MDPI

Article

Civil Servant and Expert Perspectives on Drivers, Values, Challenges and Successes in Adopting Systems Thinking in Policy-Making

Le Khanh Ngan Nguyen [1,2] , **Cecilia Kumar** [1] , **Marine Bisaro Shah** [3] , **Andrew Chilvers** [3] , **Isabella Stevens** [3] , **Rachel Hardy** [4] , **Claire J. Sarell** [4] **and Nici Zimmermann** [1,*]

[1] UCL Institute for Environmental Design and Engineering, The Bartlett School of Environment, Energy and Resources, University College London, London WC1H 0NN, UK

[2] Department of Management Science, Strathclyde Business School, University of Strathclyde, Glasgow G4 0QU, UK

[3] Royal Academy of Engineering, London SW1Y 5DG, UK

[4] Government Office for Science, London SW1H 0NN, UK

[*] Correspondence: n.zimmermann@ucl.ac.uk

Abstract: The use of systems thinking (ST) to handle complexity and wicked policy problems is gaining traction in government and the Civil Service, but policy-makers and civil servants can encounter several challenges in practice. How best to support them in understanding and applying ST in policy-making is not well understood. This study aims to explore civil servant and expert perspectives on the drivers and values of ST and the challenges, successes and solutions for its adoption in policy-making. We conducted semi-structured interviews with 31 civil servants across 17 UK government departments, agencies and public bodies, and 5 experts skilled in supporting ST use in policy-making. Via thematic analysis, we identified the values, challenges and successes interviewees experienced when implementing ST and their definitions of the term systems thinking. Civil servants were drawn into an ST approach by their academic training and exposure to it in their previous role(s), workshops, networking events and apprenticeships and through appreciating its values. Civil servants provided various interpretations of ST concepts and values with a strong emphasis on 'complexity' and 'interrelationship'. Our analysis identified eight challenge themes for the implementation of ST in policy-making, including (i) ST language and interpretation, (ii) the policy landscape, (iii) government structure and operation, (iv) methodology and technical aspects, (v) capacity and expertise, (vi) conceptualisation, expectations and buy-in, (vii) stakeholders, engagement and collaboration and (viii) evaluation and evidence. Despite the high interest in ST among civil servants across different policy areas within the UK government and the Civil Service, implementation is challenging. Recommendations for implementation include ST language in policy, systems leadership, policy-specific capacity development and evaluation processes for collecting evidence of impacts.

Keywords: systems thinking; policy-making; public policy; public sector; civil servants; interviews; thematic analysis; implementation; successes and challenges; United Kingdom

1. Introduction

Systems thinking (ST) enables users to look at problems as a whole, and to understand their interrelationships and dynamic complexities [1–3]. The systems in which policy-makers are operating and the often longstanding and intractable problems they are tasked with tackling are inherently complex. Therefore, ST provides policy-makers with much-needed tools and perspective to understand the problems holistically in a nonlinear way, and to generate potential solutions. The ST approach, which is, at its core, interdisciplinary [2], also serves as a way to bring together different perspectives and stakeholders, which is often a key part of the policy-making process.

Concerning policy development and implementation, ST aligns with other strands of knowledge, such as political science theories of the policy process, behavioural public administration and joined-up government. ST emphasises the need to consider the whole system and interrelationships between its components in policy development. This approach is consistent with political science theories of the policy process, which seek to explain how policies are developed, implemented and evaluated by examining the role of institutions, actors and power dynamics in the policy process [4–7].

The relevance of ST to behavioural public administration lies in the fact that both approaches recognise the importance of feedback loops and learning in the policy process. ST acknowledges that policies may have unintended consequences that require ongoing monitoring and adjustment, while behavioural public administration recognises that individual behaviour can change over time and may require policy-makers to adapt their policies accordingly [8–10]. Furthermore, both approaches emphasise the importance of stakeholder engagement and participation in the policy process. ST highlights the need to involve diverse stakeholders in policy development to ensure that policies are relevant and effective, while behavioural public administration recognises the importance of understanding stakeholder behaviour and preferences in policy design. It is thus evident that ST is relevant for policy-making, and interest in ST is growing in the UK government and the Civil Service.

Multiple factors can act as drivers for the implementation of systems thinking in policy-making, encouraging or discouraging decision-makers, policy-makers and practitioners to adopt and use systems thinking approaches and tools in policy-making processes. Lane et al. [11] provide a diagram of core drivers and how they reinforce each other. These include a build-up of strong examples, modellers and interested policy-makers, and awareness of these, which will strengthen opportunities for systems work in policy. Further drivers for ST can include the need to address complex policy issues that require a holistic understanding and consideration of multiple factors and interdependencies [11,12], the desire to improve policy outcomes and effectiveness [13,14], the recognition of the limitations of traditional linear approaches to policy-making [15] and the increasing availability and accessibility of systems thinking tools and techniques. They extend beyond the availability of tools and include the factors that contribute to a conceptual shift among policy-makers' perceptions and ways of working [14]. Drivers can also be internal to a policy organisation, such as the organisation's leadership, culture, values and priorities, or external factors such as political, social, economic and environmental pressures and trends [16]. Identifying these drivers can help explain why systems thinking is being implemented in policy-making and how to best support its adoption and integration into policy-making processes.

A step towards ST as a philosophy for addressing practical problems was the idea of joined-up government [17–20]. The first 'New Labour' government in the UK, led by Tony Blair, recognised the need for better collaboration between departments and agencies in order to address shared issues [21]. Their goal was to improve the flow of information to deliver better services that prioritise the needs and convenience of the customer, rather than the provider. To achieve this, the government implemented major programmes to modernise various parts of the government bureaucracy, such as the National Health Service (NHS) and the criminal justice system, as outlined in the 'Modernising Government' White Paper [22]. However, despite the ambitious nature of this project, the phrase 'joined-up' was eventually dropped as the challenges proved to be difficult to overcome. Numerous examples from social work and the criminal justice system highlight the consequences of failing to join up agencies, such as tragic cases of child abuse and murder [23–25]. These cases demonstrate that by not connecting the pieces of evidence and information, disastrous consequences can occur. Therefore, ST is vital in addressing current issues such as social and criminal justice, climate change and population health.

There have been more recent efforts to encourage and apply ST within government departments (e.g., the Department for Environment, Food & Rural Affairs (DEFRA) and the former Department for Business, Energy & Industrial Strategy (BEIS), which has now been

split into the Department for Energy Security and Net Zero, the Department for Science Innovation and Technology and the Department for Business and Trade), outside the central government (e.g., within the Greater London Authority) and in cross-departmental efforts, such as the inclusion of ST in the latest policy profession standards [26], the Government Science and Engineering Skills Assessment Tool [27] and resources by the Government Office for Science (GO-Science) to promote and support ST. The latter includes a series of documents for civil servants such as an ST toolkit [28] and a case study bank [29]. The value of systems approaches has been demonstrated in key policy areas [28]. Our systematic review, which provides rich context to this study, offers an overview of the state of the literature on the value, drivers and state of ST application in policy-making. It details how ST has been utilised, common barriers, enablers that drive ST adoption and outcomes [30].

While a clear need for ST among policy-makers has been recognised, there remains a profound knowledge gap in how to start implementing ST in decision-making. Robertson Munro and Cairney [31] reveal a lack in depth of understanding behind superficial systems thinking language in policy. Government organisations acknowledge that while methods such as causal loop diagramming, system dynamics, theory of change mapping, etc., are useful, a sound application of these methods is currently limited to pockets of analysts and specialists. Additionally, an ST framework to guide policy-makers in managing the application of such methods is missing. At a time when government challenges are ever more complex and when the policy profession has published new requirements for policy-makers to understand and apply systems approaches, it is extremely important to understand how this knowledge gap can and should be addressed.

There have been a limited number of studies that explored the perspectives of policy-makers on ST adoption in governments and public sectors [30]. These studies either focused on the use of ST in a specific policy area or a particular ST method. Haynes, Garvey, Davidson and Milat [14], Bensberg et al. [32], de Oliveira Morais et al. [33], Zucca et al. [34], El-Jardali et al. [35] and Trochim et al. [36] investigated the potential uses of ST and constraints on its applications, yet just within the scope of health policy. Scott et al. [37] and Bérard et al. [38] provided insights into how policy-makers and public officials perceive the usefulness of system dynamics. Freeman et al. [39] provided policy-makers' viewpoints on a specific waste management model and modelling experience. Lee [40] evaluated the impact of an ST course on public officials' way of thinking and daily administration behaviour to inform the design of future courses. Thus, there is a clear research gap of studies in the area of ST that go beyond a specific application area or method and that report from the view of policy-makers what drives them towards ST, what works and what is challenging around implementing ST in policy-making.

In this study, we aim to explore the views and experiences of civil servants in government and experts in the field about systems thinking. Our objectives are to investigate (i) how civil servants became interested in ST, (ii) how they define it, (iii) which values (i.e., benefits) they attribute to ST and, most importantly, (iv) interviewees' experiences around implementing ST in policy-making. The latter includes the challenges they experienced, what worked (successes) and their recommendations for successful implementation. We accomplish this via an in-depth qualitative analysis of 36 interviews with civil servants and academics. This study contributes to supporting the development of a user-informed strategy to embed ST in government and to the wider ecosystem on ST in policy-making.

2. Methods

This research was a collaboration between GO-Science, the UK's Royal Academy of Engineering and University College London, allowing each partner to play to their specific strengths in addressing the identified research gaps in ST implementation. We conducted semi-structured interviews with civil servants across UK government departments, agencies and public bodies, and academics and experts who have experience in supporting policy-makers and people in public administration more broadly in implementing ST into their work. This interview method was chosen as the most effective method to elicit inter-

viewees' views and experiences and explore any evaluative issues and reflections in a safe, open dialogue [41].

