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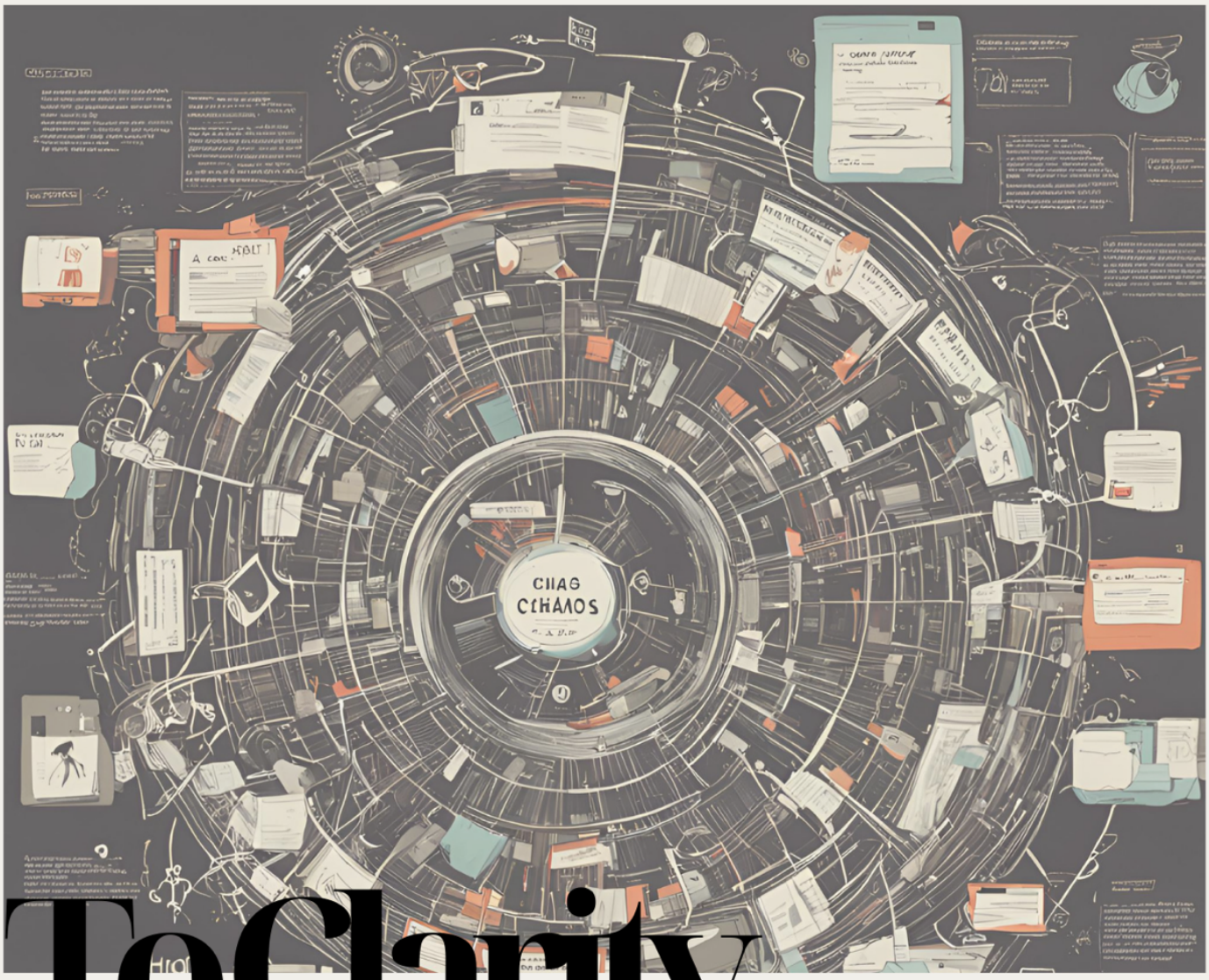
From Chaos



To Clarity

A Novel Approach to Mitigating Information Overload in Strategic Policy Making at the Dutch Police.

Renée Maria van der Poel

From Chaos to Clarity: A Novel Approach to Mitigating Information Overload in Strategic Policy Making at the Dutch Police.

Master thesis submitted to Delft University of Technology in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
In Engineering and Policy Analysis

Faculty of Technology, Policy and Management

by

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An electronic version of this thesis is available at https://repository.tudelft.nl/

TU Delft

Acknowledgments

Delft, 24th of June 2024

Dear reader,

Completing this master's thesis marks the conclusion of my time as a student in Delft. Over the last five months, I have dedicated myself to this research, which has proven to be one of my life's most challenging and rewarding experiences thus far. Therefore, I am very excited to present my research to you. Following my bachelor's degree, this master's program has expanded my knowledge of societal problems, modeling, programming, and personal growth. I look back on my student days with happiness, grateful for the knowledge I have gained and the people I have had the pleasure to meet.

First, I thank my graduation committee: Anneke Zuiderwijk-van Eijk, Rolf van Wegberg, and Amir Niknam. Each of you, with your expertise, has provided invaluable constructive feedback that has contributed to the academic integrity of this research. It has been a pleasure collaborating with you. I am particularly thankful to Amir Niknam, representing the Dutch national police, for allowing me to conduct my research at the Dutch Police and on a captivating topic. Nevertheless, I would like to thank CGI and YDigital, two consultancy firms that created the Futures Platform with time pressure for my results. Furthermore, I extend my gratitude to all the participants of the interviews and experiments for their contribution of valuable data and insights to my research.

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Finally, I thank Sebastiaan for his invaluable assistance throughout my research journey. He carefully reviewed my report multiple times and provided enjoyable distractions. Despite occasional stress, he consistently helped me remain grounded and focused.

In conclusion, I would like to reflect on a quote I have always embraced in life, which I occasionally revisited during my graduation to regain self-confidence. This is a practice I intend to continue in the future.

“Ik heb het nog nooit gedaan dus ik denk dat ik het wel kan!”

Pippi Langkous

Renée van der Poel

Executive Summary

The study addresses the critical issue of information overload faced by strategic policymakers in the Dutch national police. The research question is: “How can the national police decrease information overload while improving decision-making?”. Understanding the problem regarding information overload is essential because the police are vital for maintaining national safety. Therefore, Police decision-making must be based on comprehensive, accurate information to ensure effective and reliable outcomes. The overwhelming influx of information often leads to the skimming or bypassing specific information streams, resulting in decisions based on a partial data set, which affects decision-making. To address the issue of information overload among policymakers, an effective solution must be identified. Resolving information overload is crucial, as it directly impacts the quality and transparency of policies implemented by the Dutch police. Only complete or well-informed policies can improve resistance and maintain trust in law enforcement.

To tackle information overload among policymakers, the study utilized the Design Science Research (DSR) methodology to implement a tool to increase decision-making by only focusing on information overload. DSR is an iterative process that facilitates the implementation and testing of methods through a series of well-defined steps. The research uses both qualitative and quantitative research methods.

Initially, semi-structured interviews and a literature review were conducted to gather data on the specific challenges faced by police employees, which were then used to establish the requirements for the tool. The requirements are:

- Time-efficient policymaking
- User-friendly interface
- Structured documents and authorization
- Facilitation of consensus building
- Efficient information gathering
- Demonstration of added value
- Validation of user-input
- Comprehensive Information and Knowledge Hub
- Expandable System of Methods

Based on these requirements, a knowledge graph with ontologies was selected as the appropriate tool. A knowledge graph represents information and relationships between objects differently from traditional methods, such as PDF files. Knowledge graphs are based on ontologies, which are rules that structure domain-specific knowledge. The tool, Futures Platform, was developed by two specialist companies focusing on transforming digital environments, incorporating artificial intelligence (AI), large language models (LLM), knowledge graphs, and ontologies.

The tool was tested using an information overload formula through an experiment involving 35 participants. The formula is as follows:

Information Overload =
(Characteristics of Information × Information Processing Capacity × Available Time)
–
(Personal Factors × Task and Process Parameters × Quality of Information × Quantity of Information)

The experiment assessed the tool’s effectiveness in managing information overload by comparing responses to two questions with and without the tool. Four different groups were formed to enable both within-group and between-group analyses. Each group performed a different order or scaled-down part of the experiment, which allowed for a comprehensive evaluation of the tool's effectiveness. The groups have a balanced gender distribution among the participants, with approximately 50% male and 50% female. The demographic detail underscores the inclusivity and representativeness of the study, adding to the robustness of the results. Additionally, the groups had significant differences in educational levels and ages.

Various statistical analyses were conducted to interpret the results, focusing on the dependent variable "Information Overload" (IO) across different groups. Initially, descriptive statistics of IO were analyzed, and Quantile-Quantile plots confirmed the normal distribution of the data for all groups. The difficulty level of each question was assessed using an unpaired t-test, revealing no significant differences in difficulty between questions, regardless of tool usage. The tool's efficiency was evaluated with a paired t-test, indicating that participants experienced less information overload when using the tool. Moreover, significantly more information sources were consulted with the tool (39% with the tool vs. 11% without the tool), suggesting it enhances efficient information retrieval.

While differences were observed in subfactors like "personal factors " and "task and process parameters," these did not significantly affect information overload. The use of the tool significantly increased the novelty of the answers. One person using the tool generated an even creative and innovative response compared to two working without it. Demographic analyses revealed that for men, generally, the tool was more efficient than for women, possibly due to women's existing proficiency in document scanning and information retrieval. Age and education level yielded insignificant results. In general, the tool could decrease information overload.

However, the study has limitations. While participants enjoyed using the tool, their unfamiliarity with the tool and its status as a proof of concept, which could have been more user-friendly, affected the results. Also, the study focused only on the personal factors of the information overload formula. By also using the information factors, the results could be improved. Nevertheless, different subjects of information within the tool could be tested to see if more subjects generate positive findings on decreasing the chance of information overload. Another essential feature is that the research's knowledge graph is manually filled in. Mistakes could be made by manually filling in the information in the knowledge graphs. Implementing an artificial algorithm could prevent this, and the graph and information would be increased. The study is now tested on the Dutch national police but could be helpful within other sectors, which is worth investing in.

Future research directions are derived from the research implications and results. The tool used, serving as a proof of concept, needs to be refined and improved further. To ensure the full functionality of the tool, all employees of the Dutch police must use it for searching, adding, and validating data. Additionally, the proof of concept could be tested on various subjects of information streams. Finally, various methods, such as artificial intelligence, can be incorporated into the tool to make it more efficient and enhance its quality.

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List of Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
df	Degrees of Freedom
DSR	Design Science Research
EPA	Engineering and Policy Analysis
FP	Futures Platform
IO	Information Overload
IQ	Information Quality
KG	Knowledge graph
KIM	Knowledge Information Management
KM	Knowledge Management
KMS	Knowledge Management System
LLM	Large Language Models
PoC	Proof of Concept
QQ plot	Quantile-Quantile Plot
Req.	Requirement
UEQ	User Experience Questionnaire
V	Variable

Chapter 1
Introduction

1.1. Background

Imagine you are a strategic policy maker within the Dutch national police starting to formulate a new strategic policy. The process of developing strategic policies involves different approaches. Sometimes, a question comes from the top of the organization, while in other cases, societal developments, as noted by employees, serve as a reason. It is also possible that a trend or development is noticed by external research agencies, which can then lead to policy formation. After identifying the trigger, a phase follows in which extensive information is gathered about the specific problem or question. The police employees need to do the information searching process thoroughly since the police law is described as follows:
"The police are tasked, subordinate to the competent authority, and follow applicable legal rules, ensuring the actual enforcement of public order and providing assistance to those in need." (Kerntaken Politie, n.d.).

Police employees are influenced not only by the mentioned factors but also by various factors such as political pressures, media influence, and public trust (Fenton-O'Creevy et al., 2022). The work of the police is subject to significant change. For example, the police are confronted with new forms of crime, societal unrest, new laws, and regulations that need to be acted upon, the police organization is aging (meaning the risk of knowledge loss), and technological tools are being used (Vooijs et al., 2022). The information is collected internally and externally, from formal reports and presentations to informal conversations with stakeholders and even the assessments of advisors. As the Dutch national police are seen as a knowledge-extensive organization, decision-makers rely on the knowledge of their employees (Wolfberg, 2017), which is called implicit knowledge. Decision-makers utilize explicit knowledge for decision-making, actions, and guidance, often documenting it in formats like police standard operating procedures (Gottschalk, 2006). The information-gathering phase is time-consuming, as coordinating the involved parties and locating relevant information sources is complex. Moreover, much valuable information seems scattered and not centrally documented, making it even more difficult.

The information stream within the police and outside the police feels overwhelming. The daily influx of information now exceeds the total information created from the beginning of human civilization to 2003 (Jackson & Farzaneh, 2012). According to Gottschalk (2006), the information the police employees face is enormous. One reason is that anyone can quickly generate more information by creating, duplicating, and sharing content online. Information overload is also a well-known problem among police organizations in other countries (Olarinoye et al., 2016). In this way, the policymaker can quickly enter a situation wherein an excessive volume of information about a particular subject makes it challenging for an individual to make effective decisions. The large influx of information is hard for a human since a human has limited cognitive processing capability (Caby, 2019; Walgrave & Dejaeghere, 2016). This result is a concept that is called *information overload*. The volume of extensive documents drowns them, leaving insufficient time to review them carefully (Kock, 2022). People feel overwhelmed by the influx of information, which makes it harder for them to understand, filter, and prioritize the data effectively (Philips-Wren & Adya, 2020).

The role of the police within the population is significantly high to keep society safe, and they also need to consider the reliability of the information. Knowledge is seen as a powerful weapon if knowledge and information are findable within a reasonable amount of time (Politie, 2023). Another critical point is that the Dutch police use various platforms and programs to store information, making the search process even more challenging (Vooijs et al., 2022). Consequently, the Dutch police often skim or bypass these materials entirely, risking oversight of crucial details (Caby, 2019). Various studies have illustrated that issues such as information overload, unclear and hard-to-find knowledge,

and finding knowledge that is not up to date contribute to high work pressure and stress (Politie Nederland, 2023).

Within the police department, policymakers and officers are dealing with information overload. Simultaneously, there is a growing need to adopt a “preventive” approach to policing rather than a “reactive” one. All police employees want to look at the future of police instead of getting swept up in the hustle and bustle of daily policy life (Reporter, 2020). The struggles that the police employees experience reveal a direct lack of knowledge management within the organization. Some argue that a crucial asset in police investigations is knowledge, with police researchers confirming that the success of an investigation depends on the accessibility of knowledge. Still, the management of documents is time-consuming (Gottschalk, 2006). Making effective use of knowledge management systems allows the user and the police employees to focus on strategic policymaking and gain better insights into how to tackle a problem, which helps them to improve decision-making (Olarinoye et al., 2016). Increasing knowledge management systems is essential since individuals, especially within large hierarchical organizations, tend to withhold their expertise because it makes them valuable (Olarinoye et al., 2016).

1.2. Problem Statement

Policymakers, particularly those within the Dutch police, struggle with information overload. The rapid influx of information and limited time disturb their ability to access all necessary data for informed decision-making. In the current climate of increased resistance towards the police, their decision must be transparent, comprehensive, and inclusive of all relevant relationships and impacts. To address the issue of information overload among policymakers, an effective solution must be identified. The extent to which Dutch police employees experience information overload and their willingness to adopt new methods to mitigate it are still uncertain. Existing literature and solutions could be more extensive in addressing information overload within the context of the Dutch police force, highlighting a gap in the need for further exploration.

Resolving information overload is crucial, as it directly impacts the quality and transparency of policies implemented by the Dutch police. Only complete or well-informed policies can improve resistance and maintain trust in law enforcement. Ensuring well-informed, accurate, and transparent policies helps the police navigate the complex social dynamics and enhance public trust and compliance. The thesis explores information overload among Dutch police policymakers and evaluates their readiness for change. Through interviews and analysis of their working processes and daily challenges, the research uncovers both solved and unsolved issues related to information management. Ultimately, the study provides valuable insights into the operational dynamics of the Dutch police and proposes novel solutions to enhance policy formulation and implementation.

1.3. Research Objective

This research aims to design a method that decreases information overload within the Dutch national police. Herein, increasing policymaking is a consequence. Use a Knowledge Management System (KMS) to reduce information overload and make the large influx of information more manageable. The information management system uses a knowledge graph to demonstrate relations. A knowledge graph is a different representation of information and its relations. The system is tested, and differences are determined between the traditional way of policymaking and the usage of knowledge graphs. The experiment focused on the change in information overload among strategic policymakers within the Dutch police. Therefore, the study only includes policymakers from that domain. Therefore, the results of the experiments are not directly linked to the entire population. Knowledge graphs usually consist of domain-specific knowledge.

The domain-specific knowledge in the knowledge graph used for the experiments is about the Dutch police. An ontology is developed to formalize all the rules governing domain-specific knowledge. The rules about the types of relations and objects make it possible to create a knowledge graph. The thesis only focuses on information overload since that constitutes one of the factors

impacting decision-making (Buchanan & Kock, 2001). However, decision-making is influenced by many factors, including political shifts and social influences. (Ichimura. S, 1998). The research does not consider the other factors that influence policymaking.

1.4. Scientific Relevance

Within the variety of knowledge management systems, knowledge graphs are a reasonable fit for the struggles the Dutch national police face (Zhu, 2023; Rospocher et al., 2016). However, research has yet to be done to see if a knowledge graph including ontologies has the potential to work within the Dutch national police. Therefore, there is a need to bridge the gap between information overload and the knowledge management system by using knowledge graphs.
The research measures information overload within a large organization, namely the Dutch national police. Numerous studies explore methods to combat information overload, but there currently needs to be more research addressing the Dutch police force.

The research demonstrates the possibility of measuring information overload through experimentation. Developed by Jackson and Farzaneh (2012), a new tool or method has yet to test the information overload formula. It allows for assessing differences in information overload and evaluating the effectiveness of newly developed tools. Therefore, the study introduces a measuring instrument for assessing variations in information overload, offering insights into enhancing policymaking with a focus on public domain information overload.

1.5. Societal Relevance

Although knowledge management systems are widely used within different domains and the policy domain, the Dutch national police need help managing their information and knowledge within the organization. The importance of managing information and knowledge within the police department is also stressed by the news, which highlights the importance of trust in the police (CBS & Kantar, 2023) since the police feel the importance of preparing the police for the struggles the police face in the future.

Nevertheless, the influx of information keeps increasing, making it harder for policymakers to read and create relations. The use of digital technology, in general, exponentially expands the police's ability to perceive and process information. The increase in information seeks opportunities to improve the effectiveness of policing, but at the same time, it comes with risks to democratic law (Landman, 2023). Therefore, careful consideration is still required, which can be done using knowledge graphs.

With approximately 65,000 employees (De Politie, 2020), the Dutch police play a crucial role in maintaining safety and security in the Netherlands. However, there needs to be more tacit knowledge in collecting. Effectively managing tacit knowledge ensures everyone’s work remains relevant and usable even when police employees retire. Within the variety of knowledge management systems, knowledge graphs are a reasonable fit for the struggles the Dutch national policy is facing. However, no research has been done to see if implementing a knowledge graph system has the potential to work. The mentioned struggles underscore the necessity of bridging the gap between information overload and the knowledge management system with knowledge graphs.

