Fitting Behavioural Artificial Intelligence Technology in the banking sector: A market research study

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by
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Acknowledgements

The master thesis in front of you will try to give some insight into the banking sector, related to a novel decision-support system called Behavioural Artificial Intelligence Technology (BAIT). It situates BAIT in the institutional context of banks to determine its impact on decision processes. Hopefully, this thesis can urge banking employees or policymakers to understand the possibilities of Artificial Intelligence in general, and how solutions such as BAIT can help, primarily in detecting fraud more efficiently.

Unfortunately, the study has not panned out as I set out for in the beginning, building a choice model to tangibly show the effects of BAIT. Nevertheless, I am convinced and not to mention proud of the report that lies before you. This concludes my time at the Delft University of Technology (TU Delft) and also my time as a student. I can honestly say I could not have imagined a more difficult ending to my scholarly career. Having learnt so many divergent subjects such as network analysis, modelling choice behaviour, system design and so forth, is valuable beyond measure. This study has evoked my interest in digital transformations of socio-technical systems and it will continue to intrigue me throughout my working career.

To continue with the usual acknowledgements, with as first and foremost my graduation committee. Eric, thank you for being my chair and continuing to be my first supervisor. I know this might not have been the most relevant thesis to your expertise, but I admire your professionalism and want to thank you for all the feedback on academic writing. Rutger, I would like to thank you for the fruitful discussions on the institutional environment and organisational management, and for providing substantive feedback on my report. Last but not least, I would like to thank Councyl but especially Nicolaas, for allowing me to do my graduate research at the company. Your practical approach and insights into the real-life operations of a start-up have inspired me to alter my view of start-ups altogether. Conversations with you on the approach have helped me a lot, and hopefully, you can use this study. Moreover, I would like to thank to the other Councyl staff for the open and warm welcome when I first started to work, it gives me a lot of energy to work in an environment with kind and considerate people.

This concludes my final chapter of life in Delft. It has been a hell of a ride, gaining a lot of experiences, knowledge and most of all friends in the process. My last thanks will therefore be focused on these friends and of course my family, who have unconditionally supported me throughout everything. I hope I can repay you all with the same gratitude one day. I hope everyone will enjoy reading it as much as it has been gratifying for me.

Guus de Ronde,
March 13, 2023.

Executive Summary

Banks are currently under huge pressure to adhere to guidelines set out by De Nederlandsche Bank (DNB). De Nederlandsche Bank is the regulator that is prompting banks to very precisely investigate their clientele, also known as the Know Your Customer (KYC) principle. Banks are supposed to keep close tabs on who they do business with, how they do it, what transactions they make and for what purpose, and failing to live up to it resulted in excessive fines of almost €800 million. This is very intricate with the ever-rising number of clients and continuous transactions, up to the point that 25% of employees are working in the Know Your Customer department, with an allocated budget of almost €1.5 billion. Especially in Anti-Money Laundering (AML), employees are overloaded with work pressure, and banks have difficulty keeping up with regulations and evolving criminality.

In their role as gatekeepers, banks are dealing with growth to the best of their abilities, by looking at Artificial Intelligence (AI) or other data-driven solutions. AI, however, brings about many other technological and social issues that caution regulators and make them reticent about these innovations. Concerns about privacy, discrimination and cybersecurity are all reasonable with AI algorithms functioning in decision-making processes. Explainability versus accuracy is one of the main trade-offs that are on experts' minds and bunq has recently shown promising results in this respect, in spite of De Nederlandsche Bank's reluctance. Judicial advancements in banking have shown digital models are promising to support decisions or processes. A transition towards a risk-based approach is initialised by De Nederlandsche Bank.

Councyl is a provider of such a digital solution, having developed their Behavioural Artificial Intelligence Technology (BAIT). It is software that can help any company facing complex repetitive decisions by making implicit expert knowledge explicit, and using it to train their algorithm to emulate a decision maker. This is not limited to a single activity, so, several financial activities have been established as subjects of interest. Originating from the TU Delft and being inquisitive as well, it is in Councyl's genetics to try and understand the bigger picture. They want to know what the most pressing issues are in the banking sector, what current solutions lack, and why, to know if the addition of their service in the sector is relevant. The purpose of this thesis is thus to study the potential added value BAIT could have in the banking sector. The main research question, therefore, is formulated to add to this knowledge:

"What is the added value of BAIT in an organisation in the banking sector under the current circumstances of the institutional environment?"

The research gap identified is on practical AI tools in the banking sector. This study is thus initialised to examine the potential market for Councyl. Academically speaking, there are no reports of similar behavioural decision support systems being introduced in the banking sector or their effect on organisational processes. The approach of this research is doing a literature study accompanied by expert interviews and desk research. 39 experts from 16 different organisations inquired about their personal experiences and expertise in their respective fields. Experts are collected with almost no inclusion criteria, and banking employees ranging from junior analysts to board members are questioned.

Empirical knowledge provided by experts and attained throughout the study is used to sketch the landscape of the banking environment. The aim is to introduce insights on the feasibility of BAIT, both technically as well as under current institutional circumstances. Insights are then synthesised in a hypothetical exemplar case study to give practical examples of how BAIT could potentially change banks. The objective of the study is to provide advice to Councyl on where BAIT is best applicable. Societal relevance can be distinguished by introducing a new decision-support system to the banking sector for practitioners to consider.

The study adopts the framework of Williamson as the core by dividing the banking sector into four layers of institutions that structure social interactions. The critical systematic literature review indicates five key concepts that affect economic growth and stability in the banking sector on different aggregation levels: Globalisation, Country governance, banking or financial regulation, financial reform, and financial innovation. These notions are all interrelated to some extent, collectively influencing the adoption of innovative technologies such as BAIT. A country's ideas and sector regulations are restricting AI to flourish, with the Money Laundering and Terrorist Financing prevention Act (MLTF) and General Data Protection Regulation (GDPR) as the main catalysts. To be able to reorganise and strategically divert oneself from competitors is essential in value creation. Financial innovation is therefore a vital aspect for a bank to grow and change. An example is digital transformation, reforming and restructuring organisational processes, relying on the use of digital technology. Inspiration has been drawn from theories and frameworks about technological developments intervening in organisational processes to envision the possible change an innovation spurs in banking. The interrelations between agents and capabilities of an organisation on different institutional levels constitute the internal processes.

The BAIT methodology is taking implicit expert knowledge to train an algorithm, making experts' considerations explicit in criteria weights, to predict probabilistic outcomes of decisions. It is assumed every rational expert makes correct decisions to the best of their ability, maximising the benefits for their respective organisation. Model flexibility, transparency, explainability and accuracy are the flagships of the BAIT model. Stated Preference (SP) choice experiments are used to elicit the tacit knowledge of experts. Stated Preference choice experiments have the advantageous features of: including (realistic) alternatives not often occurring in practice, no correlations between attributes and smaller sample sizes required (setting up the model faster), with the additional benefit of avoiding complications with historical data. It is a method especially preferred in (market) research studies where information on trade-offs is absent.

Stricter regulations have caused banks to play catch up with their legacy systems and own clientele, whilst still dealing with new incoming and increasing transactions. A tenacious trade-off has occurred due to the heightened workload of quality and quantity of reports dealt with. This caused banks to be understaffed and hire under-educated personnel. Moreover, systems are not properly connected and maintained, making retrieval of information difficult and sometimes creating superfluous work by filling exactly the same data in multiple systems. Communication on client/ transaction data is prohibited between banks, increasing complications to identify patterns and show evidence to external parties. Much has been invested in dealing with these issues, but not satisfactory to current conditions.

Employees of divergent activities however also experience varying degrees of these problems. More specifically, Anti-Money Laundering, Know Your Customer and Customer Due Diligence (CDD) all have a high necessity in automation, whereas risk management and retail banking do in a lesser manner. Wholesale/ corporate banking and investment activities require no substantive automation, merely administrative improvement might be helpful or considered. The problems experienced by banking employees on workloads instigated by regulatory restrictions are opportune for Councyl to enter this potential market. Possibly 25% of employees in a bank could be supported in decision-making by Councyl.

Implementing digital technology affects organisational processes, causing strategic, organisational and technological shifts in the corporation. At the institutional level, regulation and legislation are of utmost importance in facilitating or limiting AI-based solutions. In an organisation, the design of a digital transformation should be aligned with its strategy, and system modularity is the main barrier to success. Stimulation of collaboration between the IT department incorporating the tool, end-users using the tool, and policymakers designing the tool should be continuous and iterative, spearheading accessibility, interoperability and multi-functionality. Failure should not deter banks from trying to innovate, as feedback from the system is a key source of information. Enabling the bank to adapt business rules and incrementally evolve at the same rate as criminals is almost impossible, but indispensable to progression. The process level regarding the practical use of BAIT is explained in Figure 1.

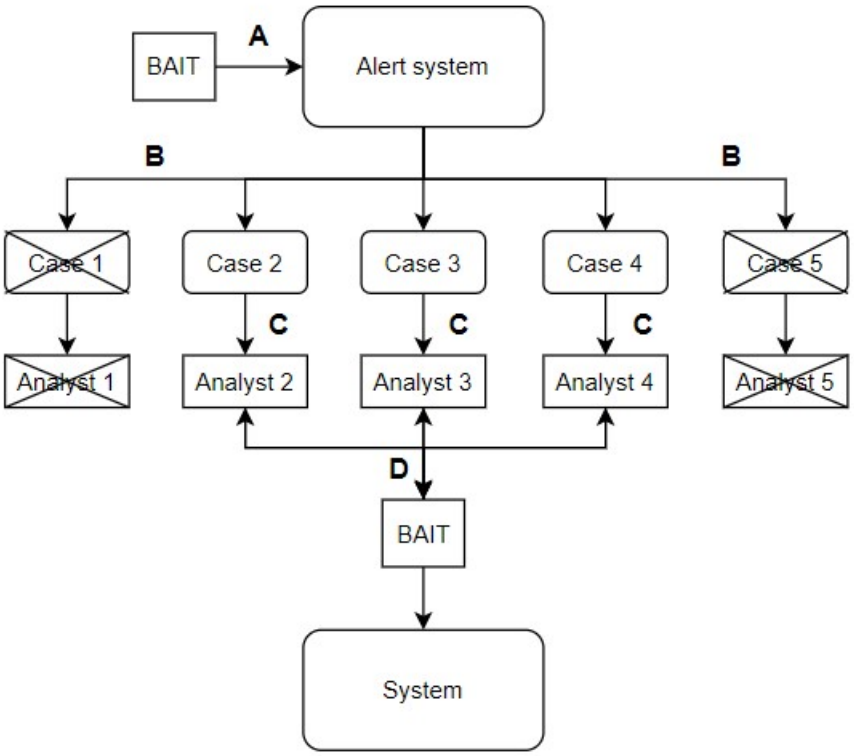

Figure 1: BAIT impacting decision processes

Merging all the knowledge accumulated in this study, four main functions of BAIT have been established: to enhance existing fraud detection tools **(A)**, efficient design of decision processes **(B)**, allocating cases more effectively **(C)**, and as an introspective training tool making considerations and implicit expertise transferable to internal or external third parties **(D)**. These uses are established for Anti-Money Laundering casuistry, however, in other financial activities one of these four types or more uses could be applied. Practitioners in their respective fields all saw potential in at least one of the four functions of BAIT.

In conclusion, the study contributes to academics introducing a decision-support system in the banking sector, followed up by empirical data on the method's feasibility. A combination of institutional economics and organisational theories leads to a market research study of a decision-support tool in the financial sector. Additionally, the commercial and societal addendum is on the dissection of the banking sector, providing insights into what way a financial organisation would institutionally change by incorporating a digitally transforming tool such as BAIT. Simply put, BAIT can be applied in almost any organisation in virtually every decision process, but understanding where it adds the most value is paramount.

The main limitation of the study is that it has a highly hypothetical, subjective means of model validation, as no pilot study was conducted showing numerical efficiency discrepancies. Subsequently, it directly leads to further research recommendations on performing such a study in a bank to show before and after results. A final recommendation to Councyl is if they should pursue clients in the banking sector, their initial focus should be on Anti-Money Laundering/ Know Your Customer related activities.

Keywords:
Behavioural Artificial Intelligence Technology, Decision support system, Institutional environment, Banking sector, Anti-Money Laundering.

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1 Introductory background

Banks are indispensable organisations in society for maintaining financial safety (Anginer et al., 2018). Moreover, the banking sector is a very complex environment that is one of the most regulated areas in the world (Chortareas et al., 2012). To operate as a bank, specific licences and permits are compulsory, for banks to establish themselves in the sector (De Nederlandsche Bank, n.d.-e). In this particular sector, De Nederlandsche Bank (DNB) is the principal regulator that supervises, guides and sanctions financial organisations to execute banking activities.

Banks are defined as financial institutions that have to satisfy four conditions: they need to serve the public, they need to be able to refund money at any given moment in time to the client's needs, give out credits to others, and the bank itself needs to take risks on credits given (De Nederlandsche Bank, 2017a). There are several external financial activities that banks can undertake, such as (sustainable) investing and giving loans, in addition to in-house operations such as risk management and quality assessment. Banks are trying to improve these services, thus searching for solutions in, for example, automation with Artificial Intelligence (AI). Despite current trends in data analyses and other measures to streamline the decision processes, banks are finding it difficult to change and comply with regulations due to their rigidness.

Fitting AI in the financial sector is difficult since the development surrounding these innovations elapses roughly. Only just very recently are banks openly allowed by regulators to look at options screening clients with AI after a juridical case of bunq showed promise (NOS, 2022b). In this playing field, other companies such as Councyl are trying to find their way into the market to introduce their service. This study will try to enlighten Councyl on several facets encapsulating the banking sector, to understand the issues, its market opportunities and barriers.

1.1 Short overview on existing knowledge

This sub-section gives a small summary of the literature acquired for this research. It provides an overview of what is examined and what remains unknown in academic works. Institutional frameworks that help structure problems, the banking environment, possible technological advancements and organisational management are subject to the literature review, provided in Section 2.

In literature, almost no scientific papers have been established except for ten Broeke et al. (2021) on the BAIT software devised by Councyl. It shows the particular functioning of the decision-support system based on expert opinions in the health sector. The banking sector, however, is studied with various perceptions. It is known how the sector evolved (Keeley, 1990; Mourlon-Druol, 2020), the unavoidable Crisis and its effect (Avgouleas, 2012; Podrugina and Tabakh, 2020; Milic, 2021), several facets of economic growth related to institutional characteristics (Lee et al., 2020), and individual banking growth (Beck et al., 2016). Many more important institutional factors of the banking sector have been investigated that determine the organisation and management of the sector (Demirgüç-Kunt et al., 2004; Larionova et al., 2018). In addition, several techniques that could revolutionise the sector have been studied (Bredt, 2019; Truby et al., 2020; Fritz-Morgenthal et al., 2022). At last, the institutional environment can be structured through the use of frameworks devised by Ostrom (2005; 2010), and Williamson (2000), in addition to the institutional change innovation brings about (Haggerty and Golden, 2002; Cillo and Verona, 2022). What remains unknown is the impact of Councyl's unique service on organisations in the banking sector.

1.2 Societal, commercial, and academic relevance

In this sub-section, the goals in several respects are discussed. The goals of the study are to provide societal, commercial, and academic knowledge on the potential of Behavioural Artificial Intelligence Technology (BAIT). Additionally, the aim is to provide recommendations on which activities or organisations Councyl should focus on.

The academic goal of the study is to provide recommendations on the possible divisions and repetitive complex choices BAIT can be utilised in. The thesis describes the operation of the self-learning algorithm and evaluates where the model fits best in the internal decision processes of banks. To attain this goal and the other objectives, existing theoretical frameworks produce newly constructed insights, subsequently utilised to analyse the institutional environment, BAIT, and the adoption of this particular innovation by banks. Additionally, this study's goal is to better understand the financial sector demarcating the institutional environment, and characteristics that are appealing for using BAIT. Deconstructing the different key indicators for financial stability and growth is important to appraise the possibilities of BAIT.

Councyl is heavily reliant on the execution of pilot studies to train their model and show if estimations of the model are realistic. Furthermore, expert input is required to control for wrong predictions and fine-tune the model accordingly. Without this feedback, validating the model's predictions is next to impossible. In this study, the model will unfortunately not be validated to compare the model's performance to actual expert decisions. But it is still valuable for Councyl to know the empirical worth of their model in the financial sector by examining its potential and getting acknowledgement from experts in the field. The commercial goal is to gather knowledge on the underlying problems and lack of current solutions in banks, to determine which activities best apply BAIT to. At first glance, it is a market reconnaissance study to establish potential customers for Councyl.

The effect the study has on society is introducing a novel decision-support tool in the financial sector that might aid banks or other financial institutions to decrease processing time within multiple types of repetitive decisions. Different activities that banks partake in could all be applications for Councyl's tool. It is important to understand the tool, get expert validation, and discuss whether or not an activity benefits from decision support. By talking to experts and sketching the possible scenarios in which BAIT can be used, they can explain from their professional opinion whether the tool has a solid foundation or not. Subsequently, if banks could be more efficient it would be beneficial for society as a whole, as they could shift focus towards public interests such as preventing financial crime or sustainability.

1.3 How to approach the research?

In this sub-section, the methodology of how to gather the information required to answer the research questions is outlined, further elaborated in Section 3. Through means of a comprehensive literature study, desk research, expert interviews, and finally an exemplar case study, insights into the present issues in the financial sector as well as operational details in the organisational structure can be manifested. Expert interviews are the main source of information since the emphasis is not on practical instrumentation of BAIT, but a more exploratory study on the why and how a bank would apply BAIT. The banking sector is dissected with several frameworks to see possible segments to exploit or potential pitfalls.

The BAIT methodology incurs expert interviews to set up the most pertinent criteria when making a decision. In this research design with divergent areas of expertise, there is no particular set of overarching criteria for every type of decision. Thus, substantive criteria are of less importance. However, it is important to conduct expert interviews to get insights into banks and understand regulators or other relevant stakeholders in the financial sector on decision-making.

Furthermore, various financial activities should be compared, determining if BAIT does or does not complement the activity. The expert interviews shed light on the internal decision processes of banks and the recurring issues that are most pressing. The literature study forms the theoretical foundation of the research, with institutional analysis and the dissection of the financial sector as a separate focus of the research. The case study tries to imagine the effect of BAIT being implemented in the decision processes of banks, reviewing whether it potentially has added value.

1.4 Knowledge required for the research

In this sub-section, the research questions are presented. The research questions are a means of gathering new information that reveals the knowledge required to achieve the study's research goals. This all leads to the following research questions:

"What is the added value of BAIT in an organisation in the banking sector under the current circumstances of the institutional environment?"

This main question is supported by several sub-questions:

"What financial activities in the banking sector are suitable for BAIT to add explicit value?"

"What opportunities and hurdles are present fitting BAIT in organisations in the banking sector?"

"What characteristics of the institutional environment affect the implementation of technologies in the banking sector?"

"How could the BAIT tool impact the internal business processes in banks?"

The first research sub-question is on establishing which financial activities could be enhanced by BAIT and why. The possibilities in the banking sector are widespread, as are the various activities that can be performed with different criteria, variables and requirements, but all by different analysts and decision-makers. A clear understanding of the sector and BAIT is required to provide insights into the issues and activities in the banking sector. If Councyl's technology could resolve the problems should be the outcome. Desk research and expert interviews are conducted to gather knowledge for this question.

The second sub-question focuses on the current barriers and opportunities in the banking sector, and the underlying reasons for them. The utilisation of BAIT would be a new technology that needs to fit the banking sector, thus requiring a thorough analysis of its feasibility. This question is answered by analysing the current practice of the banking sector, what inherent problems are present and what BAIT could offer to banks exploiting opportunities or avoiding barriers. Extensive desk research and expert interviews are conducted to obtain the information needed on this topic. Experts have to share their thoughts on the current situation in the banking sector to determine the possible implementation of BAIT.

The third sub-question builds on the framework of the institutional environment by Williamson. The banking sector is divided into four layers on which technologies might have a distinctive influence, and Ostrom's ideologies are taken as a first point of analysis for the interrelations between present stakeholders in the sector. The institutional characteristics observed in the literature review are established and evaluated on their advantages and disadvantages for BAIT. An integrative framework will determine the impact of BAIT on several institutional layers. The information for this question is obtained through the literature study, as well as thorough desk research.

The final research question closely relates to the second in terms of the inquired information and to the third in means of analysis. It is important to understand the transformation process for banks that include BAIT. This question is determining the potential outcomes of the enactment of BAIT on an institutional, organisational and process level. With expert interviews, a description of decision processes is given, and a critical reflection on BAIT will show the most suitable application. It is supported by an integrative framework of both Cillo and Verona and Haggerty and Golden's frameworks on the strategic organisation of innovation and technologies changing institutional processes in organisations respectively. Literature study and desk research are the foundation of knowledge.

1.5 Thesis Alignment with CoSEM program

The study is relevant for Complex Systems Engineering and Management (CoSEM), as it provides a market research study for a new technology that could help many financial institutions in decision-making. The proposed solution would support complex repetitive decisions that are time-consuming and still require human interaction to handle. The model is a nuanced version of regular AI algorithms that often show little transparency in its decision-making due to the vastness of data, whilst in some cases, transparency is of the utmost importance. For example, the role of banks as gatekeepers for detecting fraud could be progressed, but also their corporate social role in sustainable investing could improve if decision-makers become more thoughtful in decision-making.

The alignment with the Complex Systems Engineering and Management program of the proposed study is the socio-technical framework that is devised to try and fit an AI solution in the system. A comprehensive analytical study is performed on the banking sector by conducting desk research, augmented by expert interviews and a literature review. It involves many factors such as stakeholder dynamics, actor situations, relevant institutions, organisational structures, behavioural theories, and decision processes. The curriculum of CoSEM has taught the previously mentioned concepts, including the design of technological interventions in organisations about socio-technical complex issues including many public/ private stakeholders. The institutional frameworks that are used, complemented by a theoretical dissection of a behavioural model will create the setting of this study. The value of BAIT in the banking sector exhibits if it could penetrate the market. Complex Systems Engineering and Management highlights a scientific approach to complex multidisciplinary solutions to ditto problems.

1.6 Structure of the thesis

The thesis outline is as follows. In Section 2, a systematic literature review is delineated in relevant areas for the study. The literature review will consist of multiple theoretical subjects since different disciplines are mixed as one. The research approach and the methodological steps taken to answer the main and sub-research questions are presented in Section 3. It is devised to show how the information is attained in pursuing the research goals. Section 4 is devoted to clarifying the BAIT model itself, how choice experiments support the methodology and how a BAIT choice model is set up. In Section 5, activities in the banking sector are introduced, outlining current issues and the potential market for Councyl. In Section 6, the institutional environment of the Dutch banking sector is demarcated and explained how the BAIT tool fits this environment with a case study. An integrative framework is devised to show the hypothetical impact of BAIT on organisational structures, accompanied by a hypothetical exemplar case study. In Section 7, the results are stated and important realisations are discussed. Section 8 is the final section, in which conclusions are drawn, and theoretical & policy implications are elaborated on, consequently conveying the final recommendations for Councyl, rounded off with limitations of the thesis and prospective future research.

2 Reviewing existing literature

In this section, a broad systematic critical literature review is performed, in which four disciplines are researched relevant to this study. Furthermore, the justification for these research topics is given, along with the link to this study. To display the systematic literature review process, the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) method is applied to some extent, using several recommended inclusion and exclusion criteria (Page et al., 2021). A wide construct of search terms and concepts is introduced, which are delineated in Appendix A. In Figure 2.1, the PRISMA diagram of selecting literature is portrayed.

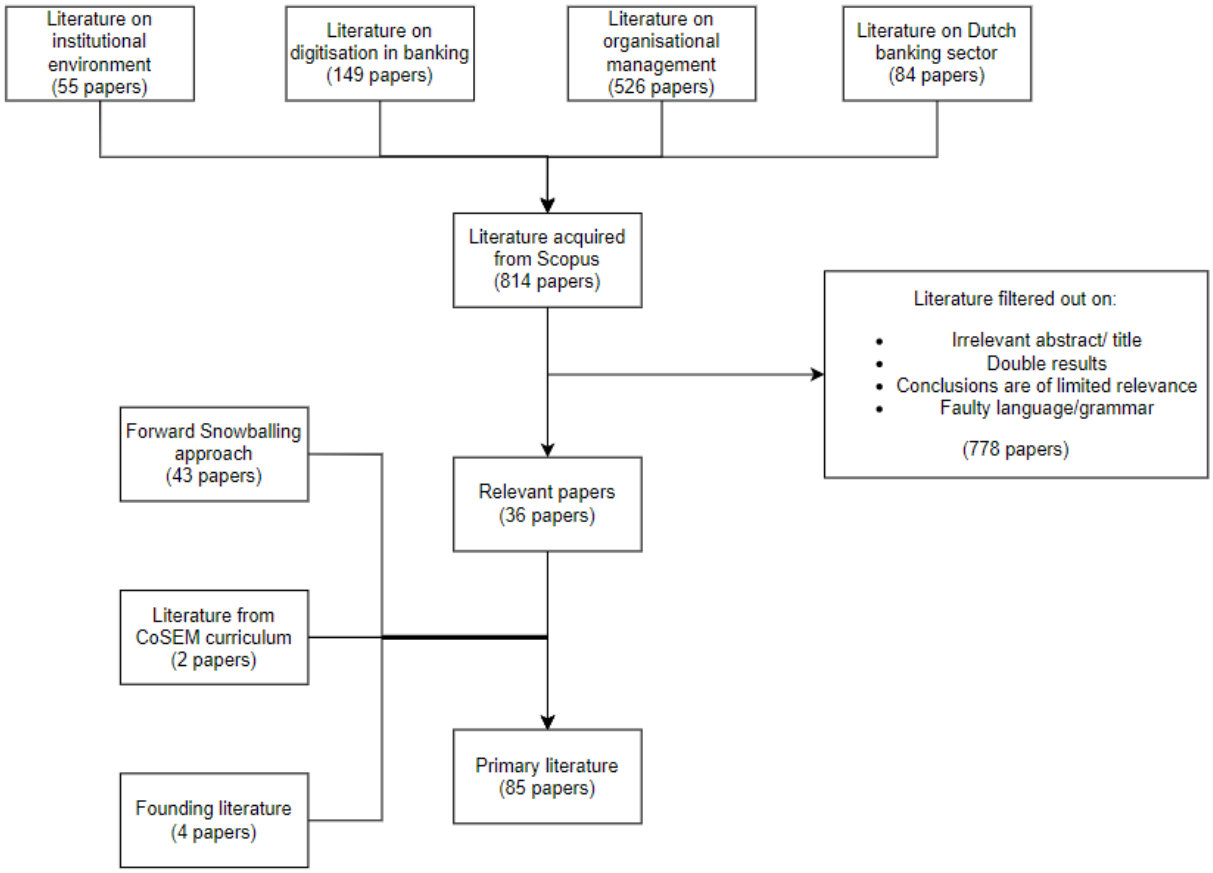

Figure 2.1: PRISMA diagram of literature selection

The literature study focuses on the institutional environment, the evolution of the banking sector, and how technology suits and changes this particular context. The institutional environment is dissected centred around the framework based on the theory of New Institutional Economics by Williamson adopting insights of Ostrom. Furthermore, the institutional characteristics of the banking sector playing a part are proclaimed. Additionally, digitisation in the financial sector is reviewed, in addition to the adoption of innovations being examined within organisations, including the impact they have on organisational structures with Haggerty and Golden, 2002 and Cillo and Verona's frameworks. Finally, the four parts of the literature review are synthesised and a knowledge gap is identified.

2.1 Literature on the institutional environment

In this section, a literature review of the general structure of the institutional environment is performed. The theoretical background for institutional analysis is based on Ostrom's and Williamson's ideologies. To understand the institutional environment, it is important to first gain an understanding of what an institution is. A widely accepted definition of institutions by Hodgson (2006): *"systems of established and prevalent social rules that structure interaction"*. In other words, the interaction and interdependence between actors are organised by a set of regulations, norms, and values, governed by a system of organisations. Institutions play a big part in the institutional environment, which Ostrom (2010), explains as an action arena in which human diversity can be understood.

This environment can be analysed with the Institutional Analysis and Development (IAD) framework shown in Figure 2.2, intended to contain a general set of factors that analysts can use to decompose systems of interest in multiple separate variables that interact such as human interactions with governments, regulations, markets, firms, and communities (Ostrom, 2010). In the action arena, the action situation is affected by certain external variables that impact the outcome and generate patterns for participants (Ostrom, 2010). There are three variables influencing the action situation: Biophysical conditions, Attributes of community, and Rules-in-use.

