, a specific analysis is presented as follows:

The degree of discretion required by tasks varies. This being said, if SLBs' tasks require a low degree of discretion, it implies that these tasks might be suitable for automation, as they are often routine and repetitive. Such tasks usually require a relatively low degree of human judgment. Therefore, automation technologies, which rely on large volumes of structured data with embedment of predefined rules, can easily handle this duplicated work. When these tasks are automated, the discretion of SLBs is reduced, as SLBs can no longer exercise their discretion on those fields that have been automated, leaving them with limited room to implement policy and handle casework (J. B. Bullock, 2019).

When it comes to high-discretion tasks, which are generally characterized by poor data quality, uncertainty about success factors, or complex systems that are difficult to model (Young et al., 2019), automation and predictive analytics are not appropriate. These systems require well-defined questions and sufficient data to train their models. In reality, high-discretion tasks are complicated, contextual, and flexible, making it challenging for these technologies to handle them effectively, even with ample data. For example, between 2012 and 2019, 25,000 to 30,000 Dutch citizens were wrongly excluded from daycare benefits due to algorithmic risk analysis that incorrectly flagged them for welfare fraud (Peeters & Widlak, 2023). This underscores the importance of human judgment, professional knowledge, and expertise in managing such tasks. Accordingly, SLBs may need ample discretion to effectively handle these tasks.

Additionally, Young et al., (2019) divide tasks into deterministic and nondeterministic. They argued that deterministic tasks can be executed accurately by using a small number of rules, while nondeterministic tasks are featured as too less or huge information, and their results are impacted and mediated by various contingencies, or competing values that create a frontier of optimal outcomes, rather than a single optimal solution. Thus, they defined artificial intelligence as '*any domain specific system using machine learning techniques to make rational decisions in terms of nondeterministic tasks'* (Young et al., 2019). With the introduction and implementation of AI related technologies, those deterministic tasks have been largely eliminated. As the system or algorithmic designers has programmed pre-defined rules and regulations into technologies based on a huge volume of data. In this case, deterministic tasks can be easily handled by AI. Accordingly, SLBs have no such kind of tasks in their working list, instead, they might seek for other tasks that require more human judgment. In some empirical research, automation of deterministic tasks improves the accountability and work quality of SLBs, as they are freed from administrative overload and have more time to tackle other required tasks (Reddick, 2005).

However, nondeterministic tasks usually require human judgment and discretion, as those tasks are very difficult being defined by rules and implicate many contextual and complicated factors. AI seems to provide a supportive role, rather than replacing human judgment. This is because

nondeterministic tasks usually provide scarce data and algorithms cannot find an accurate pattern based on those data. Hence, contextual factors, such as complexity of human nature and case work, make AI even more impotent, as AI is perceived to be rational (J. B. Bullock et al., 2022). It is difficult for those technologies, even AI, to capture those subtle aspects of reality. Consequently, what we can see here is that human judgment, to a great extent, might not be replaced by automation or other AI based technologies in terms of nondeterministic tasks. This is to say discretion will always remain in those kinds of tasks. AI serves as a tool to provide support to human judgment.

Figure 17

Task Complexity, Task Uncertainty, and Discretion

		Uncertainty	
		Low	*High*
Complexity			
Low		Low Complexity, Low Uncertainty	Low Complexity, High Uncertainty
Task Characteristics:		Few Deviations, High Analyzability	Few Deviations, Low Analyzability
Relative Strengths of Human and AI		AI Dominates	Leaning AI
High		High Complexity, Low Uncertainty	High Complexity, High Uncertainty
Task Characteristics		Many Deviations, High Analyzability	Many Deviations, Low Analyzability
Relative Strengths of Human and AI		Leaning Human	Human Dominates

Note. Source from Bullock (2019), Page 757.

Furthermore, Bullock (2019) argued that artificial intelligence can be seen as an opaque black box where human capacities of certain tasks are overtaken by AI, leading to the concerns regarding control and accountability. Considering these concerns, it is crucial to deploy AI cautiously to replace human discretion. With that reason, for tasks with low complexity and uncertainty, these concerns may be minimized (see Fig. 17), and the use of AI can be encouraged. However, for tasks with higher complexity and uncertainty, AI should be used cautiously (J. B. Bullock, 2019).

The last comment is that the impact of AI on human discretion varies significantly between low-risk and high-risk tasks. In low-risk tasks, AI can reduce the need for human discretion, enhancing efficiency and accuracy. For example, AI chatbots can handle common customer inquiries, such as checking account balances or resetting passwords, without the need for human intervention. This allows human agents to focus on more complex customer issues (Vogl et al., 2020). However, in high-risk tasks, human judgment remains essential, and AI should be used to support rather than fully replace human decision-makers. This is to say, while AI can assist in diagnosing conditions and suggesting treatment plans, the final decision rests with human doctors who can consider the patients' unique circumstances, ethical implications, and potential risks. In addition, Predictive policing algorithms can identify crime hotspots, but decisions on how to deploy officers and handle incidents require human judgment to balance effectiveness with ethical considerations and community relations (Selten et al., 2023). As AI technology continues to evolve, it is crucial to balance its deployment with the need for human oversight, particularly in tasks where ethical and complex decisions are paramount.

3. Structure oriented lens

This lens argues that structure, such as organizational structure, is able to impact SLBs' discretion. Research suggests that ICT have introduced constraints for SLBs. To be more specific, SLBs previously enjoyed full control over decision-making. In spite of that, ICT is now being used for several purposes: improving efficiency (Giest & Grimmelikhuijsen, 2020), reducing administrative costs (Busch et al., 2018), enhancing political legitimacy (Jansson & Erlingsson, 2014). Ultimately, ICT aims to promote fairer decision-making. This shift aligns with top-down policy goals, which view excessive discretion as an obstacle to effective policy implementation.

But from a button-up perspective, SLBs often resist limitations on their decision-making authority. From their perspective, discretion allows them to adapt policies to specific situations and achieve fair outcomes (Busch & Eikebrokk, 2019). Still, ICT can be a double-edged sword. Put simply, ICT provides SLBs with more information (as action resource), potentially increasing control (Bruhn, 2015). Yet, research suggests they can also hinder SLBs's work. For instance, chatbots increase the overload of SLBs due to the immaturity of this technology. Thus, SLBs have to pay extra workforce to compensate for those mistakes made by the immature technology (Vogl et al., 2020). In addition, research also suggests that the decoupling between organizational structure and digital technologies became even wider at street-level, which might pose a constraint on discretion and autonomy of SLBs and even make their tasks even more complicated (Giest & Raaphorst, 2018).

In Giest and Rapphorst's research (2018), they mentioned that bureaucrats in hierarchical organizations may find managerial influence on frontline work less problematic than those in professionalized organizations. This is likely because bureaucrats in hierarchical organizations are accustomed to working with limited discretion and following established rules (called 'weak discretion'). In contrast, professionals expect more autonomy and decision-making power (called strong discretion). They thrive on trust from managers to acquire discretion (Hupe & Hill, 2007), but hierarchical accountability might hinder the autonomy (discretion) of professionals, therefore, they are not willing to use those digital technologies (Giest & Raaphorst, 2018; Gofen, 2014).

In summary, the impact of AI and other government technologies on SLBs' discretion varies across different contexts, tasks, and organizational structures. Three lenses provide a deeper analysis of how technology impacts SLBs' discretion, offering insights into the complex interplay between technology, tasks, and organizational contexts. They underscore the need for a nuanced approach to technology deployment that takes into account these various factors to ensure that technology enhances rather than diminishes the discretion and effectiveness of SLBs in their roles.

4.2.3 From Street-Level to System Level

4.2.3.1 Forcing the System-Level Shift?

With the transformation of SLBs' work process from human interaction to interacting with ICT, the bureaucratic form of those service-providing public organizations moved forward from street-level to screen-level, eventually to system-level bureaucracies (Bovens & Zouridis, 2002). Bovens and Zouridis' seminal work has sparked significant debate among scholars in the field of public administration, focusing on three main themes: i.e., *Whether technologies reinforce or hinder*

transition from SLB to SYB? How did the discretionary power shift from SLB to SYB? and Will SLBs ultimately be eliminated? (Andrews, 2019; Aviram et al., 2024; Vogl et al., 2020).

Recent empirical research has pointed to these questions, suggesting that technologies, especially the increasing use of AI in the public sector, encourage and even force the transition from SLB to SYB (Busch et al., 2018; Wang et al., 2024; Zouridis et al., 2020). Reddick (2015) investigated citizen interactions with e-government, arguing that e-government has evolved into two distinct stages—information dissemination and a transaction-based phase—highlighting a clear connection with the literature on SLB. Built on 'e-government' practice, he further implied that the Internet has enhanced the e-citizen's capacities to interact with governments, which indicated some initial movement from street-level to system-level bureaucracies (Reddick, 2005).

This transition recently has been reinforced by the use of emerging technologies, such as AI, in the public sector. As Bullock et al., (2020) observed: '[...]*the role AI itself may play in moving organizations along the continuum towards system-level bureaucracies. Thus, it seems that by developing the organizational infrastructure for the use of AI furthers the organization along its path towards a more decisive role of ICTs in the decision-making function'* (J. Bullock et al., 2020). In that research, they investigated two cases—policing and AI use in public health insurance administration—to understand how AI has changed the bureaucratic form of public organizations. In the first case, the Los Angeles Police Department employed PredPol and HunchLab in 2008 to detect crimes (Brayne, 2017). Additionally, the New York Police Department used a program called 'Patternizer' to identify criminal patterns. Based on these cases, the authors argue that policing organizations are becoming more integrated and shifting further towards SYB with the increased use of various policing and AI systems.

In another case from that research, the use of AI by the Centers for Medicare and Medicaid Services (CMS) was examined. Authors argued that CMS's extensive experience with large volumes of data, combined with the low levels of discretion required for many tasks, makes it well-prepared for the transition to a system-level structure. These AI applications exemplify this transition to SYB. Accordingly, Bullock et al. (2020) suggested that the use of AI might drive the shift from street-level to system-level bureaucracy. This transition could impact organizational transparency and accountability due to the complexity and automation of tasks. Thus, they conclude that AI's effect on discretion is nonlinear and nonmonotonic depending on the bureaucratic form (Bovens & Zouridis, 2002, p. 200; J. Bullock et al., 2020, p. 202).

Furthermore, Wang et al., (2022) conducted an experiment among members of an urban grassroots governance project in China and found that the use of AI has a negative impact on perceived discretion and a positive influence on willingness to implement. They also argued that the application of AI accelerates the transition of organization toward a SYB, even though these organizations resisted such effort (Y. Wang & Pan, 2024). Furthermore, Aviram et al. (2023) noted that police units are experiencing a technological shift from 'street' to 'screen', and eventually to 'system' technologies. They investigated the transition of Brazilian police officers from the Military Police to the Environmental Military Police (from 'street' to 'screen' policing) to understand how perceptions of 'screen' technologies influence the acceptance of 'system' technologies. They suggested that transitioning from 'street' to 'screen' policing reduces burnout and limits discretion among police officers. This is in line with the argument where the use of technologies limited SLBs' discretion by Bovens and Zouridis (2002). Additionally, authors found

that attitudes towards “screen” technologies predict the willingness to use “system” technologies among SLBs (Aviram et al., 2024), which also aligns with the research from Busch et al., (2018). They concluded that technology has shifted traditional discretionary interventions on the streets to screen-level tasks, where technology is used for information processing in discretionary practices (Busch et al., 2018). Furthermore, Gordon et al. (2024) mentioned that caseworkers use a dashboard to process their work. They must make decisions about what is represented on the dashboard, how often it is updated, and how it is shared, all of which are moments of potential scrutiny for the screen-level bureaucrat. This indicates that technology can indeed facilitate the transition from SLBs to SYBs (Gordon et al., 2024).

