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Ironies of automation and their implications for public service automation

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ABSTRACT

Automation of public service provision has gained renewed attention as emerging technologies are said to enable automation of tasks that were previously seen as requiring human involvement. However, the merits of these automation technologies are often exaggerated. More knowledge is needed on public service automation, and much can be learned from adjacent research fields studying human-automation interaction. To lead by example, this work applies Bainbridge's (1983) concept of *ironies of automation*. The purpose is to (1) present ironies of automation, (2) explicate how these ironies can come into play when implementing automated systems in the public service context, and (3) outline implications that follow for public service automation. This is achieved by relating ironies of automation to contemporary studies on Robotic Process Automation (RPA) developments in Swedish local government. The analysis results in five ironies and a set of implications for public service automation. The ironies and implications for public service automation direct attention to key challenges that must be acknowledged in future automation implementations and show that further investigations and theoretical developments are needed on e.g., problems introduced by automation; tasks, roles, and responsibilities that follow on automation; how to design the interface between humans and automated systems in a way that facilitates monitoring, take-over, and maintenance; and, tools and methods for assessing the impact and quality of automated systems. This paper thus provides a foundation for future empirical investigations and further theoretical development on public service automation.

1. Introduction

Robotic Process Automation (RPA) has been highlighted as a new and promising technology for achieving automation of work in government organizations. Automation is not a new phenomenon in government organizations but has gained renewed attention by both practitioners and scholars as RPA, alongside various Artificial Intelligence (AI) applications, is said to enable automation of new types of work, including tasks that were previously seen as requiring human involvement (Penttinen et al., 2018; Wajcman, 2017). In this paper, *public service automation* is in focus, referring to when government organizations implement digital automation technologies (and related organizational changes) to execute parts of a public service process that were previously carried out by human professionals.

The underlying aspiration of public service automation is to speed up administrative work, improve decision quality, and reduce costs for personnel in public service processes and provision. Many studies have served to investigate potential uses, merits, and pitfalls of RPA in various types of organizations and for different types of processes (e.g., Aguirre & Rodriguez, 2017; Noppen et al., 2020; Willcocks & Lacity, 2016). There is also a growing body of literature on RPA use and its impacts in the public sector (e.g., Asatiani, 2022; Berg, 2022; Borry & Getha-Taylor, 2019; Germundsson, 2022; Kaun, 2022; Veale & Brass, 2019). Based on a comparison of RPA use in several types of organizations and sectors, Eikebrokk and Olsen (2020) stated that RPA use in public sector organizations have shown contradictory results and called for further research on the nature and consequences of RPA use in the public sector context.

As a research community, we are not lacking overly optimistic statements of how new waves of automation will revolutionize and transform public service provision to the better, nor dystopian descriptions of an AI-run future, with black-boxed decision-making as a result (cf. Roehl, 2023). To avoid such extreme and unnuanced descriptions of public service automation, we need in-depth empirical work that can capture different facets and nuances of automation. Digital government scholars can contribute with such empirical insights and help guide RPA and AI developments and public service automation in general. However, to truly advance on this topic, we do not only need empirical studies on public service automation, but we must also find better theoretical frameworks that can support a critical and nuanced

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analysis of such studies and push the knowledge front forward. Theoretical frameworks for analyzing and understanding automation and its consequences are already available in the literature, and we must do a better job of applying these in our analyses.

In this paper, to lead by example, I use Lisanne Bainbridge's (1983) landmark paper *Ironies of Automation* to learn more about public service automation. The purpose of this work is to (1) present ironies of automation, (2) explicate how these ironies can come into play when implementing automated systems in the public service context, and (3) outline implications that follow for public service automation. The ironies refer to circumstances related to automation that, when combined, lead to the opposite of what is expected (Bainbridge, 1983). An interesting aspect of these ironies is that they cannot be fully avoided; organizations can, however, acknowledge these contradictory characteristics of automation and work to prevent their most negative effects (Strauch, 2018). By addressing automation in this way, in which contradictory outcomes are allowed and acknowledged, we can form more nuanced expectations of the outcomes of public service automation.

To achieve the purpose outline above, this work builds on a hermeneutic analysis of Bainbridge (1983), when set in relation to findings from empirical studies on RPA developments in Swedish local government. This analysis is used to present five ironies associated with automation in general. With the help of these ironies, an account is given on issues relating to RPA use in Swedish local government. Based on this empirically based account, in combination with the general ironies, four implications for public service automation are presented and discussed. The implications illustrate that public service automation (1) introduces new problems in the public service process, (2) creates new tasks, roles, and responsibilities in the organization, (3) necessitates new types of interfaces between humans and the automated system, and (4) necessitates new tools and methods for assessing process quality and return of investments. The ironies and implications in combination thus direct attention to key challenges that must be acknowledged in future public service automation developments and implementations.

This work builds knowledge in a cumulative fashion by combining Bainbridge's work with current research findings from the public service automation context. The ironies presented, and the implications outlined for public service automation, can be understood as theoretical contributions that can be used to investigate, analyze, explain, and to some extent even predict (cf. Gregor, 2006) consequences of automation of public service processes. As such, this paper provides a foundation for future empirical investigations and further theoretical development on public service automation. This work is furthermore part of a special issue on data-driven governance in the age of AI, contributing to the issue with a deeper understanding of organizational aspects that must be considered when public institutions and organizations use their data for automation purposes.

The paper is organized in the following manner. In the next section, I give a brief overview of the background of this paper. Thereafter, I present and explain the hermeneutic analysis approach applied to extract ironies from Bainbridge's original text and relate these to public service automation. I then proceed to present the main features of Bainbridge's (1983) argumentation and present five ironies of automation. Thereafter, an account is given on RPA developments and use in Swedish local government, using the ironies as a theoretical lens. Last, I outline implications for public service automation, followed by directions for future research.

2. Automation, RPA, and motivation for research

To address public service automation, we must first define the core concept of automation. Automation can be defined in several ways but is here understood as "the execution by a machine agent (usually a computer) of a function that was previously carried out by a human" (Parasuraman & Riley, 1997, p. 231). Automation, as a term, thus both refers to the digital technology used to exchange the human in the process, and the change activities that make the exchange possible (Lindgren & Scholta, 2023). For simplicity, I henceforth use the term 'automated system' to refer to the technology, and 'automation' to refer to the change process. In this paper, focus furthermore lies on *public service automation*, thus referring to when government organizations implement automated systems (and related organizational changes) to execute parts of a public service process that were previously carried out by human professionals (Lindgren, 2023). Various digital technologies can be used to achieve public service automation; here, *Robotic Process Automaton* (RPA) is used as the empirical example of automation technology.