1.6. Relevance for EPA

The MSc Engineering and Policy Analysis (EPA) addresses global challenges characterized by international scope and a mix of technological and a political component (MSC Engineering and Policy Analysis, n.d.). The selected research focus centers on addressing information overload among policymakers through a platform, which is therefore regarded as both technological and political. However, suggesting that the platform completely solves the complex problem of information overload might be too hopeful, as it oversimplifies how challenging the issue is. The problem has subtle complexities. Furthermore, the proposition is that analyzing the platform's efficacy constitutes a meaningful step toward resolving the grand challenge of focusing on information, which now needs

more proof. Nevertheless, the involvement of multiple stakeholders in addressing the issue makes it a suitable fit for the EPA program.

1.7. Outline of the report

The first chapter describes the problem statement involving background information. This is followed by Chapter 2, where the research methodology is described. The rest of the chapters follow the main steps of the method. Next, chapter 3 explains the requirements for the artifact formulated through a literature review and interviews. Chapter 4, where the design is selected, is based on the existing method comparing the criteria of the solutions. Chapter 5 describes the Proof of Concept and its working principles. Then, chapter 6 describes the setup of the experiment used to test the magnitude of information overload. After setting up the experiments, the results are evaluated and formulated, which can be read in Chapter 7. Next, the discussion of the results and the research is described in Chapter 8. It ends with a conclusion that answers the main research question in Chapter 9.

Chapter 2
Research Design

Chapter 2 explains the methodology used in the study. The methodology that is used is called Design Science Research (DSR). All the steps involving the DSR are individually explained, ending with the scope of the research.

2.1. Research Approach

The thesis explores ways to enhance the creation of strategic policies for the national police, with a primary focus on addressing the current issue of information overload. Therefore, the research question is defined as:

"How can the national police decrease information overload while improving decision-making?"

To improve strategic policies, it needs to be clear which insights are required, what requirements are necessary for a new technique to be implemented, and what needs to be done to meet those requirements. Those requirements lead to a possible solution for managing information overload. Results in a proof of concept that meets those requirements and constraints of the environment, the Dutch national police department. Different methods can be utilized to analyze a proof of concept. Hevner et al. (2004) introduced a Design Science Research (DSR) framework with multiple steps for designing innovative solutions to real-world problems. Another approach is the Prototype Methodology, where the analysis, design, and implementation phases occur concurrently (Helmy et al., 2009). However, the prototype method may not be ideal for the research due to the challenges of making minor adjustments throughout the project. Design Thinking, which focuses on human aspects during innovation creation (Dam, 2024), presents another method. System development research, which uses action research to enhance situations and deepen understanding through reflective processes (Hasan, 2003), is also employed for innovations.

Nonetheless, it may not be suitable for projects with time constraints or short-term needs. Despite these options, DSR is chosen as the methodology due to its effectiveness in solving practical problems and developing directly applicable solutions that add substantial value in the real world. Its iterative nature aligns well with the project's requirements, and its stakeholder collaboration aspect is highly advantageous for the research.

DSR is a widely recognized method in the information systems and management fields that enables the development of a technological tool that fulfills human needs (Simonofski et al., 2022). It achieves a user-friendly tool by producing fresh insights for researchers and being practical and usable for practitioners. DSR aims to stimulate the creation of innovation. It is about using prescriptive knowledge to say how things should be, not just how things are. Prescriptive knowledge helps the designer comprehensively understand the users' needs and desires (Siemon, 2022). DSR is a type of research that does not choose between positivism or interpretivism; it can be based on either of these ideas and work alongside them (Gibbs, 2005). Positivism emphasizes reality using quantitative data, whereas interpretivism emphasizes meaning through qualitative data. The study adopts an interpretivist approach to understanding people's thoughts, feelings, and meanings.

The research focuses on using DSR as a bridge between theory and practice by involving design steps. DSR has steps that include formulating a problem definition, defining the requirements, creating the design, developing the artifact (innovation), experimenting, and evaluating it. The methodology of DSR unfolds through a structured process containing various phases. Initially, the goal and scope problem is followed by a literature review, which involves reviewing prior work relevant to the research and composing the requirements. Subsequently, the design of the solution takes place, where the insights gathered during the interviews and literature review are used to formulate requirements for the design, followed by an evaluation phase wherein experiments are

conducted to validate the design knowledge generated. The cycle is iterative and designed by Hevner et al. (2004). The entire DSR cycle is illustrated in Figure 1.
Chapter 3 further explains the method and its use in the thesis.
The main research question searches for a solution to improve the creation of strategic policymaking for the Dutch National Policy Department. The subsequent sub-question gradually addresses the main question, which is structured according to the DSR framework.

I. **Problem Identification**
   Sub-question 1: What are the causes and consequences of information overload for strategic policymakers of the Dutch national police department?
I. **Define requirements**
   Sub-question 2: What are the requirements for a solution to improve the strategic policymaking of the Dutch national police department while focusing on information overload?
II. **Design**
   Sub-question 3: What platform design can effectively enhance strategic decision-making within the national Dutch Police while considering the requirements?
III. **Proof of Concept**
IV. **Experiment**
   Sub-question 4: How does the proposed design work compare to the current method used for strategic policymaking within the Dutch national police department?
V. **Evaluate & Recommendations**
   Sub-question 5: What are the positive and negative effects of the designed platform on information overload in the context of strategic decision-making by the national police?

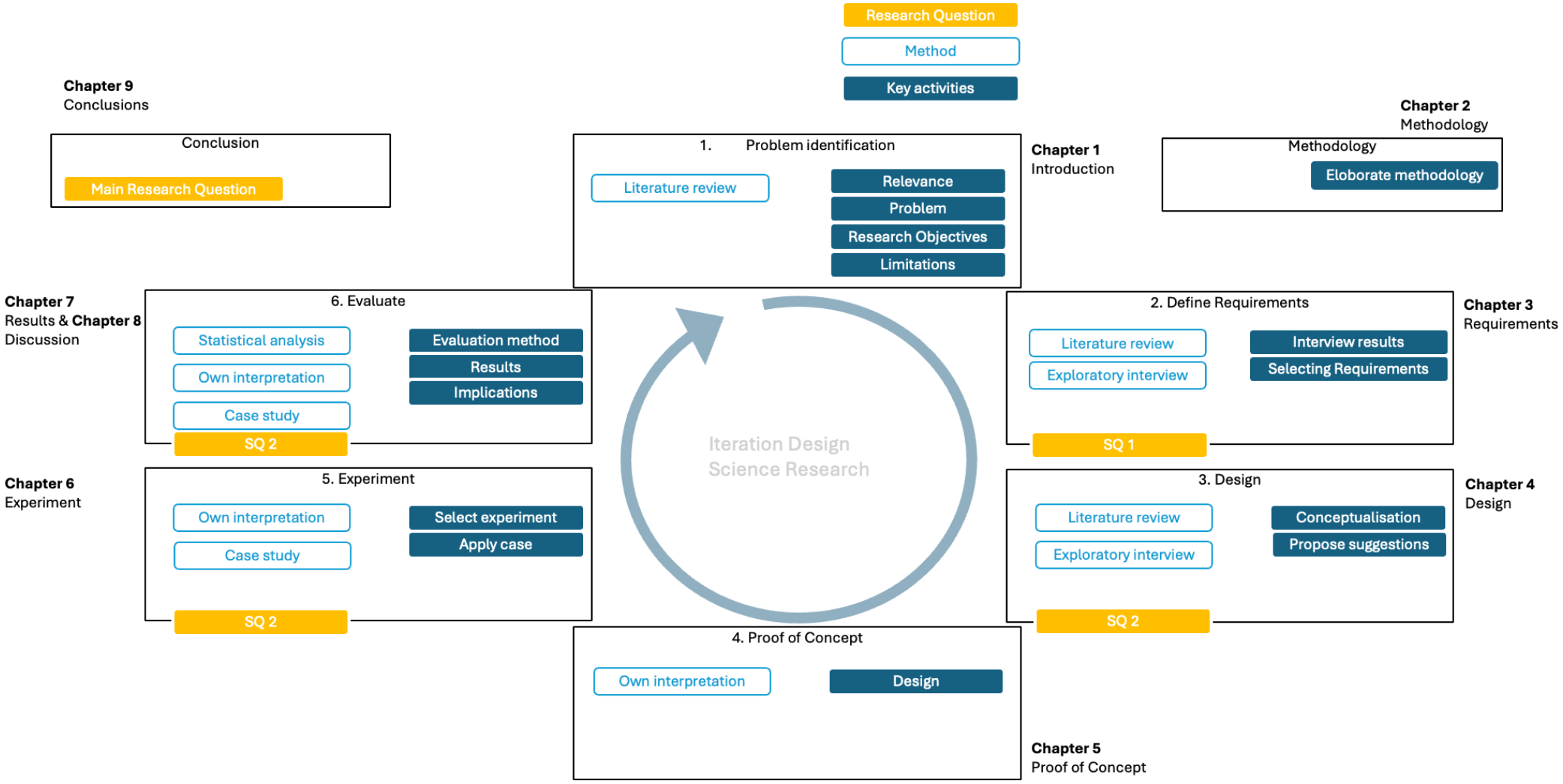

Figure 1: Design Science Research Framework adjusted for this thesis problem (Figure design based on Meijnema., 2024)

2.1.1. Problem identification (DSR Phase 1)

Within Design Science Research, the first step is discovering the problem. The first step is already described in Chapter 1, Introduction. Methods used are literature review and stakeholder interviews within the national police to determine the challenges that they are facing. An exploratory study is appropriate due to the limited knowledge surrounding the phenomenon of information overload (Sekaran & Bougie, 2016). These exploratory interviews used a qualitative approach. The preliminary findings of the literature review reported in the introduction are used to formulate the interviews.

2.1.2. Requirement identification (DSR Phase 2)

The next step in the DSR method uses a literature review and exploratory interview methods. Interviews ensure a broad spectrum of opinions and perspectives, and quantitative data could complement qualitative insights (Ulmer & Bradley-Engen, 2003). The literature review is twofold. At first, it makes it possible to create an overview of the existing solution in the literature, creating a list in which the needs and desires could be compared. Second, the literature is the first part of a framework for the requirements needed for the artifact. Those are compared to the desires and needs of the users within the national police gathered during the exploratory interviews.

The exploratory interviews are held in a semi-structured manner with strategic policymakers within the national police department. Semi-structured interviews are in-depth interviews where the respondents must answer open-ended questions about specific topics of interest (Jamshed, 2014). The interviews are held remotely using Microsoft Teams due to the various locations of the strategic policymakers, and the process is kept constant to ensure the comparability and applicability of the findings across the interviews. The interview guide can be found in Appendix A. The emphasis on strategic policymakers was selected because of the daily challenges they encounter with information overload. All the interviewees were asked for permission to record the interviews. The permissions made it possible to transcript the interviews afterward for a complete focus during the interview. The questions were formulated using a semi-structured interview format, which organized the interview process. Within the requirement identification part, the first sub-question is answered. Defining the requirements for the artifact describes “what is wanted from the design by the client and potential users.”

2.1.3. Design (DSR Phase 3)

The following part of the DSR is the design of the artifact. The design part can be divided into three different steps. Firstly, the creation of design ideas. Then, establish design guidelines. Last, crafting the system's layout, organizational structure, and operational framework for the platform (March & Storey, 2008). All the steps focus on the platform's input generation.

2.1.4. Proof of Concept (DSR Phase 4)

The name of the Pproject's Proof of concept is Futures Platform; this is the artifact. Futures Platform has different steps in the creation of the platform. At first, the tooling is chosen using the requirements created in Step 2. The fourth phase of the thesis provides a manual of the tool, including visuals on how the tool looks.

2.1.5. Experiment (DSR Phase 5)

The challenges combined with the solutions gathered from the literature have resulted in a suitable method to resolve the problem. By experimenting, the selected tool is evaluated. The experiment uses the within-subject design method. The experiment chosen approach allows all the participants to perform the same test and receive the same amount of information. Both groups are their control group and the test group. The basic idea is that a group of people are asked to answer a question about a subject. The results of the different experiments and groups are statistically evaluated.

2.1.6. Evaluate (DSR Phase 6)

The evaluation part of the DSR framework is based on the results of the experiments. The experiment focused on different parts of an information overload formula and the user experience. By using the formula, the effect of the method is measurable. A conceptual model with the expected results is created so that the results gathered during the experiments could reject or accept the hypothesis. The test is done by strategic policymakers and people with less experience in strategic policy making but still employees at the Dutch police. The variety of employees makes the results valuable since the goal is a full coverage usability score within the police. At the end of the evaluation, recommendations are drawn for improvements.

2.2. Stakeholder management

Due to the selected methodology, different stakeholders are involved through interviews and experiments. Generally, when addressing a problem involving multiple stakeholders, it is crucial to involve them actively. The engagement of the stakeholders offers insights into their goals, values, and resources, enabling an extensive understanding of potential challenges throughout the process. Understanding the challenges is vital to achieving goals efficiently and effectively. The stakeholders critical in the study are the employees of the Dutch Police. Since participants must cooperate in the interviews or experiments, engaging these stakeholders will primarily enhance comprehension of their working principles and challenges.

2.3. Scope

The thesis focuses on strategic policies within the Dutch national police department. The methods that are used primarily consider information overload. Therefore, the evaluation used is tested according to that. There could be more challenges that strategic policymakers face, but the research focuses on the information overload part. Information overload could also be considered the unfindability of documents or information. Also, the tool created has information regarding disinformation within the government. The test results may vary if a different subject is used. The information used for strategic policymakers could contain PDFs, Word files, videos, literature, etc.

Within the research, a few limitations are formulated. At first, the exploratory part of the research is based on conducting semi-structured interviews. Semi-structured interviews unavoidably include biases, which must be considered. Nevertheless, the artifact used for the evaluation was created by specialists rather than the author of the thesis. Therefore, some functionalities are not fully known, and parts of the artifact could be considered a ‘black box.’ When focusing on the evaluation, two limitations need to be stated. The participants rely on their cognitive knowledge. The user test is conducted on a small sample size. However, the focus on the police as an organization is large enough to draw meaningful results for the police but not for the Netherlands in general.

Chapter 3
Requirements

The next step of the Design Science Research framework is the creation of the requirements. At first, the literature review approach, together with the findings, is discussed. The literature review enabled the researcher to create a list of requirements. Then, the interview process and the findings are discussed, and a new list of requirements is formulated. The two lists will be compared and end with a final list of requirements the tool must satisfy. Chapter 3 describes the answer to the first sub-question: *What are the causes and consequences of information overload for strategic policymakers of the Dutch national police department?*

3.1. Literature Review Approach

A literature review is conducted to gain knowledge about the research, understand the topic, and identify a knowledge gap (Bhatta et al., 2023). The literature review aims to evaluate the core concepts regarding evaluating a tool focusing on decreasing information overload while finding the requirements a tool needs to have regarding the literature. By using search questions, the core concepts are determined. A search question was created for two items, including search terms, to formulate an answer to a question with literature from SCOPUS. The papers ranged from high cited to low.

Firstly, it is essential to know what information overload is and when people reach it. This step is done using the following method:
The search questions were:

a. *What is information overload, and when do people reach it?*
   Keywords: "information overload" OR "information literacy."
   Method: Papers with more than ten citations are scanned.
   Not included: Papers that needed more detail about misinformation and healthcare.
   Result: In total, ten papers were found to be suitable.
b. *"How does the police use information technology nowadays?*
   Keywords: "information technology" AND "police."
   Method: The method Is described in Figure 2.
   Not included: Papers with a different focus, like forensics and non-western papers
   Result: In total, 11 papers were found to be suitable.

The next step focused on the different information technologies used by the police. Therefore, the search terms used in SCOPUS were: "Information technology: and "police." The part is visualized in a PRISMA diagram illustrated in Figure 2.

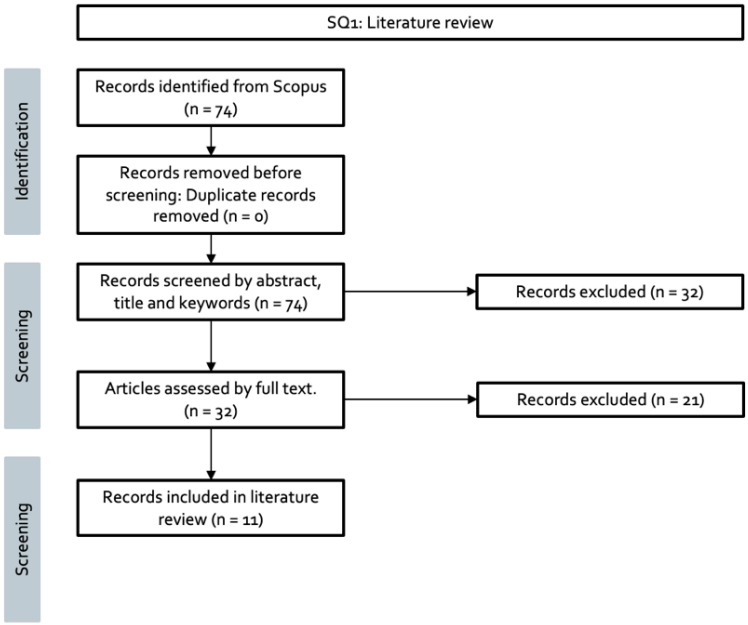

Figure 2: PRISMA diagram literature review

3.2. Results

3.2.1. Information Overload

Information overload occurs when individuals encounter excessive information that exceeds their cognitive capacity. (Roetzel, 2019). As illustrated in Figure 3, when more information is provided for a decision, the quality of the decisions rapidly decreases (Eppler & Mengis, 2004). Information overload is not only a recent issue (Edmunds & Morris, 2000), but the amount of information created daily is increasing rapidly (Bawden & Robinson, 2009; Shrivastav & Kongar, 2021).

An example is the research of Pennington and Tuttle (2007), who examined software projects and the decision strategies involved. Researchers found that within decision-making IT projects when information increases, the time to find the solution increases; therefore, managers resort to coping strategies, which results in less quality decision-making. That project was executed for IT and physicians (Rebitzer et al., 2008). The main challenge with information overload within individuals and organizations is finding the leading solution (Daradkeh et a., 2015). Another critical psychological factor is time pressure (Shrivastav & Kongar, 2021); a note must be made that that paper primarily focused on individuals, which is a different direction than the rest of the referenced literature. Individual research concludes that increased information has created a more significant challenge in quality research decisions. (Van Knippenberg et al., 2015). Finding ways to reduce information overload is essential since evidence suggests it can make progress more time-consuming and distract users from relevant information. Research on the issue of organizational information overload frames it as a problem primarily rooted in excessive paper documentation from a management perspective. However, in specific organizations, information overload is understood to include both paper-based and electronic information systems (Edmunds & Morris, 2000).

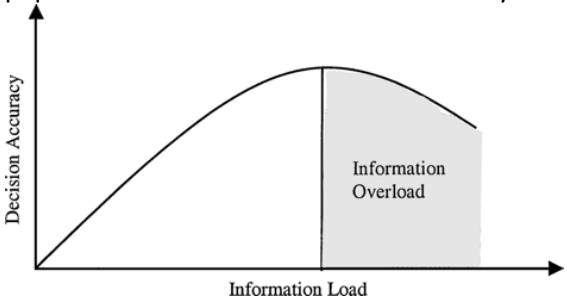

Figure 3: Information overload curve

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3.2.1.1. When do people experience information overload?

In various domains and sectors, individuals encounter information overload at different times. Overload occurs when the volume of information or choices exceeds their cognitive processing capacity, influenced by factors like age, literacy levels, technical skills, and the pace of change. Malhotra et al. (1982) note that people typically experience overload when faced with numerous alternatives or are flooded with information on multiple attributes, such as when presented with 10, 15, 20, or 25 options.