2.1. Recruitment

We used both purposive sampling and snowball sampling methods to recruit participants, aiming at civil servants in the UK government who have used or expressed interest in ST and academics and experts who have supported others in ST. Civil servant interviewees were identified from (i) individuals who have either commissioned or been involved in the Royal Academy of Engineering's systems workshops, (ii) those who have been through the Academy's Policy Fellowship programme with a particular focus on learning how to apply systems approaches to a complex policy challenge, (iii) ST practitioners who contributed to GO-Science's ST case study bank and (iv) the UK's cross-government Systems Thinking Interest Group (STIG). National and international academic and other expert interviewees with highly relevant past experience were identified from NZ's network and previous studies. The System Dynamics Sustainability Platform members also suggested further interviewees. One of them is also a civil servant outside the UK with many years of experience in using a systems approach in government. Our team discussed and made a priority list of interviewees in our project meetings. We invited them to take part in an interview via email and the STIG newsletter. This resulted in 31 interviewees who were UK civil servants and 5 who were academics or experts.

2.2. Data Collection

Interviewees' informed consent was sought via email before the interview and verbally at the beginning of the interview. We carried out interviews over Microsoft Teams in July and August 2022. LN and NZ led interviews with civil servants and experts, respectively. Both interviewers co-conducted one third of the interviews. We considered such interviews as 'conversation with a purpose' and treated interviewees as active, expert partners in this study [41]. Interviews with civil servants lasted between 14 and 43 min, with an average duration of 25 min. Interviews with academics/experts were between 38 and 72 min (51 min on average).

The interview questions (see Appendix A) covered six domains: (i) interviewees' professions, roles and experience, (ii) challenges and drawbacks experienced, (iii) successes experienced, (iv) reflections, views and recommendations, (v) feedback on the GO-Science ST toolkit content and (vi) hopes for the toolkit and its wider implementation. Whilst domains (i)–(iv) covered experiences and views on ST in policy in general, domains (v) and (vi) were more specific to the ST toolkit for civil servants developed by GO-Science. The feedback on this toolkit was not within the scope of this paper and will be reported and discussed in a separate paper. We adapted the interview questions to fit different categories of interviewees. Interviews were audio-recorded and transcribed verbatim.

2.3. The Diverse Sample of Interviewees

We had a roughly equal balance between male and female interviewees. The characteristics of 31 civil servant interviewees were diverse in terms of departmental grade, academic background, policy areas, level of knowledge about ST and experience with using ST, as described in Table 1. The interviewees were from 17 government departments, agencies and public bodies that we do not specify in this paper for confidentiality reasons. This diversity was important to ensure rich insights and the credibility and generalisability of the findings.

Table 1. Characteristics of civil servant interviewees.

Scheme		Policy Area		Level of ST Knowledge	
Female	16	Aggregates levy	1	PhD in systems approach (Expert)	2
Male	15	Agri-environment	1	Master in systems approach or equivalent training (Very good)	8
Departmental grade (Decreasing seniority)		Agri-innovation	1	Short courses (Good)	11
Senior Civil Service (SCS1)	1	Business and human rights		One-day workshop and self-learning (Basic)	9
Grade 6	7	Business finance	1		
Grade 7	19	Defence and energy	1	Exposure to ST without further training/reading (Little)	1
Senior Executive Officer (SEO)	3	Disadvantaged adults	1		
Higher Executive Officer (HEO)	1	Economics	1	**Level of experience with ST**	
Educational background		Education	1	Use ST in several projects across different policy areas (Very good)	5
Business systems analysis	1	Emergencies and resilience	1		
Cellular and molecular biochemistry	1	Environment assessment reform	1	Use ST in 1–2 projects (Good)	9
Chemical engineering	1	Health and social care	3	Use tools within own team for exploration (Fair)	8
Chemistry	1	Heat and buildings	1		
Civil engineering	1	Human resources and operational delivery	1	Explore tools for own thinking (Little)	7
Digital innovation	1	Infrastructure	1		
Disaster management	1	Innovation	1	No experience	2
Environmental science	1	Investment and engagement	1	**Government**	
History and law	1	Investment strategy	1		
International relations and economics	1	Local growth and regeneration	1	UK government (based in England)	25
Linguistics	1	Performance of directorate	1		
Math and economics	1	Policy capability and digital skills for policing	1	Scottish government	5
Medicine	2	Policy capacity	1	Welsh government	1
Not provided	5	Policy strategy	1		
Operational research	5	Population ageing, future cities	1		
Political science	2	Rail reform	1		
Psychology and animal welfare science	1	Science and technology	1		
Public health	1	Strategy development	1		
Science communication	2	Transforming public services	1		
International relations	1	Work and pensions	1		

2.4. Data Analysis

We adopted both deductive and inductive approaches for thematic analysis as our project had some specific issues to explore, but we also aimed to leave space to discover other, unexpected aspects of the participants' experience or the way they assign meaning to phenomena [42]. We followed Braun and Clarke's [43] six-phase framework for undertaking thematic analysis. In the deductive approach, we preselected themes and subthemes based on previous literature, our own systematic literature review [30] and the specifics of the research questions, whereas, in the inductive approach, we generated themes from the data through unrestricted coding. LN and CK independently analysed several transcripts each and discussed themes and subthemes with NZ as a group, followed by several iterative

refinements until there was a consensus. LN further conducted a content analysis of the interview data [44]. We all then revised draft results through discussion. Data analysis was performed in conjunction with data collection until new data no longer brought additional insights to the research questions. NVivo software was used for analysis and data management. Our diverse team of academics, practitioners and civil servants was well positioned to critique interpretations of the results.

3. Results

We report on the reasons why civil servants have been interested in ST, how they define ST and which values they see in it as well as the challenges they experienced, implementation successes and recommendations.

3.1. How Civil Servants Became Interested in Systems Thinking

The civil servants interviewed explained several factors that had acted as drivers for their interest and motivation to apply ST. Five interviewees had academic backgrounds in operational research through their PhD or Master's degrees and thus entered their roles with previous ST experience. They had taken the lead and initiated ST projects in their teams. Appreciation of ST benefits and values was the most common factor attracting interviewees (12 civil servants) to ST: *"So, the benefit I see is that if it works well, it can have sustainable impact. When it works well, it can make transformational change happen. That is potentially cost-effective and sustainable." [CS26].* An interviewee believed that there is a natural fit between a systems approach and policy-making:

> *"I think there's like a resonance between policy-making and ... systems approaches and it's the fact that they're both ... generic ... [...] You can apply them in lots of places and so I think that's a real strength of systems engineering. I think there's a natural fit there." [CS11]*

Several interviewees (i.e., 11 civil servants) claimed that they had developed their interest in ST through experience with ST in their previous role(s). *"I suppose my interest in [ST] comes from a previous role I did in [name of a project] which has some kind of ... overlaps with systems thinking ... " [CS3].* They (i.e., 10 civil servants) also mentioned exposure to ST concepts in, for example, workshops, networking events and apprenticeships. Six civil servants found ST relevant to their daily work: *"I think in our role in particular, because our whole job is that trying to be a bit of a join-up across government and spot the links. . . . . if there were just a culture of everyone else thinking in a systems thinking kind of way, it would make our job so much easier." [CS30].*

3.2. How Civil Servants Define Systems Thinking

We asked interviewees to self-define ST concepts and received diverse responses, each covering one aspect of ST. Nine interviewees defined ST as an approach to conceptualising interrelationships between different components of a system to gain a broad view of the system and understand the knock-on impact of policies on these components:

> *" ... my basic understanding of systems thinking is it's about ... spotting the connections between things and taking the wider view. So rather than looking at individual policies or ideas in isolation, always trying to look at how do they join up with something else, what are the knock-on impacts. What are the points where you can make efficiencies rather than everyone doing the same thing or subtly different things in silos?" [CS30]*

Five other civil servants explained that ST is an approach to understanding the complexity within a system:

> *" ... [ST] represents a skill set that lets you understand complexity, that's reasonably flexible and can be applied to different situations, different problems to help you, particularly with problem definition, but also with understanding the fitness of solutions from different viewpoints." [CS11]*

Considering ST as a framework of thinking was reported by four others: "So from a practical perspective, systems thinking is a framework of thinking, a set of tools and techniques that help broaden the conceptualisation of an interrelated set of issues . . . " [CS6]. Other self-definitions of ST included a whole systems approach, an approach for broadening thinking scope, an approach for collaboration, a problem-structuring approach, a problem-solving approach and systems with purposes.

3.3. The Perceived Value of Systems Thinking

The values of ST that interviewees perceived, which act as drivers to apply ST, were categorised into eight areas. Figure 1 shows these areas together with how often the interviewees mentioned them. The majority of interviewees stated that ST helps them to understand and visualise the complexity of systems and wicked problems, make interrelationships explicit and capture multiple perspectives to gain a holistic view: *"We started this whole journey . . . around how we broaden our people's perception of the factors they need to take into account when they're dealing with very complex, multidimensional problems."* [A02], and *"Systems thinking can be very helpful in structuring what seems to be an intractable or very messy type of problem which is very difficult to get a grip on"* [CS7]. Other values, including shifting thinking and mental models, acting as a learning and decision-making support tool and facilitating stakeholder participation and collaboration, were mentioned equally by ten interviewees each.