2.1. Robotic process automation

RPA has been in use since about 2010 and is still considered a relatively new type of technology. As stated in the introduction to IEEEs guide on intelligent process automation, RPA is "neither an operating system nor an application, but a platform built to provide digital process automation that mimics human operations in a digital environment". Furthermore, "it can use single or multiple applications or systems through the standard human interface layer, in the same way a human operator would" (IEEE Corporate Advisory Group, 2017, p.7). RPA thus refers to a specific type of software that can be programmed to perform structured work tasks (Penttinen et al., 2018) by imitating human users' interactions in one or several systems (Lacity & Willcocks, 2021), e.g., mouse clicks, commands, and transferring data between different systems and platforms (Aguirre & Rodriguez, 2017).

Due to the characteristic of operating in and transferring data across the user interfaces of other IT systems, RPA is often described as being a 'lightweight' form of IT (Bygstad, 2015) and non-invasive in relation to the underlying systems (Osmundsen et al., 2019). These characteristics are compared to those of traditional 'heavyweight' IT, i.e., systems requiring integration through changes made in the underlying code (Bygstad, 2017). The lightweight character of RPA is frequently used in marketing, in which RPA is represented as an automation technology that can be implemented and configured by personnel without specific programming skills. Often, RPA is described as a technology that the persons currently working in the process to be automated can configure to support their own work, thus giving human workers the opportunity to remove monotonous and repetitive tasks on their own initiative (*see* e.g., Madakam et al., 2022). However, it is uncertain to what extent RPA is used in this way in practice (Eikebrokk & Olsen, 2020).

In this paper, I refer to both RPA and AI. It is however important to note that these terms are not used as synonyms. When RPA was first introduced in the digital government context, it was often discussed as being a form of AI, owing to its ability to 'imitate' the human user's clicks in the system and thus giving the software an impression of intelligence. However, specific RPA solutions vary in degree of sophistication and complexity. Most RPA solutions used today are simple and rule-based scripts, without 'intelligent' features. There are however more advanced RPA applications on the market that include AI components and decision-support, involving e.g., natural language processing tools, computer vision, and data analytics (Lacity & Willcocks, 2021; Madakam et al., 2022). RPA and AI are thus increasingly being intertwined as technologies, but to avoid conceptual stretching it is important to keep RPA and AI conceptually separate; considering that RPA can be a 'dumb' technology, relying completely on rule-based and pre-programmed scripts.

2.2. RPA in Swedish local government

One country in which RPA is increasingly being used by government organizations is Sweden. Sweden has had a solid e-government development over time (United Nations, 2022) and a general drive for technological advancements on all levels of government. This means that the public sector's maturity is high concerning technologically driven

developments in general, making it easier to isolate and understand what is novel with RPA and how this technology fits into the already established IT-landscape. As if in response to the call by Eikebrokk and Olsen (2020) to investigate RPA use in the public sector, several scholars have conducted empirical studies of RPA development, implementation, and use in Swedish municipalities (e.g., Bernhard & Wihlborg, 2022; Germundsson, 2022; Johansson et al., 2022; Lindgren, Johansson, et al., 2022; Ranerup & Henriksen, 2022; Ranerup & Svensson, 2023). Opportunities to conduct empirical studies in this context are ample, as many municipalities in Sweden have started using, or are considering using, RPA as part of their administrative machinery (Juell-Skielse et al., 2022).

The public service that has gained the most attention in the research literature on automation and RPA use in Swedish local government is that of social assistance (e.g., Germundsson, 2022; Germundsson & Stranz, 2024; Ranerup & Svensson, 2023). One municipality has attracted more attention than others: Trelleborg Municipality. Trelleborg municipality implemented an RPA solution in 2017 to reduce the lead time in their handling of applications for social assistance. Their use of RPA was allegedly the first of its kind in Swedish local government and quickly gained media attention, in both positive and negative terms. The municipality could showcase how RPA use had significantly shortened the time needed for handling applications for social assistance. This caught the attention of policymakers such as the Swedish Association of Local Authorities and Regions (SALAR), which subsequently published several policy documents promoting RPA use in local government in general (SALAR, 2018a; SALAR, 2018b). Critical voices claimed that Trelleborg's results were not only due to RPA, but because of reorganization, standardization of the process, and by reducing the social workers' power to practice discretion in the process. Other critics stated that the RPA solution used did not adhere to public service regulations and should be abandoned. Regardless of the criticism, other municipalities decided to procure RPA for their own purposes, based on the promises of increased efficiency. Some municipalities have since tried to automate the same process (social assistance), whereas others have automated processes related to case handling of other public services (e.g., applications for safety alarms to elderly and bus cards for school children) or internal administration (e.g., forwarding invoices from one department to another). Regardless of service process type, the main motivation for using RPA in these processes has been to reduce costs for human resources, as well as reduce lead time, unwanted variations, and bias in case handling processes. In the Swedish local government context, RPA has thus primarily been implemented to improve efficiency (Germundsson, 2022), fueled by policymakers' descriptions of RPA as a means for speeding up work and increasing quality in administrative processes (SALAR, 2018a; SALAR, 2018b). Amongst policymakers and digital strategists working in Swedish municipalities, RPA has therefore been associated with highly positive values and outcomes (Toll, 2022; Toll et al., 2022), and has led to a vast array of RPA development projects across Swedish municipalities (Juell-Skielse et al., 2022).

Empirical studies of these RPA developments have touched on several issues, e.g., employees' interest for RPA adoption (Germundsson & Stranz, 2024; Juell-Skielse et al., 2022), and effects of RPA on decision-making and discretion (Ranerup & Henriksen, 2022), social inclusion (Bernhard & Wihlborg, 2022), and public value creation (Johansson et al., 2022; Ranerup & Svensson, 2023). Put together, these studies provide rich descriptions of a phenomenon that has proven far more challenging than envisioned by both policymakers and employees in local government. With a few exceptions, the municipalities' work to implement RPA has been slow, difficult, and associated with many problems (Johansson et al., 2022; Lindgren et al., 2024; Lindgren, Johansson, et al., 2022; Ranerup & Svensson, 2023; Toll et al., 2023a, 2023b). Only a small set of municipalities have succeeded in making full use of RPA thus far; whereas most municipalities covered in the empirical studies have faced various challenges in their work to implement RPA and only implemented a handful RPA solutions in their administrative processes. Furthermore, studies show how several municipalities have run RPA projects without a clear understanding of what RPA can be used for (Söderström et al., 2021), other than to keep up with others and showcase a 'modern' organization (Toll et al., 2023a). Digital government scholars can and should contribute with insights that can help guide further RPA development and public service automation in general. To advance our knowledge on this topic, we also need to learn from adjacent research fields in which human-automation-interaction has been studied for a longer period than in the digital government field. In this paper, I claim that Lisanne Bainbridge's classic work on automation can support such knowledge development.