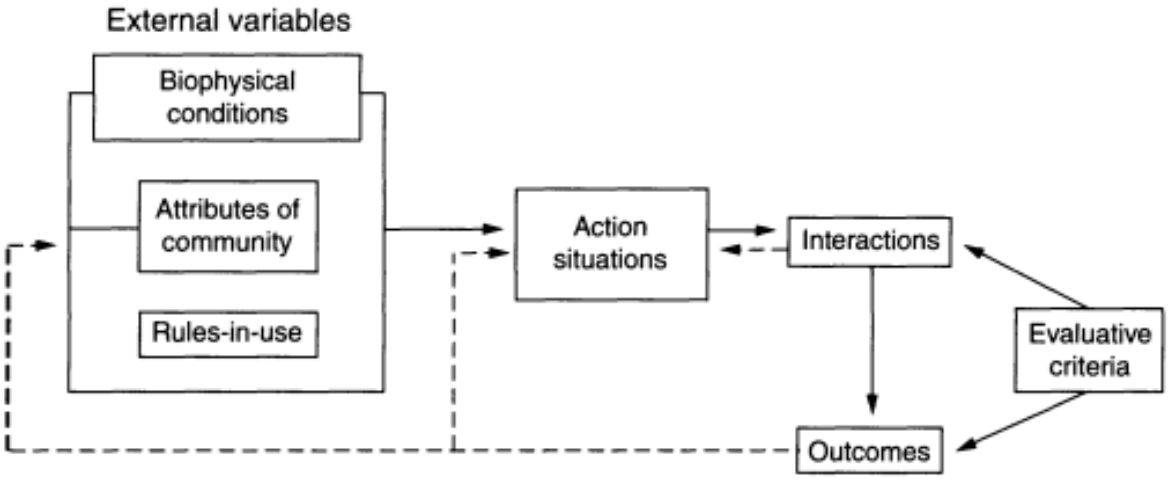

Figure 2.2: A framework for institutional analysis, adapted from Ostrom (2010)

The **Biophysical conditions** may be simplified as one of the four types of goods as defined by Ostrom (2010). Goods and services can be categorised in a combination of high or low *subtractability of use* and high or low *difficulty of excluding potential beneficiaries*; meaning if there are many substitutes provided or not, and implying if it is possible to omit an individual of a certain service or good respectively. The **Attributes of community** consist of the customs currently in place and viewed as common knowledge. **Rules-in-use** is specified as the rules and regulations wielded when sanctioning possible actions that harm society.

These three external factors influence the action situation, which delineates the set of actions any stakeholder can take within the bounds of the community. There is a recurring feedback loop with the environment, where the outcomes affect the action situation and the external variables. The action situation however also consists of an internal structure, where different positions and stakeholders have an impact on the outcomes depicted in Figure 2.3 (Ostrom, 2005).

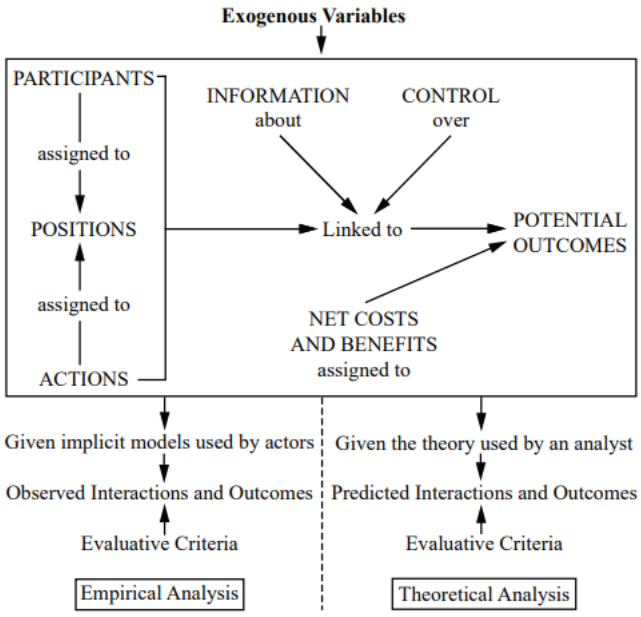

Figure 2.3: The internal structure of an action situation, adapted from Ostrom (2005)

Ostrom (2005) poses the action situation as a central point of analysis. There are factors that create the setting in which stakeholders can operate, others impact potential outcomes, summed up here:

- The set of participants
- The positions to be filled by participants
- The potential outcomes
- The set of allowable actions for those outcomes
- The control a stakeholder has over his function
- The information available to all participants
- The costs and benefits that occur with certain actions

These variables guide the interrelations between exogenous factors as well as the possible set of actions of actors in the environment. The participants, positions, and possible set of actions thereafter rely on the external variables as described by Ostrom (2010). Williamson (2000) has a different yet complementing approach to Ostroms' theories, dividing the economics of institutions into four levels of social analysis, as shown in Figure 2.4. In different layers of Williamsons' framework, different agreements, transactions, and operations are organised. How the banking sector relates to this framework is elaborated on in Section 6.1.

The first level (L1) describes the embeddedness of the informal behaviour of people within society. It comprises all institutions, customs, norms, values, and other informal traditions that have developed over a long period, such as religion. The customs rising in a system are spontaneous but display inertia in changing (Williamson, 2000). Level 1 is pertinently influencing society as a whole, as human behaviour is inherently present in all formalities. This layer interrelates to the attributes of community and biophysical conditions as defined by Ostrom.

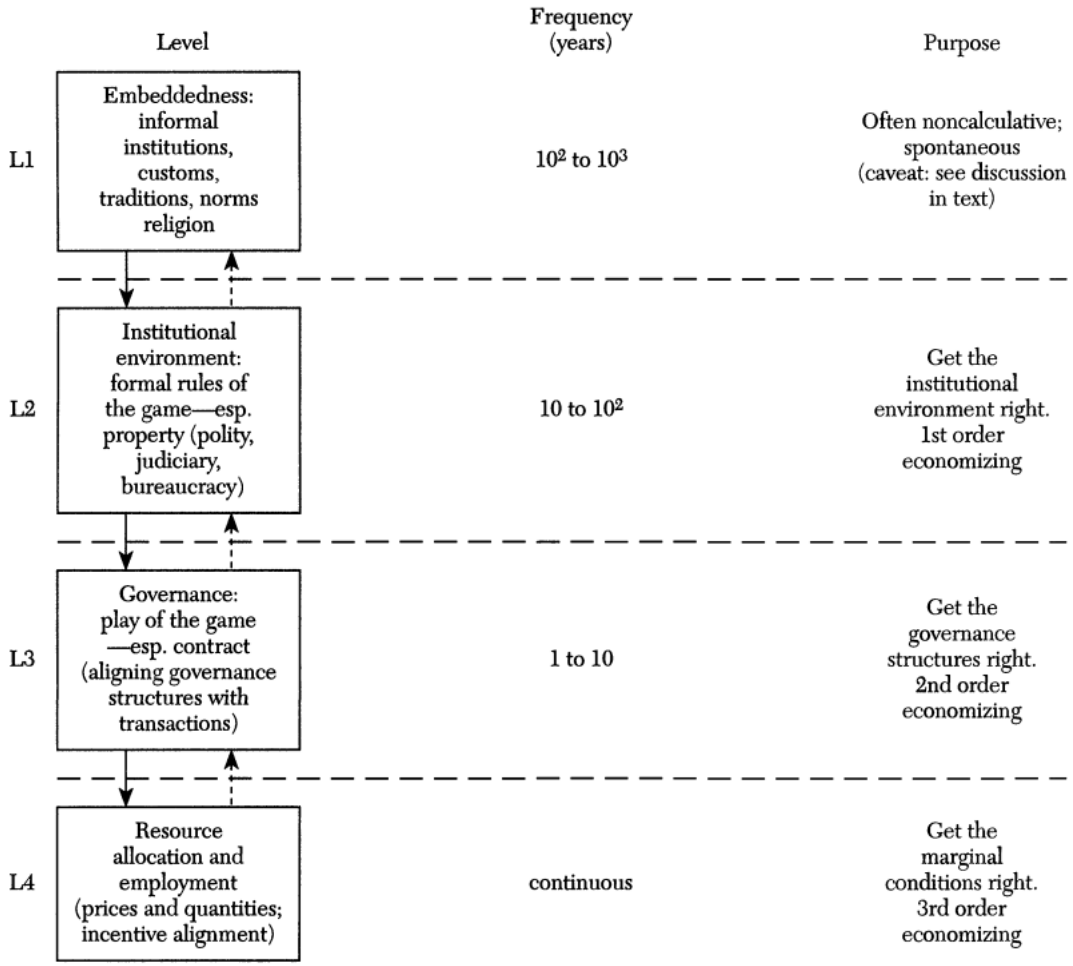

Figure 2.4: Framework on the Economics of Institutions, adapted from Williamson (2000)

The second level (L2) envelops the institutional environment, which deals with formal rules and regulations specifically regarding property rights. The legislation is established and regulated by various governmental bodies, divided into enforcing and regulatory organisations. They divide powers within the system, and Williamson (2000) argues that due to rigid governmental structures, changes are hard to push through the system. It often necessitates extreme events such as a pandemic, to cause a switch in regulations. The layer mostly overlaps with the rules-in-use defined by Ostrom.

The third level (L3) is called "the play of the game" as it resembles the playing field on which actors operate. It can be rephrased as the physical contracts and transactions of any kind that induce interaction between different organisations. It is naturally a more structured discipline that changes more often. The governance of organisations reflects the action situations of different stakeholders that Ostrom has defined.

The fourth and final level (L4) is a continuously changing environment of exchanges between employees and employers. The demand and supply alter product prices, quantities and other services. A firm can organise its allocation of resources on a daily basis. This leads to potential outcomes of the action situation described by Ostrom. The upper layers steer the layers below to certain outcomes, however, the organisation of lower layers can also affect the mindset to change the upper-level arrangements.

2.2 Literature on the institutional banking environment

In this sub-section, the historical progression of the banking sector and what aspects of the sector are serving economic growth are explored. Banks are widely regarded as one of the most essential financial institutions of the economy (Larionova et al., 2018). They used to be much more protected by regulatory barriers in the 1960s (Keeley, 1990). Developments in financial structures have varying advantages such as reduced corruption, efficient resource allocation, economic growth, and subsequently stimulating advancements in the banking sector as a whole (Ting, 2017). Keeley (1990) claimed the decline of barriers in the 1990s induced more competition, which caused banks to act less prudently concerning risk-taking, negatively affecting cost-efficiency (Yin, 2021). Following the Economic Crisis of 2008, the financial structures needed reorganisation and shifted to a more decentralised culture, which induces robustness (Alexander, 2015; Peltonen et al., 2015). The Crisis was caused by several parallel drivers such as innovations, low inflation, technological progress, and financial deregulation (Avgouleas, 2012; Podrugina and Tabakh, 2020; Milic, 2021). Focus shifts from individual banks' risks to the overall contribution of risk to the system, creating sensible regulations on a system-wide level (Anginer et al., 2018).

Thoughtful arrangements on supervision, institutions, and regulations are primary conditions for economic growth, and are severely intertwined (Fernández et al., 2010). Four key facets of the institutional environment have been identified that impact growth: **Banking regulation**, **Globalisation**, **Country governance**, and **Financial reform** (Lee et al., 2020). **Banking regulation** influences accessibility to external financials, valuations, and general financial advancement (Demirgüç-Kunt et al., 2004). Regulations are integrating markets, protecting participants, creating robustness, and maintaining financial stability (Delis et al., 2011; Andenas and Chiu, 2014). Financial stability is defined by The World Bank (n.d.): *"A stable financial system is capable of efficiently allocating resources, assessing and managing financial risks, maintaining employment levels close to the economy's natural rate, and eliminating relative price movements of real or financial assets that will affect monetary stability or employment levels."*

Banking regulations are also known to define the level of a bank's profitability (Dudchenko et al., 2020; Teixeira et al., 2020). Agoraki et al. (2011) state that banks are taking fewer risks under strict supervision and private monitoring. Increasing law and order is decreasing the cost-efficiency of banks, subsequently affecting performance (Lozano-Vivas and Pasiouras, 2010; Ben Naceur and Omran, 2011). Banks are supposed to have a positive influence on accelerating economic growth since they are better at identifying opportunities and risks (Levine, 1998). It is added that the impact of bank regulations on risk-taking is dependent on the governance structure of the bank as well (Laeven and Levine, 2009).

Globalisation had a huge impact on the growth of the financial market, also leading to market integration (Prakash, 2001). Moshirian (2000) found that globalisation is enhancing banking efficiencies in certain countries. The entry of foreign financial intermediaries primarily had an impact on the barriers between governments and led to better coordination of regulations (Ryan and Horsewood, 2011). Globally integrated markets necessitate good governance on sanctions, supervision, and resolution of disputes (Prakash, 2001). The coordination between countries also induces the cross-country information costs to be degraded (Brei and von Peter, 2018).

The presence of good **Country governance** has always been vital in the financial world due to the nature of the sector. Stronger country governance is positively affecting the employment of new and improved practices (Lee et al., 2020). Kayalvizhi and Thenmozhi (2018) found that country governance negatively interacts with the cultural dimension of individuality, indicating people/ companies are set off against governments with bad policies. Very strict regulations can limit the efficiencies that banks can achieve, as well as trust in the government's capabilities (Kayalvizhi and Thenmozhi, 2018). Governance should be evaluated on the effectiveness of policies, activity-restrictive regulations, and the ability of information sharing. These underline the importance of supervision and monitoring, providing insights into the fragility of the sector and banks' behaviour (Beck et al., 2016; H. Yin, 2019).

Developments in country governance led to a reform of cooperative banks, with special attention to tightening banking regulations (Groeneveld et al., 2018). **Financial reforms** are institutional changes to the organisational structure of banks (Lee et al., 2020). Financial reform is facilitating the availability of resources, and developing new technologies that result in fewer constraints in the financial system (Ang, 2014). Banks became more privatised and merged with others to lead to a wave of change in governance structure (Khan et al., 2017). The governance structure is explained as processes, organisational structures, and procedures that lead to decision-making (de Graaf and Herkströter, 2007). Normative judgements are receiving interest in the governance structure, and influence crucial communication processes within banks (Purnell and Freeman, 2012; de Graaf, 2018). Reforms have caused banks to refocus their business, and diversify financial activities by for example exploiting large data sets to offer personalised services/ products (Mullineux, 2011).

2.3 Literature on digital transformation in the banking environment

Before discussing innovations in banking, some disparities in terminology need to be dissuaded. Literature makes a distinction between *digitisation* (transposing something analogue into something digital), *digitalisation* (using digital technologies and data to your advantage, inherently changing processes), and *digital transformation* (integrating a technical digital solution throughout all aspects of an organisation, leading to institutional changes of processes and capabilities), as shown in Figure 2.5 (Saarikko et al., 2020; Kraus et al., 2022). Digitalisation/ digital transformation are of interest in this study.

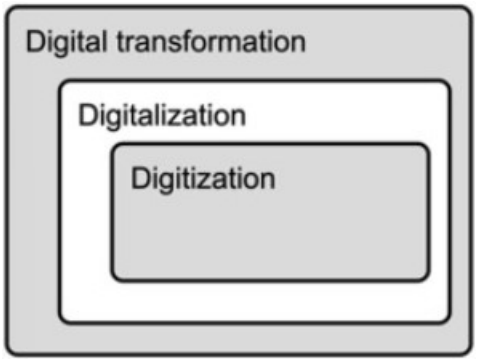

Figure 2.5: Relationship between three definitions of digital innovation, adapted from Saarikko et al. (2020)

Digital transformation has four key dimensions shown in Figure 2.6: *Use of technology*, *changes in value creation*, *structural changes*, and *financial aspects* (Matt et al., 2015). The *use of technology* concerns the ability of a company to exploit new disruptive technologies, by either developing the technology further or integrating it effectively in business operations. *Changes in value creation* are a result of the use of technology since innovative techniques influence value chains and provide new opportunities to enhance services. Mutations in value creation are leading to *structural changes* in a business, as the company needs to organise the new setup of internal processes. But in the end, the *financial aspects* should be explored before any of the three dimensions could be shaped (Matt et al., 2015).

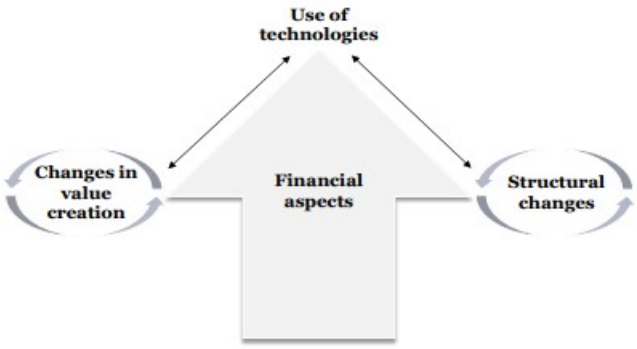

Figure 2.6: Four dimensions of digital transformation, adapted from Matt et al. (2015)

On an individual banking level, **financial innovation** is identified as one of the most important factors to improve added value and diversifying services (Bos and Kool, 2006; Beck et al., 2016). Economic growth is seen as a determinant of innovation and vice versa (Beck et al., 2016; Pradhan et al., 2016). Financial innovation is defined by Arthur (2017a): *"a process carried out by any institution that involves the creation, promotion, and adoption (including both incremental and radical) of new products, platforms, processes or enabling technologies that introduce new ways or changes to the way a financial activity is carried out."*. A downside of financial innovation is it threatens financial stability (Hu, 2015). Consequently, good governance and prudential regulation are required to let financial innovations flourish (Delimatsis, 2012; Arthur, 2017b).

Financial Technology (FinTech) companies are an upcoming trend, offering financial services integrated with technology more profitably through a digital format (Saksonova and Kuzmina-Merlino, 2017). In the banking sector, financial activities could be organised more efficiently through the use of AI (Bredt, 2019; Fritz-Morgenthal et al., 2022). The adoption of scalable AI is considered a challenge in many different disciplines, each having characteristic opportunities, barriers and perspectives, requiring specific expertise (Ali, 2020; Dwivedi et al., 2021; Sanz and Zhu, 2021). Truby et al. (2020) mentions especially the efficiency in detecting financial crimes could be greatly enhanced through the use of AI as it filters anomalies more effectively and accurately. AI could also help in better understanding and engaging with customers' needs and preferences regarding financial services (van Esch and Black, 2021).

However, consumer trust is very important for the successful application of an AI tool in many sectors, including banking (Northey et al., 2022). Banks are unsure about the engagement between AI and clients, making them less inclined to invest in further development of AI or Machine Learning (ML) techniques. Dehnert and Schumann (2022) moreover argue that traditional banks are preferred over customer advisors by more trusting people, indicating no tendency to rely on AI-based solutions. Some behavioural innovations appear in the field of finance and have potential in the foreseeable future (Dwivedi et al., 2021).

2.4 Literature on organisational processes

Organisational theories have stemmed back to the 1930s when Coase already uncovered the dynamics between organisations and markets (Coase, 1937). In time, organisations are changing due to many different drivers, such as external developments in business circumstances and technological advancement (Howard, 2023). Digital transformation entails the impact IT has on organisational structures, which fundamentally changes operational processes and capabilities (Hanelt et al., 2021). In addition, digital transformation creates opportunities for entering new or existing markets due to the new information-based technology (Li et al., 2017; Kraus et al., 2022). How organisations are institutionally changing is linked through corporate governance and the organisational architecture of the new technology (Aoki and Jackson, 2008).

Technologies cause 3 types of infrastructural changes: *strategic shift* changing the way you think and continuously adapt to developments; *technological shift* causing radical reinventions of business processes; and *organisational shift* moving towards new institutional changes in management practices, norms, culture, and structure (Zighan, 2022). Business processes are affected by external factors, in addition to IT, top-level management, organisational structure, and internal workforce (Kettinger et al., 1997). Haggerty and Golden (2002) developed a framework to show how technology triggers change, depicted in Figure 2.7.

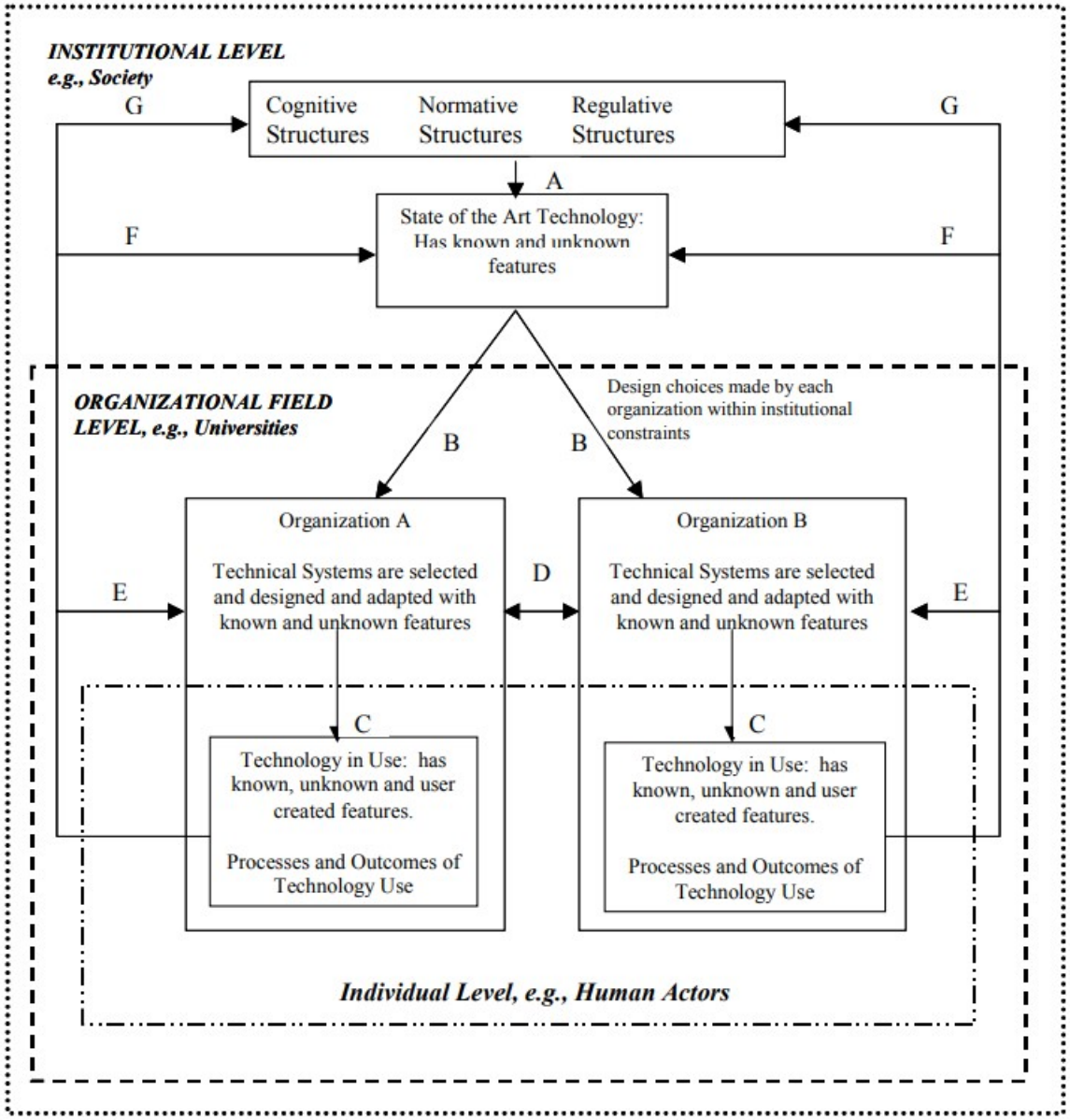

Figure 2.7: Framework technology causing institutional change, adapted from Haggerty and Golden (2002)

First, institutions impose constraints on the cognitive, normative and regulative structures, meaning what regulatory sanctions are present, funded, and condoned by the public (A). Next, the new technology becomes part of the system design of the organisation through decision-making processes (B). The technical systems are then institutionalised in the organisation by users, leading to different processes and outcomes (C). External views affect the internal construction and use of the technology since it is utilised for diverging activities (D). Over time, this technology becomes standard practice for users, organisations and society, meaning the initial structures are converting towards institutionalised technical systems, changing upper-level institutions (E,F,G).

The ideas of Haggerty and Golden are supplemented by Cillo and Verona (2022), who claim that it is crucial companies see innovation as part of the larger organisational strategic process, not solely as an R&D function. They developed a framework on strategic organisation depicted in Figure 2.8.

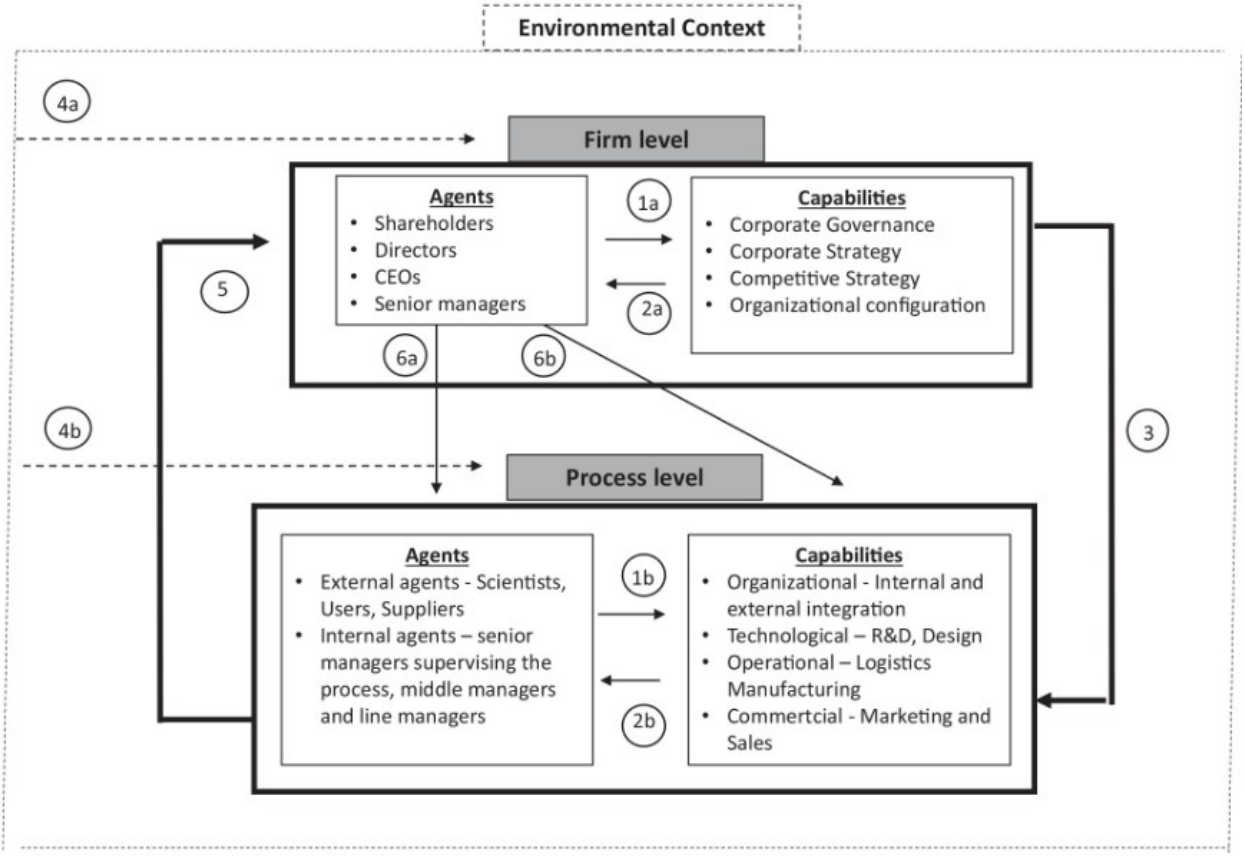

Figure 2.8: Framework strategic organisation for innovation research, adapted from Cillo and Verona (2022)

In Figure 2.8, (1) denotes decision-making, (2) shows feedback loops, (3) entails the structuring of the innovation, (4) means the trajectories of technology, (5) reflects the adaptation power, and (6) is structuring the exploration phase. Two core constructs in this framework are the **agents** that represent all stakeholders whose expertise can thrust innovation and the **capabilities** that refer to systems, values, and activities that are the foundation of organisational knowledge (Cillo and Verona, 2022).

Innovation will be conditioned based on the implementation process (Goodman and Griffith, 1991). Eight success factors are established by Davis (2017) on incremental changes in organisational processes due to technological progress:

1. Define overall strategy, objectives and audience focus beforehand.
2. Establish which metrics will determine the added value of the innovation.
3. Involve the end-users throughout the entire process.
4. Before developing the model understand the actual working environment of the end-users.
5. Implementation and development phases are to be performed in parallel.
6. Insert some sort of feedback tool with both the engineers and the end-users.
7. Understand how interdependent IT applications are affected and ensure awareness among the IT staff.
8. Pre-determine exit strategies to abolish the project.

New technologies do not always succeed in practice, organisational change failure being defined: *"an organisation's deviation from goals and outcomes that are expected and desired from organisational change."* (Schwarz et al., 2021). Three processes are posited by De Keyser et al. (2019) if a failure occurs: *Retentive* processes develop in agents keeping tunnel vision on a certain solution, losing touch with the initial approach causing tensions, and refuting the option of failure. The *reactive* process results in indicators of failure being shown in the outcomes, which also causes tensions to erupt, and agents to react with an opposing approach. At last, the *recursive* process means recollecting success factors from previous failures to inspire and to reflect on failures by making sensible revitalised considerations. Iterative and thoughtful steps need to be undertaken to properly implement any digital innovation.

2.5 Synthesising literature

Finally, this section integrates the four separate literature reviews into one coherent story. The goal is to delineate what literature has described on the four disciplines and what it implicates for BAIT. The knowledge gaps as revealed by the literature review are denoted and the research questions in Section 1.4 trail these revelations.

Williamsons' (2000) institutional design concerns four separate layers of social structures with varying changeability and purposes. Ostrom's (2010) Institutional Analysis and Development framework provides a measure to analyse the action set of actors which result in well-organised outcomes. Organising the banking sector is complex, yet critical to maintaining welfare and prosperity.

Four characteristics of the institutional environment are instrumental conditions for economic growth. Banking regulations affect a bank's optimism to take risks that allow it to become more efficient, affecting financial stability. Globalisation is the current trend that impacts efficiency, cooperation and cross-country interventions. Country governance limits or facilitates the banks in their activities, just like regulations. Financial reform is permitting banks to reorganise and diversify their activities according to the surroundings and measures to their disposition.

Digital transformation or innovation can be achieved if a company is financially responsible, and if it focuses on digital technology being the centre of changes in value creation and organisational structures. Financial innovation can diversify activities and rebuild business processes. AI is seen as a promising technique to enhance efficiencies and analyse data to support decision-makers and personalise services. Financial innovation is therefore identified as a fifth condition for economic growth, but there remains discord if AI is to be trusted, or how to implement such technologies.