> *"[ST] is getting embedded in that way in organisations that people's mental models have changed because they are now thinking carefully through every little thing. . . . . That's probably one of the biggest impacts we had on an organisation, for people to be thinking that way."* [A03]

Fewer interviewees recognised ST's values of creating a shared, collective understanding, achieving consensus and commitment, impacting policy and practice and acting as a communication tool.

> *"I see the benefit as getting a shared understanding of either what the problem is or how things work essentially. Because that's some of the things that . . . we all assume we know, but . . . until you map it out, you can test that with others and . . . different perspectives."* [CS27]

Regarding the last value mentioned, an expert suggested that ST is useful in supporting conversations with senior leaders. Experts

> *" . . . were trying to . . . help the individuals who were interfacing with decision-makers to be able to have . . . conversations with . . . very senior people, about how they broadened out their perception of the factors that need to be taken into account to support them in the decision."* [A02]
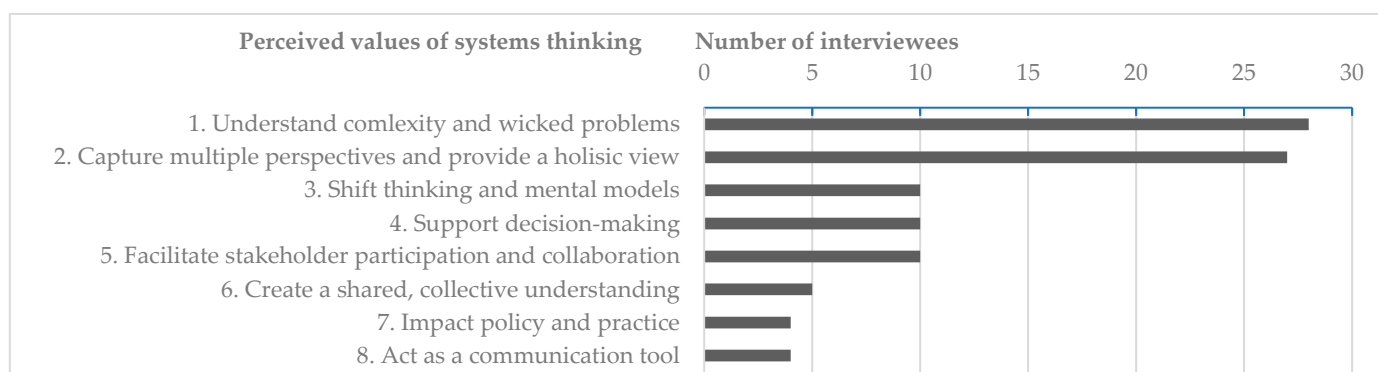

Figure 1. Interviewees' perceived values of systems thinking in policy.

The perceived values of ST among interviewees heavily focused on understanding the system and the problem while there was little recognition of its value in assisting communication and collective learning, supporting decision-making and impacting policy. The next section discusses the challenges, successes and recommendations for ST implementation in policy.

3.4. Challenges, Successes and Recommendations for Implementing Systems Thinking in Policy

Interviewees' reported challenges, successes and recommendations help explain drivers internal and to some extent external to policy organisations for implementing systems thinking in policy-making. We identified eight main themes across all interviews: (i) language and interpretation, (ii) the policy landscape, (iii) government structure and operation, (iv) methodology and technical aspects, (v) capacity and expertise, (vi) conceptualisation, expectations and buy-in, (vii) stakeholders, engagement and collaboration and (viii) evaluation and evidence (Table 2). The subsequent sections will focus on each of these themes, first describing the challenges, then what has been accomplished and, finally, further recommendations given by the interviewees.

Table 2. Challenges, successes and recommendations for advancing systems thinking (ST) implementation in government and the Civil Service.

Challenges	What Has Been Accomplished/Successes	Recommendations
Theme 1: Language and interpretation		
Unfamiliarity with ST concepts, tools and values (14) *	Practice and support networks across departments and disciplines (12)	Raise awareness of ST and its relevance to policy-making (6)
Debate around ST language, cross-discipline miscommunication (10)		Create a shared language across disciplines and management levels (5)
Complicated and difficult-to-interpret ST outputs (4)		Clarify ST concepts and values (8)
Misconceptions about ST (1)		
Theme 2: Policy landscape		
Challenging political context (7)		
Dynamics of policy-making process (2)		Further exploration (1)
Inherent policy culture (2)		
Time and resource constraints (25)		Understand accounting officer roles (1)
Theme 3: Government structure and operation		
Departmentalism, siloed working: Structure not set up to use ST (6)	Create space for ST practice (7) Support from senior leaders (2)	Systems leadership: Top-down approach (17) Establish a single accountable and empowered entity taking ownership of ST (4)
High turnover within the Civil Service (5): Discontinuity of learning and output use	Develop a knowledge bank (2)	
Operational priority, accountability and power (5)		
Promotion structure (1)		

Table 2. *Cont.*

Challenges	What Has Been Accomplished/Successes	Recommendations
Theme 4: Methodology and technical aspects		
Concern with intrinsic validity of ST (2)		
Lack of data for quantitative analysis (5)		
Difficulty in system boundary determination (6)		
Lack of access to appropriate software and technical support (2)	Have a team member with ST expertise (3)	Access to user-friendly software (3) Access to technical support (9): internal and external consultancy, mentorship from GO-Science Support journey to adopt ST (4)
Lack of complete, comprehensive, accessible policy-specific and practical guidance (5)	DEFRA's internal guidance, Acumen course's ST guideline and the GO-Science toolkit	Develop accessible guidance and toolkits (5): Build an inclusive design guide and toolkit using a co-design approach
Theme 5: Capacity and expertise		
Technical incapability to apply ST (7)	Knowledge and experience sharing (6) through workshops, seminars, conferences and case study presentations across departments	Build capacity via education and training (17) Apprenticeship, mentorship, fellowship and signposting the professional body of ST practitioners (5) Informal, practical platforms for knowledge exchange (10) Include ST in policy professional framework (6)
Lack of confidence to question and interpersonal skills, leading to discomfort in using ST (1)		Relevant soft skill training on engagement and conversation elements (1) Create a bespoke environment (1)
Theme 6: Conceptualisation, expectations and buy-in		
Reluctance to embrace a new way of thinking (10)	Build strong relationship with decision-makers through consultancy (4) Open conversations and have people work on a case study (2)	
Fear of technical challenges (6)		
Lack of appreciation of ST value (3)		Demonstrate ST's relevance to policy-making (10)
Unreasonable expectations (3) (Facilitators will perform the work)	Clarify facilitator role (1)	
Theme 7: Stakeholders, engagement and collaboration		
Decreasing quality of engagement and collaboration over time (4)		More attention to ST tools for supporting conversation (1) Support from a champion (4)
Imbalance in resources and powers between stakeholders that challenges conversational and participatory approaches (3)		
Lack of engagement of policy-makers (1)		
Lack of trust between the team and the facilitator of the process (1)		

Table 2. *Cont.*

Challenges	What Has Been Accomplished/Successes	Recommendations
Theme 8: Evaluation and evidence		
Shortfall in continual use of ST outputs (9)		
Lack of evidence of usefulness, success and impact (8)		
Lack of evaluation criteria (1)		

* The number of interviewees mentioning a specific subtheme is in brackets.

3.4.1. Theme 1: Language and Interpretation

Interviewees commonly reported challenges around ST language and the interpretation of ST outputs. They believed that civil servants were still unfamiliar with ST concepts, tools and values as they had no previous exposure to ST or did not see its values; interviewees thought this might be due to " ... *just terminology and ... a lack of knowledge of it as an approach, and why it's beneficial versus other approaches."* [CS08] as well as " ... *low-level understanding of what systems thinking is and how it may help, and kind of coming to systems thinkers in the organisation to ask them to help."* [CS08]. There was also still a debate around ST language, its scope and what it is, resulting in cross-discipline miscommunication and the potential exclusion of particular groups of people:

> " ... *they're not maybe talking in the language of systems, as I've been taught at least, so I think that is a problem too. And I'd also add as a counter problem to that language, which is, that if you just talk in terms of systems and systems thinking and causal maps and stuff, you can exclude a whole bunch of other people."* [CS01]

and

> " ... *the phrase systems thinking can mean a lot of things to a lot of different people. And sometimes it can be quite kind of intimidating or seen as a solution rather than kind of a tool. And so, I guess that's a bit of a barrier."* [CS08]

Additionally, interviewees reported that ST outputs could be complicated and difficult to interpret, hindering learning and reducing buy-in: *"Some of these causal loop diagrams get so big it's just like spaghetti. I'm getting nothing from this ... "* [A03]. A few interviewees suggested that people held different misconceptions about ST, such as that it is only a tool for exploration in silos or for use by certain experts: *"I do tend to think that systems thinking is still seen as the preserve of certain experts or certain people who've used that approach rather than it being something that all of the civil services should be working with routinely."* [CS09].

Interviewees reported a number of efforts to raise awareness and promote understanding of ST among policy-makers in the UK government through practice and support networks and engagement events, such as the Policy Fellowship Scheme, the STIG (Systems Thinking Interest Group) and the planned ST Community of Practice.

