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Ripple Effects of Law Execution Automation in Governmental Systems

The Wajong Case

TU Delft

RIPPLE EFFECTS OF LAW EXECUTION AUTOMATION IN GOVERNMENTAL SYSTEMS

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by

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EXECUTIVE SUMMARY

Algorithms and Automated Decision Making (ADM) systemize and scale down bureaucracy, improve decision-making in governmental organizations, automate actions, solve problems, and assess people (Janssen and Kuk 2016, Yanofsky 2011). Decisions previously made by government officials are herewith delegated to algorithms advising and deciding on data interpretation and associated action. This transition towards more and more ADM system use does not only have positive effects. The principles of good governance, including understandability, explainability, and proportionality, are faered to be under threat (Mittelstadt et al. 2016, Tweede Kamer 2020). The use of Automated Decision Making (ADM) systems in the public sector will become increasingly prevalent in the future (Cobbe 2019), making citizens increasingly likely to be confronted with decisions that have been made fully automatically, without human intervention (Raad van State 2018). Ever more digitization increases the opaqueness of the social benefits system in the Netherlands and leads to citizens facing most of the adverse, sometimes unforeseen effects of automation (Raad van State 2018). These unforeseen effects make the social benefits system that ADM systems are used within unsafe.

Why and how unsafeness and unexpected effects emerge is not well known. Questions on behavior emergence and what constitutes unsafeness for users of, and people affected by, the system within this field remain unanswered. This research interprets the described effect using the Design Science Research approach. The knowledge base of system safety literature and modeling knowledge of Agent-Based Modelling is used to explore why and how ripple effects emerge in the social benefits system. Ripple effects often start as a small problem in one specific place and cause more significant problems in other locations in the system. The effects are often cross-domain (different ministries) or cross-organizational (different executing organizations). The exploration is used to find an answer to the main research question.

How can ripple effects associated with automation processes of law execution in the social benefits system be modeled using a system safety perspective?

Using interviews, a system description, and literature research as being the term ripple effects is defined as:

'The emergent amplified effects of social policy'

The system description revealed how citizens experience unforeseen effects due to the interaction of laws. Because evaluations and monitoring are on the level of either law, information chains, or execution organizations, the existence of these effects and their impact on citizens does not (always) reach execution organizations or policymakers. Furthermore, the scattered knowledge of social laws among departments and organizations leads to citizens remaining unhelped and unseen. After the effects are identified, long feedback loops characterize the system, resulting from policymakers' tendency to solidify how laws should be executed in the law itself.

The social system has become increasingly complex and opaque, partly due to the habit of political figures reacting to incidents and wanting to please everyone using exceptions and transitional agreements. The increased use of information chains and basic registration has further contributed to the system's complexity. The

socio-technical system has become a network of information streams streamlining decision-making. However, when mistakes are made, the implications are much more significant. The rise of ADM systems has led software developers working at execution organizations to make normative decisions with risks of translation mistakes due to limited domain knowledge. Furthermore, the discretionary room is reduced, and a tendency to make laws in service of automation arises.

A system safety lens was applied to the complex socio-technical social benefit automated law system to explore *why* some factors increase risk. The primary assumption underlying this lens is that safety relies upon the interactions among the system components and is thus a system property, not a component property (Leveson 2016). The emergence of unsafeness in systems is called a system accident. System accidents are defined as 'losses that arise from dysfunctional interactions among system components in which no components have failed' by Leveson (2016). Ripple effects are determined to be an example of a system accident.

The leading cause of ripple effects is the lack of a hierarchical safety structure, which is seen in laws being organized per organization, and the lack of an overarching controller to ensure that overlap does not occur. The lack of this structure is partly due to the system's extreme complexity, leading to a lack of oversight on how laws and services intersect. Consequently, asynchronous evolution is more likely to occur, visible in amended laws and their associated claims on citizens' income being made without updating other laws. Moreover, mental and process models that do not align with the system they represent lead to ripple effects in law execution. Developers misinterpret laws or laws based on mental models held by policymakers about the process they are trying to influence that do not represent the actual process. This was partly found to be due to a lack of an accurate model representing a Dutch citizen (Kafka Brigade 2022). The model representation would constitute all the data points present within basic registrations and at execution organizations. This data dictates which characteristics can be taken into account in a decision on the eligibility of benefits and their quality. Because the data points available on citizens are scattered between execution organizations and different databases, it is hard to assess whether all these data points combined are a good representation of a citizen and, thereby, a representation of the process that ADM systems aim to control. The overall increase in software use has made the system highly coupled, implying that if unforeseen behavior occurs, it travels fast to other parts of the system leading to ripple effects.

Knowing why ripple effects emerge is not enough to set functional norms and standards for developing ADM systems. One would also need to know *how* they emerge. An Agent-Based Model (ABM) design is presented to explore how such effects emerge. The model was validated using input by Uitvoeringsinstituut Werknemersverzekeringen (UWV). Unfortunately, the model design in its current form does not serve to explore *how* ripple effects emerge. However, ABM is still perceived as a helpful method, albeit needing a different system description than presented in this thesis. The incompatibility on the current system description level exposes the need for shared language among disciplines when perceiving such a socio-technical effect.

Several policy recommendations are presented, including a rudimentary set-up on how to apply a safety control structure within the social benefits system.

PREFACE

Pam, pam, pam, a finished master thesis on ripple effects of ADM in governmental systems, written to explore how a system safety lens can assist in modeling and understanding this phenomenon.

I would like to use this space to express my appreciation to all the people who have been so supportive during the past half year—starting with my first supervisor, Dr. Ir. Roel Dobbe. Roel, I want to thank you for all our inspirational weekly talks. I think it is fantastic that you take so much time for your graduates to talk about not only thesis-related topics but also how to approach the future more broadly. Furthermore, thank you for connecting me to the National Cliënt Board (LCR). Combining the thesis research with an internship at such a dynamic organization for social justice has truly been inspiring and has shown me *why* I wanted to pursue this line of research in the first place. Therefore, I would like to thank Peter, Bart, Barbara, Cynthia, Rietje, and Kosta for all their input and for making me feel part of the team.

To my other two committee members, Dr. Haiko van der Voort and Dr. Ir. Igor Nikolic, it has been such a pleasure to have you both on my committee. You both surprised me with your creative and valuable feedback on the contents and form of my research, and also advice on when to take a break. I feel fortunate to have had such a diverse committee that has provided me with such different and valuable input.

I have experienced the ride of writing a thesis as both fun and excruciating at times. The process has been characterized by the most creative but also most mind-numbing hours I have spent so far in my life. But, as every student has learned from the age they have written their first report in primary school, it is essential to note in your preface that you have learned a lot in the process, and so have I, luckily. Not only now but over the last seven years.
I want to thank my family and boyfriend for being so supportive over the last seven years and making me feel that anything is always possible with hard work. Even though the COVID pandemic somewhat characterized my master's degree, I feel lucky that I did get to make so many amazing friends during my time in Groningen and Delft, and to them I say: you have been the most fun part of it all!

Laurie Pel
October 18th, 2022

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

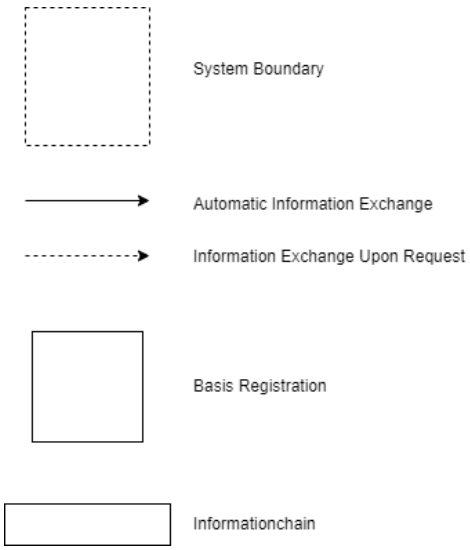


Figure 0.1: Legend for Figures

1 INTRODUCTION

Formulas, Artificial Intelligence (AI), and algorithms are increasingly used within governmental institutions to 'systemize and scale down bureaucracy and improve decision making' (Janssen and Kuk 2016). They are used to automate actions, solve problems, make predictions, and, in some government cases, assess people (Yanofsky 2011). Thereby delegating decisions previously made by government officials to algorithms, which consequently advise and sometimes even decide on data interpretation and associated action. This trend was identified some time ago as the transition of street-level bureaucracy towards a system-level bureaucracy via screen-level bureaucracy (Bovens and Zouridis 2002). Which describes a transition where the role and function of **ict!** (ict!) have become significantly more important, and consequently, the discretionary room of governmental experts is reduced. Currently, the system is most suitably defined as being in the screen-level bureaucracy, where ict! is leading, but human interference is still present in making decisions.

Decisions made by ADM systems significantly impact the perceptions, understanding, and interactions between citizens and the government (Mittelstadt et al. 2016, Tweede Kamer 2020). ADM systems involve various processes, from aids for human decision-makers to completely automated decision-making processes, across a wide variety of contexts (Araujo et al. 2020). Research shows how the use of ADM systems in governmental institutions can reduce citizens' trust towards a government (Al-Mushayt 2019) and its decisions (Sun and Medaglia 2019). Instances of privacy violations as well as a general lack of fairness in ADM systems, such as biased training sets (Dobbe et al. 2018), used by governmental institutions are at the root of this distrust (Kuziemski and Misuraca 2020). Other identified challenges include the guarantee of privacy, fairness, security, and transparency (Amodei et al. 2016). Before, governmental experts were made to account for their decisions. Thus now, the systems advising these decisions should also be accounted for in a similar or even more transparent manner as the use of ADM systems has to make sense for both governmental institutions and citizens (Bovens and Zouridis 2002). A constitutional decision entails more than the one-on-one application of the law. It also includes its justification. Without it, it proves increasingly difficult to adhere to the principles of good governance, as these values are at the core of those principles. This is a problem, as adhering to these principles is legally mandatory. The principles most influenced by ADM systems are shown in green in Figure 1.1. The transformation towards a more automated government is not necessarily negative. However, it may increase risks such as lack of accountability and unclarity of responsibility (Dignum 2018, Wirtz et al. 2019) due to the ever-increasing complexity and unpredictability surrounding ADM systems (Hernández-Orallo 2017). The mentioned challenges are not solely due to biased data sets or untested algorithms. acadm systems are also affected by socio-technical and emergent biases, which often arise as context-specific artifacts of implementation (Dobbe et al. 2018).

The transition towards more ADM system use in governmental institutions is catalyzed by the overall increase of the available amount of data and algorithmic possibilities. Widespread digitization and automation are bringing about fundamental social and cultural accelerations. More than other technologies, digitization and automation are deeply intervened in government and may even change its character (Raad van State 2018). In a way, the current governmental system is transformed into a technocratic government (Janssen and Kuk 2016). This is a transition where

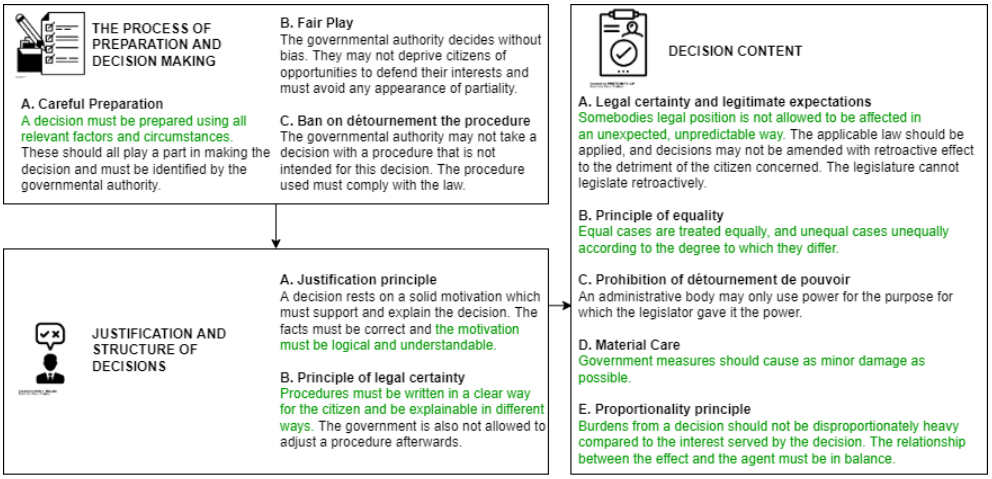


Figure 1.1: Principles of Good Governance

processes run by algorithms replace traditional administrative processes. It is expected that the use of ADM systems, systems automating decision processes using algorithms, in the public sector will become increasingly prevalent in the future (Cobbe 2019). The surge in ADM systems in the public domain gives rise to both more effective, detailed, and faster service towards citizens and makes the system it operates in increasingly more complex Raad van State (2018). Leveson and Weiss mention the *curse of flexibility*, in which many of the advantages of information technology are presented, such as their reusability but also rightly notes how these systems are much more complex than their physical counterparts. Information systems behave differently than physical systems and do not necessarily adhere to conservation laws. Information can get lost or may multiply or interact with the system unexpectedly, leading to the aforementioned unintended harmful behavior of systems (Leveson and Weiss 2009). The complexity is further exacerbated by the increase in data exchange between many different organizations with unknown consequences (Zouridis et al. 2020). These new types of data integrations are among the systems and system integration that require new constraints and standards (van Eck 2018).

Currently, formulas and algorithms and the systems they are employed in are often opaque, making it increasingly difficult for people to know how their data is used and which decisions are informed using it. This opacity inherently transforms the government into a black box, making it harder for citizens to defend themselves against governmental decisions made using algorithms (Amnesty International 2021). The perpetuated idea that algorithms transform an organization, or governmental institution, into a black box is often used as an excuse to inhibit efforts to bring greater control and transparency to all kinds of applications of the technology both in the public and private sector (The Netherlands Scientific Council for Government Policy 2021). With digitization and automation of decision-making, citizens are increasingly likely to be confronted with decisions that have been made fully automatically, without human intervention Raad van State (2018). Furthermore, citizens risk being confronted with decisions based on data from various other administrative bodies such as the Tax Authority or Municipalities. It is then much harder to verify whether the decisions were taken on the basis of correct data. Moreover, the citizen will have to make a plausible case that an error has been made; in the event of errors in the system, he will have to prove his own 'innocence' (Raad van State 2018). However, proving one's innocence is hard. Is it impossible to prove your right to benefits if the government does not tell you why an automated system says you are not? How do you prove that you are being discriminated against if the

government does not want to reveal if your nationality is taken into account for risk analysis? Alternatively, for government officials, how to ensure good governance is employed when there are no standards for processing and handling algorithmic decisions and when they are unaware of how an algorithm derives a decision. Specifically, how to ensure good algorithm use within governmental systems when there are no guidelines in exploring the broader context-specific effects of a specific algorithm and automation effort. Currently, it is even underwritten by the Dutch government itself that risks, inconveniences, and disadvantages of the use of new automation techniques by the government will be borne mainly by the citizen Raad van State (2018). The State Secretary of the Interior and Kingdom Relations has stated that one of the main goals of the Dutch Digitization Effort (DIGIBeter) is the 'protection of fundamental rights and public values'. However, the question is how those goals can be realized in practice (Raad van State 2018). Both the design and use implications of ADM systems need to be unraveled to create transparency and accountability and mitigate the unintended and harmful behavior that may emerge from the design of an ADM system (Janssen and Kuk 2016, Amodei et al. 2016).

Designing ADM systems is challenging and requires new skills and expertise for policy-makers acting in the digital world. Alternatively, there is a need for deep domain-related knowledge to ensure that algorithms 'make sense' (Janssen and Kuk 2016). The need for these new skills lays bare the additional translation step added between people using and interacting with the system, people being affected by the system, and those programming the software that defines the system's structure. Software and system developers need the expertise of their users and feedback on how it affects their field of work, and users need to understand better how these systems work and what they can do. Another fundamental mismatch is that of users, experts working at execution organizations, of such systems and the people affected by these systems, namely, citizens (van Eck 2018, Peeters and Widlak 2018).

Explicit norms and standards surrounding governmental systems employing algorithms are thus necessary to ensure automation does not imply harmful consequences for citizens. However, a question remaining is how to assess whether those implementations are deemed safe for the users of the system and, more importantly, the people affected by the system. Moreover, how to test this?

The emerging trend, where citizens face the majority of the negative effects of automation, is aimed to be understood using system safety thinking. Systems thinking and its safety lessons as extensively researched by Leveson (2016). The lessons focus on a transdisciplinary system safety approach that empowers affected stakeholders to identify hazards and translate these to concrete safety constraints both in the technical system design and institutional use, management, and oversight of ADM systems (Dobbe et al. 2019). Understanding *why* some factors increase risk is vital in designing safe ADM systems for citizens. Leveson state how unsafe situations often originate from interactions among different components within a system that satisfy their individual requirements (Leveson 2016), meaning that sometimes individual components involved in an accident work as specified, but together they create a dangerous system. Here an accident is defined as losses that arise from dysfunctional interactions among system components in which no components have failed (Leveson 2016). Safety relies upon the interactions among the system components and is thus a system property, not a component property (Leveson 2016). Using a system safety approach may thus assist in finding *why* certain unforeseen effects emerge within the Dutch social benefits system. Furthermore, the technique underwrites the importance of checking systems and ADM technology for technical risks and emergent risks, which depend on the coupling between ADM systems and the environment they act within and upon (Dobbe et al. 2018). However, in order to set useful norms and standards for the development of ADM systems, one would also

need to know *where* and *how* these unsafe effects emerge within a system. A modeling method that can assist is an ABM, a well-developed technique for modeling complex adaptive systems in a bottom-up approach. Complex adaptive systems are a dynamic network of interactions. However, their behavior may not be predictable according to the behavior of the components (Van Dam et al. 2012). The ABM approach ensures that important system actors are modeled as agents who act and interact with one another and their environment. This behavior eventually leads to emergent system behavior (Van Dam 2009). As the model's behavior is built up by the interactions of different system components, this method may be instrumental in determining *how* harmful effects emerge. The proposed methodological combination between system safety and ABM is new but does share characteristics in their focus on emergence and interactions.

1.1 THE NEW WAJONG HARMONIZATION LAW

The set-up of this research is inspired by the effects that emerged for citizens receiving Wajong benefits after the law amendment in 2021. However, the implication for the scope is that only ADM systems within law execution in the social benefits system within the Netherlands are perceived. As of January 1, 2021, a new version of the Wajong law has been implemented into the Dutch social benefits system. This law provides benefits for people who fell ill or became disabled before the age of eighteen or before they turned thirty and maximally a year after they were still following education and could not work. They are entitled to benefits if they meet specific conditions (Ministerie van Sociale Zaken en Werkgelegenheid 2010). However, unfortunately halfway through 2021, the first stories of Wajong receivers receiving a significantly lower amount than before surfaced (Rijksoverheid 2021). An analysis by Ministry of Social Affairs and Employment (SZW) together with the UWV showed that in 400 cases, this was due to the amendment of the law and, therefore, incorrect. Alternatively, 300 Wajong receivers received too many benefits due to the new associated income scheme. This result was unexpected and prompted the inspiration for a further look into the definition and exploration of the phenomenon: ripple effects.

1.2 RESEARCH GAP

The increased use of ADM systems, algorithms, and overall automation within governmental institutions have been shown to lead to adverse effects on privacy, inclusion, and accountability and increase the opaqueness of the social benefits system in the Netherlands, most often impacting citizens. The increased merging of different data structures within the public domain makes it challenging to design and keep the governmental information system focused on law automation safe. It is difficult to pinpoint why and where an automated system's unsafeness and unexpected effects emerge. Unsafeness often results from the interaction of many different components within a system. Questions on behavior emergence and even what constitutes unsafeness within this field remain unanswered. This research focuses on interpreting the described effect using a system safety lens and modeling the behavior using an ABM to explore where and how these effects emerge. The effect often starts as a small problem in one specific place and causes more significant problems in other locations in the system. The effects are often cross-domain, different ministries, or cross-organizational, different executing organizations. The described unsafe and unexpected behavior is hereafter referred to as *ripple effects* of automation in law execution. Even though research exists on the increased use of ADM systems and the broader overall trend towards a digitized government and its

associated consequences, empirical and casuistry research into ripple effects using a system safety lens has not been explored extensively.

1.3 RESEARCH OUTLINE

1.3.1 Scope of Research

Figure 1.2 gives an overview of the scope of this research. The scope of the research is limited to the social benefit domain, by which social insurance and services laws and benefits are meant. Concretely, this means only the execution organizations executing these laws are considered. These are UWV, the Tax Authority, Dienst Uitvoering Onderwijs (DUO), Social Security Bank (SVB), and Municipalities. Furthermore, only ADM systems are considered by which the translation of law to computer code is meant.

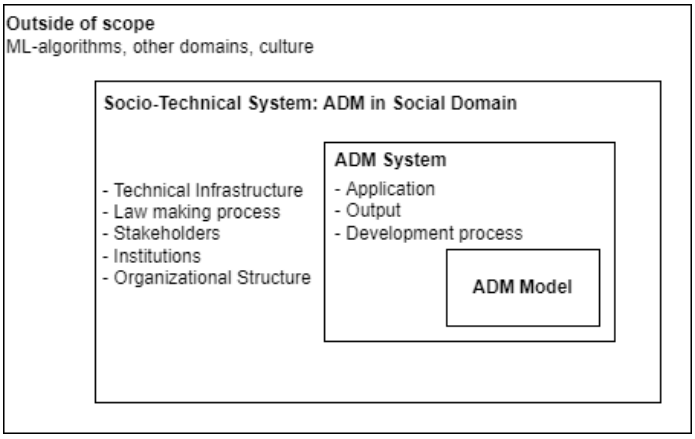


Figure 1.2: Scope Description

1.3.2 Research Objective

To explore the phenomenon of ripple effects using the design of an ABM and the interpretation of the effect using system safety to illustrate how changes or the implementation of a new or updated ADM system within existing structures can lead to unexpected effects for both government and citizens. The research thus aims to understand law automation's associated effects in governmental systems via the design of a simulation model from a system safety perspective. In order to properly design such a model, the unexpected effect is first defined as *ripple effects* using interviews, a system description, and literature research.

1.3.3 Research Questions

The following research question is constructed based on the literature review and the introductory chapter:

> *How can ripple effects associated with automation processes of law execution in the social benefits system be modeled using a system safety perspective?*

Sub Questions

To answer the research question, the following sub-questions are constructed:

1. How can the system of law execution automation in the Netherlands be described to formulate a definition for ripple effects?

2. How can ripple effects of law execution automation be described from a system safety perspective?
3. What are the model requirements for a model describing ripple effects of automation in governmental systems?

1.4 LINK WITH EPA PROGRAM

The Master thesis research is part of obtaining a master's degree in Engineering and Policy Analysis (EPA). The thesis explores how using a system safety lens and the design of an ABM can explore *why* and *how* ripple effects emerge. As the scope of research specifically targets ripple effects of law automation within the social benefits domain, the research is located at the intersection of social justice, responsible technical innovation, and policy-making, making it highly suitable for an EPA student. Technical artifacts, such as ADM systems, should be placed into a political multi-actor context to understand their impact and explore a safe application in their future.

1.5 REPORT OUTLINE

The report is divided into four parts, as shown in Figure 1.3. The first section consists of Chapters 1 and 2 describing the introduction, problem, methodology, and system to be researched. After that, the second part defines and conceptualizes the term ripple effects from a system safety perspective and is set out in Chapters 4 and 5. The third section, found in Chapters 6 and 7 focuses on the framework of an ABM and the associated model design and validation. The final part of the report consists conclusions, discussion and future recommendations which can be found in Chapters 9, 8 and 10.

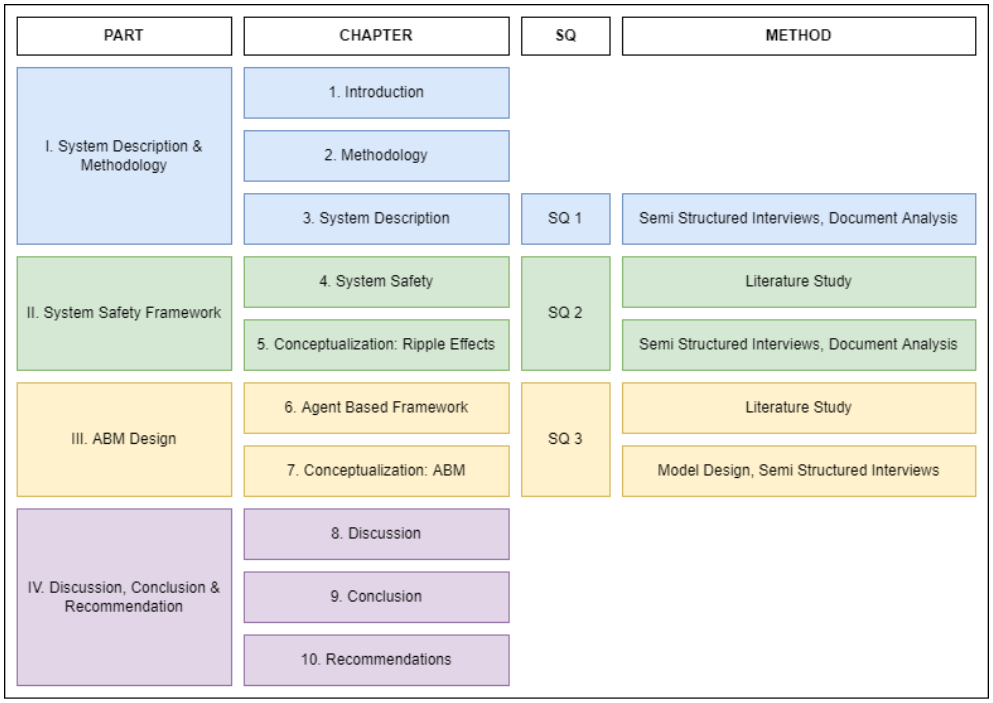


Figure 1.3: Report Structure

2 METHODOLOGY & RESEARCH APPROACH

This Chapter describes the methods used to answer the aforementioned sub-questions and main research question.

2.1 RESEARCH STRATEGY

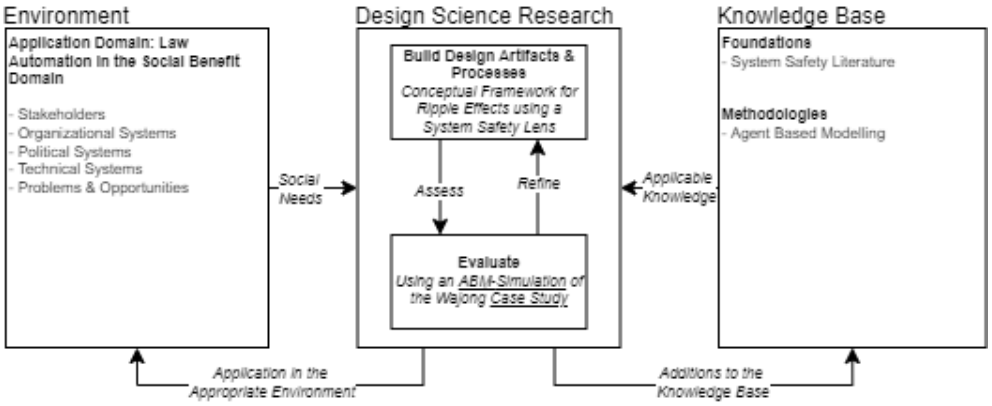


Figure 2.1: Design Science Strategy applied to Ripple Effects

This research aims to understand the complex phenomena of *ripple effects* from law automation. It further seeks to describe the effects and find its origins within the governmental system in which it is occurring. The phenomenon is aimed to be understood using a *system safety lens*. Figure 2.2 explains the methodological approach of the translation and iteration between the socio-technical system, the chosen lens, and the model simulation design.

The approach selected is a design science strategy, as it allows for a structure to be designed and tested as shown in Figure 2.1. Design science focuses on developing and validating knowledge (Hevner et al. 2004). In this strategy, the definition of the conceptual framework is the conceptualization of the term ripple effects from a system safety lens. In turn, the framework is used as input for the model usage. In this case, instrumental model use is seen as the model requirements needed for the development of a useful model. The model will be developed and validated specifically from the perspective of the Wajong case. Hereby answering the main question: how can ripple effects associated with automation of law execution in governmental systems be modeled using a system safety perspective?

2.2 RESEARCH APPROACH

The research approach follows the construction of a conceptual framework of *ripple effects* using system safety perspective (Leveson 2004), which is modeled using an Agent-Based Model (ABM). The research approach is visualized in Figure 2.2.
Below, the description of methodology per sub-question is elaborated upon.

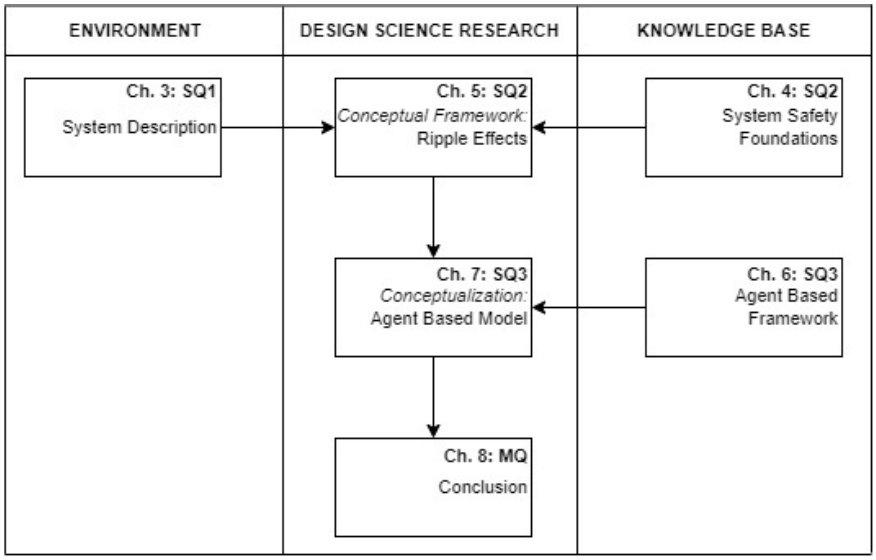


Figure 2.2: Research Strategy

How can the system of law execution automation in the Netherlands be described to formulate a definition for ripple effects?

A total of thirteen semi-structured interviews were conducted, combined with an extensive political document analysis to accurately describe the social benefits system from a law automation point of view to construct a suitable definition for the phenomenon of ripple effects. The description is further used as input for sub-question 2 and 3.

How can ripple effects of law execution automation be described from a system safety perspective?

The question is answered using the input of sub-question 1. Chapter 4 introduces several concepts from system safety. This is done using literature research. Combining the system safety perspective with the system analysis done in Chapter 3, ripple effects are described and interpreted. Chapter 5 provides the framework of the phenomenon ripple effects interpreted using a system safety lens. The framework is constructed by applying the Systems-Theorectic Accident Model and Processes (STAMP) method, explained in Chapter 4, on two case studies that are examples of ripple effects. Case studies were used specifically to explore how suitable the use of a system safety lens is within the social benefits system. The reconstruction using a system safety lens also allows for insights into the design process of law automation. It may prompt further insights into where scientific discussion is still needed and constructive to make the design- and decision-making process safer.

What are the model requirements for a model describing ripple effects of automation in governmental systems?

The last sub-question is answered by combining the conceptual framework of ripple effects as perceived by system safety with an agent-based framework. The phenomenon is translated into a model design using the first four steps of the ten-step approach by Van Dam (2009). The modeling method selected is ABM. After the model's design, the design is validated using interviews with stakeholders relevant to the Wajong case study. Some of the described methods are elaborated upon below.

2.2.1 Semi-Structured Interviews

Semi-structured interviews, a blend of structured and unstructured interviews, gather qualitative inputs from citizens receiving benefits, government officials working at execution offices, and experts on system architecture. Semi-structured interviews are used as they allow for the flexibility to uncover patterns and dive deeper when needed. As the research is strongly exploratory and the interviewees differ in their role, power, and interest in the problem, the questions asked to differ between respondents; a complete overview of all questions asked to different participants is shown in the Appendix A. All thirteen summarized and anonymized transcripts of the interviews can be found in Appendix B. Furthermore, an overview of all interviewees is included in Table 2.1.

All participants have given written consent to the use of the anonymized summary of the interview conducted. All interviews are audio recorded when given permission and summarized and anonymized. The summaries are partly used to detect categories and patterns and test hypotheses on the structure of the system of law automation and its effects and are, therefore, the primary input for the system analysis and answering sub-question 1. Furthermore, the transcripts are used to validate the simulation model design, further elaborated below.

Role	**Institute**	**Ref. Code**
Insurance Physician	Justus Medische Expertise	IP1
Insurance Physician / Policy Advisor	UWV	UWV1
Advisor IT	UWV	UWV2
Wajong Benefit Receiver		W1, W2, W3
Policy Employee	LCR	LCR1
Leadership role	BKWI	BKWI1
Head of Nederlandse Overheid Referentie Architectuur (NORA)	ICTU	ICTU1
Leadership role	de Loonaangifteketen	LA1
Ethics committee	UWV	UWV4
Head ICT	Logius	LOGIUS1
Pay-out Employee	UWV	UWV3

Table 2.1: List of interviewees profiles

2.2.2 Simulation Model - Agent Based Modelling

A practical method for judging models is as tools designed for specific purposes (Edmonds 2017). Thereby, the usefulness and quality of the model are assessed against how good it is for its declared purpose. For this research, a mixed purpose between 'theoretical exposition' and 'explanation' is desired. Which respectively means that the model aims to establish and characterize (or assess) hypotheses about the behavior of a set of mechanisms using a simulation. It can thereby establish a possible causal chain from a set-up to its consequences (Edmonds 2017).
With complex (social) phenomena such as ripple effects, it is particularly interesting to understand *why* behavior emerges. As 'complex systems display properties that cannot be understood by just looking at the properties of the individual components, but are created as a result of the structure and organized interactions between these components' (Van Dam et al. 2012). Simulation models make it possible to test conditions and cases under which an explanation of a phenomenon works and how to improve its associated assumptions.

The simulation method selected for this research is ABM. The technique has been proven to be a suitable way of growing behavior to show trends (Nikolic 2009). Furthermore, simulations can assist in identifying social and technological behaviors in a system (Ghorbani 2013). Also, one can explore different scenarios and is suitable for socio-technical systems as identified as a need for the modeling purpose of the simulation. ABM and its associated simulation can increase understanding of how behaviors or events result in emergent system outcomes. There has been extensive research into using ABM to model and simulate a socio-technical system (Van Dam 2009, Beers et al. 2009, Van Dam et al. 2012). The method bottom-up structure may provide interesting new insights that might not pop up when the underlying dynamics are obscured by aggregate metrics, as is the case in law automation systems. This characteristic retraces explicit explanatory links between micro-level interaction dynamics and macro-level phenomena (Frantz 2020). The characteristics above of the modeling method are highly compatible with the modeling purpose of explaining and exposing the phenomenon or conceptual framework of *ripple effects* as perceived through system safety.
An ABM consists of several 'agents' represented in a computer program (Van Dam et al. 2012). Every agent portrays a real-life person, organization, department, or other real entity. The core of the ABM is the interactions between the different agents. The different agents will be programmed to interact similarly to their real-life counterparts, experience the same constraints, access the same knowledge, and operate in the same environment as shown in Figure 2.3. When executed successfully, an agent-based model should be 'transparent' to inspection by decision-makers (Van Dam et al. 2012).

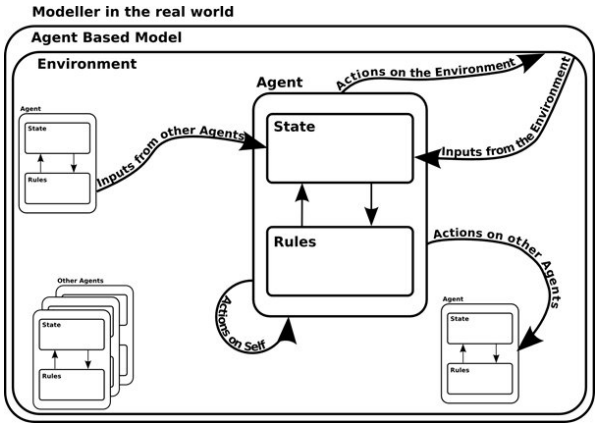


Figure 2.3: Agent Based Model Structured by (Van Dam et al. 2012)

The validation process of the ABM model design is done using the Wajong case study and interviews with relevant stakeholders. Interviews with relevant stakeholders are used to check whether the model design accurately portrays the researched system and its relevant agents. However, this validation method may be prone to the personal bias of interviewees.

The model design steps, requirements, and specifications can be found in Chapter 6.