Haggerty and Golden's (2002) framework denotes societal structures are shaping the implementation of technology, being integrated into the company and causing daily operators to alter their decision-making, strongly related to corporate governance and strategic organisation. Organisational structures are shifting as a consequence, being moulded by internal agents and capabilities as denoted by Cillo and Verona's (2022) framework. Continuously and incrementally developing business processes are conditioned on involving end-users and IT personnel throughout the entire process, to get feedback on outcomes, experiences and understanding of the staff for the technology.

Since there is no literature on the implementation of decision-support systems in banking, there remains a huge knowledge gap. Although ten Broeke et al. (2021) shows the application of BAIT in the medical sector, it remains unclear what the potential benefits are in the financial sector and at what stage in the decision process BAIT would be functioning best. Information needs to be disclosed by banking employees on the crucial issues and lack of properly implemented solutions. The institutional layers could be dissected to try and identify the additional value BAIT could produce if applied in Dutch banks, or establish if it is a feasible tool at all. How to integrate BAIT in financial institutions and seeing the effect of implementation on organisational processes and institutional structures of the system is of interest within this study, and remains unprecedented in literature.

3 Research approach & methodology

In this section, the research approach is delineated combined with the methodology of gathering information for the study. First, the method of collecting data is described, in which the use of desk research, expert interviews, and a case study is outlined. Furthermore, the acquired information is handled properly regarding the protection and processing of the data. A review of qualitative research is given in Appendix C, to discourse on the validity and reliability of this thesis' methodology.

3.1 How data is collected

The collection of data is elaborated on in this sub-section, which divides itself into three parts: desk research, expert interviews, and a case study to some extent. Desk research is required in almost any study to create the foundation of the problem formulation. Expert interviews first consider how and why the current issues in the financial sector exist, and second if Behavioural Artificial Intelligence Technology (BAIT) poses a solution. The case study would help in practically applying the acquired knowledge on whether BAIT could impact decision processes.

3.1.1 Research from behind a desk

Desk research is seen as an advantageous part of conducting market research. It combines the initial primary research of new data on the topic, and secondary research meaning the evaluation of the acquired information (Advantage Market Intelligence, 2019). The desk research of this thesis primarily consists of studying literature and google web searching to picture the banking sector. Web searches emphasise country-specific news items, context and deeper structures of the Dutch banking sector. The literature review concerns itself with the theoretical and scientific background of the study.

3.1.2 Conducting expert interviews

Expert interviews are used in this thesis to obtain practical insights into the banking sector. Expert interviews are regarded as an effective method to explore/ collect data about particular areas of expertise (Döringer, 2021). Qualitative interviews highlight certain individuals' perspectives and implore their experiences to create a better view of reality, and expert opinions are used to evaluate the quality of best practices (Studdert et al., 2002). Knowledge from the expert interviews is reflecting the "data" used for this study.

In total, 423 people from 16 different banks, regulators or other financial organisations have been outreached, resulting in 37 interviews with 39 experts. Experts are contacted through the means of e-mails, calls, or via LinkedIn using web searches on different relevant job descriptions. Almost no inclusion criteria were wielded, except for working at a bank. Experts ranging from junior analysts to heads of a department with varying expertise and functions have been interviewed. Each person that is contacted is registered in an Excel file, which keeps tabs on their name, job (function), bank/instance working at, contact details (if relevant), date of outreach, who answered, who wants to follow up, and if so, in what way and when the interview occurs.

Subjects for the expert interviews that are conducted for this research are twofold. First, experts are inquired about the underlying issues, experiences and views on the current state of the banking sector. Second, extracting information on the feasibility of BAIT in their professional opinion is the focal point. The standard questions of the interview format inquired to each participant are listed below:

Introduction

- First few minutes of small talk, introductions of persona, thank the participant for their time.
- Explain the contents of the study, the goals of the study, and what Councyl offers in general
- Explain the risks of sharing information and assure anonymous processing of data.

General questions

- What is your job title?
- What is your job/ function within the company specifically?
- What type of problems/ tasks are occurring within a bank/ your function in general?
- How are these problems not yet resolved? / How are you working on solving these problems? / What is the underlying reason for this problem to your understanding?
- If you have tried to solve it, why has it not worked until now?/ Where are the shortcomings of this solution?
- What type of rules and regulations are relevant in this issue?
- How do the internal decision processes look like?
- What happens with an intervention in the decision-making processes/ How does an intervention or innovation change business processes?

Closure

- Thank them yet again for their time.
- Ask if they want the informed consent document or if they give vocal/ written permission to use information in the thesis. If so, send a transcription of the respective interview.
- Ask if they possibly are available/ interested in another session if necessary, or if they have any contacts in the banking sector that they recommend contacting.
- Give feedback and contact details for further questions; e-mail: g.deronde@student.tudelft.nl

Complementary, more specific responses are added in Appendix F, which are tweaked to the function/ division of the interviewee. During the interview, follow-up questions are raised based on the experts' responses, which are not included in the standard format but are taken into account when assimilating the study. The most important takes are woven through the report itself in Sections 5-8, often indicated with quotation marks and in italics. These are not direct quotes, but transcribed information that cannot be traced back to an individual.

3.1.3 What does the case study entail?

Conducting an exploratory case study will be necessary to provide a tangible example of the organisational change that could be incurred by BAIT. A case study is often recognized as a suitable means to understand complex social issues (Yin, 1994). Yin (1994) continued with four functions of case studies: to explain real-life complex links, sketch the context of an intervention, describe the intervention itself, and explore situations with no clear outcomes. The case study is an exemplary exploratory case study tapping into all four applications concerning BAIT (Tellis, 1997). Section 6.3 shows what a practical implementation of a technology induces to reveal the potential impact on internal decision processes.

3.2 Measures on data processing & protection

In this subsection, the measures taken to privately process and protect the personal and sensitive information gathered in the interviews are described. The TU Delft encourage students who research human subjects to provide a list of actions to show to a reasonable extent the interviewees' data is protected throughout the study. Participants of the study are presented with an informed consent document approved by the Human Resource Ethics Committee before starting interviews, which is portrayed in Appendix G. A succinct summary of this document, together with the submitted Data Processing Agreement is described in the following:

The harvest of data will be in personal interviews with the main researcher, in the form of a phone call, online meetings on Zoom/ Microsoft Teams or a physical meeting. If audio recordings are made, these are disposed of one month after graduating. Primarily, the opinions of experts on financial activities and BAIT is collected. However, irrelevant personal information necessary for contact is known to the researcher. This information will not be spread, and substantive information is processed anonymously in transcription. If sensitive or controversial information is relinquished, it cannot be linked back to the person or organisation that originates the statements or can also be retracted from the interview. The results from the interviews are documented on the personal TU Delft One Drive, no one has access to this drive except for the lead researcher. By storing the information safely on an encrypted One Drive, risks of accidentally leaking personal information are minimised. The information is initially only shared with TU Delft supervisors and an external supervisor of Councyl to provide essential feedback, but the thesis will be published online in the TU Delft repository.

3.3 Summarising the methodology

The most important takes are given in bullet points that describe the methodology of this study, and the essential points of this section:

- Desk research on specifics in the Dutch banking sector. Is necessary to create a basic understanding of the Dutch banking sector, current trends and developments and concepts.
- A literature review is performed to delineate the theories and ideas in literature on the institutional environment, digital transformation, and organisational change inspired by technology. All literature preferably about the banking sector.
- 37 Expert interviews have been conducted with 39 experts to gain more substantive insight into daily activities in the banking sector first-hand. Experts share personal experiences, professional opinions and other empirical information to discover the most potential for BAIT. The information gathered is reviewed, transcribed once approved and intertwined through the text with quotation marks and in italics.
- The method for conducting expert interviews is reaching out to anyone in the most interesting departments for this study, ranging from analysts to board members. The only requirement is working at a bank, and contact is made through LinkedIn, the internet or personal relations.
- The expert interviews are transcribed, anonymised and checked by interviewees before being incorporated into this study's findings.
- The use of a hypothetical, exemplary case study is outlined to discuss tangible functions of BAIT.
- All information is processed according to the TU Delft guidelines on data processing & data protection of interviewees, approved beforehand by the Human Research Ethics Committee.

4 BAIT's methodology

In this section, the Behavioural Artificial Intelligence Technology (BAIT) methodology is delineated, and the explanation of the Multinomial Logit (MNL) model extracted from BAIT is given. The model combined with an explanatory example will be discussed to demonstrate the potential model value. Additionally, the advantages of the method are given, and the setup for the BAIT choice model is described.

4.1 Explanation on BAITs' inherent model

In this subsection, the Multinomial Logit model is elaborated as included in the BAIT methodology. The model is explained at the hand of random utility theory and a tangible example, on which background information is delineated further in Appendix B.

McFadden (1973) first developed a model that is known as a logit model, with its simplest form the Random Utility Maximisation Multinomial Logit model. It is widely used to represent a rational human being in decision-making that evaluates a set of discrete alternatives based on their attribute characteristics (Manski, 1977; Hauber et al., 2016; Lee et al., 2018; Elfadaly and Garthwaite, 2020). The model's most important assumptions are that a rational human being chooses the alternative that has the highest utility, having homogeneous preferences in the population (McFadden, 1973). The equation that describes the systematic part of utility and the random component of utility used for the computation of a person's own utility U_{in} is shown in Formula 1 (C. G. Chorus, personal communication, February 16, 2023):

$$U_{in} = V_i + \varepsilon_{in} \tag{1}$$

with V_i denoting the observed utility, ε_{in} representing the unobserved utility, regarding n's utility of alternative i in the choice set (C. G. Chorus, personal communication, February 16, 2023). The unobserved utility denotes the error term that accounts for the perception of utility for each alternative by individuals. Simply put, it represents personal preferences that are not quantified. The observed utility depends on a parameter estimate β_m (weight) of each attribute and the actual value of an alternative, as shown in Formula 2:

$$V_i = \sum_m \beta_m * x_{im} \tag{2}$$

with x_{im} being a certain attribute value of the criterion in reality for alternative i, m being the attribute subscript. The outcome of Formula 2 represents the utility contribution of alternative i to the set of alternatives (del Castillo, 2016). The probability of an alternative getting chosen out of the set of alternatives would then be defined as Formula 3, with probabilities adding up to 100% (Train, 2003):

$$P(i) = \frac{e^{V_i}}{\sum_{j=1..J} e^{V_j}} \tag{3}$$

where j includes i in the choice set J. This equation is perceived as the actual representation of Multinomial Logit models, as it describes the probabilistic chance a consumer picks a certain alternative knowing different values for different attributes in a discrete set of alternatives (Train, 2003). In other words, utility is derived from inherent attributes of goods and by analysing the trade-offs of consumers when making choices, the relative choice probability of each alternative is revealed (Settumba et al., 2019). This model can be applied to many different fields due to its robustness (Anderson and Ubøe, 2012).

4.1.1 Practical example of the Multinomial Logit model

Consider an analyst has multiple clients to asses, and that the analyst is trying to decide whether a client is a fraud or not solely on the parameters of the sector risk, and geographic risk. Other than those, there are no differences between the clients in this example, and the utility for an analyst detecting fraudulent clients is assumed to be positive. Both these variables have a certain meaning for everyone in the population of analysts, and they all estimate the different alternative clients on the two parameters. The intrinsic average weight for the population is estimated at 2.0 for sector risk, and the geographic risk of clients is rated at 1.0, with the values referring to β_m for the different attributes in Formula 2. Other variables that might play a role but are not taken into account are captured in ε_{in} in Formula 1, disregarded for the computation of the choice probability. The actual value of a first client A for the sector risk lies at 2, and the geographic risk variable is found at -5.5 for this client, both representing x_{im} in Formula 2. For a second client B, the values are 1.5 and -1 respectively for the risks.

If you now calculate both systematic utilities V_i with Formula 2 for the first client you get $V_A = \beta_{sector} * x_{Asector} + \beta_{geo} * x_{Ageo} = 2.0 * 2 + 1.0 * -3.5 = 0.5$ and for the second client $V_B = \beta_{sector} * x_{Bsector} + \beta_{geo} * x_{Bgeo} = 2.0 * 1.5 + 1.0 * -1 = 2.0$. There is a threshold in this example set at 70%, reflecting 7/10 experts that asses the client as a fraud. The utility for the analyst of evaluating a client not being a fraud is set at 0, necessary since this is the only other alternative. The probability of an analyst evaluating the first client as fraud is computed with Formula 3 is $P(A) = e^{-0.5}/((e^{-0.5}) + (e^0) = 0.3775$, meaning an analyst evaluates the client with a probability of 37.75% as fraudulent, below the threshold. in the other case, the probability is $P(B) = e^{1.5}/((e^{1.5}) + (e^0) = 0.8808$, which means a rational analyst then chooses client B as a fraud, as it exceeds the threshold with 88.08%. In reality, more attributes and more alternatives with various values are a part of decision-making, quickly becoming more intricate. Therefore, it is paramount to create good choice experiments emulating actual choice situations.

4.2 Features of Stated Preference Choice experiments

BAIT's methodology inherently involves using Stated Preference (SP) choice experiments, on which some theoretical background is also provided in Appendix B. This sub-section discusses the advantages of Stated Preference choice experiments compared to Revealed Preference (RP) data.

A choice experiment can be defined as a set of choices between two or more alternatives, where a respondent is queried to decide the best option among the presented alternatives with varying attribute values (Großmann and Schwabe, 2015). Choice experiments are an appropriate means to derive information on hypothetical choices or preferences (Lancsar and Louviere, 2008). To recapture the example of an analyst assessing a fraud based on two criteria, a typical choice scenario in a choice experiment is depicted in Figure 4.1. Having multiple scenarios filled in by one analyst gives information on his or her choice behaviour.

Criteria	Client A values	Client B values
Sector risk	5	8
Geographic risk	5	2
Choice		✕

Figure 4.1: Example of a choice experiment scenario

The difference between Stated Preference choice experiments and Revealed Preference choice data is that choice models based on a Stated Preference style depend on hypothetical experiments to produce data on recurring observations of individuals' preferences (Holmes et al., 2017). Revealed Preference data is based on choices that historically have been made by a group or population. A strong point, therefore, is that Revealed Preference data reveals actual choices people have made (E. J. E. Molin, personal communication, February 16, 2023). Often, a large amount of Revealed Preference data is readily available, however, in new market segments often data does not yet exist (Louviere et al., 2010).

BAIT uses Stated Preference choice experiments to elicit the considerations of experts. Stated Preference choice experiments collect data based on experimental design and can include: non-existing alternatives, new attributes and attribute levels outside current value ranges (E. J. E. Molin, personal communication, February 16, 2023). Councyl uses Stated Preference choice experiments in BAIT because it provides solutions for all limitations of Revealed Preference data:

1. Hypothetical alternatives could be included.
2. Any combination of attribute levels, values and alternatives could be a choice option if desired.
3. All options are fully known to the researcher
4. Correlations among attributes can be avoided.
5. Respondents give multiple choices, thus a smaller sample group is required.

The main drawbacks of Stated Preference choice experiments are that the choices presented are hypothetical, so there is no way of knowing the outcomes for sure. This applies only in situations where ground truths are known. Furthermore, in Stated Preference choice experiments, consequences of peoples' choices are not felt, biases are still present, there is perfect information which is not realistic, and effects of new or improved alternatives are not experienced (Kjær, 2005; E. J. E. Molin, personal communication, February 16, 2023). Part of BAIT's function is to manifest different expert opinions to fully capture decision-making. It is thereby possible to generalise results to indicate what would be the outcome of real choices.

The BAIT tool has certain characteristics which are diverging from other similar AI/ Machine Learning models. First, the psychological aspect of knowing you are training an AI model or making a difference, which is urging experts to make more considerate and deliberate decisions (Carson and Groves, 2007). People find it difficult to make their considerations explicit once asked directly, but in choice experiments, their implicit knowledge appears (C. G. Chorus, personal communication, November 10, 2020). Second, complications of using historical data are avoided, and also edge cases that are hard to distinguish are included in the experiments. An additional perk of no historical data is a low threshold for building the model, which can be realised in a matter of days.

4.3 How to come up with the BAIT model

In this sub-section, the approach of creating a BAIT choice model is delineated. BAIT is a relatively new technology in predicting complex repetitive decisions using implicit expert knowledge (ten Broeke et al., 2021). Decision-support systems, like BAIT, are mainly trusting in understanding how choices are made, its goal is to improve outcomes by helping decision-makers (Hutton and Klein, 1999).

The prime assumption made by BAIT is the fact that experts are assumed to understand the choice situations and their expertise validates the experiments (Lim et al., 2020). Tacit knowledge is often seen as vital for decision-making, and economics demonstrates it can be hard to imitate this type of knowledge (Chilton and Bloodgood, 2007). The construction of the BAIT decision model can be divided into four different stages:

1. **Creating a decision structure**:
   When creating the initial decision structure, 2-4 experts are inquired to determine up to 15 of the most pertinent criteria (ten Broeke et al., 2021). Experts have different preferences, subject to natural biases which could complicate a single expert making choices (Curtis and Wood, 2004; de Bekker-Grob et al., 2013). Using 2-4 experts to establish a criteria decision structure aggregates experts' preferences and deals with these complications (Bang and Frith, 2017). Experts should support the chosen attributes and subsequent attribute levels with evidence (Kløjgaard et al., 2012; Kleij et al., 2017). Some criteria might even be considered "knockout" criteria, meaning they immediately determine the outcome of the decision. A threshold is usually required to determine whether to make the decision.

2. **Creating choice experiments**:
   Once the desired information is acquired, the choice experiments can be set up. Different criteria are given various values over the choice experiments, to approximate the trade-offs experts make (Kløjgaard et al., 2012). Their initial view on the criteria are resembling the prior information obligatory as input for the Ngene engine to create choice scenarios (SÁndor and Wedel, 2001). Ngene is a software perfect for smartly developing preferred choice scenarios. Realistic scenarios are a prerequisite, or else the output makes no sense. Many decisions should be made such as the expected sign, type of variable, having labelled or unlabelled experiments and the number of alternatives/ levels (Großmann and Schwabe, 2015; Hauber et al., 2016; Cole et al., 2022). The set of choices depends on the experimental design (Burgess et al., 2011).

3. **Creating a choice model**:
   Each expert gets between 25-30 choice scenarios, multiplied by 10 experts giving around 300 trade-offs. This is deemed enough by Councyl to create a working choice model of expert input based on the findings of Tötsch and Hoffman (2021). The number of items in the experiments could be increased without causing issues with reliability or finishing the experiment (Lowande and Shipan, 2022). After gathering responses to the choice experiments, the choice model can be created. The choice model represents a set of criteria weights (β) estimated from the experiments, as described in Section 4.1. It covers the basics of the Multinomial Logit model but can include interaction effects and deal with non-linearity. In the end, the choice model can be exported as, for instance, an Excel.csv file.

4. **Application of the model**:
   The model can now determine the probabilities of choosing an alternative in fictitious cases, which brings the methodology to the last stage; applying it to new cases. The estimated weights are used as input along with the criteria values in a new case, and the choice model computes the probability of an alternative being chosen as shown in the example in Section 4.1.1. Clients can afterwards ask for results which can include anything from choice probabilities to the relative importance of criteria.

A pilot study could validate the model since it uses a feedback loop within the program. After experts have filled in choice experiments and the model is applied to new cases, management/ seniors double-check if the decisions made by their experts/ the model are correct. If there is a discrepancy between the assessments of the model and analysts and seniors concur with the choice model's evaluation, it is proof that the choice model could judge cases correctly. This quantitative method of verifying BAIT is preferred, however, since no such pilot study is conducted, another means of validation has to be used. Model validation will be through experts' views on the proposed BAIT model and their professional opinion on whether it has added value in the banking sector.

4.4 Recap of BAIT

Here, the final remarks and most important points concerning Behavioural Artificial Intelligence Technology (BAIT)'s methodology are reevaluated. The Multinomial Logit model distinguishes observed and unobserved utility, based on the assumption rational human beings try to maximise their utility. The utility is based on criteria values and intrinsic weights of these criteria that are estimated through trade-offs in actual choices. This model can capture any repetitive choice an individual could make, thus inherently very flexible.

Stated Preference choice experiments are a means to provide choice scenarios to individuals and make them consider multiple alternative options to make considerations explicit. BAIT exploits several advantages of Stated Preference choice experiments over Revealed Preference data: it has a psychological function that makes respondents more aware and decisive, the full range of alternatives is known and hypothetical alternatives can be explored, and complications with correlations and historical data are avoided. The main drawbacks of Stated Preference choice experiments are their hypothetical nature and not feeling consequences as a decision-maker, complicating analysis on realistic outcomes. But it is partially the goal of BAIT to unveil different preferences among experts and studying the effects of unknown alternatives.

Creating the model of BAIT can be set up in four phases: First, an initial decision structure is created by 2-4 experts to demarcate the attributes, attribute levels and potential knockout criteria. Second, 25-30 choice scenarios are established in a choice experiment, varying in attribute levels and filled in by 10 or preferably more experts to get 300 data points on trade-offs. Third, weights of the criteria are computed based on the response being a choice model. At last, the choice model can be applied to new scenarios to mimic expert decision-making. Model validation will happen in the form of qualitative expert interviews on BAIT's potential.

5 Financial activities in the banking sector

In this section, some specifics of the Dutch banking sector are elaborated on. First, developments are described followed by the financial activities in the Dutch banking sector. Next, overarching issues of activities will be given to show the possible opportunities to exploit. Thereafter, the potential market for Councyl is described shortly, finishing with a recap of the sector.

5.1 Introduction to the Dutch banking sector: developments in the sector

Adhering to legislation appears to be a significant challenge for Dutch banks, as some have received hefty fines of up to €775 million for failing to live up to regulations (van Dorp and de Boer, 2018). The directives set out by the European Union (EU) can be interpreted individually, a process regulated by De Nederlandsche Bank (DNB) in the Netherlands (De Nederlandsche Bank, n.d.-c). They supervise the Financial Supervision Act, and more specifically the Money Laundering and Terrorist Financing prevention Act (MLTF), in which De Nederlandsche Bank has given guidelines on whether or not to report transactions (De Nederlandsche Bank, n.d.-a). A noteworthy regulatory development is discussed in Section 6.1.3. Banks operating in the Netherlands do not solely have to deal with De Nederlandsche Bank, and an actor analysis consisting of backgrounds, powers/ interests and interrelations with other stakeholders is provided in Appendix D.

Technological developments have occurred in abundance over the past 20 years, many related to the internet. The digitalisation of documentation or business processes, storing data on servers, and being a global presence in the market, have all caused banks to explode exponentially. Innovative techniques have facilitated this expansion on the customer side, such as online payment methods and applications to manage accounts more easily. On the banking side, progression has been enabled by tools that can structure, analyse, and handle huge amounts of data to deal with growth such as Artificial Intelligence (AI) algorithms.

5.2 Financial activities

Banks can perform a multitude of activities in their sector. Some activities have previously been identified as potentially being revolutionised by AI in the financial industry: compliance; fraud detection and preventing money laundering; lending and credit assessments; cybersecurity; and trading and investment decisions (Truby et al., 2020). The five categories of activities that are established in this thesis: **Retail banking**, **Corporate/ wholesale and investing**, **Know Your Customer (KYC)/ Customer Due Diligence (CDD)**, **Anti-Money Laundering (AML)** and **Risk management**. The activities are combined due to their natural characteristics, not because employees necessarily perform them in parallel. Information on activities is partially acquired in the expert interviews, signalled by quotation marks and in italics.

5.2.1 General banking activities or retail banking

Banks are most known for giving out loans, mortgages, credit accounts, or financial services such as wealth management, summed up in retail banking (Majaski, 2022). *"Almost everyone nowadays has a debit card at a bank or at least an account where they can store their money."* Most consumer activities are very repetitive, thus hyper-automation is not surprisingly the betting horse in the banking sector (Consultancy, 2022a). There are sometimes already tools for these tasks, for example for customers to see how much they could lend (Rabobank, n.d.). Newer FinTech businesses however might not even provide the service of a mortgage or a loan, just basic personal or business debit accounts.

5.2.2 Investing activities or corporate/ wholesale banking

Banks also have a competitive corporate side to generate income to maintain stability in offering all services, as clients trust banks to invest or manage their money (Majaski, 2022). Business activities are inherently complex due to the variety of cases and the intricacy of clients. *"An investment decision is client-specific, thus hard to standardise."* With wholesale banking the same services are provided as with retail banking, but now for public financial or non-financial organisations. Corporate banking is similar but for private companies.

Another part of these investment activities is sustainable investing: *"Sustainable investing deals with sorting out tenders of loans, and companies trying to attain the loan need to prove they are sustainable enough on various criteria."* Banks then determine, as in every investing case, the most worthwhile companies, now focused on the green impact the company could have. These decisions are assessed once a year and started all over taking everything into account.

5.2.3 Know Your Customer

A key concept of the trend in tighter restrictions is the Know Your Customer (KYC) principle. *"Know Your Customer encompasses all the physical/ digital checks banks are required to do by law to keep a detailed client database."* Customer Due Diligence (CDD) is the umbrella term for continuous and periodic monitoring throughout the entire client life cycle. *"The goal of Know Your Customer/ Customer Due Diligence investigation is knowing who you do business with."* They can be divided into 2 separate activities: screening and monitoring (Dutch Banking Association, n.d.-b), visualised in Figure 5.1 & Figure 5.2 respectively.

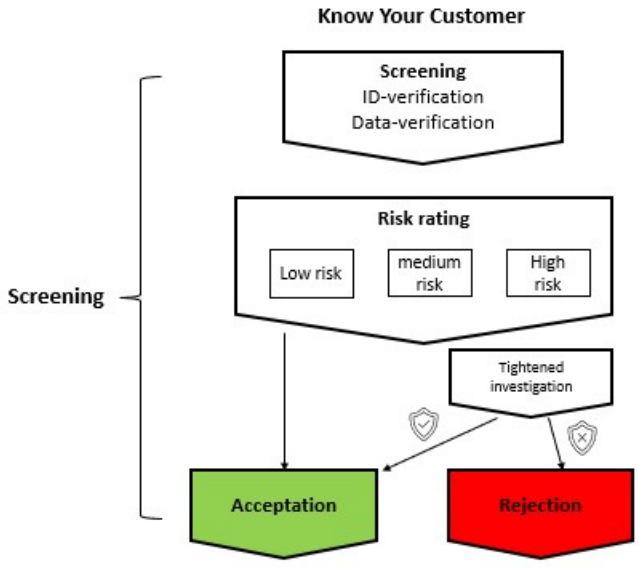

Figure 5.1: Screening process of clients, adapted from Betaalvereniging, n.d.

"The screening of an incoming client first checks personal identification like name, address, and company structure in various databases, and determines who is the Ultimate Beneficial Owner which can be held accountable, looking at registrations in the Chamber of Commerce. Clients can be both public/ private companies and individuals, which are sometimes difficult to fully uncover due to complex organisational structures. Before clients are accepted, they are assessed through means of a risk matrix, categorising them as low-/ medium-/ high-risk clients. Examples of risk are sector-related, nature of the client, geographical, business structure and so forth." The intensity of client research that is required is based on several factors regarding for example types of clients, products, services, transactions, and flagged countries (De Nederlandsche Bank, n.d.-b).

The client now needs to be continuously and periodically monitored on transactions and behaviour by banks (ABN AMRO, n.d.). Monitoring the client mainly exists of looking for unusual transactions, and it depends on the situation and/ or client what is defined as unusual (Betaalvereniging, n.d.). *"Customer Due Diligence is knowing when your client acts divergent from his regular pattern and knowing this pattern to be the actual behaviour of your client. A bakery that serves alcohol for example is deviating from normal bakeries but is not necessarily illegal. This process is repeated once every 5/ 3/ 1 years for example based on the risk group the client is in, with lower-risk clients having fewer periodic checks."*

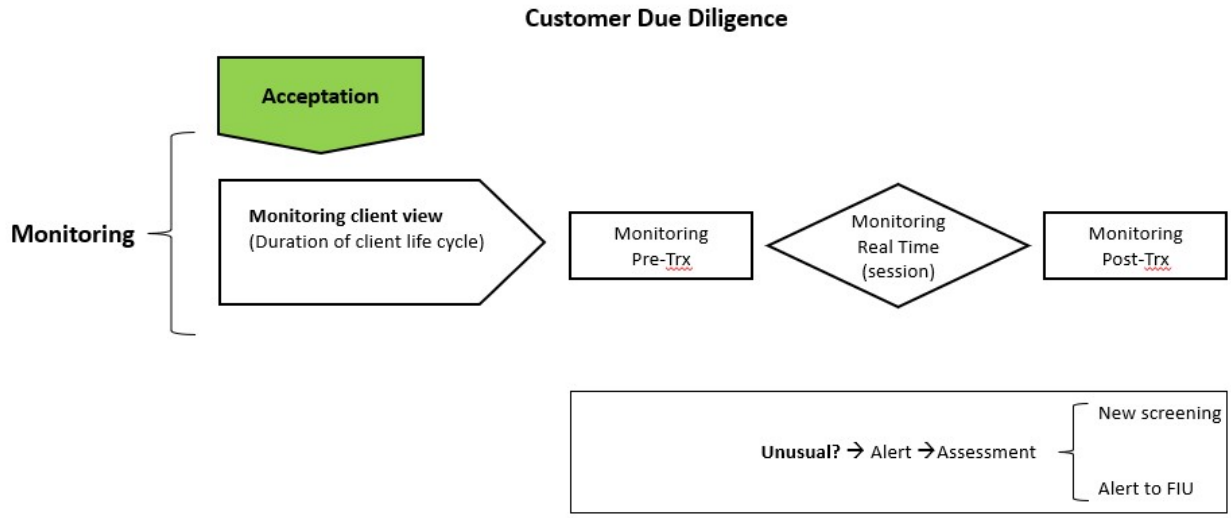

Figure 5.2: Monitoring process of clients, adapted from Betaalvereniging, n.d.