> " ... *we're getting to the stage where we've got a systems thinking interest group, which I think has got about 600 members in it across different departments now. ... there is quite a lot of senior level buy-in to these sorts of approaches. .... So that's creating the conditions for us to get better at implementing them."* [CS10]

One interviewee also revealed an effort to narrow gaps in communication across disciplines:

> " ... *the systems thinking network in [name of department] which I'm chairing ... started off as mainly an operational researcher kind of group and then we expanded that to the analytical community, which includes economists, social researchers and statisticians. ... , I now invite policy group and behavioural scientists."* [CS01]

Interviewees recommended different approaches to address the challenges around ST language and interpretation. The first suggested step was "... *educating people, getting people to be okay with that as a way of working, and being comfortable with a bit of uncertainty around lots of these issues.*" [CS31]. It was important to continually raise awareness of ST and its relevance to policy-making in accessible and clear language through, for example, curricula for civil servants, GO-Science workshops and the STIG to achieve a high level of buy-in: *"Because if they all get taught [ST] when they get inducted to being senior level civil servants, then they presumably will then think at least to ask for other people to provide them with evidence of what the system looks like, you know, and ask those kinds of questions."* [CS01] and *"... in our network I was thinking it would be good if I could get someone from STIG or GO-Science to come.... and say talk about it ... so that it's not just a sort of a link in an e-mail that people might not open ..."* [CS01].

Interviewees also emphasised the importance of creating a shared language of ST across disciplines and management levels to facilitate collaboration processes and communications with high-level policy-makers. ST being embedded in different training materials without the same language could cause repetition and confusion.

> *"... if you want to say that you're working in the whole systems approach and you want to put that on your advice to the Minister and the Minister says, 'Well, what the hell is a whole systems approach?', there's something you point to and you say, 'This is what, as policy-makers, we define as a whole systems approach or this is what we mean by systems thinking.' So that part of it is that you're not trying to have loads of different types of definitions around what systems thinking is to lots of different departments, to lots of different ministers."* [CS06]

Several interviewees agreed that clarifying ST's values was important to draw people into it and have them buy into it: *"What does it do that nothing else can do?"* [CS01] *"You have to recognise that we understand and value systems modelling, but they may not understand it at all. And so how do you convince them? It has to be something that is important to them. And they walk out the room with some value added."* [A03].

The most commonly raised challenge for implementing ST in policy was that civil servants are not familiar with ST concepts and tools and, therefore, its values. The lack of a shared language for ST caused difficulties in promoting it and created misconceptions and miscommunication across disciplines and management levels. Clarity on ST language in policy and regarding what it offers to policy-making is essential as the first step in the implementation process.

3.4.2. Theme 2: Policy Landscape

Nearly two thirds of interviewees asserted that time and resource constraints prevented policy-makers from engaging with ST: *"I do think these things are quite difficult to do in government because you've got ministers involved and you haven't always got time."* [A02] and *"... in knowing the resource-poor environment, these are things that nobody wants to hear or engage with."* [A01]. A civil servant interviewee gave an example of an ST team within a government department that had been disbanded, and the interviewee thought the reason for this was because the team had been seen as an expense and a distraction for the department. An academic believed that *"... any true effort to actually promote systems thinking happening in government should take into consideration that lack of resources and that scarcity of resources in government agencies, and local governments mostly, right."* [A04].

The challenging political context was another barrier to implementing ST in policy-making, and there were a few suggestions on how to address it: *"... I think it's difficult when you're in a political environment where there's always political change or disagreement, and particularly where there are resource constraints."* [CS09]. Complex accountability and power relationships in government could drive political priorities, such as short-term goals, as well as discrepancies between what stakeholders reported and what they did. Such challenges undermined efforts to capture accurate perspectives of a system and the motivation for applying ST to see the long-term impacts of policies.

The shortfall in understanding the dynamics of politics and the policy-making process in existing ST work led to less impactful projects and policy recommendations not being implemented. An expert interviewee asserted the following:

"And if you don't do that, we will always be thinking 'Well, why don't politicians listen to our bright, our brilliant ideas?' [. . .] But I mean, it's 50 years since we did the Limits to Growth and we're still modelling along with climate issues . . . . And that's because also, you can also find dynamics in the policy-making processes. And you should understand them as well before you can really be effective." [A05]

Two civil servant interviewees with very good knowledge and excellent experience with ST believed that the inherent policy culture hindered the use of ST in government. The need to have a clear idea of what was measured, what was measured and what it meant in the typical way of doing policy contradicted the use of ST in exploring unintended consequences. There was also a need to reduce complex policy solutions to simple options in communication with ministers: *" . . . the natural tendency for decision-making in government is to reduce it down to a set of controllable problems, a set of controllable policy options, and then a preferred option to go forward with." [CS06]*. Additionally, *"there's this challenge of doing systems thinking in a systems thinking way, and bending tools and techniques of systems thinking into a fairly inflexible policy development process in government." [CS06]*. Furthermore, there was an inherent bias towards hard systems approaches in certain roles compared with softer approaches because *" . . . working in a chief scientist's office, there is always this need to come up with stuff which is robust and well evidenced, and stuff which is based on dialogue and reflection doesn't always fit into that category." [CS10]*.

Despite enormous challenges from the current policy landscape, interviewees made few suggestions on what could be done. An expert interviewee suggested an area worth exploring further: *"If you want to promote systems thinking and system dynamics we should also understand how these policy processes work, and not only from the academic point of view but from the really dirty everyday street fighting level of policy-making." [A05]*. It was also recommended that people understand the role of the accounting officer in attracting resources into ST implementation: *"It's a very important role within this because they are personally accountable to Parliament for the spend of their department and the performance of their department . . . " [CS02]*.

3.4.3. Theme 3: Government Structure and Operation

Interviewees identified several problems with the current government structure and operation that impeded ST adoption. First, the government structure was not set up to use ST as it possessed inherent structural barriers around departmentalism and siloed working culture: *" . . . government structures aren't already set up to do systems thinking. You can identify that from a systems approach this input over here is key to delivering this outcome over here, but that input is with the responsibility of one department, and that outcome is the responsibility of a different department. . . . " [CS02]*. These barriers made connections across departments complicated and not easy to navigate, especially when such connections were *"subject to change all the time" [CS05]*. This created great difficulty in identifying the right stakeholders to engage. Second, the longstanding high staff turnover within the Civil Service led to the discontinuity of learning and using ST toolkits and outputs: *"The problem you're going to have with the Civil Service is somebody might be owning it [ST] today; in three-years' time they'll be somewhere totally else. . . . it means there's no continuity of learning within the system." [A02]*. Third, operational priority and accountability along with the promotion structure created an unfavourable environment for ST implementation. The priority of daily work, department benefits and targets, single accountability, conflicts between power and accountability and the priority of analytical support in specific policy areas prevented policy-makers from applying ST to their work: *"Another barrier is actually more built into the way that civil services are structured and the way that success is rewarded and that promotion happens in the Civil Service. . . . there's an incentive for people to work in ways which are not systemic based on that." [CS10]*.

Discrete efforts have been made to break through this structural rigidity and create a safe space for ST practice in different government departments. An interviewee described a

policy school for policy professionals in their department, in which they created time away from their job for ST training and a safe space for the experience of using ST at work with mentorship conversations with ST experts and peer networks. An academic also mentioned that they were trying to move people around and give them opportunities to practice ST in different environments so that people could gain a large amount of experience in a relatively short time. Civil servants from five different departments asserted that they were trying to integrate ST into their daily work, such as by using ST tools for conversations within their teams and with stakeholders, rather than considering these tools to be a used as a side-activity only. One of them claimed that support from senior leaders was key for ST implementation:

> " . . . *senior colleagues or ministers have broached this idea of improving the way that we do systems thinking and developing our baseline for how we go about it. And if there isn't the buy-in from senior leaders, I am not going to have much success in suggesting that we do more or do better systems thinking and practice.*" *[CS04]*

Additionally, two civil servants reported the usefulness of documenting case studies and learning materials within the Civil Service for continual knowledge and checking what had already been performed previously: *"So, we've tried to document all of the projects. . . . . to start . . . writing down, basically, what each project was, what the impact was, what methods they used, so that we have a bit of a knowledge bank that we can . . . draw off."* [CS12].

In addition to the above efforts, half of the interviewees emphasised the need for systems leadership and a top-down approach to advancing ST adoption: *"When I've seen it working, there's a clear political commitment. . . . . Simply having the systems thinking and then trying to build that bottom up, I've seen less success of that."* [CS02] and *" . . . you need leaders who are willing to listen to others, open-minded in terms of what the possibilities might be of using system thinking, and valuing the whole."* [CS26]. Another interviewee made the following comment: *"It has to be a top-down [approach] . . . You know, there's no point in doing systems thinking if you're just looking bottom up or for people who are interested, it's not enough."* [CS24].

Finally, four interviewees from both expert and civil servant groups recommended the establishment of a separate single accountable and empowered department or joint hub to take ownership of promoting and supporting ST use: *" . . . to gain more traction in government, there needs to be a department, or joint hub . . . Someone needs to take ownership of it and say 'This is important.'"* Additionally, it is

> " . . . *a mechanism that gets beyond the individual departmental boundaries and single accounting officers. . . . . So, you are responsible for the system rather than responsible for a department. And there are some really good examples. I mean, inarguably the Vaccines Task Force is an example of this where you had a single accountable and empowered person. Delivering a specific outcome which required a complex system behind it, which was to get enough vaccines into the UK. And they were able to pull levers across government, not just within the Department for Health.*" *[CS02]*

3.4.4. Theme 4: Methodology and Technical Aspects

An academic and a civil servant raised concerns about the intrinsic validity of ST methods and the insights they produce and, therefore, challenges in building trust and confidence in ST outputs: *"I don't think that if you come after two sessions and build a model based on what people tell you, I don't think anybody will trust that model. Especially if you're talking about 300 variables . . . . It's going to be like an obscure artifact, right?"* [A04] and "*I found systems approaches quite good in a qualitative way mapping connections. But often the question comes, 'Well, which connection is more important and what's the gearing and how do you quantify that?'"* [CS02]. This challenge was exacerbated by the lack of data and the time pressure required for quantitative exploration.