The feeling of overload often comes from a perceived loss of control or feeling overwhelmed by the massive amount of available information (Bawden & Robinson, 2009). Despite efforts to mitigate it, the multifaceted nature of factors contributing to overload complicates providing a simple, universal solution (Bawden & Robinson, 2009). In organizational contexts, information overload commonly appears within email inboxes, followed closely by difficulty locating specific information (Mulder et al., 2006). Mahdi et al., 2020, delved into the moment of information overload (IO), decomposing its underlying causes, symptoms, countermeasures, and consequences by closely examining the problems associated with information at the start of overload, creating insights with an understanding and addressing the pervasive issue.
Jackson & Farzaneh (2012) constructed a formula in which information overload is calculated, demonstrated in the following formula:

Information Overload =
(Characteristics of Information × Information Processing Capacity × Available Time)
–
(Personal Factors × Task and the Process Parameters × Quality of Information × Quantity of Information)

Using the formula provides the researcher with a broad answer to the question of to what extent the users experience information overload.

3.2.2. Tool requirements from the literature

The police worldwide need help finding information (also called information seeking). The work police employees conduct daily is complex and dynamic, and strategic policymakers try to simplify their tasks. Police employees deal with complex problems, including geopolitical and legal issues (Luen & Al-Hawamdeh, 2000). The decisions that police employees make need to be grounded by proper information (Sultan & Rehman, 2007; Gottschalk, 2010), which is nowadays hard to find due to the amount of information police employees are faced with daily.

Most public organizations are knowledge-expensive and need a proper knowledge management system (Luen & Al-Hawamdeh, 2001), but public organizations need one. Around 70% of police officers, according to the Delphi (2002) survey, needed help finding the correct information. Employees in large organizations such as the police spend more than 2 hours searching for documents daily (Delphi, 2002). According to the Tedmori et al. (2007) survey, around 60 % of police officers believe that a minimum of 21% of their working time could be saved if knowledge is managed correctly. Focusing on those terms' knowledge management could be an asset to integrate into the police work since the credibility of the police depends on the decisions they make. It is essential for the police since the employees must make decisions that affect the safety of citizens (Sultan & Rehman, 2007). The capturing of information varies from computer documents to people's experiences. Employees have problems managing and storing information (Luen & Al-Hawamdeh, 2000). A standardized format for capturing information/knowledge is essential to decrease information overload.

Zooming in on the culture of police employees, it is evident that they have specific habits that need to be considered. At first, some employees have an issue with sharing their knowledge. A culture change must be included to create a more open, sharing culture (Luen & Al-Hawamdeh,

2000). UK police officers prefer asking for help from their colleagues than searching for information themselves (Tedmori et al., 2007). In this case, finding the correct person with the proper information is stressful and takes extreme time. There is a high correlation between the number of years a person works at a company and the quicker the person finds the proper information due to the size of someone's network (Tedmori et al., 2007).

Despite the advancement of technology, the traditional practices within the Dutch police force have remained unchanged over the past decade. (Van den Ende et al., 2020). By adapting new technologies, police employees kept doing what they already did. Borglung (2005) already mentioned that creating an intranet where information is stored electronically created a new way for police employees to find their information, making them more prepared for daily complex issues. With the presence of electronic information, decision-making was easier.

Having a significant amount of information is essential to make an in-depth decision. Too much information can lead to ineffective processes in which not all the information is considered. When designing a tool in which the problem of information overload is tackled, the human resources and their capabilities are the most important in the process (Sultan & Rehman, 2007; Tam et al., 2021). Research has revealed that increasing the knowledge management technologies within the police improved the performance by 59% (Gottschalk & Holgersson, 2006). When the performance is improved, the relationship between the police and the citizens simultaneously increases (Guerrette & Przeszlowski, 2023). When police employees feel the tool can increase their performance, they use it (Tam et al., 2021). It is essential to remember while designing a tool for the police that even if it matches the requirements selected above, empowerment of the employees is needed, and employees need to keep seeing the added value; therefore, they keep using the tool.

Requirements for new tools from the literature are:

- **Easy to use and training**: The system could be user-friendly, and comprehensive training could be provided to ensure effective utilization (Sultan & Rehman, 2007; Tam et al., 2021).
- **Perceived values**: The system must demonstrate clear value to users, as perceived value is crucial for adoption (Sultan & Rehman, 2007; Guerrette & Przeszlowski, 2023; Tam et al., 2021).
- **Culture change**: Implementation of the system may require a cultural shift within the organization (Van den Ende et al., 2020).
- **Knowledge Sharing and Communication**: The system could facilitate sharing and communication among users to ensure that information is actionable (Gottschalk & Dean, 2010).
- **Accessibility of information**: All information within the system must be easily accessible to users, as retrieving information from various sources should not be time-consuming. (Gottschalk & Holgersson, 2006; Guerrette & Przeszlowski, 2023)
- **Integration of different information sources**: The system could integrate various information sources, including computer records and news articles, to accommodate the diverse nature of police work (Gottschalk & Holgersson, 2006).
- **Review Mechanism**: Before entering information into the system, there could be a review process to ensure accuracy and relevance (Gottschalk & Holgersson, 2006).
- **Transparency of Information Source**: The system must provide clear attribution of information sources to enable transparent decision-making by the police (Tam et al., 2021).

3.3. Interviews

3.3.1. Participants Recruitment

A semi-structured interview focuses on different open-ended questions. It uses a fluid structure, where an interview guide provides a tool for various topics on which the data needs to be collected (Jamshed, 2014). The interviews aim to gather information about the working processes of strategic policymakers and the challenges police employees face when creating policies. Therefore, the focus group of the interviews is employees of the Dutch Police who are dealing with strategic policymaking.

The group of interviewees consists of 12 individuals, a size that, while manageable, is adequate for conclusions. Qualitative research literature does not provide a specific evidence-based guideline for the number of participants to interview; instead, it advises conducting interviews until data saturation is achieved. (Guest et al., 2006; Lallemand & Gronier, 2015; Simonofski et al., 2022). At the beginning of the interview, the goal was vague, and the participants were asked to decrease the bias since the interviews were primarily to receive insight into their working processes, challenges, and struggles.

At the end of the interview, the goal was made clear. The solution in mind has been explained to the participants. In this way, the interviewees could also present their opinions about the possible solutions and what to keep in mind while designing such a solution for the Dutch police.

3.3.1.1. Data collection

The interviews are held remotely using Microsoft Teams due to the various locations of the strategic policymakers. An extra reason to do the interviews online is that the interviews could then be recorded. The record is written down in Microsoft Word to create transcripts of the interviews. All the interviews were conducted in Dutch as well as in the transcript. Before the start of the interviews, all the participants were asked for consent to record the information and use it. An interview guide has been created to create a homogeneous interview structure, illustrated in Appendix A Interview Guide. The transcripts were made using the Microsoft Word dictating function. This was then manually verified to remove errors.

3.3.2. Data analysis

The exploratory interviews are done to gather qualitative data, which is any data that is not numbers. Interview transcripts are an example of that. Interviews rely on asking questions to collect data. Interviews gather in-depth insights into an issue or spark fresh research ideas (Jamshed, 2014; Hopf, 2004). The method used for the data analysis is thematic analysis, which analyzes qualitative data by examining a dataset to recognize, interpret, and present recurring patterns (Kiger & Varpio, 2020). Thematic analysis is done according to the following steps of thematic qualitative analysis (Dye, 2023):

- Organize data
- Understand data
- Code data
- Present data

The first step is organizing the interviews to ensure that transcripts are in the same format, which makes them comparable. Then, an understanding of the data set must be created to annotate subjects, and observations must be written down. Next, the data analysis coding process starts. Coding ensures that the main themes of the interview are brought to light. The main themes of the interviews are written down to present the data.

Next, the coding phase of the interview is done. The first step in analyzing the interviews was utilizing coding. Coding involves identifying portions of the text, typically phrases or sentences, and devising concise labels or "codes" to characterize their content (Caulfield, 2023).
The legend of coding is illustrated in Table 1.

Table 1: Coding legend

Legend	Color coding
Police	
Strategic Policy Making	
Change	
Challenges	
Examples of strategic policy making	
Information	

The codes created a concise summary of codes and the recurring meanings of the data. With the codes, themes are made, which are broader themes combining different codes. The themes are illustrated in Table 2.

Table 2: Coding themes

Theme	Codes
Working Process	- Police - Strategic policy making - Information Examples of strategic policy making
Issues within working process	- Challenges Police
Improvements & recommendations	- Change

3.3.3. Result analysis

The interviews were held to gather information about the problems police employees are now facing when doing their work. The themes present insights into the main themes discussed during the interviews. The different themes are discussed below.

3.3.3.1. The work processes.

The roles of the employees within the police department that are spoken to are diverse. Still, all are crucially involved in shaping the strategic policy for the police, especially at the national level. What is striking is the multifunctionality of their roles, sometimes performing tasks nationally while at other times focusing on the interests of specific units within the Netherlands. These unit interests vary greatly, such as the importance of a border region like Limburg with 351 km of border compared to the Amsterdam unit with 0 km of border. Projects related to policy formation range from large-scale projects focused on political issues to minor, but not less critical, initiatives such as developing parking policies or managing events.

The process for developing strategic policy has various approaches. Sometimes, the question comes from the management branch of the organization, while in other cases, societal developments perceived by employees may be the cause. It is also possible for a trend or development to be noticed by external research agencies, which can then lead to policy formation. Nevertheless, a common way for strategic policing to begin is through the management branch of the organization. The reason is that police are often still focused on today's policing. "So, the moment you come up with an analysis where the insights or conclusion do not match today's practice, it is hard to receive attention for that.".

In the first phase of strategic policy, extensive information on the specific problem or issue is gathered. The information is collected internally and externally and includes various sources, from formal reports and presentations to informal discussions with stakeholders and even advisors' assessments. This phase of information gathering is often time-consuming, as coordinating the

involved parties and locating relevant sources of information is a complex process. Moreover, much valuable information must be more centrally documented, making its location even more challenging. Then, a phase of interpretation starts.

3.3.3.2. Issues within the work process

Developing strategic policy within the police department is highly time-consuming and faces various challenges. The main obstacle lies in data and human aspects, which are closely interconnected. A fundamental problem is a need for clear protocols for capturing and managing information within the police organization. The importance of knowledge management is underestimated, and convincing strategic leaders of its importance proves to be a challenge. The lack of standardized procedures leads to an inefficient search for relevant information, often trapped in employees' minds. The fragmentation of information and knowledge within the organization is not only an obstacle to making strategic policy. Still, it is also seen as a valuable resource because having the information available to police employees is valuable. However, the lack of a structured approach leads to problems regarding documentation and authorization. A participant mentioned: “I do not know all the information, so it is unclear what information is missing.” Moreover, the issue of conflicts of interest among different stakeholders plays a role, making it difficult to reach a consensus on the necessary actions. As a result, developing a strategy is feasible, but realizing the plan is often a tipping point.

Another area for improvement is accountability in maintaining information sources, such as internal pages. This originates from the time-intensive nature of the process, where keeping these pages up to date is perceived as a burden. Moreover, obtaining support for new plans could be improved by the size of the national police organization and the autonomy of different units within the organization. The organization's size complicates gathering information and making policies that apply to the entire organization. Collecting relevant information from abundant available data requires considerable time and resources. Decision-making often depends on people's interpretations, making it reasonably limited.

People, including police employees, also often do not know what "all" information is and usually fall back on their collection of sources. Automating specific tasks could simplify the policy-making process, making subsequent steps less time-consuming. The need for advanced technological solutions within the organization contributes to the complexity of the work process. Another aspect raised is the experience of information overload among employees, leading to stress and inefficiency. The inability to quickly access the required information is a constant source of frustration and hampers effective decision-making. Prioritizing challenges within the police work process is crucial to effecting practical improvements. According to interviewed police employees, ensuring information security, facilitating consensus building, and more efficiently gathering relevant information are the main pillars to work on. These aspects are crucial to reducing the time currently required for policy formation.

3.3.3.3. Improvements & Recommendations

One of the significant obstacles to change appears to be the trust in innovations, with employees needing more time due to the traditional work culture within the police. The need for cultural change is emphasized, although the traditional manner is a lengthy process that requires significant effort. Creating support for innovation at all levels of the organization proves to be a complex task and presents the daily priorities and operational challenges police personnel face. An essential strategy to achieve this is optimizing user experience and demonstrating the added value of new technologies to all stakeholders.

Employees experience abundant information systems but often need more insight into their benefits, leading to underutilization. User input validation is also crucial, given the diversity of perspectives within the organization, preventing the information from being put into the system and creating the concept of ‘garbage in = garbage out.’ Striving for real-time policy adjustments based on

societal developments is expressed as an ambition, recognizing that it requires an evolution from the current slowness in policy processes. It is also essential to reduce bias and base policies on a broader range of sources facilitated by technological capabilities.

Emphasizing metadata in information can help ensure the authenticity and currency of data, an important aspect given the diversity of disciplines within the police. A long-standing desire is the development of 'police Wikipedia,' allowing users to navigate information easily and contribute themselves. This would improve work efficiency and promote collaboration between different units. It is crucial to monitor the culture of the police force when introducing innovations. Therefore, the innovation needs to be implemented incrementally by starting small. The chances of success are most significant.

In summary, identifying and addressing the mentioned challenges requires an integrated approach, integrating technological solutions with cultural changes and user-centric design methods. The potential of a Futures platform to support these goals is significant but requires careful implementation and ongoing evaluation to achieve the desired impact.

3.3.4. Tool requirements from interviews

The interviews were used in two manners. At first to gain more insights into the problem formulation of the problem the Dutch national police are facing regarding strategic policy making and information overload. An extra reason for conducting the interviews was to gather insights into the challenges and struggles within strategic policymaking, collect possible ideas on how to improve it, and formulate requirements for the design of the artifact.

The requirements for the artifact are as follows:

- **Time-efficient policymaking**: The system must streamline the policymaking process to reduce time spent on decision-making tasks
- **User-friendly interface**: The system interface should be intuitive and a user-friendly experience.
- **Structured documents and authorization**: The system should provide a structured framework for documenting and authorizing policies to ensure clarity and accountability.
- **Facilitation of consensus building**: The system should support collaborative decision-making processes to facilitate stakeholder consensus.
- **Efficient information gathering**: The system should gather relevant information from various sources to support informed decision-making.
- **Demonstration of added value**: The system should demonstrate the added value of incorporating new technologies for all involved parties, highlighting benefits such as improved efficiency and effectiveness.
- **Validation of user input**: The system should offer mechanisms to validate user input, ensuring the accuracy and reliability of data entered into the system.

The Dutch national police are already experimenting with different solutions for information overload. The police employees had already set four requirements to match the solution of information overload. These match the requirements determined during the exploratory qualitative research in two areas. Those requirements are:

- **Comprehensive Information and Knowledge Hub**: The system must be a centralized repository for storing and accessing comprehensive information and knowledge relevant to the organization.
- **Enhancement of Collective Intelligence**: The system should promote the organization's collective intelligence by facilitating collaboration, sharing expertise, and leveraging the insights of all stakeholders.
- **Transparency in Information Management**: The system must ensure transparency by providing clear visibility into the relocation and handling of information.

- **Expandable System of Methods**: The system should be in such a way that it is easy to expand, allowing for the incorporation of new methods and functionalities as organizational needs evolve.

Improvement of Validity and Reliability: The system should enhance the validity and reliability of strategic policies by providing accurate, up-to-date information and supporting evidence-based decision-making processes.

3.4. Conclusion

The requirements are determined by comparing the literature review requirements with those from the interviews. These requirements are illustrated in Table 3.

Table 3: Proof of Concept requirements

Requirement number	Requirement
Req-001	Time-efficient policymaking
Req-002	User-friendly interface
Req-003	Structured documents and authorization
Req-004	Facilitation of consensus building
Req-005	Efficient information gathering
Req-006	Demonstration of added value
Req-007	Validation of user-input
Req-008	Comprehensive Information and Knowledge Hub
Req-009	Expandable System of Methods

Chapter 4
Design

The basics of the design are described in the design section. It focuses on the principles of the design and what is underlying the system. The chapter starts with the selected choice based on the requirements and existing methods. While keeping in mind the needs of the national police, which sometimes are underlying needs from challenges or struggles police employees face when writing strategic policy, a suitable design for the Dutch police is selected. Chapter 4 ends with a full explanation of the theory behind the chosen design. Chapter 4 answers the following subsection: What platform design can effectively enhance strategic decision-making within the national Dutch Police while considering the requirements?

4.1. Selected design

4.1.1. Literature review

Most solutions to tackle information overload within the literature talk about knowledge management. Knowledge management (KM) is identifying, organizing, storing, and spreading information within an organization (Gottschalk & Dean, 2010). Within information, there are two sorts of knowledge: tacit and explicit. Explicit knowledge is the information that is stored in computer files; this information can be searched relatively easily (Abbas et al., 2022). Tacit knowledge includes all the information that concerns experience and competence of the skills of a person (Luen & Hawamdeh, 2001). A KM system is mainly designed to focus on an organization's findability and learnability of knowledge (Abbas et al., 2022). Different papers categorize the solutions regarding information overload differently. Edmunds & Morris (2000) distribute it in personal and organizational themes. Personal information management systems deal with individual information overload and help them deal with feelings of powerlessness. Examples are folder structures or e-mail management, which allow people to find information more quickly, as Bawden & Robinson (2008) promoted a sustainable work-life balance or educated individuals to cope with increasing information demand.

While those solutions to tackle information overload primarily focus on personal themes, organizational themes could be more progressive when dealing with information overload within an organization. Organizational solutions have numerous ways to focus on. For example, literature is trying to solve information overload in the searching process, like filtering mechanisms or organization structures of the information. Most solutions are computer-based solutions. These require computer work to organize files like intranets, where internal documents are stored to share knowledge. Another example Mahdi et al. (2020) present is faceted search, an efficient technique for reducing information overload, organizing search output into topic-based groups, and offering complex filters to expedite information. Another example of knowledge management in practice is the case study within the Dutch railway company Prorail. Prorail reduced file search times using a KM system to integrate tacit and explicit knowledge (Abbas, 2022). Eppler & Mengis (2004) focused on information overload at the police department but more focused on personal themes. However, Nelson et al. (2005) pointed out a form of KM using the Natural Language Processing system, which falls under the ‘intelligent agents’ theme of KMS. Intelligent agents use software to filter important information for the user.

Different types of KMS are used in various domains nowadays. These themes are intranets, Information retrieval programs, Database management systems, Document management software, groupware, Intelligent agents, knowledge-based, expert systems, Decision support systems, knowledge mapping, and taxonomies. Healthcare has already been researching how to deal with information overload, ranging from filtering information to automatic meta-analytic calculations to systematic reviews (Klerings et al., 2015). Most of the above-provided solutions are based on

keyword-based search methods, which depend on the words rather than their meanings (Demirsoy & Petersen, 2018).

However, solutions focus on decreasing information overload by using the browsing process. Increasing the capabilities of the browsing process could help users who need more understanding of the problem (Hao et al., 2013). Often, it goes hand in hand with including domain knowledge in the system. Domain knowledge is more complicated since it is primarily unstructured information that does not contain hyperlinks like the internet has (Hao et al., 2013). When creating a system focused on the meanings of the words, the system is called semantic. It establishes links between concepts and terms. The semantic approach offers a more precise solution to a challenge within an organization but also creates extra information to make the analysis even more complete (Demisoy & Petersen, 2018).