Pre-trx monitoring entails continuous monitoring before an event on transactions, and post-trx means after an event, where an event is a system alert during monitoring (De Nederlandsche Bank, 2017b). *"Any change in client data, organisational structure or another variable leads to a re-evaluation. This can be data from the Chamber of Commerce, or if some information is missing you need to contact the client personally."* Whenever a second alert on a transaction is evaluated as actually unusual by banks, a report is built and the case is sent to the Financial Intelligence Unit (FIU). In turn, the Financial Intelligence Unit investigates the transactions extensively as they are the only actor allowed by law to keep records of all data of all unusual transactions reported by any financial institution (Financial Intelligence Unit, n.d.).

5.2.4 Appropriate risk mitigation

"Risk management or Asset and Liability Management (ALM) deals with the creation of considerate policies for all of the risks banks encounter." Risk management staff are trying to maintain the financial stability of the bank (Corporate Finance Institute, 2022a; Corporate Finance Institute, 2022b). Banks act as the first line of defence between financial acts of terrorism or other malpractices (Brits et al., 2022). Banks are legally obliged to work with a clear risk-managing policy such as the three lines of defence model as shown in Figure 5.3, most banks using this particular model (De Nederlandsche Bank, 2017b).

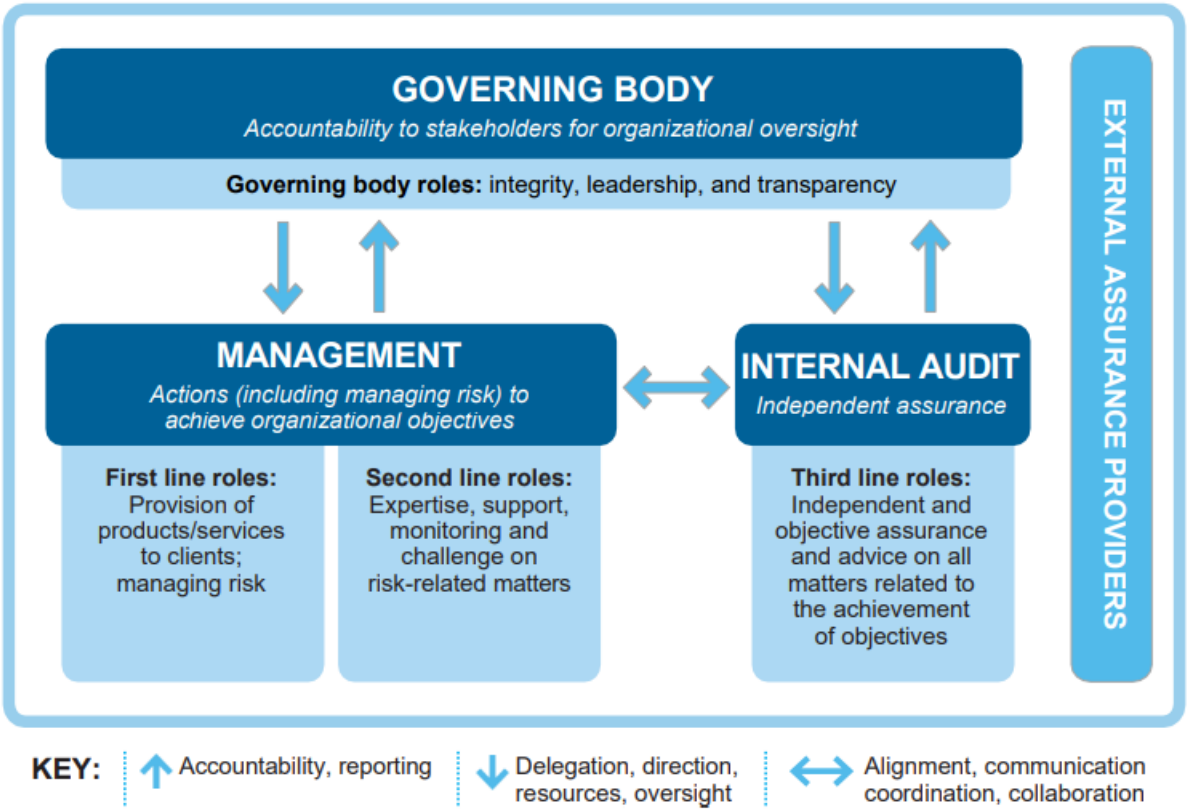

Figure 5.3: Three-lines of defence model, adapted from The Institute of Internal Auditors (2020)

The first line handles screening and monitoring clients and reporting potential fraud to the second line (IDCC, 2020; The Institute of Internal Auditors, 2020). The second line is continuously developing and improving risk management practices and policies on law, ethics, technologies, security, sustainability, and quality assurance at an organisational level (The Institute of Internal Auditors, 2020). The third line acts as a last inspection mechanism of the bank that effectively complies with legislation and guidelines (IDCC, 2020). The three lines are all supervised and supported by internal audit communicating advice on adequately performed risk management, the governing body accountable to shareholders overseeing compliance and policies, and external assurance providers independently ensuring legislative and regulatory measures are taken to satisfy requirements (The Institute of Internal Auditors, 2020).

5.2.5 Counteracting financial crimes

Unfortunately, the banking sector is also giving space for financial crimes. Criminals can defraud society with mortgages, real estate, internet banking, money laundering, and physical robberies among other things, being very creative (Dutch Banking Association, n.d.-d). Annually, €13 billion is laundered in the Netherlands through multiple channels (Rijksoverheid, 2020). The Anti-Money Laundering (AML) program of banks is therefore subject to rejuvenation and a new risk-based approach would deal better with risks (Volkskrant, 2022). High norms have been set to improve the Anti-Money Laundering measures, starting at banks (De Nederlandsche Bank, 2017b). The generic lifecycle of a typical case is shown in Figure 5.4.

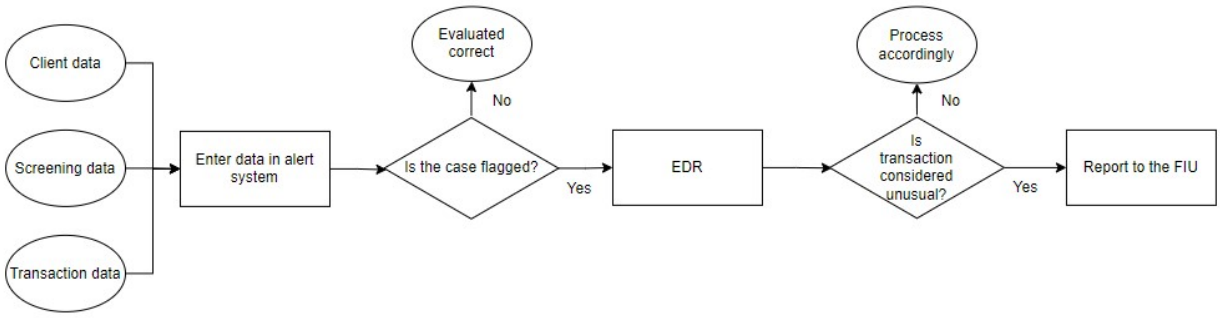

Figure 5.4: Process diagram Anti-Money Laundering case

The lifecycle of an AML case begins at the banks, by whom information is gathered on general client-related data, and the screening data/ transaction data they obtain if a client has entered the system. If there is an unusual pattern not aligning with a client's behaviour detected by the algorithms often based on decision rules, a client is flagged. *"This is called an Event-Driven Research (EDR), as some change in client information or a transaction has triggered the system."* If the case is evaluated, the case is reported to the Financial Intelligence Unit if relevant. The Financial Intelligence Unit needs to prove beyond reasonable doubt there is a case to be built against this particular client, otherwise, no further action is taken.

5.3 Issues experienced in the potential market

In the interviews, experts have been contacted to obtain insights into the biggest problems in the banking sector. It gives Councyl an indication of their potential market if they know how many banks are dealing with the issues and how much they are spending to solve it, or how many people are currently working on it. The Dutch banking sector consists of 60 banks, including 31 foreign banks operating in the country (Dutch Banking Association, n.d.-c). Per organisation, there is a difference between the size/ origin of their issues. A generalised summary of the problems perceived by employees in the banking sector is therefore given.

5.3.1 IT/ data legacy

There is a mismatch between different IT landscapes and the IT legacy systems, legacy systems being almost all old systems built up through time. Few know how the old systems work and hence changes are hard to track. This changed recently due to stricter regulations and technological advancements. Banks often had to re-evaluate their clientele because of a lack of documentation, which used to not be a problem. Combine this with ongoing client examinations and this produces a huge workload. Databases are not integrated internally, but also almost no data can be automatically withdrawn from public sources except for the Chamber of Commerce. For instance, Customer Due Diligence investigations require information from multiple databases, but few are linked, thus it has to be retrieved manually.

Data that cannot be collected from the systems or is missing, is inquired at the clients, who are not always so responsive, complicating the screening and monitoring processes. If banks ask clients to continuously provide them with private information, it reduces the perceived quality of customer relations since they are feeling distrusted and dislike all the efforts without actual gains. This means a trade-off between thorough due diligence and less customer satisfaction, both unfavourable for the bank as it costs them a lot of time, or clients are lost.

Banks also have a problem with exploiting their available data in for example transaction monitoring. There are millions of transactions going through traditional banks and monitoring them all on patterns is hard. Establishing patterns of clients that are laundering money might not solely use one account at the same bank, but might be multiple accounts in multiple banks. It does not even have to be in the same country, and there is no information on the other activities of such a client in a single account. Financial Technology companies might not even have the actual clients or client information, but can have clients of clients as well, which makes it even harder to establish the actual entity behind the transactions or determine client behaviour.

Banks cannot simply switch systems due to the complexity and the amount of information that needs to be overhauled. Each year they are trying to improve their IT systems, of which an average of 15-25% of the budget is allocated to the entire sector (Banken, 2020). For Dutch banks, it is lower most of the time but still an exorbitant sum of €100 million (BNG, 2021) for a reasonably big bank, also usually being the highest total expenditure (Consultancy, 2022a). Still, a large portion of employees do work in IT, presently growing towards 15-25% of the employees in banking (van Kampen, 2022).

5.3.2 Lack of communication

Collaboration between banks and public organisations in the sector is deficient. Banks do not communicate their knowledge of transaction monitoring and fraud detection, neither are they sharing client information. The latter has a very good reason since it is not allowed by law to share client information with external parties as the General Data Protection Regulation protects consumers. But this does mean that it is more challenging to trace the origin of a transaction. A pattern is very hard to detect if you only have access to 1 of the 20 similar transactions executed across 20 different banks, or if it is unknown if there are more transactions. This calls for information sharing between the banks involved.

Knowledge is not shared enough partially due to legislation, and partially due to the unwillingness of banks to share certain knowledge. Having insight into the same client's transactions in a different bank, in some cases, would help a lot in detecting patterns. But sharing successful decision rules or whole models that can accurately detect financial crime, would significantly add to the collective objective of mitigating fraud. Moreover, once an alert has been sent to the Financial Intelligence Unit, no feedback about their alert being justified is returned, making it tough to determine if banks acted correctly. Some first steps have been taken to sit around the table with banks and with De Nederlandsche Bank, but also separately with the Dutch Banking Association (DBA) and other banks in an initiative called Transaction Monitoring Netherlands (TMNL) (Transaction Monitoring Netherlands, n.d.). But there is still much to gain in this respect.

5.3.3 Increased workload

The increased workload can be led back to the data legacy systems being improperly maintained. But another cause is due to a transition towards stricter regulations regarding KYC/ AML as required by the DNB, induced by European legislation (Business Insider, 2019; Volkskrant, 2022). Some risks or thresholds are required by law to simplify decision-making, which raises the number of alerts at a bank. The workload gigantically increases, but the number of alerts is, harder to reduce. Tightened regulations also increased the resources banks need to invest to still maintain the desired performance levels.

An estimated 5.8 billion transactions in a year occur, which would be something around 16 million transactions a day spread over all financial organisations (Betaalvereniging, 2021). Around 263,000 unusual transactions were reported in 2021, an increase of 17,000 compared to 2020 (FIU, 2021). This is all being assessed manually, so employees are drowning in work. Ideally, some automation in the decision chain would be implemented, and even though algorithms do make banks' lives easier, they were not always supported by DNB to pursue this path (Banken, 2022). De Nederlandsche Bank is hesitant about algorithms that are not explainable.

Fear of huge fines and the regulator's judgement on using algorithms is overshadowing banks. This caused banks to overstimulate the manual evaluation of every flagged case, in addition to inputting oversensitive decision rules that flag an enormous amount of cases, overflowing the workforce even more. Truby et al. (2020) state that non-AI, business rule-based systems detecting financial fraud or unusual transactions generate a larger amount of false-positive cases. False positive means that a case is flagged as fraudulent when it should not have been. Subsequently, evaluating cases that are not fraudulent adds to the already colossal workload. It leads to a decline in the thoughtful allocation of capacities, as not every case requires rigorous analysis.

5.3.4 Understaffed and under-educated

The entire process of compliance from analysis to policy-making requires a lot of manpower. Additionally, not everyone inside banks is qualified to handle any case. Mistakes in routing cases can lead to the wrong person handling the case, either being too qualified or not qualified at all. This situation is causing the more experienced experts to deal with cases they are overqualified for. Some cases could be handled by junior analysts, but if a case is too difficult, a senior analyst or a whole different team needs to assess the case. Experienced employees can go through more cases time-efficiently.

The problem with manually handling each case individually is the time-consuming nature and it is prone to human error, thus hard cases should be resolved by competent people. The trade-off banks are currently running into is the quality of a report versus the number of reports within regulated time limits on Anti-Money Laundering cases. These analysts have to make a certain quota of cases dealt with, but also uphold a regimented level of quality. Hiring more and more people to keep up and retraining current employees are wielded solutions.

Since almost all banks are in desperate need of Anti-Money Laundering related employees, the pool of suitable personnel is too small, resorting banks to hiring insufficiently educated people. Trying to attain the desired level of quality if analysts have just started is very difficult, either they (students/ interns/ recent graduates) have had lower levels of education or lack experience for inherently harder cases. The underlying reason for the tight employment market is lacking algorithms and increased workload. Additionally, there is a too-low influx of highly-educated people and employees get offered higher wages somewhere else (van Kampen, 2022). The analysts gain training, feedback and other measures of education on their work. But still, cases are handled not carefully enough, making quality assessors do double work, which is all very inefficient.

In the end, humans are required to evaluate cases manually by the Money Laundering and Terrorist Financing prevention Act (Overheid, 2008). Currently, up to almost 25% of employees are Know Your Customer/ Anti-Money Laundering related (Banken, 2019; Volkskrant, 2022). 12,000 people are working in this department in the sector directly, more than 1000 in some bigger banks, and even more indirectly, it is still insufficient at the time (Dutch Banking Association, n.d.-a). An estimated €1.5 billion a year reflecting 15% of the total budget is invested in AML personnel (NOS, 2022b). Banks hire people because it is a quick fix to try and deal with the workload whilst trying to find solutions. Experts do agree it is not a workable/ scalable solution, but current technologies and laws are not favouring them to integrate/ develop autonomous models.

5.4 What is the market for BAIT?

Four key overlapping problems have resulted in an overview of the potential market for Councyl to provide their service. Although it differs for each bank how they experience these four problems, hence the potential market is variable for each activity. For example, the fastest increasing expenses can be allocated to compliance (Consultancy, 2022a). The product market fit of Councyl's software also depends on the type and size of the problem, so it is still important to establish this for each bank individually.

The IT issue is not the most suitable problem for BAIT. It is not meant to store huge amounts of data. BAIT would be a supplement, not replacing systems but aligning with them, so no huge updates have to be worked through. Thus as the purpose of a new IT system, there would be less interest from banks for BAIT.

For the communication problems, BAIT could be interesting. BAIT is an intuitive model and offers insights that can easily be transferred to other parties. An additional convenient feature is the explainability of the model which could be used for external communication to regulators or other banks, to show how decisions are made. This also fixes the problem of uneducated personnel. BAIT can function as teaching material on expert decision-making to less experienced analysts.

The increased workload is especially interesting for BAIT. BAIT its main function is the automation of human decisions. Automating decisions can help attenuate the experienced work pressure, which is desired in the sector (van Kampen, 2022). This also solves the issue of too few employees, one model replacing multiple analysts.

For almost all problems described, BAIT could be part of the solution. This is elaborated on further in Section 6.3. Yet there has to be serious interest in the implementation of the model before a bank is considered as a potential customer. If roughly 25% of employees would have use for it, and some larger banks have around 1000 people working for them in for instance Anti-Money Laundering or IT, this would result in 250 people in a single bank using BAIT. It is hard to determine the exact numbers that would use BAIT overall, but this is a significant amount. Moreover, one bank could use multiple BAIT models if preferred so one bank is not necessarily "one customer". This is explained in Section 6.4, where the business model of Councyl is discussed shortly.

5.5 Dutch banking sector in review

In this last section, the essential views on the Dutch banking sector and its activities, problems and insights are given. The sector is a complex regulated environment. Banks are struggling to adhere to legislation, which recent fines of €775 million have shown. Five overarching financial activity categories have been defined:

- Retail or general banking activities are regarding the services and products banks provide to individual clients such as mortgages, loans, opening accounts and so forth. Very repetitive decisions are leading this category.
- Corporate/ wholesale or sustainable investing are concerning very complex, unpredictable decisions on account management and investment options for larger organisations. Diverging, unique decision-making mostly occurs in this group of activities.
- Know Your Customer (KYC) and Customer Due Diligence (CDD) encapsulates everything that has to do with knowing the client you do business with, large or small. Screening and monitoring are the foremost activities, distinct in risk ratings based on various variables, and the nature of operations of the client in question.

- Anti-Money Laundering (AML) is dealing with everything that has to do with counteracting money laundering. Much support is required in detecting patterns in transactions.
- Risk management is covering all other risks a bank has to deal with. Exhaustive risk models exist to deal with them.

In addition, four pressing issues have been elicited from the expert interviews and personal experiences of employees in the banking sector:

- Databases and legacy systems are outdated, unconnected, and too elaborate to fix overnight. 15-25% of employees and the highest budgets are attributed to IT in an average bank. The huge and rising amount of transactions, client data and information banks have to deal with are leading to a trade-off of due diligence or quality of customer relations, caused by tighter regulations and lacking documentation.
- Communication is lacking between organisations due to privacy restrictions and unwillingness to share knowledge. It becomes more difficult to detect patterns of criminals if they are not acting through one bank or payment method, and banks are not allowed to see in other systems. Almost no feedback is given on the job performed by regulators as well.
- The regulations have caused an increased workload for banks to deal with. It is time-consuming to manually assess each case. Overly sensitive decision rules and policymakers lead to more work.
- Banks are hugely understaffed and under-educated, having difficulty keeping up their quality vs. quantity performance targets set by De Nederlandsche Bank. 25% of employees are Anti-Money Laundering-related with the demand for educated employees still rising, whilst 15% (€1.5 bln.) of the banking budget is allocated to these practices. This causes banks to hire personnel not educated for these particular tasks, lowering both the quality and quantity of the reports.

In conclusion, banks would benefit from automated tools that can support decision-making. The potential market for Councyl, therefore, consists of more than one model per bank, as each separate decision requires a new choice model. If any of the 60 potential banks would become a client, roughly 25% of the employees could be supported.

6 BAIT in the institutional setting

In this section, Williamson's (2000) framework is used as starting point of analysis to demarcate the banking sector, with an extending analysis in Appendix E. Second, the effects of the institutional environment on BAIT is discussed. Finally, the Behavioural Artificial Intelligence Technology (BAIT) tool is used as an exploratory case study as if technology were implemented in banks concerning Anti-Money Laundering (AML) cases, ending with concluding remarks.

6.1 Dissection of the institutional environment

Williamsons' (2000) framework is the foundation of the analysis that describes the institutional environment. This framework is used to structure the banking sector in four layers of institutions to gain an understanding of the arrangements that potentially influence the implementation of BAIT. Councyl would know to not enter this particular sector if it is adversely organised for BAIT, or if high barriers for Artificial Intelligence (AI) technologies are present.

6.1.1 *L1 - Embeddedness layer*

The first layer of Williamson (2000) is used to describe the traditional environment of the banking sector. These layers reflect the embedded social rules and norms of society in the banking sector. Ostrom (2010) defined so-called biophysical conditions and attributes of community to explain structures enclosed in society.

Biophysical conditions in the banking sector are the identification of the type of infrastructure, such as offices or ATMs. In addition, it reflects the type of goods a bank provides, which are public and private services. Attributes of a community reflect the current trends and culture known in society and the financial sector. The financial sector requires a certain level of transparency towards clients and regulators, induced by legislation.

Banks need to accomplish a shift in their culture and mindset to act socially acceptable in decision-making (Deloitte, 2018). Moreover, regulators try to distinguish between culpability and accountability, which firms need to account for in their business culture. Social integrity consists luckily not of immutable values but is complacent to the beliefs of a group, and can change over time according to Williamson (Williamson, 2000; Nuijts, 2018).

A trend in human behaviour is globalisation. It is an important driver for the benefit of an individual country, potentially innovating within the sector and diversifying activities (Baele and Inghelbrecht, 2009). The increased integration between global markets necessitates for governments to establish standards, monitor, enforce, and sanction (Prakash, 2001). Payments, loans, and other financial activities can be performed within seconds across the globe, inducing more transactions and requiring solutions such as automation to keep up. Global supervision on the next layer is maintained by the Financial Action Task Force (FATF).

6.1.2 *L2 - Institutional layer*

The second layer describes the rules and regulations that apply to the stakeholders participating in the environment. Country governance is pertinent to creating regulations in banking, developing national institutions allowing for competition and maintaining an open culture (Beck et al., 2006; De Nederlandsche Bank, n.d.-d). Six measures of country governance are established (Kaufmann et al., 2007):

1. *Government effectiveness*: Meaning the quality of service, and implementation of policies.
2. *Political stability*: Likelihood that political environment is destabilised.
3. *Regulation*: Level of development allowed by implemented policies.
4. *Rule of Law*: If stakeholders have faith in the law and abide by it, as well as the law being enforced if necessary.
5. *Voice and accountability*: Level of freedom of the public in determining countries' government.
6. *Control of corruption*: If public power is used for private gain or not.

These six measures are used to study the differences between economic development and the quality of cross-country institutional environment to see the impact of good governance (Houston et al., 2010). Especially rule of law, the effectiveness of policies and regulation are affecting banks and indirectly BAIT. If De Nederlandsche Bank comes up with bad policies in the banking sector, it deters new players from entering the market or existing actors to thrive. Fewer banks negatively affect clients due to the higher information/ transaction/ onboarding costs banks can consequently incur. Bad policies regarding AI repel banks to invest in these techniques, consequently detrimental to BAIT.

In addition to guiding integrity, De Nederlandsche Bank also supervises financial institutions to specific legislation (Overheid, 2006; Rijksoverheid, n.d.-b). A twin peak approach is wielded in the Netherlands, connoting there are two distinct functions between two regulators, one focusing on financial stability and supervision, De Nederlandsche Bank, and the other checks business demeanour, the Authority Financial Markets (AFM) (Hu, 2012). The Financial Supervision Act concerns the entire financial sector, to protect the system, markets, consumers, and companies against corruption or bankruptcy (Overheid, 2006; Rijksoverheid, n.d.-b). The Money Laundering and Terrorist Financing prevention Act however also plays a big role in Know Your Customer/ Anti-Money Laundering related activities as will be described in Section 6.1.3. In general, a regulator increases competition in a country, keeping banks' risk-taking in check (Levine, 1998). De Nederlandsche Bank now prescribes a risk-based approach for establishing order in cases (Brits et al., 2022).

Other laws are in effect as well, the General Data Protection Regulation (GDPR) protects clients' personal data and transaction behaviour to prevent exploitation of the owners, controlled by the Authority Personal Data (APD) (European Union, 2016b; Authority Personal Data, n.d.). Additionally, risks like cybercrime and discrimination are emerging due to the implementation of AI technologies, which an upcoming Artificial Intelligence Act (AIA) should prevent (European Commission, 2020; European Commission, 2021). Seven core elements are universally applicable and desired in AI regulations, critical for incorporation in any financial institution (Truby et al., 2020):

1. Human agency and oversight
2. Robustness and safety
3. Privacy and data governance
4. Diversity, non-discrimination and fairness
5. Transparency
6. Societal and environmental well-being
7. Accountability

The principal factors banks would try to attain are robustness, privacy and data governance, fairness, and transparency. Banks' own interests emphasise the aforementioned but they should try to fulfil De Nederlandsche Bank's expectations on the other three aspects, out of fear of more fines/ punishments. De Nederlandsche Bank however wants a focus on public safety and deems all factors as imperative.

BAIT is intuitive for humans making it transparent, is robust due to flexibility, and banks remain accountable since their internal expertise is mimicked. This might bring unfair results if experts produce unfair decisions. Furthermore, not using historic data avoids privacy concerns, and it is assumed decisions are automated for societal well-being. Other AI or Machine Learning tools still lack a certain level of data governance, transparency or accountability compared to BAIT. Next, an important development regarding regulations surrounding AI models in banking, providing opportunities for BAIT is presented.

6.1.3 Juridicial bunq case in the insitutional layer

Slowly but surely, the banking sector is in transition. The juridical bunq case has caused a stir in how banks can organise their internal processes (Dutch Trade and Industry Appeals Tribunal, 2022; Banken, 2022; NOS, 2022b). De Nederlandsche Bank accused bunq of using an algorithm improperly in their screening process (Dutch Trade and Industry Appeals Tribunal, 2022). The whole process of establishing the client risk and nature of the relationship was also doubted by De Nederlandsche Bank. A client's nature consequently affects the continuous monitoring behaviour which is presumed to be at stake with bunq's methodology, in violation of the Money Laundering and Terrorist Financing prevention Act. It works as follows:

"Once a new client opens a savings account at bunq, certain demographic variables, transaction volumes and a certain maximum number of payments determine if this client is assigned either a 'regular user profile' or not. Bunq provided statistical evidence using an AI model that users in this category have significantly less chance of being a fraudulent client based on historical data, classifies them as low-risk and gives them a 'standard payment account'. If transactions or any other behaviour indicate otherwise, bunq automatically sends follow-up questions and can adjust the risk assessment of each client."

"De Nederlandsche Bank argued this information has to be obtained before opening the account for every client individually, and bunq is using assumptions/ prejudices to determine risks and does not aptly stipulate the nature of the client relationship. But the relation is established immediately once information about the client is sent (as they are categorised in the 'regular user profile', they know the client probably wants a 'standard payment account'). De Nederlandsche Bank did not sufficiently prove bunq identifies client relations after onboarding. Bunq was found guilty of other charges, relating to different checks."

The important lesson for other banks and Councyl is that bunq's means of data analysis and using AI in their business processes to automatically peer group clients is not breaching the standard procedures of establishing the nature of a client relationship in client research (Dutch Trade and Industry Appeals Tribunal, 2022). This sets precedent for activities using similar techniques, for example, BAIT. This case alters the perception of De Nederlandsche Bank on technologies not being transparent and being more accepting. It also showed De Nederlandsche Bank misunderstood the functioning of bunq's model. The main take is that any model should be fully explainable if it would be approved by De Nederlandsche Bank. For banks, the tool needs the desired accuracy before being considered. Banks' reservations about using algorithms in operational processes could be resolved, and BAIT might get more support.

6.1.4 L3 - *Governance layer*

The third layer as presented by Williamson concerns banks' governance. Good corporate governance is key to developing businesses, is vital in aligning the objectives of banks and shareholders, and risk management is adjusted to it (de Graaf and Herkströter, 2007; Anginer et al., 2018). The amount of risk a bank is willing to take is contingent on the activity restrictions by the government (Agoraki et al., 2011). Companies try to outperform each other on operational effectiveness, meaning you perform similar activities to rivals more efficiently or differently (Porter, 1996; Keeley, 1990). This notion holds for banks, but also for Councyl. How will they position themselves in the market, will they act as a software developer or as a (tech) consultant?

Having a governance structure that focuses more on implementing original innovative technologies and is future-driven, offers more perspective to BAIT being accepted, than old rigid organisations. Financial reform is therefore required to inspire change. More specifically, financial reforms are removing restrictions, reducing the costs of successful inventions and increasing monitoring costs, in turn stimulating innovation (Ang, 2014). In Section 6.1.5, reform for companies with different sizes is delineated, to show different effects.

Innovation gives rise to complicated trade-offs in policies. These trade-offs are long-standing in the financial sector and are discussed elaborately among policymakers. These trade-offs can be transposed to trade-offs a bank must make when digitally evolving, depicted in Figure 6.1 (Feyen et al., 2021).