Civil servants also reported difficulties in determining a system boundary within the Civil Service context: *" . . . if you're trying to do systems thinking properly and work out all of the interconnections, it would just be too big. . . . . So, I think there's always going to be a bit of a*

challenge in a civil service context of, where do you draw the line" [CS30]. Other methodological and technical challenges came from the lack of policy-specific guidance, access to the appropriate software and technical support. ST projects within the Civil Service had been happening in an ad hoc manner.

Both experts and civil servants made several recommendations to address these challenges. There needed to be user-friendly software that does not require programming skills for relevant ST tools to be accessible for civil servants at work. Support when people apply ST in a project was suggested as the easiest starting point, especially in the following context: " . . . *there has to be a bit of coaching, mentoring if they have no background in the sort of tools of policy-making."* [A01]. Three interviewees found that having a team member with ST expertise was ideal in their experience. Another way to provide access to technical support suggested by an academic was forming a small team of two or three people who have experience in ST or ST experts sitting in each department with the role of internal consultancy in addition to access to GO-Science: " . . . *if somebody was able to put a team of mentors together and coaches and trainers for the first two years, the benefit they'd get back in its application and in policy would be enormous."* [A01]. When resources were not sufficient for a team to have an ST expert on board, a few interviewees hoped that they could access technical support from other teams and departments for a short period to help them, for example, run an ST workshop and carry out an analysis for a particular project. They believed that mentorship would also help people increase their competence. Therefore, they suggested a list of recommended ST consultants in different policy areas across the government that people could access as mentors. Furthermore, some interviewees mentioned guidance and toolkits to which they had referred to apply ST, such as DEFRA's internal guidance, the Acumen course's ST guideline and the GO-Science toolkit. However, they felt that there was not a complete, comprehensive, accessible guidance and toolkit specially designed for policy-makers. An academic interviewee stressed the need for building an inclusive design toolkit using a co-design approach.

> *"It was never about telling people what to do, but it was saying, 'Look, if you're already doing something, if you could ask these questions, it might embellish what you do.' But the questions on their own had to stand well in a sense, if you had nothing else but a blank sheet of paper, the questions would push you off in the right direction."* [A01]

3.4.5. Theme 5: Capacity and Expertise

Challenges around civil servants' and policy-makers' technical incapability to apply ST, raised by seven interviewees, were associated with the methodological and technical challenges in Theme 4. Interviewees suggested that people who have not had substantial training and experience in ST may find it more technically difficult, time-consuming and resource-intensive to use ST than to not use it. They were uncertain where and how to get started, what activities should be performed and what ST tools might be the right ones to use for a particular purpose, activity or scenario: *"You find yourself vacillating between thinking in systems, but approaching the problem in a more linear way. And because there isn't a clear framework about how do you work in systems in government, you don't have a how-to guide . . . "* [CS06]. There was also a reluctance to seek external capabilities and expertise to help with ST:

> *"And this is only built up over time, very slowly in my experience in terms of people in the senior levels of the department. Senior generalists in the senior civil service, for example, would tend to reach or seek out our type of . . . specialised analytical capabilities . . . ."* [CS07]

A lack of confidence in challenging answers could make people feel uncomfortable with using ST:

> *"Giving people the confidence to question was the challenge. Well, sometimes they would be talking to people who actually felt they already knew the answer. And so, it was*

quite challenging for them personally to put themselves out there and actually challenge back." [A02]

Building internal capacity relevant to particular policy areas was essential as external interventions would evaporate quickly. On one hand, interviewees with extensive knowledge and experience recommended concrete and formal apprenticeships, mentorships and fellowship programs run between the government and universities covering people who have a deep interest in ST. Signposting the professional body of ST practitioners was also a good way to refer policy-makers to capacity-building opportunities. On the other hand, interviewees with less expertise and experience in ST hoped to have informal, practical platforms for knowledge exchange: *" . . . like a forum . . . , people have been using . . . [ST] in their work and they've come across a challenge . . . Having a way of . . . discussing that with others or, or even like an FAQ list or just a list of common challenges. How to overcome them." [CS27].*

To address these challenges, over half of the interviewees discussed the importance of policy-specific ST education and training for building civil servants' and policy-makers' capacity. ST courses and programs that are specifically relevant to policy-making could land well with civil servants and policy makers. Integrating ST into courses and programs across specialties and disciplines was another approach to exposing civil servants early to ST. One civil servant expressed interest in seeing more comprehensive learning and development programs than short, standalone workshops: *" . . . I've seen lots of standalone sessions, so you end up getting the same kind of pitching in the middle summary of what systems thinking is. But it's never that kind of building up . . . " [CS30].* An academic also suggested follow-up sessions to ensure people know how to use ST:

> *"So, it really is balancing on that sort of tightrope between, wanting to raise awareness and engagement, and, you know, you're not giving them enough to go away and use it. Something has to follow it up, there has to be some conversation afterwards. . . . . Without it, you don't get anywhere. But, just one session, it can raise more confusion than solving the problem." [A01]*

Furthermore, interviewees recommended access to different modes of training including official courses, e-learning, mentoring, hybrid courses, podcasts and training sessions run by other departments that suited diverse needs. Relevant soft skill training on engagement and conversation elements, systems leadership training and creating a bespoke environment within departments were recommended. Finally, integrating ST into the policy profession framework was perceived as an effective way of triggering its use as a means for improving career prospects: *"You need to introduce [ST] in a competence level framework, so that you get exposed to it early on, and then think about the ladder that you would go up in terms of [. . .] climb[ing] that ladder of expertise." [A02].* This framework presented at the start of the recruitment process would set out clear requirement criteria in terms of ST-relevant knowledge, skills and experience required of different policy-making positions, which would scale up internal capability within the Civil Service quickly.

3.4.6. Theme 6: Conceptualisation, Expectations and Buy-In

One third of interviewees asserted that reluctance to embrace a new way of thinking was a barrier to ST buy-in and uptake and this challenge was difficult to overcome: *"Another of the main challenges or drawbacks is when people have some preconception of the problem and they think they know everything about it before they start thinking about the problem. Breaking that previous knowledge is usually problematic." [A04].* Such reluctance was suggested partly due to the impact of individuals' backgrounds, experiences and mindsets upon their buy-in and engagement with ST methods: *"So it's like a mindset and a skill-set that some people have, and some people don't and some people like to use and some people don't even have on their radar." [CS01]* and *"I think, there's a cultural mindset shift potentially from, I think, for a lot of people it's more psychologically comforting to think of things in a bit of a linear cause and effect relationship. Yeah, we all know a bit of certainty is more comforting than ambiguity, right." [CS05].* Coupling ST with consultancy helped build a good and strong relationship and trust with

decision-makers, and it helped to have an open and honest dialogue that could then lead them through a journey of ST education and use.

> *"So, I always couple systems thinking with consultancy. Because it is always understanding the position your challenge owner, customer is in and being able to build an effective relationship with them, and an open and honest relationship with them. So they know that they can trust you. . . . . It's generally a journey and quite often a process of education. And you're not always successful and you can't always go as far as you want to go, but you can normally get somewhere."* [CS13]

Some interviewees believed that fear of technical challenges reduces confidence to move into the space of ST: *"And I feel like people don't really do it because they don't really get what it is or they're maybe scared because it comes across quite technical, even though it's not technical."* [CS23] and *"I'm conscious that in some of the documentation that I've seen as I've developed my own knowledge about systems thinking, there's reference made to an awful lot of mapping tools and quite a lot of complicated analytical tools. I haven't used that at all . . . "* [CS04].

Lack of appreciation of the benefits of ST from policy-makers was considered the hardest barrier to gaining policy-makers' and civil servants' buy-in and engagement: *"So, then they sometimes don't put the value on it, because they think it was an obvious solution. But actually, they would never have got to that solution unless they had gone through that process . . . "* [A03]. An approach that many interviewees suggested was demonstrating what ST can accomplish in policy contexts and its values using case studies through open conversations and having people work on a case study.

A few civil servants with a proficient level of ST expertise and experience mentioned unreasonable expectations from the teams they had facilitated: *"A lot of the time I think they think you're going to do [ST work] for them and solve their challenges and just provide them with answers."* [CS08]. In this case, there needed to be clarification on facilitator roles and emphasis on their independence from the project and the ownership of people involved in the project:

> *" . . . one of the first things I tried to emphasise was, I've been asked to facilitate this session and take you through it and doing these techniques, but I am not an expert on this policy. I have no vested interest in pushing a particular agenda. I'm not here to direct you to formulate this solution or that solution. I'm here to facilitate the conversations between you and draw out what the key elements are."* [CS07]

In summary, the demonstration of the value of ST, the coupling of ST with consultancy and the clarification of the role of facilitators were recommended to achieve more buy-in.

3.4.7. Theme 7: Stakeholders, Engagement and Collaboration

Once a team was keen to apply ST, it was still likely to face challenges around stakeholders, engagement and collaboration. Interviewees were concerned about decreasing engagement and collaboration quality over time due to time and logistical constraints, unfamiliarity with ST, imbalances in knowledge about the topic and prejudice from past disagreements: *"I would say it got to this point where it'd been very collaborative. It got to this point and then it became maybe one person's project."* [CS03]. The imbalance in resources and powers between stakeholders also made it difficult to implement the conversational and participatory approaches in policy-making:

> *"So you identify all the main stakeholders . . . Some of them have a bunch of resources. And they believe that they can just work by themselves, right? . . . . And then you have all these other smaller agencies that have less resources, less expertise and then it is difficult to actually break those dynamics."* [A04]

Other issues included the lack of engagement of policy-makers who had the power to initiate system changes and implement policy solutions and the lack of trust between the group of people and the facilitator of the process.