In line with previous arguments, Marienfeldt (2024) suggests that the role of caseworkers in a highly digitalized context has been changed. They are no longer traditional SLBs with huge discretion. Instead, with the assistance of technologies, they are shifting to screen-level bureaucrats. This is also validated by other reviewed literature. For instance, caseworkers use client information systems (CIS) to assist and better grip information from clients (Huuskonen & Vakkari, 2013). In addition, they also use case management and workflow systems to handle complicated cases when interacting with clients (Busch et al., 2018). Decision support tools provide suggestions to police officers to judge the criminal cases (Selten et al., 2023). Electronic decision support tools can provide practical assistance to general practitioners (GPs), making routine patient care more efficient (Peiris et al., 2011) . Judges make use of adaptive case management systems to get access to online collections of legal resources (Busch et al., 2018). Teachers use online technologies to interact with students during pandemic periods (Bao et al., 2024). Thus, all those cases show that technology is enabling a certain degree of transitioning by using those government technologies.

Following the above argument, technologies seem to provide an enabling tool for SLBs and, more or less, reduce face to face interaction. As they ‘accept’ or ‘decline’ decisions by receiving those suggestions generated by the decision support technologies and might sit in front of the screen to decide cases. In this sense, their role might have become to shift to ‘screen-level bureaucrats’. These empirical research point out that technology has the capacity to enable the transition from SLBs to screen level bureaucrats. Also, it is worth noting that private companies have gained significant influence in system design, particularly in the development of systems that enable screen-level bureaucrats to carry out regulatory responsibilities (Marienfeldt, 2024). But what still remains unclear is how to define the nature of those private companies that have a strong IT and digital capacity to build large-scale systems, when they co-design or outsource projects from governments? Should they also be categorized into SYB? It seems hard to give a conclusion. But a clear landscape is that current research does not provide enough empirical insight to define the role of private companies when implicating the co-design information systems between public agencies and private companies.

Additionally, Fest et al., (2023) examined the Netherlands police to explore the role of data professionals as a new kind of SYBs. Their research suggested that while these professionals have discretionary power and are aware of public values, they often struggle to translate this awareness into responsible practices. This study reveals a tendency for data professionals to distance themselves from, or downplay, their responsibility through various arguments. This distancing behavior, the authors argue, weakens the crucial link between their discretionary power and their accountability (Fest et al., 2023). Notably, authors mentioned that the introduction of algorithms

into police organizations creates new professionals: the data professional - as SYBs. However, there seems no solid empirical evidence to demonstrate if the Netherlands police has totally transformed to SYB, even though Fyfe and Salet (2019) observed a subtle organizational shift in police organizations in the Netherlands, where ‘abstract police’ has a larger distance to citizens and greater reliance on technological systems (Terpstra et al., 2019).

In addition, Castro (2022) compared two public policies in Brazil and the mixed-ownership company (being seen as SYB in this research) to understand how interorganizational coordination happened in developing information systems in tax collection and basic education policies. The results reveal that the decision-making processes of policies are changed by using ICTs, and disputes are transferred to other locus, which information systems (IS) sometimes hide, sometimes reveal. This illustrates that technologies have capacities to impact the policy design process and will blur the disputes. In this light, those SYBs, especially system designers hold discretionary power to indirectly influence shaping policies.

Nevertheless, research also shows that the transition from SLB to SYB might be hindered because SLBs require input from multiple parties. Especially, at the system level, work in local authorities is complex due to the diverse range of processes that smart technologies need to address and the numerous stakeholders that need to be involved. Thus, it is challenging for authorities to achieve system-level transformation (Vogl et al., 2020). In addition, the transition complicates the execution of legislation, as regulations and laws must be translated into the IS to replace SLBs. This translation can shift power towards the IS and requires thorough validation. If this validation fails, organizations could face severe consequences (Peters et al., 2021). Besides, Peeters and Widlak (2023) introduced the concept of 'Infrastructure-level bureaucracy' - forms of government data exchange - to understand how mechanisms of data exchange have transformed SYB and how its inherent characteristics make it susceptible to generating unintended exclusionary mechanisms. Their findings show that the infrastructural separation of data ownership and primary processes creates unpredictability and unaccountability in decision-making, thus, improving the ‘administrative evil’ (Adams & Balfour, 1998; Peeters & Widlak, 2023).

With those empirical discussions above, three points are underscored: 1. Transitioning to SYB is more complicated than typically anticipated. It involves numerous factors, such as human expenditure on IT infrastructure and personnel, extensive stakeholder engagement, and support from public agencies. Accordingly, transitioning to SLB in practice is challenging. Despite that, with advancements in government digital capacity and continued investment in government technologies, the overall ‘system-level paradigm’ (SYBP) is becoming more attainable. Of note, SYBP, termed by the author, refers to a phenomenon where SLB as a whole has largely evolved into SYB with distinct characteristics. This concept encompasses not only the characteristics of SYBs but also their specific operational features and manifestations etc,. Current empirical evidence is insufficient to confirm the existence of this phenomenon. 2. SYBs might become policy co-designers, when they translate and program regulations and laws into the system. This process grants them huge discretion, as they are a group of people who execute the translation steps and this process is usually opaque, which is also described as ‘black box’. 3. The role and importance of SYBs is further highlighted, with the rapid use of new IS in the public sectors. For instance, research shows that the algorithmic system is developed either by an ICT department or by an external party. Compliance functions or departments ensure that the algorithmic systems comply with rules and regulations. Three interactions emerge in the horizontal relationship among

these organizational elements. These interactions result in a strong and reinforced position for technology-focused actors (e.g., engineers, data analysts) throughout the design process of public algorithmic systems (Nouws et al., 2022).

In conclusion, the transformation of SLBs' work processes from human interaction to interaction with ICT has led to a significant evolution in the bureaucratic forms of public organizations, progressing from street-level to system-level bureaucracies. This shift has sparked considerable debate and research interest in public administration, focusing on the role of technology in reinforcing or hindering the transition, the shift in discretionary power, and the potential elimination of street-level bureaucrats. While technology has enabled the shift towards screen and system-level bureaucracies, the full implications for governance, accountability, and the role of private sector actors remain areas of ongoing research and debate within the field of public administration. Further empirical research is needed to provide deeper insights into these dynamics and to inform policy and practice in adapting to and managing these transformations effectively.

4.2.3.2 Decoupling - an Easy Trap to Fall Into

This systematic review highlights that research on SYB remains predominantly conceptual (Aviram et al., 2024; Hansen et al., 2018), with a notable lack of empirical studies directly examining these bureaucracies. Examples of studies on SYB and SYBs are rare and dispersed, making the topic underrepresented in existing databases. This scarcity is likely due to the limited number of system-level cases (e.g. specific organizations or institutions) that can be studied. Additionally, insufficient resources further hinder the development and study of SYB, resulting in few available subjects for research. Consequently, much of the existing discourse is theoretical. Through systematic observation, I have identified a notable research pitfall that I term 'decoupling'. Below is a specific argument:

Bovens and Zouridis (2002) defined system-level bureaucrats as '*1. Actors, such as system designers, legislative specialists, system managers, are active in data processing. 2. Management who control the production process. 3. 'Interface agents' between citizens and the information system, such as information officers* (Bovens & Zouridis, 2002)*'*. However, current research on SYB seems to be biased towards assuming that data professionals, such as data analysts and system designers, are SYBs, but ignore the bureaucratic nature and form behind those research objects. For example, I have previously mentioned in Fest et al., (2023) research. They clearly defined the research object as data professionals, yet without clearly defending the bureaucratic form of studies organization (i.e. if this organization has transformed to a SYB). In that research, they mentioned some hints that Netherlands Police are transforming to SYB, such as the centralized national police force, primarily responsible for developing and implementing data-practices at the system level. Nevertheless, those signs are not enough to be seen a SYB based on Bovens and Zouridis (2002):

> '[...] *Routine cases are handled without human interference. Expert systems have replaced professional workers.* [...] *there are no other street-level bureaucrats as Lipsky defines them. The process of is- suing decisions is carried out-virtually from beginning to end-by computer system*'

Similar cases exist (Castro, 2022). However, this is not a criticism of such research. Instead, it serves as a general reminder to avoid common pitfalls. It is fully understandable for scholars who

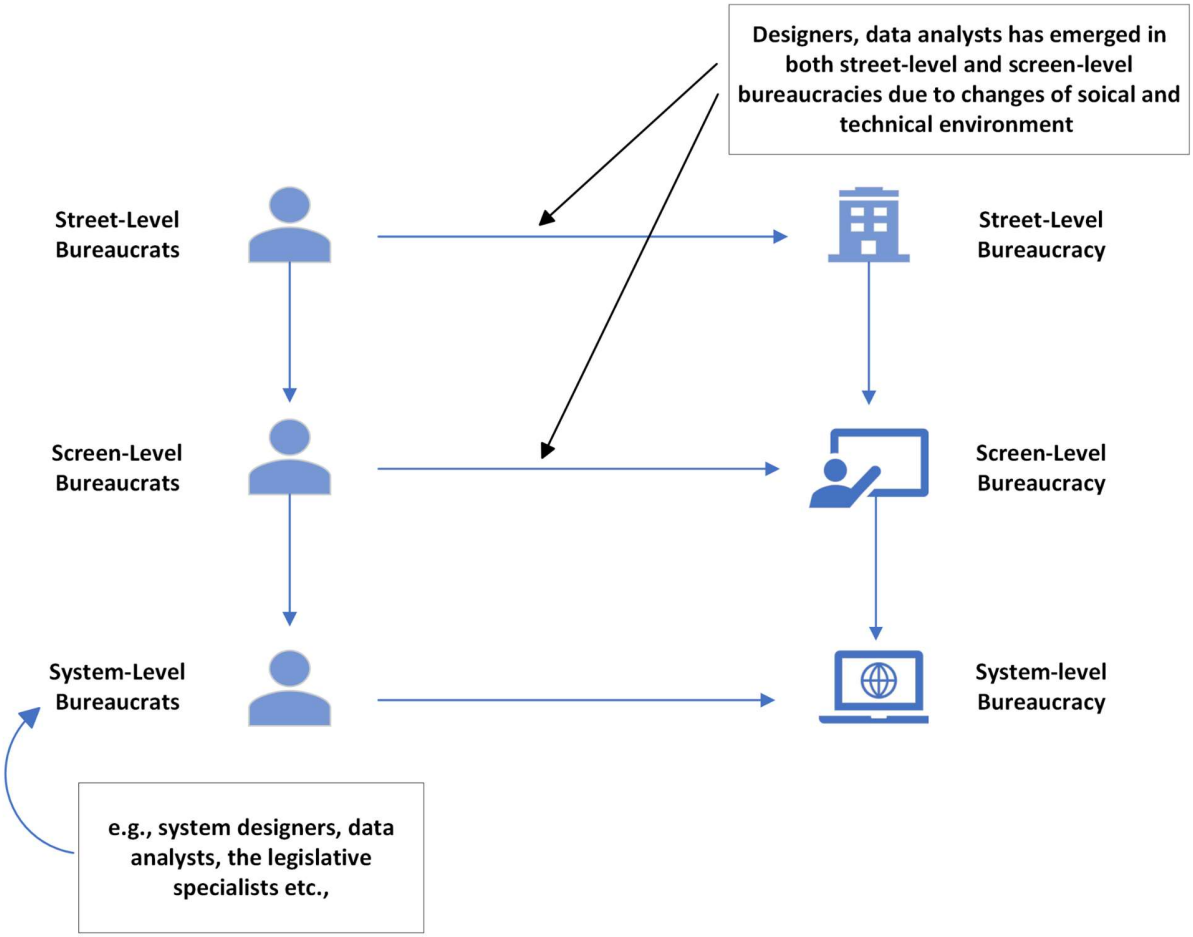
studied police organizations, where human interaction and judgment remain integral due to the complexity of cases and human nature. This is why Bovens and Zouridis (2002) excluded some public organizations, such as education, police and health industries, from their analysis focus. Therefore, if we want to study SLBs in SLB, we should first identify the level (nature) of bureaucracy (e.g. street, screen and system level). This is to say, changes in the nature of bureaucrats are accompanied by changes in the nature of bureaucracies. In this sense, we can not default to the idea that system designers or data analysts are SYBs (they can be, yet with conditions). This led to a phenomenon, which I termed '*decoupling*', where researchers largely overlook the connection between bureaucratic forms and corresponding bureaucrats, when researching system-level bureaucracy. Therefore, it is crucial to break from this stereotype in research.