3 SYSTEM DESCRIPTION

This Chapter answers sub-question 1: how can the system of law execution automation in the Netherlands be described? The objective of the system description associated with the automated law execution within the social benefits domain in the Netherlands is to find a definition for the term *ripple effects*. It aims to interpret the system from a socio-technical perspective. The analysis is based on a literature study of many governmental papers and documents. It is further elaborated upon using semi-structured interviews with experts at executing organizations and benefits receivers. The interview codes depicted in table 2.1 are used when referring to a specific interview. The system is described starting with introducing the phenomenon Automated Decision Making (ADM) system and the various information structures needed to facilitate these systems. Hereafter, a stakeholder analysis is performed. These analyses and descriptions are used as input for the socio-technical system analysis to construct a definition for *ripple effects*. The Chapter describes benefits. By this, both allowances, benefits, and social insurance are meant.

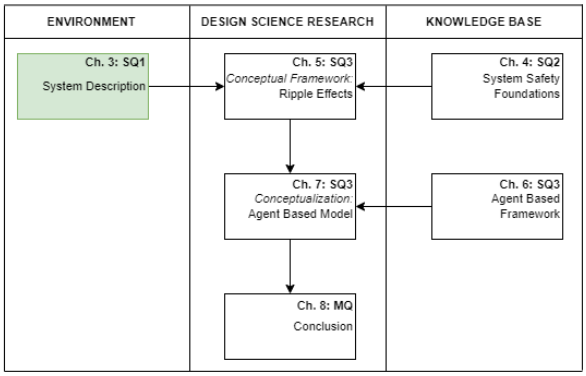


Figure 3.1: Research Strategy - System Description

A socio-technical system, as perceived within this research, and defined by Baxter and Sommerville (2011):

> (1) has interdependent parts, adapts to and pursues goals in external environments;
> (2) has an internal environment comprising separate but interdependent technical and social sub-systems;
> (3) has equifinality, which means that the system's goals can be achieved by more than one means implying design choices can be made during development.

3.1 LAW EXECUTION AUTOMATION – TECHNICAL SYSTEM DESCRIPTION

Execution organizations are increasingly automating law execution, resulting in more data sharing among (execution) organizations (Raad van State 2018). These new types of Information Technology (IT) integration need new constraints and standards (van Eck 2018).

In European law (GDPR Article 22) ADM systems are defined as (Roig 2017):

1. the automated processing generates a decision with legal effects for the data subject or;

2. the automated processing generates a decision that the data subject is otherwise significantly affected.

The increase in automation of law execution and dependency among executing offices can be traced back to the introduction of the law Structuur Uitvoering Werk en Inkomen (SUWI) in 2002. This law prescribes that Uitvoeringsinstituut Werknemersverzekeringen (UWV), Social Security Bank (SVB), and Municipalities are required to share, proactively, upon request, and free of charge, all data and information necessary for the execution of the tasks assigned by or under the SUWI law or any other law tasked to the UWV, the SVB (Eerste Kamer der Staten-Generaal 2002). Due to the law's introduction, different execution institutions were tasked to organize the performance of government tasks concerning employment and the implementation of employee insurance schemes together (Eerste Kamer der Staten-Generaal 2002). The law aimed to create an 'apply one-time service' for citizens looking for work and applying for benefits, thus essentially creating one (digital) counter for government services, which implied that citizens only have to provide certain information once. The perception was that this innovation would benefit both citizens and employers as it would reduce the administrative burden for civil servants (Alexandra C. van Huffelen 2022, Loonaangifteketen 2019). Consequently, execution organizations are responsible for maintaining electronic and information system facilities to process the necessary data (LA1). They are not allowed to share this data with other administrative authorities when it is not strictly necessary for the tasks assigned to those other administrative authorities (Persoonsgegevens and Assessment 2018). The law further prescribes that data gathered for executing one law may be recycled for executing a different law (Eerste Kamer der Staten-Generaal 2002). An example of this could be income information used for determining WW benefits, which may be used again to determine one's eligibility or height for childcare benefits.

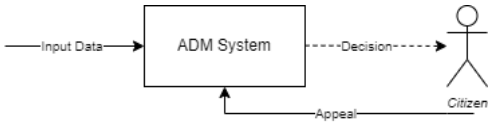


Figure 3.2: Graphical Representation of an ADM System

Figure 3.2 shows how an automated decision is made using an ADM system. Most ADM systems use *algorithms*. Such algorithms are rules and instructions that a computer automatically follows when performing calculations to solve a problem or answer a question (Janssen and Kuk 2016). The Dutch government uses algorithms in many different forms, ranging from computational models, decision trees, and other statistical analyses to complex data processing models and 'self-learning' applications (Rekenkamer 2021). Algorithmic code reflects institutional logic and represents the view of the algorithm designers and policy-makers (The Netherlands Scientific Council for Government Policy 2021). Thus, the *algorithm* used within an ADM system can be seen as the translation of law to computer code. The use of algorithms can improve the quality of public services, effectiveness, and efficiency (Ojo et al. 2019, Toll et al. 2019). Furthermore, in recent years, the digitization of processes in executing organizations has often been used as a cost-cutting measure (Crijns et al. 2018). Algorithms are assumed to be written in a programming language and process digital data.

Execution organizations automating law execution typically use prescriptive algorithms like decision trees (Rekenkamer 2021). An automated decision tree is an algorithm that is an automatic version of decision-making that a professional from

the execution organization would have done using decision rules that state 'if X, then Y, else Z'. A decision rule is a formal translation of a legal rule for a concrete application. An example could be the right to vote, which belongs to everyone aged eighteen and over. According to the if-then scheme, this right can be translated into a decision rule: if you are 18 years or older, then the right to vote. Most decision rules are considerably more complex. Decision rules can be used as an intermediate step to translate rules in human language into computer software (Raad van State 2018). It is important to note that the algorithms perceived as part of ADM systems do not make up logic to derive a decision or outcome independently (Nederlandse Overheid Referentie Architectuur) (UWV2), meaning that no machine learning techniques are used, and the decision rules are decided upon upfront.

The definition of a *model* or algorithms used within an ADM system as used by the UWV to execute social policy is defined as a combination of data, assumptions, and theories, that are repeatedly processed using a quantitative method or a system (possibly supplemented by an expert judgment) (UWV 2021), (UWV4). The outcomes of these models are used for internal or external decision-making. However, such quantitative outcomes are estimates that simplify a person's situation UWV (2021). UWV states the importance for such estimates and outcomes to still be *explainable* to clients and their influence on the decision, for example, the height or eligibility of their benefits (UWV 2021) (UWV2). Concretely, this implies that even though ADM systems are used, the citizen should be able to understand which rules are applied to derive the decision.

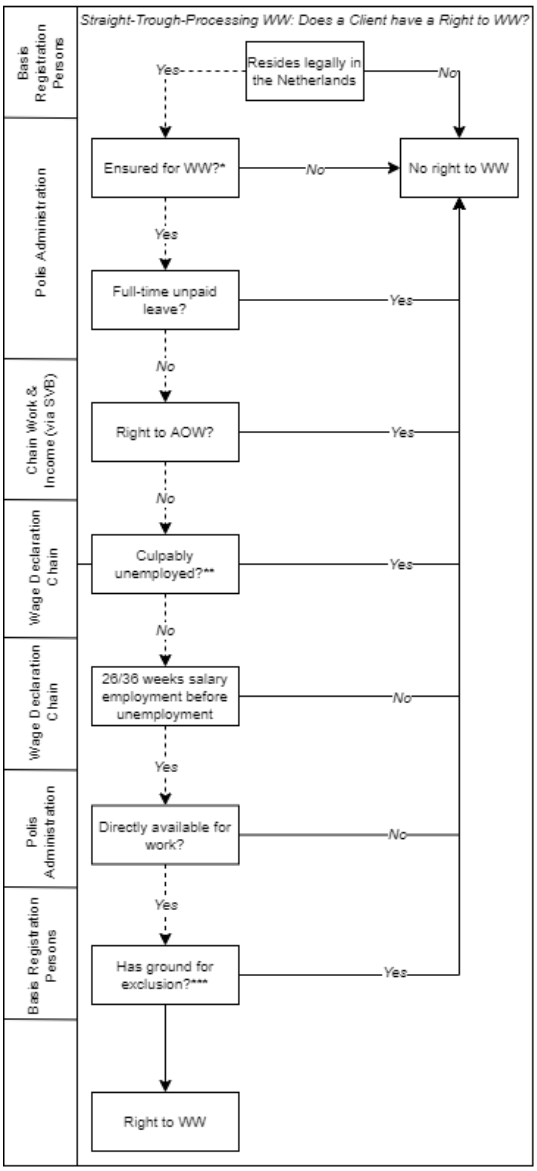


Figure 3.3: ADM System for STP of the WW - Eligibility for Benefits

In Figure 3.3 an example of an ADM system as used by UWV is shown, the Asterix indicated in the Figure are explained in the footnote[1]. UWV commented that STP is used for the execution of the WW law. However, specific logic was not provided. The decision tree, as shown in Figure 3.3, is based

o *A Dutch citizen is ensured for WW if they are salary employed.
**If a citizen quits their job, they are culpably unemployed and therefore do not have the right to WW.
***Exclusion rights are, among others, currently being incarcerated.

upon the law as available on the website of UWV (UWV2). Some of the decisions can be made quite straightforwardly; for example, is someone eligible for Algemene Ouderdomswet (AOW)? However, some decisions may be significantly harder for some citizens than others. For example, in order to be eligible for WW benefits, a citizen should have worked 26 out of 36 weeks before applying for WW benefits, however in case of sickness or pregnancy during that time, different rules are used to determine this, illustrating that in some cases ADM systems work straightforward, but this is not possible in all cases. UWV distinguishes between smooth and non-smooth cases, where logically, the non-smooth cases should be reviewed by an expert from the UWV (UWV2).

The left column in Figure 3.3 states where the information needed to follow the decision tree is located. As visible, UWV alone is not able to execute the WW law on its own after the introduction of the SUWI law. Thus, increasingly a network of administrative and executive organizations is dependent on each other(s) (information) when making decisions. Inherently, this means that the information provided by the performance of the task of one administrative body also determines the performance of a task of another administrative body. Unfortunately, Figure 3.3 only determines whether someone is eligible for WW benefits but not the height or duration of the benefits. Figure 3.4 shows how the decision derived at in Figure 3.3 is used as input for the *algorithm* used to determine the height and duration of the benefits. Another way to describe such ADM systems could thus be by the term *automated algorithmic chain decisions*. van Eck defines algorithmic decisions in the form of automated chain decisions as "decisions derived through a system that acts automatically - without requiring direct human intervention -, where the input of the system relies on data derived from output earlier in the chain and the decision, in turn, affects another decision of another administrative body in a chain" (van Eck 2018). As shown in Figure 3.4 and 3.3 the current social benefits system in the Netherlands also contains this sequentially (van Eck 2018). The existence of such systems also implies that specific templates exist for certain decisions that have to be taken in a specific way. Consequently, if the assessment has been standardized, the information needed is also known and can also be digitized and standardized (Bovens and Zouridis 2002).

Decision-making using ADM systems has replaced human judgments based on rules of thumb and transformed into a computer saying 'yes' or 'no' or 'how much' (Zouridis et al. 2020, Zuiderwijk et al. 2021, Rekenkamer 2021). Organizations, governmental execution organizations included, are increasingly built around the information system that implements the core task of the organization. In these systems, the computer makes most of the individual decisions and implements these. The Dutch social benefits system is scattered over many executing organizations, among which the UWV, SVB, Municipalities, and the Tax Authority. As stated in the example above, these organizations can no longer execute laws individually anymore. Furthermore, many of these organizations use similar or the same data points to derive a decision on the height of or eligibility for a benefit, allowance, or social insurance or use the outcome of one ADM system, within one organization, as input for another ADM system. Therefore, such ADM systems do

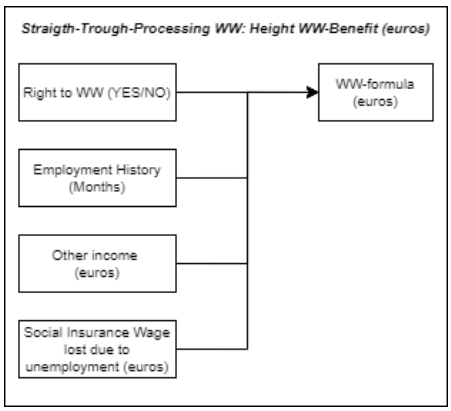


Figure 3.4: ADM System for STP of the WW - Benefit Height

not operate in a vacuum but are often interrelated, as are the laws they automate (BKWI1).

All the different execution organizations in the social benefits system work on behalf of the Ministry of SZW. The execution organization responsible for the bulk of the social benefits relevant for Wajong eligible citizens is the UWV.

An extensive data infrastructure is needed to enable the described automated chain decisions using ADM systems among and between different executing governmental offices. The required digital transformation presents all governmental organizations with similar challenges to serve citizens and businesses in the best possible way as, decreasingly, it is possible to complete institutional tasks individually (Alexandra C. van Huffelen 2022). Below, a more detailed description of the technical system and the different infrastructure components in place to facilitate ADM systems within the Dutch social benefits system is given.

3.1.1 Basic Registrations

One of the vital components within the information structure is the system of basic registers. The government defines these registers as 'the entirety of agreements and facilities aimed at the effective and efficient management of a limited number of data necessary for the performance of government tasks, recorded in data collections with a legal basis (the key registers), including their mutual relationship and the common facilities needed for collection, dissemination and use' (Bijleveld-Schouten 2010). The aim of a basic registration is thus to provide administrative bodies with reliable data quickly, efficiently, and on a large scale (Raad van State 2018). Citizens only need to provide such data to the government once ("one-off data request") as in line with the set-up of the SUWI law. There are ten basic registers with different legal grounds and governing bodies (van Eck 2018).

All government bodies use the Basic Register System data to perform their public duties more efficiently and with better service (Digitale Overheid 2021b). These key registers are used by all municipalities, provinces, water boards, independent administrative bodies such as UWV, and other organizations with a public task.

The basic registrations are ten widely used databases by governmental organizations. Often, (execution) organizations are both data suppliers and customers. Using 'DigiKoppelingen', organizations can couple with a basic registration when this information is essential for the execution of a law (NORA 2017). 'Digikoppeling' is a National standard for interfaces between different databases between governmental organizations (LOGIUS1). It can be seen as a data highway as it is how data is transported. Logius is an agency of the Ministry of the Interior and Kingdom Relations that develops products and services for the digital government (LOGIUS1). Furthermore, standards, such as 'Digikoppeling' are managed.

Different organizations using the basis registrations are obliged to report any data from a basic register they deem incorrect or likely false using a 'Digimelding'. Citizens can also report it if one of the fields in their basic registration is incorrect. This must be done proactively as due to the shared data use of basis registration, this wrong data field is then transported over data highways and delivered to all executing organizations in the Netherlands. When a specific data point in a basic registration changes, which influences eligibility for benefits, execution organizations can make sure they are notified immediately using 'Digilevering'. An overview of the interrelations between the different registers listed below can be found in Figure 3.5. Different organizations currently facilitate the connections that executing organizations use. Digikoppelingen's providers have strict privacy regulations and only function as information transporters. These data highways do not alter data, use algorithms, or save the specific data they are transporting.

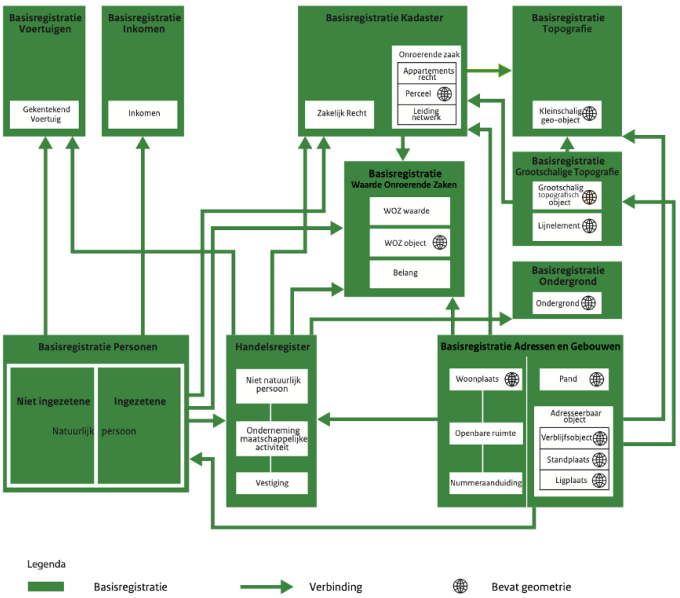


Figure 3.5: Overview of interactions between basisregistrations in the Netherlands (Digitale Overheid 2021b)

3.1.2 Information Chains

For some executing tasks, the use of the basis registrations alone is not sufficient. Therefore, different executing institutes together, with on occasion other public and private organizations, with joint (often politically) imposed objectives start chain partnerships to exchange a multitude of information (LA1) (Crijns et al. 2018). Chain initiatives are thus initiated when an (execution) organization cannot obtain all the needed information to execute the law internally combined with the basic registrations.

Chain partners, for example, UWV and the Tax and Customs Authority, are independent in their responsibilities but depend on each other to achieve joint objectives and do not have all the information to achieve these objectives themselves (LA1). A one-person management does not explicitly manage chains to issue rulings upon conflicts when certain frictions between chain partners occur. An essential characteristic of information and decision chains is the lack of (unambiguous or formal) hierarchy (LA1).

The data highways (Digikoppelingen) and basic registrations are also used in the information chains spanning different executing institutions. Chains move information from one process to another, often sequentially. In turn, these chain collaborations create both an information and a decision chain or sometimes even a network (Informatiebeveiligingsdienst voor Gemeente 2022). Using an information chain or networks for decision-making is useful: it increases the probability that data is correct, and it is usually efficient for government and citizens. However, it is not without risk for the citizen. Data sometimes has a meaning that depends on the context in which it is used (Raad van State 2018). Moreover, incorrect data can be passed on in the chain and then take on a life of its own. Ultimately, citizens may lose sight of the data collected and passed on about them within the different execution organizations (LA1) (Raad van State 2018). That is why, when studying chain decisions, it must be considered that 'the one link can always but to a certain extent influence what other links do' (Zouridis et al. 2020).

Chains operate in a highly dynamic environment, further enhancing existing legislative complexity (Loonaangifteketen 2019, Crijns et al. 2018). Political changes in governance and laws at a central and decentralized level and new developments regarding regulations, technology, social wishes, and political targets all impact

chains differently. Moreover, developments in law execution strategies and systems within different organizations are not always synchronized (UWV2, LA1) (van Eck 2018). Due to a significant backlog in system development, it is difficult to continuously keep improving upon existing chains as they are heavily dependent on the in-house systems of, for example, UWV and the Tax Authority. Furthermore, as many organizations depend heavily on the correct working of chains, the results of a chain malfunctioning can be catastrophic as many processes are deprived of accurate input data (BKWI1, LA1).
Figure 3.6 describes the system with the relevant technical system components. The Figure shows how the social benefits system is characterized by different organizations filling multiple roles simultaneously. For example, UWV is both a supplier, a customer, and an administration of a chain.
There are various examples of information chains in use today. The information and decision chains summarized and further elaborated upon in Appendix X are most relevant to the social benefits system focused on Wajong benefit receivers.

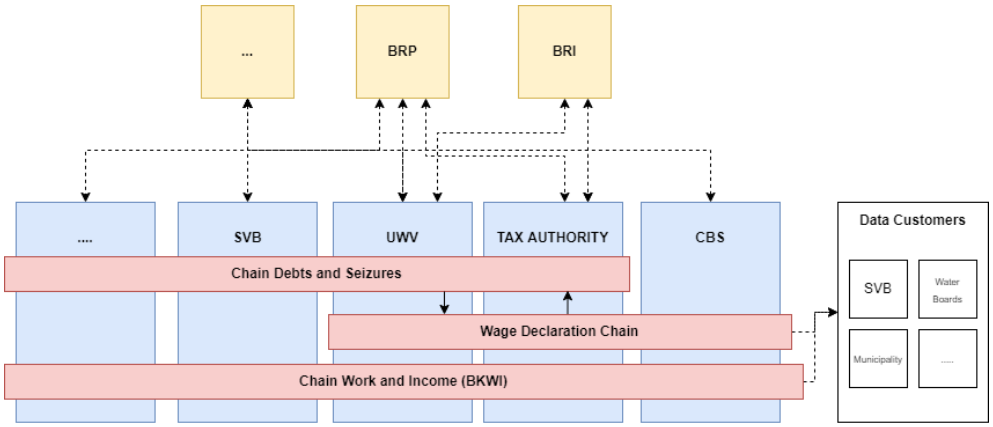


Figure 3.6: Technical System Description

Wage Declaration Chain

The Wage Declaration Chain ensures that data relevant to the UWV, received by the Tax Authority, is correctly included in the polis administration of UWV (Loonaangifteketen 2021). The chain was set up with the ambition to reduce the administrative burden for employers (submit data once) and the implementation costs for the government (use data for other purposes like benefit determination) while increasing convenience for clients (receive benefits at the right time) (LA1). In line with the SUWI law, the chain is set up according to the principle of one-off requests and multiple uses (Eerste Kamer der Staten-Generaal 2002). The chain is an initiative from the Tax Authority, UWV and Centraal Bureau voor de Statistiek (CBS), whom all use its generated data intensively (LA1). The chain was designed collaboratively between these organizations and is still managed by employees of said organizations. The data is used by 1100 other (government) organizations such as the SVB, DUO, FIOD, and municipal social services (LA1). This shared data enables these organizations to perform their statutory duties without requesting data themselves from clients. Every month 114 data points are collected from citizens, and those data points are shared upon legislative need with the data customers of the chain (LA1). However, this means that the chain transports an immense amount of data yearly, totaling over 30 million data points (LA1).

The two primary data suppliers are the chain's two main data customers. In the chain, the UWV is responsible as the administrator of the polis administration, and the Tax Authority is responsible for receiving and sharing the Wage Declaration.

The Tax Authority works together with Logius to realize this. The chain has internationally been praised for its successful collaboration and quality (Crijns et al. 2018).

Chain Work and Income

The work and income chain was explicitly set up after the introduction of the law SUWI (BKWI1). The law mandated the introduction of Bureau Keteninformatisering Werk en Inkomen (BKWI). BKWI is the data highway specifically designed for the domain of work and income. BKWI is a separate and recognizable organizational unit of UWV but also serves other parties within social security, such as the UWV and municipalities. It functions as an exchange platform of information and data, thus a form of 'Digikoppeling'. BKWI does not perform any data processing steps and does not store information. They make a distinction between viewing and reading. Suwinet-Inkijk allows government organizations to consult citizens' data stored at other government organizations or basic registrations, in a web application. Suwinet-InRead allows government organizations to read data from various other government organizations directly into their business application and fill it in in e-forms. In both cases, data is retrieved in real-time. The main difference is that a web page is used when viewing (easy to implement, but this does mean that people have to retype information if they want to store it in their system). With reading, the information is directly connected to the customer's systems (more complex to realizable, but is faster and prevents possible errors when typing) (BKWI1).

Chain Debts and Seizures

Within the Chain for debts and seizures, many government parties such as SVB, LBIO, CJIB, municipalities, and water boards are working on implementing the Simplification of the Seizure-Free Fee Act. A central calculation tool for the seizure-free fee was developed by multiple organizations, among which BKWI, Foundation Intelligence agency, and Foundation Bailiffs. The calculation tool performs the total applied calculation for determining the attachment-free rate and ensures that attaching parties can calculate the attachment-free rate more transparently and partly automated. This also makes it possible to exchange messages with the sources of the calculations BRP and UWV and allows for message exchange with(in) the confiscating organizations SVB, LBIO and CJIB. The more central control of the seizure-free amount aims to improve the quality of service for clients. Instances described by clients and BKWI included different bailiffs taking different incomes, thus leading to a different seizure amount between different bailiffs. Consequently, this significantly increased the administration load on both client and bailiffs' sides (BKWI1).

3.2 SOCIO-TECHNICAL SYSTEM PERSPECTIVE

The system relevant to law execution automation is an example of a socio-technical system in which a social system (policymakers, law executors, legislation, and clients) influences and is influenced by a technical system (ADM systems) (Van Dam 2009). These systems influence and depend upon each other for successful system outcomes (Walker et al. 2008) as partly seen in the example of the Wage Declaration chain. A socio-technical system should be jointly analyzed to produce positive practical results (Bostrom and Heinen 1977).

The previous section describes the technical components that facilitate the automation of the social benefits system. However, socio-technical systems consist of both social and technical sub-systems that are interdependent and create new types of

system behavior through their interactions (Baxter and Sommerville 2011). Therefore, in identifying relevant stakeholders and socio-technical system characteristics, it is important to consider both the social and technical sub-systems and their interrelations. To ensure all relevant system components and stakeholders are identified, the five-layer model by NORA is combined with expert interviews (LCR1). The five-layer models specifically help to identify stakeholders relevant to the construction of ADM systems, whereas the interviews assist in identifying other relevant stakeholders that such systems might influence. NORA is a set of agreements on interoperability and quality of service to enable and improve digital services in the public sector, which is complemented by a community of experts on system architecture, project leadership, and policy (Digitale Overheid 2021a). The five-layer model allows the analysis of automation within the social benefits system from all relevant angles (NORA 2021).

	Components	Involved Stakeholders
Foundation Layer	Laws and regulations	Ministries, 1st and 2nd Chamber
Organizational Layer	All products and services offered by the government	Execution Organizations
Information Layer	National semantic plane	Ministries
Application Layer	Basic registrations	Ministries, Municipalities, Execution Organizations
Network Layer	Networks, intersections and datahighways	Logius, NORA, Systemarchitects

Figure 3.7: Adapted Five Layer Model taken from (NORA 2021)

Figure 3.7 shows how five different layers can encapsulate an entire ADM system. Namely, the foundation layer specifies which law should be automated and how the organizational layer specifies how the service associated with the law works and who is responsible, specifically execution organizations are relevant here. The information layer specifies and defines the terms stakeholders use in the organizational and foundation layers. Within laws and regulations, the application layer describes the input data needed to execute the laws, and lastly, the network layer describes how that specific data is transported. Using the structure of the five-layer model, the sub-sections below first identify relevant stakeholders and their position, after which different socio-technical phenomenon present within the system are explored.

3.2.1 Stakeholder Analysis

The analysis focuses on stakeholders involved in creating ADM system and stakeholders influenced or influencing them. The five-layer model is used to identify parties relevant to the current development of ADM systems, after which the other relevant stakeholders are introduced. These stakeholders are all shown in Figure 3.8, which indicates their power or influence over the use of ADM system, and on the other axis, their interest or the amount the stakeholder might be influenced.
Following Figure 3.7, layer-by-layer different stakeholders can be identified. The foundation of an ADM system is the laws and policies aimed to be automated. Laws are constructed by Ministries in collaboration with the First and Second Chamber and checked by the Raad van State (and execution organizations) on executionability (Ministerie van Algemene Zaken 2022), making them responsible for the internal logic of ADM systems. Therefore, Ministries are also the main stakeholder

in the information layer, which makes up the National semantic plane. Here the definitions of terms are meant which are defined within the law. Furthermore, the Ministry of Internal Affairs (Tweede Kamer 2020) makes policy on the digital future. Moreover, Ministries are directly responsible for executing organizations working with ADM systems (Ministerie van Algemene Zaken 2022). This makes the *policy makers* powerful and highly interested in developing and using ADM systems. The final responsibility for the outcome of the system lies with them. However, interestingly enough, there is another side to this coin. As these policymakers are also heavily reliant on and restricted by these systems, for example, sometimes a new law or amendment may not be possible to realize due to the current state of the information systems. An example of this phenomenon is how the exclusion of gender on passports is hindered by the state of the current information systems present. The cost faced by border authorities to update the necessary information systems is too high to change regulations (International Civil Aviation Organization 2012).

Within the organizational layer, execution organizations are the main stakeholder as they are responsible for executing the law. The actual design of many ADM systems is made by software developers employed by executions organizations or is bought from independent software developers (this varies among execution organizations (BKWI1)). In this layer, the translation step between law and ADM system is made (UWV2). Mainly large execution organizations have a high degree of power as many of the ADM systems are heavily reliant upon their existing infrastructure and information sets (basic registrations and information chains) (LA1, ICTU1). Unfortunately, these systems have depreciated significantly over the past years, leaving them needing large system updates and innovation (UWV2, BKWI1, ICTU1). Execution organizations have high interest as ADM systems are used to execute the law which they are evaluated upon. A system that does not function properly will thus imply that the law is not executed properly. Furthermore, as described above, execution organizations rely on ADM systems to make law execution more efficient and cost-effective, which is necessary as they are often unable to keep up with the implementation of new laws (UWV2, BKWI1). In that sense, *policy executers* set the pace in which ADM systems are used and developed. It is important to note that large execution organizations have a large stake in developing and using ADM systems. Smaller organizations might become very dependent upon the pace of larger organizations in the future as processes become increasingly digital (ICTU1). Furthermore, software developers should be seen as independent stakeholders of the development of ADM systems as they have significant power in their influence over what certain sub-systems look like (one law or one aspect of a law) but have limited interest in the overall influence ADM system have on the social benefits system.

The application layer refers to the actual data points needed as input for ADM systems. These data points are found in basic registrations and information chains. Several stakeholders are responsible for this information upkeep, including large execution organizations, Municipalities, and Ministries. In this manner, the application layer holds a digital model representing a citizen with all data points available about them.

Lastly, the data points are transported using the described data highways. The standards for these highways are set by LOGIUS, which develops products and services for the digital government and manages standards that all government organizations use in their digital services (LOGIUS1). However, many commercial and non-commercial parties develop, within the standards, such data highways for governmental organizations, among these, BKWI for the domain of work and income. These parties have relative average interest and small power as they work at the request of the government or governmental organizations and do not influence the actual content of ADM systems. However, they act as translators from governmental information needs to information design.

System architects define the overall architecture of the digitized system to ensure a functioning ADM system (ICTU1). Overall, system architects have much power in how ADM systems are developed as they are responsible for the accumulation of the different layers, their interactions, and which environmental influences (such as the execution expert or the citizen) to include in its overall design (NORA 2021).

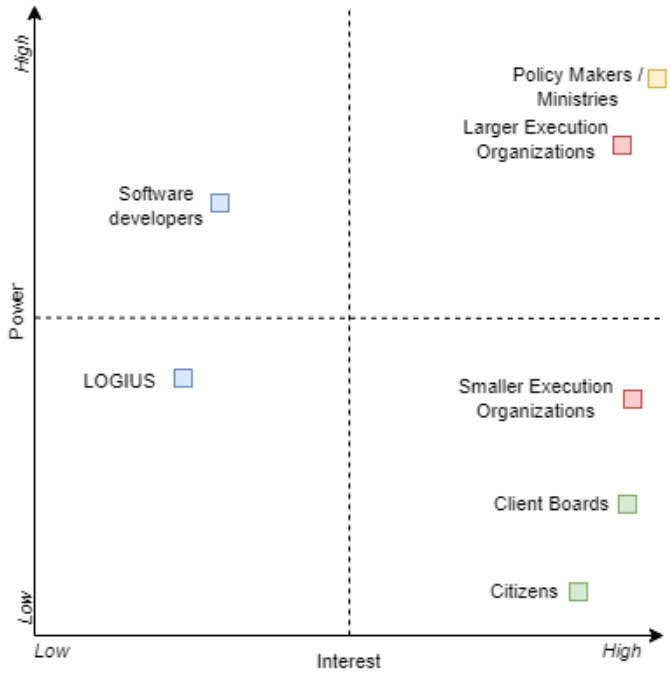


Figure 3.8: Power Interest Diagram: the use of ADM system in executing laws

The usage of the five-layer model has identified three relevant groups: policymakers, policy executors, and software developers. However, the group that might be influenced most, at least at an individual level, are citizens.
Figure 3.8 shows the different parties involved plotted for both interest and power. Currently, citizens have minimal options to influence the use of their information and how it will affect legal implications for them (M. Groothuizen 2021). One could argue that citizens have inherent power through the right to vote. However, in this specific perception, this argument may not hold as the system's structure is designed and maintained by executing organizations that are not elected. Furthermore, due to the opaque character of the current data highways and registers, it is hard to know how to object to using specific data in a certain way. Also, much unnecessary personal data is shared among governmental organizations, such as address and gender, which is not strictly necessary to execute a specific law (LA1, ICTU1). However, citizens have no option to object to it. Citizens, mainly those receiving benefits, are thus heavily influenced by ADM systems but have minimal power. A manner in which citizens are represented is via Client Boards that voice an accumulated opinion of people receiving benefits. Large execution organizations such as UWV have client boards. Furthermore, the LCR represents the interest of all Dutch citizens receiving some type of benefit in law construction and execution (LCR1). Through lobbying and clever use of media, client boards do have much more influence, and authority, than individual citizens. Furthermore, the LCR has legal influence as its founding is a result of the introduction of the SUWI law (LCR1). Nevertheless, they also have more interest as all the citizens they represent use the social benefits system and are thus more likely to be impacted by ADM systems.
After plotting all the identified stakeholders in a power-interest diagram, as shown in Figure 3.8, the following insights emerge. Namely, an in-balance between users (citizens) and developers (policymakers, executors, and software developers) of the

system, it is nearly impossible for individual citizens to influence the digital future (using ADM systems) of the government. Moreover, the actual responsibilities of ADM systems remain unclear, as execution organizations use and develop them, but Ministries are responsible for execution organizations and the development of the law. Also, a power imbalance is observed between bigger and smaller execution organizations, with UWV and the Tax Authority being very dominant in information chains and therefore having a tremendous impact on how the transition will proceed. However, perhaps Municipalities are closer to citizens in their daily life. Lastly, client boards have power in the political decision-making process via lobbying. Thus what will the law include and what not? However, the development of actual ADM systems occurs within execution organizations and thus remains harder to influence.

3.2.2 Interactions between Stakeholders

As described above, four different types of stakeholders are identified, namely, '*law makers*', by which the people in the first and second chambers and the different ministries are meant, '*law executioners*' by which the different law execution organizations are meant, '*developers*' by which software developers both internal and external from execution organizations are meant and lastly, *citizens* who are influenced by these laws and their execution. Figure 3.9 gives an overview of these types and color codes them.

Figure 3.9: Different types of people within the system

Within the process of law execution, these four types of stakeholders interact as shown in 3.10. Increasingly, execution organizations are essential in receiving and giving feedback and acting as a translator between Ministries and the citizens. *Law makers* and *law executioners* exchange institutions, both formal (new laws) and informal (restrictions on time or people, or habits) but *law executioners* and *software developers* have a socio-technical exchange in which laws are exchanged, interpreted and converged to a technical artifact, namely an ADM system. The social (law) and technical (automation) artifacts are designed by different people who do not interact directly. Even when the technical artifact is designed perfectly, still due to the structure of the law, unforeseen negative outcomes of the law may target a citizen. However, the other way around, feedback finds itself via execution organizations to policymakers. This is currently necessary as many of the social benefit laws include the method of their execution (ICTU1), which implies that if changes are needed, they need to be approved and thought of by policymakers, Ministries, and the Second Chamber, introducing a significant feedback delay within the system. Moreover, it further adds to the tendency to react fastest to incidents heavily present within media (M. Groothuizen 2021).

The interactions between the different stakeholders of the system are further tested by the influence of new and amended legislation. Executing organizations are increasingly pushed to implement new legislation while updating their outdated information systems (ICTU1, BKWI1, LOGIUS1, UWV2). Many execution organizations have minimal capacity for new or amended laws. For example, UWV has stated that often when a new coalition agreement is finalized, they have not even finished implementing all the new legislation from the previous agreement (UWV2).