3. Research approach

To achieve a nuanced understanding of public service automation, this paper presents insights from a hermeneutic analysis conducted in two steps. First, I analyzed Bainbridge (1983) to determine a set of ironies of automation. These ironies were briefly related to public service automation and RPA use in Swedish local government; the result of which was published in a conference paper (Lindgren, 2023). Second, I conducted a new round of analysis, further developing the analysis of ironies of automation and expanding the literature on RPA to which the ironies were related. Based on this second and more in-depth analysis, I furthermore outlined a set of implications for public service automation. In this section, these two steps of analysis are explained, starting with a short introduction to Bainbridge (1983).

3.1. Brief introduction to Bainbridge's original work

The work presented here builds on Lisanne Bainbridge's short paper published in *Automatica* in 1983. Bainbridge builds on socio-technical systems theory (cf. Mumford, 2006) and cognitive science (cf. Gardner, 1987), and use empirical examples of automation in industrial processes. She illustrates that automation can increase efficiency and quality in industrial processes, but that it comes at a cost of losing insights into systems operations, as well as losing some control over said operations. She points to contradictory issues caused by automation, which she calls *ironies,* defined as "a combination of circumstances, the result of which is the direct opposite of what might be expected" (Bainbridge, 1983, p.775).

The title of Bainbridge (1983) – *Ironies of Automation* – implies that she presents a set of clearly defined 'ironies' in her text; this is however not the case. Rather, she presents a line of argument, in which contradictory aspects of automation are presented and discussed; some explicitly, others implicitly. Still, many scholars have picked up on Bainbridge's idea of ironies of automation and continued to build on her work. To date, researchers active in a multitude of different disciplines and contexts have cited her paper approx. 3000 times (Google Scholar; September 2024), and it is considered a landmark paper within the research field of human factors engineering (Hancock, 2014; Strauch, 2018).

3.2. A hermeneutic analysis of ironies of public service automation

The analysis presented in this paper was triggered by an idea to extract and clearly define a set of ironies of automation from Bainbridge's original work and translate these to the public service automation context. To identify ironies relevant for public service automation from the original text, a hermeneutic analysis of Bainbridge (1983) was conducted. Hermeneutic analysis originates from literary interpretation, e.g. Bible studies, and is a method for interpretating meaning in textual data (Ödman, 2017). With time, hermeneutic analysis has become a well-used analysis method in social sciences (Myers, 2009) and the information systems field (Boell & Cecez-Kecmanovic, 2014; Klein & Myers, 1999).

Hermeneutic analysis builds on the underlying assumption that (a)

the text has an autonomous existence, independent of the author or the world it describes, and (b) the interpretation is inherently guided and shaped by the interpreter's pre-understanding (Myers, 2009). Objectivity and replicability, in the positivistic sense, is not seen as possible (nor desirable) in this type of analysis. Furthermore, hermeneutic analysis builds on the underlying idea that we come to understand a complex whole by forming notions about the meaning of its parts and their interrelationships (Klein & Myers, 1999). The iterative movement between the whole and its parts is represented by the hermeneutic circle, through which the researcher moves back and forth, through multiple iterations, between the general and the specific. This iterative analysis approach builds on principles of e.g., contextualization; abstraction; dialogical reasoning; allowing for multiple interpretations; and suspicion (Klein & Myers, 1999). An important aspect of understanding the whole is furthermore to acknowledge the phenomenon's particular social and historical context. The goal of the analysis is to form an internally coherent interpretation that is supported by the 'facts' of the interpreted material, and in which gaps and contradictions are satisfactorily explained (Alvesson & Sköldberg, 2000). Klein and Myers (1999, p.79) describes this process as "not unlike putting the pieces of a puzzle together, except that the pieces are not all given but have to be partially fashioned and adjusted to each other".

3.2.1. First step of analysis

Building on the puzzle metaphor by Klein and Myers (1999), I illustrate my research approach in Fig. 1. First, I conducted a careful analysis of Bainbridge (1983) and extracted four ironies of automation relevant for public service automation. By relating these ironies to publications presenting results from empirical studies on RPA use in Swedish local government, I re-contextualized the ironies and fashioned these according to features of the public service automation context. The first step of the analysis resulted in a list of ironies and a discussion on how these can be manifested in the Swedish local government context. These findings were published in a conference paper (Lindgren, 2023) and presented at the conference in question. Based on reviewer comments, and comments received during the conference, I then proceeded to conduct a second round of analysis.

3.2.2. Second step of analysis

For the second step of the analysis, the results of which are presented in this paper, I included a larger set of empirical studies than the one used in the first round of analysis. The text by Bainbridge was also carefully re-read. The purpose of this second round of analysis was to gain a better understanding of organizational consequences associated with automation in the public service context. These insights are presented as implications for public service automation at the end of this paper. During the analysis, a fifth irony was also deduced by relating