4.2.3.3 Data Professionals - a New Phenomenon in Street-Level Bureaucracy

Early in the 2000s, when technology was lagging behind and computer applications were just taking off in the public sector, system designers and information experts were scarce resources. Coupled with the scarcity of public sector resources at the time, most technology maintenance and development were provided by external entities (e.g., through outsourcing). However, two decades have passed, and the rapid development of e-government, digitization, and increased government investment in emerging technologies have drastically changed the institutional and social environment. The application of emerging technologies has further exacerbated these changes in the public and institutional environment. Moreover, empirical studies show a growing number of data analysts emerging in different public organizations (Fest et al., 2023; Zouridis et al., 2020). Most studies followed Bovens and Zouridis' (2002) seminal assumption that SLB will finally transform to SYB, which has been supported by substantial empirical research (Buffat, 2015; J. B. Bullock, 2019; Busch & Henriksen, 2018; Vogl et al., 2020).

Figure 18

Illustration of SLBs' Evolution



Note. Source from author

Rapid changes in the external and internal environment have led to drastic changes in the bureaucratic forms of many public organizations. Two decades after the seminal work conducted by Bovens and Zouridis (2022), the role of SLBs, such as social worker, police officers, nurses, is reshaping by the use of technologies (Aviram et al., 2024; De Boer & Raaphorst, 2023; Mathiyazhagan, 2021). In reality, a large number of data analysts and information experts have already emerged in some street-level organizations e.g., police organizations (Aviram et al., 2024; Kang, 2023), educational departments (Bao et al., 2024), as well as health industries (J. Bullock et al., 2020), with the increasing investment on technological capacities of public agencies (see Fig. 18). Not only that, caseworkers who are becoming secondary designers of information systems have mastered some expertise to modify the system, and they can even ask technologists how to optimize the system by redesigning CIS through using workarounds (Huuskonen & Vakkari, 2013). This raises a question: can the rapidly growing number of data analysts emerging in street-level bureaucracy still be characterized as street-level bureaucrats? This is quite arguable, largely not. Bovens and Zouridis (2002) argued that SYBs are former SLBs, but they have fundamental differences and should be examined critically. Thus, it is important to acknowledge the current

emerging trend where data related professionals are growing in the SLB. They have similar functions and roles as SYBs, including to help build the digital capacity of street or screen level bureaucracy and maintain and optimize the system operations. Therefore, this phenomenon indicates that we should not take data related professionals into grants as system-level bureaucrats, as they have emerged in street and screen level bureaucracy.

Therefore, with today's social and technological context, we need to take a dialectical view of professions such as 'data analysts' due to the growing number of data professions in public sectors (Fest et al., 2023). I argue that these data analysts should not be pre-assumed to be SYBs, and their roles are flexible, in the sense that they can exist in all levels of bureaucratic forms. Moreover, their role is to strengthen the nature of street-level organizations' transformation into system-level organizations. Essentially, whether data analysts are considered SYBs depends on whether the organization they work for has achieved a system-level bureaucratic form, rather than simply assuming their status based on their data-related roles.

Table 8

The Features of Street-Level, Screen-Level and System-Level Bureaucracies

Characteristics	Street-level bureaucracy	Screen-level bureaucracy	System-level bureaucracy
Organizational role of SLB	Autonomous professional	System operator	System facilitator
Human interaction	Full interaction	Partial interaction	No interaction
Role of technology	Information processing tool	Decision support	Autonomous decision-maker
Resource use	Less efficiency	More efficiency	High efficiency
Individual attention	Full attention to client concerns	Partial standardization of decision-making process	Standardized, non-reversible decisions

Note. Sources from Busch et al. (2018), Page 548.

Another comment should be mentioned is that current research lacks clear standards for determining the level of bureaucratic organization. Many empirical studies might mistakenly equate street-level Bureaucracies with screen-level bureaucracies based on superficial characteristics, such as SLBs using technology and reducing interaction with citizens. This simplification could lead to misunderstandings in the field. In future research, scholars should strive to rigorously define the organizational nature of bureaucratic form based on features based on each layer (see Table 8). This is important for two reasons: 1. It enables a more accurate assessment of whether 'system-level bureaucracy' represents a distinct bureaucratic form or merely a paradigm shift. 2. It helps reduce research ambiguity and promotes a more nuanced understanding of the transition from street-level to system-level bureaucratic organizations.

Furthermore, empirical observations tend to overlook the roles of legal experts and management and control personnel in the production process as SYBs. Bovens and Zouridis (2002) proposed three categories of SYBs, but only data professionals are being explored. This oversight may stem from the fact that system designers more readily embody the characteristics of SYBs, making them easier to identify in empirical studies. However, other roles, such as legislative experts and legal policy personnel, also play significant roles. Their involvement in activities such as collaborating with system designers and embedding laws into software highlights their importance. Therefore, future research should expand its focus to include these often-neglected roles and investigate their contributions to the transition from street-level to system-level organizations.

4.2.3.4 Will Technology Replace Humans?

There is an ongoing debate in academia about whether emerging technologies will replace SLBs, with advancements in technology intensifying this discussion. Two main arguments arise from the reviewed empirical research. Proponents of SLBs argue that they are irreplaceable because emerging technologies, such as AI, cannot handle the subtle aspects of social complexity. They believe human judgment is necessary to manage the intricate nature of street-level work. Opponents, however, argue that technologies, including AI and automation, will largely replace SLBs' work, gradually narrowing their scope and ultimately transforming these roles into SYBs. In this view, SLBs will be replaced by system designers and data professionals who design and maintain systems. Citizens' judgements and interference is seen as a disruption and being avoided (Zouridis et al., 2020). As noted in section 4.2.3.1, this shift creates 'blind spots' where SYBs translate predefined rules and regulations into systems that replace human work, thereby shifting discretion from SLBs to SYBs. The following section will present and analyze these two arguments and provide a brief conclusion.

1. The irreplaceability of human judgment

The essence of human judgment is closely akin to human discretion. When SLBs need to make decisions in their work, they rely on human judgment. Without discretion, however, SLBs cannot effectively utilize their judgment. Therefore, discretion is a crucial concept in understanding the irreplaceability of human judgment. Scholars generally assert that the complexity of cases is a key factor in why SLBs' discretion remains essential and cannot be eliminated. Buffet (2015) argued that technologies cannot fully replace the human judgment of SLBs, a perspective prominently supported in policing research. Studies on the Netherlands Police (Aviram et al., 2024; Fest et al., 2023; Meijer et al., 2021a; Meijer & Wessels, 2019) indicate that no decision-making system without human intervention has been adopted. Consequently, police officers retain significant discretion, using their expertise to make quick decisions and evaluate the recommendations from decision support tools. Selten et al. (2023) discovered that police officers do not blindly follow AI recommendations; rather, they trust only those that align with their own judgment. This finding supports the argument put forth by Barkat and Busuioc (2021), who contend that decision makers tend to trust AI recommendations when they align with existing stereotypes and biases. This type of research suggests that AI serves as a tool to support rather than replace the work of SLBs, with SLBs ultimately being the final decision-makers.

Similarly, Bullock (2019) asserted that AI is more likely to be employed to automate or augment routine tasks with low complexity, while tasks that are uncertain and difficult to analyze are less

likely to be affected. Findings suggest that AI are more likely to impact SLBs in practices with low technical complexity. However, they cannot replace human judgment in practices with high technical complexity, thus limiting their impact on street-level bureaucrats engaged in these practices. This argument is further supported by the research conducted by Zouridis et al. (2020). They argued that the crucial criterion for using automated systems is distinguishing between easy and hard cases. Easy tasks can be handled by programming rules into systems, which can then manage them using predefined routines, effectively replacing human judgment. However, they also acknowledged that difficult cases should be handled by civil servants. In particular, cases involving international factors cannot be managed by automated systems because the necessary data cannot be digitized, or converting valid laws into programming code is too complex and costly (Zouridis et al., 2020). In line with that, even with the advancement of AI technologies, it is hard for a computer to access what is in the best interest of children in child protection cases (Busch, 2017).

An interesting point to understand why humans can not be replaced is that technologies need human expertise and knowledge to adjust their errors and deal with uncertain situations. Pääkkönen et al. (2020) argued that discretionary decision-making power in algorithmic systems accumulates in areas where uncertainty about the algorithms' operation persists. They emphasized that human discretion is essential in these systems to manage uncertain situations that rigid algorithms cannot handle (Pääkkönen et al., 2020). Therefore, SLBs' discretion is unlikely to be eliminated due to the requirements of human judgements from algorithmic systems.

Moreover, Hansen et al. (2018) investigated Norwegian Labor and Welfare Administration (NAV) to understand whether screen-to-screen encounters have replaced face-to-face interactions. Their findings suggest that screen-to-screen interactions generally do not replace face-to-face encounters, as many interactions involve a combination of both types. For some groups, such as new retirement pensioners and individuals receiving family benefits, new technology has partially replaced face-to-face contact. However, for these same groups, the most typical pattern is to combine ICT with face-to-face contact. The findings illustrate that many individuals face complex problems that do not fit into predefined algorithms, in this case, the web solutions are still not optimal for hybrid paper or digital forms (Hansen et al., 2018).

In line with that, Pokharel et al. (2023) utilized a dataset combining demographic and household information with details on homelessness interventions to examine SLBs' behaviors. They discovered that caseworker decisions are largely predictable, with much of this predictability explained by straightforward decision rules. However, decisions not accounted for by these rules represent instances of caseworker discretion, which are notably non-random. Patterns emerge in both the characteristics of the households involved and the outcomes of these discretionary decisions. Caseworkers tend to exercise discretion primarily with households considered less vulnerable. Interestingly, when they use discretion to assign these households to more intensive interventions, the resulting marginal benefits are higher compared to random assignment. Conversely, there is no reduction in marginal benefit for households receiving less intensive interventions through discretionary allocation. This suggests that caseworkers effectively improve outcomes by leveraging their expertise (Pokharel et al., 2023)..

Additionally, research also demonstrated that technologies will not eliminate SLBs' discretionary power, rather they obscure it. For instance, front-line bureaucrats cope with the implementation of

e-government policies by rationing or routinizing their efforts. In screen-level bureaucracy, the tension between rules, norms, and front-line situations will no longer lead to ground-level negotiation on how to implement the law, thereby removing civil servants' normative judgment. Therefore, the adoption and use of ICT do not eliminate discretionary power but rather obscure it (Cărăuşan, 2017). Research aligned with this argument also reveals that while ICT creates more data on SLBs' decision-making and compliance with legal criteria, it lowers the quality of supervision by middle managers. Therefore, discretion does not disappear from SLBs but continues to exist due to the mixed and ambiguous effects of ICT tools on their daily work. Moreover, Jorna and Wagenaar (2007) tested the relationship between informatization and operational discretion in two large scale and automated Dutch public agencies, they found a similar conclusion that informatization does not destroy operational discretion, but rather obscures discretion (Jorna & Wagenaar, 2007).

Another interesting argument comes from Marinho (2022), who cautioned against assuming that the introduction of digitized and algorithmic systems in SLB will necessarily have negative effects. Marinho argued that new forms of exercising discretion can emerge when humans are involved at any level of the policy cycle (Marinho, 2022).

2. The fading human footprints

Some empirical researchers argue that discretion will be partially or fully replaced by the introduction and advancement of technologies. This is interesting as it also somehow indicates to which extent will human judgment be replaced. As mentioned in section 4.2.1, Busch and Henriksen (2019) introduced the concept of 'digital discretion,' describing how ICT can impact or replace human judgment. A year later, Young et al. (2019) contended that digital discretion fails to address the implications for public administration. To bridge this gap, they developed the concept of 'Artificial Discretion,' highlighting the potential for artificial intelligence to affect governmental operations both positively and negatively. In their research, the authors define AD as situations where artificial intelligence augments or automates administrative discretion. Additionally, Zouridis et al. (2020) coined the term 'Automated Discretion,' arguing that the rise of data science techniques and continuous small-scale 'bricolage' of increasingly complex systems has led to new forms of discretion, though they did not provide a clear definition. These various forms of discretion demonstrate the extent to which different technologies may replace human discretion, suggesting that technology has the potential to fully replace human judgment. This aligns with Bovens and Zouridis's (2002) assumption that SLBs' discretion is diminishing, with discretionary powers shifting to SYBs.