Multiple researchers have created systems based on semantics, also called ontologies. Boella et al. (2016) developed a system called Eunomos, which created a system based on ontologies to collaborate with different public organizations. Governmental organizations could accomplish collaboration, as they do not face business competition. Governmental organizations already share their knowledge within newspapers or other forms of communication but wish to have a method that adds their taxonomies, interpretations, and concepts to a system to increase collaboration. Taxonomies classify individuals or objects. Palmirani et al. (2012) used ontologies to build a platform to model certain legal documents. Also, Fensel & van Harmelen (2003) were busy finding solutions, including ontology, and created OntoShare, where the profiles of the users are a crucial aspect of the tool. Knowledge and Information Management framework (KIM) is a platform to find information from various sources (Popov et al., 2004).

All the solutions above have advantages and disadvantages, and the ontology-based tools have one overarching problem that takes more work to implement since experts are needed.
When selecting a KMS, it is essential to remember the future user. Sometimes, a culture change is needed, like storing the tacit knowledge, which is, in most cases, a secondary task within their already busy working life (Alberts, 2013). When all the information is stored, it needs to be in such a way that it is findable for everyone, which is a crucial problem in large organizations looking for KMS as a solution.

The literature focuses on knowledge management systems within domains and for various goals. Table 4 provides an overview of knowledge management systems at the organizational level, including their advantages and disadvantages. Table 4 illustrates the results of a literature review.

Table 4: Literature review comparison Information from Gallupe, 2001; Hahn & Subramani, 2000; Hao et al., 2014; Demirsoy & Petersen, 2018; Centobelli et al., 2018; Alavie & Leidner, 1999; Cho & Korte, 2014

Knowledge Manamgent System	**Advantage**	**Disadvantage**
Information retrieval programs	Does include external & internal information.	High potential for human error, the system has an employee bias.
Document management software	Provides capturing, storing, and distributing knowledge as documents.	Risk of outdated information, information silos and time-costly
Groupware (Intranets) (Alcoforado et al., 2019)	Facilitates collaboration between employees, sharing knowledge.	Risk of security breaches and potential of information overload mostly does only include internal information.
Intelligent agents	Filter out useful knowledge, suitable for a knowledge intensive organization.	Requires expertise, limited by the knowledge the system is trained on, may face resistance due to AI.

Knowledge based	Easy use, centralized document storage, improve decision-making.	Requires ongoing effort, risk of outdated information,
Decision Support Systems	Provides in-dept decision-making.	Need high quality information on, complex, risk of information overload.
Knowledge Graphs and Ontologies	Organizes data structured, easy access and knowledge management for the organization, other visibility of information.	Requires effort to create, could be complex.

4.1.2. Conclusion

The requirements formulated in Chapter 3 were compared to the different KMS from Table 4. The matching is done using a requirement traceability matrix demonstrated in

Figure 4. A requirement traceability matrix is a matrix that illustrates the relationship between the requirements and the selection of designs (Good, 2024). Combining the requirements formulated by the police employees with the different knowledge management systems resulted in the selection of knowledge mapping and ontologies. The main reason for that is that not only is the organization's information stored, but the information could also be stored. Also, it allows structured knowledge management and visibility of other details. The main advantage of using ontologies and knowledge mapping is that information can be created from the knowledge within and outside the organization.

Traceability Requirements Matrix

	Knowledge managment systems						
	1	2	3	4	5	6	7
	Number of uses per KMS per Users-needs						
Sum of requirements met:	5	5	4	0	7	6	8
Req-001	x				x	x	x
Req-002	x	x	x				
Req-003	x	x			x	x	x
Req-004			x		x	x	x
Req-005	x	x			x	x	x
Req-006					x		x
Req-007		x	x				x
Req-008					x	x	x
Req-009	x	x	x		x	x	x

Legend:

Requirements:

Req-001 Time-efficient policymaking
Req-002 User-friendly interface
Req-003 Structured documents and authorization
Req-004 Facilitation of consensus building
Req-005 Efficient information gathering
Req-006 Demonstration of added value
Req-007 Validation of user-input
Req-008 Comprehensive Information and Knowledge Hub
Req-009 Expandable System of Methods

Knowledge managment system:

1 Information retrieval programs
2 Document Management software
3 Groupware (Intranets)
4 Intelligent Agents
5 Knowledge based
6 Decision Support Systems
7 Knowledge Mapping and Taxonomies

Figure 4: Traceability Requirements Matrix

4.2. Design Mechanism

The created tool for the police department has two main underlying mechanisms. It is essential to elaborate on these mechanisms since their contexts are similar, and their specific context is necessary.

4.2.1. Ontology

An ontology is a way to structure and capture knowledge that is understandable to people and computers (Scholtens, 2003). It captures knowledge within an organization within a model, which users can then use to answer complex problems. Ontology is an approach that effectively stores and uses the information to integrate different flows of information to support the user on a specific

request or task ((Chernyakhovskaya et al., 2019; Bastinos & Krisper, 2013), which are maps that help reveal information from different places. Knowledge graphs bring together different kinds of knowledge so that people can improve their collaboration. The implementation of knowledge graphs improves management in hospitals. (Lasierra et al., 2014).

Ontologies focus on identifying essential subjects, including their relations and other information needed to interact with different forms of information. The method is easily extendable; new information can easily be added to the existing relationships and is easier for users to understand. Therefore, using ontology within a knowledge management system suits a large organization (Almeida & Barbosa, 2009). The advantages of the use of ontologies are (Parlar, 2021; Fundamentals, 2018):

- It makes it possible to share knowledge with a common understanding. Using the same terminology helps prevent miscommunication and improve decision-making (Graph. Build, 2023)
- Analyse domain knowledge
- Working process as a brain, which means that a knowledge graph can interlink concepts with each other.

The method used to develop the ontology is familiar, as explained by the examples in the introduction. In healthcare, they have already successfully applied ontology, which describes organizational knowledge within a healthcare institution. This foundation supports management in actions, services, and decision-making (Lasierra et al., 2014). By creating an easier way to capture the organization's knowledge, the organization can improve its working methods and goals. The creation of ontologies makes it possible to focus on the essential factors of the organization.

Creating ontologies based on the domain knowledge of the police is the first step towards a system that could help interpret information relatively simply. It outlines the types of entities, their properties, and the relationships between them (CGI, 2024). A tool based on ontology can create the fundamental priorities for the police department, making it possible to describe the police.

4.2.2. Knowledge Graph

As has already been said, there is an overlap between ontologies and knowledge graphs. Knowledge graphs mostly use ontologies to create entities and relations within the domain knowledge (WTI, 2024). Entities are people, organizations, products, or concepts. It uses ontologies to derive new knowledge (Lygerakis et al., 2022). Using knowledge graphs based on ontology increases the information search strategy and teamwork for handling information. Sharing and learning from knowledge from colleagues can be seen as a powerful tool to improve an organization (Lasierra et al., 2014). A basic knowledge graph is created with nodes and edges, in which the entity is described in the nodes, and the relation between the different nodes is the edges (WTI, 2024). An easy example of a knowledge graph is represented in Figure 5. It is presented so that it is understandable for humans and machines like computers (Tripathi, 2022). It is a graph with multidirectional relations (Parlar, 2021) and exists out of the following components (WTI, 2024; Tripathi, 2022):

- Individuals – named objects
- Classes – Group of individuals
- Entity –
- Relationship – relation between two individuals

There have been studies on how to assess the quality of an ontology. Wilson (2023) mentions that evaluating the system's quality at the end and the mid-term is crucial, avoiding the trash-in-trash-out method. So quality is referred to as the fitness of a product or service, or information for the needs of the intended users in a specified context.

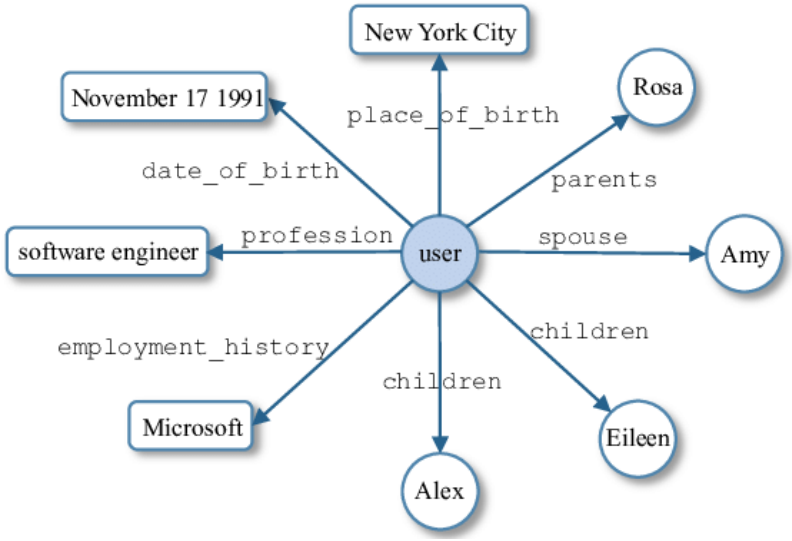

Figure 5 Knowledge graph example (Xiang, et.,2015).

Chapter 5
Proof of Concept

In Chapter 5, the Proof of Concept (PoC) is described. It mainly involves screenshots to explain the workability of the PoC in a manual format. So, it is clear what the participants will use when experimenting.

5.1. Futures Platform

The proof of concept is called Futures Platform (FP). It is designed with the help of two consultancy firms. Both consultancy companies have expertise in changing digital environments, including artificial intelligence (AI) and large language models (LLM), as well as knowledge graphs and ontologies. In the background, ontologies are created based on police-specific domain knowledge to create a knowledge graph. The knowledge graph is manually filled in using 18 documents focusing on disinformation, mostly government or police-specific subjects. It has become a comprehensive graph. However, logical relations have yet to be added due to the manual work of constructing the knowledge graph. Namely, since the manual work only includes finding relations within the documents without any other thinking steps. An overview of the knowledge graph is illustrated in Figure 6, where a screenshot is made when searching on the node “Politie.”

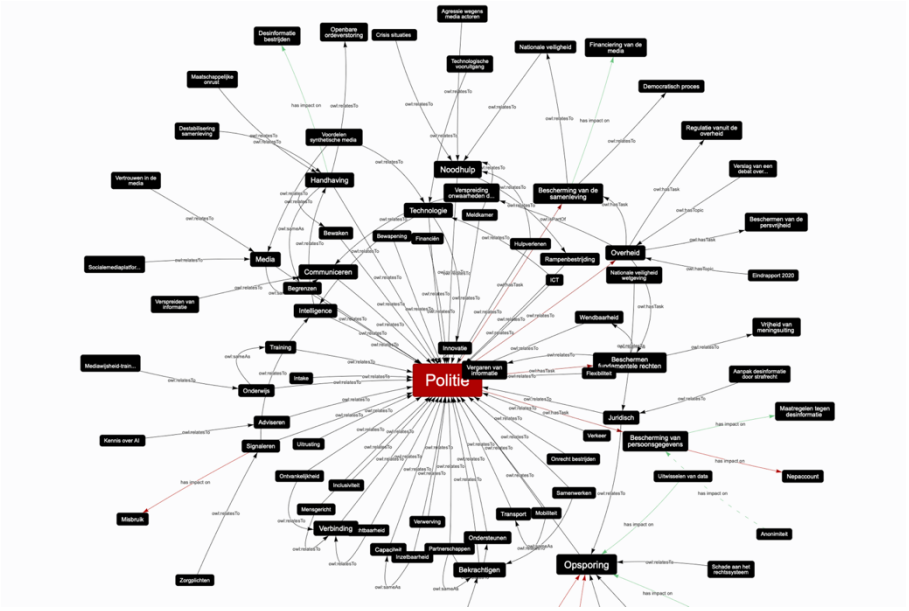

Figure 6: Knowledge graph representation in the tool

The participant can search using the ‘search term’ within the tool, as illustrated in Figure 7.

Futures Search

Figure 7: Search bottom in Futures Platform

All the information related to the ‘search term’ is visualized. The search bar cannot be used like Google, where a question is entered, and Google presents the answer. So, no extra technical functionalities are added to the knowledge graph. This part of the Proof of Concept of the Futures Platform is just another representation of the information from documents. The first object is a table with all the objects with that term in their name or description. By clicking on the wanted item, a description of that item is visualized together with a zoomed knowledge graph with the direct and

indirect relations. Each node and edge can be clicked individually to reveal more information, including the source of the information.

The knowledge graph has green or red edges (lines between nodes). Green means that there is a positive relation between the nodes and red means that there is a negative relation between the nodes. Figure 8 reveals how to redirect the participant to the full knowledge graph. That is when clicking on the logo. The start page of the tool has a filter function that can be used to resize it, as illustrated in Figure 8, a filtered version of the knowledge graph on the term “Vertrouwen in de overheid.”

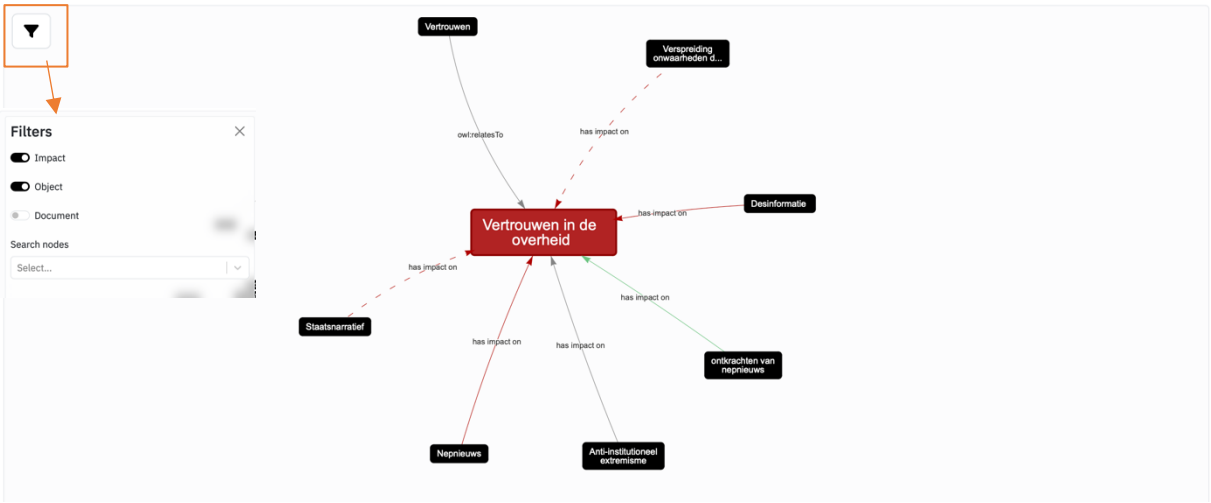

Figure 8: Knowledge graph including filter function

Participants can filter on specific nodes, including their related relations, to zoom in on a particular node. In Figure 8, only the relations between nodes are visualized, but not the documents from which the nodes or the relations are located. On every node, an edge can be clicked. A new platform page is opened by clicking, and the node or edge is explained in more detail, including a source and directed or redirected links. Clicking on a node or edge displays a zoomed-in representation of the knowledge graph. The nodes and edges can have different names and meanings. Those are determined via the ontology on which the knowledge graph is made. The nodes can be in the knowledge graph of 4 different types. The description of the types according to the ontology is described in Table 5.

Table 5: Description of the different item types according to the ontology

Name	Description
Topic	Is a broad subject area that can encompass a wide range of ideas, questions, and knowledge field. It serves as a general category under which more specific phenomena and trends can be classified. Topics are typically defined by their intellectual content and thematic elements. A topic is not something that can experience an impact.
Phenomenon	Is a subclass of topic that refers to events, occurrences, or concepts within a particular topic area. Phenomena are distinguished from general topics by their specific, manifest nature. Often studies because they have distinctive attributes or behaviour within their broader topic.
Trend	Is a subclass of phenomenon that specifically refers to the direction or pattern of evolution observed within a phenomenon over a period. Trends are characterized by a dynamic change or development in the behaviour, attitudes, or conditions associated with the phenomenon. Those are particularly noted for indicating shifts in public perception, technology, or societal behaviours
Organization	Any kind of (small or large) group a person might be a part of, such as local, community, or social network initiatives.

Also, the relations between the items can have different meanings according to ontology. All the other ties that are used are described in Table 6.

Table 6: Descriptions of relation types according to ontology

Name	Description	Extra
Has Topic	Established that a document is about a certain topic (or phenomenon)	-
Relates to	Indicates a resource, impact, or topic is related to another	-
Is Part of	Indicates that a node is part of another node	-
Same as	Indicates that a node is the same as another node	-
Not same as	Indicates that a node is not the same as another node	-
Has Impact on	Indicates an impact-type relation between a node.	Can be green, red, thick or a dotted line depending on the type of impact.
Has Task	Indicates that a node has a certain task	-

A zoomed view of the knowledge graph is demonstrated in Figure 9, where the selected node is red, and all the direct and indirect nodes are visualized. Here, all the options and impact lines are illustrated, which can be green, red, thick, and dotted.

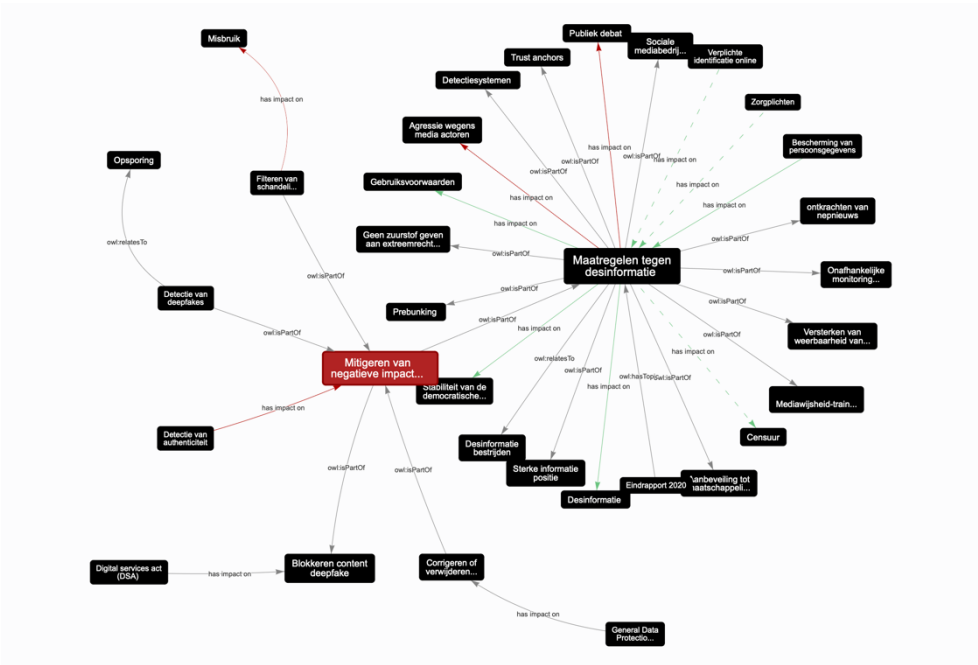

Figure 9: Zoomed visualization of the knowledge graph

Chapter 6
Experiment

Within step 5 of the Design Science Research method, the experiment of the design takes place. The first part of the chapter describes the structure of the experiment, including the dependent and independent variables. Then the assed method is explained including graphs. Chapter 6 ensures that the fourth sub-question can be answered: How does the proposed design compare to the current method used for strategic policymaking within the Dutch national police department?