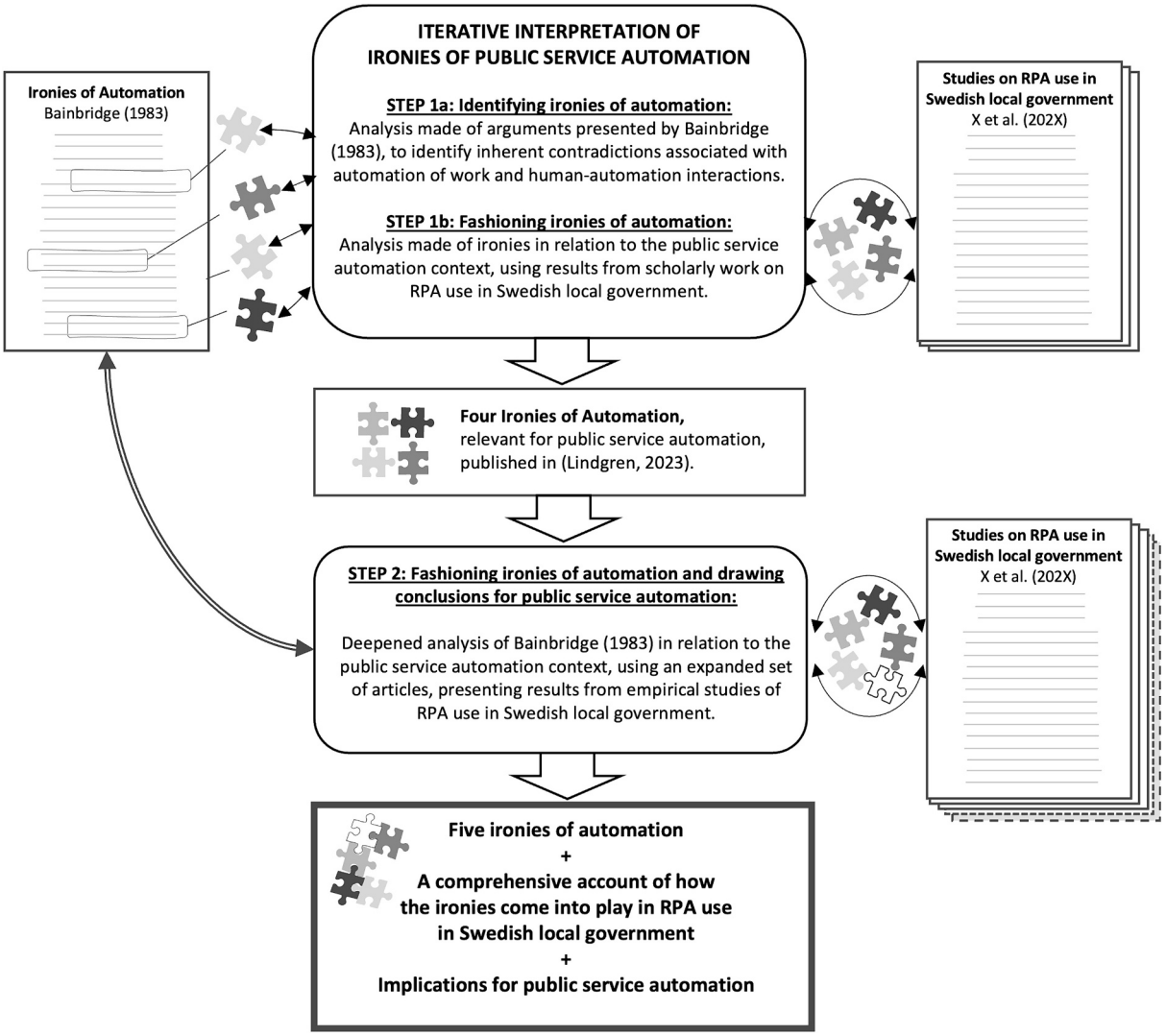

Fig. 1. Research approach – a two-step hermeneutic analysis of Bainbridge (1983) in relation to literature on RPA use in Swedish local government.

Bainbridge (1983) to the larger set of studies on RPA use in Swedish local government.

The empirical examples used to discuss the ironies are predominantly taken from an extensive qualitative case study on RPA use in Swedish local government (municipalities), conducted during 2020–2023 (*see* Lindgren, 2020), and funded by AFA Försäkring (eng. *AFA Insurance*). The study built on interpretive data generated through in-depth semi-structured interviews with (a) local government employees from several municipalities working in various roles affected by public service automation, (b) consultants from private firms selling RPA solutions, and (c) representatives of the Swedish Association of Local Government and Regions (SALAR). As part of the project, various analyses were made to better understand RPA development and implementation in terms of e.g., stakeholders involved, values guiding the development, values realized through RPA use, and organizational challenges encountered in various phases of RPA development and use. Results from these analyses were published by researchers active in the project, in both conference and journal articles (Lindgren, Åkesson, et al., 2022; Lindgren et al., 2021; Lindgren et al., 2024; Lindgren, Johansson, et al., 2022; Söderström et al., 2021; Toll et al., 2020; Toll et al., 2022; Toll et al., 2023a; Toll et al., 2023b; Toll & Söderström, 2020) and a licentiate thesis (Toll, 2022). The analysis presented in this paper can thus be understood as a kind of meta-analysis of the findings presented in these publications. In addition, the analysis was strengthened by including an additional set of articles, written by other scholars, all of which cover RPA use in Swedish local government, (e.g., Andersson et al., 2022; Bernhard & Wihlborg, 2022; Germundsson & Stranz, 2024; Gustafsson & Wihlborg, 2019; Johansson et al., 2022; Juell-Skielse et al., 2022; Ranerup & Henriksen, 2022; Ranerup & Svensson, 2023; Wihlborg et al., 2016).

The findings reported on RPA use in Swedish local government have been used to fashion the puzzle pieces to fit the public service automation context. The choice of using examples from only one country and level of government is partly based on convenience, as I have extensive experience of studying RPA development and use in this setting. However, and more importantly, using experiences from one country and level of government helps to keep certain contextual circumstances stable in the analysis, such as the underlying political, institutional, and legal context. Although there are 290 municipalities in Sweden, and they differ in size and circumstances, their operations rests on the same legal structure and overall assignment.

4. Ironies of automation

In her work, Bainbridge (1983) discusses the use of automated systems in industrial work processes, including both physical robots and computerized systems. There are four actors in her narrative: (1) the operator; (2) the automated system; (3) the designer of the automated system; and (4) the person with the ultimate responsibility of the process output (the operator, or a manager). According to Bainbridge, the classic aim of automation is "to replace human manual control, planning and problem solving by automatic devices and computers" (1983, p. 775). In comparison to automated systems, humans are seen as slow, unreliable, inefficient, and as sources of error in the process. While the automated system is working as intended, the process is effectively and efficiently performed. Sooner or later, however, the automated system is bound to malfunction, and problems will arise. The ironies of automation addressed by Bainbridge (1983) mainly concern circumstances related to continuous monitoring and maintenance of the automated system, and how to resolve issues that emerge when the automated system malfunctions.

The main argument for introducing automation is that the automated system will improve the quality of the process by simplifying or taking over tasks and decision-making from the human operator (Bainbridge, 1983). Automation is expected to reduce workload in the organization and eliminate human error in the work process (e.g., tasks and decision-making). However, Bainbridge claims, there are inherent circumstances associated with automation that, when combined, can result in the direct opposite of what is expected from automation (i.e., *ironies*). The ironies that follow on my analysis of Bainbridge's argumentation are summarized in Table 1, but further description of the main arguments in Bainbridge's text is needed to contextualize these ironies.

First, Bainbridge problematizes the underlying view on human abilities and performance expressed in the discourse on automation. In particular, the human operator is seen as unreliable and a source of error in the process and must therefore be replaced by an automated system. However, the designer of the automated system, who is most probably also a human, is not seen in the same light. According to Bainbridge, human weaknesses are highlighted in relation to the operator, and at the same time downplayed in relation to those actors designing the automated system. This tendency is dangerous, as it prepares ground for automation surprises. Furthermore, Bainbridge (1983) illustrates how designers seldom can automate complete processes, leaving the operator with a fragmented set of tasks. This can, in turn, lead to new operator problems that falsely accentuate the view of human operators being unreliable. Building on socio-technical systems theory (cf. Mumford, 2006), Bainbridge highlights that exchanging human operators with automated systems in a particular process does not remove the risk of human error affecting the output of that process. The automated system is still placed within a larger socio-technical system in which (other) humans are involved. Thus, automation does not per se eliminate human error from the process and system operations; implementing an automated system can furthermore infer *new* types of error and problems in that process and its output (Bainbridge, 1983).