However, most conclusions of these studies remain inconclusive, often using subtle language that leaves room for interpretation. The transition from SLB to SYB is still largely theoretical and conceptual, and the impact of technologies and users within organizations is complex and difficult to understand. Some research even shows that SLBs have not shifted towards the characteristics of SYBs. Hansen et al. (2018) investigated the NAV, a frequently studied case by Norwegian researchers, and found no clear signs of NAV developing towards SYB. Their findings align with other international studies, which also indicate that few cases show evidence of a transition from SLB to SYB (Aviram et al., 2024; Buffat, 2015; Reddick, 2005). In their investigation, new technologies have not replaced face-to-face communication due to the complexity and difficulty SLBs face in using new ICT systems. Instead, NAV operates as a hybrid organization, combining

both digital and traditional communication methods. This supports the view of some scholars that the assumptions of Bovens and Zouridis remain largely theoretical, with empirical evidence not yet providing a persuasive conclusion (Aviram et al., 2024; Campion et al., 2020).

In some cases, research has shown that technologies might have little or no impact on SLBs' discretion. For instance, technology doesn't necessarily restrict SLBs' discretion due to moderating institutional factors. These factors include the social complexity of the cases they handle, the advocacy skills of the caseworkers and their clients, and the specific technology itself (Busch, 2017). This illustrates that the impact of technology on discretion is not always straightforward and can vary significantly depending on the context.

In section 4.2.2, I summarized three lenses, including a task-oriented lens divided into four layers: *complexity, types of tasks, risk and uncertainty*. In line with the discussion in 4.2.3.4, the full replacement or automation of human tasks typically occurs in simple cases that can be managed by systems programmed with pre-defined rules and regulations. However, in the cases of these four layers, current technology struggles to fully automate high-level or complicated cases. This is because machine learning algorithms often lack the necessary data or information and cannot discern the subtle aspects of these tasks.

Some scholars argue that automation can replace the work of SLBs, but this argument is highly context dependent. Automation is effective only for SLBs handling simple cases (Busch, 2017; Young et al., 2019). However, due to social and technical complexity, cases can always become complicated, making it difficult for AI or other smart technologies to completely replace SLBs' discretion. Consequently, a full transition from SLB to SYB is challenging. This observation leads me to argue that the shift to SYB is a highly contextual phenomenon. For SLB where human judgment is crucial, a complete shift to SYB is nearly impossible, as SLBs within Street-level bureaucracy are always needed to handle tasks that systems cannot automate. Research has shown that SYBs are often disconnected from the work of SLBs, meaning that SYBs might have little understanding of what SLBs are actually doing (Bovens & Zouridis, 2002). Hence, SYBs cannot fully serve the role of SLBs. On the other hand, in large-scale executive agencies where work is highly routine, transitioning to SYB is much easier and more likely. Some research has already demonstrated such transitions.

Accordingly, I argue that the transition from SLB to SYB is a highly contextual phenomenon, rather than simply seeing it as a process, depending on the nature and types of public agencies and the impact of contextual factors on SLBs. While large-scale executive agencies may find it easier to transition to SYB, organizations heavily reliant on human judgment may find it challenging, if not impossible, to fully make this transition.

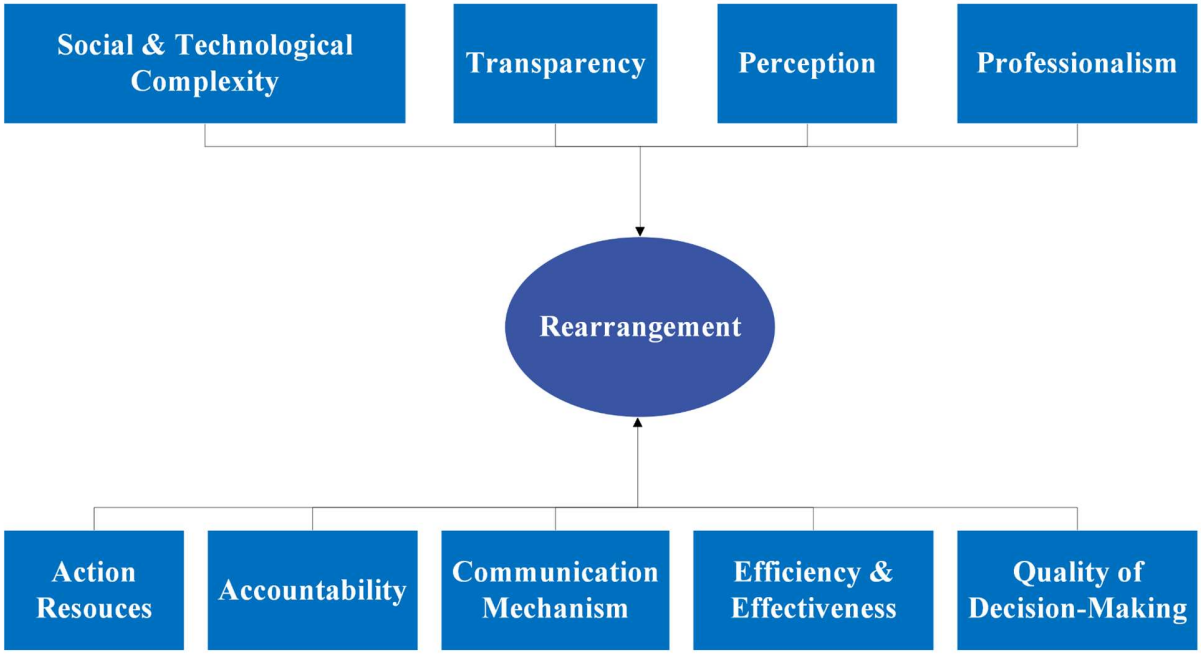
4.3 Rearrangement

The increasing use of digital technologies in SLB has facilitated and even forced the transition process (Bovens & Zouridis, 2002; J. Bullock et al., 2020; G. Wang et al., 2024). This transition underscores the impact of government technologies on SLBs' work, particularly in how these technologies rearrange their tasks. The review of empirical research reveals that government technologies can have both enabling and hindering effects on individuals' work, as noted by many scholars (Bovens & Zouridis, 2002; Buffat, 2015; Veale & Brass, 2019). However, a systematic

examination of this process remains unclear. From the literature review, I identified two types of thesis—facilitation and impediment—and summarized their characteristics in Table 9. Based on this table, I extracted nine main themes (see Fig. 19) to illustrate how technologies will impact SLBs's work. This section will present a detailed analysis of these themes.

Figure 19

Nine Main Themes to Study Rearrangement



Note. Source from the author.

1. Action resources

Buffat (2015) introduced the 'enablement thesis,' which emphasizes how technologies can provide frontline workers and citizens with additional resources for action. This research adopts this concept, defining action resources as tools that facilitate SLBs' daily work, such as saving time, providing information (Busch, 2017), and reducing costs (Busch et al., 2018). In addition, Bovens and Zouridis (2002) argued that the use of ICT in public services can significantly reduce administrative costs and provide high-quality information, leading to better decision-making by giving SLBs a stronger foundation for their decisions (Busch, 2018).

Furthermore, ICT, as an action resource (Buffat, 2015), have been used to address issues such as hindering manipulation of information streams (Peeters & Widlak, 2018), detecting fraud (Bullock et al., 2020), and mitigating biases (Wenger & Wilkins, 2008). Digital technologies also differ from traditional assessment forms by having a higher capacity for information processing and the potential to disintermediate SLBs (Dunleavy et al., 2006). All of these cases demonstrate that the action resource will essentially impact the SLBs' work and enable, or hinder, their rearrangement.

On top of that, Busch (2017) also investigated a court case, demonstrating that ICT can provide judges with more information about court practice much faster compared to two decades ago, when

judges had to rely on heavy books and often lacked access to certain legal sources. In this context, ICT has significantly improved the basis for decision-making. Similarly, Løberg (2020) examined how frontline workers in the NAV perceive the efficiency of electronic communication with clients. The research found that electronic communication technologies save frontline workers' time, making them more available for clients and reducing the cost for clients to seek services. However, Løberg also noted that electronic communication can increase the demand for services, suggesting a potential resource trade-off between service efficiency and availability. In short, action resources are a pivotal factor to examine the SLBs' work as well as the rearrangement of their work (Løberg, 2021).

2. Accountability

Empirical research indicates that government technologies can potentially enhance accountability in various ways. Reddick (2005) argued that e-government benefits the public sector by reducing the discretionary power of SLBs, thereby enhancing bureaucratic accountability. Additionally, e-government also reduces transaction costs (action resource) by automating public service provision, eliminating the need for extensive staffing. Supporting this, Gordon et al. (2024) studied municipal employees in a large northeastern U.S. city and found that dashboards, while increasing accountability, also impose pressures on employees to provide constantly updated and outward-facing data to meet external stakeholder demands. Some of those SLBs' work (usually referring to those simple cases) was freed by technologies, they, then, have more time to deal with complicated cases, which further enhance their job quality and responsibility. Nevertheless, technologies might not necessarily impact accountability, but it might change the place where the accountability comes from. Petrakaki (2017) argued that e-government significantly changes the organization of public sector work by digitizing structures and information. These changes do not necessarily improve or weaken accountability but rather shift its sources, thereby altering the locus of accountability within the public sector. Accordingly, we should consider accountability as a factor when examining the rearranging process of SLBs.

3. Communication mechanism

Using technologies effectively enables forming a good communication mechanism, which is crucial for SLBs to leverage technologies to streamline processes, reduce response times, and enhance service delivery (Veale & Brass, 2019). By clearly conveying the use and benefits of technologies such as e-government platforms (Buffat, 2015), SLB can promote transparency, allowing citizens to understand decision-making processes and resource allocation (Giest & Grimmelikhuijsen, 2020). Moreover, transparent communication about technology implementation and its impact fosters trust between the government and its citizens (Mahmood et al., 2020). Additionally, clear communication ensures the proper allocation and utilization of resources, preventing duplication and promoting cost-efficiency. Conversely, inadequate communication can result in siloed operations, where government agencies fail to collaborate effectively, leading to fragmented and inefficient technological implementations (Giest & Raaphorst, 2018; Saxena & Guha, 2024; Wastell et al., 2010). Thus, communication mechanisms should also be incorporated into account.

4. Efficiency and effectiveness

Efficiency and effectiveness are also key indicators for understanding how technologies impact SLB's work, with results that can either enable or hinder their performance. Geist and Paaphorst

(2018) suggest that managers and SLBs operate within a principal-agent relationship, where managers often face an information deficit regarding the actions of street-level workers. These workers might pursue personal goals or make decisions misaligned with broader organizational objectives. To address this, managers employ IT tools, such as decision support technologies, to monitor the decisions of SLBs, reducing information asymmetry and giving managers more control. This oversight allows managers to compare actions and decisions across different bureaucrats and standardize these decisions by providing clear guidelines.

Research also indicates that negotiations between SLBs and other bureaucrats, driven by the development and maintenance of IS, promote policy coordination. These negotiations help develop IS that generate the necessary information and actions for effective policy coordination and implementation, thereby improving implementation efficiency (Castro, 2022). However, in the context of UK local authorities, while AI technologies like chatbots might replace human work, they also increase SLBs' workload, as SLBs must correct errors caused by these technologies and ensure the system remains useful and usable. Therefore, technologies have either 'enable' and 'hinder' capacity, as noted in TTU framework, to impact efficiency and effectiveness (Vogl et al., 2020). For this reason, it is important to incorporate this dimension into the rearrangement SLBs's work.

5. Quality of decision-making

The quality of decision-making involves the discretionary changes caused by the use of technologies by SLBs. Most research in this field focused on how government technology affects SLBs' discretion, revealing that technologies often curtails SLBs' discretion. However, the impact of government technology on the quality of decision-making has been less studied. Examining decision-making quality from empirical research can help to better understand the rearrangement of SLBs' work. For instance, algorithms can enhance decision-making processes by collecting and processing information from various sources, as seen in the roles of judges (Busch et al., 2018), police officers (Aviram et al., 2024), and case workers (Ammitzbøll Flügge et al., 2021). Digital regulatory technologies also influence police officers to be stricter in their discretionary practices, with enforcement attitudes acting as intermediaries. Both official and private digital regulatory tools encourage bureaucrats to enforce decisions more stringently. In this case, technologies can force them to make cautious decision making, thus, improving the quality of decisions (Wang & Pan, 2023).