Interviewees did not report specifically what had been performed successfully, but they recommended ST tools for triggering and improving conversation, which could contribute to resolving this issue but were not paid much attention. An academic suggested that

> " ... *if you understand systems thinking also as that way of involving stakeholders in a conversation, then usually the tools are not difficult .... So, the difficulty does not come from the complexity of the tools .... But the difficulty in the implementation of this more conversational and or participatory approaches to think about problems usually comes from lack of balancing resources or lack of balance in powers you know.*" *[A04]*

A champion could also help start the conversation with the team and accomplish goals.

3.4.8. Theme 8: Evaluation and Evidence

Challenges around evaluation and evidence on the usefulness and impact of ST impacted other aspects of advancing ST implementation, but no potential solution was recommended. First, the lack of evaluation criteria made it difficult to measure the success of ST application: *"I don't know if we did set any criteria at the start actually, for measuring whether or not it was successful ... " [CS03].* This contributed to the lack of evidence of ST usefulness and impact, as several interviewees noted:

> *"I think that there needs to be a case made and a narrative made for how busy policy officials can do this successfully and that it improves the policy that they are being asked to design and deliver. Because, if that's not there, then it's going to be very difficult to convince people."* *[CS04]*

There was also a shortfall in the continual use of ST outputs reported by several civil servants due to the lack of a delivery and governance system for these outputs: *"And then we had all of our kind of good outputs since then, all of us have been kind of pivoted onto different roles. ... we've kind of ramped that down." [CS03]* and *"If it's just an analytical process and you don't actually have a tech systems approach to the delivery and governance as well." [CS02].* This also shows how evaluation interlinks with the government structure and operation, with civil servants switching roles quickly.

Thus, a number of challenges, successes and recommendations have been described, but not every challenge was met with a corresponding recommendation for action.

4. Discussion
4.1. Discussion of Results with Implications for Research and Practice

Our analysis captured the perspectives of 5 experts in ST and 31 civil servants across 17 departments, agencies and public bodies within the UK government, offering a holistic view of the current state of ST implementation in the government and the Civil Service and providing a unique contribution to support the development of strategies to embed ST in policy making. Participants have various academic backgrounds and levels of ST knowledge and experience, and work across different policy areas. The inclusion of diverse participants, which is a strength of our research, produces rich insights into the drivers for ST in policy-making; it shows participants' interests in and motivations to use ST, the values they see in ST and the challenges they have encountered in using ST and supporting ST implementation, as well as their experience of what has worked well and suggestions of what should be done.

Whilst several civil servants claimed that they were drawn into ST by exposure to its concepts in previous roles, workshops and networking events and that they appreciated its values, only a few found ST already fully relevant to their daily work. At least ten different self-definitions of ST emerged from a small number of civil servants, indicating great variations in how they interpret the concepts of this approach. They repeatedly referred to 'interrelationship' and 'complexity' in their self-definitions. The value of ST in changing what people know was substantially more visible to interviewees than its value in shifting thinking, facilitating communication and impacting policy. Our interview analysis also indicated several aspects that need to be considered for the successful implementation of ST,

ranging from abstract aspects (language and interpretation; conceptualisation, expectations and buy-in) to technical, practical aspects (methodology and technical aspects; capacity and expertise; evaluation and evidence), and from strategic aspects (policy landscape) to operational aspects (government structure and operation; stakeholders, engagement and collaboration).

Our study revealed an increasing interest in ST across the UK government and the Civil Service; however, the level of recognition of and familiarity with ST among civil servants and policy-makers is still low. ST is seemingly more common in some departments, such as DEFRA and the former BEIS, than others due to the nature of policy problems these departments are facing and the academic background in operational research of civil servants working in these departments. Debates around ST language across disciplines contributed to difficulties in increasing awareness of ST and clarifying its concepts, methods, values and relevance to policy-making. Inconsistency and confusion with ST language were also evidenced in the responses of the interviewees with less knowledge of and experience with the approach. Our findings are in line with many studies that have also raised the issue of ST language [34,45,46]. Atkinson, Wells, Page, Dominello, Haines and Wilson [45] found that health policy-makers lack confidence in ST and resist adopting it as they are not clear about what ST is and what it can offer. Using different language to talk about ST would cause great challenges for communication across disciplines, which is particularly vital for policies spanning across several disciplines, and for communicating with high-level policy-makers. Interviewees reported efforts within the government and Civil Service to increase awareness of ST and suggested an urgent need to create a shared language of ST in policy contexts. Our study shows that to achieve this, it is important to consolidate knowledge around ST concepts, methods and values and co-create a widely accepted language with civil servants and policy-makers.

Time and resource constraints were the most commonly reported challenges for implementing ST in policy-making. However, interviewees made few recommendations on how to overcome these constraints. They also did not suggest solutions to address other challenges around the policy landscape. These constraints substantially hinder efforts to address other challenges in advancing ST implementation. Lack of time and budget have been well reported in the literature as persistent barriers to engaging with stakeholders through participatory processes [47,48], ST capacity building [14,35] and evaluating ST applications [49]. While the literature tends to discuss time and resource constraints in terms of stakeholder engagement, our study offers insights into how these constraints have discouraged civil servants from adopting and applying ST. Understanding how resources could be used to support ST embedment in policy-making, which our research contributes to, would be the first step in addressing resource-related challenges.

Our interview analysis generated new insights into the structural, operational and cultural factors within the UK government and the Civil Service that impact ST implementation. This aligns with the findings by Rovenskaya et al. [16] that merely improving individuals' ST capabilities is insufficient. Interviewees repeatedly stressed drivers internal to policy organisations such as the role of systems leadership and a top-down approach to implementing ST in policy-making. They suggest that buy-in and support from senior leaders are essential to creating a safe environment for discussion and collaborations. Some interviewees also asserted that they had seen more successful ST applications with buy-in and support from senior leaders. Interviewees also recommended establishing a single accountable and empowered body that takes ownership and leadership of ST adoption, as current efforts to promote ST use have been ad hoc and at a department level, potentially creating duplication and inefficient use of resources. However, as ST use is context-dependent, it is important to maintain flexibility and encourage creativity within each department in implementing ST.

Interviewees suggested various forms of education and training for capacity development, ranging from formal programmes and courses to informal platforms for knowledge exchange. Nevertheless, these modes of learning are still under the paradigm of knowledge

transfer in which civil servants acquire knowledge from experts and their peers. There have been few discussions on knowledge co-production in which policy-makers actively learn through reflective thinking in the context of ST applications and co-create knowledge with researchers and their peers. Such knowledge is more likely to be trusted and useful for policy-makers [50,51]. This approach is promising within the government and the Civil Service, but more time- and resource-consuming and challenging in terms of processes [14,52]. It also calls for more knowledge on the cognitive processes of developing ST capacity via co-production, education and training. In addition, capacity development needs to be designed specifically for the fast-paced policy landscape, government structure and operation.

Although a lack of impact evidence has led to difficulties in justifying the value proposition of ST in policy-making, this challenge has not received sufficient attention. While interviewees frequently mentioned how ST is valuable for generating new insights and policy-makers' knowledge acquisition, they rarely discussed how ST shifts policy-makers' thinking, which could transform the principles by which they carry out their work and thus offer a greater potential for policy impact. Experts and civil servants with a high level of experience in supporting ST implementation also asserted that people tend to be reluctant to embrace a new way of thinking, and thus shifting policy-makers' mental models is extremely challenging. The conceptual impact of ST on policy-makers has not been well discussed in the literature [14,32,53]. Additionally, a lack of evidence of policy impact hampered efforts to clarify the values and relevance of ST to policy-making that were emphasised by interviewees. Reporting the presence of ST practice was generally considered a success, without further work to assess the quality of practice and policy impact. The literature has also shown gaps in systematically linking ST applications and policy impact, as well as guidance and expertise, to conduct evaluations [14,32,33,45,49,54–59]. There is more work to be done in terms of understanding and demonstrating ST's conceptual impact and policy utility, including investigating how policy-makers' mental models shift, co-developing guidance for evaluating ST applications and impact evidence and documenting real-world case studies as evidence.

4.2. Limitations

This study has a number of limitations that should be acknowledged. First, the interviewees in our study were experts and civil servants who have used ST, supported ST implementation or been interested in ST and, therefore, were more likely to appreciate its values and support its adoption in policy-making. Although their responses provided insights into reasons why a number of civil servants and policy-makers are still reluctant to implement ST, we do not know to what extent these insights reflect the perspectives of those who do not support ST. However, the breadth of different roles, academic backgrounds and policy areas suggests a high level of interest in ST across the UK government and the Civil Service. Future research could collect complementary evidence from diverse users, e.g., by adopting other research methods such as ethnography and case study analysis. It will also be useful to map the causal factors driving ST uptake and their interrelations in more detail. Second, most civil servants participating in our research were experienced officials with substantial policy responsibilities but were not part of the senior management team, which indicates that the views of high-level policy-makers were underrepresented. It would be very interesting in future research to elicit high-level policy-makers' perspectives, as their buy-in and support were suggested to be key to the success of ST implementation in policy-making. The UK Government Office for Science has developed an ST leadership guide [60], but Király et al. [61] also suggested contradictions between political leadership and ST. Future research can thus explore such tensions in the implementation of ST in political decision-making. It could use ST to understand the feedback relationships between senior policy-makers' and civil servants' ST views and practice, and challenge conflicting views and practice. Third, although the academic and other expert contributors had diverse backgrounds, system dynamics expertise was somewhat more represented and the

contributors do not represent the entirety of the ST field. The scope of participants and the fact that they were bounded by the policy landscape in the UK limit the generalisation of our findings. Future research could conduct cross-government as well as international analyses to test the transferability of the findings. Fourth, many themes we explored in this study have been addressed in related literature, such as the aforementioned political science theories of the policy process [4–7], joined-up government [17–20] and behavioural public administration [8–10]. An in-depth exploration of the linkages is beyond the scope of this study. Such an exploration in the future could also shed light on how factors outside policy organisations such as political, social, economic and environmental pressures affect the adoption of ST.