Second, Bainbridge (1983) outlines what is left for the humans in the process after an automated system has been implemented. In addition to stating that some tasks in the process may be left to the human operator also after automation, she sketches two new tasks that emerge: (1) monitoring and (2) take-over. To ensure that the automated system operates successfully, it must be monitored. When the system malfunctions, which it will at some point or another, its operations must be taken over by the human operator. Building on research on human cognition (cf. Gardner, 1987), Bainbridge illustrates severe issues related to both tasks. Monitoring computerized automated systems in real-time is not possible due to the speed and black-boxed nature of the system's operations. Monitoring is thus described as "one of the worst types [of tasks]; it is very boring but very responsible, yet there is no opportunity to acquire or maintain the qualities required to handle the responsibility." (Bainbridge, 1983, p.776). She further illustrates that take-over is an equally impossible task for the human operator, as "… when manual take-over is needed there is likely to be something wrong in the process, so that unusual actions will be needed to control it, and one can argue that the operator needs to be more rather than less skilled" than before (Bainbridge, 1983, p.775). This last aspect furthermore highlights that, even though an automated system is implemented to reduce the influence of humans and their 'weaknesses' on the output of the process, automation creates a situation where the 'inferior' human still must superintend the automated system and compensate when it fails to perform according to expectation. This, in turn, places higher demands on the human operator (Bainbridge, 1983), and thus necessitates upskilling of the human operator after automation.

Based on the argumentation thus far, four ironies (#1–4 in Table 1) can be deduced from Bainbridge's work. Last, however, it is also possible to deduce a fifth irony from her line of reasoning (#5 in Table 1), when combined with experiences made of RPA use in Swedish local government. As expressed by Bainbridge (1983), automation is expected to reduce workload in the organization and eliminate human error in the work process. Consequently, automation is also expected to reduce costs for human work in the process. At the same time, automation generates increased work and costs in other parts of the organization, related to IT and an increased need for highly skilled personnel (e.g., IT specialists, consultants, legal experts). New tasks related to monitoring and take-

over can also drive new types of costs for the organization. Costs inferred by automation are however likely to be distributed across several functions in the organization, which can obscure the total cost of automation. These circumstances in combination means that automation can come at a higher cost than that of manual work, without the organization fully realizing this.

5. Relating the ironies to RPA use in local government

In this section, I proceed to discuss and relate the ironies outlined above to experiences made of RPA use in Swedish local government. Through this account, I illustrate how the ironies can come into play when implementing automated systems in the public service context. To keep this account at a reasonable length, only irony #1 and #2 are treated separately, and the remaining ironies are treated in combinations.

5.1. *Errare humanum est (to err is human) – irony #1*

Bainbridge (1983) clearly criticized the techno-optimistic and deterministic assumptions about the world that tend to guide automation and the design of automated systems. For example, the first irony highlights the overly pessimistic view on the operators' abilities to perform their work, and the overly optimistic view on the designer's ability to amend for the operators' flaws. It also highlights a general fixation and exaggeration of human error, as if human operators' individual mistakes can be meaningfully separated from the larger socio-technical system. These aspects, criticized by Bainbridge, are clearly visible in the discourse on automation in the Swedish context. A content analysis of Swedish policy documents on automation in general shows that the potential winnings of automation are often exaggerated, and that potential risks associated with automation are downplayed in these documents (Toll et al., 2020). Similarly, policy documents published by SALAR, concerning public service automation in local government, are skewed towards the overly positive view on automation (Toll, 2022). The RPA development projects studied so far have thus been guided by overly optimistic hopes (Lindgren et al., 2021; Söderström et al., 2021), fueled by exaggerated policy documents, and unnuanced yet successful marketing (Toll & Söderström, 2020).

Similarly, the discussion on public service automation highlights the need to reduce human error. This is clearly visible in the policy documents promoting RPA use in local government (e.g., SALAR, 2018a, 2018b), in which automation is presented as a way to reduce the risk of error in human case workers' information handling. Removing error from the process is indeed central to RPA development, as well as hindering new errors from emerging because of automation; if not correctly programmed, an RPA solution can make a large number of faulty actions in a very short time. This is a well-known feature of RPA and the general awareness of risking to introduce new errors is therefore high in RPA development projects. The fear of making mistakes, and accommodating for risks of future yet unknown errors, is also contributing to slow and lengthy development projects.

Interestingly, the guiding policy documents also present automation as a way of reducing *bias* in case workers' decision-making. Bias is a different kind of error than those addressed by Bainbridge (1983). However, Bainbridge's claim that new errors can be built into the automated system applies also to bias. New forms of bias can be built into the process, and into decisions made by the system, via the design of the automated system or based on historical data used to train the system. This is addressed in the scholarly literature on RPA, in which there are ongoing discussions on biases in algorithms and potential issues of negative designer influences (Rizk & Lindgren, 2024), especially when AI is involved in the RPA set-up. In relation to RPA use in Swedish local government practice, the discussion on bias in underlying data or system configurations has not been as prominent thus far. But this lack of explicit attention to bias can probably be explained by the fact that most RPA solutions in current use are rule-based, designed based on the underlying legal frameworks for the service in question, and do not yet include machine learning algorithms or data analytics. If more generative technologies are used, bias embedded in the underlying data and system design must be explicitly addressed.

The first irony thus highlights that no matter what actions are taken to remove humans from the process by means of automated systems, humans are still involved in the design, use, and monitoring of these systems. The main lesson that can be drawn from Bainbridge (1983) on this point is therefore to look for and prevent errors and problems in more places than in the human operator's actions, and to acknowledge that new problems can be created because of the design and use of an automated system. This also means that we must expand on our understanding of roles involved in the design of public service automation.

5.2. *Roles involved in the design of automated systems – irony #1 and #2*

Bainbridge (1983) addressed four different roles involved in automation. Of course, the roles used by Bainbridge must be understood as a simplified proxy for a larger set of stakeholders. However, to better understand public service automation and acknowledge the complexity of stakeholders in the public sector setting (cf. Rowley, 2011), there is a need to expand on one of the roles covered by Bainbridge: the *designer* role.

Current studies on RPA use in Swedish local government clearly illustrate a need to activate a large and varied set of stakeholders in the design of the automated system (Lindgren, Johansson, et al., 2022; Ranerup & Svensson, 2023; Toll et al., 2022). Said studies have illustrated that to design a functioning RPA solution for public service automation, the designer must have in-depth knowledge about RPA technology; the organization's existing IT-infrastructure; the process to be automated; and underlying legal frameworks that guide government operations and the policy implementation in question (Lindgren et al., 2024). These competences are not likely to be present in one individual or profession; collaboration across a large set of stakeholders is therefore needed to combine the right resources and competences (Lindgren, Åkesson, et al., 2022; Lindgren, Johansson, et al., 2022). This, in turn, puts pressure on the managers orchestrating RPA development, to ensure buy-in on all levels, including the political level. Although the need for involving many stakeholders is schoolbook material concerning information systems and digital government developments in general, many Swedish municipalities have learned this lesson the hard way by failing to achieve this (Lindgren, Åkesson, et al., 2022). Involving stakeholders with legal expertise early in the development process seems to be an especially important lesson learned.