Additionally, digitization has reduced the number of requests processed daily by frontline workers, allowing monitoring department staff to focus on identifying and questioning unsanctioned requests. In other words, they have more time to process casework and carefully make decisions (Alshallaqi, 2022). Besides, smart technologies, such as computerized systems, assist in decision-making during complex and time-pressured situations by providing guidelines, intervening in service decisions, and using machine learning algorithms to predict future outcomes (Rogge et al., 2017). Predictive analytics enhance collective intelligence and create a positive feedback loop for data collection, processing, and presentation (Vogl et al., 2020). However, the effectiveness of these technologies heavily relies on the contextual knowledge that SLBs contribute to the design process. Furthermore, AI systems have significant potential to enhance bureaucratic decision-making, as they generally offer greater accuracy than human decision-makers by leveraging large volumes of data. Additionally, these systems' predictions typically exhibit less noise and unwanted

variability in judgments, making the decision-making process more precise and reliable (Sunstein, 2022). With those cases, incorporating quality of decision making as a dimension is crucial to investigate the rearrangement of SLBs' work.

6. Social and technological complexity

Social and technological complexity refers to the multifaceted and interconnected nature of social and technological systems, which can hinder SLBs' work. By considering both social and technical aspects, we can better understand the external factors that influence the rearranging SLBs' tasks. Yeung (2019) suggested that citizens' legitimate interests prompt them to seek competent human intervention to contest automated decisions. However, human oversight may be impractical if the system employs independent machine learning dynamics that operate at speeds and with complexities beyond human monitoring capacity (Yeung, 2019, p. 25). This highlights the technological complexity of algorithmic systems and the potential dangers posed by machine learning. Moreover, ICT systems are traditionally designed by system designers who often lack extensive experience in street-level work (Bovens & Zouridis, 2002). This might cause some technical problems, as these designers translate ambiguous laws and regulations into system architectures, implicating some human factors, such as human nature, discretionary use, which further results in the instability of the system. This is supported by the fact that these algorithms significantly influence policy implementation outcomes (Henriksen, 2018).

Additionally, Sheikh et al. (2011) further observe differences between senior and junior clinicians in the use of such software, influenced by hospital hierarchies. Senior clinicians can delegate online data entry to junior staff while maintaining their traditional paper-based record routines. Campbell et al. (2006) also note that when systems fail to fully support one clinician's workflow or delay processes, workload is redistributed, leading to frustration and ineffective workflow synchronization. Both cases reveal some subtle social and technological aspects on the use of technologies, which require us to evaluate both factors when considering the rearrangement of SLBs' work.

Research also demonstrated a discrepancy between caseworkers' informal discretion and their actual practices under information technologies. This disparity means that while managers may believe their goals have been achieved through digital records, the reality may be quite different. For instance, caseworkers may continue to use paper-based records and only enter information into the digital system much later (Geist & Raaphorst, 2018; Wastell et al., 2010). Accordingly, when instigating the rearranging process, how those complexity can hinder SLBs' work and what strategies can be used to mitigate those mistakes should be examined carefully.

7. Transparency

Existing empirical studies indicate that technologies can enhance information transparency for citizens and provide them with action resources by facilitating certain functions (Buffat, 2015). Supporting this, De Corte et al. (2019) argued that standardized documentation processes in technological platforms improve transparency. This is because standardized documentation makes it easier to locate and access information. When documentation follows a consistent structure, users know where to find the information they need, making the whole process more transparent (De Corte et al., 2019).

Breit et al. (2021) suggest that digital follow-up systems in NAV increase frontline workers' availability to clients by allowing workers to "outsource" certain responsibilities to clients through digital platforms, thereby reducing the "noise" from incoming inquiries. This increased transparency in service interactions also encourages workers to be more careful about their communications with clients. However, Pithouse et al. noted that while ICT promotes transparency, it can also mask actions behind the apparent accountability of ICT. (Breit et al., 2021). Similarly, government technologies have the potential to make interactions more transparent, but they can also operate in an opaque and unaccountable manner, as seen in some cases involving police (Bloch-Wehba, 2020). Therefore, the information and interaction transparency should be thoroughly examined.

8. Perception

Perception refers to how SLBs view the use of technologies, which can manifest either positively, such as through active acceptance, or negatively, such as through automation bias. Understanding SLBs' perceptions of technology is significant as it influences SLBs' insight into how to integrate technologies into their work. For example, SLBs might resist using emerging technologies due to a lack of knowledge, leading to fear and reluctance (Arni & Schiprowski, 2015). Consequently, understanding SLBs' perceptions also indicates the extent to which they use technology to re-organize their tasks.

Empirical studies highlight different aspects of this phenomenon. Aviram et al. (2023) found that the perceived usefulness of technologies and the fear of being monitored are crucial indicators for predicting acceptance. They argued that there is a tradeoff between using technology to expand discretion and achieve individual goals, and the managerial monitoring that these tools enable. This tradeoff is evident in police officers' perceptions of the shift to "system" technologies. While the usefulness of technology in helping police officers achieve their professional goals positively predicts acceptance, the perceived monitoring negatively affects their acceptance. Furthermore, empirical research also indicates that automation can enhance the practical implementation of operating programs (Buffat, 2015) and reduce machine bias through human backtesting and feedback (Raisch & Krakowski, 2021). However, digitalization often makes decisions by SLBs more rule-oriented and less tailored to individual citizens' circumstances (Busch & Henriksen, 2018; Miller & Keiser, 2021).

In addition, Snow (2020) proposed a conceptual framework to investigate how SLBs interact with algorithmic decision tools (ADTs), examining whether they display algorithm aversion, defer to automation bias, or combine automation bias with their own judgment (a process termed artificing by author). The research indicates that artificing is the most common interaction type, followed by aversion, with deference being rare. Snow argued that factors such as understanding of the tool, human judgment, perceived value of the tool, opportunities to modify the tool, and alignment of the tool with user expectations significantly influence the use of ADTs. This research underscores the importance of perception in determining the acceptance of algorithmic tools (Snow, 2021). Similarly, Stelten et al. (2023) found that police officers do not blindly trust AI technologies but tend to follow AI recommendations that align with their preexisting beliefs. This highlights the potential for street-level discretion to correct faulty AI recommendations, yet it also underscores the limitations of relying on AI to eliminate human biases. Additionally, research suggests that the persuasiveness of computers can lead street-level bureaucrats to set aside their experience-based

judgment in favor of computer-recommended solutions (Busch, 2017; Wihlborg et al., 2016). This phenomenon emphasizes the complex dynamics between human discretion and technological influence in decision-making processes. Therefore, it is important to understand the various perceptions SLBs have about using government technologies, as these perceptions will impact their use of such technologies.

9. Professionalism

Professionalism refers to the competence, skill, experience, and knowledge of professionals, and in this review, digital literacy is also incorporated. Professionalism impacts SLBs' abilities to tackle their daily routines, especially as they navigate new technologies. For example, caseworkers must update their technological knowledge and adapt to new situations involving the use of technology in their work. Effective use of these technologies is crucial, as failure to do so can burden them and hinder job performance. This can lead to resistance, neglect, or even defiance against using technology (Busch et al., 2018).

Empirical evidence shows that the complexity of technologies affects not only SLBs' acceptance of them but also compels SLBs to acquire new expertise to manage their daily tasks. Busch (2017) found that judges, who are typically older and less familiar with computers, struggle to handle digital tools effectively. Although courts provide internal training, this increases judges' workloads and demands higher digital proficiency. The author argues that the extent to which ICT can offer judges more relevant legal sources and a better basis for judgment depends on their skills (Busch, 2017). This skill gap might cause judges to miss crucial information because they are unable to use all the functions provided by the database system. These findings highlight the importance of digital literacy as a component of professionalism for SLBs. Ensuring that SLBs are proficient in using new technologies is essential for improving their job performance and reducing resistance to technological adoption.

Moreover, Gordon et al. (2024) found that the pandemic forced people to realize the insufficiency of existing datasets. Consequently, there was a need to reconsider data collection methods to seamlessly integrate new data into daily work. This situation required SLBs, especially those with low digital capacities, to acquire new knowledge and skills. As a result, their capacity and professionalism improved, enhancing their ability to handle their work effectively (Gordon et al., 2024). On top of that, Breit et al. (2020) also suggested that digitalisation can free up capacity and allow frontline employees to better manage caseloads and handle complicated cases. Thus, based on empirical evidence on professionalism, we should be incorporated into the examination of SLBs' work rearrangement.

Table 9

Facilitation and Impediment of technology on SLBs

Function	Level	Main Themes Derived from Service supply-side	Service Supply-Side	Service Demand-Side
Facilitation	Micro-Level	➢ Action resources ➢ Accountability ➢ Communication ➢ Quality of Decision Making ➢ Efficiency and effectiveness ➢ Perception ➢ Professionalism ○ Digital literacy ➢ Transparency	- Action resource (information, time, cost etc) - Accountability - Availability of services - Better communication - Improving working quality - Improve decision making - Information processing abilities - Professionalism (e.g. expertise and knowledge) - Prevent personal bias - Reduce information asymmetry - Reinforce enforcement style	- Better communication - Cost Savings - Customization and Personalization - Convenience and efficiency - Enhanced service quality - Increased accessibility for public services - Preventing discrimination - Transparency
	Macro -level		- Enable collective intelligence - Prevent bureaucratic bias - Manipulation of information - Lower administrative cost - Transparency (Interaction) - Corruption - Policies coordination	- Better policy coordination and implementation - Citizen engagement and participation - Empowerment - Improved accessibility for Government Information - Reduced corruption and fraud - Support for social inclusion and equity

Impediment	Micro-Level	➢ Efficiency and effectiveness ➢ Perception ➢ Professionalism ○ Digital literacy ➢ Digital complexity ➢ Professionalism	- Automation bias - Costs and Budget Constraints - Data overload and Information Complexity - Digital divide - Disparity among caseworks by using technologies - Extra workload - Resistance to Change and Training Needs - Require digital capacity - Miss crucial information	- Automation bias - Communication barriers - Complexity of Technology - Data overload and information complexity - Digital divide - Digital Literacy and Access - Digital divide - Limited human interaction - Resistance to change and complexity - Privacy concerns
	Macro-level		- Blur policy design process - Blur responsibility - Beyond human supervision - De-citizen centric - Legal and Ethical Concerns - Unfairness	- Digital exclusion - Economic disparities - Inequality in Service Delivery - Impersonal and inflexible Processes - Legal and Procedural Complexity - Legal and Ethical Concerns

Note. The micro level in this table pertains to individual factors. In contrast, the macro level refers to more abstract factors that extend beyond the individual level. The themes summarized in the table are only for the service supply side. Besides, this table is summarized by the author.

4.4 Integration of Empirical Evidence with the TTU Framework

This section aims to synthesize and integrate the empirical evidence from the reviewed literature with the TTU framework. Section 4.4.1 discusses why the TTU framework aligns with the existing empirical evidence, followed by a detailed analysis. Section 4.4.2 articulates three specific relationships.

4.4.1 Explanation of Framework Compatibility

The TTU framework aims to examine the dynamic interactions among three actors: technologist, technology and users. It seeks to bridge the understanding gap on how technologists and users interact by addressing the discontinuities of time and space through the use of technologies (Giddens, 1986; Orlikowski, 1992). The reason why TTU framework fits with reviewed studies is that the roles of users and technologists directly correspond to SLBs and SYBs respectively. This is to say, SLBs, who typically handle frontline casework, frequently use technologies within their organizations, either to assist in deriving more information with their purposes or as mandated by their organizations. Thus, they are users of government technologies. Moreover, as SLBs regularly use these technologies in their daily work, they draw on their knowledge, resources, and norms, shaping the organizational structure. This process enacts a set of rules and resources, gradually influencing the structure of their organization, which align with the central assumption of TTU framework.