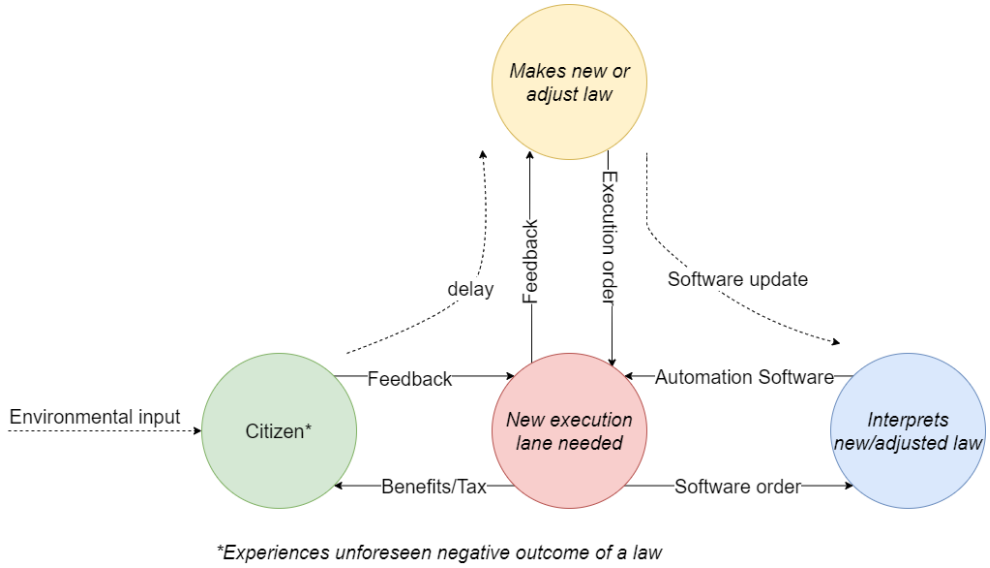


Figure 3.10: Interactions among different relevant actors in the system

3.2.3 Coding Law

The step from law to ADM software can be seen as interpreting or coding the law in a certain way. As described above, execution organizations function as translators between lawmakers and software developers. The pre-programmed decision rules coded by software developers ensure that a choice made by the administration on the interpretation of transformation from law to code is carried out in the same way in all cases (van Eck 2018). Decision rules, as stated by UWV, are explicit instructions on what to do in particular cases and make up the actual model within ADM systems (UWV 2021). However, programmers make many choices when interpreting legislation and translating rules of 'natural' language into a computer language for automated processing. Consequently, this means that after the processing system has been built, the interpretation of the legislation has been determined 'once and for all. It can also mean that amendments to legislation or interpretation are not processed in time, as was the case in the Wajong harmonization (Rijksoverheid 2021), when clients received too few benefits because of a problem with the guarantee amount. Writing decision rules can, therefore, almost be seen as formulating policy. This programmed processing system cannot make an ad hoc decision on a single case. The ADM system has rules for all similar cases and can, therefore, not deviate on a case-by-case basis. This method of arriving at accurate instructions makes the software developers make normative choices. Any form of vagueness or discretionary room for execution experts is eliminated in writing such pre-programmed rules (Zouridis et al. 2020). Such techniques are already employed at UWV in their use of STP, which completely automatically assesses whether somebody is eligible for WW benefits, whereafter the money is transferred automatically too (UWV2).

An example of difficulties experienced in pre-programming rules for automating benefits is distinguishing between complex and easy cases. A system can process an 'easy' case by straightforward subsumption of facts under rules. Is your income not too high for this benefit? Do you have a right to this insurance? Easy enough. However, what happens when multiple benefit schemes intersect and influence each other? One would argue that civil servants should process these cases to ensure that the client is not negatively impacted. Nevertheless, it remains hard to determine what to classify as complex and straightforward cases, as much of the complexity originates in the interaction between the different laws and execution organizations. In the Dutch system, the insight is that 80% of the cases are straightforward, and 20% are complex (UWV2). Unfortunately, a paradox is visible

as people's problems become more complicated (low income, disability), and the system becomes more complex, while it should be more straightforward for those people (BKWI1). Moreover, people's life courses have diversified tremendously over the years. Thus the decision rules should be future-proof or regularly updated to deal with and move with the complexity in people's lives. The current social security system was built when specific life events were far more predictable. Thus, if ADM system is the translation of the law, do these systems have the correct rules to identify a complex case? Moreover, are these rules updated often enough, as the definition of a complex case may very well alter over time. Often, mistakenly, the assumption is made that a technological system such as an ADM system can be seen in a vacuum from the development of the larger social system it operates in. This is a common developer mistake in which technological systems are limited to technical components, and '*politics*' are separate. However, the technical design of the automation of laws is inherently part of the law-making system as 'in a technological system, organizational form follows technical function, but technical function follows organizational form too' (Hughes et al. 2012). In that sense, developers are law coders who might have difficulty interpreting a domain outside their expertise. Software developers often do not have expertise in the law and policy (Leveson and Weiss 2009).

Automation is often seen as a manner to increase change capacity and lower the backlog at execution organizations (Tweede Kamer 2020). However, this implies reusing and sharing information which affects legislation as linking files leads to harmonizing laws and regulations (Tweede Kamer 2020). Due to old legacy systems, large backlogs, and minimal change capacity, laws are often developed parallel to or almost in service the information system with which the law must be implemented (ICTU1), which implies replacing vaguer terms with unambiguous terms. Expert judgments are gradually removed from the automated enforcement of legislation as the discretionary room becomes smaller. Different execution organizations think along with those new policies to achieve good and easily digitizable laws and regulations (UWV 2021). However, due to the increased complexity of the system and the trouble of implementing new policies and laws into the existing information system, the priority is digitizability. Consequently, the reduced discretionary room may lead to digital rigidity (Bovens and Zouridis 2002). Citizens must be allowed to draw attention to specific circumstances that do not fit within the existing algorithms and may influence the outcome of a decision. For this, a certain degree of discretionary space remains necessary. Also, past research indicates that it has become increasingly difficult to 'test' the decision rules present within ADM systems to verify whether a decision was just or not (van Eck 2018, Kafka Brigade 2022).

3.2.4 Interactions in the Law

The socio-technical system is characterized by interactions among the different types of stakeholders but also between laws and information needed to execute these laws. The Dutch social welfare state is based on the exchange of financial resources (money) and data about the rights and obligations of individual citizens to make (automated) decisions on benefits provision. This data is exchanged among different execution organizations as shown in the technical system description (van Eck 2018).
The increased complexity, over the years, within the social benefits system, may not necessarily only be due to the introduction of ADM systems but, in essence, be more due to the complexity of the legislation (M. Groothuizen 2021). ADM systems are merely the translation of agreements made in the law. Unintended consequences or the emergence of harmful effects of an implementation are not exclusive to ADM systems. Individual laws also fail because of causes outside of automation (Roots

2004, Dilulio Jr 1994). Nevertheless, as the agreements made in the law are translated into ADM systems, these mistakes or disproportionate situations are included in these systems too. Thus, errors can occur in an ADM version of systems just as much as in an analog version. However, one could argue that the implications of an automated law failing or erring implies a much larger number of clients being impacted (van Eck 2018).
Specifically, citizens using several social benefit schemes may find it hard to estimate the effects of a change in a law on their situation (BKWI1, UWV2). Laws affecting citizens are often fragmented across Ministries and implementing organizations and do not always consider their effect on each other. This is further exacerbated by the strategy of Ministries of reacting to incidents, partly due to media and political pressure, in making laws and the ambition to please many different groups in society (UWV3). Consequently, many transitional arrangements are needed to spare existing users of legislation (UWV2) even in simplifying regulations. Often policy remains zigzagging due to political pressure (van der Vlist en Dick Heerschop 2020). Old schemes will remain in effect for existing users, with the result that different groups will continue to exist side by side for years to come, and so will the accompanying information systems making it increasingly difficult to manage and oversee these systems (van der Vlist en Dick Heerschop 2020). Consequently, policies and laws are often vague, with many exceptions. Moreover, stacking of laws is a common problem for citizens (van der Vlist en Dick Heerschop 2020, C.E.G. van Gennip 2022, M. Groothuizen 2021). This is the phenomenon where the combination or interaction of different social laws has a disproportionately negative effect (M. Groothuizen 2021). The increasing number of amendments to legislation by the Second Chamber also contributes to complexity and rules that are difficult to explain to citizens. This lack of explainability makes it hard for citizens to understand what is expected of them, leading to the underuse of certain social benefits schemes (M. Groothuizen 2021). Furthermore, it is increasingly difficult for execution professionals to properly understand legislation which is further exacerbated by the use of ADM systems which have limited the opportunity to find a customized and fitting solution for clients that fall outside of the 'standard' cases (UWV3) (M. Groothuizen 2021). To ensure that laws are executable, implementation tests are done by the execution organizations on proposed policy measures. However, these tests are not always done, or the information in them is presented in a more rosy way than it is according to the shop floor (UWV1) (M. Groothuizen 2021). In addition, there is hardly any information available about the feasibility of legislation and regulations for citizens. Tests are merely done on whether the execution organization can execute the law and not what it would mean for a citizen (M. Groothuizen 2021, van der Vlist en Dick Heerschop 2020).
When stacking of laws occurs, sometimes clients purposefully stop their rent subsidy as they are ordered to pay it back for years, leading to stress (W1, W2). They would rather not have the financial support than the stress of a possible payback notice. Many receivers of social benefits have very irregular incomes, meaning determining benefits is challenging. Other instances of this stacking of laws also influence insurance physicians who purposefully disapprove clients for work capacity as the law, and its execution has such hard limits in them and differences between different versions of laws are substantial (UWV2, IP1).
Researchers concluded that the allowance system often puts vulnerable groups in financial trouble, stating that the welfare state makes vulnerable groups even more vulnerable. The highly opaque patchwork of regulations aimed at income policy has increasingly become vaguer and inexplicable (Marike Stellinga).

3.2.5 Monitoring & Evaluation

The social benefits system's evaluation is based on the evaluations of either the functioning of chains, whether they are working as planned, or the execution of in-

dividual laws, whether people are using job coaches, and whether the funds go out on time (UWV1, UWV2)? Which is similar to the execution test. The intersection between different laws is often not evaluated or tested for executionability. Furthermore, it might even be the question if such evaluations are exhaustive as the highly interconnected system of basic registrations and chains is hard to audit, according to NOREA. One fundamental problem is determining whether the entire chain is in view before assessing it (Blankena 2013).
UWV mentions how citizens experience concurrence and transition situations between different laws but do not consider this in their yearly evaluation on service (C.E.G. van Gennip 2022). To ensure that different social laws are executed as envisioned, execution organizations such as UWV have yearly evaluations, but often only after five years of being operational, of different laws (M. Groothuizen 2021).
Laws are increasingly transcending ministries. Consequently, one Ministry can be responsible for the legislation while the other Ministry is responsible for the execution organization that implements this law. This structure causes ambiguity in responsibility and supervision. Often when a client gets stuck, and their situation does not match the ideal image[2], law executing institutions point at each other to find a solution or are not even aware that the client is facing problems partly due to how evaluation and monitoring is set-up (van Eck 2018). Signals about problems in the execution of laws do not always reach the right people within execution organizations, or employees do not feel safe reporting bottlenecks in their work to their supervisors (M. Groothuizen 2021). If the signals eventually reach the correct department, civil servants do not always share them with the Second Chamber because the minister could get into trouble (M. Groothuizen 2021). Furthermore, a government study found that different execution organizations report very differently about their performance (M. Groothuizen 2021) (LA1).

3.2.6 Networks & Organizations

As described in the technical system description, the use of information- and decision chains has increased significantly in the last years, consequently increasing the interdependence among different execution organizations (Loonaangifteketen 2019) making existing systems even more complex (van der Vlist en Dick Heerschop 2020). When information is made available outside the boundaries of an organization, the situation is prone to interoperability issues. For example, are the semantics of data fields equal in all government systems, or can one data point mean one thing in system A and a new thing when transported on the data highway in system B? After evaluating the current use of information chains, the call for overarching infrastructure is present (Informatiebeveiligingsdienst voor Gemeente 2022). This is also because both UWV and the Tax Authority work with outdated legacy systems, some even from before major mergers in 2002 (LOGIUS1), and their semantics on a definition for, for example, 'day wage' (C.E.G. van Gennip 2022) are not the same.
The other side of the increased networking, through chains of different execution organizations, is reducing the number of errors in the administrative process (Loonaangifteketen 2021). When organizations use the same data source, the likelihood of an error occurring in the various administrative processes is notably reduced; however, the other side of this proposition is that if the source is wrong, this is carried through to all other execution organizations. Furthermore, the interdependence and reuse of data make it difficult to set a well-founded objection to a chain decision. Even when a citizen is right, this does not always lead to reversing all consequences. For example, clients described an increase in their weekly hours and how they were consequently cut on their premiums (tax agency) and their benefits (UWV). The double recovery turned out to be unjust, but the person already was in debt restructuring when they were vindicated (W3). Meaning the decision has

2 The ideal image here would be, for example, someone applying for a WW benefit of which all relevant information is available who would not receive any childcare-, health- or housing-benefits

already taken on a life of its own as a 'given' in another administrative body, and citizens themselves must resolve the problems that have arisen.

The increased use of information chains also implies that vertically organized government organizations are increasingly working with horizontal information chains that transcend individual organizations. Such chains are often more vulnerable than the organizations that participate in them realize (LA1). Incidents have consequences for the entire chain (Informatiebeveiligingsdienst voor Gemeente 2022) due to the interdependence between organizations. An example would be if UWV makes changes to its system concerning the basic insurance polis, it would also force the Tax Authority to change its systems. Consequently, frictions between horizontal interests within an information chain and vertical interests within an executing organization are bound to occur (Informatiebeveiligingsdienst voor Gemeente 2022, Tweede Kamer 2020). Thus one of the conditions for data exchange between different governmental organizations is the support from horizontal management to cooperate (LA1). Internal processes should be adapted to serve the overarching chain processes in which horizontal interest thus trumps vertical interest.

For execution organizations often, as other priorities emerge within their organization, focus diverges from the chain towards its own organization (LA1). Many execution organizations face an immense challenge in updating their existing information systems while responding to the demand for amendments to legislation and regulations. Adapting existing systems often is no longer sufficient, and entire systems should be replaced (UWV 2021). Here, the identified dominance of some organizations would mean their vertical interest would trump the chain's horizontal interest. This makes a chain more vulnerable (LA1, ICTU1).

NOREA, a Chain Auditing working group, noticed that risk and security specialists do not sufficiently inform their management about the risks of chain automatization or ADM systems and advise to jointly manage chains, with an eye for 'the tension between vertical control from the owner and the horizontal connection between the organizations' (Blankena 2013). Thereby, the focus should be on responsibility, which would deal with vague organizational boundaries. Furthermore, another identified risk is the administration of data flows (Kafka Brigade 2022). An overall lack of overview of data streams between organizations (ICTU1) can lead to a data point leading to effects occurring outside the (execution) organization in which the data point originated. Using the described chain decisions by the different execution organizations can lead to a conclusion being reached without an institutional actor present, leading to the loss of context. The absence of context may change a data point's meaning to such an extent that legal consequences follow (Kafka Brigade 2022). The lack of overview describes the general in- and output streams and the timeliness of data, when it was last updated, by whom and why it is not logged (Kafka Brigade 2022).

3.3 DEFINING RIPPLE EFFECTS

The system description on both technical and socio-technical levels aimed to (1) describe the system associated with law automation within the social domain and (2) find a suitable definition for the term *ripple effects.* Effects often start as a small problem in one specific place but cause more significant and often unforeseen problems further down in the system. Important to note is that the definition was specifically constructed to define the phenomenon in the social benefits system. The term amplified refers to both the increased scale of impact and the duration due to automation. Within this system, often, ripple effects are undesired, meaning they were unplanned and resulted in a negative outcome (Leveson 2016).

The definition of ripple effects is determined to be:

"the emergent amplified effects of social policy"

The system description is summarized within Figure 3.11. The meaning of the several * within the image are explained below:

* Citizens experience the interaction of laws (due to the stacking of laws) which leads to unforeseen negative effects of interactions. Due to the manner of evaluation and monitoring (law, chain, or organization level), these issues do not (always) reach execution organizations. This is exacerbated by the scattered knowledge of social laws among departments and organizations.

** Long feedback loops emerge in law execution due to the fact that policymakers solidify how laws should be executed. Combined with the tendency to react specifically to incidents and please everyone (using exceptions and transitional agreements), the social system has grown to be increasingly complex and opaque.

*** Normative decisions are made by software developers at execution organizations with risks of translation mistakes due to limited domain knowledge. Furthermore, the discretionary room is reduced, and a tendency to make laws in service of automation arises.

**** The increased use of information chains and basic registration has made the socio-technical system a network of information streams, reducing mistakes and streamlining decision-making. However, when mistakes are made, the implications are significantly larger. Furthermore, using these networks implies that vertically organized execution organizations should work in service of a horizontal chain (in which some organizations are dominant) which might lead to tensions.

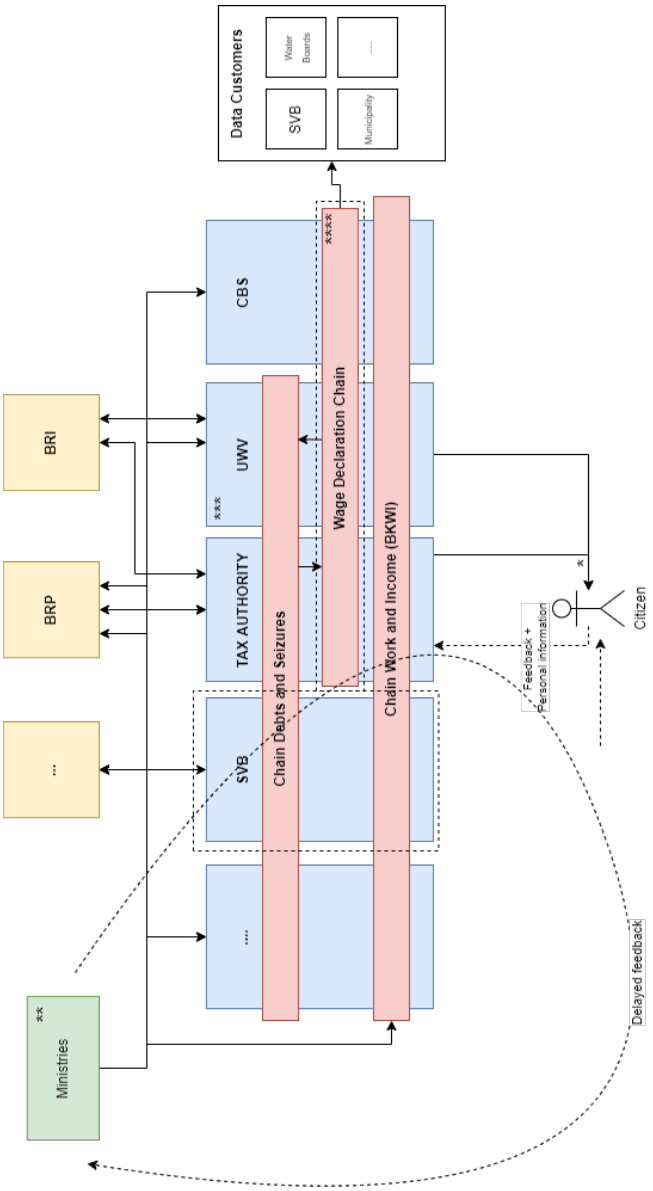


Figure 3.11: Display of Socio-Technical Social Benefit System associated with Law Automation

4 SYSTEM SAFETY

This Chapter introduces relevant system safety concepts using literature research. First, the necessary ontology is laid out as a basis to answer the second sub-question: How can ripple effects of law automation be described from a system safety perspective? As mentioned in Chapter 3, ripple effects from law automation are defined as 'the emergent amplified negative effects of opaque social policy. The primary purpose of the second sub-question is to understand *why* ripple effects emerge.

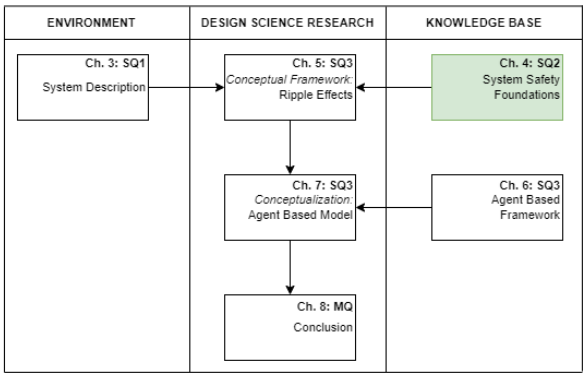


Figure 4.1: Research Strategy - System Safety Foundations

Algorithms, and thus Automated Decision Making (ADM) systems using them, are characterized by the The Netherlands Scientific Council for Government Policy as being a *system technology*, similar to for example the combustion engine. These types of technology are characterized by their complex and unpredictable nature (The Netherlands Scientific Council for Government Policy 2021). Thus, focusing on how this specific technology impacts society is vital instead of solely focusing on its features. Historically, new system technologies created new tasks for the government to ensure that its development and use aligned with public values. Public values have been, in a way, recorded in the principles of good governance (Pennarts 2008). Execution organizations should act by these principles when executing the law, either with or without ADM systems. Among these ten guiding principles are (1) explainability, (2) understandability, (3) equality, (4) do no harm, (5) proportionality, and, (6) legitimate expectations. Many of these mentioned principles may be at risk with implementing ADM systems when done unsafely.
Introducing a new system technology often leads to developing a new 'policy infrastructure' to ensure that this innovation is used safely (The Netherlands Scientific Council for Government Policy 2021). As ADM system can be complex and unpredictable, as shown by the emergence of ripple effects, a new policy infrastructure is needed. System safety lessons are explored to explore whether this lens may be used to design safe ADM systems. For some system safety definitions or factors, examples are given to illustrate their relevance.

4.1 SYSTEM SAFETY CONCEPTS

A common language is established before using system safety principles to interpret the social benefits system.

4.1.1 Complex Socio-Technical Systems

As introduced in Chapter 3, a socio-technical system, as perceived within this research, is defined by Baxter and Sommerville (2011) as :

> (1) has interdependent parts, adapts to and pursues goals in external environments;
> (2) has an internal environment comprising separate but interdependent technical and social sub-systems;
> (3) has equifinality, which means the system's goals can be achieved by more than one means, implying that design choices can be made during development.

Socio-technical systems, however, are becoming increasingly complex Leveson (2016). This increased complexity is partly explained by the increased use of software in systems. Where hardware systems have physical constraints and adhere to laws of nature, software systems do not have those constraints. For example, information may disappear, multiply or mutate. Safety has a broader scope for software than failures in that it includes dysfunctional interactions among system components (Leveson and Weiss 2009). These interactions contribute to the number of unknowns in a system. A simple system, having a small number of unknowns in its interactions within the system and with its environment, becomes interactively complex when the level of interactions reaches the point where they cannot be comprehensively anticipated, planned, understood, and guarded against (Leveson and Weiss 2009). Different types of complexity can be observed, namely, (1) interactive, (2) dynamic, (3) decompositional, and (4) nonlinear, which respectively are driven by (1) interactions among components, (2) changes in the system of time, (3) the structure of a system not being consistent with the functional decomposition and (4) cause and effect not being related directly or obviously.

If the Social Benefits System is taken as an example of such a socio-technical system with several sub-systems, the larger system is the entirety of all social benefit execution in the Netherlands. Several sub-systems here could be Uitvoeringsinstituut Werknemersverzekeringen (UWV), the Tax Authority, and Social Security Bank (SVB), which are made up of different institutional components. A commonly accepted definition of institutions is the formal and informal rules that organize social, political, and economic relations (Baxter and Sommerville 2011). Formal laws are then a product of the ADM system deciding on benefit time and amount, which is a technical system, and the re-integration trajectory, which is a social system. All sub-systems have a system goal that should contribute to the higher overall system goal. Thus in the sub-system of the Werkloosheidswet (WW) law, the combination of sub-system goal 'height and duration of benefit determination' and 're-integration trajectory' make up the sub-system goal of the WW law 'providing financial support to laid-off and ensured people while finding a new job'.

4.1.2 Safeness

Dobbe (2022) defines safety within systems as

> 'socio-technical and emergent system properties requiring integral approaches to instantiate these across the design and operation of a system as well as its institutional context'

This definition is shared by Leveson (2016), who defines it as

> 'an emergent property of systems and states that 'safety can be determined only in the context of the whole.

Safety, therefore, can only be assessed by considering the broader socio-technical system, all its components, technical, social, or socio-technical, interactions between technological artifacts and operators, dynamics which describe the behavior of complex systems over time, and environment[1]. Consequently, emergent properties can only be understood when perceiving all social and technical components and their interactions over time. Emergent properties are described as properties that are not the sum of their parts but emerge from component interactions (Leveson 2004). Leveson et al. (2009) actively takes in another stance than other existing theories surrounding accidents, such as the Normal Accident Theory or High Reliability Organizations. As Leveson et al. (2009) states that safety and reliability are not the same thing. A system can be reliable but still unsafe and vice versa. HRO theory actually does define it as equivalent (Roberts 1990). This difference may be due to how reliability is defined within technical systems, namely, 'the probability that a component does not satisfy its specified behavioral requirements over time and under given conditions' (Leveson et al. 2009). In this sense a system can be extremely reliable but still produce accidents.
Formalization and computation are thus insufficient to capture how a system will behave in practice. System safety aims to 'prevent foreseeable accidents and minimize the effects of unforeseen ones'. This, thus, does not matter that nothing unforeseen should happen. However, a system becomes unsafe when component failures, external disturbances, and dysfunctional interactions among system components are not adequately handled after they happen (Leveson 2016). Adequate handling of an external disturbance could be a car before a self-driving car unexpectedly slows down and a safety constraint stating that a minimum distance to the car should be kept instead of driving at the indicated speed.

4.1.3 Accidents

An accident is 'any undesired and unplanned event that results in a loss' (Leveson 2004). As stated above, safety heavily depends on how a system handles foreseen and unforeseen accidents. Before the large-scale implementation of software within systems *accidents* were often perceived as the result of single or multiple component failures (Leveson and Weiss 2009). This perception assumes a certain extent of causality. A component malfunctioning leads to an accident. For example, an execution expert makes a calculation mistake in the amount of benefit someone has a right to. This assumption follows that high component reliability will also lead to fewer accidents. Therefore, in the past, the logical approach to preventing such accidents was to 'provide redundancy or enhanced component integrity, thereby reducing the probability of component failure or the impact of the failure on the overall system' (Leveson and Weiss 2009).

Due to the rise of the use of software within physical systems and system components, a different type of accident has been identified, namely the *system accident*. In these types of accidents, the individual components operate as specified, or at least do not fail, but their combined behavior leads to a system loss or *system accident*. Such accidents thus arise from the interactions within the system and are unexpected as the interactions are unforeseen. Accidents result from complex dynamic processes, not simply chains of failure events. Furthermore, significant accidents arise from a slow migration of the entire system toward a high-risk state. Therefore, there is a need to control and detect this migration.
The existence of these accidents inherently debunks the assumption that reliable systems are also inherently safe. A system may have very high reliability but still produce reliably biased or harmful results or have catastrophic accidents (Leveson and Weiss 2009). *System accidents* are defined by Leveson and Weiss (2009) as

1 The system is the part that is being studied, while the environment is the remainder that lies outside the boundaries of the system that the system interacts with.

'losses that arise from dysfunctional interactions among system components in which no components have failed.'

Crashing on Mars
An accident occurred in the landing of a spacecraft on Mars. In the landing of Mars Polar, the software turned off the spacecraft descent engines prematurely, 40 m above the Mars surface (Euler 2001). However, the software did satisfy all requirements provided to the software developers. In this case, the software developers were not informed about the possibility of the landing leg sensors prematurely emitting signals before the spacecraft had reached the surface (Leveson and Weiss 2009).

4.1.4 Control Structure

As stated in Section 4.1.2, safe systems have a manner in which to handle unforeseen interactions and circumstances in the form of safety controls. In some systems, safety or the lack thereof is thus not a 'reliability problem but a control problem' (Leveson 2016). Leveson (2016) states that perceiving safety as such allows for a more effective way of designing safe systems, specifically socio-technical ones.
A method specifically set up for this purpose is STAMP, which focuses on enforcing behavioral safety constraints instead of preventing failures using a safety control structure. Leveson and Thomas (2018) defines this as a system model composed of feedback control loops that enforce constraints on the system's behavior. STAMP consists of three main concepts, namely, (1) safety constraints, (2) hierarchical control structures and (3) process models as shown in Figure 4.2.

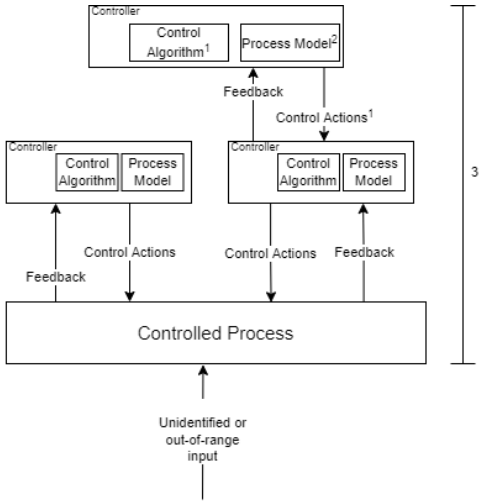


Figure 4.2: Safety Control Structure

Safety constraints are how unexpected events are dealt with and limits on how the system can achieve its goals. A control algorithm and a process model are used to enforce these constraints (Leveson and Thomas 2018). The overall hierarchical control structure ensures that all individual controllers' safety controls are enforced and coordinated. In that sense, hierarchy does not necessarily entail a top-down approach, but such a structure would ensure that no two conflicting safety constraints may be enforced simultaneously. The control algorithm represents the controller's decision-making process which determines which control actions to provide. For a human operator, these might be all the operating procedures available. The process model represents the controller's perception of the system upon which decisions are based, which should be continually updated by feedback from the controlled process. This is called a mental model within system safety (Leveson and Thomas 2018) for a human operator. An effective process model should at least meet the following conditions.

1. The goal: the safety constraints that the controller must enforce;
2. The action condition: the controller must be able to affect the state of the system;

3. The observability condition: the controller must be able to establish the state of the system through feedback, observations, and measurements;

4. The model condition: the controller has a model of the process.

Specifically, the model condition implies that a process model holds an internal belief about the process it is controlling and other relevant parts of the system's environment. In an open system, the system inputs and outputs cross the system boundary. It is specifically necessary to update process models using feedback on the controlled process as the environment, all components that are not part of the system but do influence its state, the system operates in might influence its state. A system's state is the relevant properties describing the system at any time. For example: in an air transportation system, the number of passengers at a specific gate. For human operators, process models are called mental models (Leveson and Thomas 2018).
As systems have become increasingly complex. Many controllers are needed to keep a system safe. Also, these increasingly complex socio-technical systems can be modeled as a hierarchy of organizational levels. Here, the higher levels are more complex than the ones below. Within and among these levels, behavior may emerge. Therefore, hierarchy is essential in a safety control structure. It indicates control and authority within the system, and higher-level controllers have authority over the lower-level controllers. Again, this structure is more complex for open systems as there is a need for communication with components outside of the system influencing its state and vice versa.

4.2 SYSTEM ACCIDENTS: COMMON FACTORS

However, why do accidents happen, even with a safety control structure? Accidents occur when the control structure or actions do not enforce safety constraints. This may be due to a process model being inaccurate, a faulty or incomplete hierarchy, or the lack of or faulty safety constraints. Leveson (2016) states that there are a few common factors present in many system accidents that may emerge due to or cause a faulty or incomplete control structure. Below are six of these common factors, and examples are provided.

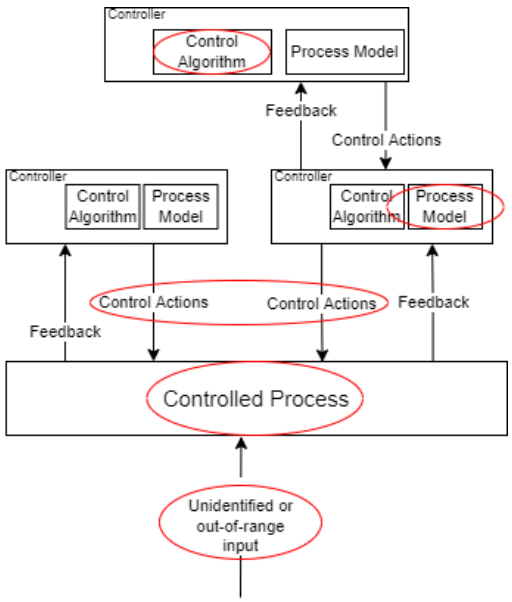


Figure 4.3: Faulty Safety Control Structure

4.2.1 Asynchronous Evolution

Asynchronous evolution is defined as a system in which one part changes without the necessary changes in other parts' (Leveson 2016). Thus, changes to sub-systems, albeit carefully designed, do not consider their effects on other parts of the system. Figure 4.3 shows the many places where common factors for accidents may occur. *Asynchronous evolution* occurs, for example, when a process

model is updated, but the associated control algorithm is not. This may occur due to the inaccurate assumption that systems are static while they rarely are (Leveson and Thomas 2018). More often, systems are continually adapting. Therefore, to ensure asynchronous evolution does not occur, the entirety of the control structure should, in a way, be future-proof. However, this is very hard to realize as safety constraints often lag behind technology. This is perceived in legislation surrounding privacy and algorithms in Europe (Raad van State 2018). Safeguarding against asynchronous evolution, or in a broader sense adopting a control structure, does not mean that the system cannot contain any redundancy. If a certain system part is updated, the other parts should be updated accordingly. Moreover, these different system parts should be coordinated using a hierarchical structure. However, (Leveson et al. 2009) and (Perrow 1999) both state that redundancy may be limited in effectiveness as it can introduce new complexity and encourages taking risks.

Friendly Fire
An accidental shoot-down of two U.S. Army Black Hawk helicopters by two U.S. Air Force F-15s in the no-fly zone over northern Iraq occurred because the different pilots could not communicate. The newer F15 models were updated with jam-resistant radios; however, it was not anticipated that these radios could not communicate with the older radios in the Black Hawk helicopters (Leveson 2016).

4.2.2 Overlap

Overlap often occurs due to a faulty or incomplete control hierarchy as shown in Figure 4.3 with two controllers constraining the process with no central control. Overlap is defined as a situation where multiple controllers, such as laws or ADM systems or law execution professionals, control the same process or processes with common boundaries. In these overlap areas, the potential for ambiguity and conflicts among interdependent decisions arises (Leplat 1984). Both types of overlap are shown in Figure 4.4. A controller is a mechanism by which the difference between a system's actual value and the system's desired value can be influenced (Leveson and Weiss 2009). The left side of the image shows how two controllers may give conflicting signals to the same controlled process leading to unforeseen interactions. An example could be two managers managing the same employee and both giving them tasks without consulting each other. The right side of the image shows how if processes do not have clear boundaries or shared boundaries, unclarity on responsibilities between different controllers may emerge.

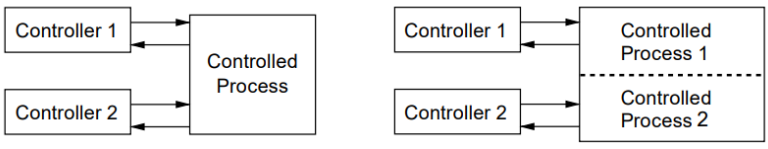


Figure 4.4: Overlap taken from Leveson (2016)

Waiting until the cows come home
An iron and steel plant was often experiencing accidents occurring at the boundary of the blast furnace department and the transport department. These accidents arose because a signal informing transport workers of the state of the blast furnace did not work and was not repaired because each department was waiting for the other to fix it.

4.2.3 Software Requirement Error

If a safety control action or process model is incorrect, often this is due to a software requirement error. *Software errors* are never random but due to misunderstandings or mistakes made or translated by the software developers (Leveson and Weiss 2009). If the specified behavior is unsafe, it does not matter if the software is very reliable. It will then, *reliably*, produce unsafe situations. The basis of such accidents are almost exclusively flaws or errors in the *software requirements* and not necessarily the programming itself (Leveson and Weiss 2009). This further illustrates the insight from Chapter 3 in which it became apparent how a technical system or software application cannot be seen in a vacuum from the political decision-making process prescribing the requirements.

Furthermore, software requirements, as do laws, include assumptions about the controlled process and its environment. Often harmful scenarios appear when those assumptions prove incorrect (Leveson 2016). Within system safety, the importance of the role of software is underwritten as it is described as controlling interactions among system components and thereby describing and dictating the overall system (Leveson and Weiss 2009). In this sense, software requirements errors can lead to many accidents as they may lay the basis for incorrect, late, early, or no safety constraints.

Therefore, designing ADM systems is challenging and requires new skills and expertise for policymakers (or other domain-specific experts) and software developers. Moreover, there is a need for deep domain-related knowledge to ensure that ADM systems make sense (Janssen and Kuk 2016). The programmer or software developer may lack specific knowledge and experience about the context, even though this knowledge is essential to reach an informed decision. Therefore, adequate feedback on and within (the design process of) ADM systems is crucial (Peeters and Widlak 2018).