6.1. Experiment Selection

The experiment is done to collect results for evaluation. Quantitatively and qualitatively, this is done by calculating the participants' information overload magnitude. The overall goal of the experiment is to determine the tool's effectiveness in terms of information overload. The experimental setup makes it possible to test the hypothesis:

"By answering a question with the help of the Futures Platform, the information overload of the participants decreases."

The test is conducted with four different groups. Two groups comprise around 11 persons, and two others have 7. The larger groups perform the entire experiment. These groups are part of the within-group design. A within-group design is an approach for an experiment in which all the participants are offered all conditions. The goal is to measure the change within the changing conditions, with or without the Futures Platform. The within-subject design research can be done if there is a causal relation between the dependent and the independent variables (Bhandari, 2022). Since the sample size is small for this experiment, it is an approach that ensures reasonable statistical results.

The smaller groups perform one part of the experiment. One part of the experiment means that only 1 question is answered with or without the tool. These groups are used to perform a between-group design analysis. Between groups analysis illustrates the differences between two different groups.

All the participants are employees of the National Police of the Netherlands, primarily working with strategic policy and innovation. In an experiment, the researcher controls the independent variable while observing the dependent variable to determine if changes in the independent variable affect the dependent variable. The variables are illustrated in Figure 10

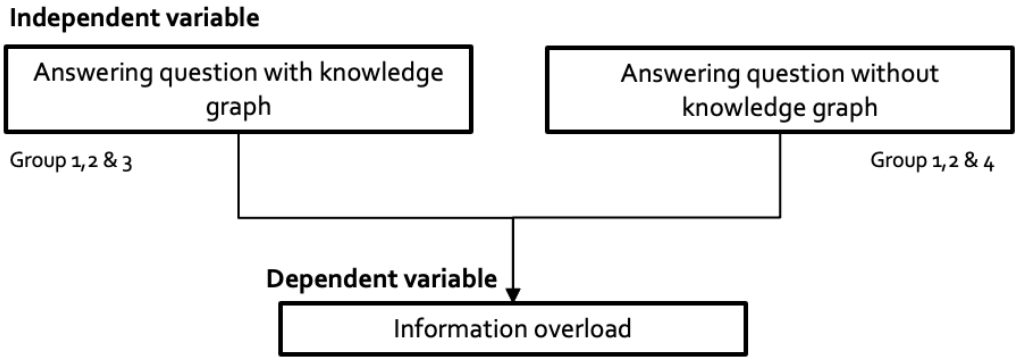

Figure 10: Variables of the experiment

TU Delft

Independent variable: What is changed*?*

The tool uses knowledge graphs with police-specific ontologies to capture information from selected reports. These reports now address disinformation within governmental organizations. The documents talk about disinformation and how governmental organizations must deal with it. The subject was chosen because it is a relevant topic for the police, who do not know how to deal with it—the independent variable changes in the test since the tool is only used once. The knowledge graphs and ontologies of user experience are used in the test to gather insights into the working principles of the tool. The user navigates through the ontology-based platform to answer a question and provides feedback on ease of use, clarity, and satisfaction afterward.

Dependent variable: What is measured?

Information overload is compared using the participants' results with and without the tool. The tool's efficiency is measured through information overload. The tested variables are based on the user experience from the participants' feedback and the information overload formula from Jackson and Farzaneh (2012). A full description of the formula is presented in Appendix C, in which all the factors of the formula and its working principle are described. Within the formula, three factors are held constant. These are Characteristics of information, available time, half of the task and process parameters, and Quality of information. The reason why those are constant is that the information that is provided remains the same throughout the entire experiment. The available time is constant since all the participants have the same time to perform the task. Only the representation of the information differs since, in one part of the experiment, the participants need to read the documents in a PDF format, and in the other part of the experiment, the information is represented in a knowledge graph representation. The rest of the formula's factors are measured within the experiment and used to calculate information overload. The dependent variables are demonstrated in Figure 14

Moderating variable: What factor influences the relation between the dependent and the independent variable?

All the moderating variables are illustrated in Table 7.

Table 7: Moderating variables

Variables	Name	Description
V1	Group numbers	Number of the group the participant is in; 1,2,3,4
V2	Order	The order of the group, did the participant start with the tool; Yes of No
V3	Gender	The gender of the participant; Men, Female or others
V4	Age	The age of the participant; ranges from 10 year starting from 18 until 64
V5	Educational level	The highest achieved educational level of the participant
V6	Answer satisfaction with tool	If the participant is satisfied with its answer; Yes or No
V7	Answer satisfaction without tool	If the participant is satisfied with its answer; Yes or No
V8	Time spent with tool	The time spent on answering question with tool in seconds
V9	Time spent without tool	The time spent on answering question without tool in seconds

Experiment instruments / Materials

The researcher needs computers with the Futures Platform and the participants' questionnaires for the experiment. The Futures Platform is used through a website. Further, no extra material is needed to experiment. All the answers are collected via Qualtrics.

Experiment

As illustrated in Figure 11, the experiment is based on the within-subject design type. A within-subject design refers to an experimental setup where identical participants experience various experimental conditions, which means that every group of persons is its control group (Scriptium, 2023). Using this method, all the participants eventually performed the same experiment with the same conditions. The assumption has been made that groups A and B have similar performance due to the size of the groups. Before the beginning of the experiment, the participants are divided into two groups. These groups followed a different order of the experiment but, in the end, performed all the same tasks.

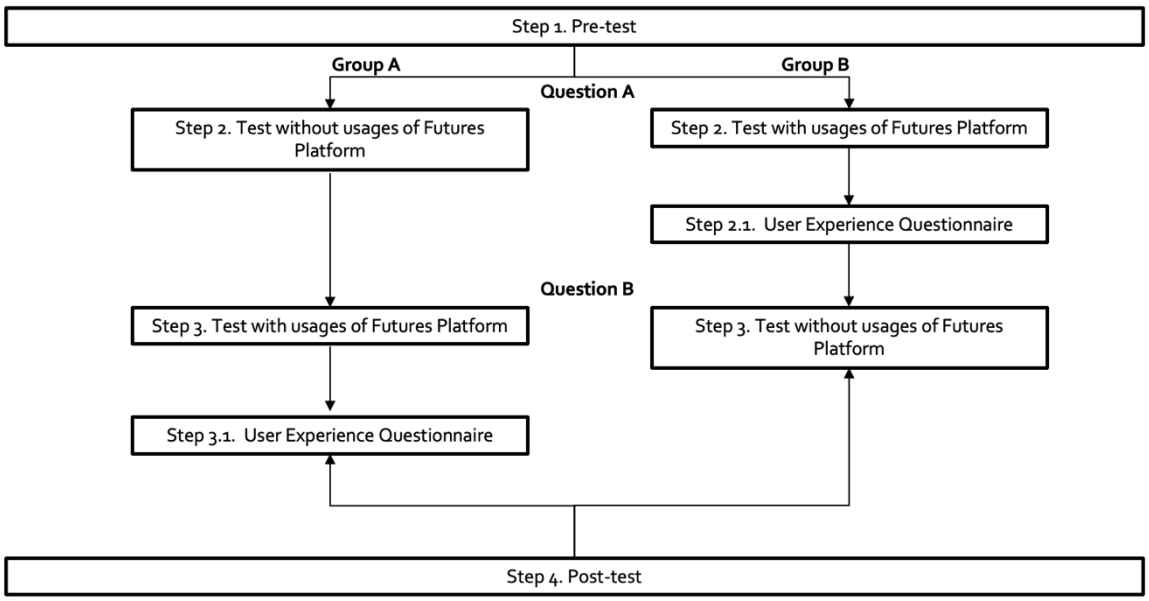

Figure 11: Experimental set-up

The complete experimental setup is illustrated in Appendix B. The beginning of the experiment is the pre-test. In the pre-test part, the participants answered seven questions, giving insight into their factors like experience, age, and gender, also called the demographics. Also, a digit span test is executed, resulting in an individual average short-term cognitive memory of all the participants. Then, depending on the group the participant is in, the groups start by answering question A with or without a tool. The information used for the experiment is about disinformation since the topic is essential for the police to prepare. All the data is kept constant; only the representation of the information differs. The tool presents a representation of the information in a knowledge graph form, illustrated in Figure 12; the other method keeps the representation of the information in the traditional manner, a bundle of PDF files.

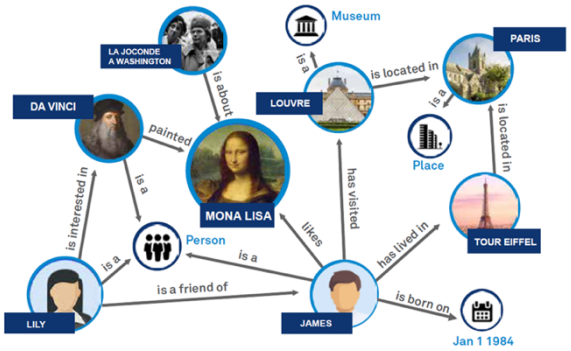

Figure 12: Knowledge graph example (Wang, 2023)

The main difference between the traditional manner and the tool is the representation of the information. Traditionally, the participants must scan documents or sometimes even more than 100 pages. The tool lets the participants see all the information, including its relations, in one overview and is easily clickable to see related topics or relations.

In both parts of the experiment (so with or without the tool), the participants answer comparable questions, one about public order and one about citizens' trust in the police through disinformation. After using the tool, participants answer a short questionnaire highlighting their experience with the tool. The questionnaire is called the User Experience Questionnaire and can be found in question 12 in Appendix B. It is a commonly utilized survey for assessing users' subjective perceptions of product user experience (Schrepp et al., 2017). It takes around 3 to 5 minutes to fill in. UEQ focuses on hedonic and pragmatic quality. Hedonic quality is the experimental and emotional aspects of the service. Pragmatic quality refers to functional and utilitarian parts of the service. This questionnaire is a simple and fast manner to receive user feedback. A few essential parts of the questionnaire are used to measure information overload since the questions focus on expertise and cognitive style. After the second part of the experiment, the roles are flipped, and the participants perform the test with or without the tool, depending on their previous task. The experiments end with a post-test questionnaire and nine questions to gather more information on their experience and working process.

6.2. Assessment methods

At the end of section 3.2.1.1. a formula is provided for calculating information overload. The formula is studied, and the different aspects are analyzed. All the first descriptions come from Jackson & Farzaneh (2012) but are further explored.

Information Overload = (Characteristics of Information × Information Processing Capacity × Available Time) − (Personal Factors × Task and the Process Parameters × Quality of Information × Quantity of Information)

How can information overload be measured after the experiment?

The information overload formula operates based on a tipping point, like the principle of a lever. It functions using a balance scale mechanism. The scale range has changed according to the range created by Jackson & Farzaneh (2012) from [-100.000 – 100.000]. Since three variables are held, the scale is decreased to [-1000 – 1000]. Within the scale, for and against factors contribute differently towards information overload, as illustrated in Figure 13. By increasing the For-factors, the likelihood that information overload occurs decreases. The Against-factors work oppositely. When their functionalities increase, the answers increase the possibility of information overload. The first three against factors need an extra explanation. When personal factors increase, experience, motivation, and skills decrease, and the participants need to work harder to accomplish the job. The same holds for the tasks and process parameters. The more complex and newer the tool is, the

higher the score, and the more it could lead to information overload. The quality of information does not work intuitively since the lower the quality of information, including the relevance and validity, the higher the score, creating information overload.

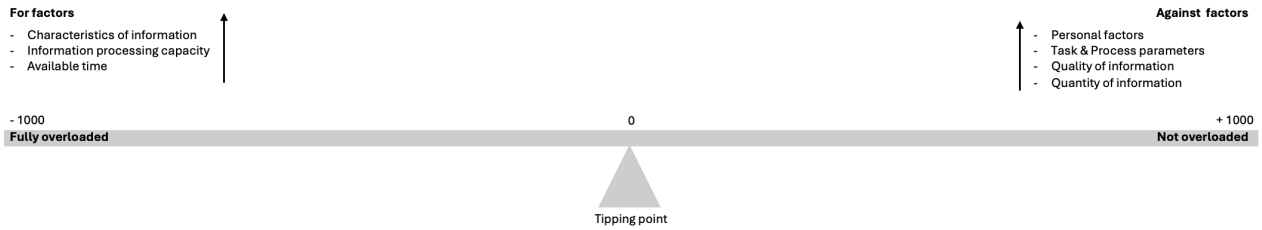

Figure 13: Information overload scale

All the factors included in the evaluation have their manners of measurement. A digit span test measures information processing capacity. A digit span test is used to measure the short-working capacity of the participants, which results in the participants' knowledge of the capacity. Their capacity ranges from 4 to 9 digits. When focusing on available time, Jackson & Farzaneh (2012) found that the more time a person must complete their work, the less information overload the participants experience. However, all participants' available time remains constant.

The personal factors are determined via the survey and the User Experience Questionnaire. The pre-test data is analyzed to gain insight into the participants' basic features/ demographics. The UEQ is analyzed using basic statistics such as mean and variance. Schrepp (2023) mentions a benchmark in the UEQ handbook; the values of the UEQ are compared to the benchmark to see if the results match the results of other products. It is essential to see if the results can be used in the information overload equation. No attention is drawn to the participant's situation within the survey and the questionnaire. Therefore, the personal situation is kept at 0. The rest of the individual factors range from 0 to 2 depending on the results of the questions.

Four parts are used to formulate a value for the task and process parameters: task complexity, task novelty, number of other tasks, and number of interruptions. In the last two, the number of different tasks and interruptions is 0 since it occurs in an enclosed space where no other tasks or people can disturb the participants. The reason for the task complexity is the difficulty of the task changes when using the Tool. The assumption is that the Futures Platform task is more complex due to the tool's novelty. For task novelty, the researcher analyses the results and counts the number of challenges and innovations the participant has found. The last two factors focus on the information. At first, the quality of the information is kept constant since all the participants receive the same information. However, the quantity of information has changed. In the formula, quantity is derived from the amount of information available to the participants, but in the research, it is the amount of information the participants have read. The quantity of information is calculated since the participants had to write down references. As the scale demonstrated in Figure 13, another conceptual model has been drafted to see the effects per part of the factor and how the factors contribute to information overload. It maps out how the different variables of the formula relate to information overload, as illustrated in Figure 14.

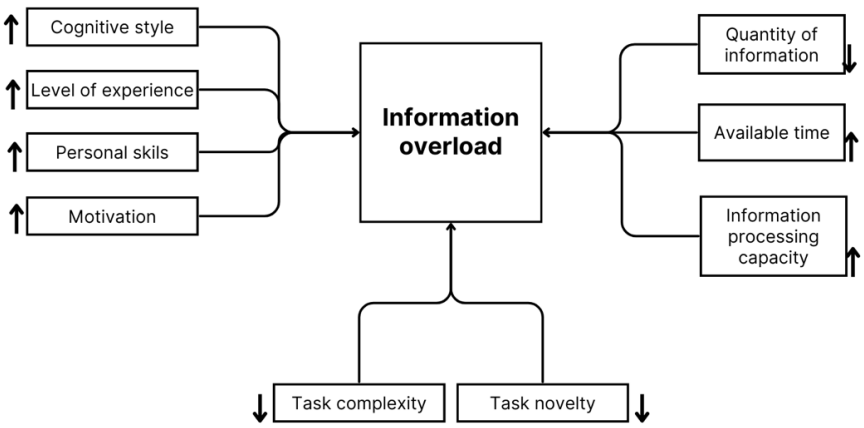

Figure 14: Conceptual Model Information Overload, the signs indicate a positive effect on information overload. Therefore, when a sign points upwards, it will decrease.

Chapter 7
Results

In chapter 7, the results of the experiments are discussed. Considering all the factors of the information overload formula makes it possible to check hypotheses regarding information overload. Answering the tool's effectiveness concerning information overload and the reasons behind the differences. Starting with the analysis method, in which the analysis steps are presented. The results are then presented, along with participant observations and feedback during the experiment. The final part of the chapter considers limitations and discusses the results. The complete chapter ensures that the last sub-question can be answered: What are the positive and negative effects of the designed platform on information overload in the context of strategic decision-making by the national police?

7.1. Results

7.1.1. Primary outcomes

The experiment results allow the researcher to check the results of the designed tool based on information overload. All the data gathered during the experiment check the difference in information overload while using the tool or not. The data also makes it possible to check where the difference comes from, which group experiences less information overload, and why. Different information points are analyzed through the questions asked during the experimental setup, as Appendix B illustrates. The participants' demographics, including age, gender, educational level, information processing capacity, and experience in policymaking, are part of the results. Furthermore, when answering the question, not only the answer but also the time the participants took to answer the question is recorded. Also, the participant's experience is captured to check the participant's experience with the tool, including satisfaction with the answer presented.

Now, it is time to look at the population, what groups caused the effect, and why the tool performed in such a way. The population of the experiment is employees of the Dutch national police, all having a role in strategic policymaking or innovation. The usable participants were 35 persons. The people who participated in the experiment were about evenly distributed in terms of gender, with 51% of the participants being male and 49% female, when looking at all groups. These distributions are more skewed when looking at the specific groups. For example, Group 1 had a different distribution, with generally more men: 73% men and 27% women.

The central part of the experience is to check the tool's relevance concerning information overload. The experiment was designed to produce four different analyses by categorizing participants into four groups, each following a different order of tasks. Two groups were required to complete only one part of the experiment, explicitly answering one question with or without a tool. This design enabled the researcher to investigate key differences across these conditions. The average differences between the four groups are described in Table 8.

Table 8: Summary of Information overload measures (Mean ± SD)

Group	IO without the tool	Time spent without the tool (min)	IO with the tool	Time spent with the tool (min)
1	278	16.30	375	15.05
2	402	15.73	445	11.95
3	236	16.28	x	x
4	x	x	371	9.07
Average	345	16.10	397	12.02

As seen in Table 8, the chance that participants experience information overload is smaller when they use the tool. Also, the time spent answering the questions decreased by around 25%. The differences of IO with Group 1 and Group 2, as well as the average of all the groups, including the standard deviations, are demonstrated in Figure 15. In general, the chance of receiving information overload decreases by 6,5% while using the tool.