The transition from SLB to SYB involves the role of SLBs gradually transforming into SYBs, including system designers (Bovens and Zouridis, 2002). In this case, SLBs might be replaced by automation through technologies, leaving only SYBs to maintain and update the system for public services. Therefore, SYBs in this context are equivalent to technologists within the TTU framework. Following this logic, we can use the concepts of ‘SLBs’ and ‘SYBs’, corresponding to users and technologists, to explore and validate the TTU framework. By examining this transitioning relationship, the reviewed literature is used to validate the framework's applicability and usability. With these reasons, the following passages will form a dialogue around 1. the transitioning relationship from SLB to SYB. and 2. SLBs and SYBs.

4.2.2 Technology, Technologist and Users

Table 10 presents an overview of the literature on three key relationships. As shown, most of the reviewed literature focuses on the relationship between technology and users, followed by the relationship between technologists and technology. Besides, the relationship between technologists and users has less empirical research, which might limit the ability to validate related hypotheses. A specific analysis of each section is provided as follows:

Table 10

Overview of Literature regarding Three Relationship

Relationship (Mutual)	Reference
Technology - User	[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,30,31,32,33,34,35,36,37,38,39,40,42,43,44,45,46,47,48,49,50,51,52,53,54,56,57,59]
Technologist - Technology	[1,2,4,6,9,10,11,13,18,19,24,33,35,36,37,38,41,43,45,47,49,52,53,55,56,58]
Technologists - User	[2,9,11,13,14,18,19,33,36,37,41,43,45,49,53,58]

Note. Reference numbers correspond to Appendix 4

1. Technology and users

According to the TTU framework, when users decide to use a specific technology, they inherently determine their mode of interaction with it. This decision is influenced by their knowledge, expertise, and experience. By way of illustration, SLBs, as users of technologies, choose to use technology either to improve their efficiency (Ammitzbøll Flügge et al., 2021; Fest et al., 2023; Vogl et al., 2020) or as required by their organizations (Saxena & Guha, 2024). In both cases, they make decisions to either:1. accept the usefulness of the technology or 2. resist using the technology (Arni & Schiprowski, 2015; Naweed et al., 2017). These decisions are guided by their own knowledge, perceptions, and available resources. This process not only reshapes their own use of technology in the future but also influences the perceptions and usage patterns of other users within the same organization.

The value of technologies is realized through their usage. If a technology is created but remains unused, its creation is pointless.This is to say when technologies are used with a specific purpose in mind, they can significantly enhance the user's work. Empirical evidence supports this, showing that technologies prove their value through use, providing benefits to users. This is particularly evident in public sectors such as the police (Meijer & Wessels, 2019), hospitals (Aguirre et al., 2019), and welfare departments (Hansen et al., 2018). For instance, predictive policing systems offer useful suggestions to police officers, aiding in handling criminal events. Casework management systems improve the efficiency of caseworkers by providing comprehensive information, reinforcing the continuous use of technology. Additionally, electronic decision support tools assist GPs in making routine patient care more efficient (Peiris et al., 2011). These examples reveal that using technologies enables users to achieve their goals while simultaneously adding value to both the technology and the users. This mutual reliance aligns perfectly with the TTU framework. However, technologies can also hinder users. This is evident in cases where technology increases the burden on caseworkers (Vogl et al., 2020), leads to reliance on incorrect algorithmic recommendations (Saxena & Guha, 2024), or traps users in digital cages (Jorna & Wagenaar, 2007; Nouws et al., 2022; Peeters & Widlak, 2018). Both enabling and hindering functions are fundamental properties of technology - ‘enable’ and ‘hinder’ as listed in TTU

framework - but they only exist through use. As mentioned earlier, technologies are meaningless without usage.

Moreover, the use of technologies by users is influenced by various contextual factors, including institutional properties, prevailing social and cultural norms, available resources, interpretive frameworks, and power dynamics etc. These factors are summarized in Table 11.

Table 11

Institutional properties that impact the use of technologies.

Main-theme	Sub-Theme	Sub-Theme	Reference
Institutional Properties	Organizational Dimension	Structural Arrangements	[2,7,8,16,21,33,39, 53]
		Culture, Ideology, Standard	[1,3,6,10,11,12,17, 20,21,30,31,34,38, 42,44,45,46,54,57, 58]
		Control Mechanisms	[1,7,9,12,13,15,24, 26,35,52]
		Communication Patterns.	[5,12,14,41]
	Environment Dimension	Government Regulation	[4,9,18,19,27,32]
		Power dynamics	[18,37]
		Professional Norms	[1,6,9,12,18,22,34, 38,44]
		Technological Knowledge Level	[7,11,29,43,50,55]
		Socio-Economic Conditions	[2,4,6,11,13,16,18, 23,36,53,56]

Note. Summarized by the author. Also, reference numbers correspond to Appendix 4

User activities are significantly impacted by various social circumstances, particularly pointed out in the TTU, and the use of technologies is no exception. When users engage with technologies, they are influenced by contextual factors within social circumstances. Institutional properties, in particular, play a key role in shaping human activities in the context of technology use. Orlikowski (1992) categorizes these institutional properties into organizational and environmental dimensions. This, in turn, is being incorporated into the TTU framework, as noted in Chapter 2. The literature review reveals that institutional properties greatly influence human interactions with technology. Habitual use of technology can both shape and be shaped by the cultural norms and values of the institution. Particularly, cultural norms are able to shape technological patterns. Meijer et al. (2021) conducted a comparative study on predictive policing, identifying two emergent patterns: the

'Algorithmic Case' in Berlin and the 'Algorithmic Colleague' in Amsterdam. Authors argued that these patterns stem from administrative cultures and are shaped more by dominant social norms and interpretations than by technological features (Meijer et al., 2021b). Additionally, the use of e-government in Egypt affects collaboration and organizational change, which in turn impacts administrative discretion (Reddick, 2005). Both cases implied that the use of technologies is sharp and impacted by the cultural dimension, either on micro or macro level, which is in line with the argument from the TTU framework.

Moreover, managers might set standards or norms for their employees in terms of how they should behave within organizations, and their ideology influences how employees perceive and interpret the use of technology. These factors create a power dynamic within organizations. However, employees do not always meet their managers' expectations, since they might use their own judgments, norms, and interpretative schemes when using technologies to handle their tasks, as noted in the TTU framework. This is to say, managers might believe that digital records are being used effectively to achieve their goals, but in reality, caseworkers might still rely on paper-based records and only enter information into the digital system later (Giest & Raaphorst, 2018; Wastell et al., 2010). Additionally, caseworkers can also act as secondary designers, using small-scale tricks within CIS to maintain continuity in a client's trajectory, relying on shadow systems to manage their entire clientele, and taking shortcuts in producing statistical information (Huuskonen & Vakkari, 2013)

In addition to these examples, other cases involving control mechanisms (J. Bullock et al., 2020; J. B. Bullock et al., 2022; De Boer & Raaphorst, 2023; Huuskonen & Vakkari, 2013; Løberg, 2021; Nouws et al., 2022; Peeters & Widlak, 2018; Reddick, 2005; Young et al., 2019), structural arrangements (Bovens & Zouridis, 2002; Castro, 2022; Giest & Grimmelikhuijsen, 2020; Gordon et al., 2024; Hansen et al., 2018; Peeters & Widlak, 2023; G. Wang et al., 2024; Young et al., 2019), government regulations (J. Bullock et al., 2020; Busch & Henriksen, 2018; Marston, 2006; Saxena & Guha, 2024; Tucker et al., 2022; Y. Wang & Pan, 2024) and technological knowledge levels(Aviram et al., 2024; Lember et al., 2019; Peters et al., 2021; Veale et al., 2018; Young et al., 2019; Zouridis et al., 2020), socio-economic conditions (Busch, 2017; Busch & Henriksen, 2018; Castro, 2022; Christin, 2017; Gordon et al., 2024; Jansson & Erlingsson, 2014; Peeters & Widlak, 2023; Pokharel et al., 2023; Reddick, 2005; Saxena & Guha, 2024; Zouridis et al., 2020) also demonstrate the significant impact of institutional factors on technology use. These cases further validate the TTU framework in understanding how users engage with emerging technologies.

On top of that, when technologies are developed and used habitually, they might become institutionalized, as presented in the TTU framework. This is because regular use of technologies integrates technologies into the daily routines and standard practices within organizations, making it an integral part of operations. Over time, this can lead to the development of standardized procedures and formalized policies, ensuring consistency, efficiency, and reliability. Nevertheless, when integrating institutionalization of technology into SLB research, it usually points out a fact that SLBs' discretion will be reduced due to the standardization and routinization of their work, which, in turn, reinforce the transition from SLB to SYB (Bovens & Zouridis, 2002; Busch & Henriksen, 2018; Zouridis et al., 2020). This effect appears particularly pronounced in caseworker research (Ammitzbøll Flügge et al., 2021; Caswell et al., 2010; Hansen et al., 2018; Marienfeldt, 2024; Van Den Berg et al., 2023). For instance, caseworkers use CIS to process their work,

partially being automated and standardized. As a result, their discretion is limited by automation. However, the decrease in their discretion might also transform them into screen-level bureaucrats due to the interaction of technologies (Ammitzbøll Flügge et al., 2021; Huuskonen & Vakkari, 2013; Ranerup & Henriksen, 2022). Additionally, caseworkers begin to accept and internalize the technology as a natural and necessary part of their daily work. This fosters a sense of dependency and trust in its reliability and effectiveness, making the technology indispensable (might be seen as an automation bias). Besides, continuous use leads to the development of skills and expertise among users (as discussed in the section 4.3 - Professionalism), further integrating the technology into the institutional knowledge base (Busch, 2017; Gordon et al., 2024; Vogl et al., 2020). Also, technologies may become mandated by regulations, standards, or compliance requirements, further institutionalizing their use. Social dynamics and organizational pressures also play a role, as widespread adoption creates a network effect that promotes conformity and institutionalization (Orlikowski, 2000; Rodríguez-Espíndola et al., 2022).

While users adopt technology to streamline their work and improve outcomes, the use of technology can lead to both intended and unintended consequences due to factors such as user behavior, system design, and contextual influences, as mentioned in TTU. For instance, algorithms come with a steep learning curve (Christin, 2017) or require caseworkers to spend additional time on data entry, increasing their overall workload and stress levels (Vogl et al., 2020), potentially leading to burnout. Technology systems may not always be adaptable to the specific needs of caseworkers or clients. Technical glitches, system downtimes (Giest & Raaphorst, 2018), or rigid workflows can hinder rather than help caseworkers, leading to resistance (Christin, 2017). Additionally, data collected and processed by case management systems might be misinterpreted or misused, resulting in incorrect decisions. To be more specific, if caseworkers misread automated risk assessments or rely solely on algorithmic recommendations, it could result in inappropriate results (Giest & Raaphorst, 2018).

2. From technologist - technology

When designing technology, technologists incorporate interpretative schemes, facilities, and norms to ensure the technology aligns with user needs, organizational contexts, and societal expectations. This is easy to understand, for example, technologists need to appropriate their expertise and knowledge to design the information systems that fit with users' needs (Peters et al., 2021). This helps create interfaces and functionalities that are intuitive and easy for users to adopt. When designing a new software application for SLBs, technologists use familiar metaphors and workflows based on how social workers currently manage cases, ensuring the technology aligns with their existing practices (Veale et al., 2018).

In addition, facilities ensure that technology can be effectively used within the available environment. For instance, in a hospital setting, designing an electronic health record system that integrates seamlessly with existing medical equipment and databases ensures that doctors and nurses can access and update patient information without disrupting their workflows (Aguirre et al., 2019; Tsai et al., 2020).

Furthermore, technology serves as a crucial feedback mechanism for technologists, primarily through direct input from users. Surveys and questionnaires deployed post-interaction allow users to share their experiences, satisfaction levels, and suggestions for improvement. This structured feedback can lead to the formation of systematic improvements. As discussed in previous sections,

the work of some SLBs has been increasingly automated. Thereby, SLBs now contribute data to technologists digitally rather than face-to-face (Bovens & Zouridis, 2002). In this process, both users and technologists must regularly use digital records to ensure the validity of the data and feedback mechanism, thereby collectively improving the system. This involves adhering to established norms (reasons for doing so), utilizing appropriate facilities (digital forms), and following interpretive schemes (methods of implementation).