> **Back to Mars**
> *Returning to the crashed Mars Polar Lander. A software requirement error due to incompleteness led to the requirements, not including the necessary information about how the noise generated with landing would interact with the landing leg sensors. A requirement should have been that the vehicle should ignore inputs from the sensors when the spacecraft is still too high above the Mars surface (Leveson 2016). This illustrates how an accident can occur even when the software requirements are met because of faulty or incomplete requirements. The fact that noise may occur on Mars must have been outside of the knowledge domain of the software developers, and when not told, this factor was not included by them.*

4.2.4 Inaccurate System Boundary

Leveson (2016) describes how a hazard, a certain system state, and a particular set of worst-case environmental conditions will lead to a system accident. An accident can never be seen in a vacuum from its environment. Therefore, potential future accidents might not be foreseen due to wrong assumptions about the system's environment or how individual systems influence each other when they are, wrongly, not part of a larger hierarchical structure, as shown in Figure 4.3. Furthermore, the system boundary must reach beyond only a technical artifact, like an ADM system, as they are affected by their context and its associated bias. Moreover, because the technical artifact interacts with a human operator creates new possible unforeseen interactions to provide safety controls for (Dobbe et al. 2018).

By drawing a very narrow system boundary or not including the environment as an important source for disruption, safety focuses on the component level instead of the system level. For example, when working with ADM systems, a risk for cyber-attacks or biases may be very logical to address within one technical artifact but does not include how the larger overall system may migrate towards a state of high likelihood for system accidents.

Traffic Control
Within an air traffic control system, an accident could be a collision between aircraft. Therefore, a designer would want to ensure a minimum distance between aircraft. However, the designer of an airborne collision avoidance system may have control over the separation distance but not over other factors that determine whether two aircraft that get close together collide. These factors could be visibility, weather conditions, or whether the pilot is absentminded. Ideally, these factors are under the control of other sub-systems, such as air traffic control in directing aircraft away from poor weather conditions. However, these factors should be identified as influencing the systems state (Leveson 2016)..

4.2.5 Mental Models

As stated above mental models can be seen as the human equivalent of a process model (Leveson and Thomas 2018). Such models are used by people to organize information into patterns and are often built up of personal experiences and, in a way, portray how someone perceives the world and how it works (Kemp and O'Neil 2018). Logically, as the system in which a person operates changes, so must the mental model of the operator (Leveson 2016) as shown in Figure 4.5. Figure 4.5 shows how systems develop over time due to environmental influences. The operator's model must be updated accordingly using feedback from the actual system. Sometimes this feedback is not there, comes too late, or might be incorrect due to the incomplete feedback structure or experiencing a time lag.

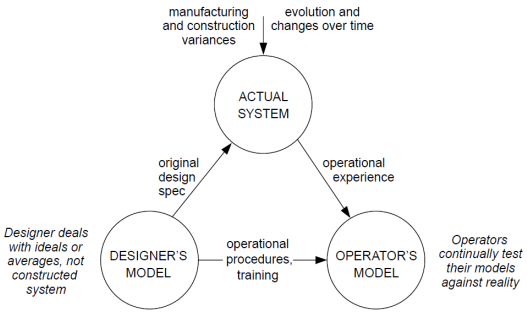


Figure 4.5: Mental Model Development (Leveson 2016)

As stated in Section 4.2.3, software requirement errors are often due to a lack of domain knowledge leading to incomplete requirements. Thus, in a way, wrong mental models may be a source of these errors. Furthermore, this effect may be a vicious cycle if vise versa, the operator of the, for example, ADM system now does not accurately enough know how this automated system works and, in turn, has a wrong mental model about it (Leveson and Weiss 2009). Therefore, organizations and the experts working there, using ADM systems, should, individually and collectively, build mental models of the decision support systems they work with (Van Kleek et al. 2018) as they may be more nuanced evidence than the ADM system's raw yes/no response. The build of such mental models may also allow for spotting situations where the ADM system output is expected to be wrong or in need of further examination, Leveson (2011) stresses the value of a human operator. However, achieving such feedback within a highly digitized system with a significant knowledge gap may be hard to achieve.

I did not recognize your Picture
Returning to the friendly fire incident described above. The mental models of the

F-15 pilots and the actual process state differed significantly. They thought the helicopter would look like, and what it looked like differed. The wrong mental model was explained by the training the pilots received. The training pictures used for helicopter recognition were all taken from the ground up and had not included the specific Black Hacks they encountered. Taking into account the mental model of the F-15 pilots, the decision made is not strange, but it led to an accident partly due to a wrong mental model about the process.

4.2.6 Coupling

A system is tightly *coupled* if fast-paced processes can in no way be isolated from the rest of the system, the system cannot continue to operate safely (Perrow 1999). Leveson et al. (2009) defines coupling in terms of 'degree and type of interdependence among system components' and how behavior of one component has the potential to impact the behavior of other components. A tightly *coupled* system is highly interactive, with each part linked to many other parts and these parts being dependent upon each other (Perrow 1999). Consequently, unexpected behavior spreads fast to other parts of the system, affecting the status of other parts and leading to accidents if the system does not have an adequate control hierarchy, meaning. A tightly coupled system creates more potential interactions, which may lead to unexpected effects (Leveson and Weiss 2009) and makes it harder to foresee how they would lead to accidents. Often, this happens when processes are instant, there is little slack, and processes work in a chain Leveson (2016). System accidents are a result of unplanned interactions among the coupled components. Complexity and how tightly a system is coupled are often related. As mentioned, complexity increases with software such as ADM systems.

Three Mile Island: Careful It is Wet
The Three Mile Island accident was a near meltdown of a nuclear reactor in which over 30,000 gallons of radioactive water escaped, and a complete meltdown of the reactor was narrowly averted. The accident was mainly due to unexpected behavior quickly traveling to and affecting the state of other parts of the system. A human error in repair caused a small amount of water to seep into the wrong system, which caused a safety system to shut down the main pumps. However, the backup pumps did not turn on as maintenance men forgot to re-open their valves after servicing them. The warning light that should have alerted the workers was not seen, as a repair tag was hanging in front of the light.

This example also includes wrong mental models about the system's behavior and the assumption that the backup pumps would work. However, the accident's severity was mainly because the unforeseen behavior could quickly influence the rest of the system. The highly coupled characteristic of the system made the accident inevitable (Leveson et al. 2009).

5 CONCEPTUAL FRAMEWORK: RIPPLE EFFECTS FROM A SYSTEM SAFETY PERSPECTIVE

This Chapter focuses on developing a conceptual framework for ripple effects using a system safety perspective, answering the second sub-question: how can ripple effects of law automation be described from a system safety perspective? Chapters 3 and 4 are used as input. Two case studies are used to understand the social benefits system from a system safety perspective. For these case studies, a Systems-Theorectic Accident Model and Processes (STAMP) approach explores whether system safety is suitable for interpreting the system. Interpreting the system description using a system safety lens set up in Chapter 4 allows us to understand why ripple effects emerge in the social benefits system. The Chapter finished with a conceptual framework interpreting ripple effects which enables the coupling of theories fostering insights in practical situations, namely system safety and the occurrence of *ripple effects*.

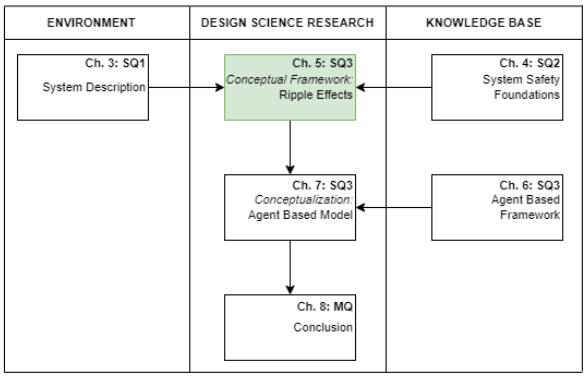


Figure 5.1: Research Strategy - Ripple Effect Framework

Within this Chapter the terms, *wrong*, *faulty* and *incomplete* are used to describe different control structure components. It is important to note that these terms are used within the context of the system safety lens and that these normative labels can only be assigned with hindsight. Thus certain components turn out to be wrong, faulty, or incomplete once they are evaluated. It is important to understand *why* certain assumptions or models used were wrong to ensure that, in the future, they can be more successful (Leveson 2016).

5.1 SAFETY: SOCIAL BENEFIT SYSTEM

Safety, as described in Chapter 4 was broadly described. However, in Automated Decision Making (ADM) systems, especially in governmental systems like the social benefits system, safety is vague (Dobbe et al. 2021). Because what defines a "safe operating space"? Can we define unsafe situations for citizens, or is this concept inherently subjective? How do 'we' know, experience, or guarantee that something is safe, and a question underlying this is, who is 'we'? Ideally, an ADM system (for the use of law automation) would have a concrete definition of what it would mean to be safe. However, current design processes focus on security as a criterion of engineering design, operational conditions, or end-user experience (UWV 2022a, Loonaangifteketen 2021). Because safety is inherently vague, such characteristics are translated into operational conditions and criteria such as 'did you receive your benefits in time?' but not 'does the benefit help you be financially secure?'. The

vagueness of criteria begs whether an evaluation of safety is even possible in the current social benefits system if execution organizations assess for the criteria.

5.2 SYSTEM ACCIDENT: RIPPLE EFFECTS

As in many reports mentioning emergent behavior surrounding law automation (W1, W2, W3), not a specific technical artifact malfunctioned. It may be that the processes driving the emergent phenomenon of ripple effects are not necessarily components of the system that have individually malfunctioned. From this perspective, a ripple effect, *the emergent amplified effects of social policy*, may thus actually be a *system accident*. Therefore, it is imperative to find the driving factors for this phenomenon. As shown in Chapter 4, an inadequate control structure may lead to common factors involved in system accidents, such as overlap and asynchronous evolution. System accidents specifically describe a loss. Ripple effects, in their current definition, do not describe this. However, the Dutch social benefits system is based on rights and duties. Meaning that although the effect may emerge positively, logically, when perceiving monetary effects, as it is the focus of the following case studies, the effect will be reversed. The funds will be reclaimed, which is an example of a negative emergent effect. The emergence of the effects and the fact that they were unplanned indicate that ripple effects work out harmfully for citizens. This is in line with the general phenomenon where citizens feel the brunt of the consequences of automation.

As described in Chapter 4, to more complex a system becomes, the harder it is to control safety adequately. The social benefits system is described as impossible to oversee (ICTU1) (van der Vlist en Dick Heerschop 2020, M. Groothuizen 2021, Leveson 2016). The system is characterized by all the different types of complexity as introduced by Leveson (2016), namely (1) structural, (2) nonlinear, and (3) dynamic complexity. Assuming the system's function is to ensure citizens' livelihood using benefit insurance and services, its function is inconsistent with its structure. Cause and effect are not always related, as is illustrated by ripple effects, and the system and its environment continuously change over time. Not only because society changes, but so do laws.

As the complexity of systems, with a significant scale of impact on citizens' safety, increases, a systemic approach to develop and operate safe and sustainable systems is functional (Rasmussen 1997, Renn 2017). A proactive systems approach, as introduced in Chapter 4 accounts for the system's interactions with its environment and subsystems, thus considering the system as a whole instead of a sum of its parts (Rasmussen 1997, Leveson 2011). Systems technologies with the potential to be as disruptive as ADM systems should be designed for safety both focused on their life cycle (changes over time) and environment (Klinke and Renn 2004, van de Poel and Robaey 2017).

5.3 CASE STUDY 1: THE HARMONIZED WAJONG LAW

The Harmonized Wajong Law: Work Must Pay (or not?)
The introduction of the harmonized Wajong law aimed to ensure that an increased amount of worked hours should result in a higher income. People classified under the Wajong require extra support to participate equally in society, as the capacity to work and earn are not always equal (Iederin 2020). The amount of Wajong benefits is calculated using a function settling income from work with benefits. The new Wajong bill in-

cludes a transitional provision for old versions translated as a guarantee scheme, meaning Wajong receivers are guaranteed at least the amount they received under the old law. The Wajong Law includes provisions for people with disabilities to adapt their workplace and income support to acquire an equivalent income. Concretely, the claim was made that for every additional euro earned by a Wajong recipient, this citizen would at least retain 30cts of this euro.

Before implementation of the law, several interest groups filed complaints resulting in five amendments to the law (Eerste Kamer 2020). The interest organizations, including the National Cliënt Board (LCR), Federation of Dutch Trade Unions (FNV), and Iederin, a network for chronically sick or disabled people, were initially lobbying for a change in the income formula used under the new Wajong law. The earlier mentioned guarantee scheme is incorporated into the formula and proves complex and even harder to communicate to civilians receiving benefits adequately.

The Harmonization of the Wajong law also introduced a new income regulation. For Wajong benefit receivers who work with wage compensation - less wage by an employer for performing function with supplementation via Wajong benefits - a so-called compensation factor has been introduced. This means that less wage income is set off against the Wajong benefit. However, after more than half a year, it was found that in practice, the compensation factor was not only applied to the wage earned via wage compensation but also, to other incomes of the Wajong benefit receiver from, for example, WW or WIA benefits. The application to all combined benefits resulted in a higher benefit than intended by the amended law. There were 700 cases of citizens receiving either too much or too little benefits after the change in the law Rijksoverheid (2021). Per January 2022 the law was amended to rectify this (Rijksoverheid 2021). Citizens that had received too many benefits did not have to pay this back. However, they may experience a consequential drop in income-dependent schemes such as rent- or healthcare subsidy drops or repayments. Apart from these issues, other Wajong benefit receivers indicated that increased working hours did not result in a higher income (W1, W2). One benefit receiver indicated that after starting a 25-hour work week, his income only increased by 9 euros (W1). Wajong benefit receivers even indicated that they have stopped their rent subsidies due to the constant overpayment and then having to pay back the amount (W1, W2, W3).

Other citizens working with wage dispensation experienced that when they fall ill, they enter the Ziekte Wet (ZW). Some of these citizens fell between two stools when they were not helped to re-integrate by either Municipalities or the Uitvoeringsinstituut Werknemersverzekeringen (UWV) (M. Groothuizen 2021).

Different system accidents or ripple effects emerge within this case study. Namely, the incorrect amount of benefits, the law not working out as expected (the 30ct on the euro was not the outcome), and citizens falling between two stools in their reintegration trajectory.
Figure 5.2 shows, high-over, the control structure of the Harmonized Wajong law. Three different types of incompleteness are found in the safety control structure using a STAMP approach, which aims to 'identify the safety constraints that were violated and determining why the controls were inadequate in enforcing them' (Leveson 2016).

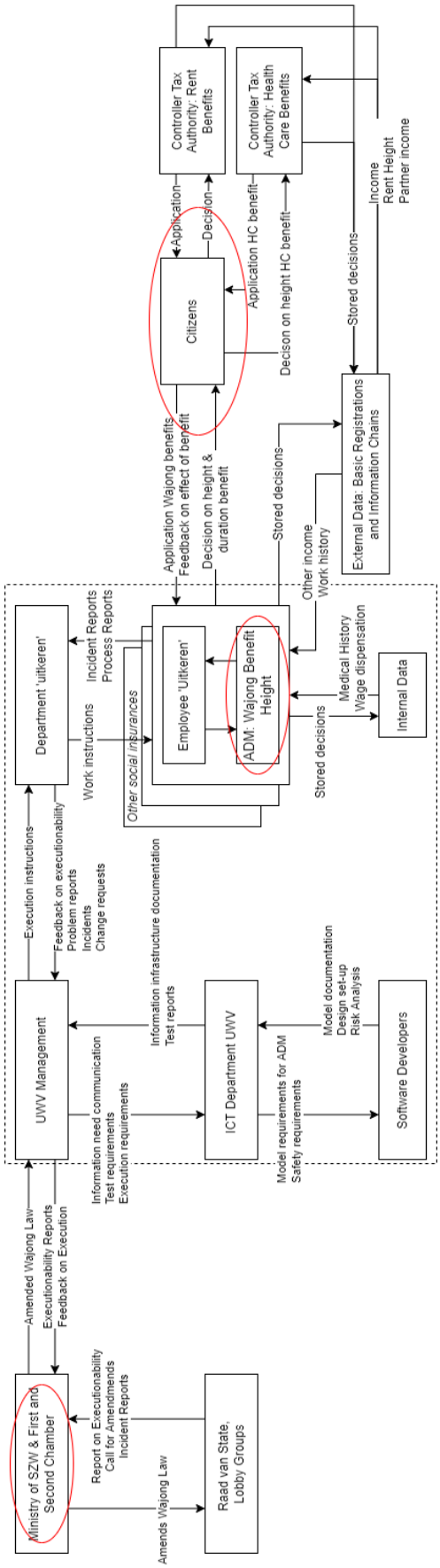


Figure 5.2: STAMP Applied to Ripple Effects in the Harmonized Wajong Law

Starting in the upper left corner. The control structure depreciated the moment the law was amended. In the design of the new law, the effect on other laws or interactions of the Harmonization of the Wajong was not taken into account, which is increasingly difficult due to the complexity of the social benefit legal system. This allowed for instances where a small change in income invoked cascade effects in other benefit schemes. *Asynchronous evolution* is visible as the claim, 'citizens will be guaranteed 30ct per euro of additional income through work', which cannot be made without adjusting the other controllers (laws such as healthcare benefits) in the system accordingly. Because if someone receives a salary next to their Wajong, this not only affects the level of the benefit but also benefits such as health care and rent benefits that people receive and, for example, the speed with which they have to pay off their student debt (Suzanne de Visser 2021). The phenomenon is known as stacking of laws with execution organizations (Ministerie van Sociale Zaken en Werkgelegenheid). Because the Dutch social benefits system has grown and has been incrementally adjusted after problems occur, the system has become more complex and, therefore, more prone to errors (Ministerie van Sociale Zaken en Werkgelegenheid). The incremental growth of the social benefits system, often characterized by delays due to political pressure, has made it virtually impossible to check the impact of amendments or new laws for citizens, thereby not being able to guarantee whether *asynchronous evolution* is occurring within the system (BKWI1, ICTU1) (M. Groothuizen 2021). UWV, for example, also perceives situations where an individual client (or client group) is affected more severely than others – often also due to circumstances outside the client's control – where the question is whether that was the intention of the legislator (M. Groothuizen 2021) due to unforeseen interactions between laws.

Next to asynchronous evolution, one might argue that the mental model about the income of Wajong benefit receivers was incorrect. One of the main pillars of the law was that an increase in the number of working hours or pay should result in a higher monthly income. However, one could wonder whether a wrongly held *mental model* about such citizens might have influenced this decision. As multiple Wajong recipients stated: 'I would like to work more hours, but I have a progressive illness which limits me to do that. That is the entire reason I am in the Wajong' (W2). The mental model held about citizens within the Wajong was that monetary encouragement would indeed lead to people wanting to work more, which might prove incorrect as these people are physically unable to. The question of why the mental model held by policymakers on Wajong receivers' income potential was wrong may be answered by the ever-growing divide between execution experts and policymakers and the lack of feedback given by clients that was incorporated into the new law (UWV2, LCR1).

Next, the middle identified control structure fault is the wrong control algorithm with which the Wajong benefits are calculated. 'Income' was not defined as only income out of work but, more generally, all types of income, which is an example of incompleteness. By not explicitly stating which type of income to perceive, income from other insurance schemes was also considered for the guarantee amount. This incompleteness is an example of a software requirement error within the system safety lens but has also been identified as a semantics problem. This could be solved by using the 'rule management method' in which a structured vocabulary is used, structured writing, and traceability application from source to implementation, harmonizing legislation and decision rules (ICTU1), leading to more consistent government decision-making.

The software requirement error or problems with semantics may be due to different reasons, one of them being a wrong mental model of the software developers or even the policy employee. The software in itself did not cause malfunction. However, it did provide the wrong safety controls[1]. The mental models that turned

1 Even though it is not explicitly stated by UWV works with ADM systems on all benefit schemes mentioned, the example illustrates how incomplete requirements (law specifics) lead to accidents

out to be wrong might result from translation mistakes and distance between policymakers, executors, and software developers. A lack of knowledge about ADM systems lawmakers and executioners and the lack of domain-specific knowledge of software developers make the translation process from law to code prone to interpretation errors. This is a problem as policies are decided upon by the government and made public, implying there is authority to deviate, and a court can review the policy rules. However, decision rules used by ADM systems are not decided upon specifically by the government. They cannot directly be reviewed by a court (van Eck 2018, Chatila and Havens 2019) (ICTU1).

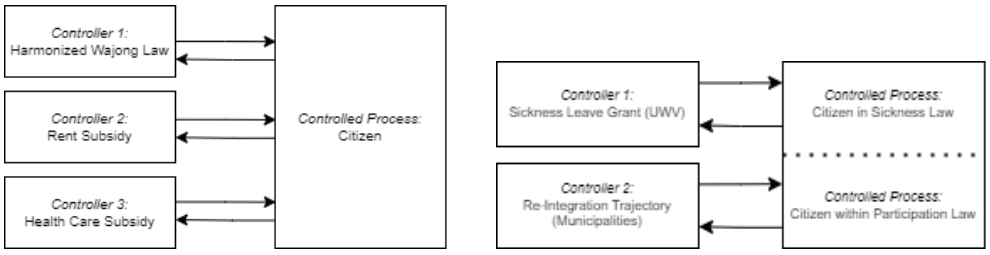
The fact that the mistakes were only spotted after six months might imply that the disconnect in the level of knowledge between software developers and the experts at execution organizations may lead to ADM decisions being accepted too easily in the workplace (Oordt and Tollenaar 2010). This is also a problem for the explainability (principles of good governance) as 'because the computer says so' is not a convincing argument Blankena (2013).

Furthermore, the relatively large scale (700 cases) illustrates how execution experts no longer interpret the law differently per different assessments. As decision rules (faulty in this case) have defined every possible scenario, the room for discretionary space is limited. Consequently, information systems have to become neatly structured and in-complex systems. The law has to be laid down as concretely as possible, also referred to as computer-conscious lawmaking (Bing 2016); however, this may be at odds with the call for increased customization of laws for citizens (van der Vlist en Dick Heerschop 2020, M. Groothuizen 2021, van Eck 2018). This, in turn, also means that if a software requirement error leads to a ripple effect for one citizen, logically, this effect will occur for many citizens (van Eck 2018). Unfortunately, the current structure of law making thus does not allow for feedback to quickly influence the system's structure as how law should be executed is formulated very specifically by Ministries and the First and Second Chamber (ICTU1). In that sense, a long feedback loop, as in the social benefits system, is not likely to identify the aforementioned safety problems before ripple effects emerge.

The 'problem' identified on the right side of the control structure shows a lack of a hierarchical control structure. As the process being controlled here is citizens' income, the Wajong law is an obvious subsystem of a larger system. However, other laws influencing a citizen's income are not controlled via a hierarchical control structure. Consequently, overlap between different laws working on a citizen can occur. The interaction between the different laws and execution organizations responsible can lead to benefit funds being unjustly reclaimed twice (W2) by the Tax Authority and UWV. This mainly happens when a benefit is paid out for too many months next to an income. UWV will reclaim these unjust benefits when this is found; however, the Tax Authority has taxed a citizen's income consisting of benefits and salary for several months. Thus, a citizen pays taxes on income they must pay back (W1, W2, W3) (Radar 2021). While this is incorrect, a citizen can only be repaid after an entire year when the yearly Tax Declaration is made. This example illustrates how the overlap between the different laws working on a citizen makes for conflicts between independent decisions as, on their own, they are both legitimate executions of the law, but together they are not. Part of this problem is also the timing of the control actions of the respective laws. Benefits by the Tax Authority are set yearly, whereas the benefits by UWV are reviewed at least once every half a year (LCR1).

Another example of overlap, not included in Figure 5.2, were the described issues with the ZW. The overlapping parts between different institutions are shown in Figure 5.3b. In this instance, two different types of controllers, namely *illness benefits* by UWV and *a reintegration trajectory*, are working on two processes that are very similar but not the same. As the controlled process UWV is working on is an ill citizen that has a right, due to social insurance, to sickness leave benefit. In contrast, Muncipalities' reintegration trajectory is working on the controlled process of a citizen within the Participation law. As this is the same citizen, the process

boundary is very similar; this sometimes leads to ambiguity on who is responsible for the reintegration of such citizens. This is an example of the partitions between departments and (executive) organizations in the knowledge of laws and citizens. Not all municipalities take up this role, and citizens consequently fall between two stools, not being helped by either UWV or their Municipality (M. Groothuizen 2021). Overlap due to ambiguity on the system border shows how divisions between departments in implementing organizations or municipalities can contribute to the fact that a citizen sometimes has to wait significantly longer for an answer. This is also due to the division of knowledge over the organizations and departments as stated in Chapter 3. Where only a few employees know everything about one law (UWV1). This may become a more significant problem as many of these employees retire soon (UWV1). This may eventually lead to an increase in the period that a citizen wrongly receives a benefit, which also increases the repaid amount. This is a good example of ripple effects. The effect of the law (do I have a right to this benefit) is amplified negatively (unjustifiable benefits received longer than needed but also mental effects). A lack of aftercare and proper transfer to another organization if a financially impactful decision can lead to a citizen getting into financial difficulties and not knowing how to deal with this (Oomkens et al. 2022). A client in the Wajong law described the negative effect of the partitions on her mental health when she was consequently redirected with her questions even if the UWV reached out to her (W2), leading to stress even more so because no execution official can give a definite answer on her financial situation and the impact on her benefits after she started working as a self-employed professional.
Figure 5.2 also includes the example of overlap due to the lack of a hierarchical control structure between different types of benefits.



(a) Harmonized Wajong Law **(b)** Partitions between Municipalities and UWV

Figure 5.3: Examples Overlap in the Social Benefit System

5.4 CASE STUDY 2: CODE 98

An Unhappy Addition to the Family
A Dutch woman welcomes her Canadian partner to the Netherlands with a work permit. In 2001, Jack, her partner's five-year-old son, also came to the Netherlands. His American mother cannot take care of him.

The original idea is that the boy goes back to his mother in the United States, so they do not apply for a residence permit for him. After two years, it turns out that he cannot go back. In March 2003, they applied for a residence permit from the Aliens Police. An error in the administration means they need a stamp on the five-year-old's birth certificate. The stamp arrives too late because figuring out how to get this stamp takes more time than they have. The aliens police tell the IND to stop the procedure because no one is found during a home visit. However, the visit took place at an old address. At the same time, the IND, which takes over the tasks of the aliens police during this time, tells the family that there is still enough time to hand in the specific stamp.

While the woman and her partner do not yet know that the procedure has been stopped, the IND puts a so-called 'code 98' in the municipal personal basis registration, meaning that the five-year-old boy is in the Netherlands illegally. That code sets a whole series of events in motion. Immediately the rent subsidy is stopped because the woman offers shelter to someone without a residence permit. The idea behind this is that people without a residence permit do not get a semblance of legality, making them harder to deport. Nevertheless, not only does the Tax and Customs Administration system respond to code 98, but Municipalities, the UWV, and the Social Insurance Bank also see this information. The use of basis registrations may make it harder for citizens in a difficult situation to prove they are in the right. Suppose someone does not agree with the determination of his income by the tax authorities and appeals for legal aid to the Legal Aid Board for this dispute and is confronted with a refusal of the addition due to the income test based on the income test of the same income data that has been established by the tax authorities and recorded in the Basic Register of Income (BRI). These mistakes have immense consequences. The family's need for money quickly became acute, which led to the pair being unable to pay the costs of arranging the residence permit for the boy. The family lived with a gap of five hundred euros a month for five years. 'The electricity was cut off, we could not buy groceries anymore.' and 'The stress is beyond description' (Vissers 2021).

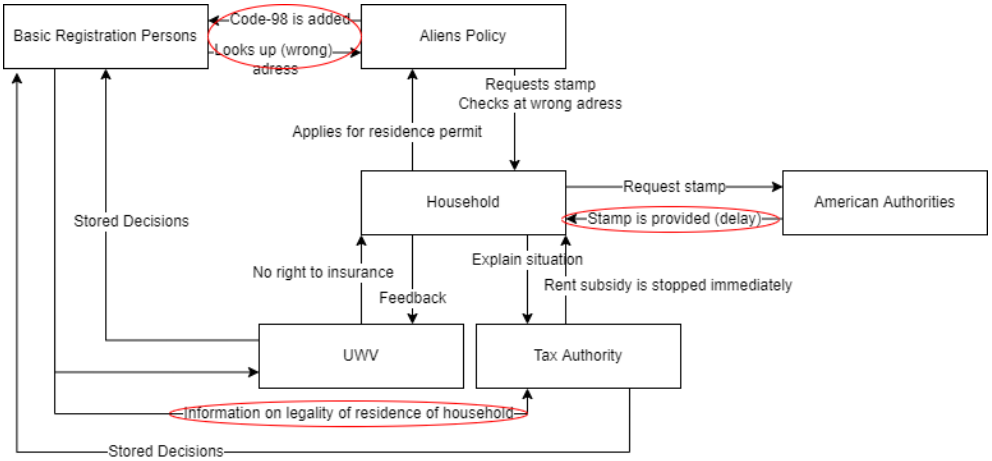


Figure 5.4: STAMP Applied to Ripple Effects in the application of a permanent residence

Figure 5.4 shows how the system where ADM system operate in is highly coupled. Which explains the severity of the outcome for the specific citizen. Due to the increased use of basic registrations and information chains, a mistake travels quickly through the system. UWV (2021) state that their systems are highly coupled and interdependent. The decision made by a ADM system in one department or organization creates a legal fact that, in the form of input data, serves as the basis for another decision in the chain (van Eck 2018). van der Vlist en Dick Heerschop (2020) state how there is a 'great chance of pass-through error' due to increase in networking between executing organizations. Here, that is seen by the decision to label the household with 'code-98', which has grave legal consequences. It is important to note that ADM systems do not make up these conditions. Those requirements are set by policymakers and translated by software developers (van Eck 2018). In a way, this might prove a lack of safety constraints on stopping rent subsidies. For example, before immediately stopping the rent subsidy, a safety constraint of calling the citizen for an explanation could have been useful.

The use of software further increases such complexity, which is likely to grow in the future by the increased use of software in executing laws (Leveson and Weiss 2009, Mittelstadt et al. 2016). Not only does the increased tightly coupled system allow for pass-through errors it may also become increasingly difficult for citizens to prove their rights in a dispute when the government uses a single source of truth. If this source is incorrect, it is still used and saved by all execution organizations. Thus the lack of safety controls on the system has allowed the system to become highly coupled without any slack. This is seen by the quickness of repercussions and the intolerance for a delay (waiting on the stamp). Furthermore, mental models on the controlled process (legality of all household members) turned out to be wrong. However, they were doubled down on using the same data for several decisions. The case shows that a lack of data (no stamp) can also mean no income. Thus, even though a citizen is entitled to a benefit, a lack of information could mean they do not receive this income. The 'model' describing the citizen, which could mean the vast amount of data points present at execution organizations and in basic registrations, can be outdated with grave consequences. In that sense, no data, or in this case, no stamp, can mean no income.

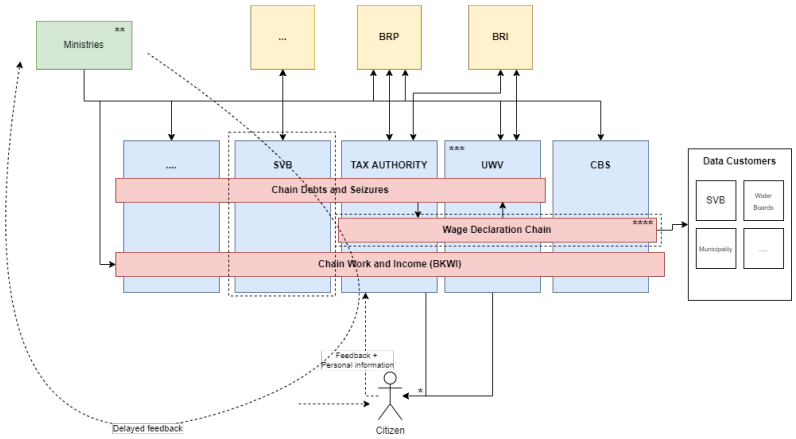


Figure 5.5: Social Benefit System - Summary

Remember the summarized system description derived in Chapter 3 as shown in Figure 5.5. Many of the phenomena described in Chapter 3 can be explained using the STAMP method. However, a general insight is that the social benefits system lacks a hierarchical control structure. Organizations, and individual social insurance and services, are seen as individual systems while they are not. If the citizen's income, as registered within the basic registration, is perceived as the controlled process, several social insurances and services can be seen as controllers of this process. However, external environmental inputs also influence this process, such as work income, a new partner, or people falling ill. By perceiving the different laws as their own system and not as a subsystem of a larger hierarchy, two drivers of ripple effects are left outside of the view of policymakers and executors. Within policy and politics, this phenomenon is known as white spaces, a class of risks that fall between well-defined organizational, policy, process, and scope elements and are not otherwise reflected in risk assessment and management activities' (Prieto 2020). The environmental factors influencing the system and the interactions between different controllers due to the lack of a hierarchical safety structure are located outside of the view. This lack of oversight is further fueled by evaluations done by individual laws, organizations, or information chains, which are underwritten by UWV (2021) too, who states there is a lack of supervisory coverage where coverage is scattered, and responsibilities are unclear. This makes it possible that a law such as the Wajong can be scored quite high in evaluation but does lead to ripple effects for recipients of the law (Ministerie van Sociale Zaken en Werkgelegenheid 2010). The structure, or lack thereof, also explains the tension between horizontal and vertical interest,

thus information chains or execution organizations. The increasing data exchange, partly through information chains but also across domains, raises the question of whether the current data exchange system, which focuses on specific domains, can meet the new types of citizens.

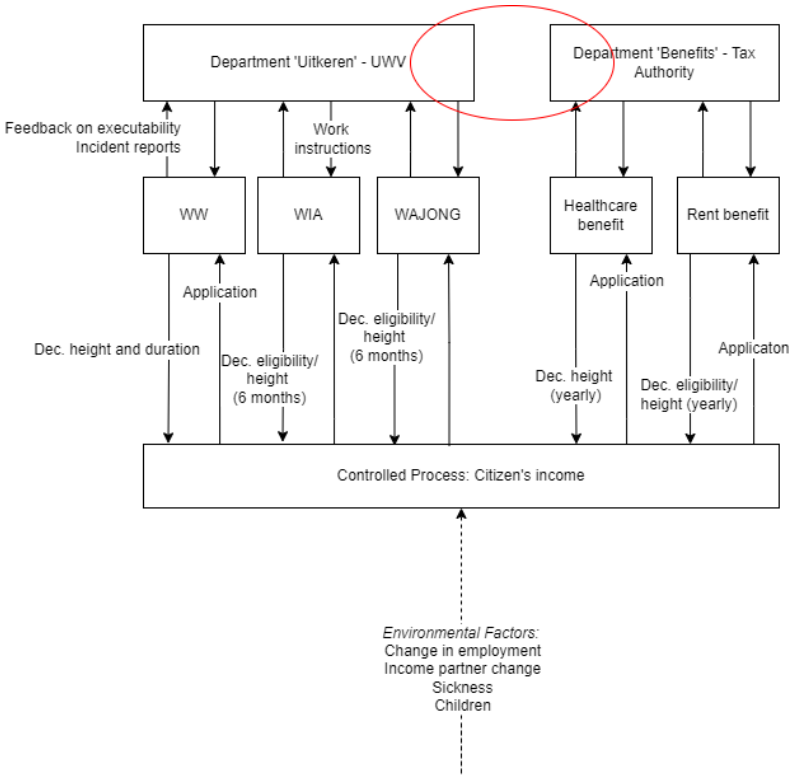


Figure 5.6: Social Benefit System - Lack of Hierarchical Control Structure

5.5 SYSTEM SAFETY FRAMEWORK: RIPPLE EFFECTS

By perceiving the social benefits system through a system safety lens using two case studies, the phenomenon described in Chapter 3 can be interpreted. The following conclusions about this phenomenon are found.
Ripple effects are a an example of a *system accident*. Figure 5.7 shows the different components that contribute to the emergence of ripple effects.
The main driver of ripple effects is the lack of a hierarchical safety structure, which means laws are organized per organization, and no overarching controller is present to ensure that overlap does not happen. The lack of this structure is partly due to the system's extreme complexity, meaning that oversight of how laws and services intersect is not present. This, in turn, makes *asynchronous evolution* easier to occur, which is seen through laws being amended with claims being made without updating other laws accordingly. Overlap on boundary areas is present as citizens with a right to social benefits interact with many different execution organizations, which are all responsible for a different part of social security for citizens. Consequently, some citizens fall between two stools and are, in practice, not helped by either organization. The increased use of basic registrations and information chains has led to the system becoming very coupled, which implies that if unforeseen behavior occurs, it travels fast to other parts of the system leading to ripple effects. Lastly, how the law is made does not allow for optimal use of feedback within the system, as laws and the execution of laws can only be changed at the highest political level.