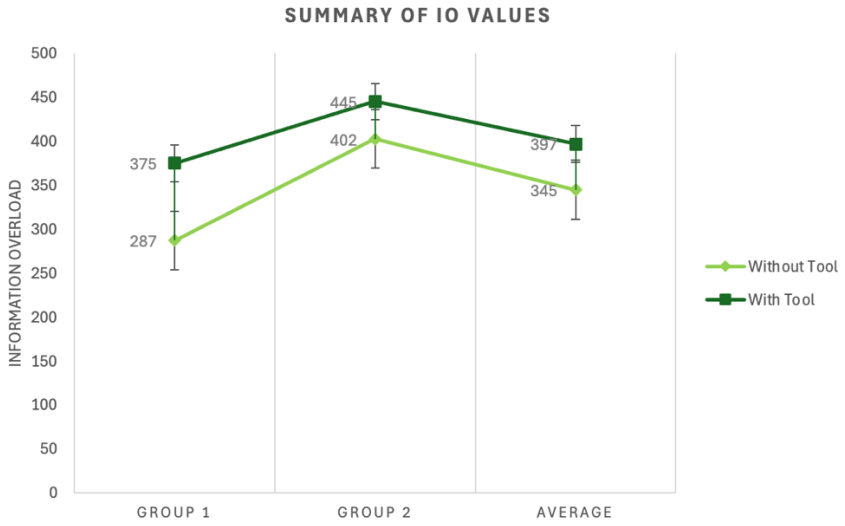

Figure 15: Summary of Information Overload (mean values +/- standard deviation)

7.1.2. Statistical analysis

To interpret the results, various statistical analyses were conducted. Initially, the descriptive statistics of the dependent variable, Information Overload per group, is analyzed. Descriptive statistics reveal the essential characteristics of a data set (Hayes, 2024). For statistical inference procedures, it is crucial to know if the data is normally distributed, the variable is continuous, and the means are the interests. Testing whether the data is normally distributed uses Quantile-Quantile plots (QQ Plots). Within a QQ plot, the data follows a straight line if the data is normally distributed. The complete QQ-plot calculation is illustrated in Appendix D. All the groups have an approximately normal distribution when looking at the dependent value Information overload.

Followed by an assessment of the difficulty level for each question. If no significant differences were found in the Information Overload (IO) per question, it could be inferred that the difficulty of question 1 was comparable to that of question 2. The comparison of the values is done between different groups; therefore, the unpaired t-test has been used. An unpaired t-test is a statistical test that compares the means of two groups and tests if the means are significant. Those groups are independent. The difficulty level of each question is determined using two hypotheses: a null and an alternative hypothesis.

$$H_0: \mu\_Q1_{(Group\ 1)} = \mu\_Q2_{(Group\ 3)} \ \& \ \mu\_Q1_{(Group\ 2)} = \mu\_Q2_{(Group\ 4)}$$
$$H_1: \mu\_Q1_{(Group\ 1)} \neq \mu\_Q2_{(Group\ 3)} \ \& \ \mu\_Q1_{(Group\ 2)} \neq \mu\_Q2_{(Group\ 4)}$$

The unpaired t-test is conducted twice for questions 1 and 2. Groups 1 and 3 did change in answering questions 1 or 2, but both responded to the question without the tool. The differences for groups 2 and 4, where the participants also changed in answering questions 1 or 2 but responded to the question with the tool. Since the direction of the alternative hypothesis needs to be clarified, the unpaired t-test is conducted two times, which means that the average could be lower or higher than the other mean. The alpha value used is 0.05. If the p-value of the two-tailed is smaller than 0.05, the null hypothesis needs to be rejected; otherwise, accept the null hypothesis. In these tests, both values are more significant than 0.05. Therefore, the null hypothesis is accepted, so the difficulty level per question with and without the tool is approximately the same. The results created in Excel are illustrated in Appendix E.

Having these results, the efficiency of the tool is analyzed. The efficiency is determined with groups 1 and 2 since those groups conducted the entire experiment with and without the tool. A quick look at the descriptive data reveals that IO's magnitude is higher based on the average values. This means that the participants using the tool experienced less change in information overload than those using the traditional information-searching method. This is yet to be a significant result since the values of IO are close to each other. To determine if the results significantly differed, a paired t-test was done. The next type of test looks at the differences within 1 group with two different states. The participants answered a question with and without the tool. Within-group analysis calculates the differences between the cases, and that mean is used to test the significance difference. Within-group analysis includes a paired t-test in which a new hypothesis is formed.

$$H_0: \mu_{(\text{Group 1with tool})} = \mu_{(\text{Group 1 without tool})} \,\&\, \mu_{(\text{Group 2 with tool})} = \mu_{(\text{Group 2 without tool})}$$

$$H_1: \mu_{(\text{Group 1with tool})} > \mu_{(\text{Group 1without tool})} \,\&\, \mu_{(\text{Group 2 with tool})} > \mu_{(\text{Group 2 without tool})}$$

The paired t-test is a one-tailed test since the mean value of the IO with the tool is assumed to be higher than that of the IO without the tool. The higher the value, the less likely the person would feel information overload. Again, an alpha value of 0.05 is used. Both p-values resulted in a value below 0.05. Therefore, the null hypothesis can be rejected, and the alternative hypothesis is accepted. In this way, it could be assumed that there is a significant difference between the means with and without the tool. The mean with the tool is significantly higher than the mean without the tool.

7.1.3. Comparative Analysis

All these initial statistical inference procedures made it possible to conclude the tool's effectiveness regarding information overload. It is essential to know the origin of the difference. Since the information overload formula exists out of different factors, these factors are the first focus points of the information overload differences. Information processing capacity is the first factor of interest. The higher the information processing capacity, the higher the information overload on average. Therefore, people with a higher processing capacity have less chance of experiencing information overload with and without the tool. The tool's efficiency is not determined by the information processing capacity since the differences are roughly the same for every number, as illustrated in Figure 16.

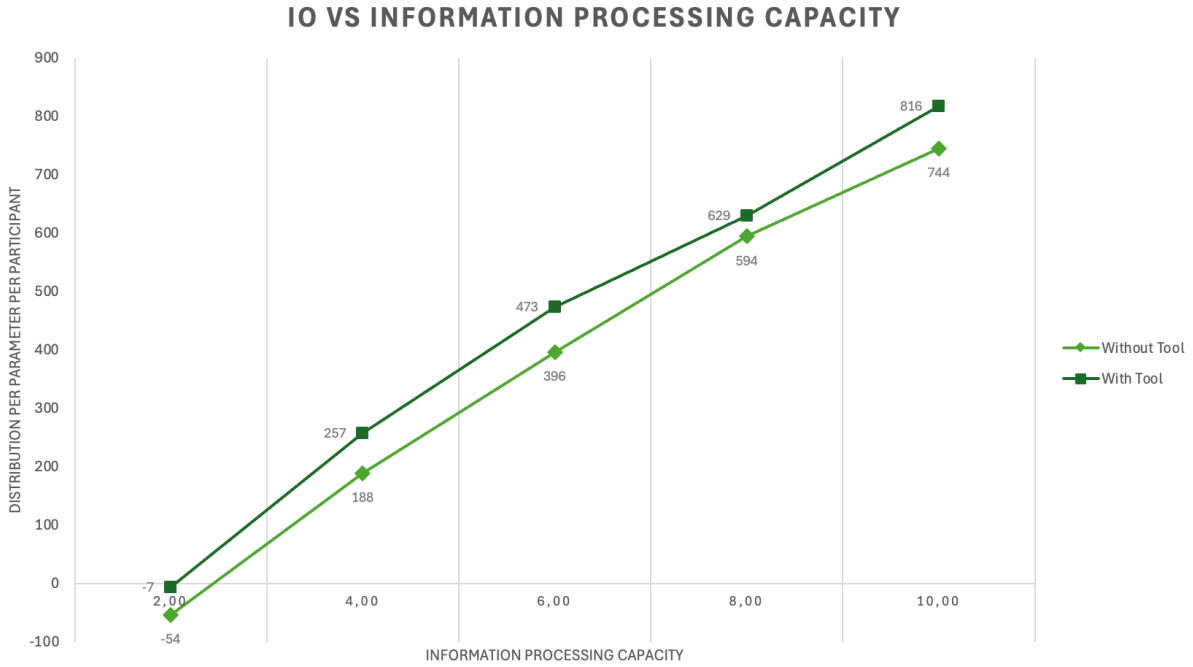

Figure 16: Averages of Information overload with or without the tool vs. information processing capacity

Other factors in the formula emphasize personal characteristics, task and process parameters, and the quantity of information utilized. As depicted in Figure 17, a significant change is observed in the quantity of data. The maximum number of information sources available was 18 documents. The calculation of information quantity is based on a formula that increases with the number of sources used. The more sources utilized, the higher the number, indicating how much information a person can process quickly.

The comparison between the number of sources used with and without the tool reveals a significant difference: 39% of the sources were used with the tool, compared to only 11% without it. The results indicate a substantial increase in the number of documents accessed using the tool. The tool demonstrated relations between specific topics, and relations related to those topics are also easily visualized. Therefore, more documents could be used in the limited time offer for the experiment. The increased quantity indicates that the answer to the question is more comprehensive and substantiated using the tool. Focusing solely on the information overload formula, a significant change is the increased number of documents used.

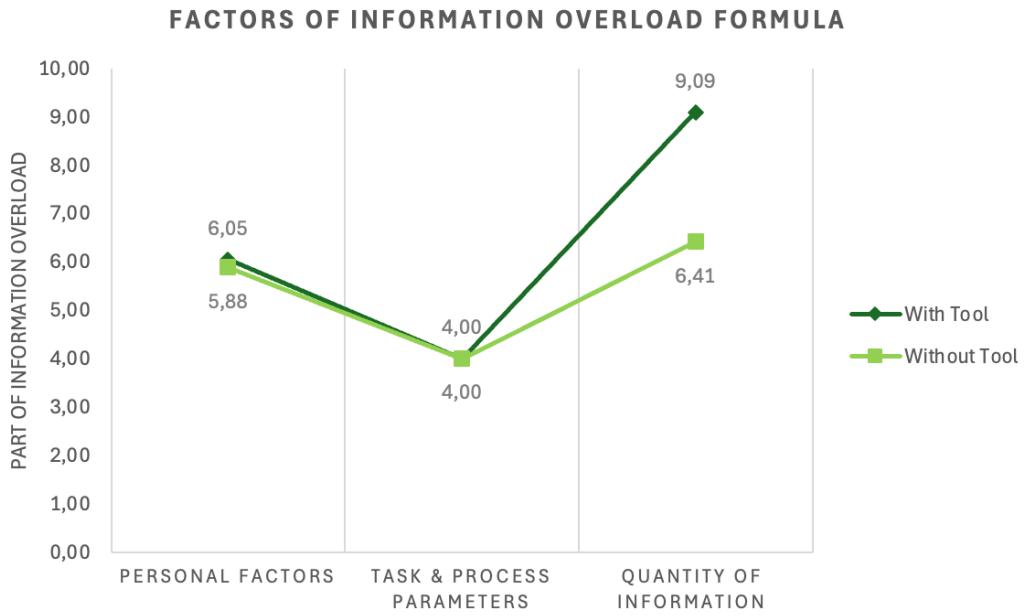

Figure 17: Division of different factors of the information overload formula plotted against their value

Zooming in on the sub-factors of 'personal factors 'and 'task & process parameters. There are interesting differences, although they did not affect the magnitude of information overload. Namely the task novelty within 'task and process parameters. This parameter focuses on the creativity and innovativeness of the answer provided to the question. The novelty of the answer with the tool was four on a scale from 0 to 5, and the answer without the tool was 2. In general, one person answering a question with the tool creates an answer that is as creative/innovative as two persons traditionally answering a question. No correlation has been found when looking at the relation between the quantity of information and the novelty. The fact that the novelty of the answer did not change the information overload value is due to the assumption that it has been done in task complexity. Due to the novelty of the task while using the tool, the assumption has been made to give that a two; therefore, the overall score of the 'task and process parameters' did not change.

On average, the values for 'cognitive style 'and 'personal skills' are similar with or without the tool. There is a small variation in the means of 'level of experience' and 'motivation.' The experience level is higher for the traditional manner, whereas the motivation is higher while performing the newly introduced manner. This indicates the similarities of the means for the personal factors.

7.1.4. Demographic factors

The experiment also examined the demographics and experience of the participants, as well as the order in which they used the tool. Participants who first worked with the tool and then without it generally reported higher satisfaction with their answers. Interestingly, that group was typically more satisfied with their answers obtained without the tool than with it. Conversely, participants who started without the tool and then used it reported the opposite pattern—indicating a significant impact depending on the order of the experiment, as illustrated in Figure 18.

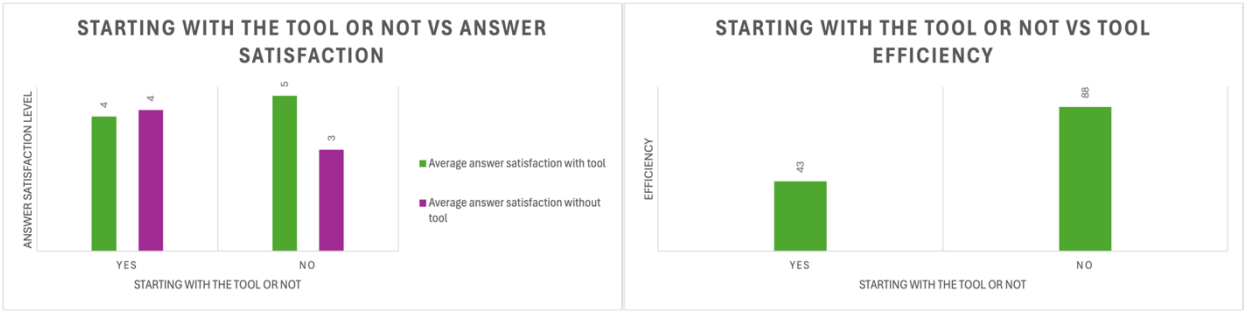

Figure 18: Answer satisfaction depending on the order of the experiment. Left indicates the difference in answer satisfaction level versus the order of the experiment. Right the efficiency of the tool versus the order of the experiment.

Regarding the tool's efficiency and gender, men generally experience a more significant difference regarding information overload in favor of the tool, as depicted in Figure 19. A reason for the efficiency difference could be that women, on average, experienced less information overload using traditional methods, resulting in an almost equal performance with and without the tool, suggesting that women are skilled at scanning documents and finding relevant information. Time was another factor; participants took four more minutes to formulate their answers without the tool than with it. Comparing this to the results per gender resulted in the following: women took six more minutes without the tool and almost four more minutes with it. Thus, the tool's efficiency was higher for men, who had a higher likelihood of experiencing information overload in the traditional manner than women. The dataset also examined other demographics, such as age and educational level. However, these factors yielded insignificant results, partly due to the spread of the group and the presence of outliers affecting the results.

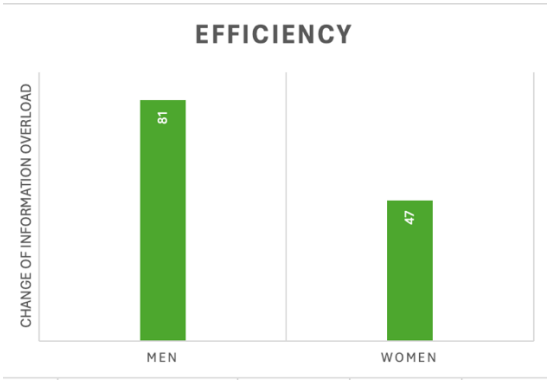

Figure 19: Average efficiency of tool vs gender

The experiment included questions about participants' willingness to continue using the tool. Generally, participants were inclined to continue using it. However, there was no direct relationship between the desire to use the tool and its effectiveness. Participants who used more data and produced more creative and innovative answers were more likely to want to continue using the tool and incorporate additional data.

Looking back at the gender difference, the novelty of the answers was not one of the marked differences between women and men. However, a slight difference is seen in favor of the women,

who were more creative and innovative with their answers. One reason for that could be because of the increased time women spent answering their questions.

An essential feature for further development of the tool is that almost all the participants indicated they would use it daily. Most of the doubts were indicated due to the early stage of the tool. Nevertheless, around 60% of the participants see the platform's potential. However, the tool stage needed to convince the participants of their willingness to add their documents to the platform due to the time constraints of the tool.

7.1.5. User Experience Questionnaire

Participants in the experiment were required to complete a brief questionnaire with 26 items, each rated on a scale from -3 to +3. The questionnaire's scales provide a comprehensive overview of user experience, assessing both pragmatic quality (efficiency, clarity, dependability) and hedonic quality (originality, stimulation) (User Experience Questionnaire (UEQ), n.d.). To illustrate the tool's usability, the mean values of the six identified areas are compared to a benchmark. The UEQ benchmark enables comparing one product's results to a large set of other products, in this case, 452. Compares the tool's results to the benchmark.

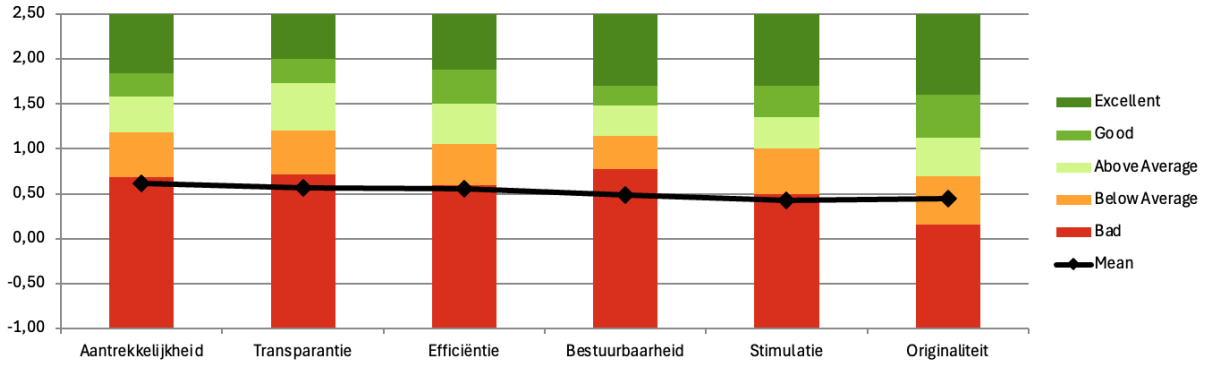

Figure 20: Mean results of the areas of interest compared to the created benchmark

As illustrated in Figure 20, the tool currently needs to perform more adequately. All elements of user experience fall below average or into the poor category. Suggesting the tool's functionalities must be improved, leading to a suboptimal user experience. However, despite the poor usability results, the tool reduced information overload compared to the traditional method. Therefore, enhancing the tool's functionalities could further improve its performance.

The user questionnaire could be more effective for identifying specific functions that need improvement. It mainly indicates which of the six areas requires more attention. 'Controllability' (translated from 'bestuurbaarheid') needs attention, according to the UEQ. Nonetheless, all areas are currently underdeveloped and require more attention, according to the UEQ.

7.1.6. Experimental Findings

During the experiment, participants needed the tool in the second part to answer questions. The participants searched for ways to navigate documents more efficiently than traditional methods. Additionally, as the tool was a proof-of-concept, usability issues were noted. Participants, mainly men aged 45 and older, could have engaged more seriously with the experiment, possibly due to resistance to change and novelty. Thus, it motivates the elderly group to require more care.

Challenges with the knowledge graph primarily involved the quality and verification of the information. Missing relations in the knowledge graph due to incomplete documentation hindered users from finding the correct answers. Despite the inexperience of the participants in working with knowledge graphs, most experienced the knowledge graph as pleasant and more manageable than searching or scanning the documents. Also, people experience pressure because they only have 20

minutes to answer a question. Another critical factor explained as a psychological factor is time pressure (Shrivastav & Kongar, 2021); a small note must be made that the paper mainly focused on individuals, which is a different direction than the rest of the referenced literature.

The overall representation of the knowledge graph caused around 5 participants to experience information overload, as participants felt overwhelmed by the volume of information. People also indicated that searches were done using two different modes. The traditional way is to search without creativity, but just CTRL-F on a term from the question that would lead them to specific answers. With the tool, however, people became much more creative and discovered relationships that would not have been found using CTRL-F in a document.