4.3. Wider Contributions

This study provides several insights beyond what has been discussed in our systematic review [30]. Firstly, existing studies that often describe finished work provide little insight into the journey of ST adoption and users' experience. In addition to the challenges around the language and interpretation of ST that are frequently reported in the literature, some interviewees reveal that the difficulty in interpreting ST outputs contributes to the shortfall and discontinuity of using those outputs to inform policy. While several studies have discussed the challenging political context as a barrier to ST implementation, there is a lack of discussion around the impacts of the dynamic policy-making process and inherent policy culture, on which this study sheds light. Our study also highlights civil servants' experience of adopting ST in policy and the methodological and technical challenges they have encountered. Those challenges include difficulty in determining system boundaries, decreasing quality of engagement and collaboration over time, lack of trust between the team and the facilitator of the process and fear of technical challenges. Additionally, some civil servants believe that the operational priority and accountability and intrinsic structure for promotion within the Civil Service do not support ST application.

Secondly, our study shows multiple efforts across departments within the UK government and the Civil Service to promote ST uptake and build capacity for ST implementation, ranging from knowledge and experience sharing and creating a safe space for ST practice to developing ST leadership.

Finally, interviewees provided several recommendations for advancing ST implementation in policy, reflecting the reality within the UK government and the Civil Service better than existing ST literature. Such realities are typically addressed outside the ST literature in political science theories [4–7] and particularly the field of behavioural public administration [8–10,62]. Our study suggests a supported journey to adopt ST tools, top-down support for promoting ST uptake, the need for clarifying ST's relevance and values to policy-making to gain buy-in and engagement, integrating ST into policy professional frameworks, and the need for a single accountable, empowered government body leading ST implementation.

5. Conclusions

Our research offers a unique contribution to understanding the opportunities and challenges of implementing ST in policy-making through interviews with civil servants across the UK government and the Civil Service and experts in the field. Our analysis shows a high interest in ST among civil servants across different policy areas but several challenges around the implementation of the approach in policy-making. Highlighted areas include the development of a shared language of ST in policy, systems leadership and engagement of high-level policy-makers, policy-specific capacity development of ST and evaluation processes for gathering evidence of impacts. The scope of participants is both a strength and a limitation to the generalisation of our conclusions.

Appendix A

Interview questions for academics
Questions before interview

1. Would you be able to share any materials that give us insight into how you have supported systems thinking in policy?

Questions at interview
Your systems thinking experience

2. Could you, please, describe your role and experience related to supporting the implementation of systems thinking in policy? What was done and what was your role in this?

Experienced challenges and drawbacks

3. Where have you experienced challenges and drawbacks in supporting the implementation of systems thinking?
4. How exactly did the reported challenges come about?
5. What would have avoided or eased them from the beginning?

Experienced successes

6. Where have you experienced successes in implementing/supporting the implementation of systems thinking? I.e., what works?
7. How come it was successful?
8. Is there anything else to say about what is needed to ensure success in the systems thinking journey or with the application of specific methods and tools?

Toolkit content

9. What is your reaction to the Government Office for Science's systems thinking toolkit documents?
10. Are the documents what you would you require from such documents, or is something different or something else (e.g., additional/different tools, different presentation) needed?
11. Is there anything else users would need on the journey to using systems thinking? What are the enablers and barriers for you to implementing this in practice?

Interview questions for civil servants
Questions before interview

12. Could you share your definition of systems thinking?
13. Could you briefly describe your role, grade, department and profession?

Questions at interview
ST definition and experience

14. What is systems thinking for you? How would you define it?
15. Do you have any experience related to implementing/supporting the implementation of systems thinking in policy? What was done and what was your role in this?

Experienced challenges and drawbacks

16. Where have you experienced challenges and drawbacks in the implementation of systems thinking?
17. How exactly did the reported challenges come about?
18. What would have avoided or eased them from the beginning?

Experienced successes

19. Where have you experienced successes in implementing/supporting the implementation of systems thinking? I.e., what works?
20. How come it was successful?
21. Is there anything else to say about what is needed to ensure success in the systems thinking journey or with the application of specific methods and tools?

Hopes for the toolkit

22. What benefits do you see in using systems thinking and what reasons do you have for taking it up?

Toolkit content

23. What is your reaction to the systems thinking toolkit documents?
24. Are the documents what you would you require from such documents, or is something different or something else needed (e.g., additional/different tools, different presentation)?
25. Is there anything else you/users would need on the journey to using systems thinking? What are the enablers and barriers for you to implementing this in practice?

References

1. Senge, P.M.; Sterman, J.D. Systems thinking and organizational learning: Acting locally and thinking globally in the organization of the future. *Eur. J. Oper. Res.* **1992**, *59*, 137–150. [CrossRef]
2. Sterman, J. *Business Dynamics: Systems Thinking and Modeling for a Complex World*; Irwin McGraw-Hill: Boston, MA, USA, 2000.
3. Amissah, M.; Gannon, T.; Monat, J. What is Systems Thinking? Expert Perspectives from the WPI Systems Thinking Colloquium of 2 October 2019. *Systems* **2020**, *8*, 6. [CrossRef]
4. Cairney, P. Complexity theory in political science and public policy. *Political Stud. Rev.* **2012**, *10*, 346–358. [CrossRef]
5. Sabatier, P.A. Toward better theories of the policy process. *Political Sci. Politics* **1991**, *24*, 147–156. [CrossRef]
6. Colebatch, H.K. Policy analysis, policy practice and political science. *Aust. J. Public Adm.* **2005**, *64*, 14–23. [CrossRef]
7. McGee, Z.A.; Jones, B.D. Reconceptualizing the policy subsystem: Integration with complexity theory and social network analysis. *Policy Stud. J.* **2019**, *47*, S138–S158. [CrossRef]
8. Sanders, M.; Snijders, V.; Hallsworth, M. Behavioural science and policy: Where are we now and where are we going? *Behav. Public Policy* **2018**, *2*, 144–167. [CrossRef]
9. Strassheim, H. Behavioural mechanisms and public policy design: Preventing failures in behavioural public policy. *Public Policy Adm.* **2021**, *36*, 187–204. [CrossRef]
10. John, P. *How Far to Nudge? Assessing Behavioural Public Policy*; Edward Elgar Publishing: Cheltenham, UK, 2018.
11. Lane, D.C.; Munro, E.; Husemann, E. Blending systems thinking approaches for organisational analysis: Reviewing child protection in England. *Eur. J. Oper. Res.* **2016**, *251*, 613–623. [CrossRef]
12. Beaudoin, C.; Mistry, I.; Young, N. Collaborative knowledge mapping to inform environmental policy-making: The case of Canada's Rideau Canal National Historic Site. *Environ. Sci. Policy* **2022**, *128*, 299–309. [CrossRef]

13. Wolstenholme, E.; Monk, D.; Smith, G.; McKelvie, D. Using system dynamics to influence and interpret health and social care policy in the UK. In Proceedings of the 22nd International Conference of the System Dynamics Society, Oxford, UK, 25–29 July 2004; pp. 1–21.

14. Haynes, A.; Garvey, K.; Davidson, S.; Milat, A. What can policy-makers get out of systems thinking? Policy partners' experiences of a systems-focused research collaboration in preventive health. *Int. J. Health Policy Manag.* **2020**, *9*, 65–76. [CrossRef]

15. Freeman, R.A.; Yearworth, M.; Cherruault, J.-Y. *Review of Literature on Systems Thinking and System Dynamics for Policy-Making*; UK Department for Environment, Food & Rural Affairs: London, UK, 2014.

16. Tõnurist, P.; Rovenskaya, E.; Mechler, R.; Dieckmann, U.; Wagner, F. Introducing systems thinking into public sector institutions: Learning by doing? In *Systemic Thinking for Policy-Making: The Potential of Systems Analysis for Addressing Global Policy Challenges in the 21st Century*; Hynes, W., Müller, J., Lees, M., Eds.; OECD: Paris, France, 2020. [CrossRef]

17. Ling, T. Delivering joined–up government in the UK: Dimensions, issues and problems. *Public Adm.* **2002**, *80*, 615–642. [CrossRef]

18. Kavanagh, D.; Richards, D. Departmentalism and joined-up government. *Parliam. Aff.* **2001**, *54*, 1–18. [CrossRef]

19. Mulgan, G. Joined-up government in the United Kingdom: Past, present and future. *Canberra Bull. Public Adm.* **2002**, *105*, 25–29.

20. Davies, J.S. The limits of joined-up government: Towards a political analysis. *Public Adm.* **2009**, *87*, 80–96. [CrossRef]

21. Blockley, D.I. The importance of being process. *Civ. Eng. Environ. Syst.* **2010**, *27*, 189–199. [CrossRef]

22. Cabinet Office. *Modernising Government*; White Paper; HMSO, The Stationery Office: London, UK, 1999.

23. Department of Health and The Home Office. *The Victoria Climbie Inquiry. Report of an Inquiry by Lord Laming, Cm 5730, January*; HM Stationery Office: London, UK, 2003.