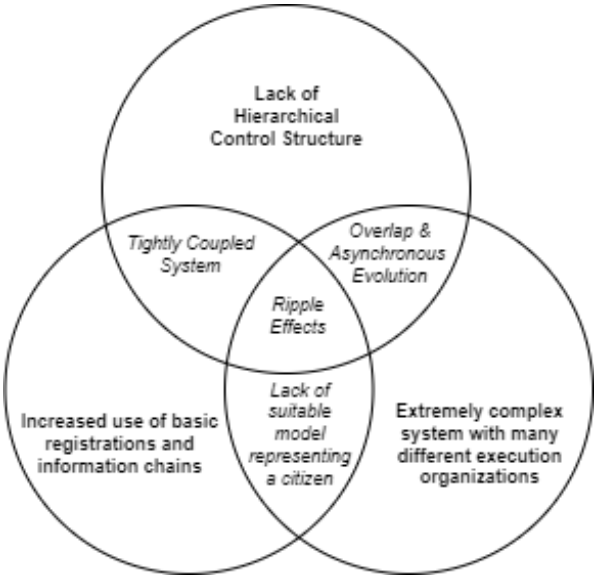


Figure 5.7: Venn Diagram - Ripple Effects from a System Safety Perspective

This, combined with the need for laws with clear language to transform into ADM systems, has significantly decreased the discretionary room for execution experts.

On a lower level, wrong, as determined afterwards, mental and process models lead to ripple effects in law execution. Developers misinterpret laws or laws based on mental models held by policymakers about the process they are trying to influence that do not represent the actual process. This may, in part, be actually because the Dutch government does not have an accurate model representing a citizen (Kafka Brigade 2022). The model representation would be the data points present within basic registrations and at execution organizations. The available data on citizens dictates which characteristics can be taken into account in a decision on the eligibility of benefits and their quality. If the government is working with outdated data, the decision will be too. Moreover, this would imply that the system would consequently fall behind the facts. Moreover, as the data points available on citizens are scattered between execution organizations and different databases, it is hard to assess whether all these data points combined are a good representation of a citizen and thereby a representation of the process that ADM systems aim to control.

5.5.1 Citizen's Income as the Controlled Process

The following section proposes a setup for a control structure for the social benefits system that could reduce the number of system accidents or ripple effects. A control structure has a hierarchical control structure, a process model, and safety constraints. If specifically targeted towards ripple effects within the social benefits system, the following control structure can be seen as the departure point for designing for safety.

Several interviewees indicated how automation and digitization intensify coupling in a system but could also offer a solution for the effects experienced by citizens (LOGIUS1, ICTU1). An example could be the development of a mandated and coordinated environment where all citizens' information comes together. Such an application would add tremendously to the insight and knowledge of citizens on social security. It would not prevent a ripple effect but may detect one after it occurs. However, it would make it easier for citizens to provide feedback to execution organizations earlier, as they would know the impact of environmental or law changes before seeing the monetary impact on their bank account, which is also a crucial part of the control structure.

Within the social benefits system, citizens described issues with receiving the wrong amount of benefits and having to pay back large sums after a significant amount of time, leading to uncertainties on their social security. Do I have a right to this money, or will they reclaim it? As understood by the researcher, the objective of the social benefits system is to provide social security for citizens. Social security is defined as 'the system of laws and measures that ensures that people still have an **income** at the time of incapacity for work, illness, pension or unemployment.' (Juridisch.nl 2022) Therefore, the *controlled process* would be the citizen's income as perceived by the government in the basic registration income upon which different controllers work that can influence the 'state' of the process. In this case, that would be the height of the income. A definition of safe states and unsafe states should be found to ensure the controlled process remains safe. In the case of the social benefits system, there is a legal lower boundary that people should receive monthly. This amount differs between citizens as it depends upon age, household composition, and wealth, which is only relevant for citizens receiving 'Bijstand'. Ideally, we would thus find a manner to ensure that the *controlled process* thus a citizen's income would never get into an unsafe state. In this case, that would be, a citizen would never receive an income lower than the social minimum defined based on wealth, household composition, and age. A preliminary design for such a control structure is given in Figure 5.8. Notice how the Ministry of SZW functions as the 'highest' controller in the hierarchical control structure. For this structure to work, the feedback structures between the lower-level controllers and the controlled process must work optimally; otherwise, signals that would set off safety constraints would not be received. This would imply that as the income is provided monthly, feedback on the process would also be received and given monthly. The process model of the Ministry of SZW on the controlled process (a citizen's income data point as perceived in the basic registration income) should also be correct. A process model has a goal, an action condition, an observability condition, and a model condition. In the case of social security provision, the goal condition would be **enforce the minimum social income**. The action condition would be **adjusting provided and reclaimed funds (monthly)**. The observability condition would be that **non-insurance and services income**, **date of birth**, **household composition** and **wealth** should be observable as data points in either the basic registration persons or the polis administration of the UWV. Lastly, the model condition would imply that the process model is continuously updated using the feedback structure described in Figure 5.8. Here the process model needs to have an up-to-date perception of *why* the citizen needs assistance in their social security (sickness or unemployment?) as this would also determine the hierarchy in providing and reclaiming funds. Again, hierarchy here does not necessarily mean top-down but would prevent the unjust double reclaiming of funds, for example. It is essential to note that this setup is very rudimentary, and many unknowns should be answered before it is useable. Some of them have been discussed in Chapter 9.

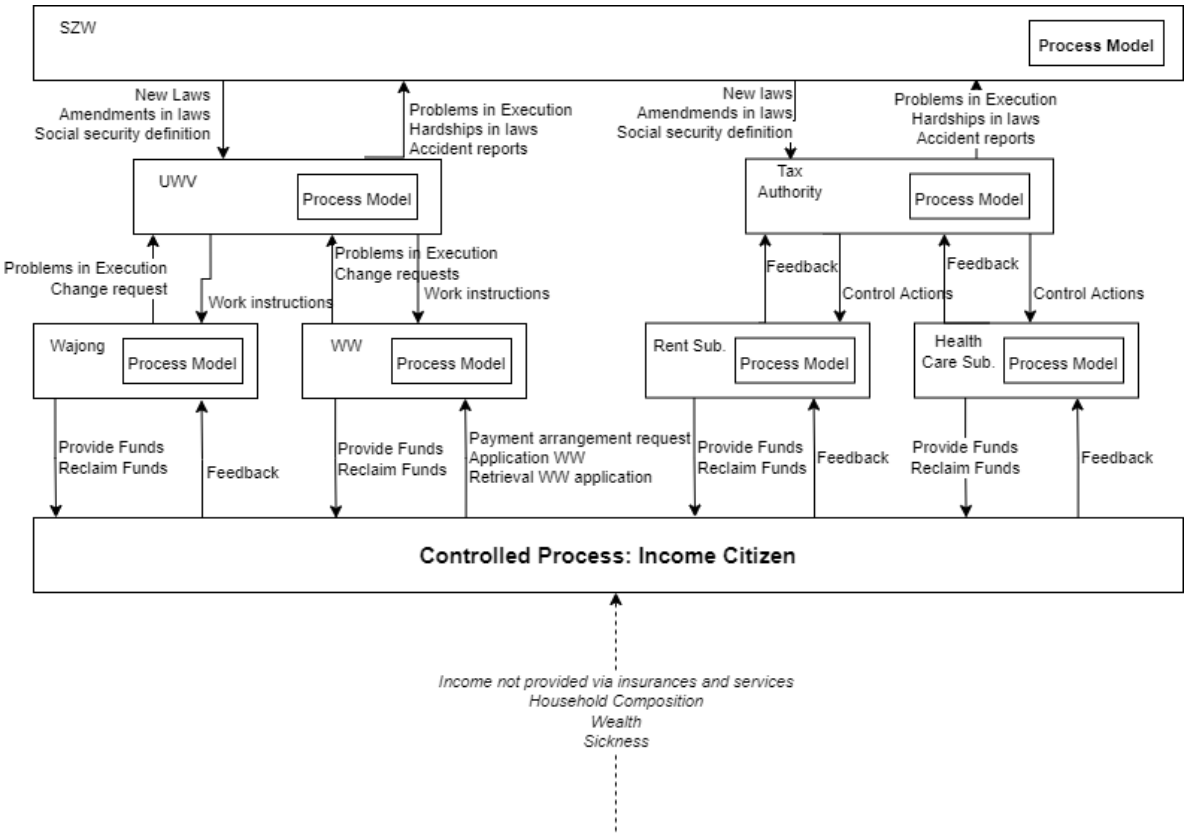


Figure 5.8: Control Structure for Social Security

6 AGENT BASED FRAMEWORK

This chapter introduces the first four steps of the ten-step approach to constructing an Agent-Based Model (ABM). The basic concepts of an ABM are introduced to enable presenting a model design in Chapter 7. The combination between a system safety lens and an ABM could prove useful as both are based upon behavior emergence from interactions (Leveson 2016, Van Dam et al. 2012).

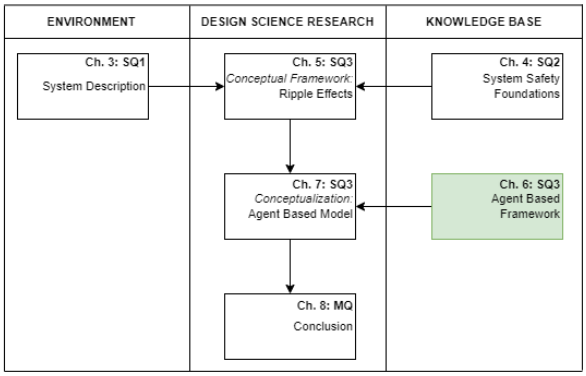


Figure 6.1: Research Strategy - Agent-Based Framework

6.1 AGENT BASED FRAMEWORK

The first four steps of the ten-step approach by Van Dam et al. (2012) are followed for the design document of the ABM capturing ripple effects.

Step 1: Problem formulation and actor identification

Van Dam et al. (2012) states that an ABM is created to solve a certain problem or assist in solving this problem. The model aims to increase the knowledge about an emergent effect. The simulated version of the system helps to increase insight into the possible nature of the real-world systems, how they function, and how they may change due to interventions or efforts to influence the system's behavior.
A bottom-up system description is needed. The description starts with the emergent patterns of interest. The problem owner, other actors involved in the system, and the role of the modeler within the system.

Step 2: System Identification and decomposition

In the system identification and decomposition phase, the elements identified in step 1 are grouped as either agents or interactions. All definitions are taken from Van Dam et al. (2012).

> **Agents** represent one or more actors in the system. They have boundaries, states, behavior, and the ability to interact and make independent decisions.
>
> **Objects** can not make independent decisions within an ABM.
>
> **Interactions** are how agents influence each other.

States describe and specify properties that describe the agents. States change through interactions and vice versa. Together, these are **behaviors**.

Step 3: Concept formalisation

After identifying agents, states, relationships, behavior, and interactions, these should be formalized. This is mainly to make them less context specific[1] and dependent (Van Dam et al. 2012). The meaning of the different components becomes specific in the formalization. This is done by translating 'natural language' into computer-understandable language. The formalization allows the model's description to be used beyond one domain.

Step 4: Model formalisation

After the identification and formalization of all model components, the interactions of the components should be identified. These interactions will eventually lead to emergent patterns. For an ABM the behavior of agents is defined by Van Dam et al. (2012) as 'which agent does what with whom and when'. This step is very prone to assumptions, which should be meticulously recorded. It is also important to indicate when a loop or action is finished. Once the narrative is set up, this should be formalized within an algorithmic representation. Within the formalization of the narrative, several types of operations are used, among which are computations and assignments, iterations and loops (execute the same action multiple times during a one-time step until a certain condition is met), conditions (if, else statements), in- and output (displays variables).

6.2 VALIDATION

Validation of an ABM focuses on the question 'did we build the right thing' (Van Dam et al. 2012). Would the design answer the question posed by the problem? There are different types of validations available for such types of models, namely, historic replay, face validation through expert consultation, literature validation, and model replication. Historic replay and expert consultation are most relevant for this research as the model is designed but not actually built.

Historic replay compares models to a real-world situation via a scenario experiment. The scenario describes a path from a point in the past to a current state within model space. The scenario's people, actions, and situations are parameterized and translated into the model. Then, experiments explore whether the emergent patterns from the observed scenario are present in the simulations and if the outcomes and end states of the model resemble the current state in the real system. If a pattern emerges in the computational experiment that corresponds to the trajectory described in the scenario of known situations, we can claim a degree of validity by the model.

Expert validation relies on domain experts and problem owners that discuss the behavior of agents, the patterns of behavior of the system, and the application of the model for its designed purposes.

1 An example is a contract, is this a verbal agreement or does it always contain the same information points (Van Dam et al. 2012)?

7 CONCEPTUALIZATION: AGENT BASED MODEL

This research aims to find how the social benefits system can be modeled from a system safety perspective. Modeling the system using an Agent-Based Model (ABM) while adhering to the insights of system safety may give insight into the *why* and *how* of ripple effect emergence. This Chapter presents model requirements for capturing the earlier defined ripple effects from a system safety perspective. The first four steps of the design method of an ABM, as defined by Van Dam et al. (2012) were introduced in Chapter 6. First, the problem is described, after which the involved actors are described, followed by the model design. The model design contains the second (system identification and decomposition), third (concept formalization), and fourth (model formalization) steps. The system description given in Chapter 3 and the insights explored by using a system safety lens found in Chapter 5 are used as input for these steps. Remember, the modeling purpose introduced in Chapter 2 was determined to be 'theoretical exposition' and 'explanation'. Which respectively means that the model aims to establish and characterize (or assess) hypotheses about the behavior of a set of mechanisms using a simulation (Edmonds 2017).

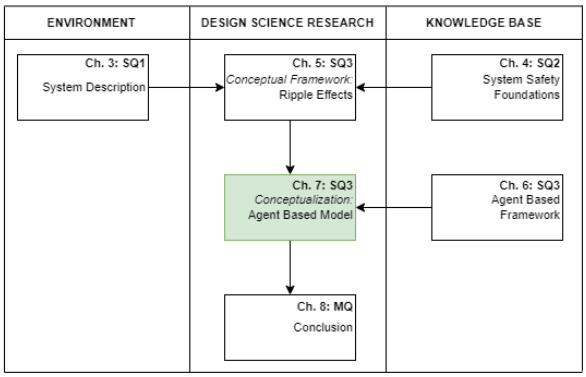


Figure 7.1: Research Strategy - Conceptualization ABM

As per sub-question three, the Chapter puts forth a model design using pseudo code, not an implementation of a model that captures ripple effects from a system safety perspective. The document defines the model processes in pseudo-code, which includes the definition of variables, their states, and the response functions that specify how states change for each variable. It thus provides a design for a model that can capture ripple effects. However, it is essential to note that the model design is rudimentary and should function as a set-up for a more elaborate and detailed design.

7.1 AGENT BASED FRAMEWORK

The first four steps of the ten-step approach by Van Dam et al. (2012) are followed for the design document of the ABM capturing ripple effects.

Step 1: Problem formulation and actor identification

The problem observed is the emergence of ripple effects within the social benefits system, which consequently negatively impacts citizens. From a more structural point of view, the system safety lens assisted in understanding *why* the phenomenon emerges. However, this approach remains at a high-over level and thus does not explain *how* the behavior emerges. Thus, is one of the common factors enough to

lead to a system accident, or might it be the combination? Here, the model ambition for the ABM comes into play. The model aims to increase the knowledge about *how* ripple effects emerge within the social benefits system.
The **problem** is defined as a lack of insight into *how* ripple effects emerge and which factors are most influential in their emergence.

The **observed emergent pattern** is ripple effects, defined as 'the emergent amplified negative effects of opaque social policy.

The **hypothesis** on their emergence is that uncontrolled interactions among system components within the social benefits system lead to the occurrence of the common factors, which, combined with a worst-case scenario (complex cases), lead to ripple effects. The following common factors or control structure deficient are identified in Chapters 3, 4 and 5:

- The general lack of a safety control structure leads to overlap between different laws and execution organizations that exercise control upon the *income* of the citizen.
- This also contributes to a general lack of oversight on the laws influencing a citizen's income leading to a higher chance of *asynchronous evolution* where parts of the system are updated without the necessary change in the rest of the system.
- Translation mistakes between policymakers and software developers can lead to incorrect process models, leading to overlap and incorrect safety constraints.
- The lack of a hierarchical safety control structure leads to interactions between different sub-systems (laws), and the similar structure in evaluation and monitoring makes ripple effects go unnoticed before they have arrived at the citizen.
- Information about citizens and laws is scattered and incomplete (incomplete mental models), leading to overlap in boundary areas.

Problem owner is the Ministry of Ministry of Social Affairs and Employment (SZW) they have the final responsibility of executing social laws.

Other actors are defined in Section 3.2.1. The other actors are the First and Second Chamber, execution organizations, software developers, citizens, and client boards. For the bottom-up approach of an ABM within the organizations, it is relevant to differentiate between different departments. Several interviewees (W1, W2, W3) describe that the bulk of the ripple effects they have experienced stem from interaction with or among Uitvoeringsinstituut Werknemersverzekeringen (UWV) and the Tax Authority. Therefore, these are the only actors taken into account for execution organizations. Within these organizations, different departments are distinguished.

Modellers role within the social benefits system is not a formal one. However, the modeler has focused on finding a definition for ripple effects and explaining why and how they emerge from the assumption that they exist. Furthermore, the modeler has not spoken to all stakeholders.

Step 2: System identification and decomposition

Systems of the scale of the Dutch social benefits system are so large and complex that they can only be interpreted from a limited viewpoint, meaning that all information gathered will contain many simplifications and assumptions. The system is simplified to ensure the model can still be overseen. Therefore, only the Tax

Authority and UWV are taken into account as execution organizations, as these organizations execute the bulk of social laws
The time frame selected is one month per tick, partly because new income heights are registered monthly at UWV (W2). The minimum time the model should run is 24 months to see ripple effects emerge, as the Tax Authority determines benefits yearly.
The following agents, properties, actions, and interactions are defined:

- Citizens
  - can
    - *apply for a benefit* at either the Tax Authority or UWV
    - *get frustrated by having to pay back benefits*
    - *can withdraw their benefits applications*
    - *can file an official complaint* with the pay-out employee
  - has
    - *a disability* or not
    - *a working history*
    - *a rent*
    - *income*

- UWV has the following agents:
  - Pay-out Employee Wet werk en inkomen naar arbeidsvermogen (WIA)
    - can
      - reclaim benefits based on a citizen's income
      - petition for law change after a complaint from a citizen
      - *use an Automated Decision Making (ADM) system to calculate benefit height*
      - *can judge benefit application* of a citizen after an *application*
      - *question ADM decision*
      - *give feedback on ADM* to ICT employee *can ask advice* to other pay-out employee
  - has
    - *experience*
  - Pay-out Employee (Wajong) *can* and *has* the same properties.
  - Pay-out Employee Werkloosheidswet (WW) *can* and *has* the same properties.
  - ICT Employee
    - can
      - *pass on feedback* to software developer
      - *order amended ADM system* from the software developer after a law amendment
    - has
      - *experience in software development*
      - *experience in social law*
  - Software Developer
    - can
      - *change ADM system* upon order by ICT employee

        - *make a mistake in the translation of law to* ADM
    - has
        - *work pressure*
        - *experience in social law*

- Tax Authority
    - Has the same agents as UWV but for healthcare and rent benefits.

As the aim is to try to model a socio-technical system, the technology is an ADM system. The following table identifies the relationship between the agents towards the technology.

Agent	Relationship	Physical Node
Pay-out employee	consults	ADM
ICT employee	owns	ADM
Software developer	builds	ADM
Citizen	-	-

Table 7.1: Agents and Technology Relationship

The environment is described to *dictate amendments to law*, *randomly distributes* citizen income and disabilities at the first time tick. Furthermore, the environment should continually influence citizens' income and disabilities.

Step 3: Concept formalisation

Below all formalized properties of the agent *citizen* are given. The citizen has an ID, as the model should be able to track specific citizens' frustration over time. Employees also have IDs as they vary in experience and might make different decisions based on this experience. Furthermore, the citizen can either have a disability or not, several years in working history, which should be added during the model run. The rent amount indicates if and how much rent is paid and should be set to zero when the citizen does not rent. Income is defined as income out of work and benefits. Properties 5-8 should be defined using a decision tree or algorithm, which can be defined when more information is available on the specific interactions between citizens and employees at execution organizations. An example of such a decision tree for *complaining* could look like Figure 7.2.
The remaining overviews of properties for the other agents can be found in Appendix C. Furthermore, the Figures for the citizen agent are shown showing interactions on *information*, *money* and *internal considerations*. The overviews for the other agents are also provided in Appendix C.

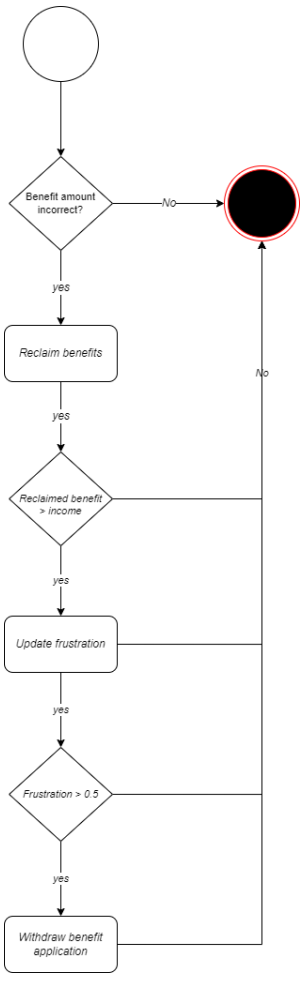


Figure 7.2: Example Decision Tree - Frustration Citizen

Step 4: Model formalisation

The sequence diagram shows the different patterns of interaction. As described in Figure C.4. Different types of interactions are shown. The following types are distinguished: monetary and information interactions, which

Number	Variable	Type	Range
0	Citizen ID	Integer (ID)	
1	Disability	Boolean	
2	Working history	Integer	>=0
3	Rent	Integer	>=0
4	Income	Integer	>=0
5	Benefit Application	Boolean	
6	Frustration	Floating point	>=0, <=1
7	Benefit Withdrawal	Boolean	
8	Complaining	Floating point	>=0, <=1

Table 7.2: Properties of Citizen

are indicated by blue and red arrows. The patterns of interaction are divided per phase, making them easier to recognize. Each phase shows the main interactions between agents.

An interactive agent is shown by a light green trunk. When interactions affect the agent, this is visualized by an arrow touching the interactor's trunk with the front or back of the arrow. When the back of the arrow originates from an interactor, this agent initiates the interaction. Square arrows (dotted line) represent a reconsideration or an update of the interactor.

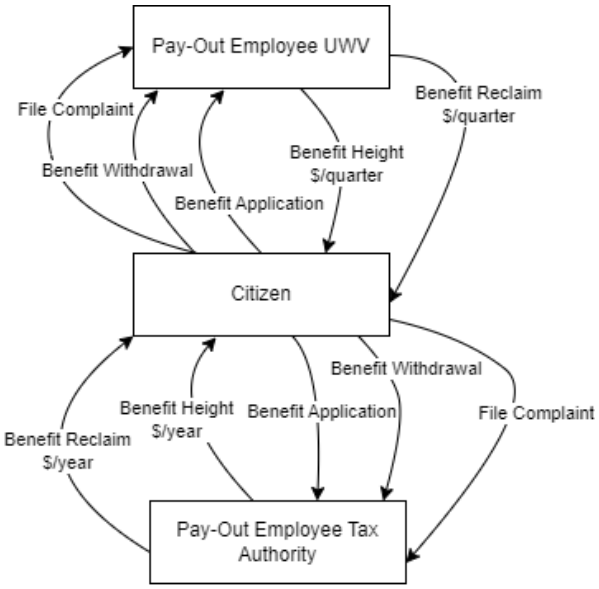


Figure 7.3: Interactions Citizen

The following phases are identified: (1) amended law and (2) benefit calculation and reclaiming. Below, the interaction pattern for the first phase is shown. The other interaction pattern can be found in Appendix C. When coding the model design, multiple other scenarios should be developed for the model to be helpful.

Figure C.4 shows the law amendment phase. Here, several interactions are shown, which are shown in more detail in Figure 7.3. After the amendment of a law (environment), the ICT employees at the Tax Authority and UWV check if the amendment is relevant to their organizations. If so, they order an ADM system, either new or amended, with the software developer. The software developer checks whether they have enough capacity to change the system and, if so, changes the system, which changes how pay-out employees execute benefit applications done by citizens. This influences the height of benefits received by citizens. Based on the difference, citizens can choose to file a complaint, and based on this complaint, pay-out employees may decide to petition for a law amendment. The other patterns of interaction are shown in Appendix C. Many assumptions are made about the specific process within the Tax Authority and UWV. These are presented in Appendix C.

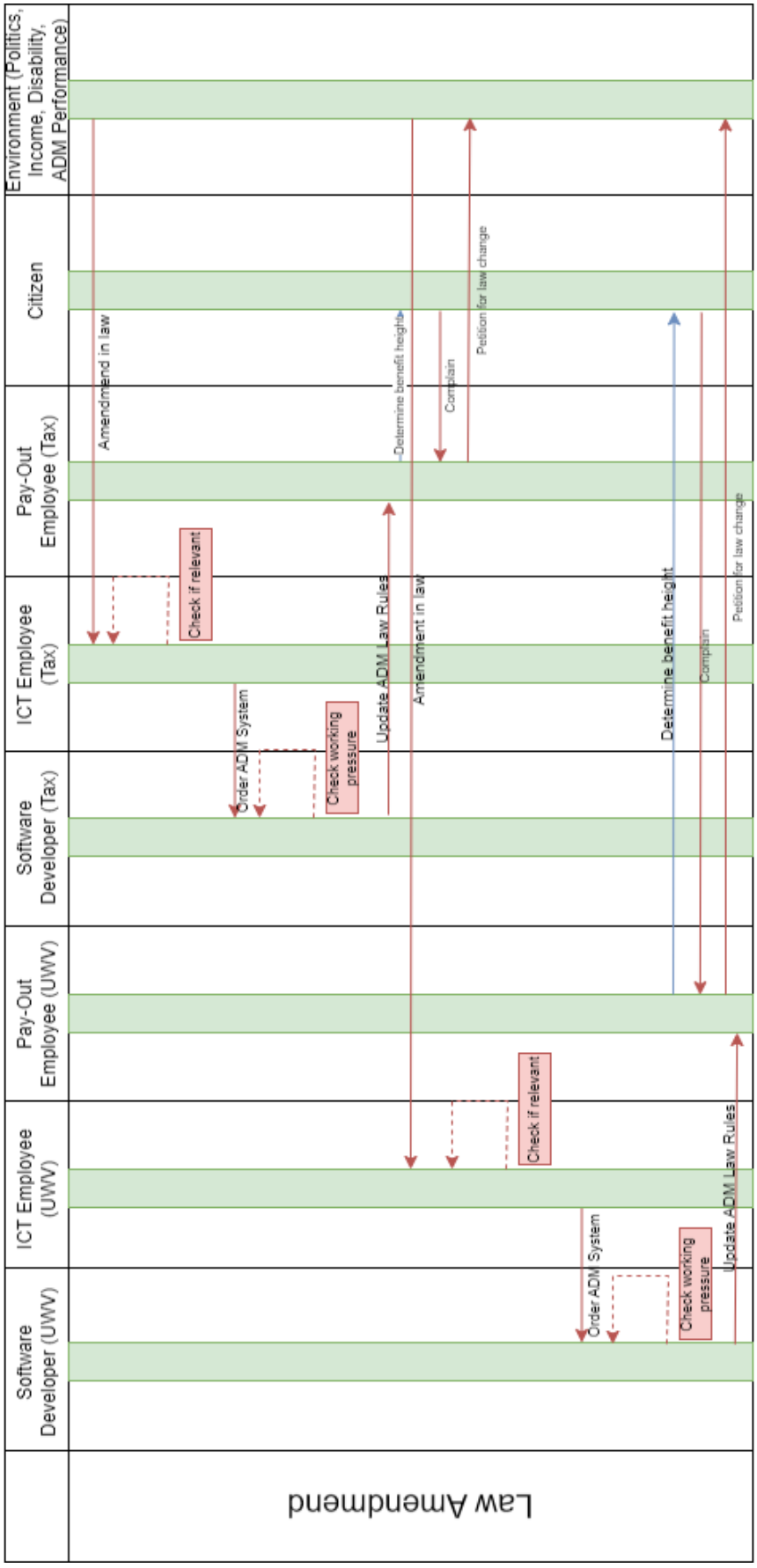


Figure 7.4: Pattern of Interaction after Law Amendment

7.2 VALIDATION

The validation of the model design is done using the two methods introduced in Chapter 6.
First, using expert feedback by an employee of UWV of which the transcripts are shown in Appendix C. This feedback is valuable as it allows for new insights, necessary iterations, and specific domain-specific knowledge. Furthermore, it gives feedback on the *mental model* of the modeler about the social benefits system, which is translated into the model design. This is important, as the mental model of the modeler is bound to be wrong as it is based upon fragmented information gathered using governmental documents and expert interviews that all provide information on small parts of the system. It allows for an estimation of how well the system is translated into the model design.
The validity check focuses on whether the model's representation of the social benefits system aligns with the expert perception of the system's structure, includes all relevant agents, and is recognizable in the interactions. The presented model design is descriptive. It may prove to have a large discrepancy with the real world, which has a negative effect on its value of exploring and explaining the phenomenon of ripple effects to stakeholders. However, as the social benefits system is highly complex, the model design had to be simplified to be modeled and give any insight. The feedback from the UWV employee is somewhat neutral as some aspects, such as the lack of interaction between the Tax Authority and UWV, is nicely shown. However, the model design is stated to be so oversimplified that it might lose its purpose of exploring the effects within the system. The focus on solely monetary exchanges within social laws unjustifiably excludes interactions with labor experts, insurance physicians, and re-integration experts, all interactions where frustration can also emerge. However, significant changes were made based on the input. Furthermore, verifying whether the model design was understood is hard.
Several modelling changes were made based upon the expert feedback which are shown in Table C.8 in Appendix C.
Second, using a specific Tim (W1) scenario to apply the historic replay validation method described in Chapter 6 is impossible for the current model design set-up. Due to a lack of in-depth information to construct the interaction algorithms, it is impossible to retrace Tim's situation to validate the model. Moreover, as the information given by Tim heavily influences the model set-up, it might also have been somewhat circular reasoning. It would have made much sense that his specific situation would align with the model as it is based on his situation.
Overall, it is harder to assess the quality of the ABM as the design could not be tested in a modeling program or with existing data. Also, actual model design errors will only become apparent when the actual programming is done.

8 CONCLUSION

The main objective of this research was to model the ripple effects of law automation in the social benefits system using a system safety perspective. The modeling the phenomenon using a system safety lens and Agent-Based Model (ABM) allows to explore insights into *why* and *how* ripple effects emerge. The social benefits system description was combined with theoretical foundations of system safety and modeling foundations of Agent-Based Model (ABM) to explore valuable insights. Through applying a system safety lens on case study examples of ripple effects, insights into structural characteristics of the system explaining why ripple effects emerge were found. The drivers, or common factors, behind ripple effects are further explored using an ABM design, which, when executed, should promote exploration of knowledge (on which common factors are most influential and in which combination) to ensure that future system design fits the characteristics of the evolving system and which stimulates the evolution towards a safer system. The assessment using a system safety lens allows for reflection on both the process of law automation and the system's structure.
The research objective was split into three distinctive parts. Namely, a system description, the development and application of the system safety lens, and the development and design of the ABM. The main research question encapsulating these parts is:

> How can ripple effects associated with automation processes of law execution in the social benefits system be modeled using a system safety perspective?

To answer the research question, the following sub-questions were constructed:

1. How can the system of law execution automation in the Netherlands be described to formulate a definition for ripple effects?
2. How can ripple effects of law execution automation be described from a system safety perspective?
3. What are the model requirements for a model describing ripple effects of automation in the social benefits system?

A system description from a socio-technical perspective answers the first sub-question:

How can the system of law execution automation be described?
The social benefits system is an open socio-technical system that continuously changes over time and is shown in Figure 8.1. The system was, and still is being, incrementally built and is consequently characterized by different types of complexity. The use of software further exacerbates this complexity. The system is characterized by a power in-balance between developers and users of the ADM systems used. Citizens experience the interaction of laws (due to the stacking of laws) which leads to unforeseen negative effects. Due to the manner of evaluation and monitoring (law, chain, or organization level), these issues do not (always) reach execution organizations. The lack of feedback is amplified by the scattered knowledge of social laws among departments and organizations. Long feedback loops emerge in law execution because policymakers solidify how the law should be executed within the law itself. Thereby dictating that any change in the law execution should pass

through the Second Chamber. The social system has become increasingly complex and opaque due to the tendency to react to incidents and the aim to please everyone (using exceptions and transitional agreements). Software developers make normative decisions at execution organizations with risks of translation mistakes due to limited domain knowledge. Furthermore, the discretionary room is reduced. Also, a tendency to make laws in service of automation has arisen. The increased use of information chains and basic registration has made the socio-technical system a network of information streams, streamlining decision-making. However, when mistakes are made, the implications are significantly larger. Furthermore, using these networks implies that vertically organized execution organizations should work in service of a horizontal chain (in which some organizations are dominant) which might lead to tensions. These insights, combined with the original hypothesis on ripple effects, led to the following definition:

"the emergent amplified effects of social policy

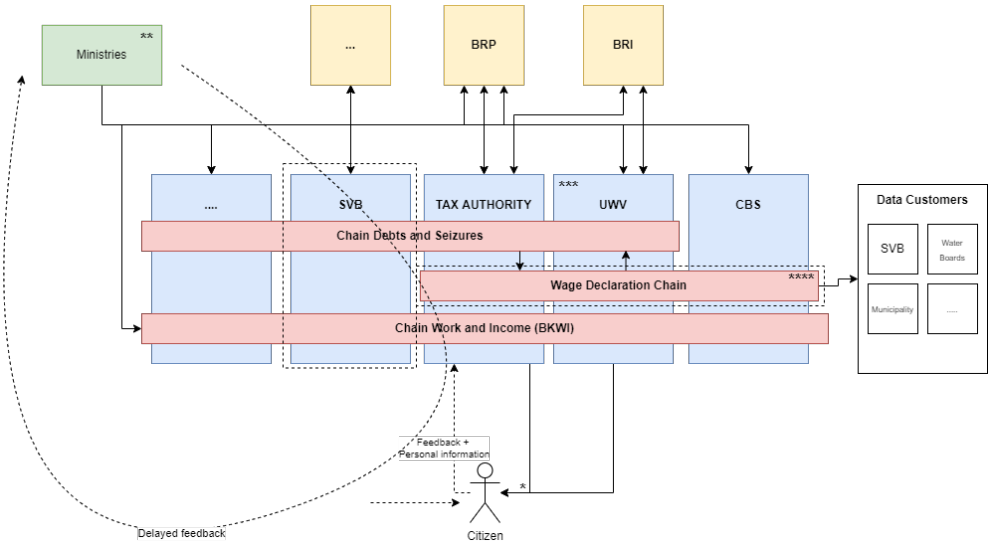


Figure 8.1: Display of Socio-Technical Social Benefit System associated with Law Automation

Combining a system safety lens (Chapter 4) with the System Description allows for the description of the social benefits system from this perspective answering the second sub-question:

How can ripple effects of law automation be described from a system safety perspective? By perceiving the social benefits system through a system safety lens using two case studies, the phenomenon described in Chapter 3 can be interpreted. The following conclusions about this phenomenon are found.
Ripple effects are a an example of a *system accident*
The main driver of ripple effects is the lack of a hierarchical safety structure, which means laws are organized per organization, and no overarching controller is present to ensure that overlap does not occur. The lack of this structure is partly due to the system's extreme complexity, meaning that oversight of how laws and services intersect is not present. This, in turn, makes *asynchronous evolution* easier to occur, which is seen through laws being amended with claims being made without updating other laws accordingly. Overlap on boundary areas is present as citizens with a right to social benefits interact with many different execution organizations, which are all responsible for a different part of social security for citizens. Consequently, some citizens fall between two stools and are, in practice, not helped by either organization. The increased use of basic registrations and information chains has led to the system becoming very coupled, which implies that if unforeseen behavior occurs, it travels fast to other parts of the system leading to ripple effects. Lastly,

how the law is made does not allow for optimal use of feedback within the system, as laws and the execution of laws can only be changed at the highest political level. This, combined with the need for laws with clear language to transform into ADM systems, has significantly decreased the discretionary room for execution experts.
On a lower level, wrong mental and process models lead to ripple effects in law execution. Developers misinterpret the law, or laws are made based on wrong mental models held by policymakers about the process they are trying to influence. The process within this research that is aimed to be influenced is the citizens' income as perceived within the basic registration income. Consequently, this leads to to insight that execution organizations are increasingly interacting with the abstraction of a citizen or the collection of data points available on this citizen. This collection influences the quality of a decision made by an ADM. The available data, and its quality, on a citizen dictates which characteristics can be taken into account in a decision. Unfortunately, it is hard to assess whether the collection of data points is a good representation of a citizen and, thereby, a representation of the process that ADM systems aim to control, as the data points available on citizens are scattered between execution organizations and different databases.
Lastly, to further understand how ripple effects emerge, an Agent-Based Model (ABM) design encapsulates the behavior from a system safety perspective, answering the third and last sub-question:

What are the model requirements for a model describing ripple effects of automation in the social benefits system?
An ABM approach was chosen for its bottom-up approach, open boundaries, which are complementary to the open socio-technical system. Moreover, the focus on behavior emergence via interactions is complementary with the insight that system accidents, thus ripple effects, emerge from unforeseen interactions. Once executed, the model design should give insight into *how* ripple effects emerge. However, unfortunately, the ABM design proved more difficult than initially foreseen. Limited access to operational knowledge that is considered classified according to executions organizations led to many assumptions made within the model design. Furthermore, the lack of detailed information has led the focus of sub-questions 1 and 2 to heavily be on the structural characteristics of the system and how they lead to ripple effects. This focus somewhat diminished the potential synergies between ABM and system safety. Therefore, the model is significantly less developed than it could have been, if provided with the needed detailed information.
After validation by Uitvoeringsinstituut Werknemersverzekeringen (UWV), a conclusion on the model design's usefulness is drawn. The model design and setup in its current form do not serve to find *how* ripple effects emerge from the system safety framework set up in Chapter 5. However, this does not mean an ABM may not be helpful. A different system description level is needed to accurately facilitate insights using an ABM. The current system description proved useful in exploring and exposing system structures that lead to ripple effects. Ripple effects may sometimes emerge due to a combination of these structural flaws and not necessarily an interaction. This proved a vital difference in the conception of what interaction is between system safety and ABM. There are possible similar interactions between the two methods. The interaction level, described in both ABM literature and system safety literature, focuses more on feedback and interaction between ADM systems and operators.
The incompatibility on the current system description level does expose the absolute need for shared language among disciplines when perceiving such a socio-technical effect. Terms such as interaction have been shown to mean different things in different disciplines leading to incorrect assumptions about their synergies on specific levels.