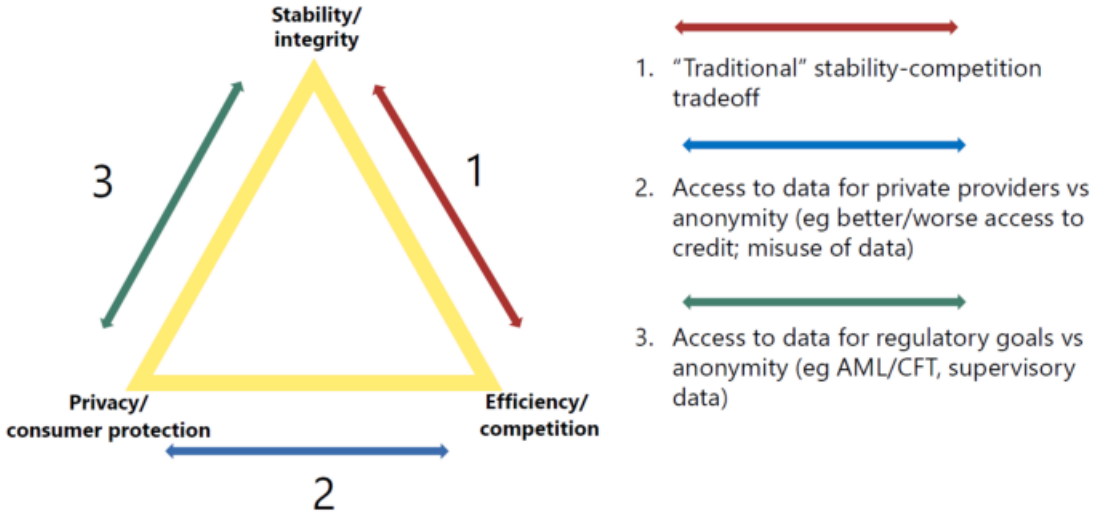

Figure 6.1: Policy trade-offs from digital transformation in finance, adapted from Feyen et al. (2021)

The *stability/ integrity vs. efficiency/ competition* trade-off has always been present in banking. On the one hand, lowering barriers to enable market entry leads to competition, greater efficiencies and diversified activities, all beneficial for consumers (Chortareas et al., 2012). On the other hand, competition is not always conducive to financial stability, as more profitable institutions are incentivised to act more prudently, leading to the moral hazard of becoming too-big-to-fail (Keeley, 1990; Feyen et al., 2021). Digital innovations shift the focus of regulators from price-induced policies towards data-driven and growth-centred approaches (Mullineux, 2011; Feyen et al., 2021).

The *efficiency/ competition vs. privacy/ consumer protection* trade-off is caused by a data-driven society. Exploiting data streams has a unique potential of being used countless times by different stakeholders without being depleted (Feyen et al., 2021). Any piece of information is considered as additional value, thus sharing it would increase efficiencies, enhance inclusion and induce personalised services. Privacy concerns, however, are discontinuing developments in this particular area. Many risks are tied to digital data storage, being susceptible to cybercrime and other leaks, causing severe damage to individuals and the whole sector.

At last, the *privacy/ consumer protection vs. stability/ integrity* trade-off is the binding aspect between data and finance. Sharing data can alleviate asymmetric information and is beneficial for stability and integrity. Additionally, automation driving down marginal costs is very enticing. Personal or transaction data can be used to enhance performance or diminish illicit activities respectively (Feyen et al., 2021). Unfortunately, data cannot be shared due to the General Data Protection Regulation, which is very protective of individuals. Concerns about algorithms having bias and discrimination are present, in addition to excluding individuals unable to provide sufficient information for more sophisticated systems (Feyen et al., 2021).

Innovations must find the perfect trade-off between the three integral aspects of digital transformation in finance. Thinking about these trade-offs concerning BAIT, some interesting takes are popping up. Due to BAIT's characteristics as stated in Section 4, these trade-offs are either dampened or even avoided. Between stability and efficiency, the tool inherently tries to support decisions more efficiently, whilst maintaining financial stability by making good choices for society. If efficiency and privacy face each other, similar efficiencies towards data-driven methods are achieved without the hassle of privacy intruding data sets, as no client-specific or historic data is utilised. At last, privacy vs. financial stability is seen as a sensitive issue. The BAIT algorithm still has biases present and could result in discrimination but that is only the case if the experts that trained them are biased or discriminatory. Moreover, this bias is supposed to be captured by BAIT to be able to reveal different expert opinions.

Thereafter, the model can be fine-tuned according to a more ethically justified approach. Human connection and involvement by the bank are deemed crucial in considering ethical complications and challenges (Mogaji et al., 2021), something BAIT can provide. Subsequently, BAIT could enhance integrity by using expert opinions to support decisions instead of a private data model. The pressure in finding the perfect compromise could be alleviated with BAIT. But banks should be willing to take the risk on such innovations.

6.1.5 Does size matter?

The differences between innovative adaptation by different sizes of organisations are leading to divergent results. Various-sized organisations have different switching/ transaction costs or coordination problems that could occur in the governance layer. Several examples of companies that underwent digital transformation are stated, to observe how businesses alter. Banks come in every size and form, so, to determine a potential market for Councyl it is interesting to see who to target: large traditional or smaller innovative FinTech corporations. A distinction between large organisations and Small and Medium-sized Enterprises (SME)s needs to be made.

In larger organisations, coordination problems arise due to the vast size of the operations, as experts determined: *"In banking, for example, larger clients also have more ties to a bank in different departments (loans, accounts, investments etc.), thus any shift in policy regarding a particular client incurs discussion with multiple branches."* This heavily affects communication efforts and is very time-consuming since more departments need to approve steps.

Orlikowski (1996) showed some interesting findings in a case study on a large software company implementing a tracking support system over two years. The transition was incremental and ongoing, posing recurrent interaction between human agents and social structures, with technology shaping the course but not being the instigator. The realisation of the revolutionary change happens often with multiple iterations and discussions (Karlsson et al., 2017). Before implementation, the company had no work division, no documentation and an individualistic approach to problems. After the support system had been incorporated, the processes transformed in five ways (Orlikowski, 1996), very similar to Davis' (2017) eight success factors discussed in Section 2.4:

1. Shifting towards electronic documentation in the tracking system database.
2. Redistributing responsibilities over multiple employees.
3. Collaboration incurred between specialists.
4. A company-wide system that is supported, interdepartmental and multifunctional.
5. Accessibility of the system and extractability of information.

In Schmidt et al. (2017), the impact of digitalisation on information systems is investigated for an insurance company. Value creation is enabled by digitalisation and manifests itself in network effects through a digital platform. The insurance life cycle is impacted throughout, exploiting data for identifying behaviour and personalised services (Schmidt et al., 2017). From an operational perspective, automated decision-making/ client interaction requires domain knowledge intertwined with software in the business process. Data needs to be restructured for reliable data modelling from an informational perspective (Schmidt et al., 2017).

For smaller organisations, it is easier to adapt banking employees disclosed. *"For example, if a business rule produces a surplus of false positive cases, a quick re-evaluation by the teams can be realised to reformulate the rule. Instead of waiting a long time on acceptance, in smaller organisations changes can be attained more time-efficiently or can even be accomplished by one individual."* There are fewer coordination issues inside the organisation, as communication passes more smoothly and fewer people are a part of the process (Karlsson et al., 2017).

Fundamental reasons could be that fewer innovative endeavours are undertaken in parallel and the organisational structure encourages employees to have multi-functional roles (Karlsson et al., 2017). *"For more substantial changes of restructuring digital infrastructure with new technologies, also in smaller organisations many different teams are involved in decision-making. This increases the difficulty of making a big decision on a disruptive project."* Another struggle is the limited time and resources small organisations do have to think of strategy, often prioritising current practices (Karlsson et al., 2017). Quick communication and flexibility are mostly advantages of Small and Medium-sized Enterprisess, yet it could also mean a risk of being an unstructured organisation, affecting innovation.

What can be taken away from the practical digital transformation of companies of different sizes? The internal mindset and eagerness to proactively seek change in value creation, intra-organisational communication and collaboration, a system-wide reorganisation, and interoperability between innovative technology and existing structures are all a must for all companies. Any significant modification to the company structure still needs acceptance from multiple teams. This means the acceptance process lasts longer and takes effort despite BAIT's flexibility and short set-up time. The dissimilarities between different-sized organisations are the speed they can adjust regarding quick changes in applications or policies. A single BAIT choice model has a major downside that it only helps a single decision, any changes would require a new choice model. It might not be worth it to integrate BAIT in the systems without checking its additional value first.

6.1.6 L4 - *Resource allocation layer*

At the fourth level, it is described how employees of traditional banks continuously improve and apply these trade-offs in their work. In the case study in Section 6.3.3, a more specific delineation is given. *"In Financial Technology companies, employees are working on model optimisation to try and increase performance or reduce huge investment costs, not necessarily to attain more cost-efficiency."* Matters of cost-efficiency are driven by basic economic mechanisms that are particularly interesting for allocating resources: Economies of scale, Economies of scope, and Network effects (Feyen et al., 2021).

One of the facilitators of bank growth through innovation is the scale economies a new service can incur (Berger, 2003). Banks are supplying a wide array of services to an even broader scope of clients, thus providing tools or a manual to work with to somewhat structure these processes is deemed necessary. Economies of scope are achievable with BAIT, as multiple varying models can be supplied on one platform. Economies of scale and network effects are less relevant because new models need to be built for different decisions and the network does not really expand. *"In addition to different activities needing guidance, the focal point is making the life of their clients as comfortable as possible."* The conclusions on the institutional analysis for BAIT is discussed next.

6.2 Implications of the institutional environment for BAIT

Analysing the institutional environment leads to some observations for BAIT. Globalisation and transparency in the embedded layer are to the liking of BAIT. Internationally more cases arise, often being more complex, which BAIT can support in decision-making. Transparency is the main benefit of BAIT, desired by the De Nederlandsche Bank. If De Nederlandsche Bank also concurs on BAIT's added value, banks might be eager to use it or similar tools in practice.

The institutional layer shows country governance and legislation are critical. Due to the laws and regulations, activities are limited in performance and technological developments are stalled. Bunq has breached the walls of ignorance surrounding AI models, showing their effectiveness. AI gained a brighter perspective, and BAIT adheres to all guidelines set for AI techniques, which could result in a competitive advantage.

To the governance layer, BAIT's potential is contingent on regulators being auspicious towards AI. Financial reform only occurs if banks are willing to take risks. Since the typical trade-offs of privacy vs. stability vs. efficiency are sidestepped with BAIT, it is an interesting model to consider. All sizes of companies rely on system-wide integration, interdepartmental accessibility and extractability of information, and collaboration with experts. In large organisations, more coordination and communication problems arise, being time-consuming. Smaller organisations are more flexible but have fewer resources to implement strategies.

At last, financial innovation pushes the boundaries of data exploitation mixed in with banking. Digital transformation is structurally changing the value chains of financial services and in turn cost-efficiency (Schmidt et al., 2017). Economies of scope are manageable with BAIT because of its flexibility, increasing cost-efficiency. In conclusion, the banking sector is favourable to BAIT. Model characteristics and sector requirements are a good fit, resting the hopes of implementation on convincing banks of BAIT's worth.

6.3 Intervening in organisations: A case study of BAIT applied to AML cases

In this sub-section, Behavioural Artificial Intelligence Technology (BAIT) will be used as an exemplary, yet hypothetical case study to find the impact on decision processes within financial organisations. It will merge accumulated findings of the literature review, expert interviews and personal interpretations. The activity established as most promising for Councyl and banks is Anti-Money Laundering (AML), which will be used as a practical example. Fitting BAIT in banks will change their operational processes, thus what issues might it solve, and how does it affect performance are essential questions.

An analysis is performed based on the frameworks of Haggerty and Golden and Cillo and Verona as presented in Section 2.4 in Figure 2.7 & Figure 2.8 respectively. The institutional changes an innovation induces can be divided into 3 levels: the institutional level, the organisational field, and the process (human) level, strongly coinciding with Williamson's framework. The internal action situation of the Institutional Analysis and Development framework will be used as an analogy for the different possible actions a bank and its employees can engage in, leading to potential outcomes (Ostrom, 2005). The findings of the analysis are assimilated in an integrative framework depicted in Figure 6.2.

In this framework, there are three key terms identified: *Agents*, *Capabilities*, and *Processes*. *Agents* are the decision-makers on their respective levels, shaping the *Capabilities* and creating/ performing *Processes*. *Capabilities* involve the potential actions *Agents* can undertake, and determine the contents of the *Processes*. The *Processes* lead to potential outcomes of decisions, giving feedback to *Agents* and causing re-evaluation for core *Capabilities*. Each level will now be discussed, building further on Section 6.1.

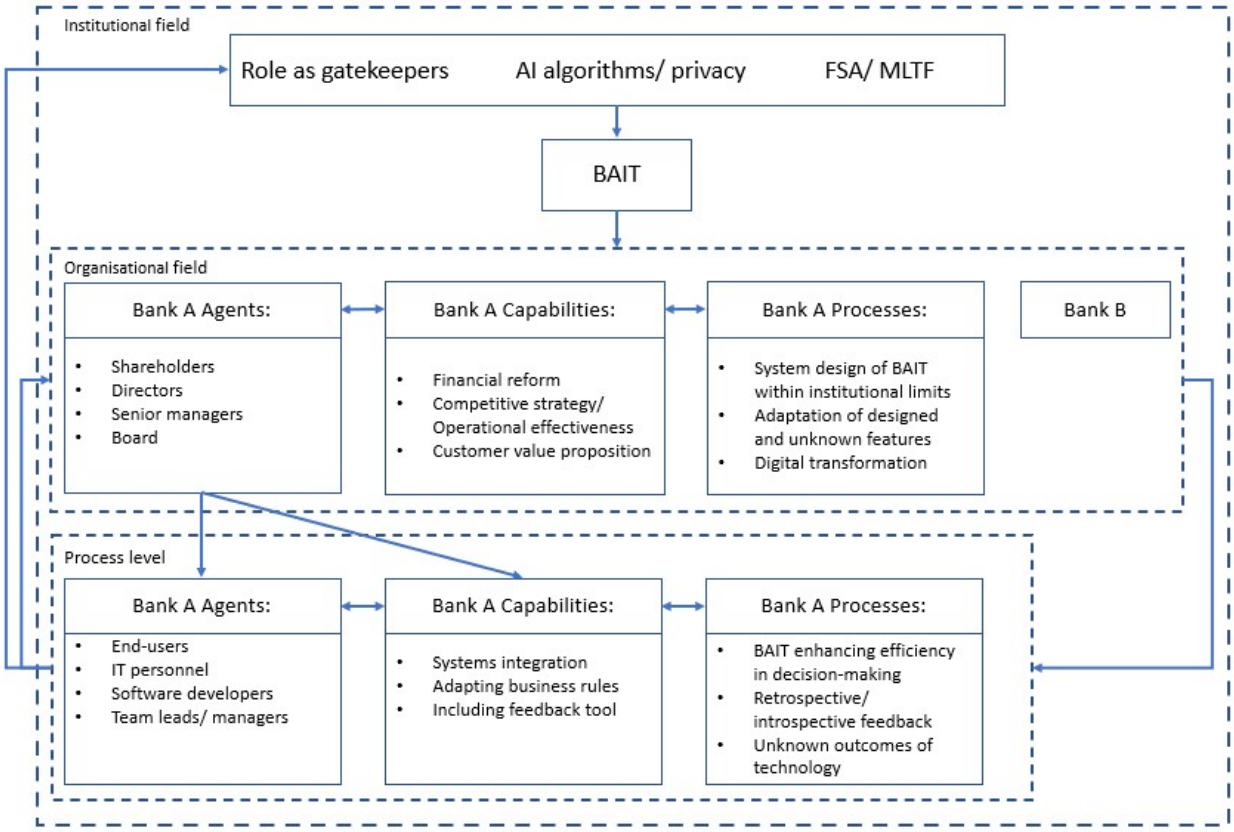

Figure 6.2: Integrative framework of BAIT causing institutional, organisational, and process change

6.3.1 Institutional field/ societal level

The internal action situation of Ostrom (2005) is an intriguing tool for structuring the participating stakeholders' powers, goals, positions, and relations. Banks are free to organise processes within the confines of the law. *"Regulators are hesitant to allow data-driven solutions to autonomously support decision-making."* The Authority Personal Data is checking the use of algorithms and privacy retention.

As missing or lack of data is often an issue in unravelling certain Anti-Money Laundering cases, sharing client information is desired by banks to distinguish patterns in data. This is however not allowed due to the General Data Protection Regulation, which is integrally interrelated with developing technologies and financial regulations. *"On top of that, the public distrusts AI and data-driven solutions because they do not know how it works. Banks, therefore, cease to use algorithms in their processes out of fear for fines or worse client relations."* As a consequence, every bank fends for itself and tries to make the most of its available data, leading to inefficiencies.

Experts do not expect that BAIT will revolutionise the sector. The Financial Supervision Act and the Money Laundering and Terrorist Financing prevention Act might be limiting the tool, but it is within their bounds. Moreover, the public view on AI might change if there is an example without privacy issues. Banks could improve their role as gatekeepers if it is a more accurate means of detecting fraud, in combination with transparently explaining decision-making to external parties. AI solutions should not replace humans, however, combined with multiple autonomous AI agents, fraud detection is more effective (Gao et al., 2006).

If BAIT would become the benchmark technology and would be implemented, not all organisations would immediately adopt the tool. Despite the relatively small change at the institutional level, it triggers technological adaptation within financial organisations and serves as a mechanism for change. Furthermore, over time the technology will be embedded in organisations and embraced by human operators, becoming institutionalised in the organisations (Haggerty and Golden, 2002). If De Nederlandsche Bank sees BAIT's added value and it is allowed, it might even get more support from banks.

6.3.2 Organisational field/ firm level

Altering business processes by intervening with technologies will help create an understanding of how BAIT could impact banks (Schmidt et al., 2017). Digital transformation forces banks to update their technological infrastructure, within law constrictions (Cillo and Verona, 2022). Companies can rework the internal systems, that influence organisational structures, individual decision-making and control (Lanzallo et al., 2020).

Note that in Figure 6.2 there are no relations between banks, as almost no communication is present on knowledge, tools or data. BAIT should be incorporated into banks making design choices. It is potentially increasing operational effectiveness or reworking organisational structure. The tool needs to be "owned" by someone within the company, to ensure the correct implementation and development of the model. For example, a Digital Officer might be appointed controlling model oversight, which shifts the powers, relations and coordination outcomes between the agents on the firm level, and agents on the process level (Lanzallo et al., 2020; Cillo and Verona, 2022).

Throughout the entire process, analysts should be involved to better understand the work environment and make the tool relevant to practice (Davis, 2017). Additionally, a bank should ensure the IT personnel is aware of the transformation's effect and connectedness with other applications. Access has to be provided to both upload/ unload data in the online environment, in addition to all users being introduced to the environment for smooth sailing. *"Offering training, workshops or other informative measures to operate the new technology is advised. Data storage should be interoperable once a new technology is attached to the main system."* The workflow should be sketched and system requirements should be defined (Cai et al., 2022).

Digital strategy is vital to stay competitive in an industry (Hess et al., 2016). Instead of looking at the general applications of AI and altering them to use-cases in banking, first define the crucial dimensions that fuse financial competence into the architecture of AI, then help effective execution in financial institutions as well as incentivising innovation (Sanz and Zhu, 2021).

Transformation is consisting of emphasising the customer value proposition, modifying the operational model, and a combination (Berman, 2012). A bank can enhance products/ services, or redefine core elements of the customer value proposition. Business processes are subsequently transformed, impacting human agents in a new culture (Bogéa Gomes et al., 2020). The top management layer is critical to transformation and controls the activities, as activities happen because the manager orders to (Coase, 1937; Nadkarni and Prügl, 2021). It depends on the strategy of upper-level management on how to allocate internal capabilities and resources.

A new challenge arises, as developing innovations continuously is a risky venture, not knowing how things will pan out and costing money initially (Haggerty and Golden, 2002; Matt et al., 2015). Therefore it is extra important to have an exit strategy in place as well (Davis, 2017). Corporate leaders need to decide whether they want to stimulate exploring options that are potentially beneficial but disruptive at the process level or rely on current strategies (Cillo and Verona, 2022). *"Fast-growing FinTech companies might want to produce all tools in-house. They initially care more about the liveability of employees and growth by for example automating more administrative tasks, rather than cost-efficiency."*

Findings are reconsidered at the organisational level based on experiences at the process level (Cillo and Verona, 2022). One can also learn from failure, by using retentive, reactive and recursive processes (De Keyser et al., 2019). Staying open to input prevents a tunnel vision towards the solution, and having a backup strategy is also mitigating this danger. Taking the successful elements of previous failures helps to reflect and handle abrupt changes better. A consensual environment driven by discussion is desired, to harness the collective knowledge sitting with the end-users, assuming they strive towards the same goal (Felin et al., 2017). *"Either BAIT gets implemented having severe consequences to daily operations for analysts, or banks consider other alternatives to solve their problems."*

6.3.3 Human level/ process level

Internal capabilities on the process level in a bank could change due to new innovative technologies such as BAIT. More effective decisions are made and agents can take up different tasks or backlog projects. The bank could become more research and product development focused, to evolve BAIT to new uses or integrate it smoothly in the digital transition of different departments, resulting in new job functions and activities. Due to the vast amount of cases being handled, organisations might not fire employees with renewed efficiencies, but they could be re-designated.

To give some more context on how decision processes change and improved efficiencies are achieved, it is now assumed BAIT is used by Anti-Money Laundering analysts and is compatible with systems. Analysts within that bank are working on various cases that have different importance and strain, accumulating implicit practical knowledge along the way. BAIT is trained by Anti-Money Laundering experts, and banks want to create smart queries to find red flags that can indicate money laundering. Without models such as BAIT to support the decision, this quickly becomes a complicated mess, since there are too many criteria and too much data to work through for humans alone. Remembering the process diagram of Figure 5.4, the locations in the case lifecycle BAIT could intervene is depicted in Figure 6.3.

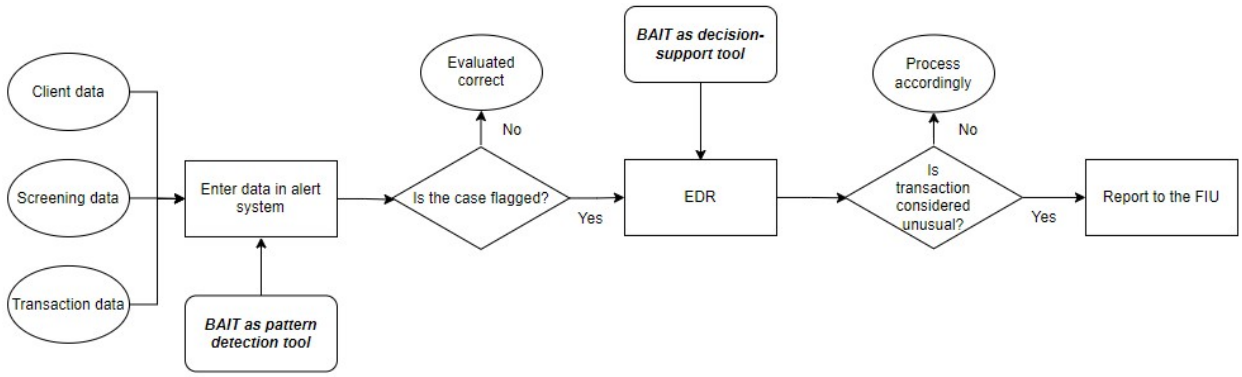

Figure 6.3: Process diagram Anti-Money Laundering case with BAIT

In Anti-Money Laundering cases BAIT can be used at the transaction monitoring level to learn how experts recognise patterns in data. Zoomed in on the previous figure, this functionality is portrayed in Figure 6.4. Cases could be filtered more carefully by including expert considerations on contextual factors, thus decreasing the amount of Event-Driven Research (EDR) in general for analysts. The alert system in this case is some type of algorithm that triggers clients based on some simple and rigid decision rules.

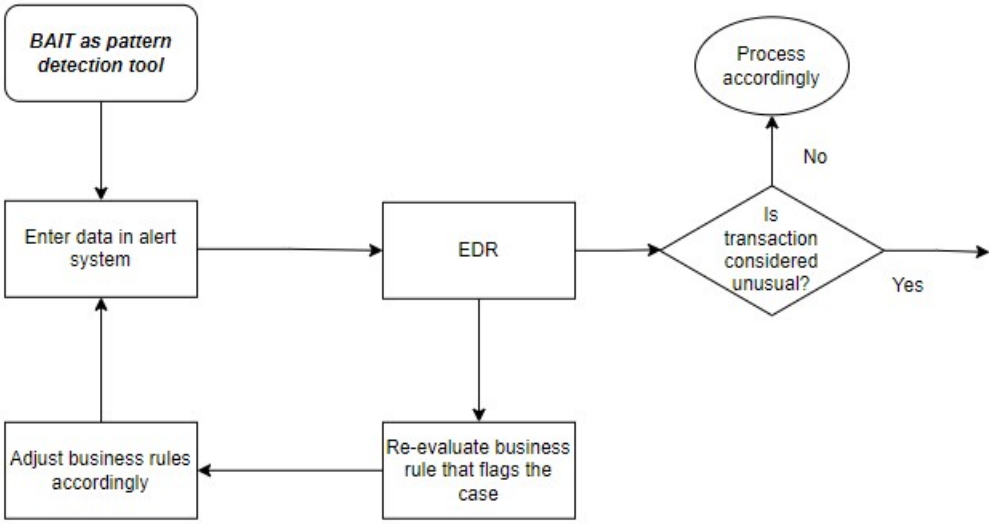

Figure 6.4: BAIT as a pattern detection tool

"The system would be less sensitive with flagging, and easily identifiable false positive cases are already caught by the algorithm. Subsequently, the scope of false positive cases that can be filtered out using the tool narrows." This refers to the crossed-out cases in Figure 6.5. Fewer cases could also mean fewer employees and lower wages are required. Interaction between the employee and the model is not involved in this case. The insights experts in the second line of defence could be supportive of giving the alert system more nuance on certain decision rules. Since there is disparate data, it is difficult to standardise the information to apply BAIT. *"You would need to create an Application Programming Interface (API) of the tool/ software to share information between existing systems, since partners are already working with banks about compliance, to still be a scalable solution for banks."*

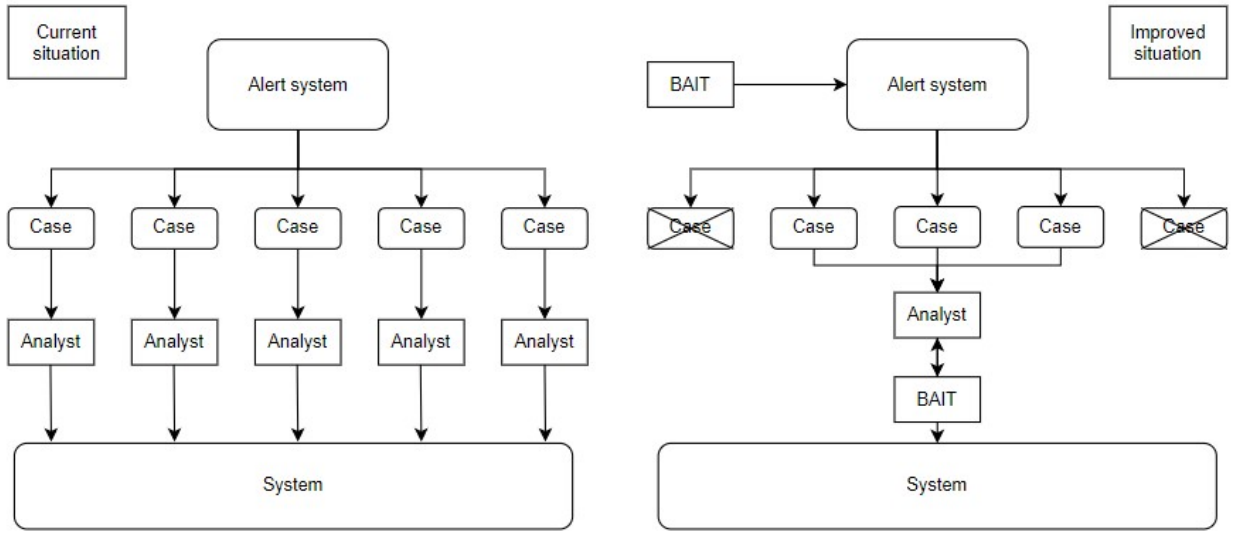

Figure 6.5: Decision process efficiency of old situation vs new with BAIT

Another spot in the decision process where BAIT can intervene is with the Event-Driven Research itself. Why have banks resorted to impractical costly solutions such as hiring personnel, and not tried to optimise the decision process? Or why have solutions not worked for them up until now? *"Many decision rules or thresholds are not allowed to change due to regulation. But the current workload of complying with the laws, as well as trying to catch up with past wrongful documentation is impossible to deal with on short notice."* BAIT could be trained by authoritative experts, and the model could then be supporting a single (or more if preferred) analyst dealing with far more cases than usual. The effects would entail increased efficiency in dealing with cases with fewer employees, also visualised in Figure 6.5.

There is however another way to deal with the workload, as the model could even be used to establish the case is too hard for someone with less knowledge in the field. Meaning, efficiently routing cases to the right person to avoid inefficiencies or double assessments. For example, if a high-risk country is making a transaction banks are obliged to trigger the case. To deal with the superfluous amount of cases, banks give a certain risk ranking to all cases that pop up in the system. Analysts would deal with higher-risk cases first, and go down the order as determined by the model. This would mean banks still deal with the same number of cases, however, they route the cases more efficiently conforming to the risk-based approach of De Nederlandsche Bank (Brits et al., 2022). This alteration of the process is portrayed in Figure 6.6.