Chapter 8
Discussion

Chapter 8 provides a discussion of the research findings. First, the results of the experiments are discussed, including reflections on the different methods used for the research.

8.1. Research findings

The literature review highlighted the critical issue of information overload within police work. Addressing the challenge regarding information overload is essential as it impacts decision-making and efficiency. The findings suggest a new approach to managing information, which could be transformative for police operations. However, the applicability of these solutions must be considered carefully. It is vital to assess how practical these solutions are for different parts of the police force and whether they can be implemented across various departments. Cultural change and hierarchical structures play significant roles here. Innovations often require new working methods, which can take time to adopt in a large organization. Implementing small, manageable steps could be a practical way to achieve the ultimate goals.

The interviews provided valuable insights into the challenges faced by the police organization. Interestingly, participants shared similar perspectives on the issues within the police force. These conversations revealed a readiness for a new way of working. Despite the initial challenges, ¾ the participants were enthusiastic about the new tool and made considerable efforts to provide comprehensive responses. Their dedication was evident; 2 or 3 participants even wanted confirmation from the researcher to ensure their answers were thorough. The enthusiasm indicates a solid willingness to embrace innovation. Although yet to be user-friendly, the tool developed to combat information overload was met with a positive response. Despite its early stage of development, participants managed to use it effectively and provided valuable feedback. This adaptability is noteworthy and suggests that with further refinement, the tool could significantly benefit the police force. The tool's success is encouraging, indicating a potential for broader adoption once fully developed.

The study yielded a notable finding concerning personality characteristics among individuals. Initially, it was hypothesized that the younger the age, the lower the chance of experiencing information overload with the tool, but the results did not support the hypothesis. Surprisingly, the findings indicate that age does not significantly impact efficiency. Similarly, it was anticipated that participants with higher levels of education would learn the tool faster and achieve more outstanding efficiency scores. However, the results also contradicted the assumption.

Managing stakeholders throughout the study were challenging. Coordinating schedules to ensure everyone could participate in the experiment required significant effort, especially since it demanded around 1.5 hours of their time. Additionally, the management day on May 14th, where the experiment was a focus point, required extensive preparation and organization to ensure all participants could experiment correctly using their laptops. Despite these challenges, the involvement and commitment of police employees were crucial for the success of the research.

Conversations with police staff from various organizational levels confirmed the need for change in information management. The participants indicated that starting small and gradually scaling up would be effective. Police employees are intelligent and need to see the immediate benefits of innovations to embrace them fully. Engaging in discussions with various personnel, from policy staff in The Hague to frontline officers, highlighted a collective willingness to consider new ideas. The focus could be on ensuring that these innovations benefit all parts of the police force, ultimately leading to a more efficient and effective organization. Specialists in certain professions often believe that their 30 years of experience cannot be replaced by a tool, which may make them less inclined to participate in experiments. It is important to emphasize that these experts are

irreplaceable, and their expertise is invaluable to the organization. The tool can enhance their work, making it more efficient without reducing the significance of their contributions to policy.

Chapter 9
Conclusion

In the final part of the research, the conclusion addresses the research question: “How can the national police decrease information overload while improving decision-making?”. Chapter 9 begins with concise answers to the sub-questions outlined in earlier chapters. The discussion then moves to the implications of the research, highlighting its significance for society, the police, and policymakers, including a section on scientific relevance. The chapter also addresses the study's limitations and concludes with recommendations for future research.

9.1. Conclusion

Sub-question 1: What are the causes and consequences of information overload for strategic policymakers of the Dutch national police department?

Strategic policymakers within the Dutch police observe information daily to prepare the police forces for the future. The influx of information is increasing rapidly, and more data is being recorded. Strategic policymakers at the Dutch police need to be transparent when making new decisions since it is a governmental organization. Since more and more information is coming from them, it becomes more challenging to derive a solution. Not only this but the police are also influenced by different actors (Fenton-O’Creevy et al., 2022).

Another important factor the police must consider is the changing environment in which police employees must act (Vooijs et al., 2022). A problem the police need help with is the implicit knowledge and the location of it. Finding the correct information is time-consuming. The information policymakers need to read while formulating new policies from outside and inside the organization feels overwhelming. Therefore, policymakers can quickly enter a situation where all the information makes it challenging to make an effective decision. At that moment, people exceeded their limited cognitive processing capability, which is called information overload (Caby, 2019; Walgrave & Dejaeghere, 2016). Another cause of information overload is seen in the different platforms police employees have where information is stored. The feeling of information overload leads to skimming or completely bypassing materials, risking oversight of crucial details (Caby, 2019).

Sub-question 2: What are the requirements for a solution to improve the strategic policymaking of the Dutch national police department while focusing on information overload?

A literature review and semi-structured interviews made it possible to create a list of requirements for strategic policymakers to improve their working processes. Literature suggests different solutions against information overload, including implementing a new system like a knowledge management system. When implementing a new tool or method within an organization like the police, it is essential to keep in mind the variety of people working there, so it needs to be *easy to use*.

Also, due to the organization’s size, a new system could facilitate consensus building, create a helpful method for structuring documents, have possibilities to validate users' input and increase the organiz*ation’s collective intelligence.* Furthermore, it could benefit policymakers regarding *time* while illustrating an almost immediately *added value* for the users. Lastly, since the police are dealing with changing environments, the system needs to be flexible. Those requirements would help strategic policymakers decrease their information overload and increase the quality of their decision.

Sub-question 3: What platform design can effectively enhance strategic decision-making within the national Dutch Police while considering the requirements?

Most solutions regarding information overload focus on knowledge management systems. A knowledge management system identifies, organizes, stores, and spreads information within an organization (Gottschalk & Dean, 2010). Different knowledge management systems are used, such as information retrieval programs, groupware, decision support systems, knowledge graphs, and ontologies (Demirsoy & Petersen, 2018).

All the different systems have their advantages and disadvantages. According to the literature, the most common knowledge management systems are compared to the requirements set. Five of the KMS matched more than half of the requirements. However, knowledge graphs and ontologies matched eight of the nine requirements. The only area for improvement with knowledge graphs and ontologies is that it requires time for users to receive and understand the functionalities. Therefore, ease of use differs when implementing the tool in a company. Nevertheless, comparing their advantages with the requirements from the literature review and the interviews, knowledge graphs, and ontologies is suitable for the Dutch police.

Sub-question 4: How does the proposed design work compare to the current method used for strategic policymaking within the Dutch national police department?

Traditionally, strategic policymakers create new policies by reading information from reports, newspapers, and websites. The information is presented in the same way: blocks of text. The tool creates a different representation of the information via a knowledge graph, which is like a mind map, but all the lines between the blocks are relations between the blocks. Relations between objects are illustrated as lines between the objects. The type of relations and objects are predefined in a knowledge graph employing ontologies. Ontologies are a way to structure and capture understandable knowledge for persons and computers (Scholtens, 2003).

Most of the time, knowledge graphs work with ontologies as rules to structure domain-specific knowledge. Two specialist companies in knowledge management, semantics, and data created the tool. These companies made the back end of the tool. For usability, the tool has been filled with 18 documents about disinformation related to the government and police. Filling in the documents is done manually, without any tacit knowledge, and all information concerns a person's experience, competence, and skills (Luen & Hawamdeh, 2001). Therefore, there could be missing relations between objects. The proof of concept created is called Futures Platform. It is only a different representation of the information: artificial intelligence or other tools that have yet to be used to increase the quality of the tool.

Sub-question 5: What are the positive and negative effects of the designed platform on information overload in the context of strategic decision-making by the national police?

The information overload formula tests the difference in the tool's effectiveness compared to the traditional method (Jackson & Farzaneh, 2012).

Information Overload =
(Characteristics of Information × Information Processing Capacity × Available Time)
–
(Personal Factors × Task and the Process Parameters × Quality of Information × Quantity of Information)

The higher the value of information overload, the less chance individuals experience information overload during a specific task. Within the experiment, only the information processing capacity, personal factors, task and process parameters, and the quantity of information are assessed. The rest of the variables are kept constant. Using the formula creates the possibility of comparing the change in information overload per individual or per mean of a group. Since the experiment was conducted

with four groups, different statistical inference methods focused on between and within groups. The delta between the values per person with or without the tool determines the efficiency of the tool.

In general, the chance that participants experience information overload while using the tool is lower than when participants use it traditionally. Men reveal a significant difference higher than women. The effectiveness of men is approximately 81, compared to 47 for women, indicating that the value of information overload for men using the tool is 81 points higher than without the tool. Another essential feature is that the higher the information processing capacity, the higher the information overload values, meaning less chance of feeling information overload. However, the high information processing capacity does not affect the tool's efficiency. Also, the quantity of information used by the participants with the tool is significantly higher than without. That is one reason the tool decreases the chance of feeling information overloaded compared to the traditional method. Furthermore, in general, participants were satisfied with the tool and their performance while using the tool. Since the tool is still a proof-of-concept, improvements are needed to improve its functionalities and efficiency compared to the traditional method.

Main research question: "How can the national police decrease information overload while improving decision-making?".

All the knowledge gathered from the sub-questions can help answer the main question. Information overload can be solved by implementing a knowledge management system. At the same time, the focus is mainly on the Dutch police struggle with the poor structuring of documents, changing environments, and different actors, all of which affect the quality of decision-making. These struggles are about information overload or unfindable information. Most companies have solved the problem of information overload by implementing a knowledge management system. Different knowledge management systems have different functionalities, disadvantages, and advantages that work in various situations.

For the Dutch police, a knowledge graph with ontologies is a suitable fit. A knowledge graph creates a different form of data representation. Implementing the knowledge graph positively affects the change of information overload. For 86 % of the participants, the chance of feeling information overloaded decreased when using the Futures Platform. A significant difference was that the tool was illustrated to be the most effective in men. Men had, in general, an effective rate of 80 and women of 47.

Furthermore, the higher the information processing capacity, the lower the chance of information overload in general but not the tool's effectiveness. The tool is a proof of concept and requires work to increase its functionalities. Hence, the results presented are a mid-term evaluation. However, as Wilson (2023) already mentions, assessing the system's mid-term quality is essential. For now, using a knowledge graph to represent information could positively affect decision-making while focusing only on the change in information overload.

9.2. Societal and Scientific Relevance of the Research

Scientific Relevance

The research advances our understanding of how a different information representation in the form of knowledge graphs impacts information overload, specifically within strategic policymaking contexts. Existing literature on the topic did not connect the use of knowledge graphs to decrease information overload at the Dutch police. Therefore, the study presented a novel and relevant subject. By focusing on the potential of knowledge graphs to mitigate information overload among strategic policymakers within the Dutch national police, the research addresses a critical need for innovative solutions in information management and decision-making processes.

Methodologically, the study employed a comprehensive approach to identify and evaluate challenges faced by policymakers. This led to developing and refining a customized knowledge graph explicitly created for the Dutch police force. The study carefully assessed the efficiency of knowledge

graphs in decreasing information overload. The findings offer promising insights into the potential of knowledge graphs to improve the quality and effectiveness of strategic decision-making processes.

Societal Relevance

Beyond its scientific contributions, the research holds significant societal relevance, particularly in empowering policymakers within the Dutch national police. By clarifying the complex challenges associated with information overload, the study provides policymakers a valuable tool to navigate complex information streams more effectively. This capability can stimulate the development of innovative and informed policies, thereby enhancing the overall quality of policymaking within the Dutch national police.

Moreover, by enabling policymakers to leverage data more efficiently, the research supports the growth of evidence-based policymaking practices. Shifting towards more informed decision-making processes ultimately contributes to more effective governance and impactful societal outcomes. The methodology and insights generated by the research also lay a foundation for future interdisciplinary collaborations and knowledge-sharing initiatives to address information overload challenges across various organizational settings. The comprehensive approach helps policymakers improve their strategies and encourages the use of modern information management practices needed to tackle today's societal issues.

9.3. Limitations

Significant limitations need to be described in the study. The knowledge graph was constructed manually, and implicit relations and nodes needed to be defined, resulting in an incomplete knowledge base that could not fully support answering questions or finding relevant information. Another area for improvement while manually filling in the information is that the data is biased and could sometimes be incomplete, which is a familiar challenge within knowledge graphs (Chen & Yeoh, 2020). Due to the subject of the question, namely disinformation, the participants searched the knowledge graph for ways to validate the information. This decreased their time for answering the question. Using a different subject can help avoid this.

Another obstacle found during the experiment was the digit span memory test. Almost half of the participants needed help understanding the test, which resulted in problems when filling in the numbers. Therefore, these results cannot be assumed to be 100% valid. Also, some participants had never worked with a knowledge graph. Therefore, it took time for them to fully understand the tool's functionalities, even after a small demo. It is comparable to a new game like chess; when the participant has never played chess, it will take time to get the hang of it. Since the experiment had a time constraint, people needed more time, which affected the tool's effectiveness.

Another significant limitation of the experiment is the tool itself. The tool is still a proof of concept, and functionalities must be improved. Zooming or searching in the graph were the main struggles mentioned by the participants. These limitations of the tool may negatively affect its effectiveness. When focusing on the information overload formula, variables are manually filled in, like the novelty of the answer and the information quantity. The researcher determines novelty based on the information that has been read about the topic to fill the knowledge graph manually. Due to this, the researcher has much knowledge about the subject and the answers to the questions that can be presented. However, this has biases that affect the participants' IO values. The quantity of the information is only determined by the researcher when using the tool since finding the references for the relations was hard in the knowledge graphs. The sources used were assumed by looking at the answer and the knowledge graph.

9.4. Future research

The study highlights several limitations that create opportunities for further research in using knowledge graphs to reduce information overload among strategic policymakers. The variables of the formula used to calculate information overload are focused on the personal factors of the participants. The variables focusing on the information have yet to be considered. A deeper understanding of information quality and characteristics could yield different results.

Furthermore, the research underscores that while the developed tool serves as a proof of concept, it requires further refinement and enhancement to maximize its impact in mitigating information overload. The proof of concept, as mentioned before, has caused struggles for the experiment participants, which may be prevented if the user experience functionalities of the tool are improved. Also, people needed to gain experience working with a knowledge graph. This has created delays in finding an answer to the question or the correct information. When the participants keep using the tool, its useability will improve and not affect the experiment's results.

The study suggests that it is crucial to include more than just police employees who make strategic decisions in the research to ensure accurate results. It also stresses the need to look beyond current limits to fully understand how the tool can further decrease information overload among participants. Ensuring the full functionalities of the tool requires that all the employees of the Dutch police work with the tool in terms of searching, adding, and validating the data. By extending the pool of participants, all the tool's challenges are brought to light, and eventually, the tool is suitable for all. Another essential feature to mention is testing the proof of concept on different subjects to see if the subject of the experiment affected the information overload results. Nevertheless, a knowledge graph including ontologies is an extendable knowledge management system. Different methods, such as artificial intelligence, could be inserted into the tool to make it more efficient and improve quality.

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Appendix A Interview Guide

Strategische beleidsvorming interviewgids:
Interviewmethode: Semigestructureerd
Tijdsbestek: +/- 1 uur
Doel van het interview: Informatie verzamelen over hun gebruikelijke werkproces bij het opstellen van strategisch beleid voor het nationale beleid en informatie verkrijgen over hun uitdagingen en wensen voor verbetering, zodat de tool wordt geëvalueerd op basis van hun behoeften. Ik zal hun behoeften omzetten in metingen met betrekking tot een bepaald kader voor informatiekwaliteit.

1. **Werkproces**
    - **a.** Kunt u uw rol binnen de politie beschrijven?
    - **b.** Op welke deliverables wordt uw werk beoordeeld?
    - **c.** Wat is uw ervaring met betrekking tot strategische beleidsvorming binnen het politiedepartement?
    - **d.** Kunt u beschrijven hoe u over het algemeen te werk gaat bij het schrijven van (strategisch) beleid stap voor stap?
    - **e.** Wat voor type data gebruikt u?
        - **i.** Bronnen (extern, intern)
        - ii. Impliciet/expliciet
        - **iii.** Structuur (PDF, Word, Excel, Video, Images)
    - **f.** Hoe vaak voert u dit proces ongeveer uit?
        - **i.** Welke fases zitten er in dit proces?
        - **ii.** Welke stap(pen) kosten de meeste tijd
    - **g.** Interpretatie van informatie
        - i. Hoe interpreteer je informatie uit een bron?
        - **ii.** Hoe stel je verschillende perspectieven op elkaar af in een analyse?
        - **iii.** Hoe bepaal je de waarde van je informatiebronnen?
    - **h.** Van welke tools maak je gebruik tijdens je analyses?
    - **i.** Hoeveel tijd heeft u over het algemeen om dit te maken?
    - **j.** Hoe koppel je je conclusies aan beleidsprocessen?
    - **k.** Hoe ziet het eindresultaat van je analyse eruit?
        - i. Hoe belangrijk zijn visualisaties hierin?

2. **Problemen binnen het werkproces**
    - **a.** Met welke uitdagingen wordt u geconfronteerd met betrekking tot strategische beleidsvorming binnen het politiedepartement?
        - i. Data
        - ii. Technologie
        - iii. Mensen
        - iv. Proces
    - **b.** Zijn er repeterende taken binnen je werkproces die je graag geautomatiseerd ziet?
    - **c.** Is dit duidelijk beantwoord? NEE, denk aan een specifieke uitdaging waar u mee te maken krijgt tijdens strategische beleidsvorming. Kunt u daar meer over vertellen?
        - i. “Hoe probeer je momenteel deze uitdaging(en) op te lossen?”
    - **d.** Duidelijk: JA -> Ga verder

3. **Verbeteringen**
    - **a.** Van de genoemde uitdagingen, kunt u de top 3/5 noemen die voor u het belangrijkst zijn om aan te werken?

b. Waarom zijn die factoren belangrijk voor u?

4. **Futures Platform**
   "Leg het platform uit"
   a. Hoeveel vertrouwen heb je in de informatie van het Futures platform (kunt u dit toelichten)?

5. **Aanbevelingen**
   a. Hoe ziet u de impact van een mogelijk Futures platform?
      i. Sterke punten
      ii. Zwakke punten
      iii. Mogelijkheden
      iv. Bedreigingen
   b. Waar ziet u de grootst mogelijke toegevoegde waarde van het Futures Platform op uw werk?

Bedankt voor al die waardevolle informatie. Is er nog iets dat u wilt toevoegen voordat we eindigen?

Appendix B Experimental Design Plan

Experiment

Start of Block: Introductie

Instructie Experiment
Beste Meneer/ Mevrouw,

Hartelijk dank dat u mee wilt doen met dit experiment. Het experiment is een onderdeel van mijn masteronderzoek.

Het experiment ziet er als volgt uit. Eerst krijgt u een enquête waarin vragen worden gesteld over je demografische gegevens en werkervaring. Dan volgt het experiment waarbij je 2 vragen moet beantwoorden waarbij je eerst een vraag beantwoordt zonder de tool en daarna een vraag beantwoordt met de tool. Het experiment eindigt met een post-test enquête waarin naar je ervaring wordt gevraagd. De gegevens evalueren het gebruik van de tool die is gemaakt voor het masteronderzoek. In totaal zal het experiment 60 minuten duren.

Belangrijke regels voor het experiment:

- Tijdens het experiment wordt niet onderling gesproken over het experiment inclusief het onderwerp.
- Er is 1 deel van het experiment wat op tijd zal gaan, hierbij is het belangrijk dat u niet gestoord wordt. Wilt u van tevoren naar het toilet of andere belangrijke activiteiten ondernemen om zo het experiment zo zorgvuldig mogelijk te kunnen voeren.