9 LIMITATIONS AND FUTURE WORK

This Chapter discusses the implications of this research's scope, method and design choices—moreover, it presents directions for future research to explore further.

9.1 SCOPE

The choice to solely focus on Automated Decision Making (ADM) systems within the social benefits system has implications for the validity and usefulness of the insights gathered. By solely perceiving ADM systems, the implications of other algorithmic influences and how these might interact with such systems are left outside the scope. However, this interaction may prove a source of ripple effects. For example, one of the interviewees (UWV2) mentioned how classification algorithms determine whom to call first. The combination of the use of ADM system with such algorithms may be very influential in how execution experts interact with citizens and, thus, how ripple effects arrive at citizens.
Furthermore, the choice to solely focus on social benefit insurance and services implies that the effects are geared towards monetary and emotional damage. However, within a different domain, for example, spatial planning, very different variables are relevant, and the insights gathered may prove only helpful within this context. Also, as the system proved much more complex than initially foreseen, many simplifications were made in the system description and modeling efforts. For example, the interaction between execution organizations and Municipalities is very relevant to how social laws impact citizens, but this was not taken into account (Vonk and Tollenaar 2012). As the research was initiated through a ripple effect in the harmonized Wajong law, the scope's focus has remained on Uitvoeringsinstituut Werknemersverzekeringen (UWV) and the Tax Authority. The modeling effort only focused on these execution organizations but left possible interactions between DUO or the Social Security Bank (SVB). Herewith, the problem is framed to be a social security problem. At the same time, this is not necessarily true, as ripple effects (perceived as a system accident) can emerge in all domains and do not have to be monetary.
Lastly, the exploration of the system has heavily focused on structural insights, *why* do things happen due to how the system is designed. However, cultural aspects have not been explored. For example, the cultural difference between the Tax Authority and UWV could prove one of the reasons for the overlap between these organizations. Furthermore, it is possible that diving further into the culture around the use and design of ADM models could prove insightful in how feedback is used and communicated. Both are essential parts of system safety.

9.2 METHODS

9.2.1 Interviews

The interviews significantly influence the perception of the social benefits system. Unfortunately, the Tax Authority was unavailable for interviews, so assumptions on how their ADM systems interact and are controlled may be wrong. Furthermore, interviewees talked about the Ministry, but the Ministry of Ministry of Social Affairs

and Employment (SZW) was also unavailable for an interview. The central government's opinion on the future of ADM system use and how this transition fits into the larger transition of the digital government could have been beneficial in developing recommendations. If only to guarantee no double work is done. Moreover, only citizens receiving Wajong benefits have been interviewed. These people are characterized as complex cases, as their employment is often not standard, they work with wage dispensation, or their illness is progressive. The fact that no citizens applying for Werkloosheidswet (WW) or Wet werk en inkomen naar arbeidsvermogen (WIA) have been interviewed may have influenced the perception of how well the system works and how safe it is. Lastly, as the topic felt like a sensitive one by interviewees, many of them opted for only a summary and not a transcript which in turn has the risk that the researcher has interpreted certain statements from their point of view, making the method less objective than it usually would be.

9.2.2 System Safety

System safety finds its roots in systems theory developed to deal with complex systems containing advanced technology (Leveson and Thomas 2018). The primary source of information for developing the system safety lens applied to ripple effects is taken from Leveson (2016). However, many of the examples described by Leveson (2016) have a much smaller scope than the social benefits system. Thus explaining why ripple effects emerge could be done using this approach; however, it is quite hard to determine when all relevant components are in view, mainly because not all relevant actors were available for interviews. The assumption, now, was made that the controlled process is a citizen's income, as perceived within the basic registration income, as that allowed for the identification of several factors impacting the process. However, this dilutes the other emotional and legal impact that might have occurred too. Furthermore, other researchers might state that ripple effects are not system accidents. When two planes fly into each other, this should not happen. However, paying back benefits or the fact that people relatively increase very little once they start working could be seen as characteristics of the law. The law is stated in that manner and is executed in that manner. Harm is done, but is the harm significant enough to constitute a system accident?

Furthermore, the perception of taking the 'citizens' income' as a controlled process is novel as the more extensive socio-technical system continuously impacts this variable. Where in other system safety examples, socio-technical factors were critical. For example, what is the culture, and what did the operator do? The process now is part of a citizen, which makes it harder to determine what a safe space would be. Would this be a basic income? Does this income level change if you do not work or work part-time? Moreover, who decides this as this is a very political and contentious topic?

9.2.3 Case Study

Two case studies are explored in Chapter 5. The case studies are a surface-level description of the actual system accident. They may have simplified the situation to the point where the Systems-Theorectic Accident Model and Processes (STAMP) analysis is not functional anymore because many of the influencing factors were left outside of the scope. Furthermore, as many different types of citizens use social benefits and provisions, it would have been interesting to compare different system accidents that occurred within the execution of the same law to build more knowledge on why the system accident could emerge. In this sense, the approach to apply STAMP to a ripple effect situation showed how a system safety lens is compatible with this type of system to explain *why* certain phenomena occur. However, traditionally, (Leveson 2016) has applied the method to incidents that only occur

once. For example, the helicopters that were shot down, in this case, it is obvious from which situation to depart within the STAMP analysis. However, many citizens receive benefits within the social benefits system and some experience ripple effects. Should all, or at least more than one, citizens be included in the analysis to accurately determine which factors contributed to the emergence of the effect?

9.2.4 Agent Based Model

The model has become a highly simplified abstraction of the social benefits system. This is mainly due to the lack of information provided or openly available by execution organizations. This has considerable disadvantages, the system safety lens is not completely captured, and the model formalization step is very rudimentarily executed as it is very difficult to dissect which steps are taken internally by execution organizations. Furthermore, as one of the insights of the system description was that many structural design characteristics lead to ripple effect emergence, the quality of interactions and the bottom-up approach of an Agent-Based Model (ABM) is not fully captured. This could be different had the research focused more on the internal feedback structures relevant to system safety than the system structure. However, it should be noted that the research should behave in collaboration with an execution organization to gather sufficient insights to actually describe these feedback interactions. Furthermore, as the model is not coded but presented in pseudo-code, the actual executable value of the model is unknown. In general, an ABM could have been an interesting opposing school of thought against the system safety lens. As with a well-developed model of feedback structures and law automation execution, different strategies could have been tested. For example, system safety is focused on determining the unsafe regions within a system and ensuring that safety controls ensure that the system does not end up in this state. However, another school of thought is that it does not matter what the system does as long as it fulfills its primary goal. Comparative analysis on the emergence of ripple effects with different strategies can be done using an ABM. Furthermore, even though system safety describes interactions and system accidents, and ripple effects are not a cause-and-effect phenomenon, the lens does lean more towards 'explore and act'. In which the systems structure, and past accident inspection, allow for exploration of what possible safety constraints are needed. An ABM approach combined with this could introduce more 'randomness', in the sense that a much more considerable amount of combinations can be explored and even predicted. For example, what if a basic registration is hacked or if a data point mutates, but there are safety measures? What if both happen? The approach would increase the ability to predict and adapt to future common factors for system accidents that might not have happened yet.

9.3 FUTURE WORK

9.3.1 Feedback and ABM development

As the main conclusion on why the design of the ABM was not as compatible with the system safety approach in explaining how ripple effects emerge was the level of the system description, using a different level approach for further research might allow for more optimal use of possible synergies between the two methods. Focusing on the feedback structures often characterized by interactions between policymakers, policy executors, software developers, and citizens, the lack of hierarchical feedback structure can be explored further, and how a lack of proper (shorter) feedback loops contributes to the emergence of ripple effects. Moreover, the bottom-up approach of ABM would prove more insightful as, in these interactions, the transmission of feedback and quality is vital in the outcome. The use, and in this research also execution of, an ABM design could give insight into why ripple effects are often discovered quite late and what the role of interactions between employees working at ministries and execution organizations is. Furthermore, it could incorporate further how likely employees are to trust or go along with decisions made by ADM systems which could be used as input for possible safety constraints. Also, this would give insight into the larger transition, as sketched in the introduction, from street-level bureaucrats to system-level bureaucrats. As currently, the screen-level bureaucrat is experiencing a reduction in the discretionary room due to **ict!** (ict!) becoming ever more critical. Furthermore, executing the ABM design could be verified and used to test different types of safety constraints.

9.3.2 Domain and Audience Validation

One of the considerations in applying the recommendations presented in Chapter 10 is the applicability outside of the social benefit domain. Therefore, using a cross-domain analysis could give insight into the usefulness of a system safety approach, explaining *why* certain behavior emerges and if using the approach is realistic in preventing such behavior. As for people living around the lawful minimum income setting, a safety constraint might be more straightforward as much of their income streams are regulated by governmental organizations. People not living around this lawful minimum income only report their wealth and other assets once a year. Would a control structure still work with the feedback quantity being much lower? Verifying whether the approach using a process model to control a citizen's income works for all types of citizens gives insight into the approach's usefulness in actually designing for safety. Moreover, to ensure one incompletely designed system is not replaced by another, the method should be verified across domains, thus perhaps it works for income (right to social security), but does it also work for other civil rights such as housing, the right to education and the right to healthcare. As the majority of the technical system description can still be used and is part of the socio-technical analysis, this research should focus on the differences in the impact on citizens and whether these are also due to an incomplete or faulty control structure. The main objective for such a research is thus to validate if the system safety approach is actionable in the 'real world and compensate somewhat for the bias endured by this research due to the people interviewed.

9.3.3 Expansion of the term ADM - Combined research with Execution Organizations

One of the main threats to the validity of this research and its associated recommendations is the lack of input collected from execution organizations other than UWV. Furthermore, although useful, the input provided by UWV does not include

the necessary details to accurately assess the feedback structures present within and between execution organizations. Joining research efforts by setting up a research direction specifically with one of the execution organizations might be a way around the information barriers. Such a research set-up could include both ADM system and algorithms that assist in execution work and focus on whether the interactions between such systems may lead to emergent behavior too. Furthermore, this would allow for the further development of the ABM, which would significantly improve with information on how certain laws are executed step-by-step.

10 RECOMMENDATIONS

This Chapter presents several (policy) recommendations targeted at execution organizations and policymakers at Ministries and in the First and Second Chamber. The recommendations are divided into short- and long-term, as some include a significant structural change in laws, their execution, or construction.

10.1 SHORT-TERM RECOMMENDATIONS

The following recommendations focus on applications that are implementable in a shorter horizon.

10.1.1 Expanding upon Ethics

Execution organizations such as Uitvoeringsinstituut Werknemersverzekeringen (UWV) have a manner in which they target ethics surrounding widespread automation. A Data Ethics Committee advises, solicited and unsolicited, the UWV on the impact of data applications, such as Automated Decision Making (ADM) systems, that impact citizens. Both internal and external experts take place on the committee. The committee now focuses on ethical responsibility and transparency. In a way, an internal algorithms register is established in service of this committee. Consequently, UWV has described how forming this committee has allowed them to take back influence on how they execute laws. Because two external (professors) are involved, it is no longer entirely possible to overwrite the opinion of UWV in whether a law is executable or ethically executable in the manner policymakers would like (UWV4). The professors involved would not cooperate with a staged ethical committee without influence. This committee already uses a standardized manner in which specific algorithms are evaluated, taking into account impact and environment, among other things (UWV4). One of the recommendations would be to expand upon the tasks of this committee and build out the requirements for an ethical data application. For example, the committee could set standards for the development process of such applications. The translation mistakes between policy executors and software developers will likely be reduced if multi-disciplinary teams develop such systems. UWV has stated that their decisions should remain explainable. Explainability on both sides, thus (1) how were decision rules developed and by whom, but also (2) how do execution experts then use those decision rules and why should be answered in order to adhere to this explainability ambition. Setting this as a requirement for an ethically responsible data application, it would become part of the standard process of developing such systems. It should be mentioned that while such an expansion would impact the development of internal ADM systems within UWV, it does not get to the root of the more structural processes at the root of the identified ripple effects. Furthermore, it does not address the differences between execution organizations and may even further the divide in approach between, for example, the Tax Authority and UWV. Also, as the committee specifically focuses on ADM systems and algorithms, it does not address the effects due to the governmental data structure described in Chapter 3. Lastly, as the committee does not employ full-time employees, the additional tasks may delay the overall transition towards decision systems with safety in mind.

10.1.2 Updating Mental Models

Increasing sharing of expertise among users and developers of systems may assist in updating mental models held about laws and the controlled process (in this case, how a citizen's income is influenced) that have proved wrong in hindsight. ADM system developers need the expertise of their users and feedback on how it affects their field of work, and users need to understand better how these systems work and what impact that makes on people affected by them. The affected group, citizens, possess relevant expertise and feedback on the operation of these systems. The government can encourage increased dialogue between developers and execution experts, and the people affected by the technology. Concretely, researchers argue to translate this dialogue into mandated feedback mechanisms for ADM systems used in the public sector in domains such as the social benefits system (van Eck 2018, Peeters and Widlak 2018). This mandated feedback structure would result in significantly shorter feedback loops after the emergence of ripple effects. There are different manners in which its structure could be established. One of them is changing how evaluations are done at execution organizations. As the ambition of the government is to become 'one government', ideally, one would have one evaluation of social security, focusing on experience on the citizen's level. Thus, do you feel socially secure? Why not? Why yes? What would you need to feel socially secure? The change in feedback structure would have a two-fold result, (1) earlier detection of ripple effects (ripple effects no longer fall in unmonitored spaces), (2) the timely updating of mental models at execution organizations and policymakers. Updating mental models lead to fewer incorrect process models. It would allow for a better overview of what the controlled process looks like and what other factors influence it, making it more likely to develop laws that are accurately tuned with the process they are trying to influence. Thereby moving away from the evaluation of means and moving towards an evaluation of ends. Nevertheless, the ends must also be subject to evaluation (Argyris 1977). Perhaps goals set when a law was introduced turned out to be outdated.

Such a feedback structure assumes some of the underlying assumptions found in (Roberts 1990), where there should be a 'culture of reliability where it is assumed that each person and component in the system operates liable there will be no accidents. As shown in Chapter 3, such a culture does not exist yet. The suspicion citizens propagate towards the government and execution organizations is based upon years of experience and may be hard to eliminate. Furthermore, it is important that non-measurable feedback also has a place within the feedback structure. However, as the structure should encompass several organizations, perhaps even ministries, and should reach citizens, a place for more informal feedback may not be realistic. Furthermore, a risk of such an increased amount of feedback may be that recommendations do not pay sufficient attention to the strength of the existing situation and the risks of the new situation as they are driven by individual case feedback (De Bruijn 2007). The focus of feedback on individual case levels also may cloud the updating of mental models, as there are, for example, many different types of Wajong benefit receivers. The structure should be sufficiently refined so that one experience by a certain citizen does not necessarily overwrite the mental model held by the entire target audience. Or only perceiving feedback on individual cases on their own, thereby not giving sufficient attention to the question of why and how one case relates to other cases.

10.1.3 Interaction Information

For several social insurances, 'calculation help' is present on the website of UWV. Such applications calculated the expected gross income of a citizen given their income, whether they use wage dispensation and when they first were eligible for social insurance or service. As benefits by the Tax Authority are calculated based

upon the gross income of a citizen, such 'calculation help' could be expanded upon with the impact on one's benefits, as many interviewed citizens indicated that the interaction between insurance and benefits leads to a problem with paying back a large amount of money. The Tax Authority currently provides benefits upon request and checks the eligibility of a citizen one time per year. By including a module focused on the impact of gross income (an increase due to an amended law, for example), citizens can change their request for benefits provided by the Tax Authority accordingly, leading to a shorter time of the incorrect amount of benefit being paid to and a more minor overall effect. The expansion would not solve all problems but would make the change in benefits more explainable and transparent. It would also communicate to citizens that even though gross income might increase due to new legislation, this does not necessarily mean their net income. A possible setback of such a calculation help may be that it is too hard to realize. If it had been possible, given all the different exceptions and transitional agreements, it would have been developed for execution experts themselves.

10.2 LONG-TERM RECOMMENDATIONS

The presented recommendations require significant time to implement or take a legal overhaul of the current system.

10.2.1 Shortening the loop

One conclusion derived from the system description was the long feedback loops that characterize the system after a ripple effect has emerged. The reason was the tendency to lay down how the law should be executed in the law itself, leaving little space for on-demand feedback when execution difficulties arise. As the citizens' population is diverse, it may be hard to foresee all possibilities in which law might prove in-executable. Providing more discretionary room within may prove a solution. UWV has indicated that problems they experience with the gross pay-back of benefits[1] that were provided net is a problem they would want to solve, but cannot right now as it is part of the law. This may be done using several instruments. However, the structural change would imply breaking the habit of solidifying the execution detailed within the law. On a minor scale, problems in the execution are being identified and put forward to be solved by execution experts. An example of a successful initiative is garage 'de bedoeling' which would translate to garage the meaning, in which experts in execution can put forth dossiers of citizens that fall in between laws, experience stacking of laws, or law works out specifically adverse for a citizen. In these cases, a multi-disciplinary team would work together to find a solution and document this to ensure similar cases are solved similarly. However, this is only possible when there is enough discretionary space for these execution experts to navigate toward more workable solutions within the space provided by the law. This problem has been identified by execution organizations themselves that state that sometimes they find a solution but are not allowed within the legal room to apply it to the citizen. They refer to the quote by former Raad van State president, 'there is nothing more unequal than treating unequal people equally' (UWV 2022b). Furthermore, providing more discretionary space makes it easier for citizens to appeal a decision made by execution organizations. Citizens can only appeal the process (did the process include all relevant factors, was it transparent) and not the actual decision (UWV2). More discretionary space would imply that execution organizations can be blamed for not adhering to the guidelines for good

1 When citizens have received too many benefits, but this is concluded in the new year, net received benefits should be paid back gross. At the end of the year, the overpaid amount can be asked back from the Tax Authority (Radar 2021).

governance as they did have the legal space for it (LCR1). However, not specifying execution measures in the law might also imply a new array of risks in which large execution organizations have to work together without a political mandate to do so, which might exacerbate existing tensions between horizontal and vertical interests.

10.2.2 Limit on Transitional Agreements

One common difficulty in executing laws and automation the processes executing laws mentioned is the large number of transitional agreements accompanying a new law. Implying that many information systems exist parallel upholding the transitional agreements. However, if new laws were consistently applied to the entire population, unforeseen interactions would not appear as likely. In the current system, it may be virtually impossible to design without having asynchronous evolution if different versions of the law can exist next to each other. Instead of having transitional agreements, one might state that a new law should work for the entire population. Also, this would reduce the potential number of translation mistakes, as there are fewer, often unexplainable, exceptions to the law. Thus it should not matter, as in the example of the new Wajong law, if you turn 18 before 2015 or after 2015. If policymakers genuinely believe that the new rules surrounding the Wajong help (all) citizens improve their social security and participation, why not apply them to the entire population? In the new Wajong, for example, a significant part of citizens that used to have a right to the Wajong are now placed within the Participation law because they have some ability to work (UWV1, UWV3). Some stakeholders stated that the new law is a form of a disguised budget cut (LCR1). If the new law applied to the entire Wajong population, it would force policymakers to ensure the new law and associated changes in the height and eligibility of benefits are explainable. Furthermore, on a personal note, it would equalize generations and, in a way, consider generational discrimination. Currently, young people feel the brunt of the austerity of the social system in the Netherlands, and because they are not 18 when laws are changed, they have no legal right to oppose it. In contrast, older generations may enjoy a much more convenient or generous version of the law for the rest of their life only because they were born a few years earlier. However, it should be mentioned that this recommendation was formed from insights from interviewees and the researcher's opinion and does not necessarily find its basis in system safety. In order to successfully execute such recommendations, extensive overhauls in the political system are required. As transitional agreements are sometimes even laid out within a law before it changes, citizens can always retain their right to Wajong benefits, for example (W1, W2).

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A INTERVIEW QUESTIONS

The appendix gives an overview of the several interview set-ups used in the research. As per the methods, all interviews are semi-structured.

A.1 GENERAL INTRODUCTION

The aim of this interview is to describe and understand the system associated with law automation within the social domain for a Master thesis research at the Technical University Delft. The main aim of the research is to explore and capture the emergent (often negative) effects of law automation that can harm citizens.
The information provided during the interview will be summarized and anonomyzed and used for the purposes of the master thesis. If possible, the interview is recorded.

A.2 INTERVIEW SET-UPS

A.2.1 Wajong Receivers (W1, W2, W3, LCR1)

The main objective of the interviews is exploring the following points:

- Impact of harmonized Wajong law
- Explainability of Wajong Law
- Feedback and communication with UWV
- Effects of concurrence of laws
- Social impact of the social security system
- Role of client boards
- Experience and feedback with Tax Authority
- What would be a socially secure situation?

A.2.2 Insurance Physicians (UWV1, IP1)

The main objective of the interviews is exploring the following points:

- Wajong application from the perspective of an insurance doctor
- Documentation obligation
- Communication and feedback within and with UWV
- Updating work capacity assessment
- Problems within Wajong legislation
- Consequences of Wajong harmonization

- Inclusion experts in law design
- Role of information systems in the job of insurance physicians

A.2.3 UWV Employees (UWV2, UWV3)

The main objective of the interviews is exploring the following points:

- Algorithm and ADM use in execution
- Interaction between laws
- Design process new execution street for new legislation
- Political pressure
- Difficulties in execution

A.2.4 Ethics Committee (UWV4)

The main objective of the interview is exploring the following points:

- Role ethics committee
- Decision-making power ethics committee
- Role political pressure
- Interactions data applications and laws
- What is human oversight
- System perspective in algoritmic oversight

A.2.5 Logius

The main objective of the interview is exploring the following points:

- Role Logius
- Logius' innovations and their role
- Future of the digital government
- Legacy systems
- Design process digital government building blocks and feedback
- Risks and opportunities of informationchains

A.2.6 Data Highways (LA1, BKWI1)

The main objective of the interviews is exploring the following points:

- Role of informationchains
- Risks and opportunities of information chains
- Risks because of the chain
- Impact legacy systems of execution organizations on the chain
- Design process chain changes

- Control and monitoring the chain
- Feedback on data quality
- Future of information chains
- Future of the Digital Government

A.2.7 System Architects (ICTU1)

The main objective of the interview is exploring the following points:

- Role of system architects
- Explanation of the five-layer model
- Risks and opportunities due to information chain use
- Computer conscious law making
- Legacy systems at execution organizations
- The role of shadow databases
- The risk of concurrence of laws
- Future of automated decision making
- Future of the Digital Government

B SUMMARIES OF INTERVIEWS

All interviews are given a number corresponding to the number in table 2.1. This number is used in several chapters to refer to interviews. All summaries are checked and agreed upon by the interviewees.

B.1 INSURANCE PHYSICIAN (IP1)

Interviewee description
Interview with an insurance physician formerly working at the UWV for many years. He is focused on legal disputes between clients and the UWV and moral deliberation and ethical consideration in disability assessments of clients. Since his departure, clients are more likely to contact him, sometimes leading to advice on the best course of action.

The interviewee describes multiple issues related to executing the (new) Wajong law. Namely, conditions are challenging to quantify or describe, often leading to people trying extremely hard to prove their right to Wajong benefits. Furthermore, there are some deviations between insurance doctors and labor experts in whether people's sustainable work capacity is zero. The introduction of the criteria of 'sustainable work capacity has not made the process surrounding the Wajong any easier. Before the Wajong 2015, a criterion perceived the actual loss of wages as a criterium just as the WIA uses. The new criterium has many rules: being able to work 4 hours a day, 1 hour non-stop work, etc. The criterium was never properly evaluated. They have seen a lot of differences in interpretation between insurance doctors and labor experts.
The criterium has been co-created between SZW and UWV. Here they focus on what is legally feasible. However, we doctors encounter a problem. One may not have work capacity now, but the next question to be answered is: can you develop it in the future (an aspect which also has to be assessed)? If this is the case, you disappear into a big hole. If you are lucky, you could still be entitled to assistance (bijstand). This overall assessment of saying people have no chance of developing labor capacity is complicated regarding medical content. A positive development is almost always possible from the perspective of professional ethics. However, many interests play a role when this issue directly influences someone's eligibility for benefits. This leads to challenging and annoying, and often unproductive discussions. The idea of 'writing someone off' makes doctors feel uncomfortable. I will not say that there can be no further development for clients. It's not a good law at all. On the other hand, if you are rejected according to the criteria, all doors close. You have no work capacity. It feels like 'game over' while some claimants would sooner or later like to participate one way or another. New solutions must be sought for this situation, making the system messier than it already is. Overall, it's much tinkering with criteria, guarantee schemes, and transitional arrangements. It has become the most complicated disability law in the Netherlands ever. At the time, there was always only one legal policy officer at UWV who knew everything about the Wajong Act and its changes over the years.
Being forced to prove that your handicap can never improve feels immoral, which was not the case in versions before 2015 Wajong. The result of stricter criteria

means that the inflow is much lower than before, and it has become much more challenging to qualify for Wajong; thus, people are less likely to apply. The influx was far too high, and SZW wanted to counter that. From that perspective, the law was successful, but it often turns out sour in individual cases.
If you have not been able to function in the labor market for ten years, you will be eligible for the Wajong Act, which does not require any assessment. This feels counterproductive as nothing is allowed to happen for ten years, which is at odds with the idea of participation. They see people give up and limit themselves to doing volunteer work because they can never exceed the social minimum.
Generally, there is a collaboration between an insurance doctor and an occupational health expert for an assessment. One of the problems is that the occupational health expert has no insight into the medical data. The main idea is that the labor expert should be able to work with the conclusions of the medical report concerning the work restrictions but not with the diagnosis or medical history. Now you have examples where you can read between the lines about autism or AHDH, but you are not allowed to mention the actual condition or diagnosis. It can be complicated to consider someone's labor capacity without a medical explanation of the diagnosis. This is not specific to the Wajong Act but broader for the WIA. Therefore, it depends on how the insurance doctor interacts with the employment expert in these cases. If they do not interact regularly, misunderstandings arise quickly. Furthermore, it also leads to misunderstandings with the client. Sometimes, the client thinks that the employment expert does not understand what is happening to them, which leads to lots of misunderstanding and frustration. The insurance physicians work with two versions; the medical examination report and the 'cleaned' report, which serves as an insurance medical report. The diagnosis and other medical data are not included in this last report. After the benefit decision, the client receives the cleaned-up version by default. Often clients get confused as they feel there is little information in the report or this information is incorrect.

Systems
UWV uses many systems. To find the correct information, you must search very carefully; there's probably a lot more than you think. There have also been discussions about dealing with duplicates, signal terms, certain code information, and what you can protect to ensure a client's privacy.

B.2 INSURANCE PHYSICIAN AND POLICY ADVISOR (UWV1)

Introduction
The interviewee works as a Policy Advisor for Social Medical Affairs at the UWV. He started in 1985 as a doctor at the Medical Service and has been a registered insurance doctor since 1992. Since 2002 he has been working at the UWV in the department that deals with social and medical affairs policy. In this department, they advise the management and the Board of Directors of the UWV and - often indirectly - the Ministry of Social Affairs and Employment.

Signaling and Feedback
Employees of this department receive signals from both the implementation, execution and clients and try to pass them back to the Ministry of Social Affairs. However, this does not always lead to the desired changes in the law or its implementation, even if it concerns matters that lead to more consistent regulations or improved execution. The interviewee indicates that he has a poor idea of what is precisely causing this.

Construction of Laws
In principle, the UWV is involved at a very early stage. However, which people are

involved varies and has changed over time. The interviewee indicates that these are often not people from social and medical affairs but the strategic office (the staff service of the Board of Directors). At the moment in the development of the law, people from social and medical affairs are called in, but these are often not content experts. The executive professionals often only speak at a late stage when things are on the table that focuses on the professional side but then there is little room left for change. The interviewee indicates that this 'distance' has increased. In the past, more executing professionals were involved early in the group. Over the years, content experts have moved further away from the legislative process. One reason for this could be that there are now more sections at the UWV, which means that the distance between implementation (policy) on the one hand and the level at which decision-making takes place has increased. An example of this is the revision of the WIA. At the time, the group that was involved from UWV looked even more diverse. The group included people closer to the implementation, such as social and medical employees and people from the strategic office.

Before the law goes to parliament. The UWV is first asked to perform an implementation test. This test is performed once and is fixed from that moment on. He also mentions that because the implementation test is at an advanced stage in the development of the law, a great deal has often already been negotiated between the UWV and the Ministry of Social Affairs and Employment. However, UWV can still exert its influence before the chamber hearing by approaching the House of Representatives committee. Before a law is enacted, there is an extensive political process. Several political interests are weighed here.

Political pressure

In the past, the interviewee noticed when a minister had a specific plan, for example, with the amendment of the WIA, where the law had to and would be amended within the minister's term of office. This was under enormous time pressure at the time. The pressure comes not only from the Ministry but is also experienced by employers and trade unions.

Process Wajong renewal 2015

Social, medical experts, and policymakers were mainly involved in developing the work capacity criterion. In addition, all existing Wajongers had to be re-examined (around 180,000). Together with the police department, they have devised and followed a procedure based on pre-selection. A decision tree was used in which a pre-selection was made based on information from the file of existing Wajongers, with the result: permanent or no work capacity. In addition, some of the Wajongers were called up for a new examination if no conclusion could be drawn based on the pre-selection or if the person concerned disagreed with the outcome of the pre-selection. In addition, as usual, clients could object to the final decision. This process took several years.

Client Experiences

Sometimes, clients come to the UWV with an experience that is very important to them but not for their work (disability) assessment. This experience could be about their work experience or health, which does not affect the assessment 1-on-1. It is essential to train people internally on why certain decisions are made so they can explain to clients which parts count in this assessment and which do not.

Difficulties in implementation concerning legislation and regulations

Previous cabinets sometimes tried to accommodate interest groups, and ministers started to plan and tinker with the existing legislation. These adjustments were in each other's way and presented problems with execution. Another example that the interviewee cites is that concepts can be defined differently in different laws, and this applies, for example, to the concept of daily wages. Years of subsequent

legislation, often also creating many 'exceptions to the rules, has resulted in the implementation becoming too complex here and there, as a result of which only a few specialists within the UWV are aware of the ins and outs. In this context, the interviewee describes a colleague (lawyer) who is virtually the only one who knows everything about no-risk policies. When this colleague explains something about it, most of those present drop out because of the complexity of the matter, this complexity increases the risk of errors, which can harm clients' interests.

Civil servants at the Ministry are far from implementation practice. There is a significant variation between civil servants in the extent to which they are open to input from execution practice. That also works to the extent to which one can exert influence.

Examples WIA and Wajong
WIA
The difficulty with the WIA assessment is that a statement must always be made about the sustainability of occupational restrictions. So it is a forecast. A prognosis says something about what the insurance physician expects but not what will happen. In the future, there are always unknown variables. The only thing doctors can predict is whether someone really cannot recover, so recovery is out of the question (for example, in rheumatism or metastatic cancer). From the professional point of view, adding a 'low chance of recovery to the sustainability criterion was undesirable because of unknown variables that cannot be adequately assessed. There is a much larger bandwidth visible in the results of the assessments because doctors may subconsciously project their perception and standards onto someone's prognosis. Another problem that arose due to the creation of two schemes within the WIA was that people who were permanently fully incapacitated for work and, therefore, eligible for IVA were not eligible for reintegration resources. So even those who became incapacitated entirely for work on occupational health grounds but who were often still capable of everything could not claim help with reintegration. This presents the employment expert with a dilemma in implementing the law because the only way to support someone who wants to and can return to work would be not to grant an IVA. This problem has been raised and mentioned after the law's implementation but has not been changed. The problem was also written down in later evaluations, but the Ministry did not amend the law and its implementation.

Wajong
The interviewee describes that the permanent lack of work capacity test remains an estimate, mainly because someone is young. The bandwidth of variation is narrower within the Wajong Act than within the WIA Act. Only those who are eligible for the Wajong Act are those who have a permanent lack of work capacity. Therefore, no group with a 'low chance' is also admitted. On the other hand, the limitations are now being looked at and the occupational health aspects: to what extent is such a development still possible that someone will ultimately have access to work capacity? Sometimes that is relatively easy. For example, if someone has such a severe personality disorder, doctors are sure he will never be able to develop employee skills. However, it is often not so black and white, and it is not certain that someone cannot develop further. As a result, few people have been admitted to the Wajong Act since 2015.

B.3 ADVISOR IT (UWV2)

Introduction The interviewee has been working at the UWV for nine years in the advisor position. Her position focuses on, among other things, ICT and data.

Algorithm use / Automation within UWV
At the UWV, algorithms are used in different layers of the organization. Both in the implementation and execution of laws, An example of a support algorithm is an automatic client classification for collecting payments. The interviewee mentioned that the UWV is aware that this type of classification may also lead to employees of the UWV calling differently classified clients with a biased attitude.

An example of an algorithm used in executing laws is the Straight-Through-Processing (STP) technique. This technique is used when applying for unemployment benefits (WW). This algorithm ensures that someone can automatically apply for unemployment benefits, provided that no red flags are raised within this process. If this is the case, an employee of the UWV will still assess the application manually. At the moment, there is an STP rate of about 15%. Variables that are checked include; entitlement to benefits, age, employment history, etc. The STP process is easier for people who have a well-documented employment history. Several "ejection reasons" act as red flags in the STP process. The interviewee indicates that automation and algorithms are used within the unemployment benefit (STP). UWV also works with the 'Work Explorer' questionnaire with several variables. Based on this questionnaire, an estimate is made of the chance of a client returning to work within one year; based on this outcome, various types of services are offered to the client. The Work Explorer is an ICT application of the UWVWerkbedrijf.

Wajong
The interviewee indicated that the Wajong Act is very complex legislation, which often goes hand-in-hand with less implementation automation.

Policy/Law vs. Algorithm
According to the interviewee, if things go wrong in the implementation, this does not necessarily mean that the automation is not working correctly. It is also possible that social legislation does not interact appropriately, and we only find out about this during the implementation phase. In that case, it is more beneficial to adjust the law than the automation application. Some laws, the interviewee, points out, are just really complex. An example of this is the WIA, and the UWV even offers webinars for applying for a WIA benefit.
A distinction is made between 'smooth' and 'non-smooth' cases. The latter category concerns clients who have to deal with a combination of different laws or regulations within or outside the UWV. In very complex situations, a client has a permanent contact person within the UWV.
SUWI chain UWV uses the SUWI Net (operated by BKWI). This party is also working on a module for the seizure-free foot. UWV supplies data to the SUWI chain and extracts it when necessary.
Debt chain The Ministry of Social Affairs and Employment is the client of this innovation, and UWV will be one of the data users. The chain must function here so that all relevant debt claims agencies work with the same attachment-free rate and are allowed to share this among themselves. This chain includes, among others, municipalities and should ensure that signals about clients getting into debt problems are picked up earlier.