A related circumstance identified in the studies of RPA use in Swedish local government, is that local government organizations often lack formalized processes and methods for conducting and orchestrating RPA projects. This involves both development and design of automated systems, as well as processes for funding and implementation (Lindgren, Åkesson, et al., 2022). Instead, the studied organizations have tended to make up their own ad hoc methods for mapping processes and designing, orchestrating, and implementing automated systems; pilot-studies with trial-and-error approaches have been frequently applied (Lindgren, Johansson, et al., 2022). It seems as if the managers involved have not been prepared for how RPA development will affect their work content and responsibilities. Moreover, those with the most knowledge of the process to be automated, the human operators, have often not been sufficiently involved in these ad hoc RPA projects. As illustrated by Andersson et al. (2022), the experience of female case workers involved in social welfare is typically not given enough attention and acknowledgment in the design of automated systems in local government. Managers and designers take lead of the development, without enough understanding of the process they are about to automate (Andersson et al., 2022; Johansson et al., 2022). Furthermore, funding beyond the pilot-project is often missing. This combination of circumstances causes

Table 1
Ironies of automation relevant for public service automation. Based on Bainbridge (1983) and Lindgren (2023, p.400-401).

IRONY	DESCRIPTION
Irony #1 *Related to the underlying view on **human** abilities.*	All humans involved can be potential sources of error and it is impossible to eliminate the risk for error altogether. Eliminating the human operator from the process does not necessarily eliminate the risk of error in the process. For example, designer errors can be a major source of operating problems. Automation is not per se a way of eliminating error from the process and system operations; rather, automation can be a new source of error and problems.
Irony #2 *Related to consequences of automation, in particular **fragmentation** of work.*	Automation requires that all actions of the system can be defined and programmed into the automated system. With complex work tasks and processes, not all aspects are likely to be of this programmable character. Therefore, the designer who tries to eliminate the operator through automation still leaves the operator with the tasks the designer cannot think how to automate. Due to automation, the operator can be left with an arbitrary collection of fragmented tasks. This fragmentation, in turn, can be a source of new types of error and problems in the process, as well as increased stress and decreased job satisfaction for the operator.
Irony #3 *Related to tasks left to the human after automation – **monitoring** the automated system.*	Automated systems require monitoring to ensure that they are performing successfully. Monitoring automated systems in real-time is not possible for the human operator due to cognitive constraints. For this reason, automated alarm systems are often put in place to monitor the automated system. Yet, the responsibility of monitoring is put on the human operator or manager. Monitoring automated systems and their alarm systems is very boring, but at the same time an important and highly responsible task. Due to the speed and black-boxed nature of automated systems, there is no real opportunity to acquire or maintain the qualities and knowledge required to handle the responsibility of monitoring. Monitoring thus risk being an impossible task that can lead to new errors and problems in the process, as well as stress and decreased job satisfaction for the person with the ultimate responsibility of the process output.
Irony #4 *Related to tasks left to the human after automation – manual **take-over** when the automated system malfunctions.*	When the automated system fails and manual take-over is needed, the operator must be highly skilled and knowledgeable not only in the operations of the automated system, but also in how the automated system itself is functioning. This is an impossibility for highly advanced and sophisticated systems, especially if the operator seldom gets to use these skills. Also, when a take-over is required, there is likely to be something wrong in the process, so that unusual actions will be needed to solve the task. After automation, the operator therefore needs to be more, rather than less, skilled than before.
Irony #5 *Related to distribution of **costs** inferred by automation.*	Automation is implemented to reduce costs associated with human work in the process. At the same time, automation generates increased costs in other parts of the organization by increasing IT-related costs and increasing the need for highly skilled personnel. Costs inferred by automation are likely to be distributed across several functions in the organization, obscuring the total cost of automation. As a result, in total, automation can come at higher cost than that of manual work, without the organization fully realizing this.

problems already in the development process and has led to several failed RPA initiatives not proceeding beyond the pilot phase (Lindgren, Åkesson, et al., 2022; Lindgren, Johansson, et al., 2022).

5.3. Tasks after automation – irony #2

The second irony directs our attention to what is left after an automated system has been designed and implemented, and how the human operator still involved in the process is supported (or not) in handling tasks that could not be automated. When automation works at its best, the automated system does what it is programmed to do, and the human operator has new work content that is supported by the automated system. The 'perfect' use of RPA, as expressed by practitioners and policymakers in the studies on RPA use in Swedish local government, is that the RPA performs monotonous routine tasks and thus free up time that case workers can spend on more valuable and meaningful tasks. However, it remains an empirical question if local governments will succeed to fully realize this vision. Also, removing all routine tasks does not necessarily result in a good work environment, and calls for studies on who gets to decide whether a task is routine or valuable (Berg, 2022).

The studies on RPA in Swedish local government referred to here have not fully covered the aspect of fragmentation, but it must be noted that in the Swedish local government context, most RPA systems currently in use are not fully autonomous. Rather, the automated system only performs parts of the process, and a human operator completes the process by e.g., taking the formal decision. This is a form of fragmentation, even though the division of labor between system and human has not been addressed in terms of fragmentation in the literature included in this analysis. However, the extent to which this division of labor affects the human operator's ability to successfully perform their work has been extensively discussed, especially in terms of effects on street-level bureaucrats' ability to use discretion in decision-making after automation (e.g., Bernhard & Wihlborg, 2022; Ranerup & Henriksen, 2022; Ranerup & Svensson, 2023; Wihlborg et al., 2016). When implementing automated systems in public service processes, an important lesson to be drawn from Bainbridge (1983) is thus to consider what tasks are left to the human operator and how these tasks fit together to form a comprehensive work situation for the humans interacting with the automated system. If not properly contextualized, tasks left after automation can become meaningless and boring, or overly complicated and stressful.

5.4. Monitoring and take-over – irony #3 and #4

Turning to the third and fourth ironies, relating to monitoring and take-over, there is a generally expressed concern that automated systems in public service provision will eventually black-box decision grounds and the decision-making process. This concern is expressed both in the literature and in public service automation practice. The black box could potentially be opened for inspection using monitoring systems, with interfaces towards the human operator in charge of monitoring. Regarding RPA use in Swedish local government, RPA solutions in use typically send notifications to the human operator through email when something is wrong in the process. But, as highlighted by Bainbridge (1983), even if the system operations and decision grounds are made visible initially, it is likely to be difficult to maintain visibility and understanding over time (See Table 1).