Start of Block: Informed consent

Informed Consent
Formulier Informed Consent

U wordt uitgenodigd om deel te nemen aan een onderzoeksproject getiteld MSc Thesis: Information Overload among Strategic Policymakers. Dit onderzoek wordt uitgevoerd door Renée van der Poel, student Engineering & Policy Analysis aan de Tu Delft. Het doel van dit onderzoek is het evalueren van een nieuwe methode om informatieoverload bij Nederlandse nationale politie tegen te gaan. Het experiment duurt ongeveer 60 minuten. Het experiment ziet er als volgt uit.
De verzamelde informatie zal worden gebruikt voor het afstudeeronderzoek, de scriptie en mogelijk voor presentaties en wetenschappelijke publicaties. De informatie zal in geanonimiseerde vorm worden opgeslagen op de TU Delft Repository, die openbaar toegankelijk is. Uw antwoorden in dit onderzoek blijven vertrouwelijk en persoonsgegeven zullen niet openbaar worden gemaakt. We minimaliseren eventuele risico's door de gegevens alleen op de TUD-schijf op te slaan en persoonlijke gegevens na 1 maand na afronding van de scriptie of eventuele publicatie te verwijderen. Uw persoons gegevens zijn tot het moment van verwijdering alleen in te zien door Renée van der Poel (

Door te klikken op de onderstaande knop, erken je dat: 1. Deelname aan het experiment op vrijwillige basis is 2. Je op de hoogte bent dat je op elk moment het experiment kan verlaten om wat voor reden

dan ook, zonder dat je die reden kenbaar hoeft te maken.

- ○ Ik geef toestemming, begin met het experiment
- ○ Ik geef geen toestemming, I doe niet meedoen met het experiment

End of Block: Informed Consent

Start of Block: Start

Q1 Welke groep ben je geplaatst?

- ○ Groep 1
- ○ Groep 2

Q2 Wat is je deelnemersnummer?

Start of Block: Pre-test

Q3 Wat is u sekse?

- ○ Man
- ○ Vrouw
- ○ Anders (specificeren) _____
- ○ Wil ik niet zeggen

Q4 In welke leeftijdscategorie valt u?

- ◯ <18
- ◯ 18 - 24
- ◯ 25 - 34
- ◯ 35 - 44
- ◯ 45 - 54
- ◯ 55 - 64
- ◯ 65 - 74
- ◯ 75 - 84
- ◯ 85>

Q5 Wat is het hoogste opleidingsniveau dat u hebt voltooid of de hoogste graad die u hebt behaald?

- ◯ Lager dan middelbareschooldiploma
- ◯ Middelbareschooldiploma of vergelijkbaar
- ◯ HBO maar geen diploma
- ◯ Wo maar geen diploma
- ◯ Hbo-bachelor
- ◯ Wo bachelor
- ◯ Masterdiploma
- ◯ PHD
- ◯ Anders, namelijk _____

Q6 Klik op de link. Hierbij wordt gekeken naar u brein geheugen. Zou u de uitkomst van u test hier willen noteren?

_____

Q7 Hoeveel ervaring heeft u met strategisch beleid maken?

- ○ 0 jaar
- ○ 1-2 jaar
- ○ 2-5 jaar
- ○ 5-10 jaar
- ○ > 10 jaar

Q8 Hoeveel ervaring heeft u met strategisch beleid maken bij de **politie**?

- ○ 0 jaar
- ○ 1-2 jaar
- ○ 2-5 jaar
- ○ 5-10 jaar
- ○ >10 jaar

Q9 Welke ervaring heeft u met strategisch beleid maken? (Als 0 jaar, laat deze dan leeg)

_____

End of Block: Pre-test

Start of Block: Part 1

Part 1 In dit deel van het experiment, ga je een vraag beantwoorden met behulp van de data die gegeven is in de volgende link: XXX (Dit is de link die leidt naar de documenten waaruit het antwoord geformuleerd zou moeten worden).

Q10 Wat is de verwachte impact van desinformatie op het vertrouwen van de burgers in de politie de komende jaren? (De vraag moet beantwoord worden met de documenten, probeer geen impliciete kennis te gebruiken) (Refereer naar de bron die gebruikt is in het antwoord door de titel van het bestand te vermelden)

_____

_____

_____

_____

_____

End of Block: Part 1

Start of Block: Part 2

Part 2 In dit deel van het experiment, ga je een vraag beantwoorden met behulp van een tool. (Een korte uitleg over hoe te tool gebruikt moet worden is aan het begin van dit onderdeel van het experiment.)

Q11 Wat is de verwachte impact van desinformatie op de openbare orde de komende jaren? (De vraag moet beantwoord worden met de documenten, probeer geen impliciete kennis te gebruiken) (Refereer naar de bron die gebruikt is in het antwoord door de titel van het bestand te vermelden)

_____

_____

_____

_____

_____

End of Block: Part 2

Start of Block: User Experience Questionnaire

Q12: UEQ **Gebruikers tevredenheid vragenlijst**
Elke rij heeft 7 opties. Het is belangrijk om je ervaring van het gebruik van de tool te evalueren. Hierbij is het belangrijk dat je niet te lang nadenkt en je eerste gedachte neerzet.

	1	2	3	4	5	6	7	
Vervelend	○	○	○	○	○	○	○	Plezierig
Niet begrijpelijk	○	○	○	○	○	○	○	Begrijpelijk
Creatief	○	○	○	○	○	○	○	Saai
Makkelijk te leren	○	○	○	○	○	○	○	Moeilijk te leren
Waardevol	○	○	○	○	○	○	○	Minderwaardig
Saai	○	○	○	○	○	○	○	Opwindend
Niet interessant	○	○	○	○	○	○	○	Interessant
Onvoorspelbaar	○	○	○	○	○	○	○	Voorspelbaar
Snel	○	○	○	○	○	○	○	Langzaam
Aanmoedigend	○	○	○	○	○	○	○	Conventioneel
Obstructief	○	○	○	○	○	○	○	Ondersteunend
Goed	○	○	○	○	○	○	○	Slecht
Moeilijk	○	○	○	○	○	○	○	Makkelijk
Onaantrekkelijk	○	○	○	○	○	○	○	Aangenaam
Gewoonlijk	○	○	○	○	○	○	○	Toonaangevend
Onplezierig	○	○	○	○	○	○	○	Plezierig
Veilig	○	○	○	○	○	○	○	Niet veilig

Motiverend	○	○	○	○	○	○	○	Niet motiverend
Voldoet aan verwachtingen	○	○	○	○	○	○	○	Voldoet niet aan verwachtingen
Inefficiënt	○	○	○	○	○	○	○	Efficiënt
Duidelijk	○	○	○	○	○	○	○	Onduidelijk
Onpraktisch	○	○	○	○	○	○	○	Praktisch
Georganiseerd	○	○	○	○	○	○	○	Onoverzichtelijk
Aantrekkelijk	○	○	○	○	○	○	○	Niet aantrekkelijk
Vriendelijk	○	○	○	○	○	○	○	Niet vriendelijk
Conservatief	○	○	○	○	○	○	○	Innovatief

End of Block: User Experience Questionnaire

Start of Block: Post-test

Q13 Statements:

	1	2	3	4	5	6	7
Tot op welke hoogte ben jij bekend met het onderwerp misinformatie?	○	○	○	○	○	○	○
Hoe tevreden ben jij met jou resultaat **zonder** tool?	○	○	○	○	○	○	○
Hoe tevreden ben jij met jou resultaat **met** tool?	○	○	○	○	○	○	○
Hoe makkelijk was het op specifieke informatie te vinden **zonder** tool?	○	○	○	○	○	○	○
Hoe makkelijk was het op specifieke informatie te vinden **met** tool?	○	○	○	○	○	○	○

Q14 Heeft u impliciete kennis gebruikt om vraag 1 te beantwoorden? Zo ja, welke impliciete kennis? (Kennis vanuit u eigen systeem, zonder gebruik van de rapporten)

Vraag 1:
Wat is de impact van desinformatie op de openbare orde?

○ Ja _____

○ Nee

Q15 Heeft u impliciete kennis gebruikt om vraag 2 te beantwoorden? Zo ja, welke impliciete kennis? (Kennis vanuit u eigen systeem, zonder gebruik van de rapporten)

Vraag 2: Wat is de verwachte impact van desinformatie op het opsporingsproces de komende jaren?

- ○ Ja _____
- ○ Nee

Q16 De tool die u heeft gebruikt werkt met knowledge graphs en ontologie om verbanden te leggen tussen relaties die belangrijk zijn voor de politie. Voor zover u weet heeft u al eerder met deze technologie gewerkt?

- ○ Ja
- ○ Nee

Q17 In hoeverre denkt u dat u ervaring u geholpen met het gebruik van de tool

0 1 2 3 4 5 6 7 8 9 10

(0 = niet), (10 = volledig)

Q18 Welke taak vond u het makkelijkst om te voltooien?

- ○ Met tool
- ○ Zonder tool

Q19 Wat was/waren de grootse uitdaging(en) van het gebruik van de tool? (Meerdere uitdagingen mogelijk)

_____

Q20 Zou u de tool gebruiken in het dagelijks leven en waarom?

- ○ Ja _____
- ○ Nee _____

Q21 Ik ben van plan door te gaan met het gebruik van de tool om documenten te lezen in mijn werk (Venkatesh et al., 2011)

- ○ Ja
- ○ Nee

End of Block: Post-test

Start of Block: End

Bedankt voor u medewerking aan dit experiment. Als alle data verwerkt is ontvangt u van mij of van Amir de resultaten. Mocht u nog vragen of opmerkingen kunt u dat hier vermelden of mailen naar reneevdpoel@gmail.com.

_____

End of Block: End

Appendix C Information Overload Formula

This formula is studied, and the different aspects are analyzed. All the first descriptions come from Jackson & Farzaneh (2012) but are further explored.

Information Overload = (Characteristics of Information × Information Processing Capacity × Available Time) − (Personal Factors × Task and the Process Parameters × Quality of Information × Quantity of Information)

All the different factors within the formula are explained.

Characteristics of information

The characteristics of information are described as the complexity times, ambiguity times, uncertainty, and novelty of the information itself. Information complexity combines multiple inputs like understanding the facts (rule complexity) and firm understanding (strategic complexity). It refers to specific aspects of the environment, such as the impact of an organization. The second factor is ambiguity, meaning the same information can be interpreted in multiple ways (Schneider, 1987). The meaning of the information itself could be more transparent to the reader. Also, uncertainty plays a role, which refers to the amount of information needed versus the amount available. This can be distrusted by, for example, unavailability of information, lack of knowledge regarding causes and effects, and inability to determine probability. The last part of the characteristics of information is about novelty. Novelty is about whether the presented information provides the readers with new insights or perspectives. Bringing fresh ideas and content may cause trouble since people need more familiar reference points. Processing and integrating this new information into existing knowledge structures requires more cognitive effort but is personally dependent. Characteristics of information, including complexity, uncertainty, and ambiguity, directly influence information processing capacity. Information overload can occur not only due to the sheer volume of information but also because of its qualitative attributes. Ambiguity adds to the cognitive load by requiring additional effort to decipher and understand the intended meaning, contributing to information overload.

Information Processing Capacity

Information processing capacity refers to the cognitive ability of an individual to receive, process, and utilize information efficiently within the constraints of the human brain's storage and processing limitation. Miller (1956) found Miller's Magic Number; people can remember 7 (+/- 2 numbers) short term. An example of how to find a person's number is by conducting a digital span test. Digit Span assesses your ability to recall a sequence of numbers displayed on the screen one at a time. (Battista, n.d.). In general, when people have a higher processing capacity, they can cope with more significant amounts of information and are less likely to experience information overload.

Available Time

The available time is a relatively easy factor in the formula. It refers to the amount of time/ duration of the search process. This factor can be held constant within a user test since everyone received the same time to do their task.

Personal Factors

Personal factors are determined by the level of prior experience + personal skills + cognitive style + motivation + personal situation. So, personal experience encompasses various individual characteristics, experiences, skills, and circumstances that influence how individuals perceive, process, and manage information. When analyzing information overload, it is crucial to consider these factors since familiarity could affect someone's performance and well-being.

Task & the Process parameters

Task and process parameters are assessed by summing the task complexity, novelty, number of interruptions, and other tasks the person needs to perform. Task complexity refers to a specific task's difficulty, including the amount of information, interdependencies, and potential obstacles. Task novelty discusses how many innovations and challenges result from that task. This part brings challenges and opportunities to learn and innovate within an organization. Another critical element in the process is the number of interruptions and other tasks a person must perform in its function.

Information quality (IQ)

Information quality has multiple definitions, and many researchers have searched for a manner to calculate it. However, this experiment keeps the information streams equal, so information quality is not a considered detail. The value of information quality is kept constant.

Information Quantity

The quantity of information is the amount of available and relevant information for a specific topic. For example, how much information is there to write a strategic policy about misinformation? An overabundance of information—whether available, supplied, or requested—can lead to difficulties in managing and processing information effectively.

Appendix D QQ-plot calculation

The complete calculations of the QQ plots are done in Excel. Below is a general explanation of how QQ plots are calculated.

1. Order the data set from small to large.
2. Then, the data points are split into equal areas within a normal distribution in equal areas n+1. These equal areas are calculated based on the number of data points.
3. Then, with a standard table, all the values can be found for each area. So, the plots are found in a table for every specific area.
4. Then, the values are plotted. The y-values are the sample quantiles, the observed value in the data, and the x-axis are the theoretical quantiles, the expected values, to receive a normal distribution. The ordered value (i) is plotted against the standard normal distribution's i/(n+1) quantile. For example, the first i value is plotted against the i/(n+1) quantile or the n^{th} percentile. If the data is normally distributed, the smallest value of the data set will lie around the first value of the first area, and so forth.
5. If the data points follow a reasonable straight line, the data is approximately normally distributed. This method tries to develop a technique that approximates what has expected if the data set is sampling from the standard normal distribution.

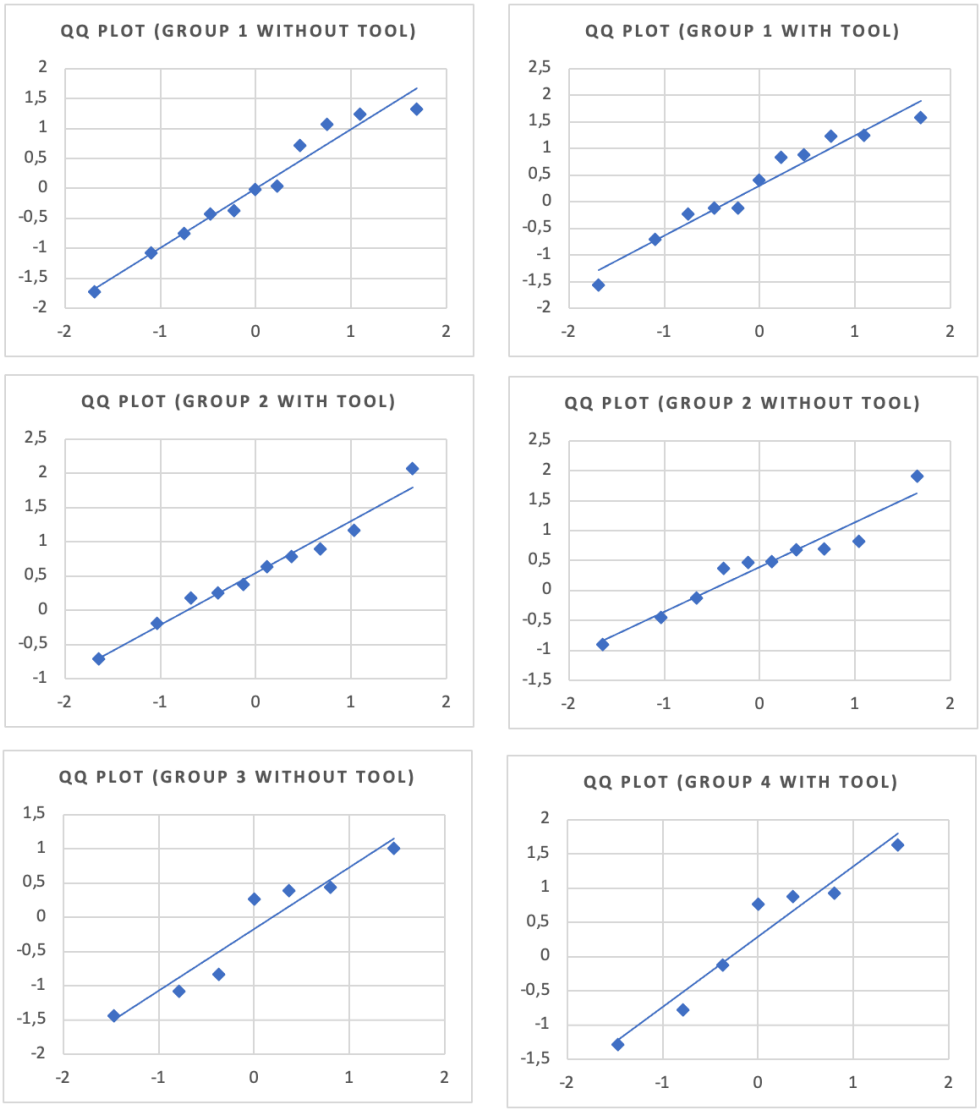

Figure 21: QQ plots of the different groups

Appendix E Unpaired and Paired t-test results

Unpaired t-test

The unpaired t-test reveals the significance between two groups, in this case, groups 1 and 3 and 2 and 4. The calculation is done in Excel using the T-test: two-sample unequal variance.
The results are illustrated in Table 9.

Table 9: Unpaired t-test Excel results

	IO Group 1 without tool	*IO Group 3 without tool*
Mean	287	236
Variance	84362	72244
Observations	11	7
Hypothesized Mean Difference	0	
df	14	
t Stat	0,378	
P(T<=t) one-tail	0,356	
t Critical one-tail	1,761	
P(T<=t) two-tail	0,711	
t Critical two-tail	2,145	

	IO Group 2 with tool	*IO Group 4 with tool*
Mean	427	371
Variance	48033	91999
Observations	11	7
Hypothesized Mean Difference	0	
df	10	
t Stat	0,427	
P(T<=t) one-tail	0,339	
t Critical one-tail	1,812	
P(T<=t) two-tail	0,679	
t Critical two-tail	2,228	

Paired t-test

The paired test reveals the significance within the group while using the tool or not. In this case, groups 1 and 2. The calculation is done in Excel using the T-test, two samples of equal variance. The results are illustrated in Table 10.

Table 10: Paired t-test Excel results

Group 1	*IO Without Tool*	*IO With Tool*
Mean	290	371
Variance	86918	75005
Observations	11	11
Pearson-correlation	0,928	
Hypothesized Mean Difference	0	
df	10	
t Stat	-2,459	
P(T<=t) one-tail	0,017	
t Critical one-tail	1,812	
P(T<=t) two-tail	0,034	
t Critical two-tail	2,228	

Group 2	*IO without Tool*	*IO with tool*
Mean	402	445
Variance	49387	49441
Observations	10	10
Pearson-correlation	0,97	
Hypothesized Mean Difference	0	
df	9	
t Stat	-2,519	
P(T<=t) one-tail	0,016	
t Critical one-tail	1,833	
P(T<=t) two-tail	0,033	
t Critical two-tail	2,262	