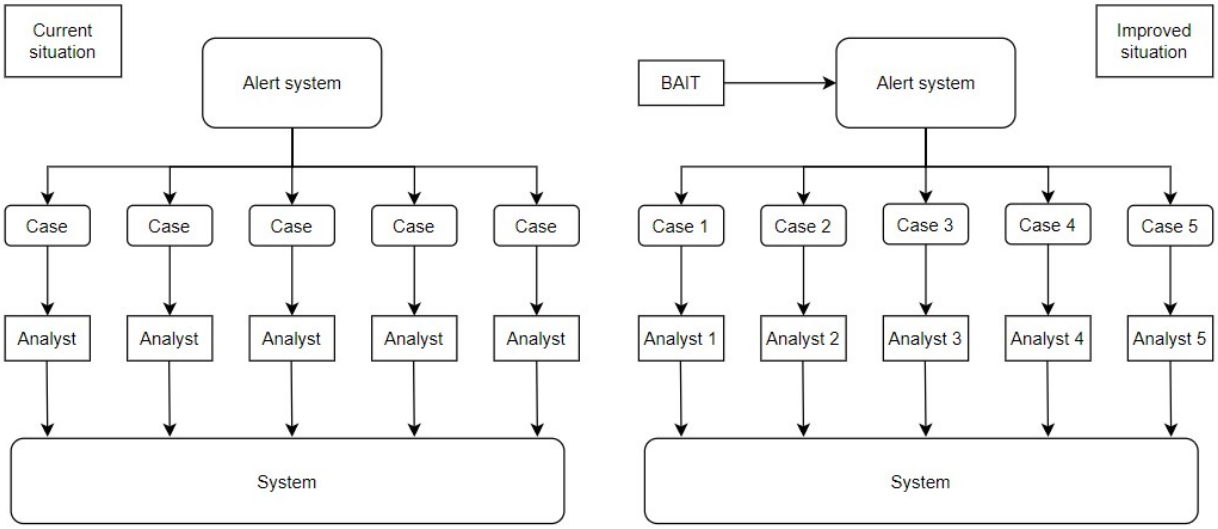

Figure 6.6: Decision process of risk assessment old situation vs new with BAIT

Suppose analyst 1 is solely capable of dealing with case 1 due to its complexity or high-risk rating, it would be preferred this case is immediately routed towards this particular analyst. What happens when only analyst 1 is capable to deal with all 5 cases for instance? BAIT again could step in. Suppose analyst 1's knowledge is captured in a model. In that case, his expertise can be translated towards the other analysts that had no cases assigned, and they would get feedback from their smartest expert without having to ask it directly. Senior analysts are not forced to deal with simpler cases, or junior analysts could deal with difficult cases, allocating resources more thoughtfully. All analysts could handle similar cases as analyst 1 and even learn from his considerations in the process. In an ideal situation, every analyst with the help of BAIT could handle all cases. This leads to another function of BAIT.

At last, BAIT could function as a training tool to introspectively look at how decisions are made. This process is depicted in Figure 6.7. An example would be if an analyst would make decisions based heavily on a single criterion, say ethnic profile, this would immediately be insightful. Managers could decide based on the information that their analysts make decisions based on ethnicity change needs to occur.

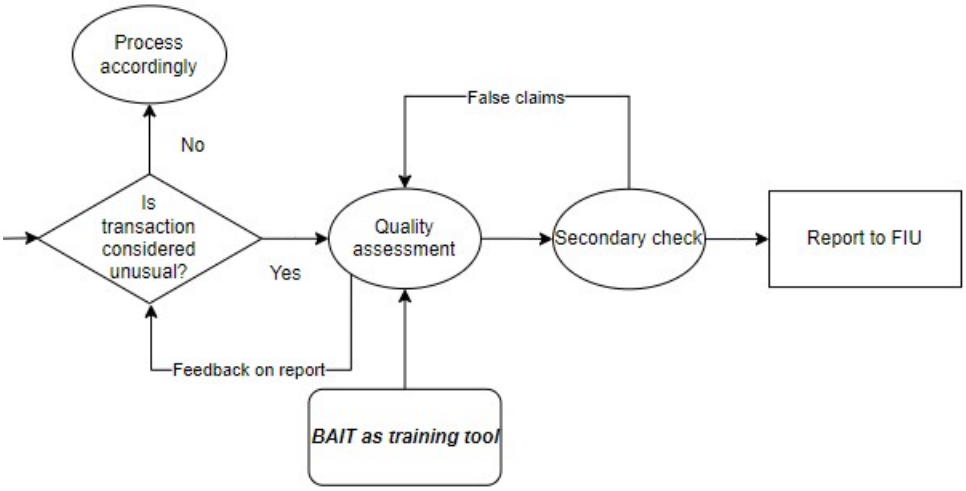

Figure 6.7: BAIT as a retrospective tool

The other way around, a possible application is to instruct younger analysts on how to make decisions, translating expert knowledge to others but not using the model to decide. If their experienced peers train the model, the model can show inexperienced colleagues how to evaluate cases this way. For instance, before a case is considered unusual internal mechanisms assess the quality and validity of the claims.

It even could function as a tool that helps in external accountability, or creating awareness among banks' customers. If clients are profiled and want to know what places them in a certain risk category for example, the model shows the weights of the decision and thus the reasoning behind the classification. It could prevent misconceptions between customers and banks, but also shows accountability towards the regulator on how decisions are made.

6.4 Does the banking sector affect the business model of Councyl?

Recalling the BAIT methodology presented in Section 4, the service Councyl offers is a bit more complex than just building a choice model. First, the term "business model" is introduced. A business model is an all-encompassing term that involves in what way a (usually technology-based) company provides their goods or services to customers, and how they attain competitive advantage, both technically as well as financially (DaSilva and Trkman, 2014). In other words, the strategy of making money and all that it entails.

In short, Councyl's business model is building a choice model to clients' requirements, with clients initially being the owners of the model. The model represents a set of criteria weights. This is giving clients access to the insights/ considerations for a standard fee in a preferred format. If the client is satisfied with the model(s), wants to adjust them in-house or has another reason they want to alter the model, they can get a "licence" for the model for an increased periodic fee. The online landscape in which the choice model is created is then made available for customers to interact with. The underlying written software is not, however, making it less enticing for banks to own one choice model.

So, in case a new decision needs to be modelled, Councyl will build this specific model the client would own, but to modify values or amend certain aspects, a licence would again be necessary. In the future, partners of Councyl will be trained to be able to work in this online environment. And the endgame would consist of customers of Councyl being able to fiddle with the model themselves, but Councyl would still be required as experts on creating the decision structures and providing help where necessary.

The changes initiated by BAIT described previously are more of analogue modifications of the decision process at the process level. The impact on the actual digital infrastructure is a bit harder to assess since each bank has individual systems with which the BAIT landscape needs to be integrated. *"The service should be packaged as a compatible Application Programming Interface."* There are several databases and legacy systems that the tool could use to retrieve information from and incorporate into its decision. Or the other way around, by using the outcome of BAIT as input in another system to speed up work.

Since Councyl already operates as preferred by banks and advised by financial experts, there is no need to revise the business model. Moreover, clients' preferences differ, thus each customer relationship would be initiated differently and consists of various possible structures of model ownership adjusted to desires. In addition, the nature of the agreement between customers and Councyl relies on the type of problem that needs solving. If a single model will suffice for its insights, there is no need to integrate systems with BAIT. If a more continuous management approach is desired by banks for a persistent problem, this would mean the arrangement is different.

6.5 Summing up the institutional environment for BAIT

Some summarising and concluding remarks are made on the analysis. The first level of Williamson (2000) affects BAIT through transparency and globalisation, which are the current trends that induce the need for explainable automation tools.

The second level plays an integral role in the opportunities and barriers for BAIT through national legislation and regulation. Concerns on privacy, trustworthy AI and financial regulations are limiting data-driven models to thrive. BAIT's characteristics of robustness, transparency, privacy and accountability are aligned with sector requirements. Additionally, bunq proved AI models are feasible in banking. De Nederlandsche Bank therefore is more open to fully explainable models.

The governance of trade-offs between financial stability, consumer protection and efficiency to shape any digital transformation in finance are mitigated by BAIT's characteristics. Corporate governance and strategic organisation determine whether or not an innovative direction is taken. It also relies on the size of the company and whether enough resources are available to initiate digital innovation. Small and Medium-sized Enterprisess are relatively faster in communication, it is easier and less time-consuming to adapt to change relative to larger organisations, but often have other priorities. Economies of scope are achievable by BAIT. For a digital system to be successful it needs:

- Overall strategy, objectives, and measures are determined beforehand, with a proper exit strategy to prevent tunnel vision.
- Collaboration between specialists and end-users throughout the entire process of implementation.
- Entire digital systems integration throughout the organisation being compatible, accessible, interdepartmental and multifunctional.

At the institutional level in the banking sector, this means for BAIT it should be designed within the limits, not reworking legislation but compliant with it. Public opinion is paramount for the acceptance of AI, thus privacy and bias concerns must be addressed by the technology.

At the organisational level, stakeholders can conceive competitive strategies to change their customer value proposition by intervening in business processes through innovation or digital transformation with BAIT. Furthermore, depending on the size of the changes, the decision on embedding new operations in existing processes, or creating a new subsidiary or department for substantial changes is vital. New roles but also relations can arise between employees in the top-level and lower-level staff, focused on model development and communication.

This in turn influences the process level, where daily work is altered through the use of BAIT, by supporting the decision-making process. The tool could enhance efficiencies and reduce required employees, allocate cases effectively, give introspective insights for external or internal parties, or complement basic decision rules with more contextual considerations by experts. Councyl's business model and tool are aligned with banks' predilections on system integration, model flexibility, and problem requirements, thus not needing modifications for the banking sector. The banking sector's institutional environment is therefore benign to BAIT.

7 Results & Discussion

In this section, the results of the qualitative research are elaborated on, followed by a discussion on important takes. The results are merely subjective takes obtained by the analyses performed in this study. Some statements are drawn from expert interviews, often in italics and signalled by quotation marks. The discussion is led by intuition and based on gathered knowledge acquired in particular research.

7.1 Empirical findings of the study

In this subsection, the sub-research questions are answered to formulate a conclusion on the main research question presented in Section 1.4 and finalised in Section 8.1. They are handled one by one to create a clear overview of the insights gathered in this study and act as a sort of synthesis.

7.1.1 Could activities be improved by BAIT?

The financial activities are reviewed showing if Behavioural Artificial Intelligence Technology (BAIT) would pose a solution. In addition, the lack of automation in the individual activities is summarised and it will become clear what activities are potentially interesting for Councyl to start meddling in, shown in Table 7.1. The first sub-question is looking at the individual financial activities' quality being elated by BAIT:

"What financial activities in the banking sector are suitable for BAIT to add explicit value?"

Table 7.1: Overview on observations in financial activities

General observations	Rules and regulations are limiting AI possibilities. People are hesitant in trusting AI/ fear of being replaced. Experts see benefits of BAIT, but issues with implementation. The key lies in integrating BAIT into existing systems. Activities do not require automation. Transparency is vital to De Nederlandsche Bank.	
Observations single activity.	*Reasoning for (lack of) automation*	*Solvable by BAIT?*
Generic banking activties	Decisions not complex enough, mostly fully automated. No need for human or technological intervention.	+/-
Wholesale/ corporate banking	Money management is different for every party. Automated decision-making is very complex.	- -
Risk management	Many risk models/ matrices are already in place. In credit applications BAIT might be useful, but no urgency.	+/-
Sustainable investing	Very delicate decisions, repetitive but each time re-evaluated. No automation is required nor used within these decisions.	- -
Anti-Money Laundering	Misconceptions on regulations. Algorithms are not yet trusted, reluctance by regulators. Too much work pressure to look into automation solutions.	+ +
Customer Due Diligence	It is not an issue to determine the risks of a client. Decisions are already supported with risk matrices that expedite straightforward decision-making.	+
Know Your Customer	Trivial reports need to be written manually. Workload is high but not unmanageable.	+

The general issues are mainly caused by the IT landscape that is not properly addressed and current regulations. *"Traditional banks did not come up with sufficient policies because regulators did not require strict measures, as well as technological advancements being ahead of the law."* This drastically switched in recent years, as people distrust AI due to its complexity. It is vital in any department or organisation that BAIT is integrated into existing systems to be approved. *"If communication between systems is impossible, changes are already occurring to the situation, and models fall behind". "In general, better models lead to better decision-making in practice, thus any progression is desirable."* The most gain can be obtained with repetitive activities in need of transparent decision-making.

General banking activities (or Retail) are known the best by the public, as almost everyone has a credit account. Personalised products and services can be created by banks using AI (Bredt, 2019). Recent automatic tools have been developed to check if you are eligible for a loan, for example, to get an indication of what you could be getting (Rabobank, n.d.). So, automation was pursued to refine business processes. Unfortunately, this also means that no similar solution might be chased due to other activities having more critical issues. *"However, if a client is applying for a loan, banks should still manually assess each applicant."* Therefore, standard banking activities for more repetitive tasks are suitable for the BAIT model to automate. Unless there is no predominant use found for BAIT in these activities, banks are interested in the tool.

Wholesale/ corporate banking are not necessarily commensurable activities, but for the assessment for BAIT, they are categorised together. It entails different investment or money management decisions for different types of clients (public, individual, and business clientele). *"Due to the vast amount of options for different client's needs and requirements, the decisions are hard to standardise in a single investment decision structure." "There might be opportunities to use peer grouping for similar clients, but even then their prerequisites might vary too much."* BAIT requires a decision structure to predict future outcomes, less suitable for diverging problems. For a similar reason, **Sustainable investing** is not suited for BAIT. *"You look at a blank file, compare all suitors for investment on numerous criteria and come to a collective decision."*

Many different risks are present in **Risk management**, all with different criteria. If a single model could value the considerations of experts in each category this would be complementing existing risk models. For example in credit applications, a manual assessment is given to the applicant about what criteria are present in the case circumstances. Using BAIT to make the considerations explicit and make the critical variables comprehensible is valuable. Similar to Customer Due Diligence, determining risks is not usually the issue but reducing spent time due to administrative tasks would be the main perk. BAIT would need to be integrated with the in-use risk models to add value to the process.

*"**Anti-Money Laundering** casuistry has the most potential for intervention with BAIT due to the high actuality of the problems." "Since regulations sharpened, banks have been catching up on documentation, IT legacy systems and enormous amounts of transactions to comply." "Anti-Money Laundering activities consist of evaluating if a client is fraudulent based on transaction data patterns and other demographic variables."* Every case is legally required to be handled manually, but this is currently futile with banks receiving €775 million-high fines. Almost all experts of banks, regulators and other organisations confirmed the hypothetical value of BAIT in this field. In addition, literature identifying AI can attain higher efficiencies, especially decision-support systems based on expert knowledge are apt in decreasing false alarm rates in Anti-Money Laundering (Bredt, 2019; Truby et al., 2020; Fritz-Morgenthal et al., 2022). BAIT might therefore be able to help surrounding 25% of a bank's employees detect fraud more efficiently.

Customer Due Diligence gives rise to complex evaluations of client risk during monitoring or Event-Driven Research. Exhaustive risk matrices and questionnaires have already been developed to determine a client's risk, and manual appraisal is not an issue. These risk matrices provide straightforward decision-making. *"But in some classes of risk, for example, sector risk, the risk detection tool could be a bit sensitive and repetitive in triggering cases, causing repetitive cases for analysts to deal with."* BAIT could appraise and route cases based on their risk to transition to the risk-based approach the De Nederlandsche Bank aspires (Brits et al., 2022; Consultancy, 2022b).

Know Your Customer employees desire automation to speed up the process, but their work pressure is less pressing. Repetitive administrative tasks can be automated to relieve employees, for example in retrieving information automatically. *"It is often already possible, but creating a report and filling them in on the basic requirements is still conducted manually."* With client onboarding for example, BAIT could already fill in the standardised report on the scores for different criteria and advise on whether to accept the client or not. This means the analyst just has to hit accept on elementary cases and not write a full report about it, and manually check the rest. *"Automating the administrative tasks themselves is possible, but integrating the tool with current systems to concoct the entire obligatory report might help even more."*

7.1.2 Opportunities and hurdles present in the banking sector

Sub-question 2 discusses the banking sector's prospects and barriers for BAIT in financial organisations. A quick overview is given in Table 7.2, not in any particular order:

"What opportunities and hurdles are present fitting the BAIT tool in organisations in the banking sector?"

Table 7.2: Opportunities & Hurdles present in the banking sector

Opportunities	**Hurdles**
Large issues in increased workload and uneducated employees/ understaffed banks.	Full automation not supported enough, no autonomous decision systems allowed.
Regulators and banks becoming more recipient on data-driven approaches.	Privacy, data sensitivity, and AI reluctance to fully implement innovations.
Accuracy, transparency, compatibility & flexibility of BAIT aligning with sector requirements.	Criminals are very innovative as well.
Data legacy systems need revision. Openness of the law.	Misconceptions on interpretation of the laws. Integration with existing systems in practice.
Good communication between organisations is desired.	Employees feel replaced or undervalued. General distrust in AI.

Banks' problems such as huge workloads, not enough qualified personnel, outdated IT/ data legacy systems and more restricting regulatory developments cause severe struggles. These problems however present opportunities for Councyl to provide their service to mitigate banks' issues. For instance, BAIT as an automating tool can compensate for the lack of employees, and as a training tool for the under-educated staff. *"The main barrier that occurs for Councyl and other software providers for that matter, is to make their tool compatible with a bank's internal systems."* No bank is eager to use a separate tool if it is not interoperable and modular with other data systems. Scalability is important for AI applications that create value in the sector if humans decide to intervene in institutional processes (Sanz and Zhu, 2021).

If the barrier of digital transformation is conquered, there are some opportunities present in the banking sector. The constant trade-off between quality and quantity opens up room for services that alleviate the workload and improve quality in these processes. Stricter regulations regarding client-related investigations and monitoring as required by the De Nederlandsche Bank are the cause of this (Volkskrant, 2022).

De Nederlandsche Bank wants to reduce the number of criminal streams in the sector, possibly with data-driven models provided they are explainable.*"Instead of focusing on reducing the number of flagged cases by the alert system, since most alerts are required by law, the emphasis should lie on ranking the alerts properly on risks."* De Nederlandsche Bank tries to convey this notion with their article on the risk-based approach (Brits et al., 2022). *"Banks cannot deal with all alerts, but they should deal with all high-risk alerts."*

"In Customer Due Diligence, almost any change in client-related information triggers a renewed investigation which becomes very repetitive if a client structure is more convoluted. Information on certain clients can be incomplete or untraceable, and retrieving it from public databases is difficult. Clients are not happy if they have to provide exhaustive information with every change and be doubted, thus proper (public) data management is desired." "In Know Your Customer, many reports are filled in with information that should be automatically accessible data but are all written by hand." The allocation of employees writing dozens of simple reports is inefficient, therefore automation is desired.

People might be wary of using AI in decision-making, based on the inherent risks it brings along. Risks of cybercrime, discrimination, bias and other privacy issues have been widely highlighted as problematic in AI solutions (European Commission, 2020). Though, recently more and more is permitted if banks can make the AI model insightful for DNB, related to the promising bunq case. *"Banks have interpreted the Anti-Money Laundering regulations as absolute truth, whilst it is perceived by regulators to function as guidance, causing disorder and miscommunication between the parties."* Fear of sanctions drives banks in pursuing inefficient solutions as hiring personnel. Communication on knowledge between banks, regulators and external parties is desired. *"Open communication between banks on client/ transaction data would heavily improve capabilities of detecting financial fraud."*

AI is yet to be allowed by law to be an autonomous decision-maker, thus either ultimately it is a decision-support system and policy-makers should change their views on human necessity in Anti-Money Laundering decision-making (Truby et al., 2020). Companies offering AI-based fraud detection tools are expected to be the most viable in the business, assumed to be faster and cheaper (Bharadwaj, 2019). Skill, knowledge, and experience on AI are required to make the technology work nonetheless (Ali, 2020).

Due to the open interpretability of the Money Laundering and Terrorist Financing prevention Act, it opens up possibilities for organising operations internally. Therefore, models such as BAIT belong to the possibility of being implemented in banks. BAIT has the advantage of not using personal data and being explainable, thus policy trade-offs between stability, privacy and efficiency are avoided to a large extent.

Reducing the time and resources wasted reassessing incorrectly marked Anti-Money Laundering cases will increase the trust in regulations by the banks (Truby et al., 2020). *"Criminals, however, are just as if not more innovative in circumventing the laws or decision rules that are created."* Model flexibility is, therefore, a must, and the versatility of BAIT can be capitalised on. For BAIT there are possibilities to automate but for each activity, it has to be investigated what the model does exactly and how it improves processes before implementation.

Employees sometimes also feel they are being replaced if AI is implemented, dispute the ability of AI to reproduce the right outcome or become lazier/ negligent of their tasks with a decision-support system like BAIT. For example, if BAIT already has its evaluation of the case prepared and it seems to be an easy outcome, analysts might concur with the model without a second thought. This would defeat the purpose of the BAIT model as a means to educate analysts about making certain considerations.

7.1.3 Institutional characteristics and their effect for BAIT

Sub-question 3 refers to the institutional characteristics that are present in the banking sector, as described below:

"What characteristics of the institutional environment affect the implementation of technologies in the banking sector?"

The relevant institutional characteristics could potentially speed up or halt the process of innovating within the sector. Banking and country regulations, in addition to financial reform/ corporate governance, financial innovation and globalisation are discussed. These will all be treated individually with respect to their effect on BAIT, shown in Table 7.3.

Table 7.3: Influence of institutional characteristics on BAIT

Institutional characteristic	**Type of effect with respect to BAIT**
Globalisation	*Positive:* Induces more work leading to more necessity for automation. Decentralisation causes a shift in diversifying services.
Country governance	*Slightly negative:* Regulations/ laws limit technological prosperity. Innovative drive of the government gives perspective.
Banking or financial regulation	*Neutral:* Open interpretation of MLTF is misguiding. It is allowed to organise activities/ processes internally.
Corporate governance or financial reform	*Slightly positive:* Banks urge for data-driven solutions grows. Depends on the strategic organisation if BAIT is offered a chance.
Financial innovation	*Positive*: Digital transformation improves and diversifies services. Added value should be investigated and proven.

Globalisation
Globalisation has implications advantageous for BAIT, as many more transactions/interactions are produced between banks and clients, making an automation tool helpful. However, a bank operating in multiple nations also is subjugated to the country's national legislation. Cross-country coordination can create a better environment for banks to enhance their efficiencies. Current digital and physical infrastructures are globally arranged, and the focus lies on customer satisfaction with many alternative services available. Decentralisation offers stability in a more robust banking sector, incurring a switch towards diversified activities, convenient for flexible tools such as BAIT.

Country governance:
Country governance and a technology-driven view are of the utmost importance. If the national government gives space or even subsidises AI studies and development of tools, the environment is much more benevolent to solutions such as BAIT. Bad policy deters the cultural individuality of companies, consequently reducing competition. More undue restrictions lead to less trust by banks, also affecting their efficiencies (Truby et al., 2020). The effectiveness of policies, rule of law, and regulation benefiting scalability of solutions are especially important measures of country governance that impact the development of BAIT. De Nederlandsche Bank is open to innovative solutions if they are manageable, robust, privacy conservative, non-discriminatory, transparent, socially acceptable and accountable. They expect fully explainable models of their subjects under regulatory control, BAIT dealing with all concerns of De Nederlandsche Bank.

Banking or financial regulation:
Technological progress, financial regulation and country governance are severely intertwined and need coordination (Delimatsis, 2012). Banking regulation highly affects the sector's financial stability, efficiencies, risk-taking, economic growth, and banking activities. They are emphasising the integrity of participants and the protection of consumers. The impact a regulation has depends on its contents, as more innovation-driven regulations are beneficial to incorporating BAIT in the banking sector. Laws such as the General Data Protection Regulation but mostly the Money Laundering and Terrorist Financing prevention Act are causing issues for banks concerning limiting innovative solutions in development. The law is open yet subject to misinterpretation between banks and De Nederlandsche Bank. The openness does allow banks to organise activities pushing the boundaries, as bunq has proven recently. Regulations thus very much make or break the possibility to implement AI solutions. The transparency and explainability of BAIT could make it feasible.

Corporate governance or financial reform:
A bank's mindset and system interoperability are decisive if technologies are to blossom. Large banks benefit from available resources but have more coordination issues with people, time and effort, whereas smaller organisations are more flexible but lack strategic organisation or structure and might develop technologies in-house. In general, larger banks have more opportunities for product differentiation and outperform smaller banks but are equally proficient as specialised banks due to niche market conditions (Bos and Kool, 2006). Financial reform enables risk-taking to reorient the organisational structure. Constant deliberations on integrity, efficiency, and consumer protection are integral to digitally transforming a bank, BAIT's properties avoiding these trade-offs. Luckily for Councyl, most banks are trying to improve.

Financial innovation:
Financial innovation is not so much an institutional characteristic but more a determinant for growth in individual banks. Banks try to renew, improve or diversify their services. BAIT could be such an innovation, provided that added value is clear. Financial innovation is related to other institutional characteristics as they mostly limit it, except for globalisation. The co-integrated relationship between economic growth, financial development and innovation is favourable for society (Pradhan et al., 2016). Disruptive technologies could be imminent to the financial stability and safety of the sector in the case of inexplicable data-driven models making decisions. But the limited complexity of BAIT does not likely reshape the banking sector, rather being an intermediate step from simple rigid decision rules towards full scale Machine Learning models that can transparently predict cases and adapt perfectly to available data.

7.1.4 Decision processes transformed by BAIT

Banks have been focusing heavily on digital transformation in recent years (Consultancy, 2022a). This relates to the final sub-question, reflecting on the institutional changes innovative technologies inspire, presented again below:

"How could the BAIT tool impact the internal business processes in banks?"

By incorporating BAIT, restructuring might be necessary at the organisational level, making it compatible with systems it needs to load data from/ dump data in. *"With large banks and FinTech companies, firing employees is less relevant since there are many backlog projects and they are trying to scale, so there is always enough work for people."* New roles should be handling the day-to-day management and integrating the model throughout the corporation. Employee(s) should be responsible for the ongoing development of the BAIT model. The tool needs to be continuously updated, maintained, and developed to assure end-users can work with it. Any project that alters internal structures needs collaboration between multifunctional specialists and end-users, interdepartmental system accessibility and thoughtful (exit) strategies.

At the process level, other changes occur affecting the agents and capabilities. Decision processes could be evolved in multiple ways, and there are different parts of the processes where BAIT could be put into practice, depicted in Figure 7.1.

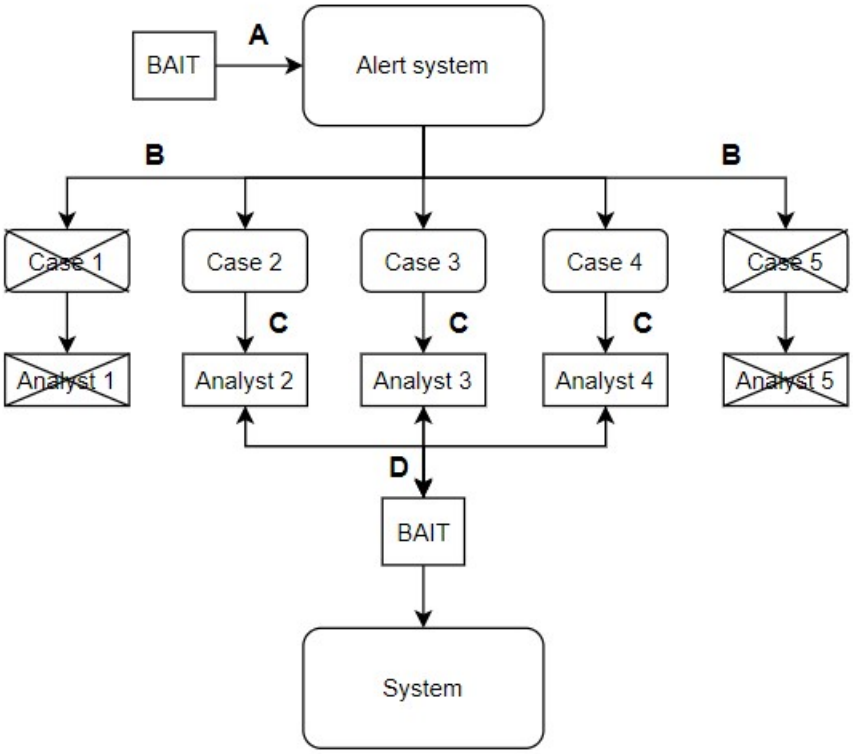

Figure 7.1: BAIT impacting decision processes

Human agents would be relieved of the workload by a supporting tool, decreasing the number of false positives **(A, B)**, by more appropriately (risk-based) allocating cases (**C**), by introspectively educating personnel on decision-making **(D arrows up)**, and efficiently handling cases **(B, D arrow down)**. Additionally, it has a communicative function towards external third parties explaining decision-making. Staff should be trained to understand and handle the online work environment for optimal use of BAIT. Not merely the analysts should be educated but also the IT department managing the systems, managers to justify the model internally, compliance officers to devise policies and other employees that might need to explain the model to external parties. The processes differ for varying activities. In Know Your Customer for example, BAIT could be used as an efficiency tool, and in Customer Due Diligence it might be more attractive as a risk-routing model.

However, no exact lines can be drawn between different organisations on how to implement BAIT and how it affects decision processes for different activities. All banks operate in their way, having very divergent issues and different requirements for their technical solutions. *"You have to convince banks or board members of the numerical added value of BAIT, showing efficiency figures before and after implementation, in the process showing how this affects, for example, the work rate of employees, preferably for each activity or bank individually."*

7.2 Discussing on the yielded observations

In this subsection, the findings are discussed giving rise to new insights. What place in the organisation is appropriate for BAIT remains the question. An approach is to show De Nederlandsche Bank the transparency and applicability of the model, as financial innovation enhances transparency when monitoring banks as a positive effect (Lee et al., 2020). If you can convince De Nederlandsche Bank of BAIT's transparent attributes, expert-based decision support tools might get endorsement by De Nederlandsche Bank.

Third party independent regulator
Having an independent regulator is a condition that positively influences faith in the proper governance of AI (European Commission, 2020). The entity would regulate all AI practices in the Netherlands, with an overarching European/ international organisation that supervises, communicates, and shares knowledge. Recently, the Dutch government has given the authority to control and supervise algorithms to the Authority Personal Data (NOS, 2023). This regulator should also be able to transparently explain risks and refute them, as public trust is very important in applying AI (Northey et al., 2022). Banks remain unsure about the engagement between AI and clients, making them less inclined to invest in further development of AI techniques (Dehnert and Schumann, 2022). Implementation of BAIT is closely related to the government's acceptance of AI technologies.