Bainbridge (1983) illustrated that the use of automated systems initially tends to rely on the experiences of the humans who used to work in the process, and their ability to compensate for issues that arise after automation. This tendency is clearly visible in the studies on RPA use in Swedish local government, showing that issues and tasks related to monitoring have typically been observed and addressed too late in the implementation process (Lindgren, Johansson, et al., 2022). This, in turn, has created problems related to monitoring and take-over after the automated system has been implemented, and for some organizations, these tasks have come as a surprise (Toll et al., 2023b). In some municipalities, these tasks have evolved as case workers involved in the design of the RPA solution have developed new skills related to both process and technology (Lindgren, Johansson, et al., 2022). These skills

set them apart from other case workers in the organization and, after the automated system was implemented, made them suitable monitors of the system. These individuals thus became responsible for supervising the automated system, sometimes against their own will and interest, since they were the only ones who truly understood the automated system (Lindgren, Johansson, et al., 2022). In turn, this created a dependence on a few individuals in the organization and thus an undesired vulnerability for the organization. Learning from Bainbridge (1983), it is difficult, and potentially more difficult for each new generation of human operators interacting with the system, to ensure that the human operator has the right skills to monitor the automated system and compensate when it fails. Interestingly, however, there are also examples of municipalities that have understood the challenge of monitoring and retained human operators in the process, handling a smaller subset of cases manually, to ensure that there are still people in the organization that can monitor the automated system and do a take-over when necessary.

In the Swedish local government context, despite a vast array of RPA development projects, fully automated systems are still novel and not widely used. The general interest for utilizing this technology is however high (Juell-Skielse et al., 2022). It is therefore important to take the monitoring- and take-over issues seriously as this development progresses. Tasks related to monitoring and take-over are likely to significantly change the work content for many people working in close proximity to automated systems. Already in 1983, Bainbridge forecasted that it would become increasingly difficult to recruit people who have the right skills – and interest – to work as supervisors of automated systems. Thirty-one years later, Hancock (2014, p. 453) built on Bainbridge's arguments and asked if humans will only be kept in the loop "in order that blame can be attached to some living entity?". This is a relevant question to ask also in relation to public service automation and highlights the need for policymakers and digital strategists to carefully consider what roles people can play in an automated future.

5.5. *Reskilling and reconfigurations of roles, responsibilities, and costs – irony #1–5*

Combining all ironies help to highlight that competences needed to develop and interact with automated systems are different from those required before automation. Also, because of automation, completely new tasks emerge. These tasks must be carefully considered and designed from the very beginning of the development. Bainbridge (1983) highlighted monitoring and take-over as new core tasks after automation. The studies on RPA use in Swedish municipalities highlight an additional task: *maintenance* of the automated system, also discussed in the general RPA literature (e.g., Asatiani, 2022).

As the automated system is developed, it is connected to other systems in the organization's existing digital infrastructure. Apart from maintaining the automated system through regular system updates, the connections with other systems must also be continuously maintained for the automated system to work properly. This is particularly true for lightweight automation like RPA (Bygstad, 2015, 2017). The connections made between the RPA and the standard human interface layer of the connected systems, i.e., the lightweight quality of the system, changes the ways in which the system can be maintained (in comparison to traditional IT systems). This characteristic has, so far, provided a challenge for the traditional IT-departments at Swedish municipalities (Lindgren, Åkesson, et al., 2022). New roles must be created, with responsibility for monitoring the automated system's connections to other systems and updating the automated system when needed.

Furthermore, the legal and political context in which the public service operates must also be actively monitored – as changes in policies and underlying legal frameworks affect rules and decisions embedded in the design of the automated system (e.g., eligibility and payment criteria). These changes must be continuously monitored and reflected in the configuration and design of the automated system. However, this is a different type of monitoring and maintenance than that related to the technology and requires a different skillset. Thus, new tasks and roles must be created related to other, policy-oriented, changes that may affect the operations of the automated system. For the municipalities covered in the studies on RPA use, this was typically an unexpected new role when first introducing RPA in the organization (Lindgren, Johansson, et al., 2022).

All these new tasks related to automation and automated systems, as well as the reallocation of responsibilities from the human operator to other actors in the organization, call for substantial reorganization of existing work processes, roles, and responsibilities. Such changes, in turn, require resources and drive additional costs, and stands in contrast to the intention of reducing costs through automation. The empirical studies on RPA in Swedish local government show that it is difficult for these organizations to form a complete picture of expenses related to automation, and thus also assess whether costs are reduced by automation. If we look at the case handling process in isolation, in which the need for human resources is reduced after an automated system is implemented, costs may indeed have been reduced after automation. But if we widen our gaze and include the increased costs associated with automation as organizational change (e.g., procurement of new technology, additional IT personnel, consultants hired to configure the RPA, process analysis and modeling, project management during development and implementation, new roles concerned with monitoring and maintaining the system, and more), then a different picture is likely to emerge. As illustrated in the empirical studies of RPA use in Swedish local government, local government organizations often lack methods for monitoring expenses that are distributed over several functions and departments within the municipality. This, in turn, risks obscuring the total cost of automation (Lindgren, Åkesson, et al., 2022). As indicated by the fifth irony, automation can come at a higher cost than that of manual work, without the organization fully realizing this. It should be noted, however, that this may only be an initial problem. With time, it is possible that there will be a return on the investments needed to implement automated systems. However, new automation technologies are continuously introduced on the market and RPA soon risk being considered an outdated technology in need of replacement, thus driving further needs for investments in new technology and upskilling of personnel.

6. Implications for public service automation

From Bainbridge (1983) we can learn that government organizations considering implementing automated systems must be prepared that, in their attempt to improve processes through automation, they are simultaneously likely to introduce new types of problems in the process and organization. If not carefully designed, automated systems may result in the direct opposite of what is expected (Bainbridge, 1983), as indicated by the five ironies. These ironies are inherent to automation and cannot be fully avoided (Strauch, 2018). Government organizations can, however, acknowledge these ironies and work to prevent their most negative effects. The account on RPA use in Swedish local government furthermore explicates different ways in which the five ironies can come into play in practice. Relating the ironies to current RPA use in Swedish local government serves to retrospectively describe and partly explain how and why RPA developments have been slow and difficult in this context. Furthermore, the five ironies can be used for prediction of implications for public service automation in general. Based on the analysis put forth in this paper, combining the insights from all five ironies and the experiences made from RPA use in local government, a set of implications for public service automation can be outlined:

- **Automation introduces *new problems* in the public service process.** After automation, sooner or later, new errors and problems will emerge in the process and affect its output. These are likely to be unexpected and both qualitatively and quantitatively different than

previously known problems. These can emerge based on e.g., the operations and functionality of the automated system and its connections to other systems in the overall IT-infrastructure; the quality of data used in the process; the automated system's compliance with underlying legal frameworks; human-automation interactions; and reconfigurations of tasks and responsibilities in the organization. Apart from monitoring the automated system, the organization must thus design routines for how to handle automation surprises and incidents that may occur.