The feedback loop between users and technologists is pivotal for successful technology development and refinement (Vogl et al., 2020). This iterative process enhances technology functionality and user experience, fostering dependency and trust in its reliability. Through these mechanisms, technology becomes deeply integrated into institutional and social contexts, reinforcing its role and significance in everyday operations.

3. Technologist - users

In this section, I propose some assumptions to test the framework. As mentioned in section 2.2.2.3, I did not make assumptions about the previous two relationships since current research and data are sufficient to explain those assumptions and internal relationships. However, the relationship between technologists and users is understudied, especially in public administration. Therefore, I cannot determine if factors such as institutional properties will impact the communication channel. My instinct suggests the answer is 'YES,' but relevant literature in my database is quite rare, which may affect the validity of these. Thus, in the following content, analysis is provided:

> **H1:** When users give feedback to technologists, they are co-designing a specific technology. The co-design might enhance product development, but it is not necessarily being perceived positively.

When users provide feedback to technologists, particularly in the development of algorithms, it enables technologists to refine and improve the artifacts (Veale et al., 2018). For example, in the public sector, this feedback could lead to enhancements such as improving the accuracy of predictive algorithms used in law enforcement (Meijer et al., 2021b; Meijer & Wessels, 2019) or optimizing algorithms in healthcare to achieve better patient outcomes (Aguirre et al., 2019; Giest & Raaphorst, 2018).

Despite the potential benefits, co-design and feedback are not always embraced, often due to concerns about privacy, biases in algorithms (Kordzadeh & Ghasemaghaei, 2022), or resistance to change (Busch et al., 2018; Naweed et al., 2017, p. 32). For instance, citizens, as users, may resist the use of automated decision-making algorithms in government services due to fears of discrimination or lack of transparency. In many cities, Police organizations use algorithms to predict crime hotspots and allocate resources accordingly (Meijer et al., 2021b). Citizen feedback on these algorithms might underscore concerns about potential biases or invasion of privacy. Critics argue that such algorithms can reinforce existing biases in policing practices, despite the intention to enhance public safety. While co-designing technology through user feedback has the potential to significantly enhance product development, it is not universally perceived positively (Lember et al., 2019). The key lies in transparent communication, addressing concerns about privacy and bias, and ensuring that the technology truly serves the public interest. Government technologies, such as algorithms, play a critical role in the public sector, and their design should involve robust dialogue with diverse stakeholders to achieve fair and effective outcomes

> **H2:** When technologists communicate with users, they tend to perceive the technology in very different ways. The understanding toward technology is based on their background, including personal expertise, culture and organization context.

Technologists often have a deep understanding of the technical aspects of the technology, influenced by their specialized knowledge and experience. In contrast, users may perceive the technology differently based on their varying levels of technical proficiency and expertise. This might create a situation where technologists need to provide explanations to illustrate the technical part when communicating with users (Vogl et al., 2020). In addition, technologists are also influenced by the organizational culture, impacting their approach to designing and implementing technology solutions. This is to say, the context in which technology is deployed within organizations greatly influences its perception and utilization, shaped by factors such as organizational structure, policies, and goals. For instance, Peters et al. (2021) conducted interviews to understand 'the validation dark spots'. They mentioned that most interviewees agreed the large part of environment law has shifted a system that is similar to system-level bureaucracy. But different opinions exist among technical oriented designers and the policy designers in terms of this transition relationship. Policy designers appear to think that the decision process will be fully automated. The technically oriented designers think that the processes around permits are being digitized without touching on the balancing and prioritizing itself. Hence, authors argued that the technical people are more aware of the limitations of the technology whilst the non-technical interviewees experience a 'feeling of being taken over' by the technology (Peters et al., 2021).

Additionally, technical system designers tend to distinguish the simple cases that can be automated and the more complicated cases that always need human intervention. They see the value of automation on top of digitalization. This further supports my previous augment: '*[...]organizations heavily reliant on human judgment may find it challenging, if not impossible, to fully make this transition*.' On the other hand, policy designers do not always see where automation may be applicable to save resources. Accordingly, this case illustrates that technologists and users view the use, function and value of technology very differently (Peters et al., 2021). In this way, technologists must understand the specific needs and challenges of the organization to effectively design and implement solutions.

> **H3:** Users will modify the parameters of technologies to their advantage and even use the technologies in an unintended way from technologists' perspective.

Users often adjust the parameters or settings of technologies to better fit their workflows or specific needs, which can lead to deviations from the original design intent as perceived by technologists. This hypothesis has been preliminary discussed and validated in section 4.3. The following contents are some more evidence to reinforce this argument. Busch et al. (2018) identified five strategic responses to how SLBs react to institutional complexity. They found that judges might resist digital tools to retain their autonomy and discretionary power. In such cases, ICT may have minimal impact on judges' practices (Busch et al., 2018). This is not the expectation from technologists. Moreover, Arni and Schiprowski (2015) reported on the implementation of a profiling tool in the Swiss canton of Fribourg, revealing that, contrary to expectations, caseworkers intensified their efforts for jobseekers classified as easy to place by the tool. This response was opposite to the intended use, which aimed to allow caseworkers to spend more time on those

classified as difficult to place (Arni & Schiprowski, 2015). Similarly, Barnes et al. (2015) found that in Denmark, caseworkers collectively renounced a profiling tool because they felt uncomfortable justifying their decisions when they went against the tool's recommendations (Barnes et al., 2015). Accordingly, based on these cases, we can see users might modify the parameters of technologies and use them in unintended ways. While this can lead to positive outcomes by enhancing functionality and meeting diverse user needs, it also poses challenges in terms of security, support, and maintaining the integrity of the technology.

> **H4:** The design and implementation of technology will be impacted by power dynamics, institutional properties, ideologies within the organization.

The design and optimization of technology in the public sector are influenced by power dynamics, institutional properties, and organizational ideologies, which collectively shape how technologies are developed, implemented, and used. Power dynamics within organizations significantly impact decision-making processes related to technology design and implementation (also discussed in the section 4.3 and being supported). This is supported by research conducted by Giest and Raaphorst (2018). They investigated electronic health care records in the UK and found that hospitals have very limited control over the current system, resulting in a lack of influence on software configuration for specific contexts within the hospitals. National-level decision-makers often underestimate the time required to build, configure, and customize technology, further exacerbating this issue. This disconnect creates a divide between management and daily system users. While hospital managers view the data management tool positively, clinicians who use the system daily evaluate it largely negatively. This negative perception stems from a mismatch between IT systems and existing power relations within the hospital hierarchy. For instance, when the system fails to support a clinician's work routine during their shift or causes delays, the additional workload is transferred to other staff members, leading to resentment and ineffective work synchronization (Giest & Raaphorst, 2018). Hence, power dynamics and hierarchical structures in organizations influence how technology is perceived and used, often leading to discrepancies between intended and actual outcomes in technology implementation

4. Structure - The final result of the TTU framework

The final objective of the TTU framework is to establish a structure through the habitual use of specific technologies, as users draw on their knowledge, resources, and norms to conduct their daily activities. This process enacts a set of rules and resources through the use of these technologies.

The structure in most of the reviewed literature is straightforward to capture, as the research primarily focuses on SLBs using specific technologies, especially algorithmic tools such as client information systems and decision support tools, for their daily activities. In this regard, they often use these tools recurrently, either for their own purposes or as required by their organizations. These tools are generally employed to handle casework, improving efficiency and performance. However, the use and acceptance of these technologies is a complex phenomenon influenced by many factors, which can hinder the enactment of structure. As discussed in the previous section, SLBs might adopt different coping strategies when reacting to the use of technologies, considering that these tools might potentially curtail their discretion or due to other reasons such as lack of expertise or fear of using them. Consequently, they might ignore, modify, resist, or even defy these

tools, using them in unanticipated ways. In this light, it is very interesting to capture the different structures emerging from research. Orlikowski (2000) summarized six structures to explain how structure is enacted by human agents through the appropriation of their norms, facilities, and interpretive schemes with their ongoing practice to shape the structure (technology-in-practice). The validation of the enactment of structure is determined by these three factors. The aim of this research is primarily to validate the enactment of these structures. Therefore, I draw on the six types of structures summarized by Orlikowski. Additionally, I further expand "2 structure" based on current findings to better suit the research context. In the following part, I will provide a brief introduction to the six structures and then explain how the new structure was enacted.

During the process of identifying structure from the review literature, 29 studies were excluded for several primary reasons: 1) Most of the literature was conceptual, focusing on technology but not its actual use. 2) Some studies had a broad scope, such as global studies, which did not meet the criteria for structure enactment. Additionally, 3) some empirical quantitative studies concentrated on technological properties rather than the practical use of technology.

Additionally, 30 studies were included within 8 different structures as shown in Table 12. The majority of research focused on process support structure (27%) and limited use structure (20%). This result aligns with the previous discussion, highlighting the dual role of these technologies in either supporting or hindering the establishment of structure. This argument further validates the varying effects of most technologies currently used in the public sector. This is to say while these technologies are primarily designed with supportive intent, their inherent complexity and specific characteristics often prevent this support from effectively translating into practical use (see the complexity structure). Therefore, the manifestation within these structures actually reflects the actual technology use.

Moreover, four studies were included in the collective-problem-solving structure. In this category, frontline workers generally possess detailed technical knowledge, engage in collaborative efforts, and have the necessary facilities for use. For instance, in reference 16, dashboards were examined in the context of the COVID-19 pandemic. Frontline professionals, who previously had little interaction with technology, were assigned as data workers, requiring them to frequently use dashboards to respond to citizens' needs. This necessitated updating their knowledge to better serve the public. During this period, the daily practice of data discretion was driven by values of racial equality and inclusion, making collective problem-solving the norm (Gordon et al., 2024). In this sense, the habitual use of technology institutionalized its use, as frontline workers became reliant on these tools. This reliance reinforces institutionalization, a conclusion consistent with the propositions of TTU.

Additionally, three studies were included in the collaboration technology-in-practice structure. In this type of structure, organizations are typically nonhierarchical and characterized by cooperation, requiring users to have extensive technological knowledge. For example, reference 5 identified the 'algorithmic colleague' pattern through the use of predictive policing. Here, there was extensive interaction between the experience and knowledge of intelligence experts, the perceptions of reports and briefings by street officers, and the crime anticipation system. Most intelligence experts

had a positive attitude towards the crime anticipation system, which further shaped the collaborative 'algorithmic colleague' (Meijer et al., 2021a).

Furthermore, the process-support structure emphasizes team collaboration and a learning orientation, requiring social workers to have extensive technical knowledge. In studies like reference 26, frontline workers used electronic communication platforms for their tasks. Research showed that this technology saved time, eliminated traditional power symbols in the office, enhanced team collaboration, and made customer service more convenient, significantly improving service delivery (Løberg, 2021).

The characteristics of the remaining structures are summarized in table 12. However, it is important to note the differences between the improvisation and individual productivity structure. This is to say the improvisation structure emphasizes team-focused collaboration, while the individual productivity structure focuses on individuals using technology to achieve their goals. Both structures require frontline workers to possess competent technical knowledge. In addition, the limited technology use in practice is characterized by users' limited technological knowledge and usually work within hierarchical organizational structures, which restricts technology use (Orlikowski, 2000).

Finally, this paper proposes two additional structures: First, the cautious-use structure arises from skepticism and distrust of technology, which leads to critical usage. This is particularly evident in the use of AI, as seen in reference 30, where frontline workers expressed concerns about algorithmic biases, prompting cautious behavior. Second, the technical complexity structure is akin to the limited use structure, where technology use is restricted. However, in the technical complexity structure, this limitation is primarily due to the intricate nature of the technology itself (Snow, 2021). For example, in reference 13, the digital divide and complexity reduced middle-aged and elderly participation in technology use. Similarly, reference 4 demonstrated that algorithm functionality issues increased work pressure, time constraints, and resource limitations for frontline workers, highlighting the negative impact of technological complexity on technology use (Saxena & Guha, 2024). Therefore, based on all cases provided, the central logic of the TTU framework has been substantiated.