Sharing knowledge
A shared information-based platform between parties in the Transaction Monitoring Netherlands (TMNL) (maybe even the Financial Intelligence Unit and enforcers), managed by De Nederlandsche Bank or another independent third-party regulator such as Authority Personal Data should be erected. *"Cooperating with other banks, exchanging client data, and creating alliances that benefit the whole sector's efficiency is the ideal outcome."* Banks should not rely on but gain from other institutions in client/ transaction research. Centralisation of data facilitating collaboration would be a better arrangement, as a concentrated banking sector with fewer banks has a positive effect on financial stability, being less prone to systematic failure (Allen and Gale, 2004). This would however be a possible obstacle for BAIT since the data would be structured to increase interoperability, meaning conditions for more data-driven solutions would improve.

"If knowledge of transaction monitoring techniques or client information could be safely shared, this would help banks in better detecting financial fraud." Anti-Money Laundering experts, for instance, working for regulators or enforcers are less acquainted with the tools for data analysis but more with the typical behaviour of clients, whilst analysts need to identify those patterns. Effective supervision and information sharing could increase cost-efficiency (H. Yin, 2021). In combination with technologies like Blockchain (Blockchain is a technology that safely packages and shares data in immutable blocks used by a dedicated network of users, tracking all transactions), for instance, the client data can be shared safely throughout the value chain.

Realign views
The wishes of regulators are not aligned with banks' capabilities, and legislation hinders the merging towards the collective goal. *"De Nederlandsche Bank needs to renounce their view of a bank having no criminals in their books, which is impossible to achieve, and banks need to be more meticulous in their function as gatekeepers."* In the quest towards explainable (AI) models that perfectly filter out criminals, BAIT could act as a functional bridge between the opposing views, consisting of features that comply with the wishes of both sides in the model. By using no historical data, BAIT retains privacy and transparency but is also unable to capture a lot of different variables and too complex situations. But this entails that regulators and policy-makers have a better insight into banks' decision-making. The available data streams on transactions for banks however would then not be exploited, so this issue remains untouched.

Legislation and models lagging behind

"Unfortunately, legislation almost always plays catch up with technological advancement." This means that before any adjustment to the law is made, technology is already one step further. Banks are restricted within the confines of the law, but criminals are not. This leads to another point of discussion on BAIT in the AML industry, that criminals are innovative in deceiving banks and making cash streams invisible to authorities, circumventing laws (Openbaar Ministerie, 2021). *"Is the model adaptive enough to deal with new trends in fraudulent activities? The new ways of fraud change almost just as fast as the business rules that are revised to catch them."* A BAIT choice model can be made for any situation, so although it is flexible, it is time-consuming and might not be worth it to reconstruct a model for every unique case. Being able to quantify the advantage of using BAIT compared to current practice is key in convincing banks to use the tool.

8 Conclusions, implications, limitations & future research

In this final section, the concluding remarks are made on the study. First, a concise conclusion is drawn from all analyses to answer the main research question. Next, the theoretical and policy implications, followed by recommendations are appended to this conclusion. Furthermore, the limitations bound to methodologies, analyses and other assumptions are discussed. At last, future research opportunities are shortly described to give an idea of what potentially might be beneficial to study further.

8.1 Summarising succinct conclusions

In this subsection, the purpose is to solely present conclusions on the findings accumulated through this study. Furthermore, the theoretical and policy implications are given. A final take on the main research question is presented, once more rendered below:

"What is the added value of BAIT in an organisation in the banking sector under the current circumstances of the institutional environment?"

The added value of Behavioural Artificial Intelligence Technology (BAIT) could be distinct in three parts in an organisation: First, it can be seen as a tool to incur greater effectiveness in routing cases towards the right employee, preferably based on existing risk assessments. Appointing a better-equipped analyst to appropriate cases deters multiple evaluations or errors. Second, the model could be used to enhance efficiencies, relieve workload and in time reduce the number of employees necessary to deal with cases. An employee supported by BAIT could deal with the same number of cases on his own as a legion of analysts without the tool. Thirdly, the tool could be seen as a training or introspective tool to construe decisions being made by analysts/ employees. As authoritative figures train the BAIT model, it shows junior analysts operating the model how particular decisions are made. The model then serves to transpire insight into decision-making to analysts, external regulators or even customers.

At last, BAIT could add value in the front-line making more thoughtful decision rules in the existing transaction monitoring alert systems and enclosing more context to the rules. It could result in fewer false positives, as it takes into account for example expert considerations on patterns in data. Councyl as an organisation can use several strategies to penetrate the financial market. Their stance is clear, trying to provide its service somewhere in the financial sector adding the most value. Since banks are such large organisations, it is more difficult to pinpoint the exact team/ experts to target with the study to implement the BAIT tool. Often banks have many divisions going over a case and assessing it with their individual views.

Concerning where BAIT could add value, much could be gained in Anti-Money Laundering/ Customer Due Diligence/ Know Your Customer cases. More repetitive tasks like giving out loans and risk management are suitable for the BAIT model to automate. Complex and varying decision-making like sustainable investing/ money management for wholesale/ corporate clients is less interesting for BAIT. In opportune cases, the BAIT model would intervene in the decision process as summarised above.

The most significant barriers dissuading BAIT in the banking sector are the relevant legislation, data sensitivity and practical system integration. The Money Laundering and Terrorist Financing prevention Act is open to misinterpretation, making it difficult to comply, with criminals evading it creatively. De Nederlandsche Bank is not supportive of autonomous AI decision-makers, and general distrust in its potency is guiding. BAIT could take away privacy concerns.

Open regulations, however, in addition to recent jurisprudence on using AI models in decision processes, also present opportunities due to the huge increase in workload. Automation and re-routing to deal with superfluous cases are two of BAIT's functions, substituting less educated employees and relieving high wage costs. BAIT's features of accuracy, flexibility, compatibility and transparency are aligned with sector requirements, avoiding complications of historical data. Banks could communicate decision-making more easily to regulators and policy-makers. BAIT could be the intermediate step between simple decision rules and completely understandable AI/ Machine Learning models that accurately predict human decisions.

The current institutional environment plays a part surrounding BAIT's implementation. Globalisation and corporate governance are seen as positive instigators of financial innovation. BAIT's flexibility can deal with global transactions that spur more repetitive decisions or diversified activities. BAIT's properties help avoid complex trade-offs in efficiency, privacy and stability when financially reforming a bank. Adaptation of BAIT differs for different sizes of organisations, as large banks naturally are led by more coordination efforts. Smaller-sized enterprises on the other hand can communicate more efficiently, however, their lack of resources might block the possibility to pursue new solutions. Country governance and financial regulations could decelerate innovation in the banking sector unless they are designed within institutional limits and according to technical guidelines. De Nederlandsche Bank requires risk-based, accountable, safe, privacy-retaining and transparent models, whereas BAIT can reflect these qualities.

Business processes could become more streamlined by being converted through BAIT. At the institutional level, BAIT would not revitalise the sector but serve as a trigger to show AI applications could function according to regulations. At the organisational level, designing the system to adjust the value proposition, as well as having (exit) strategies are key. New roles of systems operator, developer and integration supervisor are required to ensure proper usage. System integration at the hand of IT developers collaborating with managers and end-users of the model is necessary to correctly apply BAIT. Incremental and iterative steps towards digital transformation are vital, henceforth including end-users from the initial designing phase to the end phase. At the process level, BAIT supports day-to-day business processes with one of the four functions mentioned.

8.1.1 Theoretical & practical implications

What does this study's narrative mean for Councyl, scholars and society? In academics, a new expert-based AI tool is introduced in the banking sector, and the opportunities and hurdles are described for these types of technologies. Williamson's framework is used to deconstruct the financial sector in four layers, which has previously not been used in a market research study. It helped to structure different interrelations of institutional characteristics that affect BAIT's possible implementation. Keeping the regulatory layer in mind is of utmost importance when developing digital or data-driven solutions in the banking sector. Moreover, knowing how digital transformation impacts an organisation is vital in practice.

Furthermore, this thesis urges financial experts to pursue thoughtful data-driven solutions such as BAIT. The possibilities with AI are endless and working from case to case is too short-sighted. Radical change necessitates strategy and an incremental and iterative approach towards digital transformation is the best approach as identified by literature (Orlikowski, 1996; Davis, 2017). BAIT could be incorporated into many different activities, the assignment lies in investigating where banks could use the tool for good.

For Councyl, the theoretical implications entail the current problems in the banking sector and its opportunities/ pitfalls. It provides insights from different employees of different stakeholders, trying to sketch a complete view of the banking sector. It is valuable to know what the biggest issues are and who hurts the most, to be able to capitalise on them for different individual activities. Also, Councyl should think about which use of BAIT is most feasible. It pivots on a bank's strategic views, necessity, and preferences if BAIT will be implemented, provided that a predominant use is found.

As for practical implications, Councyl's next step in providing their service in the banking sector would not be recommended for immediate pursuit. The sector is arranged too commercially and even though there are apparent problems, no bank is eager to develop a test model. The urgency is absent, or there is too limited time to start looking at a potential solution as BAIT. Since Councyl is a start-up trying to establish a market, having other sectors more interested in the model is more conducive to their development.

If Councyl decides to try and enter the banking sector as a market for their service, the best bet would be placed generally in Anti-Money Laundering, Customer Due Diligence, and Know Your Customer activities. Literature has widely recognised the potential of AI in detecting financial fraud (Bredt, 2019; Truby et al., 2020; Dwivedi et al., 2021; Fritz-Morgenthal et al., 2022) and personalising other financial services (van Esch and Black, 2021). And reminiscing on the expert interviews conducted with many different experts, these fields would be recommended by those who daily encounter manual cases with lacking systems or no supporting models.

This study has shown which financial activities could be improved by BAIT and how. The practical application of BAIT as a pattern detection tool would gain the most, narrowing down the scope of false positive cases occurring in banks. Many cases are triggered causing a redundant workflow, and some are fixable by adding more thoughtful or nuanced decision rules in the alert system when monitoring transactions. Referring back to the societal relevance of this study, this thesis introduces a means to detect financial fraud transparent yet accurately that organisations could benefit from. *"Fighting financial crimes is a highly actual problem of society and any improvement in this department is very welcome."* Creating better-personalised services, efficient processes, and competitiveness in the sector, in the end, benefits the public.

8.1.2 Final recommendations for Councyl

This market research study comes to an end, but what does it mean for Councyl? The banking sector has been examined comprehensively and many insights have been established. The main takeaway for Councyl is that the high actuality of the issues, recent news messages and experts experiencing the same pressure, back up that there is much potential to introduce their service in the banking sector. Although almost all interviewees saw the possible added value of BAIT, relatively few were interested in more information for a pilot study, most of them having no interest due to various reasons. This also gives information on the urge banks feel to pursue similar technologies, whether they are already working on them or do not have time to devise a study (maybe just not with a student) at the time of writing. Therefore, it would not be advised to focus all attention on this sector based on experience gained from the conducted interviews. Nevertheless, once the right person is contacted that does seem interested enough in BAIT, there could be much to gain.

8.2 Limitations spurring further research

In this subsection, the limitations and possible complementing future research are discussed. Limitations and anomalies from reality almost always incur new questions. This further research could diagnose whether this study is right in its presumption of BAIT being beneficial to the banking sector.

8.2.1 Limitations of the study

One of the limitations of the study is the lack of insight information on actual decision processes. It is heavily reliant on the subjective views of experts. People speak out of previous experiences, might inflate stories, or are not as knowledgeable on the topic as preferred. They might not be allowed to share internal processes or decision-making, only their thoughts on activities and BAIT. This relates closely to another limitation, as it has not been possible to talk with an expert on every financial activity, and functions within a company overlap. Tasks between financial organisations could also diverge for the same denomination. Due to this lack of insight into the business processes, only hypothetical indications of potential added value are given. Establishing how organisational structures would change once BAIT is implemented is only possible once it is tested in banking.

Moreover, what remains the question is what the actual impact of BAIT is if it is implemented in a bank. Quantification of the efficiency increase, numbers on the false positives it prevents or other measures to prove BAIT is factually improving internal business processes is pivotal for inferring the added value of BAIT in the banking sector. Unfortunately, the research was unable to come to the stage of doing a pilot study demonstrating the improvement by BAIT. It cannot be determined if the model would pan out as described in the research without rock-solid numbers, only hypothetical perceptions are entertained. This deficiency is dampened by conducting expert interviews to create respondent validity. Experts shared their professional opinion if the suggested BAIT software would be of added value, and although most were positive about BAIT, it is too complex of a question to think about all facets and conclude if the tool can be implemented.

8.2.2 What future research could entail

In future research, several topics are recommended to pursue, with as first and foremost a practical pilot study. Verifying if BAIT could predict decisions in the banking sector would be the goal. For example, if the BAIT methodology is applied with Anti-Money Laundering experts to determine potential frauds. After training, validation and testing, it is possible to conclude if the choice model could replicate human efforts and detect fraud. Involving practical experience would also validate BAIT, as currently purely hypothetical assumptions are exerted on some of the financial activities. In collaboration with banks, Councyl could chase this research if called for. Other financial institutions could also benefit from similar applications, all dealing with similar regulatory restrictions and complex repetitive decisions.

BAIT focuses on experts' knowledge to train the model, where Councyl's interests lie. It has to be noted that the Multinomial Logit model is also perfectly viable for capturing the preferences of banks' customers, to tailor services to their needs. This allows banks to effectively target and give out personalised products to each of their client groups. This has been applied in different sectors or is already even applied in some banks. Although this is another direction Councyl is emphasising, as it requires a large data set on the preferences and demographics of clients and a different type of questionnaire. But it remains a possibility that banks might find intriguing, even though there are more complex models that might be more suited for large historical data sets.

Another interesting topic could be replacing the Multinomial Logit model of BAIT with a more intricate model, for instance, a Mixed Logit model. Mixed Logit models overcome the inherent limitations of Multinomial Logit models by having a correlation between unobserved variance over time, showing taste variations between subjects, and they do not exhibit the Independence of Irrelevant Alternatives property and fix the independent and identically distribution assumption. This would spread utility more representational to reality among alternatives, possibly replicating choices more accurately, by taking personal preferences into account. Maybe the model could be applied to other financial activities if it could deal with more complex situations.

However, other complications are arising with Mixed Logit models, which are more intricate and need more respondents to set up a choice model (also requirements on distributions for parameters have to be thought of and so on). Future research should shed a light on whether it is worth increasing the accuracy of the model at the cost of transparency. It is a possibility if a customer of Councyl is with them for a longer period. The customer might decide they want an even more accurate choice model for a specific decision, then this could be realised. It is up to Councyl if their interests lie in perfecting their current practice, or looking for more complex methods to possibly increase prediction accuracy.

Hopefully, this study gives some understanding to Councyl how their tool could contribute to the banking sector. Since it concerns the hot topic of fighting financial crime in society and algorithms possibly interjecting processes, the banking sector also could learn what a tool such as BAIT could provide. In the end, it is up to banks to BAIT criminals, by improving their fraud detection systems.

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Appendix A - Systematic critical literature review

In this Appendix, the full literature review process is shown. One would expect at least 15-20 pieces of literature obtained from the initial search, supplemented with a forward snowballing method to go deeper into the material. However, since there are multiple subjects, a range of 5-10 papers as a basis is deemed enough, in addition to the founding papers of theories. All literature is sought after on Scopus, except some grey literature found through Google or Google Scholar. A notion has to be made that these numbers reflect the search at the time of writing, and can differ if re-enacted in a follow-up study.

In Scopus, some operators help seclude literature and work. One can group terms and words in a single group by using the parenthesis "()". The "AND" operator means you can combine two different search terms, and it will look for both in the same papers. This is usually helpful in narrowing the scope of the search. Papers either having just one or none of the two terms will be excluded. Additionally, the "OR" operator searches for papers including at least one of the two terms it combines. It is useful when broadening the scope of the search.

At first, for the institutional analysis, a search term must be created. The scope of the search is both the setting in which the stakeholders participate and the evolution of the banking sector. Therefore, multiple constructs of synonyms and terms are used to find literature on these topics. The first term needs to dive into the theory of institutional analysis, and is formulated as follows: ("Institutional environment" OR "Institutional Economics") AND ("government interventions" OR "regulations") AND ("banking sector" OR "financial sector" OR "banks"), resulting in 55 papers. Of the 55 papers, all papers are screened first on the title, after that on the abstract, and if believed relevant literature, the paper is scanned on the content. Furthermore, both papers of Ostrom (2005; 2010) and the paper of Williamson (2000) are the foundation of the institutional analysis. In Table A.1 the relevant papers from this field are depicted, and why they are relevant.

Table A.1: Literature overview Institutional Environment

Literature	**Relevance**
Fernandez et al. (2010)	Describes the link between economic growth and institutions.
de Graaf (2018)	Study on the regulations surrounding Dutch Rabobank, normative judgements become increasingly important in financial sector.
Anginer et al. (2018)	Interprets effects of characteristics of the institutional environment on a macro-economic level.
Teixeira et al. (2020)	Research on the influence of regulation on banks' profitability.
Dudchenko et al. (2020)	Study on the impact of institutional environment on banks' efficiency.
Lee et al. (2020)	Relation between financial innovation, the efficiency of a bank, and the institutional environment.
Yin (2021)	Shows the impact of banking regulation on a bank's cost efficiency.
Founding Literature	**Corresponding frameworks**
Williamson (2000)	Williamsons' framework on different economic institutions.
Ostrom (2005)	Book on understanding actors behaviour.
Ostrom (2010)	IAD framework portrayed and applied.

The second search term derived to understand more about the banking environment is: ("banking sector" OR "financial sector") AND ("Netherlands" OR "Europe") AND ("evolution" OR "innovation"), resulting in 84 papers. The scientific articles emphasize the history of the financial sector and its progression towards current regulations in the Netherlands based on European directives. The same methodology of screening applies here, and emphasis lies on papers regarding the European Union and the Netherlands presenting the banking sector. This search string adds to the first term on the banking sector in general, less focused on the institutional setting. In Table A.2 the papers from the initial Scopus search are summed up.

Table A.2: Literature overview banking environment

Literature	**Relevance**
Bos and Kool (2006)	Is about the importance of bank strategies.
Alexander (2015)	Talks about restructuring of the sector after the crisis.
Pradhan et al. (2016)	Describes relationship between financial innovation and economic growth.
Saksonova and Kuzmina-Merlino (2017)	On the implementation of FinTech.
Groeneveld et al. (2018)	Study on the cooperative banking initiative (example of Rabobank).
Bredt (2019)	Study on the potential of AI in the financial sector.

Thirdly, the organisational management and processes are studied with another search term: ("Organisational management" OR "Organisational processes") AND ("change" OR "structural change" OR "institutional change") AND ("Technology" OR "innovation" OR "digitisation"). This search resulted in 526 papers. The emphasis lies now on organisational processes that are changed by innovations and preferably digitisation techniques such as AI. The goal is to find literature on how institutional changes in firms are taking place, as well as a methodology on how to do so effectively. This supports the aim of the study to find which place in an organisation BAIT has the most added value. In Table A.3, the literature in this field is shown and why it is relevant.

Table A.3: Literature overview organisational processes

Literature	**Relevance**
Goodwin and Griffith (1991)	Different processes described to deal with new technologies.
Kettinger et al. (1997)	Study on re-engineering business processes.
Haggerty and Golden (2002)	Provides framework on institutional change by technological adaptation.
Davis (2017)	Case study on incremental innovations adoption on business value.
Saarikko et al. (2020)	Research on digitial transformation within firms.
Zighan (2022)	Paper on the structural shifts caused by disruptive innovations.
Cillo and Verona (2022)	On strategic organisation for developing innovations.
Howard (2023)	On managing organisational change with an holistic approach.
Founding Literature	
Coase (1937)	Coase's theory on the strategic/ economic representation of a firm.

At last, a fourth search is conducted to combine all disciplines. A combination of the previously used search terms is denoted as: ("financial sector" OR "banking sector" OR "banks") AND ("regulations" OR "institutions" OR "legislation") AND ("digitisation" OR "innovation" OR "Artificial Intelligence") AND ("governance" OR "organisational governance"), resulting in 149 papers. Some papers have already been scanned through/ seen in previous searches, however, the combination of the terms is exactly the type of paper necessary to link the different scientific areas. The aim is to support the claims that the implementation of AI in banking heavily depends on national regulations and corporate governance. In Table A.4 the papers are summed up.

Table A.4: Literature overview AI in banking

Literature	**Relevance**
Prakash (2001)	Talks about globalisation in the financial world.
Mullineux (2011)	Study on corporate governance in the financial sector.
Avgouleas (2012)	Book on governing the globally expanding financial market.
Hu (2012)	Article on the impact of regulation and innovation on financial stability.
Delimatsis (2012)	Explains interrelations between prudential regulation and financial innovation.
Andenas (2014)	Book on governing responsibility with financial regulation.
Hu (2015)	Article on governance mechanisms.
Arthur (2017a)	Literature review on financial innovation described.
Arthur (2017b)	Case study on two financial innovations.
Ali (2020)	Paper on digitising the economic sector.
Podrugina and Tabakh (2020)	Trying to properly regulate the financial market.
Truby et al. (2020)	How to use and regulate AI in banking.
Lee et al. (2020)	Financial innovation and influence of institutional characteristics.
Sanz and Zhu (2021)	Scaling AI in the financial sector.
Fritz-Morgenthal et al. (2022)	Trying to manage risks of AI in the financial sector.

Literature stemming from these searches shapes the literature acquired from Scopus. Not all papers, however, are used in the literature study, as some papers are left out due to different exclusion criteria. These inclusion criteria are mainly subtracted from the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) method, which means authors of scientific literature should create a full, transparent, and accurate overview of the reason behind the review, how it is performed and what is found (Page et al., 2021). The main filter is looking at the title and abstract; if deemed irrelevant the papers are not read. After an abstract shows promise, the introduction, results and conclusions are scanned thoroughly. If there are contradicting or double results, conclusions have limited relevance, papers are also excluded. At last, poor grammar or faulty language could be a determinant of rejecting a paper. The residual papers are appointed as the relevant papers for this particular study, combined with all disciplines resulting in 36 papers.

The relevant papers are accompanied by two additional pieces of literature in the Complex Systems Engineering and Management master program (Williamson, 2002; Hodgson, 2006). Moreover, four founding papers of institutional analysis are identified in the relevant papers, which are believed to be essential in explaining the institutional environment. At last, a forward snowballing technique has been used to gather more literature on similar topics, meaning in the relevant papers other literary works of the same or other authors are scanned for relevant ancillary worth. The extra number of papers acquired with this technique is 43, some directly related to the relevant fields, and some more explanatory on definitions or important terms. Thus, the primary literature consists of 85 papers.

Appendix B - Background on utility & experimental design theory

In this Appendix, some more theoretical background on Multinomial Logit (MNL) models and Stated Preference (SP) choice experiments are given on which the Behavioural Artificial Intelligence Technology (BAIT) model is built. It just contains background information on the theories and their histories, in addition to some other less relevant assumptions. The goal is to elaborate on the advantageous characteristics of utility theory in predicting individuals' behaviour, and how to exploit them. But first, consumer behaviour theory and its fruition in random utility theory are discussed to elaborate on the background of BAIT's Multinomial Logit model. Secondly, experimental design theory is evolved into the use for BAIT.

Random Utility Theory

Random utility theory is examined for this background part of the literature review. The search phrase used for this part: ("Multinomial Logit Model" OR "MNL model") OR ("Random Utility Maximisation" OR "utility theory") AND ("experts" OR "financial experts"), resulting in 43 papers. The focus lies more on theoretical papers on MNL models and utility theory. McFadden's (1973) paper lies at the core of the theoretical background in this subject, and his paper is the starting point of applications of Multinomial Logit models. These papers are scanned more quickly and not all are studied compared to the main literature study.

Consumer behaviour theory is a well-known discipline that tries to understand human behaviour in deciding what products or services to select from a collection of choices (Luce, 1959). Lancaster (1966) argued a new approach to describe utility as a function of multiple attributes of goods that can be combined in a group, which gives rise to utility. Moreover, consumer theory supposes homogeneous goods (Lancaster, 1966). A choice situation can be formulated to maximise a consumer's utility and meaning an individual is able or willing to acknowledge a difference in utility (Lioukas, 1984). The consumer is presumed to rationally maximise his utility through evaluation of the associated attributes of the set of discrete alternatives, simplifying choice behaviour (Train, 2003; Nadadur and Parkinson, 2012; Lee, 2018). A final assumption as opposed to classic consumer theory claiming consumer choices are deterministic, as Thurstone (1927) first presented that choices are probabilistic and Luce (1959) and Marshak (1960) developed this notion further.

Multinomial Logit models originate from consumer behaviour theory, an economic representation of consumers as rational beings maximising their preferences (Manski, 1977; McFadden, 2001). McFadden (1973) introduced a conditional logit model or the Multinomial Logit model with the observed utility as a stochastic representation of individual tastes, combined with the unobserved utility, a stochastic reflection of idiosyncrasies of individuals' tastes for each attribute of an alternative, to define the full utility function. Walker and Ben-Akiva (2011) notes that Multinomial Logit models are best applied to situations of trade-offs on catching behavioural intricacy or ease of estimation. The unobserved utility is assumed to be Gumbel and type I extreme value distributed, meaning an independent and identically distributed (Train, 2003). Colombo et al. (2009a) links the randomness to either unobserved characteristics, personal taste, or measurement errors.

Another fundamental assumption made in MNL models, is the axiom of Independence of Irrelevant Alternatives (Luce, 1959; McFadden, 1973; McFadden, 1978; Train, 2003). It means that the presence of additional alternatives does not matter when determining the ratio of logit probabilities of two alternatives (Train, 2003), where the ratio looks like Formula 4 for any two alternatives i and k:

$$\frac{P(i)}{P(k)} = \frac{e^{V_i} / \sum_j e^{V_{j=1..J}}}{e^{V_k} / \sum_j e^{V_{j=1..J}}} = \frac{e^{V_i}}{e^{V_k}} = e^{V_i - V_k} \tag{4}$$

This ratio shows that the probability of choosing i over k does not depend on any other alternatives than i and k, regardless if there are more alternatives in set J. In other words, the improvement or addition of a similar new alternative to the choice set affects other alternatives proportionally, which is unrealistic. Luce (1959) already specifies this notion only holds in certain choice situations, as it is inappropriate in other situations with similar alternatives as confirmed by Domencich and McFadden (1975). Bliemer et al. (2009) state only the difference in utility between the chosen and non-chosen alternatives matters in determining choice probabilities. The Independence of Irrelevant Alternatives assumption is mainly beneficial for simplifying econometric estimations and predictions (McFadden, 1978).

Experimental design theory

Another background literature search on Stated Preference choice experiments is performed, a large part of the BAIT methodology. The search string envisaged finding scientific articles on this topic: ("Experimental design theory" OR "choice experiments" OR "stated preference choice experiments" OR "stated choice experiments" OR "discrete choice experiments") AND ("financial sector" OR "banking" OR "experts"), resulting in 229 documents.

Experimental design theory entails the theory underlying creating the optimal and most efficient designs when using discrete choice experiments or conjoint analysis in certain situations (Bliemer and Rose, 2010). Louviere and Lancsar (2009) argued that experimental design is the most critical aspect to ascertain the model used for estimation, and determining the level of accuracy for discrete choice experiments. Usually, the goal of this type of conjoint analysis is to let experts stipulate their opinions with pairwise comparisons between alternatives to reveal preferences for features of a product/ service about the overall utility (Jefferson et al., 2021).

Stated Preference choice experiments are a method that can obtain valuable information in many different fields, like public welfare analysis and environmental resource economics (Louviere et al., 2000). This method can extract marginal values for various attributes of goods, and approximate welfare effects of alterations of these attributes to forecast consumer behaviour in the market (Colombo et al., 2009b). Lancaster (1966) believed that if common consumer preferences are in some way represented in a choice pattern, individual choices combined with personal predilections in collecting goods can be utilised to figure out the nature of consumer behaviour. Carson and Groves (2007) found that stated preference choice experiments should be designed in such a way that if the respondent cares about the outcome of an experiment and has the idea he has a potential influence, it creates an incentive to answer truthfully.

One of the main advantages of SP choice experiments is that information is acquired that could not be revealed if the choice situations were restricted in any other way with actual choice behaviour (Kjær, 2005). Kjær (2005) also mentions that researchers can control the set of choices, and ensures variation in data over the entire range of possibilities. The hypothetical nature of this type of choice experiment is often criticised (Adamowicz et al., 1994). There are disadvantages such as responses not reflecting actual behaviour, less incentive to provide correct responses or behaving non-strategically, being costly, and being vulnerable to breaking rules on economic evaluation (Kjær, 2005).

It is important to know what type of variables are occurring in the SP choice experiments. Multiple facets such as the expected sign, whether it is a categorical or numerical variable, and the linearity of the criterion plays a role (McFadden, 1984; Hauber et al., 2016). The types of variables can be nominal, ordinal, numeric, or have no type (qualitative) (Klieštik et al., 2015). Kaur et al. (2018) define nominal variables as having two or more categories, with no intrinsic ordering between different options. Ordinal variables however do have ranks in categories, but no specific values are added to the options. Numeric variables can either consist of a specific value in an interval, which means it can be measured along a scale but has no true zero point. Ratio variables have the same properties as interval variables, but they do have a true zero point (Kaur et al., 2018).