24. UK Parliament. *Shipman Reports*; HMSO: London, UK, 2005. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/273227/5854.pdf (accessed on 15 March 2023).

25. The Stationery Office. *Bichard Inquiry Report*; HC653; The Stationery Office: London, UK, 2004.

26. Policy Profession. Policy Profession Standards. Available online: https://www.gov.uk/government/publications/policy-profession-standards (accessed on 25 November 2022).

27. Government Science and Engineering. Take Control of Your Professional Development: GSE Skills Assessment Tool. Available online: https://governmentscienceandengineering.blog.gov.uk/2021/02/05/take-control-of-your-professional-development-gse-skills-assessment-tool/ (accessed on 25 November 2022).

28. Government Office for Science. An Introductory Systems Thinking Toolkit for Civil Servants. Available online: https://www.gov.uk/government/publications/systems-thinking-for-civil-servants/toolkit (accessed on 10 November 2022).

29. Government Office for Science. Systems Thinking: Case Study Bank. Available online: https://www.gov.uk/government/publications/systems-thinking-for-civil-servants/case-studies (accessed on 16 July 2022).

30. Nguyen, L.-K.-N.; Kumar, C.; Jiang, B.; Zimmermann, N. Implementation of systems thinking in public policy: A systematic review. *Systems* **2023**, *11*, 64. [CrossRef]

31. Robertson Munro, F.; Cairney, P. A systematic review of energy systems: The role of policymaking in sustainable transitions. *Renew. Sustain. Energy Rev.* **2020**, *119*, 109598. [CrossRef]

32. Bensberg, M.; Joyce, A.; Wilson, E. Building a prevention system: Infrastructure to strengthen health promotion outcomes. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1618. [CrossRef]

33. de Oliveira Morais, L.M.; Kuhlberg, J.; Ballard, E.; Indvik, K.; Rocha, S.C.; Denise Marques, S.; Letícia de Oliveira, C.; Gouveia, N.; Amélia Augusta de Lima, F.; Waleska Teixeira, C. Promoting knowledge to policy translation for urban health using community-based system dynamics in Brazil. *Health Res. Policy Syst.* **2021**, *19*, 53. [CrossRef]

34. Zucca, C.; Long, E.; Hilton, J.; McCann, M. Appraising the implementation of complexity approaches within the public health sector in Scotland. An assessment framework for pre-implementation policy evaluation. *Front. Public Health* **2021**, *9*, 653588. [CrossRef] [PubMed]

35. El-Jardali, F.; Adam, T.; Ataya, N.; Jamal, D.; Jaafar, M. Constraints to applying systems thinking concepts in health systems: A regional perspective from surveying stakeholders in Eastern Mediterranean countries. *Int. J. Health Policy Manag.* **2014**, *3*, 399–407. [CrossRef] [PubMed]

36. Trochim, W.M.; Cabrera, D.A.; Milstein, B.; Gallagher, R.S.; Leischow, S.J. Practical challenges of systems thinking and modeling in public health. *Am. J. Public Health* **2006**, *96*, 538–546. [CrossRef] [PubMed]

37. Scott, R.J.; Cavana, R.Y.; Cameron, D. Client perceptions of reported outcomes of group model building in the New Zealand public sector. *Group Decis. Negot.* **2016**, *25*, 77–101. [CrossRef]

38. Bérard, C.; Cloutier, L.M.; Cassivi, L. The effects of using system dynamics-based decision support models: Testing policy-makers' boundaries in a complex situation. *J. Decis. Syst.* **2017**, *26*, 45–63. [CrossRef]

39. Freeman, R.; Jones, L.; Yearworth, M.; Cherreault, J.-Y. *Systems Thinking and System Dynamics to Support Policy-Making in Defra—Project Final Report*; UK Department for Environment, Food & Rural Affairs: London, UK, 2014. [CrossRef]

40. Lee, T.-P. Using systems thinking to improve organizational learning in the public sector: Perspective of public officials. In Proceedings of the 25th International Conference of the System Dynamics Society, Boston, MA, USA, 29 July–2 August 2016.

41. Ritchie, J.; Lewis, J.; Nicholls, C.M.; Ormston, R. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*; SAGE: London, UK, 2013.

42. Gale, N.K.; Heath, G.; Cameron, E.; Rashid, S.; Redwood, S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med. Res. Methodol.* **2013**, *13*, 117. [CrossRef]

43. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]

44. Hsieh, H.-F.; Shannon, S.E. Three approaches to qualitative content analysis. *Qual. Health Res.* **2005**, *15*, 1277–1288. [CrossRef]

45. Atkinson, J.-A.M.; Wells, R.; Page, A.; Dominello, A.; Haines, M.; Wilson, A. Applications of system dynamics modelling to support health policy. *Public Health Res. Pract.* **2015**, *25*, e2531531. [CrossRef]

46. Holmes, B.J. Can systems thinking become "The way we do things?" comment on "What can policy-makers get out of systems thinking? Policy partners' experiences of a systems-focused research collaboration in preventive health". *Int. Health Policy Manag.* **2021**, *10*, 284–286. [CrossRef]

47. Jessiman, P.E.; Powell, K.; Williams, P.; Fairbrother, H.; Crowder, M.; Williams, J.G.; Kipping, R. A systems map of the determinants of child health inequalities in England at the local level. *PLoS ONE* **2021**, *16*, e0245577. [CrossRef]

48. Littlejohns, L.B.; Baum, F.; Lawless, A.; Freeman, T. The value of a causal loop diagram in exploring the complex interplay of factors that influence health promotion in a multisectoral health system in Australia. *Health Res. Policy Syst.* **2018**, *16*, 126. [CrossRef]

49. Hamilton, S.H.; Fu, B.; Guillaume, J.H.A.; Badham, J.; Elsawah, S.; Gober, P.; Hunt, R.J.; Iwanaga, T.; Jakeman, A.J.; Ames, D.P.; et al. A framework for characterising and evaluating the effectiveness of environmental modelling. *Environ. Model. Softw.* **2019**, *118*, 83–98. [CrossRef]

50. Heaton, J.; Day, J.; Britten, N. Collaborative research and the co-production of knowledge for practice: An illustrative case study. *Implement. Sci.* **2016**, *11*, 20. [CrossRef]

51. Freebairn, L.; Atkinson, J.-A.; Kelly, P.M.; McDonnell, G.; Rychetnik, L. Decision makers' experience of participatory dynamic simulation modelling: Methods for public health policy. *BMC Med. Inform. Decis. Mak.* **2018**, *18*, 131. [CrossRef]

52. Rycroft-Malone, J.; Burton, C.R.; Bucknall, T.; Graham, I.D.; Hutchinson, A.; Stacey, D. Collaboration and co-production of knowledge in healthcare: Opportunities and challenges. *Int. J. Health Policy Manag.* **2016**, *5*, 221–223. [CrossRef]

53. Zokaei, K.; Elias, S.; O'Donovan, B.; Samuel, D.; Evans, B.; Goodfellow, J. Lean and systems thinking in the public sector in Wales. In *Lean Enterprise Research Centre Report for the Wales Audit Office*; Cardiff University: Cardiff, UK, 2010.

54. Lamont, T. But does it work? Evidence, policy-making and systems thinking comment on "What can policy-makers get out of systems thinking? Policy partners' experiences of a systems-focused research collaboration in preventive health". *Int. J. Health Policy Manag.* **2021**, *10*, 287–289. [CrossRef]

55. Canyon, D.V. Systems thinking: Basic constructs, application challenges, misuse in health, and how public health leaders can pave the way forward. *Hawaii J. Med. Public Health* **2013**, *72*, 440–444.

56. Carey, G.; Malbon, E.; Carey, N.; Joyce, A.; Crammond, B.; Carey, A. Systems science and systems thinking for public health: A systematic review of the field. *BMJ Open* **2015**, *5*, e009002. [CrossRef]

57. Egan, M.; McGill, E. Applying a systems perspective to preventive health: How can it be useful? comment on "What can policy-makers get out of systems thinking? Policy partners' experiences of a systems-focused research collaboration in preventive health". *Int. J. Health Policy Manag.* **2021**, *10*, 343. [CrossRef]

58. Khan, S. Overcoming barriers to applying systems thinking mental models in policy-making comment on "What can policy-makers get out of systems thinking? Policy partners' experiences of a systems-focused research collaboration in preventive health". *Int. J. Health Policy Manag.* **2021**, *10*, 281–283. [CrossRef] [PubMed]

59. Voinov, A.; Jenni, K.; Gray, S.; Kolagani, N.; Glynn, P.D.; Bommel, P.; Prell, C.; Zellner, M.; Paolisso, M.; Jordan, R.; et al. Tools and methods in participatory modeling: Selecting the right tool for the job. *Environ. Model. Softw.* **2018**, *109*, 232–255. [CrossRef]

60. Department for Business Energy & Industrial Strategy. Systems Leadership Guide: How to Be a Systems Leader. Available online: https://www.gov.uk/government/publications/systems-leadership-guide-for-civil-servants (accessed on 24 March 2023).

61. Király, G.; Köves, A.; Balázs, B. Contradictions between political leadership and systems thinking. *J. Clean. Prod.* **2017**, *140*, 134–143. [CrossRef]

62. Simon, H.A. *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organizations*; The Macmillan Company: New York, NY, USA, 1947.