- **Public service automation necessitates *new types of interfaces* between humans and the automated system.** After automation, even for fully autonomous systems, there will still be a need for human interaction with the system. The design of the interfaces through which humans interact with the automated system must not be left to chance or ill-informed designers. Successful design of such interfaces requires design processes that are mindful of human cognition and how to present necessary information to the human operator, in the right way and at the right time, as to not black-box machine operations that the human is responsible for monitoring, interacting with, and maintaining over time.
- **Public service automation creates *new tasks, roles, and responsibilities* on multiple levels of the organization related to development, implementation, monitoring, use, maintenance, and management of the automated system.** After automation, new tasks and responsibilities emerge concerning monitoring of the automated system and its operations and taking over operations when needed. Also, new tasks and roles emerge in relation to e.g., developing the system, training the algorithm(s), maintaining the system and related routines, and incident management. New tasks, roles, and responsibilities require clear job descriptions and routines for how to handle various issues in relation to the automated system. These changes, in turn, creates a need for re- and up-skilling of existing personnel, and recruitment of new professional roles. New roles are likely to require expert competencies in relation to e.g., advanced automation technologies, systems integration, IT-governance, change management, policy implementation, and legal requirements.
- **Public service automation necessitates *new tools and methods* for assessing quality and return of investment.** After automation, process operations, tasks, roles, and responsibilities have changed. What was previously done in one part and function of the organization, may now be distributed over several systems, roles, and functions in the organization. To assess if an automated system is living up to expectations, as well as understand its effects on policy implementation, new tools and methods are needed for capturing and assessing impact, quality, and return of investments.

Whereas the five ironies are formulated in a general manner, the implications above are more direct and action-oriented and can serve as a foundation for creating mitigating measures. The first implication is derived from the first irony; the second implication is derived from a combination of the second and third irony; and the third and fourth implications build on a combination of all five ironies. Compared to Bainbridge (1983), the implications presented here are rather obvious extensions of her argumentation. However, in the empirical studies on RPA use in local government addressed above, several of these aspects of automation were reported as automation surprises. The ironies and implications can thus be used in combination to guide organizations in avoiding foreseeable problems, and to design tasks and routines for how to deal with unforeseeable issues that arise when the automated system is in use.

Please note that this paper is not meant as an argument against the use of automated systems in public organizations and public service provision. On the contrary, automated systems can be highly valuable in this setting and be used for improving operations in public service provision in many ways. Automated systems can also be used to perform completely novel tasks that can add value to government organizations. That being clearly stated, automated systems must not be introduced on false grounds or overly optimistic expectations of the merits of these systems (Eikebrokk & Olsen, 2020). The likelihood of succeeding with public service automation will increase if automation is introduced based on realistic expectations, rooted in an in-depth understanding of its potential uses, requirements, and limitations. The ironies and implications for public service automation presented here can serve as a useful reminder that even though automation can simplify specific processes and tasks, automation can simultaneously add to the complexity of public service provision.

7. Directions for future research

In this paper, new knowledge is presented by combining Bainbridge's work with current research findings on RPA use in Swedish local government. Based on the hermeneutic approach applied, this work thus serves as a translation of ideas from one setting to another; combining experiences made a long time ago, in a different automation context, with experiences made in the current setting of public service automation. Using the terminology of Shirley Gregor (2006), the knowledge generated through this exercise can be understood as theoretical contributions that can be used to analyze, describe, explain, and to some extent even predict public service automation. Consequently, this paper provides a foundation for future empirical investigations and further theoretical development on public service automation.

The ironies presented here build on extensive analysis of literature. Irony #1–4, deduced directly from Bainbridge (1983), can be considered as relatively robust and are likely to be transferable to many different automation settings. However, irony #5 is a product of this paper, by relating Bainbridge (1983) to the literature on RPA use in Swedish local government. This irony must therefore be considered as a hypothesis that is open for further investigation regarding its prevalence in public service automation. The same goes for the implications presented. This work furthermore used RPA as the empirical example of automation technology. The lightweight character of RPA makes it different from other automation technologies (Bygstad, 2015, 2017), and can affect the transferability of the arguments made here. The ironies are likely to be transferable to other automation technologies, but the implications drawn for public service automation may differ slightly across different types of automation technologies. Future work should investigate whether this is the case.

Similarly, the work presented here is limited to one level of government (local level) and a specific geographical and cultural context (Sweden). This is a clear limitation and calls for studies investigating the ironies and their implications for public service automation on other levels of government and in a wider geographical and cultural context. The results presented here are likely to be transferable to many other contexts than those addressed explicitly, but additional analysis can add new facets and nuances to our understanding of public service automation on different levels of government and in different contexts. Also, new facets and nuances can be added to our understanding of public service automation by investigating the ironies and their implications in relation to different theoretical perspectives, as well as different types of public services. For example, differences in complexity of the underlying legal frameworks and public policies are likely to influence to what extent the ironies will come into play.

Last, to clearly connect this work to the wider theme of the special issue, a final comment on AI is needed. New automation technologies are currently being introduced on the market that include more advanced AI applications, promising automation of an even wider set of public services. Whether or not these promises will be fulfilled is an open question. Still, the automation landscape will continue to evolve, calling for continuous reinterpretations of what automation is, can, and should be. This evolution also calls for continuous discussions on the potential winnings and issues caused by automation in the public sector. The five

ironies and their implications presented here can serve as a starting point for such reinterpretations and discussions. They can also guide analysis of how the use of AI applications triggers organizational change, and the practical implications of such developments. For example, the importance of having structured high-quality data is likely to increase as generative AI applications are used and decision-making becomes an autonomous task performed by an automated system. How and by what (human) role in the organization should the quality of these data be assured and monitored? What (human) role should be responsible for the output generated by the system, what competence is needed for taking on this responsibility, and what system interface is needed for successfully communicating the grounds of the decision to the person responsible? Based on the ironies and their implications, a multitude of different questions can be asked that can guide a critical and nuanced analysis of the use of AI and data-driven models for public service automation purposes.

To conclude, a variety of research topics and questions for future empirical investigation and theoretical development can be generated based on this work, and the list of ironies and implications for public service automation can be expanded. The ironies and implications presented here illustrate that further empirical investigations and theoretical developments are needed on e.g., (1) problems introduced by automation; (2) tasks, roles, and responsibilities that follow on automation; (3) how to design the interface between humans and automated systems in a way that facilitates monitoring, take-over, and maintenance; and, (4) tools and methods needed to assess the impact and quality of automated systems in public service provision. Although limited to a specific technology, context and organizational perspective, the analysis presented here thus contributes with important insights on automation in the public sector, helps unpack current developments, builds knowledge in a cumulative fashion, and serves as a starting point for further research and theorization.

CRediT authorship contribution statement

Ida Lindgren: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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