New legislation (implementation test and implementation test)
The interviewee broadly describes the following timeline in the creation of a new or amended law: (1) political desire, (2) new/amended law, (3) UWV. Step 2, for example, includes the execution test. UWV always tries to indicate clearly in the implementation tests when something is or is not (yet) possible. In the latter, the UWV has become increasingly transparent in recent years. This ensures that sufficient urgency is felt within the Ministry that it is a precondition for the implementation that x, y or z is changed in the law or the implementation. In addition, the UWV is

working with the Ministry on setting up the Implementation Test. This test is done after the law is enacted, and an analysis is performed to verify whether the implementation of the law is going as expected. For example, this test also identifies the negative side effects of the law's introduction so that the Ministry and UWV can take measures together to deal with these unintended side effects.

Political reality
The UWV is, despite the merger of the various organizations in early 2000, it is still quite a fragmented organization. The organization is partly still compartmentalized, and a lot of expertise is located within these departments. For example, the one expected problem is the knowledge that flows away because people are retiring, and their knowledge of the law and internal processes is not sufficiently documented. This pillarization is also visible in using the many different IT systems at the UWV. Due to the establishment of a merger, different departments still work with different systems, some of which are legacy systems from before the merger. The UWV has a combination of new information systems and old legacy systems in almost every department. The interviewee indicated that all implementing organizations are affected by this. The implication of the size and structure of the organization makes it difficult to get an overview of which automation applications a client will be dealing with. A client may have to deal with multiple departments in his client journey. Automation applications are developed both centrally but also by specific departments that are then also responsible for this.

Another problem for the further development of the ICT and information structure of the UWV is that the organization can never leave; the service has to run day in and day out, 24 hours a day. The UWV provides more than 1.2 million monthly benefits and is called more than 1 million times a month, with the question: when will the money be in my account? This example illustrates very well how dependent people can be financially on the UWV and how it is not an option to shut down for a month. A solution that is occasionally used for this is the parallel development of new applications that are first rolled out in parallel on a small scale to test them.

The UWV cannot keep up with the Ministry at the pace it changes policies and laws. It often happens that the UWV is still executing and changing the implementation processes of legislation from the old coalition agreement if the new coalition agreement has already been signed. The UWV would like to be involved earlier in the law's construction, which is now being worked on.

GDPR
In an information chain, different execution institutes can exchange information more broadly, provided that information is necessary for executing the law. All information that the UWV exchanges within the SUWI chain is necessary to implement social legislation.
Future

- A track-and-trace code for a benefits application for a client which allows a client to gain more insight into the status of their request.

- A customer file: the interviewee gives the example of Wehkamp; if you bought something there two ago, left a review six months ago, and now call customer service, then the operator can see exactly what your history is with De Wehkamp and can adjust the service accordingly. At the moment, this is not done enough at the UWV, and because of the pillarization of the organization, it is sometimes challenging. The customer file should provide more insight into this.

- People on unemployment benefits must report their income every month. However, some clients earn 0 euros every month; they still have to enter 0 euros every month. The UWV is looking into whether this could not be made more customer-friendly.

B.4 LEADERSHIP ROLE (BKWI1)

Introduction
The interviewee has worked at the UWV for more than ten years in various departments, focusing on strategy, finance, and ICT in recent years. He currently works at the BKWI organizational unit within the Business Office.

What is BKWI
BKWI is a separate and recognizable organizational unit of UWV but also serves other parties within social security, such as the SVB and municipalities. The initiative for BKWI arose from the SUWI Act and the Single Request Data Act. Article 62 of the SUWI Act stipulates that UWV, SVB, and municipalities provide each other with all data and information necessary for the performance of their duties and that they jointly maintain the electronic facilities for processing this data resulting in BKWI's services in the form of Suwinet. It functions as an exchange platform of information and data and, in that respect, can be seen as a kind of data highway. BKWI and BKWI perform no data processing steps and do not store information. BKWI facilitates access to data for (executing) organizations that need this data. They make a distinction between viewing and reading. Suwinet-Inkijk allows government organizations to consult citizens' data, stored at other government organizations or basic registrations, in a web application. Suwinet-InRead allows government organizations to read data from various other government organizations directly into their business application and fill it in in e-forms. In both cases, data is retrieved in real-time. The main difference is that a web page is used when viewing (easy to implement, but this does mean that people have to retype information if they want to store it in their system). With reading, the information is directly connected to the customer's systems (more complex to realizable, but it is faster and prevents possible errors when typing).

New laws
When UWV, the SVB, or municipalities want to consult new data via Suwinet, the BKWI will check whether there is a legal basis for the data exchange. Data may often be shared from the GDPR point of view, provided a legal basis exists for this. However, a new law does not have to be the only reason to exchange new data. There is a difference between Suwi parties (UWV, SVB, and municipalities) and non-Suwi parties. Non-Suwi parties must specify in more detail that they commit to the Suwi policy frameworks (UWV, SVB, and municipalities are already legally obliged to do so). Data is disclosed in various ways via Suwinet. For this to run smoothly, there must be uniform rules and agreements regarding privacy and security, ICT management, data standards, and the chain's architecture. In practice, BKWI sees new architectures and agreements often drawn up for new data exchanges, and this is inefficient and leads to a proliferation of rules and accountability mechanisms. To keep the situation workable for implementing organizations, it could and should be more connected to what is already there.

It regularly happens that source holders and customers implement changes in their system that have consequences for the chain. With adaptive maintenance, BKWI ensures that the necessary changes are implemented so that other parties in the chain continue to receive the data required for their tasks. BKWI does more than only

inform, and they make the necessary system adjustments.

Debt Chain
In 2019, the Ministry of Social Affairs and Employment commissioned BKWI to co-develop the necessary technical provisions for the vBVV Act in response to the Broad Debt Approach Action Plan. BKWI has been working in the debt chain since that date. However, BKWI has developed the debt chain much earlier (ca. 2019). The vBVV Act regulates that the attachment-free rate of debtors can be determined using computerized data. Together with Stichting Inlichtingenbureau (IB), BKWI has been commissioned by the Ministry of Social Affairs and Employment to develop a central vBVV facility to calculate the attachment-free rate. The central facility enables data exchange between creditors and thus ensures that citizens with debts must provide less information. The central facility also ensures that the attachment-free rate is determined unambiguously. Furthermore, BKWI has developed the data transport for the central facility, making it possible to exchange messages with the sources BRP and UWV and message exchange with the confiscating organizations SVB, LBIO, and CJIB. The IB has created a portal for municipalities and water boards and has developed a calculation tool. The idea of the chain is that every relevant organization involved determines the attachment-free foothold for a citizen in the same way and based on the same information. The attachment-free rate depends on the situation and is the part of the income or benefit that cannot be attached so that citizens with debts have enough money left to provide for their primary needs. Benefits may also be seized.

Political reality
Policies are increasingly transcending Ministry, and so is data exchange. Currently, one Ministry is responsible for the legislation; however, the other Ministry is responsible for the implementing organization that implements this law (for example, in the case of the allowances affair). That can cause ambiguities. Complexity is not necessarily due to automation but, in essence, more due to the complexity of the legislation. Furthermore, the influence of the media and political pressure ensures that social legislation is becoming increasingly complex. One of the initiatives working on streamlining this more is Work on Implementation. Policies affecting citizens are often fragmented across ministries and implementing organizations, making it complicated for citizens to estimate the effects of a change on their situation.

The interviewee mentions that income policy is an excellent example in this regard: When clients receive a Wajong benefit and have a (small) job, they probably want to know what it means for their situation when they start earning more. It is easy to calculate the effect on the Wajong benefit, but it becomes more complicated when one wants to know the consequences for their allowances (MinFin / Tax Authorities) and the child schemes (e.g., Childcare Allowance; SVB). Also, a client may have a partner with a benefit from the Participation Act (municipalities), you are still following a course (DUO), and there are probably many more examples.

The interviewee mentions how it is not a realistic solution to bring all the policies that affect the citizen's income under one Ministry. This is not realistic but also unnecessary. Automation/digitization can offer a solution by developing an environment where all citizens' information comes together, and citizens can turn the buttons to assess the effects. A precondition for this is that a) someone is given/-takes the mandate to build such an environment and b) the policy (and how this is implemented) is adequately coordinated.

B.5 HEAD OF NORA (ICTU1)

Introduction to Research
The research is about capturing the effects of automation of law implementation, mainly within the social domain. We are now working from direct and indirect ripple effects. Sometimes they are due to automation, but sometimes it is due to the system's structure or the law itself. Eric Brouwer is interviewed in his role within ICTU and specifically NORA.

Conflicting legislation
The interviewee worked for 8.5 years at the Social Insurance Board, where he supervised organizations such as UWV. At that time, a number of their processes and the effectiveness of ICT investments were assessed by them. The report published was mentioned in the Chamber by the minister. The minister thought it was good that it was written down, but nothing further was done with it. The report focused on how different legislation can interfere with each other. It also showed that some ICT investments were unhelpful because they were not in sync with the development of the law. That's tricky because they weren't allowed to assess the law at the time, and we had to take it as a given.

The interviewee also found it difficult in conversations about architecture. Why aren't we talking about the law? It was always about agreements on processes, systems, and the networks with which they exchanged data but not about policy or the law. That's why he focuses on the five-layer model.

The Service Concept
always starts with agreements about what you want to regulate. For example, the agreements that the Tax and Customs Administration and the UWV make about data exchange. The theme of chain control originates from there. The same applies to the wage tax return chain. It's about the government speaking to citizens with one voice. The citizen expects things. Those expectations are based mainly on the agreements made in politics, laws, policy documents, and communication. From the publication on rijksoverheid.nl, citizens can see what they are entitled to in which situation. That is the start of the agreement.

Something can go wrong in implementing or fulfilling this agreement, and you must be able to repair this. Therefore, there is a need for a feedback loop; how is the agreement's implementation going, was that expected? And if not, do we have a process to improve this? That's the basis of the service concept. But you don't see that reflected almost anywhere in the design of government service processes. It is a shame because that would practically be the quality test of the architecture. In addition to the implementation test, you would also have an implementation test after the law has been in process for a year. Does the system work as intended?
It's a shame that when the first system architecture began in the Netherlands 20 years ago, agreements were not immediately made. The Netherlands is a forerunner in this. This is also due to the sharing of knowledge. You can see that now, for example, with the GDI.

ICTU frameworks and rules
ICTU is a minor player. Yet it is important because the ICTU contributes not so much to a single government organization but to where they come together—working together and dealing with ICT. For example, in chains, you often see that one or a few large parties are dominant and that the other parties then have to drop out. The police are often dominant in a chain with other judiciary parties. Or in the cooperation between the UWV and the Tax and Customs Administration, where it is difficult to harmonize the 30-year-old understanding of the concept of salary. But

those are also the things you learn a lot from.

If you start looking at social security and the work and income domain, you are in the KARWEI architecture. Within that domain, you already see much overlap between, for example, the wage tax chain and personal budgets. So that's an excellent example of social security on the one hand and healthcare on the other. There are all overlapping domains, and it's never strictly one domain. That's where NORA also becomes relevant with tips and frameworks for collaboration, such as the chain management that all domains need.

NORA is not ICTU, and NORA is one of the programs within the ICTU. ICTU is an advisor, system developer, project manager, or temporary management but always from the initiative of a partner. And ultimately, it is always transferred to a management partner. DigiD is an example of something that ICTU set up, supervised, and handed over.

Quality testing
You start with the agreements around a system. That means starting with social values. In NORA, these are called quality goals. That's what policy frameworks and legislation aim to do. The Dutch government also researches the quality of services in this way. People are often probed on about twenty/five factors—speed of service, transparency, or safety. One aspect becoming more important is reliability, and those aspects change over time. The interviewee thinks service agreements should focus solely on the social effects, not the system; that's irrelevant. Legislation should be about preventing or stimulating specific effects in society. The desired output should be determined first before you start talking about time or budget. After, the laws and proposals or how we should do that are relevant. The implementation should involve executing organizations that, given their time and budget, can determine what the service can look like. Now you move towards a service design, an outline of what service could mean, which also involves quality criteria.

Concrete agreements are needed before looking at the systems that need to be developed, what data you will exchange, and when. Then to check whether your output is correct or desired, measuring points in different places in your system are needed. However, this does not mean you have to automate everything; you mainly want everything to be accessible up to the counter for people without digital skills. But behind the counter, everything can be digitized and automated. However, measuring points should not solely be in your digitized system, but there should also be sufficient contact moments with the client. What happens if law execution goes wrong or someone does not understand it? Is there a phone number, or can you send an email? That's also a feedback design. Depending on the type of service, you have different test moments and criteria. In the five-layer model, each layer has another testing moment. It is also essential to include citizens with multi-problems in the assessment moment. It is clear who is responsible for which service, but NORA also focuses on who is responsible for the convergence of services and their effects. This could be, for example, a minister or secretary of state. This would work better than it does now because there would also have to be accountability in the Chamber.

Errors in the law
Error is the law structure is why architecture is needed because they are always related things. When someone starts a new program, people should be aware of the context of the question, what is already there in the domain and how that affects the law or project. There is also duplication of effort; WaU is working on one counter, but they delivered a report of which 20 versions already exist.

For example, on GDI architecture and GDI interaction, there have been reports for 30 years. There are all architectural designs from large but diverse parties, which we have just updated. WaU does not use those. Many places have a long history and experience with GDI and system architecture. But still, the choice is made to pull up a can of external advisors. One million euros in tax money further and you have another report.

Chain connectedness
The chains are connected, and the same parties come back in different chain plates. The only new thing is the different cross-section used for the new report. A new manager often means a new investigation and a new report. For administrators, that's fine, but for architects, it feels like the umpteenth time wine has to be put into new bottles. All those reports don't change anything in the base.

Legacy systems and Compartmentalization
UWV, for example, works a lot with funnels. A lot is coming at them, from the WaU or Europe, for example. Change is needed, but they are also working on a significant system change. There is a list of priorities, so they will adapt at a different pace than other parties. Manifesto parties (UWV, Tax Authority) can develop things themselves significantly. They can attract ICT people and manage and innovate processes. They work with mortuary construction to eliminate old processes and systems and put in new ones. Old systems programmed with Cobol will not work with APIs (based on the Environment Act, which prescribes APIs). Municipalities will experience this as a split. Employees don't want to work in a department with many legacy systems because they want to innovate. But you still have to keep those systems up and convert to a certain extent, but that takes a lot of money and time because rebuilding an existing house is much more complex and expensive than new construction. This conversion is the priority and the big challenge for all those big parties. This has to do, among other things, with business operations, enterprise architectures, and programs within and between organizations. The complexity of this transition should not be underestimated. It is not surprising that it takes years.

Dominance within the automation process
Small municipalities find it very difficult to do anything themselves. They don't have the people for it and can't attract them because there is no budget. Therefore, there are many mergers of municipalities, especially in the back office. Requesting a BSN in Amsterdam is the same as in Groningen, and you could have one big Municipality at the back end. The same as one big Tax Office, UWV, or Police. Especially in the back office, because now we work with clones.

Shadow databases
Temporarily, this is still possible. On paper, certainly. But it will be different in the future, especially with the use of APIs and self-sovereign identity (SSI). Because then you get more of a yes/no in a decision instead of the whole file. So, for example, is someone 65? Yes, instead of someone's date of birth. So then, parties only see the information strictly necessary for the decision. Because it doesn't say in the law that, for example, Laurie gets a benefit, but that if a citizen meets the following requirements, that person gets a benefit. So then the Municipality doesn't need to know who you are but only your bank account number. Another authority can check again based on other data whether the decision is correct.

Complexity that transcends organizations - limits of the basic service concept
You see that it becomes challenging with multi-problems. In other words, if several laws converge on a single citizen. This is even more difficult than when several organizations have to implement one law together. Suppose different services have to be provided by different organizations for a citizen. So you are not only unem-

ployed, but you are also sick, you have a child, and you are divorced. Then you see crazy things happen because many organizations think I'm used to carrying out only my piece of the social system. If things go wrong in executing laws for clients experiencing multi-problems, you see that sometimes people even commit suicide because the legislation does not appropriately help them.
A former colleague of the interviewee is currently working on the Flint project. Many legislative lawyers are working on setting up the law differently so it can be better automated. That you can better translate the rules from laws into programming rules, that's why the interviewee also argues for open-source software, because you can read the legislation, but not software, unless it is open-source. Then there can be better control. We can then check whether the law has been interpreted correctly. All laws will soon be regulated in this way.

Literature sometimes describes making laws for automation as something negative as laws are then made for automating quickly instead of focusing on the social effect you want to achieve.
The interviewee acknowledges this. He contributes that the bigger problem is that we have already determined how laws should be executed in the law itself. That's very difficult because you make it very difficult to adjust things. So you can't make absolutely any easy adjustments without the issue first going to the Chamber, having a debate, having a solution thought out by policymakers, and then having feedback.

Ideally, politics would stop with this practice. The Ministry and Chamber would make laws with outcomes in the back of the mind but not written down in such detail. That doesn't mean that the service or law should not be the responsibility of a minister but more that the Chamber has to be about the social implication of what we want to achieve and the executing organizations about how we are going to achieve that.

Sometimes it's more expensive to exclude people than to give everybody a surcharge, for example, because the execution costs are so high relative to what you achieve. That is something an executing organization would know, but policymakers might not. Thirty-five years ago, the idea was that we would move more and more toward target legislation and therefore have fewer laws. But all we have is more laws with more implementing rules leading to problems because the Chamber decides with several policy officials how the implementation should do. It would be nice if they would steer more on output. You have to reason based on the social effect. Now it is decided in advance that something should happen. That will then happen, whatever it takes, even if it is no longer efficient. In a new system, there must be more discussion between policy and implementers. That's where the big problem lies; the Ministry and Chamber ask too much, too fast, and too detailed. As a result, it is no longer feasible.

ICT or BIT assessment
External parties always do the actual test. You would expect frameworks such as NORA to be tested there, but that is not done. You see other organizations that have adopted NORA of their own accord, such as the SVB. It's not so much about testing the architecture. It's mainly about testing how these administrators make good agreements with each other. And how they implement the service concept. And that is not being done. We are now looking too much under the hood at systems and data. While the core is about what agreements have been made, whether they are honored, and are these agreements are not interfering with existing agreements. This test is done far too little. The Ministry of BZK wants too much with too many changes and too soon, and the demands on all implementing organizations are too high. If things go wrong in the implementation, the situation for citizens

with multi-problems only worsens.

System Security
It connects well with social values as promoted by the five-layers model. Ideally, one would know what people think of government services. Do citizens understand the agreements? Those are all on the government website. Then you have to see how many checkpoints you need to check how well things are going. The CBS, for example, has many indicators, and you want to have simple indicators of how things are going in services. For example, you could ask citizens what their opinion is within the social domain. How are services perceived? Then you get an indication. As system architects, you can also play a role in quality requirements, for example. When is a law or service successful? Then you contribute to that by setting the framework. *Feedback loop - how to report on the outcome?*
There is more and more evaluation per service by the large implementing organizations because they have to be accountable. But whether this helps you as a citizen is not tested. They don't have the whole picture. For that, you have to delve much deeper into the chains and domains. There is a beeping system where interest representatives are present to report on social unrest. There are also really many surveys done. Thousands of people are surveyed every year to give that kind of reflection. There are plenty of indications of whether people are or are not satisfied with government services. But the question, "Am I being helped in my livelihood?" is not asked that much. They are mainly technical instrumental questions. It is also important that civil servants take responsibility and work together. So you don't get implementation and policy pointing back and forth at each other.

Keeping the Finger on the Pulse
You could do that, for example, with a menti-meter, also used in the business world. Or you could use a voter guide only for one domain and have something like a social yardstick. It is challenging to do anything with the system architecture in this area now, as only the tip of the iceberg is visible. As with link data, you would like an overview of where the information flows. Models have become so enormously dynamic and complex that you can't oversee them. So then, you must see which pieces are relevant to keep an eye on. You could also categorize that according to the five-layer model. That is also in the translation of those laws into logical rules. You certainly see in our social insurance system that it hangs together. It wasn't designed that way. It grew out of all those little chamber debates. And that's how the information household grew because every law has its little system.
That is why we are now going to restructure. The relationship between laws should be more clear. But we are not there yet. We are working more and more with a semantic level that is published on LinkData. In this way, checks on whether terms such as daily wage are used consistently across all domains and implementing organizations can be done.

B.6 LEADERSHIP ROLE DE LOONAANGIFTEKETEN (LA1)

Introduction
The interviewee works as a chain manager for the wage tax return chain. The wage tax return chain is a collaboration between the UWV, the Tax and Customs Administration, and the CBS. The concrete task is: to process data of everyone in employment or with a benefit. Employers submit the wage tax return. Within this declaration, you have an employer's part, which is for the Tax Administration, and an employee's part (nominative part), which is forwarded to the UWV. On an annual basis, this involves about 30 billion points of data. There are 160 billion in levies and premiums collected per year. The data from the policy administration is then made available on request to all kinds of public customers who need it for

their services, for example, the CAK or the Tax Administration itself for the pre-completed tax return and the UWV for calculating benefits. But also water boards and municipalities, for example. There are 1100 customers in this chain, all of whom can make efficiency gains within the government. It all started because we did not want to burden citizens unnecessarily with having to submit multiple applications.

Start of the Wage Declaration Chain
We started with our backs turning to each other. The cooperation was not working. Up to the administrative level, there were sometimes massive arguments. People were sent to meetings without being allowed to make any commitments, which didn't work and led to panic. The political attention is there immediately when it comes to so much money. And sometimes, you do need a crisis like that to get something done.

Implications of Data Integration
You saw that everyone was focusing on their topic. The UWV concentrated mainly on building the policy administration. And the Tax and Customs Administration focused on getting the data in and putting it through. But what they didn't do together was look at interfaces. How do you transport information from one organization to another? This also involved a common understanding of definitions. Sometimes the same data was understood to mean something completely different at the Tax and Customs Administration than at the UWV. When building new applications, you end up entirely with things running side by side. In the beginning, many messages got lost and ended up in a waste bin.

Political Decision
It was challenging to start a collaboration this way but also a political decision. The UWV had just set up a whole department with people to set up the administration, and the UWV also did the premium collection. All that had to be transferred to the Tax and Customs Administration, and they weren't received very well there. So the biggest first hurdle was setting a common goal: what do we want, how are we going to get there? It was not about technical drawings and interfaces.

The first task is to agree on what is meant by various terms. That is very narrow. An example is a difference in what an impact analysis means; if you ask the Tax and Customs Administration and the UWV, you get two very different things. One has done it in great detail and the other reasonably globally. If you don't know that about each other and you meet up next time, the party that did it so thoroughly is disappointed. So if you don't know each other's culture, you're just waiting for misunderstandings. The interviewee gives the example of the picture, a rabbit or a duck, to clarify situations at the beginning; we are looking at the same thing but seeing something different.

Programming a Inconsistent Terms
It got totally out of hand. Then the minister went to the Chamber. He instructed the Tax Authority and the UWV to come to a solution. Those parties had let it go wrong. Then both parties expressed the feeling; we won't let this go wrong again. So both Boards of Directors met every week on Friday morning. That's where all the measures of the integral problem analysis were provided. The priority was to get the chain working before it could be stable and robust. In the beginning, a lot of emergency bandages were put in place. There was a great deal of attention; the chairmen spoke with the ministers every week. The sense of urgency was also very high. The chain received the best people from both organizations and could work well together. There was a lot of attention and energy, and the top set a good example. We are now 15 years further on. Now the chain office has to work much harder to keep that attention. Chairmen now only have to visit once every three months.

And even that is arduous. It is currently running so well that the priority is on other problems. That is a risk because if the administrative attention is not there before you know it, you start talking to the replacement of the replacement. And that trickles down to all the underlying consultations, and you lose your commitment in no time. That is now the most significant challenge: keeping the administrative attention.

A separate chain agency
A separate chain agency was vital because in the beginning, for example, people sat on two measures taken to get the chain working and monitor them.

Organizational Interest or Chain Interest
An inspiring chain goal is fundamental. That started as administrative burden reduction and efficiency. But at a certain point, people don't get out of bed for that anymore. That is why the citizen perspective was added: burden reduction, citizens are bothered less, and fewer mistakes are made. The interests of individual organizations must not get out of step with the interests of the chain, and they must remain in balance. If the interests are out of balance, it is risky. However, the chain is now so robust that the risk is minimal. Now that things are going so well, people are less aware of what the chain does. Last year, with the NAU regulation primarily based on the chain's data, people realized again how valuable the chain is. In the past, the interests of individual organizations were subordinate to those of the chain, and now there is more of a tendency for that to turn. An example is the sizeable technical backlog at the various implementing organizations. Then you must keep asking each other how you can help each other. If, for example, the Tax and Customs Administration were to ask the Chamber for a policy-free period, the chain office would try to get the UWV to follow suit so that they put this forward together. In the end, it will go faster, and you will be able to improve the wage tax return chain further.

Working on your technique simultaneously
The focus now is very much on strengthening the foundation. Back then, a data set was established using steam and boiling water. But it wasn't well-founded. So what do the UWV, the Tax and Customs Administration, and the CBS need? We put in that data set. We are now examining whether it is logical, for example, to include gender or address in the wage tax return chain. In terms of automation, not much can be done now because the foundation is not in order. But in the intervening period, things can already be prepared. And when the time comes, we can implement the resulting adjustments more quickly.

Integration of Chains
The chain agency monitors. The execution organizations do it themselves. The UWV is the counter for the customers and supplies the data to the chain. They have also set up a whole organization for people who want to use the data. Then they look at whether that is legal and whether it is the best solution for that question. There is also the occasional use of BKWI, for example, for using SUWI net data. BKWI is also a kind of customer of data in that respect. More and more chains are linked. For example, the 'derdenbeslag' chain is linked without the payroll tax return chain knowing it. The interviewee thinks this is not convenient because it was done without sufficient research. If a change in the data set is done within the chain, it takes about two years. That has to be worked out first. Then it has to be shared with the market, asking: if we want to ask this do you have that in your records? Can you provide it, or do you still have to build it? Then they talk to software suppliers about how it works in the administration, among other things. And then, it has to go through all the clients for consultation and the implementing organizations for implementation tests. That takes a very long time, about two

years in total. Now the Ministry has added the attachment of the 'derdenbeslag' chain and finds it problematic that the process takes so long. The wage tax return chain sees the attachment chain as a customer, and they distinguish between chains and customers. Among the chains, they see the organizations that collect information, so the tax authorities, the UWV, and the software developers ensure the data quality. And then, the customers also have a separate consultation where they can express their wishes. But even though, according to this logic, the third-party attachment chain is a customer, the Ministry of Social Affairs and Employment linked the chains together without really thinking things through. As a result, they want to make changes faster. But they can't because there is a methodology and a whole ecosystem around the chain. But that is not very easy.

Different roles
You have to be very careful about that. There are also different roles at the UWV, for example. A role as withholding agent (withholding payroll taxes for the benefits), role as administrator of the policy administration, and role as a customer (data on income). This must not be mixed up because you get goat paths that are only beneficial to one organization and do not benefit the chain. So in what capacity do you sit at the table?

Implementation
At the beginning of setting up the payroll declaration chain, things were changed in the code to make changes to the policy administration. Not everything went right immediately. For example, all the data could be received but not delivered. At that time, programming was still really done in the database itself. Then we realized that this could no longer go well, and we couldn't find anything. In the new set-up, everything is documented, a test street has been developed, and an acceptance environment. Everything is as it should be. People thought this was ridiculous at first, especially the original builder of the system thought it was exaggerated. But this is the most crucial database in the Netherlands, so you can't just sit around fiddling. Also, there was a real focus on the collaborative design of the interfaces. How is it going with you? How is it going with us? In the beginning, we worked around it; large parties such as the SVB were only allowed to deliver at the weekend, for example, which was monitored very closely. There is also a kind of top 2000. These are the Netherlands' largest employers or benefit organizations, with about 25 of them. These companies are still monitored monthly, so there is always more or less what is expected (wage tax returns). Also, remember that if you miss those, your customers also miss a lot of information.

Monitoring
Whether the message meets the technical specifications is checked at the gate (at Logius - Belastingdienst). If so, all plausibility checks are done. And then, the information is included in the policy administration. This is because the database source has to be kept pure. Employers get feedback (after six weeks in writing) if, for example, the BSN and date of birth do not match. But then the declaration has to be done again. The chain does not change data. Now, there is a project to see if there can be faster and digital feedback to correct errors in the declaration more quickly.

Errors in the Chain
That is why we go back to the employer or the withholding agent. They have to submit a new return; we will not adjust the data ourselves. We use what comes in on the return. But you have used what is received in their tax return.
Questions on why there is no correction option are asked, for example, with fraud surrounding COVID benefits. Employers make a wage declaration based on BSNs, and he appeals to the NAU, but it turns out that those people never worked there.

Fortunately, that is quickly seen. But then we have to get that data out of the system. However, we can't correct it. That original fraudster can't be found anymore, so we flag that data, and it's not delivered to anyone. But we are now considering whether there should not be a correction possibility after all. That possibility could mean slippery ice. Because this example seems logical, but with other things, it may be less clear. That is why you always must go back to the source to keep it pure.

Benefits determination by the Tax Administration
Then, the Tax Authority also neatly requests the UWV. Which then looks at what information the Tax Office needs. Then the UWV builds the delivery. That is custom work. The link is often based on the BSN, except when it is linked to CBS because the information is anonymous. That depends on the purpose of the link.
Further development of links
The parameterization of links is now increasingly being looked at. So you may not need the entire policy administration but only a few fields. In the past, for example, all the municipalities could look into each other's data via BKWI. Of course, you don't want that. This is now all protected, partly due to the AVG.

Control mechanisms in the quality chain
There is accurate monitoring of the stability of the chain. The tax authorities indicate to the UWV what you can expect in terms of the quantity of data, which the UWV then rechecks. There is also a kind of standards framework; for example, the data delivered by the Tax and Customs Administration to the UWV must be included in the policy within four days. If something crazy happens, we immediately start calling. What's going on? Can we help? Often it is something trivial. The person responsible is on vacation, for example. We also encourage employers to report early so the chain can use the data immediately.

Self-employment
Set up for premium payers, and ZZP'ers don't do that. So at the time, they were deliberately left out. In the meantime, you hear a call for collective insurance for disability. I don't rule out a similar administration for ZZP'ers, but it is a complicated issue.

Future
The question now is also very much whether it makes sense for us to pump around 30 million pieces of data. Wouldn't it be possible with the new technology to tap into the administration of the withholding agent and then only look at the relevant data? It's also crazy that the government has a vast database that really "lives" somewhere. You're not going to sustain this in the long run, and it's hazardous and also becomes too much data. But people also find such a significant change in the future exciting, and they are reluctant to make changes because it works now. But the current collaboration is also a compromise, work was taken away from UWV, so they got the administration's custody in return.

Legacy systems
That is tested very well. A joint steering committee is also set up if a project affects the chain. All adjustments are discussed in detail at the depots. You have to work together. Organizations are looking for connections in these kinds of subjects. We have joint planning.
Negative sides of automation - Shadow Databases Customers prefer to have everything themselves because you don't want to depend. That's why we focus very much on proportionality: what do you need? Otherwise, the administration of a policy will lead to a second life with a pension insurer. We still make corrections, but then they don't work correctly. And then citizens are mangled because the data is incorrect. Basic registrations work fine in themselves. But the wage tax return chain is not.

But the chain couldn't meet all the requirements for such a registration, with, for example, a reporting-back obligation. And the current system works well. So that's a waste of energy. But perhaps it would be good in the basic sense. That's not what the politicians are for now.

Digital government
The government doesn't know what it wants. There are occasional rumblings of one extensive digital database, and you can ask yourself whether that is preferable. There's something everywhere; you can at least pull up some of your data. And in terms of cybersecurity, it's a nightmare; we retrieve 114 data points per person a month alone, which is too precious.

Risks to chains
Dulled focus because things are going so well. There is a kind of cooperation methodology, but still, you work around other cooperation laws that do not fall under the wage declaration chain. The same mistakes are made again even though sometimes the same people are involved. You see people doing it their way without consulting each other. The chain sounded the alarm, and the problem was resolved. But it's interesting that people still fall back into old behavior even though they have been working in the chain for fifteen years. And sometimes, colleagues from the UWV and the Tax Administration work together more than internally with the actual colleagues.

A feedback loop in the chain - Calculating benefits
Benefits are not included in the policy. And in that case, the Tax and Customs Administration is a customer. If a tax authority has misestimated, a new declaration is made. So back to the source. With benefits, there are also many other registrations used. And that is the responsibility of the Tax and Customs Administration, which then contacts all the relevant sources.

Relationship with Logius
Logius is a partner and gateway for the Tax and Customs Administration. They make agreements together.

B.7 POLICY EMPLOYEE (LCR1)

The Secretary General of the Dutch Client Board is interviewed.

What does the LCR do?
The LCR voices people's input on benefits, out of work, or otherwise in need of help from the government. They provide opinions on unemployment, disability, or retirement provisions. The National Council of Clients (LCR) has the legal task of making the voice of such people heard. Subsistence security for everyone is their primary objective. The LCR does this through various channels. These include social media campaigns such as 'hetgaatovermij', 'wiewatwajong' and 'praatmeeoverhetuwv'. LCR has a significantly more extensive reach within the target group than, for example, the UWV. The LCR is trusted and found by clients. Execution organizations involve the LCR in implementation tests in the form of client tests and sometimes in guidance committees.
Within the lobby surrounding the harmonized Wajong law, the LCR was active. The lobby aimed to change the formula for income. The main reason was that many amendments were needed to achieve the same result, which made it unnecessarily complex and could have been achieved by changing the formula. You also saw that many MPs were sympathetic, but it is just a political game that the Minister wants

his way. A new law is often just a cover-up of something else, like cost cutting.

So changing the law is a budget cut?
The Wajong2015 is just a budget cut in disguise. There were too many people flowing into the Wajong. Then they changed it to that a citizen has to be rejected entirely (no capacity to work) before you are entitled to Wajong. Otherwise, citizens end up in the Participation Act and thus in the Social Assistance (bijstand). This change substantially affects citizens' incomes because different rules apply to, for example, household income for the income test. For example, the Wajong does not consider a partner's income, whereas the Social Security Act does. In addition, this new law does not fit the target group. The law either characterizes a group of young disabled people as people on welfare (you can work, but you do not) or writes them off participation completely.

Does that seem like a harsh law?
Traditionally the policy has been that people should be 'punished' for receiving welfare. Penalties are imposed if people do not apply for jobs or if they make mistakes. However, several studies show that this does not work. There is no trust in citizens when very often that is not fair. People need more help.

What kind of struggles does the LCR observe in clients?
People are forced out of the house after their 18th birthday because they cannot afford it financially. The household income is too high, so they are not entitled to welfare. However, that makes it very difficult for people to become independent. Another example is that citizens have to pay back the gross amount of the excess benefits received while they receive the net amount if the recovery is in the new fiscal year. This generally creates an immediate income trap that people cannot solve directly or for which people have to eat their savings. Therefore, it becomes challenging for people to accumulate anything if they constantly hover around that minimum.

The difference in review times?
Yes, that is because, for example, the Tax and Customs Administration only tests the legitimacy of benefits once a year. The UWV does that twice a year and more often if necessary. As a result, especially at the UWV (benefits) there is a high risk of (1) too much or too little benefit due to the outdated legality test and (2) of having to pay back the gross amount. Moreover, that overpayment can be requested back from the Tax Office, but many clients do not understand that either. This could be solved, for example, by a monthly settlement for this group with both Tax Office and UWV.

Does a lack of explainability lead to unneeded mistakes?
The lack of understanding is due to the explainability of legislation and how its communication. For example, the Wajong calculation tool only focuses on people in paid employment, not self-employed people. While this group traditionally has many ZZPers. In addition, different organizations refer to each other but do so very vaguely. So, for example, UWV would mention to citizens to consider benefits from the Tax Authority, but not which benefits and where to find the information on these benefits. There are now so many exceptions and different versions that it is tough to explain to clients. They no longer understand their rights. Making mistakes happens more quickly than too.

What is the responsibility of execution organizations?
Social legislation works with advances. The LCR believes that if execution organizations give someone an advance, a particular responsibility lies with the execution organization that provides it. Of course, giving someone two years of WIA when

they were not insured and then asking them to pay it back seems inefficient. Also, citizens assume that execution organizations know their rights and obligations best; thus, if they receive the funds, they must have a right to it. UWV should have filtered those people out sooner. They need better filters at the beginning of the screening process (better monitoring) so fewer people get unjustified advances that they have to pay back. That in itself also reduces the pressure on the system. Implementing organizations also provides advances within social legislation for which one could logically say the person was not entitled. That is not due to the long queues at the insurance doctors.