Table 12

Type of Enactment

Structure	Technology Acceptance	Feature	Structure Consequence	Reference
Collective-Problem-Solving Technology-In-Practice	High	Detailed technical knowledge & Collective & Infrastructure	Reinforce status quo	[16,19,21,36]
Collaboration Technology-In-Practice	High	Extensive technical knowledge & Collaboration & Infrastructure	Reinforce status quo	[5,16,48]
Process-Support Technology-In-Practice	High	Competent technical knowledge & Team focus & Infrastructure	Reinforce status quo	[5,8,12,26,37, 38,39,58]
Improvisation Technology-In-Practice	High	Competent technical knowledge & Team focus & Infrastructure	Transform status quo	[1,6]
Individual-Productivity Technology-In-Practice	Moderate	Extensive technical knowledge & Individual & Infrastructure	Reinforce status quo	[17,20,50]
Cautious use Technology-In-Practice	Moderate	Competent technical knowledge & Individual & Infrastructure	Reinforce status quo	[30,34]
Limited-Use Technology-In-Practice	Low	Limited technical knowledge & Hierarchical & Infrastructure	Preserve status quo	[24,27,44,51, 56,59]
Technical-complexity Technology-In-Practice	Moderate	Competent technical knowledge & Team focus & algorithm	Hinder status quo	[4,13]

Note. The structures and their main characteristic within the table have been identified by Orlikowski (2000). I further expand 2 structures, caution and technical complexity technology-in-Practice, from empirical evidence. Reference number corresponds to Appendix 4

5 Conclusion

This research is guided by three key questions as shown below, which I attempt to address through a systematic review following the PRISMA method.

Main RQ: How do street-level bureaucrats rearrange their work around the use of government technologies?

- Sub Q1: What is the role of technologies on the transition from street-level bureaucracy to system level bureaucracy?
- Sub Q2: How discretion is impacted by using those government technologies.
- Sub Q3: To what extent government technologies can replace human judgment within current research?
- Sub Q4: How do technologies, technologists and users' interplay with each other within public context?

Furthermore, this study has two main objectives: first, to answer the research questions, and second, to validate a combined framework of technologist, technology, and user, using empirical data from the reviewed literature. In terms of the reviewing process, from February to April, I focused on identifying and screening literature. In the initial screening round, I collected 299 pieces of literature, including journal articles, conference papers, and book chapters. The second and third round of screening, I further incorporated 33 articles into the database, which constitute 332 literature in the reviewed database. Following the inclusion criteria outlined in Chapter 3, I excluded 273 unrelated literature, leaving 59 articles for the final review. From April to June, I analyzed all the selected literature using thematic analysis with the support of Nvivo 14 software.

The findings began with a discussion on discretion, a central theme regarding the use of government technologies within the SLB and SYB research fields. The purpose of introducing this debate and its concept is to lay the groundwork for understanding the rearrangement of SLBs' work. As there are many factors implicating the discretion in terms of how technologies impact on SLBs' work. With discretion as a background, transitioning to the rearrangement of SLBs' work becomes more comprehensible. Additionally, the discretionary debate, TTU framework, and the rearrangement of SLBs' work revealed four pivotal topics: 1) discretionary forms, 2) interplay among technologists, technologies and users, 3) the transition relationship from SLB to SYB, and 3) nine sub themes of rearrangement. As can be seen, all of which can ultimately offer five crucial contributions.

Firstly, this research introduces the TTU framework to help researchers understand the dynamics among technologists, technologies, and users. This framework is grounded in the theoretical perspectives from Giddens (1976, 1979, 1984) and Orlikowski (1992, 2000). I summarized and proposed three dynamic relationships into Fig. 4 in section 2.2.2. The legitimacy of this framework is rooted in Giddens' theory of structure, the structurational model of technology, and technology-in-practice theory. Additionally, insights from Bailey & Barley (2020) are incorporated to enhance the framework's perspective. This framework makes a theoretical contribution to technological

governance by, especially, providing an approach to understand how technologists interact with users, a topic often overlooked in the public administration field.

Secondly, the discretionary debate and the evolution of discretionary forms provides a clear understanding of current academic discourse on discretion. I proposed a discretionary framework to understand discretionary research, divided into three lenses: context-oriented, task-oriented, and structure-oriented. This framework, supported by empirical studies, offers a comprehensive approach to studying how technologies can influence SLBs' discretion. Moreover, I observed that research on SYB remains largely conceptual and theoretical, with the transition from SLB to SYB being more complex than anticipated. This transition involves many factors, such as extensive stakeholder engagement and significant human and infrastructural investment. Despite increased public sector investment reducing some barriers, the transition remains a complicated political and social phenomenon that requires critical examination.

Thirdly, a notable research pitfall is the assumption that data professionals, like system designers and data analysts, are pre-conceived as SYBs. This is not to say data professions are not SYBs, they can be but not necessarily. Thus, defining SYBs requires recognizing whether their organizations have transitioned to SYB. Moreover, current empirical research and observation has shown that increasing data professionals emerge in the SLB. But those organizations have not been transitioned to SYB. Accordingly, this indicates the need to reconsider their roles and how to define their nature. Based on evidence, I argued that the role of data professionals is flexible, in the sense that they can be either SLBs, screen-level bureaucrats or SYBs. Moreover, the main function of those data professionals is to reinforce the transition of SLB toward SYB.

Fourthly, this research examines whether SLBs will be replaced by machines, an issue closely linked to the transition from SLB to SYB. Increasing automation in the public sector is narrowing the scope of SLBs and their discretion, which reinforce the argument that ' *hundreds of individual case managers have all vanished, their pivotal role in the organization taken by systems and process designers*' (Bovens & Zouridis, 2002). However, empirical results suggest that, argued by me as well, the transition from SLB to SYB is a highly contextual phenomenon, rather than a simple process. It not only depends on the nature of public agencies, but also various contextual factors. While large-scale executive agencies may find it easier to transition, organizations heavily reliant on human judgment may find it challenging, if not impossible, to fully make this shift.

The empirical research indicates that technologies indeed impact SLBs' work, but the process of studying this impact remains unclear. Hence, using an inductive approach, I divided current empirical research into two categories: Facilitation and Impediment thesis, indicating the facilitating and impeding effects caused by government technologies (as discussed in section 4.3). Based on this categorization, I created a matrix with vertical contents representing micro-level and macro-level impacts and horizontal contents representing the service supply side (referring to SLBs) and service demand side (referring to users) (see Table 13). I then summarized the main themes within existing literature in the reviewed database, identifying nine central themes related to SLBs on the service supply side. These themes provide a valid framework to study the rearrangement of SLBs' work and how technologies impact it, directly addressing the main research question. Of note, the concepts of 'Facilitation' and 'Impediment' thesis draw from Baffat's Enablement and Curtailment thesis (2015). Moreover, those nine themes provide an approach for researchers to study how technologies impact SLBs' work.

The final discussion of this thesis synthesizes the findings with the TTU framework. The two main relationships (technology and technologist, and technology and user) are fully aligned with current research and validated. However, the relationship between technologist and user was not firmly tested. Nonetheless, the research still manages to show some evidence supporting the framework of these hypotheses. This highlights a gap in public administration research, where the integration and communication mechanisms and interaction between technologists and users are often overlooked. Scholars need to understand how SYBs interact with SLBs to deepen the study of the transition from SLB to SYB. While empirical studies indicate a tendency for SLBs to be replaced by SYBs, in reality, SLBs still hold significant power in casework. Therefore, it is crucial to understand the dynamics of this relationship.

By integrating all the findings, this research has largely answered the research questions. Firstly, regarding the main research question, nine themes derived from empirical evidence can be utilized to investigate the rearrangement of SLBs' work. Secondly, for sub-question one, the role of government technologies, especially AI and algorithms, serves as a catalyst for the transition from SLB to SYB. In other words, government technologies not only encourage but also force transition from SLB to SYB. Nevertheless, I also argued that for some public agencies that require SLBs' judgment to deal with complicated cases are almost not possible to transition to the actual 'SYB'. Thirdly, for sub-question two, I provided a discretionary framework to understand how discretion is impacted by government technologies, mainly from three aspects: context, task, and structure. Fourthly, for sub-question three, I argue that the transition from SLB to SYB is a contextual phenomenon, influenced by the type of public agencies (e.g., large-scale executive agencies) and various contextual factors affecting SLBs. While large-scale executive agencies may find it easier to transition to SYB, organizations that heavily rely on human judgment may find this shift challenging, if not impossible, to fully achieve. Based on all these findings, the research questions are to a great extent addressed, ensuring the integrity and consistency of this thesis. Lastly, for the sub-question, TTU framework that has been largely validated can be used to reveal the relationship among technologists, technologies and users.

This research also has its limitations. Firstly, while I aimed to conceptualize government technology broadly to understand its impact on SLBs' work, the vast amount of data made it difficult to fully integrate all findings, resulting in conclusions that are more general. Additionally, the searching results from the review show a bias towards AI-related topics, which might not fully reflect the new conceptualization of government technology, even with three rounds of searching. Future research should expand research beyond AI to explore other emerging government technologies. Furthermore, in forming the TTU framework, I attempted to integrate the relationship between users and technologists, but current research on this relationship is scarce. Although some cases validate the hypothesis, they are not sufficient to provide solid proof. While I argue that the TTU framework is designed to be used in both public and private contexts, all empirical research was from the public administration field. In this case, this framework remains its empirical limitation. In the future study, scholars can further validate it in different contexts and expand this framework. The following is the final remarks on the future research:

Firstly, the relationship between users and technologists deserves greater attention in the public administration field. In SLB research, technologists typically refer to SYBs, and users refer to SLBs. According to Bovens & Zouridis (2002), SLBs are expected to be eventually eliminated,

leading to a transition from SLB to SYB. However, after two decades, research on SYB remains largely conceptual, as the transition to SYB is far more complex than anticipated. It is not a straightforward process but a contextual phenomenon like I argued, involving numerous factors to transform an organization fully to SYB. Only about 6% of the research in the database directly relates to SYB and has been published within the last three years. Moreover, the delineation between SLB and SYB is quite vague. Two points arise from this. First, the scarcity of empirical cases regarding SYB indicates that this research field remains largely conceptual. Second, the transition from SLB to SYB still has a long way to go. Current research shows that SLBs are still essential for daily operations, especially in complex situations. It is uncertain when, or if, SYBs will fully replace SLBs in the future. Therefore, it is crucial to understand the relationship between SLBs (users) and SYBs (technologists). This raises some assumptions. For example, SLBs may not be entirely replaced, or they could coexist with SYBs. Thus, more empirical data is needed to understand this relationship better and to expand and validate the TTU framework in the future.

Secondly and lastly, research should move beyond focusing solely on discretion and incorporate other topics. Currently, 43% of research in the reviewed database centers on discretion, primarily examining whether SLBs' discretion is enabling or curtailing in various national contexts. While the results vary, they generally fall into the categories of curtailment, enablement, and continuation theses. However, it remains unclear how emerging government technologies, such as AI, impact the work of SLBs and SYBs. This question should expand beyond the discretion field. Recent research has shown that technologies, especially AI and algorithms, tend to curtail SLBs' discretion by automating and replacing low-complexity tasks. However, they struggle with high-complexity tasks due to the inadequacy of predefined rules and the lack of comprehensive data for training. This pattern has become commonplace according to existing research results. Therefore, it is time to move beyond this area. Consequently, three new research directions are proposed: first, combining discretion with other topics such as transparency and accountability etc; second, increasing attention to organizational-level or technological governance; and third, examining the specific impacts of different government technologies on SLBs.

Thirdly and lastly, Bovens & Zouridis (2002) categorized three groups of people as SYBs, notably including data professionals like system designers, who have garnered considerable attention. However, roles such as legislative experts and legal policy personnel are equally significant in system design but largely ignored. Their involvement in activities like collaborating with system designers and embedding laws into software underscores their importance. Therefore, future research should broaden its scope to encompass these often-overlooked roles and investigate their contributions to the transition from street-level to system-level organizations.

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