How do discretionary space and Good Governance interrelate?
Right now, a citizen can only object to the UWV's process. So the UWV has executed the process well. However, if there is no discretionary space in the law, it is more difficult to criticize that process. Then it also very much depends on how discretion is interpreted. Is it on behavior, so the civil servant may adjust his behavior to act in line with the principles of good governance, or is it only allowed if this is explicitly described in the law? Views on this vary; judges also find this difficult and are often cautious. The current principle of good governance is based on due process. The discretionary margin of a judge can only be applied in situations when it is explicitly stated in the law. However, the Dutch Client Council believes that the principle of good governance should be about the government's behavior. For example, is it proper to execute a law in a certain way? It is then essential to formulate the term good governance broadly and not to define the principle specifically. Experts can then act from their expertise during execution; there is more room to shorten feedback loops. Thus, how far can a civil servant deviate from the norm? Eventually, this would also allow moving towards case law in which exceptional cases are handled separately, for example, in a custom workshop. Here, lessons would be learned so that similar cases are solved similarly.

This extra room for discretion would also help clients. After all, they can now only object to the process, and the objection would then focus on whether the official has looked at the client file correctly and executed the law as prescribed. However, the current process does not allow to object to the prescription of the law execution and whether that is unreasonable, as was the case in the Child Benefit affair.

How to execution organizations tackle this now?
Customized workshops offer a solution to the issue of discretionary space. Such workshops exist in different forms at the SVB and the UWV. In these, different experts work together on a case. In a way, this allows the system to move towards a case predicent. An example of a dastardly concurrence of laws is solved the in the way every time. This is done at the SVB, but they can only do that if there is enough room for it in the law. Otherwise, hands are tied.

How do such cases reach the workshops?
Often too late when there are already quite some problems. Ideally, a beeping system focused on early signaling would be central. Early signals that citizens receive too much or too little benefits or allowances combined with identifying external factors, such as divorce or illness, could help citizens before it is too late. People are good at surviving, and the problems only come to light when all the money has run out, and very significant debts have already been built up. That runs counter to the purpose of social security. Execution organizations should find a manner to monitor whether citizens are heading for problems around their Social Security.

Would a minimum income or basis income work?
Yes, there already is a legal minimum income. In a way, that is managable. However, given that the Dutch system is tied up with rights and obligations, this becomes

more difficult in practice. Because what if a citizen works part-time or is deliberately unemployed? Will they get less or the same? In addition, a few variables are needed to monitor whether people are heading into debt accurately. Accurate monitoring of when and why clients get into difficulty proactively is complex because you don't have the same information for all clients. For example, in debt monitoring, you want to see if people suddenly have a sharp decline in equity. If, for example, you can see that people have bought a car, it is not surprising, but if the drop is due to consistently higher costs than income, you can predict that that household has a high chance of building up debt problems. However, this cannot work for all citizens because you need either a bought house (WOZ value known) or a social rental home on which rent allowance is obtained before the government has insight into the monthly housing costs. Moreover, people are often good at keeping their heads above water for a very long time, so structural hardships in the system only surface late. Early detection of any problem requires certain information currently unavailable for some problems. This task is executed via client councils. But the UWV has a client council to pick up on these signals, but the Tax and Customs Administration does not. Recently, however, the Tax Inspectorate was set up.

B.8 ETHICS COMMITTEE (UWV4)

The interviewee is an external member of the Committee on Data Ethics at the UWV.

What is the Committee Data Ethics?
UWV released the data ethics compass, which focuses on handling data ethically. It was constructed partly due to the new AI-act and GDPR. Also, to prevent a tragedy such as the benefits affair at the UWV. It can be seen as a moral infrastructure with which one can assess data applications. Several values are central; openness, autonomy, and fairness. When a new or amended data application is constructed, it is self-assessed using the data compass. Some applications are very trivial (for example, how many Nespresso cups do we still have left), but judging whether someone is applying for jobs correctly, which influences their right to WW, is another story. There is a triage system for that, which indicates how thoroughly one should assess an application. Based on that, an investigation and recommendation are made to the board by the Data Ethics Committee. The committee consists of internal and external members. It is diverse in departments and domains and includes two external members contributing from their academic perspectives (professors).
The committee aims to ensure that ethical decision-making has a place in the governance of the UWV. Hence, now there is an evaluation after the first year. Are there significant areas for improvement for the compass and the committee?
They have been contacted by other European countries interested in what the committee does. Also, for example, the Belgian UWV. The Tax Authorities also asked how the committee was used, which serves as an example.

How can the relationship between the ethics committee and parties (developers, system architects) within UWV be characterized?
The self-assessment is done by the relevant parties (that includes system architects), so in that manner, relevant parties within UWV are also included. There is a standard form that is submitted to the committee. Then the committee can ask for additional information or investigate. Ultimately they give a recommendation to the board in the form of yes, yes if, no unless, or no.
It is about big things, which are used UWV-wide. For example, the job application scan. Citizens have to be able to show that they are actively applying for a job. Occasionally, people do their best but without results. What is the matter here? A fraudster or someone unlucky or discriminated against? Alternatively, culpable

unemployment is also tough to detect. Alternatively, risk scans on unemployment, how likely is someone to return to work within a year.

Do different data applications interact?
Perhaps the label of one application can haunt a citizen within the other applications. So, for example, if a citizen scores high on the risk scan for unemployment, does that also impact them in the job application scan? Perhaps that would be a ripple effect. That is undesirable or should only occur when upfront it was deemed justified and thus was thoroughly thought about. It cannot just emerge.
How can the culture within UWV be described?
There is a noticeable switch from fraud detection to helping people. It is observable in the attitude (screen-level bureaucrat). For example, when someone is consistently writing bad job application letters, is that unwillingness and people trying to scam the UWV, or do people need help writing that letter?

The interviewee is impressed by how seriously the experts at UWV take their work. The situation is macro-economically good now, too, and unemployment is low, which may provide more room.

What is the role of political pressure regarding decision-making?
Of course, political pressure exists, but it is still an implementing organization, so that makes sense. However, there is room. The fact that UWV has set up this 'circus' around ethics, which is really not optional, as both external members are not there for show. The interviewee indicates: I am out if they (UWV) do not take it seriously.

Moreover, the interviewee states there is room in how to execute policy and law. A counter-narrative of human scale and discretionary space is emerging, focusing on how to interpret policy and law.

In general discretionary space has been declining due to law structurization. How does this new narrative fit that?
An organization setting up the ethics committee publicly is somewhat of a counter strategy against curtailed discretionary space. It is committed, including through media attention and debate about ethics. UWV, in a way, is taking back space. Space is created to get somewhat out of political pressure and KPIs and focus on impact. There are good arguments for doing this, also through the AI act and GDPR.

What is meant by equity as described in the data ethics compass? (normative?)
That is a discussion we keep having, also with developers. For example, by looking at how does, the application perform relative to a human advisor? However, it has to be articulated and formulated. The definition used should be evaluable, defendable, and explainable. Moreover, that has to be constant.

What is meant by human oversight?
A UWV employee always acculturates it. As the interviewee understood it, the abstinence of benefits cannot be done by an application—an advance maybe or a calculation. A citizen's file may be brought to the attention based on an automatic application. However, a person still has to determine whether that is indeed justified. Moreover, that is also done with random samples, so the files that are brought to the attention are sometimes to ensure that bias is not occurring.

One of the bottlenecks indicated by UWV is the explainability of a decision. Is that also visible in the data applications?
The people who create the data application are good at describing what happens there. They use specific techniques specifically to get things more transparent. That includes weighing accuracy against explainability. These questions are well answered and well thought out. There is a constant search for methods that are re-

spectful of privacy but capable of flagging discrimination, for example.

Would cooperation with the Tax Authority make sense?
That would certainly be possible. Of course, everyone is now working on an algorithm register. However, there needs to be a national architecture for that. The idea is that AP will do that, and there must be a plan. UWV ethics committee is also in talks to lend a helping hand there.

Are applications tested in a vacuum or the system?
It involves contextuality and integrity, use limitation, and purpose specification. It should not be transferred if the information is developed in a particular context. This issue is high on the agenda. Information transfers can be done, but they must be carefully thought about.
General points are also named based on a case. So case-specific, this must be adjusted before UWV can roll it out, but also, for example, in general, it is essential to ensure that no information leaks to other parts of the system. Another example would be purchasing technology from external parties. It is not impossible, but it has to go past the ethics committee, and UWV has to think about it.

B.9 WAJONG BENEFIT RECEIVERS

B.9.1 Wajonger Reciever (W1)

The interviewee has been receiving a Wajong benefit since 1994. At 18, he was given a 100% incapacity for work score. At the time, he fell under the old Wajong Act and is currently under the Wajong 2010 rules. Sometimes a client is invited to switch, but that also depends a bit on which situation is most favorable for the client. For example, he switched in 2018 because of the rules of the old Wajong. He could lose his Wajong after a year of work.

The interviewee has contact with many different authorities, including the UWV, the Tax Authorities, the GAK, DUO, the Municipality, and the Social Insurance Bank. He has a repayment scheme with several organizations for excess allowances and benefits received. The interviewee indicated that he experienced much stress from this and showed his extensive administration. An example he cites is during his time at a school in Enschede, where he worked as a facility employee, where, despite his 25-hour working week, he only had 9 euros more net income than his time without work.

The interviewee describes the process of applying for wage dispensation. This is a scheme that employers can use. This is granted if the employee is entitled to a Wajong benefit and cannot perform a work task at the same pace as other employees in the same position. The interviewee describes that he finds this a perverse arrangement because it makes it difficult for Wajongers ever earn the job wage. He describes that employers hire Wajongers if they can receive a wage dispensation for this person, but as soon as they have to or can permanently employ them, they do not do this. He expects that this also has to do with the fact that the no-risk policy for Wajongers will then be abolished, and the employees will bear an additional risk of absenteeism due to illness of Wajongers.

However, the interviewee does not agree in concrete terms with assessing his work capacity and the associated wage dispensation calculation. UWV implies that a labor expert must go along with a Wajonger in the provision, according to the interviewee. However, the interviewee finds that this is not being done enough. He thinks a work plan is not an official document but an opinion piece. In the process

he describes with his previous employer, he indicates that he felt mistreated, unsafe in the workplace, and discriminated against compared to other employees. This is partly due to the T+2 scheme, in which he describes that an employer can request three years of wage dispensation for an employee before he has to be hired permanently. As a result, the interviewee indicates that he feels that he only counted within society for a couple of years and then suddenly no longer.

He also describes how employers experience no incentive to report honestly if a Wajong employee has improved in his employee skills. For example, he was classified as a cleaner, after which he was given more and more extra tasks, but this was not visible in the wage dispensation percentage. That is also the responsibility of the labor expert, but according to the interviewee, he often gives an incomplete story.

The interviewee noted that because his employer in the past received a wage dispensation on his wages, he now also accrues less pension. Because he only accrues pension on the part over which his employer pays him, not the part of his supplementary benefit from the UWV (Wajong). The interviewee indicates that he finds the communication about allowances and benefits very unclear. For example, rent allowance has been claimed back from him for years, even though his father always draws his attention to passing on his new income when he has a job. Due to the stress that the constant rent allowance reclaims give him, he has decided to stop his application for rent allowance while he would be legally entitled to this. He expects that part of the tax credit was wrongly applied twice to his salary and benefit. As a result, he indicates that he has the feeling that outflow is not being rewarded. It is a social carousel, and it is impossible to get out. The interviewee indicates that it now feels like going to work for a 'good feeling', but that feeling cannot pay the rent. Another point about communication is that, for example, the interviewee was unaware of a confidential adviser.

B.9.2 Wajong Reciever (W2)

The interviewee is a 40-year-old economics graduate (2008) from the University of Utrecht. He started working in 2009. Today he works as a legal advisor and ombudsman at Unlimited Employment. Here the employees work as a kind of social impact striker. They collect signals about the labor market. What is going well, and what could be improved? The focus of the organization is on laws and regulations.

The interviewee was first introduced to the Wajong in 1998 because of his muscle disease. Until 2017 he was eligible for Wajong benefits; however, the interviewee 'unsubscribed' from the benefit, making him ineligible in the future. This decision was made because the interviewee had been earning 'too much for years to qualify for a monetary Wajong benefit. This means that the interviewee had not been receiving benefit funds for years. However, he was still obliged to provide his monthly income and received many letters from the UWV. This experience was very unpleasant; therefore, he canceled the benefit. However, this comes at a risk as he can no longer go back into the Wajong. This is an excellent example of the bureaucracy the interviewee describes. This bureaucracy is very present in the Wajong benefit process and ultimately was the reason for him to cancel his Wajong benefit. However, he experiences this as a risk as you give up a safety net.

When the interviewee had a right to Wajong, this was the Old Wajong. Switching between different versions of the law often was only practical if a client had a certain amount of income and a particular Wajong benefit. At the time, the interviewee was entitled to an increased income through the Maatman scheme.

In the old Wajong Act, the formula led to a sawtooth in the income of Wajong receivers according to how much income from work they received. If a client started working a little more, they would suffer financially. That is better in the current Wajong Act. However, the interviewee indicates that it has not only changed for the better. He describes that it is occasionally difficult, especially for self-employed entrepreneurs, to fit into the changed schemes. For example, the guarantee amount described in the transition from the Wajong Act only takes effect a year later. The new formula does not consider the level of education and the fact that not everyone works for a boss. That is logical because there will be no new people in the Wajong who still have work capacity. In addition, the interviewee describes that mainly academically educated Wajongers in his network do not know what they are entitled to within the Wajong law.

Under the old Wajong Act, more than 95% of people were deemed unfit for work. A client was either fully approved or found to be unfit for work. However, that did not matter for their Wajong benefit because they still ended up in the Wajong. Under the new Wajong, the consequence of labor capacity is fewer benefits because clients end up on social assistance (bijstand) instead of in the Wajong.

The interviewee describes the many different executing offices he has contacted for his social security. Among others are the UWV, the Tax Authorities, and the Social Insurance Bank for benefits, taxes, and allowances. In the beginning, for Wajong, housing and healthcare allowance, but also, for example, the disability allowance (an allowance for people who are incapacitated for work, also from the UWV).

The interviewee describes how his Wajong benefits were always paid as an advance. The UWV estimates a client's rights to a Wajong benefit. This is usually checked every six months. Therefore, large repayments are not uncommon. The interviewee describes an example where a reclamation did not go well and that a Wajong benefit and other allowances were wrongly reclaimed. The undesired effect of this was that this client first ended up in debt restructuring before he was proved correct in the illegality of this double recovery. Here, the interviewee describes that a client never wants to work again because the effect of working in debt restructuring has cost money and caused much stress.

Another phenomenon the interviewee describes is how the current system does not fit well with practice. He describes how practice should now adapt to theory instead of the other way around and should be about citizens and employers. Within his organization, he received 300 signals in 3 years about people where the situation had to be adapted to the theory.

B.9.3 Wajong Reciever (W3)

Introduction
The interviewee obtained her bachelor's degree in Notarial Law and is 27 years old. She works as an expert in the field of inclusion for people with disabilities and gives training courses, workshops and lectures to companies and government agencies. When she turned 18, she immediately applied for a Wajong benefit. At the time, she was rejected for 25% due to her cerebral palsy. Nowadays, this percentage is slightly higher. She entered the Wajong Act in 2015. As a result, she was in a bit of an in-between period. During her studies, she first fell under the old system, with 'students don't work, so her Wajong benefit was only 25% of the Statutory Minimum Wage. During the introduction of the new Wajong Act, this percentage was adjusted to 70% from 1 September 2020.

Wajong
The interviewee is still entitled to Wajong. If a client is in paid employment, this income must be passed on to the UWV by the client every month. However, the interviewee works as an independent entrepreneur. For self-employed persons, the expected annual profit must be passed on. This expectation is directly calculated in the Wajong benefit. If there is a change in this expectation, this must be reported within a week, after which this will be verified again by the UWV. In addition, she is entitled to a guarantee scheme because she ended up in the Wajong Act before 2015. This one suits her well.

Information Provision
The interviewee indicates that she does not find the information provided concerning the Wajong Act sufficient. Specifically, when it comes to concrete figures, the calculation tool for the Wajong Act does not work for student clients or self-employed entrepreneurs. The calculation tool is only focused on people in paid employment. According to the interviewee, homogeneity is wrongly assumed in a traditionally very heterogeneous group. She also indicates that occupational health experts may adopt a proactive attitude in providing information to clients.

The interviewee also describes being sent from one place to another if she has questions about, for example, kilometer reimbursement and driving licenses as a self-employed person. Her annual counselor does not know this exactly, so she is sent to customer service again, who will redirect her to the website. The interviewee describes how employees of the UWV are not thinking along with clients, and there is a feeling that the sole responsibility lies with the client to find the correct information. She also describes how many employees of the UWV do not know many things because they only have one specific piece of knowledge.

Side Effects
The interviewee indicated that she started her business during her studies. In this, she had to indicate her expected turnover. She has not received any guidance in this, while stories about other clients who were offered an accounting course also reached her. Due to her estimate of her turnover that was too high, she received a direct message from the UWV, 'your Wajong benefit is now being stopped, even though she had no income from her company at that time.

In addition, she describes a zero-hour contract in which she worked for her university. This contract was extended, but the interviewee forgot to inform the UWV. By forgetting to report this, she received an official warning from the UWV that this should not happen again and that she otherwise risked a fine or exclusion from the Wajong Act. Fortunately, after consultation with her labor expert, this turned out to be not so bad in practice, and after the intervention of this employee, the warning could be removed from her file.

Generally, passing on income from a 0-hour contract is challenging. The interviewee indicates that the system does not take this into account. She can only enter how much she earns per week, four weeks, or month. There is no option to tick a box with '0-hour contract' and then enter the hourly wage.

Interaction between the Tax and Customs Administration and the UWV
The interviewee describes much uncertainty about her ultimate income since these are only fixed in September of the following year. She describes the following calculation chain that ultimately determines both her benefit and entitlement to benefits: Tax return IB – Calculation IB – recalculation of Wajong – allowances (rent and healthcare etc.). She describes that she does not know whether her IB will still be recalculated after the recalculation of surcharges. She hopes to have clarity in September, but no one seems to be able to say exactly.

As a result, the interviewee indicates that it is challenging to estimate whether you have received too many or too few allowances and the effect on the financial situation. This is very unpleasant.

B.10 CUSTOMER EXPERIENCE PROFESSIONAL (UWV3)

B.11 HEAD ICT – LOGIUS (LOGIUS1)

The interviewee has worked as head of ICT at Logius for five years.

Role of Logius within the Digital Government
Logius provides the Generic Digital Infrastructure (GDI) in the Kingdom. Where in the past, solutions were built in different places, these are now consolidated into Logius. It is a hotchpotch of all projects, and eventually, Logius came into being. All government parties facilitate the GDI. DigiD, for example, is used by almost all government organizations. Across the government, Logius provides generic building blocks, which are supplied to the Tax and Customs Administration, for example, and they, in turn, build them into their systems, thus supplying them to citizens and businesses. Using the example of DigiD again, it is nice to log in in the same way with every organization and not have 40 different ways of doing it. This prevents all these government organizations from developing their own building blocks individually.

Diginetwerk and Digilevering
Those are different services. Logius stands for access and data exchange, and data exchange is a service we provide in Diginetwerk. For example, we also have the Haage ring, where data can be exchanged securely within The Hague. Digilevering is the reporting and retrieval of information, and this enables government parties to communicate with each other securely. Logius provides the Digilevering for some key registers. They are not doing it for all registers because it is not necessarily a conscious choice but more the current status quo.

Side by Side development of Data Sharing - Logius and other chains
Enormous governance has been put in place concerning the GDI. Parties such as the Tax and Customs Administration and the UWV, the large implementing organizations, are sitting at that table. The Logius or GDI programming councils first led it. We consider what other generic building blocks might be helpful within these councils. However, there is also a policy table above that (OBDO). That is where more of the policymakers sit together. The policy table discusses the budget. Then the discussion moves on to the need, what we want, and below that, there are a few customer councils, or at least that is how it was, get-togethers. They meet on a specific topic, such as data exchange. That is also where government organizations get together to talk about that specific topic.
The National Identity Data Service is also focused on data sharing. However, that is also an implementing organization of the Interior and Kingdom Relations. They are concerned with the Basic Registration of Persons, with which municipalities work a lot.

Future of Data Sharing, APIs and/or Databases
In terms of vision, Logius is reasonably compliant with policy, and the vision is made at BZK. When that is decided, parties like Logius work on implementing it. An example of innovation is the mijnoverheid application. The great thing about that is that people have been saying for years that they should have control over their data. First, you need to know what data is available within the government.

The tendency is that citizens want to determine who does what with their data. People are critical and think everyone is just exchanging data, but the control must lie with the citizen. According to the interviewee, this is perhaps the direction we are heading. Nevertheless, you can at least see what data is already known through the application. The next step could be to ask for consent in sharing or retrieval. Technically, we are closer to that kind of scenario.

Legacy Systems at Executing Organizations Legacy systems are a challenge for the implementing organizations. Logius is about 15 years old, compared to the Tax and Customs Administration, which has been working on automation for many more years. Therefore, the Tax Authority suffers much more from Legacy systems. Large execution organizations have been saying for a long time that they do not want to interfere with the systems because they work. However, then you get stuck. It is up to the institutions to adapt; Logius makes the innovation available.

Decision-making process building blocks
That is at the administrative table, where large organizations commit to innovation, tell what they want, and discuss the budget. The payment structure will change in 2023 when central funding is introduced for Logius. Currently, they still work with p * q for invoicing government organizations. That is not ideal as Logius want innovations to be used. Now there were times when organizations would say stop using DigiD because we no longer have a budget for Logius. That is why there is now central funding by BZK. The interviewee is curious as to what that will do to usage. It is also a good development that there is more talk between policy and technology. For example, the State Secretary first came to tell Logius this is what the Ministry wants to tell Europe on innovation in data sharing; is that possible? In this way, development is done together.

Feedbackloops in development
Logius has a production house with a number of trains where they work SAFE (agile). From those trains, they talk intensely with the Tax Administration, UWV, etc., and then with the software developers on that side. But also, for example, with Public Health. Nationwide (OCW, DUO), they provide services.

Logius delivers fairly generic building blocks. An example of innovation is DigiD authorization. At the moment, sometimes illegal practices happen where people give their DigiD to someone else so that they can arrange things for them. Legally this is not good news, but operational, this is sometimes needed.

Fraud detection for DigiD
There is fraud detection on the systems surrounding DigiD. If there are suspicious transactions (applications), a DigiD is immediately blocked. The owner of the DigiD account is then immediately contacted. Is this perhaps a case of fishing? Fraud detection on DigiD is only done by Logius and communicated directly to the citizen. However, they work very closely with National Cyber Security Center.

Risks to Building Blocks and Automation
One that has been passing by on LinkedIn is sovereignty. Does Europe still have access to their data? Can we be held hostage by the big Tech companies or China?

Coupling, error fixing
Only source data is exchanged among execution organizations. There are no data processing strokes done. Currently, beep systems around errors in the Basis Registrations work. However, citizens are not informed that basic registration would affect other institutions or benefits. A message like: your basic registration has changed, we have passed this on to X, Y, and Z. Then citizens can immediately

realize if that information is incorrect and why it is essential to sound the alarm. Alternatively, that citizens should perhaps give consent for this passing on. But it is a dilemma because enforcing the change immediately throughout the chain also ensures that institutions have to claim back less unjustified advances. It is also a way of relieving the burden on the public. So it is a balancing act.

Chain Partner for the Digital Government
Logius supplies building blocks for the digital chain. Logius provides a control tower that makes data exchange possible. These are all chains in which Logius ensures that the right building blocks are present. In the past, they also had the port of Rotterdam in DigiPoort, a collaboration between the military police and the Tax and Customs Administration which automated the import. The Tax and Customs Administration has taken that back to itself. Those chains sometimes transport the same information but not over the same road, so they do not interfere with each other.

C MODEL DESIGN

C.1 CONCEPT FORMALIZATION

Number	Variable	Type	Range
0	Employee ID	Integer (ID)	
1	Experience	Floating Point	>=0, <=1
3	Reclaim Benefits	Boolean	
4	Petition for Law Change	Boolean	
5	Use ADM to calculate benefit height	Integer	>=0
6	Judge benefit application	Boolean	
7	Question ADM decision	Boolean	
8	Give Feedback on ADM to ICT employee	Boolean	>=0

Table C.1: Properties Tax Authority Pay-Out Employee

Number	Variable	Type	Range
0	Employee ID	Integer (ID)	
1	Experience	Floating Point	>=0, <=1
3	Reclaim Benefits	Boolean	
4	Petition for Law Change	Boolean	
5	Use ADM to calculate benefit height	Integer	>=0
6	Judge benefit application	Boolean	
7	Question ADM decision	Boolean	
8	Give Feedback on ADM to ICT employee	Boolean	>=0

Table C.2: Properties UWV Pay-Out Employee

Number	Variable	Type	Range
0	Employee ID	Integer (ID)	
1	Work Pressure	Floating Point	>=0, <=1
2	Experience in Social Law	Floating Point	>=0, <=1
3	Change ADM system	Boolean	
4	Make a mistake in social law	Boolean	

Table C.3: Properties Tax Authority Software Developer

Number	Variable	Type	Range
0	Employee ID	Integer (ID)	
1	Work Pressure	Floating Point	>=0, <=1
2	Experience in Social Law	Floating Point	>=0, <=1
3	Change ADM system	Boolean	
4	Make a mistake in social law	Boolean	

Table C.4: Properties UWV Software Developer

Number	Variable	Type	Range
0	Employee ID	Integer (ID)	
1	Experience Social Law	Floating Point	>=0, <=1
2	Experience Software Development	Floating Point	>=0, <=1
3	Pass on feedback	Boolean	
4	Order ADM system	Boolean	

Table C.5: Properties Tax Authority ICT employee

Number	Variable	Type	Range
0	Employee ID	Integer (ID)	
1	Experience Social Law	Floating Point	>=0, <=1
2	Experience Software Development	Floating Point	>=0, <=1
3	Pass on feedback	Boolean	
4	Order ADM system	Boolean	

Table C.6: Properties UWV ICT Employee

C.2 MODEL FORMALIZATION

The model formalization appendix shows the different patterns of interaction for the identified phases. Furthermore, it specifies the interactions shown in this pattern.

The pattern distinguishes two types of interactions, namely, monetary and information interaction, indicated in respectively blue and red arrows. The design is set up in three phases. Each different pattern of interaction shows the main interactions between agents.
The pattern of interaction shown in Figure C.1 shows the interactions involved in **one year** concerning a benefit application. The interaction is initiated by a change in the citizens state, either in income or in disability, due to this change the citizen will apply for the benefit associated with the state change. So if a citizen falls ill, they will apply for WIA whereas if they become unemployed they will apply for WW for example. After the application, the pay out employee will determine the height of the benefit. Important to note here is that this interaction happens four times a year thus 4/12 ticks for UWV employee and 1/12 ticks for the Tax Authority. When the benefit is re-calculated a reclaim interaction can occur when the citizen has received too much funds. However, due to the asynchronous timing of the Tax Authority and UWV it can occur that funds are reclaimed twice, as described in the system analysis. Due to the reclaimed funds, a citizen can get frustrated, if a certain frustration threshold is met, the citizen can decide to withdraw their benefit application.

C.3 ASSUMPTIONS

An overview of the assumptions made in setting up the model design is given in Table C.7. As not enough information was present to accurately develop the algorithms within the model not many assumptions are made concerning the specifics of agents actions. However, when the model would be developed it is vital that assumptions concerning these interactions are registered.

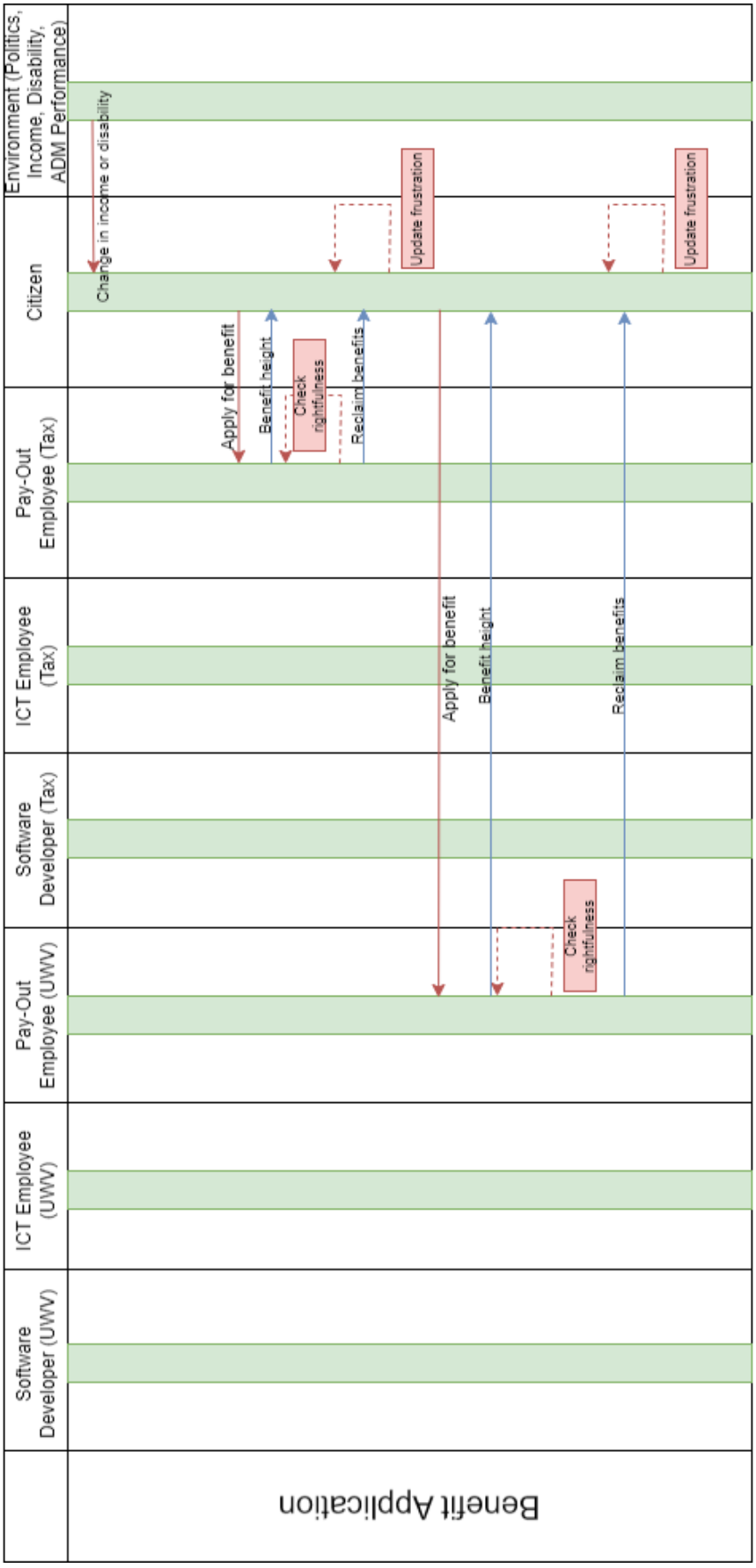

Figure C.1: Pattern of Interaction Benefit Application and Reclaiming

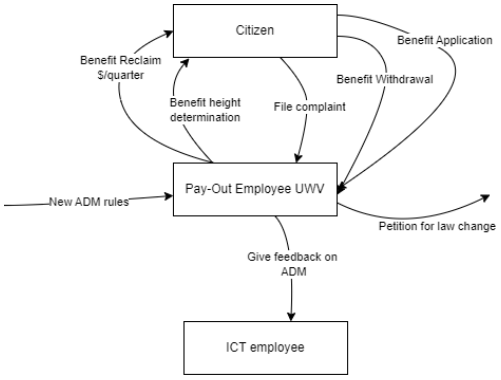

Figure C.2: Interaction Pay-Out Employee

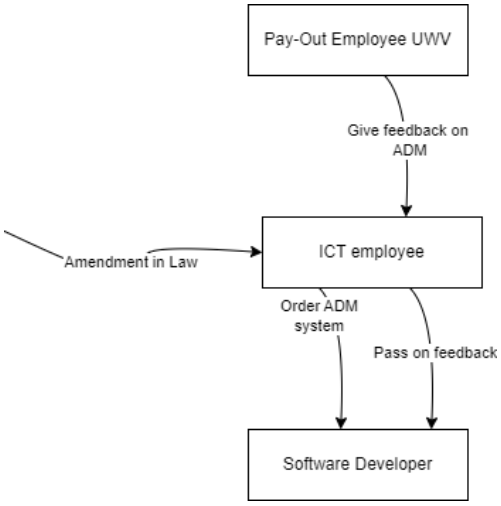

Figure C.3: Interaction ICT Employee

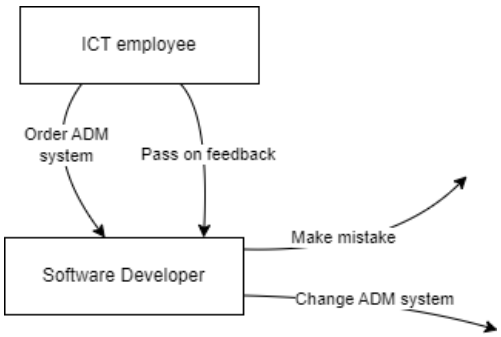

Figure C.4: Interaction Software Developer

C.4 VALIDATION

This Appendix sections shows the transcripts of the validating session done with an employee Information Services at the Pay-Out department of UWV. The interview code UWV4 is used for this.
Comments were given orally, via telephone, to the researcher.
The structure and interactions, or more lack thereof, between UWV and Tax Authority employees is nicely shown. However, one of the comments made was the heavy focus on the monetary parts of the system instead of the other associated services for social law. Such as re-integration or an assessment on work capacity, these are all not present, and the employee would say these interactions are also vital in determining whether a client gets frustrated or not. However, for the chosen scope they think the right employees from UWV are included for

Agent	Assumption	Source
Citizen	Get frustrated due to interactions with execution organizations	W1, W2, W3
Citizen	Withdraw benefits applications due to reclaimed benefits by UWV and consequental uncertainty on income	Suzanne de Visser (2021), W1, W3
Pay-Out Employee Tax Authority	Benefits are reclaimed and determined yearly	Suzanne de Visser (2021)
Pay-Out Employee UWV	Benefits are reclaimed and determined either monthly or half yearly, thus an average of 3 months is taken	UWV4
Tax Authority Software Developer	ADM systems are developed in house by the Tax Authority	BKWI1
ICT-Employee UWV	Information applications are coordinated by the information facilities (ICT employee in the model)	UWV (2021)
Software Developer	High working pressure can lead to a waiting list for new ADM systems	UWV (2021)
Pay-out Employees	Can lobby (via the board of the execution organization) for a different manner to execute the law	UWV4, C.E.G. van Gennip (2022)
Pay-out employees	The Tax Authority and UWV do not coordinate benefits	UWV2, C.E.G. van Gennip (2022)

Table C.7: Assumptions made for model design

the interactions. However, they state they miss the citizen in the pattern of interactions as they can influence employees at UWV at least with their feedback on how laws are structured. It does show the impact of work pressure on quality and waiting times nicely. And how, more social processes influence the quality of a more technical artifact.
A nice addition would be the inclusion of different scenarios so then we could perhaps use such a model to test different timelines of information application orders. Or use the model to show the Ministry how haste influences the citizen. They see how the patterns of interaction and state descriptions could help making a model but do remark that due to the many assumptions and lack of insight from the Tax Authority the model design might need massive overhaul before it actually becomes representative.
After explanation of the modelling method the employee remarked that one of the problems with an ABM could be how the rule based model might not be able to capture discretionary space or explore new solutions. However, the researcher remarked here that the model design was made with the intention of exploring the phenomenon of ripple effects and not solve it.
Lastly, the employee indicated that the review period differs between clients and also between social laws. As with some clients a half year evaluation of income suffices and for other a monthly one might be more suitable.

Several changes in the model design were made based upon the validating session. These are presented in Table C.8.

What	Change
Agents	Citizens were first identified as objects as it was assumed that the feedback given by citizens would not impact the decisions made by pay-out employees. After expert consultation, this proved false, therefore citizens are added as agents with autonomous decision power.
	The inclusion of multiple pay-out employees that have different levels of experience to illustrate how even though ADM systems automate part of the process, a skilled employee with experience remains vital.
Interactions	File complaints by citizens was added as a interaction between pay-out employees and citizens which influences the decision of pay-out employees to petition for a law amendment.

Table C.8: Model design changes made

COLOPHON

This document was typeset using LaTeX. The document layout was generated using the arsclassica package by Lorenzo Pantieri, which is an adaption of the original classicthesis package from André Miede.