Additionally, having labelled or unlabelled attributes influence the perception of the experiments (Cole et al., 2022). Labelled variables have names for the attributes with substantive connotations to respondents, not only implying their order of appearance (Rose and Bliemer, 2009). Unlabelled attributes denoting the names of alternatives does only convey the order of appearance (Rose and Bliemer, 2009). This decision influences the number of estimated parameters, whereas unlabelled experiments do not evaluate Alternative Specific Constants parameter estimates (Rose and Bliemer, 2009). An Alternative Specific Constant is a specific utility an individual derives from a certain alternative, usually linked with one's preference (del Castillo, 2016). The Alternative Specific Constants try to find the errors' mean for the utility of a good in a discrete choice model (Daly et al., 2016).

Appendix C - The practice of qualitative research

This Appendix discusses the reliability and validity of qualitative research. Special attention is given to the methodology of conducting expert interviews. Eliciting knowledge from experts is a fundamental activity that shapes the cognitive and social evolution of humanity (Shadbolt and Smart, 2015). There are also imperative considerations on what to retrieve in the interview, how to deal with expert bias, aggregate the knowledge, and how to encode information for further breakdown (Jefferson et al., 2021).

The validity and reliability of qualitative research elaborated on by Noble and Smith (2015). In this particular context, reliability entails consistency throughout the study of certain analyses and preventing potential biases to affect results. The validity of a study, on the other hand, reflects the integrity and scientific accuracy of the methodology resembling the data obtained (Noble and Smith, 2015). In the naturalistic paradigm of qualitative research, there is a need for trustworthiness, on which reliability and validity are based (Guba and Lincoln, 1981). The trustworthiness of the research can be distinct in four separate terms stated below (Guba and Lincoln, 1981; Morse et al., 2002; Rolfe, 2006; Noble and Smith, 2015). In Figure C.1, the relations of all these qualitative measures are depicted.

- *Credibility*: Means how well the intended theme of the study resembles the data and analytic processes. Could be seen as a form of internal validity (Rolfe, 2006).
- *Dependability*: Taking into account the factors of the changeability of the data due to external phenomena or research-induced changes. This relates more to reliability (Rolfe, 2006).
- *Transferability*: The degree to which gathered information can be transpired to other groups or researchers and be generalised. This represents a form of external validity (Rolfe, 2006).
- *Confirmability*: Rolfe (2006) adds a fourth term being the confirmability of a study, largely translating to the presentation of the outcomes.

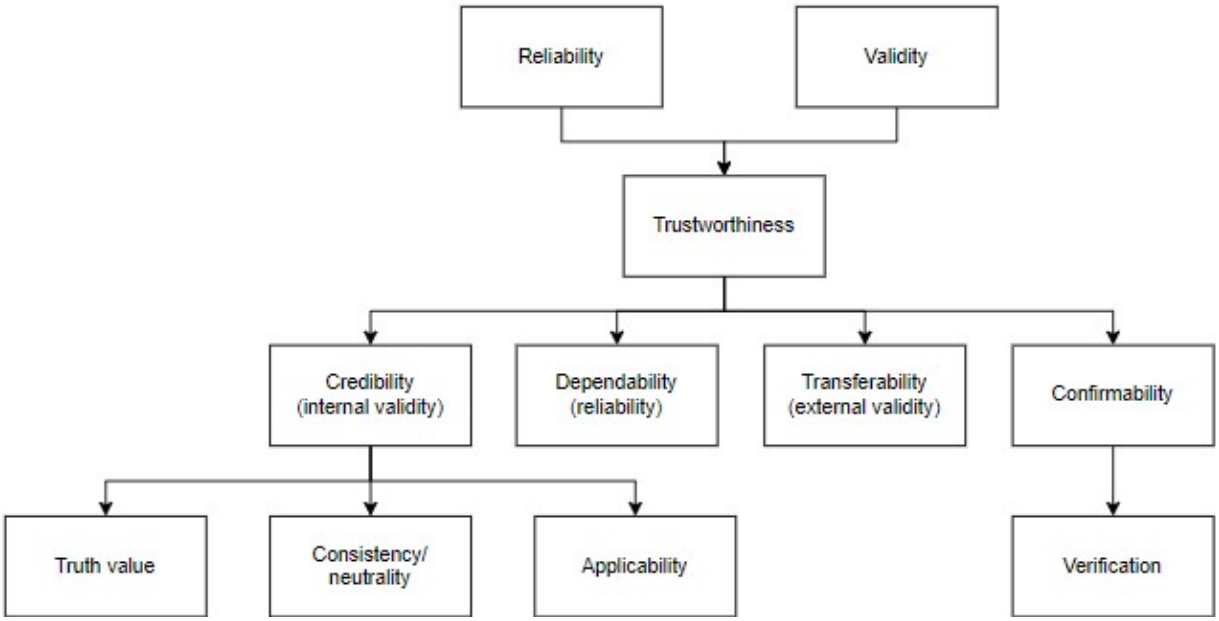

Figure C.1: Measures of qualitative research

The gathered information should be intrinsically objective, but persistent observation and member checks can adequately prove *credibility* but also *dependability* (Guba and Lincoln, 1981). The ability of the writer to keep interpretations open on results and to transfer the entire process onto his readers is defined as *transferability* (Noble and Smith, 2015). Even though findings should be open to interpretation by the reader, they are supposed to be objective and transparent to maintain neutrality (Graneheim and Lundman, 2004). *Confirmability* is retained through verification, another important activity in qualitative research, meaning the process of ensuring and being sure (Morse et al., 2002). Data should be systematically revised, moving back and forth between design and implementation for congruence between separate parts for safeguarding the reliability and validity of the study. For example, smaller conclusions or rather syntheses are a means to look back on earlier findings (Morse et al., 2002).

To verify the trustworthiness of the outcomes on credibility, several measures are developed to preserve a high level of integrity: *Truth value*, *consistency/ neutrality*, and *applicability*(Noble and Smith, 2015). These measures overlap with the naturalistic term for 'credibility' of Guba and Lincoln (1981) but also deliver strategies to retain it. One solution to increasing the *truth value* in research is performing member checks or respondent validation to establish credibility (Graneheim and Lundman, 2004; Noble and Smith, 2015). This encompasses sharing the outcomes and discussing the final remarks with peers or respondents to see their views. *Consistent research* is attained by meticulous documentation of the entire research process (Noble and Smith, 2015). Seeing if the study is *applicable* can be dealt with by stating a comparison case to which similarities and differences of all potential perspectives can be dissected (Noble and Smith, 2015).

If findings can be richly showcased and generalised for other contexts, the quality of the study will increase, in turn, the trustworthiness will also be reliant on the interpretations of the observations that are most probable, meaning the transferability increases (Graneheim and Lundman, 2004). Although Noble and Smith (2015) argued these measures are to improve the credibility of qualitative research, the measures also improve dependability, transferability, and confirmability.

Moreover, acknowledging and dealing with biases is important. Critical self-reflection on own perceptions and respondents' personal bias often occurs in qualitative research and could endanger the rigour of the study, however, is necessary for this type of research (Sandelowski, 1993). The stories of the participants can change with time, events or other external variables, becoming inconsistent as time passes. (Graneheim and Lundman, 2004). A clear path of the structure of the study is required to provide transparency to be able to transfer the interpretations to the reader (Graneheim and Lundman, 2004). It is difficult to guarantee the objectivity of a researcher, as he is not banking on his a priori judgements and has a propensity to iteratively integrate obtained information into the study (Guba and Lincoln, 1981).

In this thesis, respondent validation is mainly used. Furthermore, small syntheses of information, an incremental approach, careful documentation, critical self-reflection, and generalisation of outcomes are all used to enhance this qualitative study. Normally, to determine the worth of technological advancements, one can look at the shift in ratios of productivity, or use econometric analysis on the best-performing firms in the sector (Berger, 2003). Instead, other measures are taken to maintain reliability and validity.

Appendix D - Actor Analysis

In this Appendix, a full actor analysis is executed to give background information on relevant stakeholders in the banking sector. First, an overview of the participating stakeholders in the entire financial sector is described, to show the interrelations between stakeholders and how it affects the banks and their strategic position in the sector. Next, the actors' powers and interests positions are highlighted. Furthermore, their formal and informal interrelations are discussed, which affects the actions they can out in the action situation. At last, a comparison of the financial sector with other sectors is given, to indicate if Behavioural Artificial Intelligence Technology (BAIT) has any grounds in the financial sector. It has to be noted that of course not all stakeholders are included, only the most common, acting out financial, regulatory, and enforcing activities.

Participants' positions & goals

The participants in the action arena are identified and their individual goals/ purposes are outlined. It is interesting to know the background of the potential stakeholders in the system and what their goals are, to see if they could be allies for instance.

Councyl
Councyl is a company that tries to make implicit knowledge of experts explicit, by providing their BAIT software/ tool/ model to customers. Like any company, they try to generate profits and exploit their expertise and unique service to aid clients where other solutions/ companies/ technologies do not suffice. But they are also curious about the potential advantages and pitfalls of the methodology in the financial sector, as compared to other sectors that have proven to be interesting. Concerning objectives, they aim to really add value in the financial sector with their tool, and also to understand in what capacity Artificial Intelligence (AI) is compatible with this particular sector.

Regulators
One of the most influential stakeholders is De Nederlandsche Bank, which is the formal regulator of the Dutch banking system. Their key goal is to create financial stability in the Netherlands and facilitate sustainable welfare for all (De Nederlandsche Bank, n.d.-c). The De Nederlandsche Bank focus on the supervisory role of a regulator and alarms or reprimands banks with mismanagement. They are supported by the Authority Financial Markets, who have authorisation over the conduction of content-related business (Authority Financial Markets, n.d.-a). Their main goal is to supervise saving, investing, insurance, and other financial activities to uphold a transparent market. They are also appointed as legal guardians of the financial market and can exclude entities from entering the market to maintain the fair treatment of clients (Authority Financial Markets, n.d.-b).

Banks
The other main players in the action situation are the banks, not making a distinction here between public and private banks. Banks have the same inherent goal as any business, earning more money. Their way of doing so is not so different from other businesses, they provide services/ goods to their customers and try to smartly invest to get an advantageous rate of return. There is however a difference, as banks also have a societal role to prevent financial crimes. Banks are required by the Financial Supervision Act to actively persecute and investigate harmful clients or transactions (Overheid, 2006). There are many employees of banks experts in their respective fields that try to advance the operations of the bank as cost-efficiently as possible. Trying to find these experts and conveying their opinions is emphasised in this study.

Enforcers
Some stakeholders are allowed to enact if the De Nederlandsche Bank or Authority Financial Markets decide there has been a dereliction. The Financial Intelligence Unit's task is to assess every transaction that has been flagged as suspicious by banks (Financial Intelligence Unit, n.d.). They try to uncover possible illegal cash streams, financial terrorism or other crimes related to money laundering. If the case is suspicious, the Anti Money Laundering Centre tries to build a case against the malpractice of the clients or banks regarding these transactions (Anti Money Laundering Centre, n.d.). Their goal is concentrated on nationally and internationally preventing money laundering, and sharing their knowledge in the process. The Anti Money Laundering Centre does not work alone and cooperates if necessary with the other partners of the Financial Expertise Centre. This includes the police, the Financial Information and Investigation Service and several task forces to share expertise and fight financial crime. The Financial Information and Investigation Service is actively and physically searching for the criminals, warranted by the government. Clear communication and transparency are key to making the pursuit of criminals work.

Clients
Clients are mostly dependent on the banks they are in contact with, and are somewhat outside the scope of the research. The goal of most clients is to safely store/ invest their money for the future. Nevertheless, a small portion of clients is participating in financial crimes. They use banks to launder their money for example, and this behaviour of clients is something the experts in banks need to uncover. A client can be anything from a person to a large company in private banking.

Government bodies
There are many instances of the government that have an impact on the legal environment as well as on the organisational structures of banks. The Ministry of Finance is in the end responsible for the proper enactment of regulation by the De Nederlandsche Bank and Authority Financial Markets. The goal of the Ministry is to ensure these regulators do their jobs, to create a financially healthy, honest, and integer environment for the public (Rijksoverheid, n.d.-a). The House of Representatives is enabling the Ministry to perform its supervision and has the same goals for the Netherlands of maintaining a highly financially stable, healthy, sustainable, and safe country for all (Tweede Kamer, n.d.). They form prudential laws and regulations that establish the Ministry as a supervisory actor.

However, European bodies directly influence the legal environment, as they can create directives that each member of the European Union (EU) needs to take into account with national legislation (European Union, n.d.-b). The European Commission can set out directives the European Parliament can then deliberate on (European Parliament, n.d.). The goals of these stakeholders are also in the best interest of every citizen of an European Union member state, by protecting their freedom, creating a strong economic foundation, and representing the interests of Europe (European Union, n.d.-a). The European Central Bank is representing the European Union for maintaining financial stability and monetary policy (European Union, n.d.-b).

Independent bodies
The independent bodies have a mixed role of being supervisors as well as authoritative bodies that can discipline certain stakeholders. The best example is the Authority Personal Data, they are independently responsible for every stakeholder to adhere to European privacy directives (Authority Personal Data, n.d.). The goal of the Authority Personal Data is to protect every constitutional right of citizens regarding their privacy and protect the personal data of all individuals, companies, and other entities (Authority Personal Data, n.d.). The monetary side of policies is checked by the Netherlands Court of Audit, which is independently ensuring the responsible use of public money (Netherlands Court of Audit, n.d.-a). The government needs to justify their revenues, expenditures and allocation of resources to the Netherlands Court of Audit, being solely responsible by law (Netherlands Court of Audit, n.d.-b).

Specifically, supervising the compliance on the Money Laundering and Terrorist Financing prevention Act, the Financial Supervision Office is installed, which is independently checking and contributing to legal security in the financial sector (Financial Supervision Office, n.d.). The Dutch Banking Association is the union for national and international banks that tries to connect banks amongst themselves and society. Their purpose is to ensure a safe, sustainable banking sector and to tie the objectives of banks and the public (Dutch Banking Association, 2021). An initiative is set up called Transaction Monitoring Netherlands, in collaboration with other banks. They share expertise in monitoring/ screening clients and keeping the financial environment safe (Transaction Monitoring Netherlands, n.d.).

The leading organisation on Anti-Money Laundering policies is the Financial Action Task Force, which determines international standards and identifies countries lacking in their operational excellence (De Nederlandse Bank, 2022). The European Banking Federation, whose goal is to vocalise the interests of banks in the European Union collaborates with the Dutch Banking Association (European Banking Federation, n.d.). The overall coordination of maintaining financial stability is handled by the Financial Stability Board (Financial Stability Board, 2020). They advise national and international policymakers for strong regulatory and supervisory systems and try to create a level playing field. The European System of Financial Supervision but particularly the European Banking Authority are important for creating financial stability and striving for an effective prudential regulatory environment (European Banking Aunthority, n.d.). The European Banking Authority is responsible for the determination of binding technical norms and guidelines to create a coherent European rule book.

Powers and Interests

It is now interesting to see how these actors interact and which stakeholder can apply their functions in achieving their goals, and that of society. The relation of the powers and interests of the different stakeholders are displayed in a power/ interest grid as explained by Ackermann and Eden (2011). There are four quadrants in which participants can be categorised:

- Subjects: *They do not have a lot of power but the decision-makers often influence their lives with policies, thus have a high interest.*
- Players: *They are often decision-makers and are the main players of the game.*
- Crowd: *They do not have a lot of power or interest and are seen as wallflowers. They could be potential stakeholders and are often omitted from analysis due to their small role.*
- Context Setters: *They have a lot of power but are sleeping dogs you do not want to startle. Primarily set the circumstances and policy-makers should try to turn them into cooperative players.*

In the power/ interest grid in Figure D.1 the participants of the game are categorised. The powers and interests in this context are related to striving for the best organisation of the Dutch financial sector and ensuring financial stability, reflected by the positions of the stakeholders in each quadrant. It emphasises the operation and organisation of financial activities in banks and how stakeholders can be of influence.

The Crowd of the game are present for both having too low power and too low interest in the Dutch banking sector. Clients themselves have almost no say in how banks organise their activities, they are just subject to it. Furthermore, the Netherlands Court of Audit (NCA) and Financial Supervision Office (FSO) can oversee the government on the financial system. The Authority Personal Data (APD) can be very strict on measures regarding the privacy of clients, however, they cannot meddle in the internal organisation of banks. The Financial Stability Board (FSB) has no legal power to force institutes to employ their recommendations, however, is an internationally renowned organisation in the financial sector, having slightly more interest. The European Banking Federation (EBF), European Banking Authority (EBA), and the European Central Bank (ECB) are all interested in the banking sector and do have an impact to some extent on the Dutch sector, however, they also have different priorities.

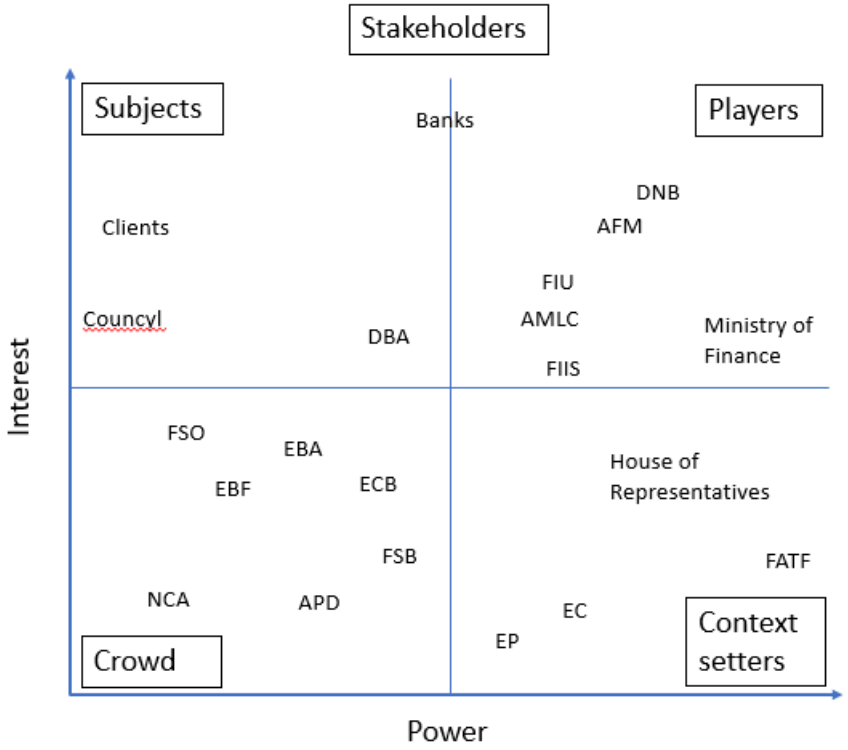

Figure D.1: Power/ Interest grid Dutch financial sector

The Subjects are the banks, the Dutch Banking Association, clients, and Councyl to some extent. Banks are of course very interested in the circumstances they are required to operate in, as well as having control over their internal policies. However, they are reliant on the Context setters/ Players for certain organisational and external regulations. Therefore, they cannot be completely seen as having enough power to be a Player. Clients are also interested in the issue at hand but have less influence on either the financial sector as a whole or the operations of the banks. They do have a choice on what bank they pick based on their preferences. The Dutch Banking Association (DBA) often tries as best as they can lobby for the banks' needs, often not having enough impact to structurally change things. Councyl is interested enough to get to know the banking sector to pursue opportunities, however, have no power over banks or policies in any way, only offer their services.

The Context setters are powerful, yet less interested stakeholders that often determine the legal setting. The European Parliament (EP) and European Commission (EC) establish European regulations in directives, that are imposed on the members of the European Union, leaving room for interpretation. However, their interests are not merely focused on the financial sector, let alone the organisation of the Dutch banking sector. The House of Representatives interested in the national organisation, however, have to deal with all of the well-being of the country, not exclusively the banking sector. The Financial Action Task Force (FATF) is creating the context and setting a precedent for regulations. It is expected their recommendations are implemented by countries, and they are checking every country on compliance and effectiveness.

The Players are the interesting stakeholders, as they hold the power and are interested enough to make a difference in the sector. The regulators in the Authority Financial Markets (AFM) and De Nederlandsche Bank (DNB) can reprimand banks for bad behaviour, as well as set precedents to which banks need to adhere. They are creating the setting in which banks need to function in. The regulators are supported if necessary by the enforcers Financial Intelligence Unit (FIU), Financial Information and Investigation Service (FIIS), and the Anti Money Laundering Centre (AMLC) in finding potential deviant behaviour of clients in the transactions of banks. They have less prudential power, but more intrusive jurisdiction. The Ministry of Finance is overseeing all these parties in the performance of enforcing the law. They are the responsible party towards the government and Europe.

The idea of the power/ interest grid is a means to create an overview of the stakeholders involved and to see which might be able to assist in achieving your goals. Additionally, the analysis offers a structured vision of how to move forward in future strategic conversations (Ackermann and Eden, 2011). The powers combined with the interests show if there are potential allies in the game, and who to please during negotiations. Since most of the context setters are big European organisations, it is harder to align national incentives with theirs. The possible interesting players that could support a bank in their cause are other banks, but also the Financial Intelligence Unit, the Anti Money Laundering Centre and the Dutch Banking Association to some extent. There is much to gain in the collaboration between these parties, especially in sharing client data/ knowledge on transaction monitoring and the thinking of the different analysts dealing with the cases. Alignment in these respects would greatly increase the ability to filter out potential money laundering practices from legitimate transactions.

Formal relations

The formal and informal interactions between the mentioned stakeholders are now demarcated. The stakeholders are almost all part of the same system of creating and maintaining financial stability in the Netherlands. Each actor has a different role to play and is intertwined in some way with one another. These relations are shown in Figure D.2.

Banks provide a certain service to clients matching the needs of individual clients and act as gatekeepers for society. But how they provide their service is heavily regulated by the government, in particular, the De Nederlandsche Bank and the Authority Financial Markets (De Nederlandsche Bank, n.d.-c; Authority Financial Markets, n.d.-a). The De Nederlandsche Bank has the supervisory role of the two, whereas the Authority Financial Markets deals with the business conduct of banks (Authority Financial Markets, n.d.-b). They coordinate in their surveillance role and are supervised by the Ministry of Finance. The Ministry needs to answer the House of Representatives. Once banks are breaching the rules or clients are flagged by the system, the regulators signal parties in the Financial Expertise Centre, consisting of several lawful enforcement organisations such as the Financial Information and Investigation Service, the Financial Intelligence Unit, the Anti Money Laundering Centre, and the police (Financial Expertise Centre, n.d.).

The Netherlands Court of Audit is in turn supervising the process of the De Nederlandsche Bank and the Authority Financial Markets as an independent organisation that reports directly to the government (Netherlands Court of Audit, 2017). They can also look at future expenditures or revenues of the Ministry of Finance and if they are handled sensibly. The Financial Supervision Office has integral supervision over the monitoring process of clients to increase awareness and perform their risk-based investigations (Financial Supervision Office, n.d.).

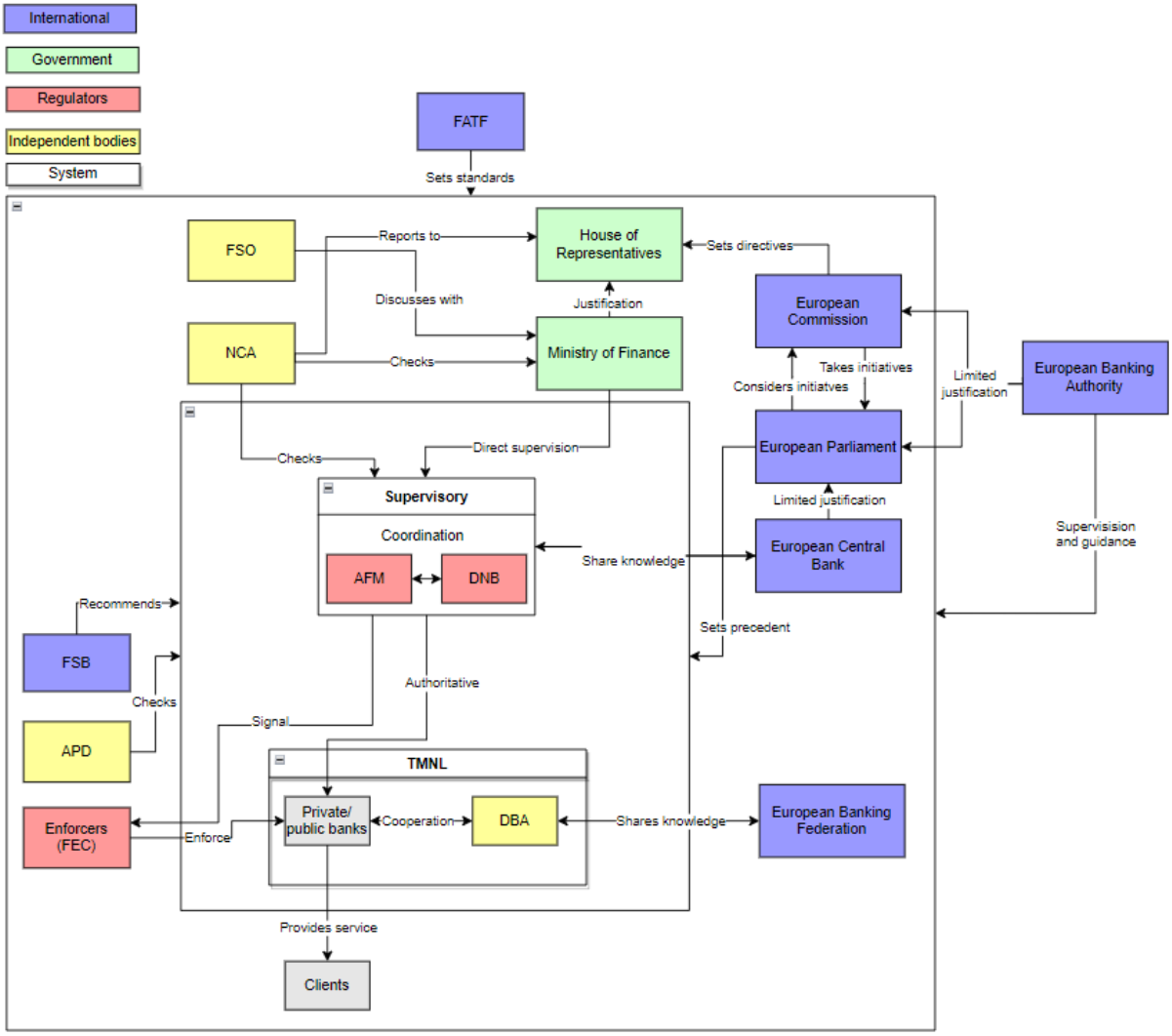

Figure D.2: Formal Chart of stakeholder relations banking sector

The government sets up the rules and regulations, according to European law as presented by the European Commission and the European Parliament. The European Commission has the juridical power to take initiatives for new or make amendments to existing directives, and the European Parliament will deliberate whether the proposal is good or not (European Union, n.d.-b; European Parliament, n.d.). The European Central Bank concentrates more on the supervision of banks in particular, not the entire financial sector, and shares expertise on regulating them (European Union, n.d.-b). The European Banking Authority is independently trying to create an improved market and supervise the practical application of the rules, however, still justifying their actions to the European Parliament and European Commission. The Dutch Banking Association is collaborating with banks, serving the economy, by for example guidance on avoiding sanctions by adhering to legal obligations (Dutch Banking Association, 2021; Dutch Banking Association, 2019). They are part of the European Banking Federation, who share intelligence and protect banks across Europe (European Banking Federation, n.d.). Financial advice on policies for the financial sector is given by the Financial Stability Board, to which no stakeholder needs to comply (Financial Stability Board, 2020).

One of the laws that impede the swift implementation of new innovations is the General Data Protection Regulation (GDPR), which is checked by the Authority Personal Data, important throughout the entire system (Authority Personal Data, n.d.). All the financial stakeholders have to effectively install the standards set by Financial Action Task Force in their national legislation (De Nederlandse Bank, 2022). They are the authoritative party on institutional compliance and the effectiveness of the results countries get. A country can be placed on two separate warning lists if it lacks in its implementation.

Several external parties that affect the financial sector are depicted outside the smallest rectangle in the Figure D.2. They are however important to indicate which actors influence the action situation and can be seen as external factors in the internal action arena. The action/ legal arena itself lies within this rectangle with the most important stakeholders. It goes to show that banks are dealing with a large network of stakeholders, all with their own views on topics. It is also important to note there are many more stakeholders that are present in the financial sectors not discussed.

Appendix E - Institutional analysis

In this Appendix, the institutional environment of the entire financial sector is described. These analyses will all be based on both the analyses of Ostrom's ideas (2010) and Williamsons' framework (2000). First, the four relevant layers of institutional context are described. Second, the effects they have on Behavioural Artificial Intelligence Technology (BAIT) are described.

Dissection of the institutional layers

Williamsons' (2000) framework is the foundation of the analyses utilised in the study that describes the institutional environment. The four layers are defined for the financial sector as explained in Section 2. For each layer, it is discussed what parts of the theories are relevant for that particular layer.

L1 - *Embeddedness in the financial sector*

The first layer of Williamson (2000) relates to the traditions of stakeholders that participate in the financial system or more globally in society. Ostroms' equivalent would be the Attributes of community and the Biophysical conditions in banking. These are external variables impacting stakeholders' potential set of actions in layers 3 & 4 and set the legal environment in layer 2. The terms are defined as:

- **Biophysical conditions**: the identification of the type of infrastructure and the type of good a bank provides. Furthermore, it entails the physical and digital banking structure that is used. Varying from offices and Automated Teller Machines to the digital infrastructure of databases of transactions or personal data of clients. Banks' services could be considered on the one hand as public goods, protecting the community against financial crimes. There is a low subtractability of use with few instances able to defend the public from these specific crimes, but a high difficulty of excluding potential beneficiaries as it is a very complex system to regulate. On the other hand, gaining a personal account or loan can be seen as a private good, as many different competitors are offering the same service thus there is a high subtractability of use, but there are low barriers to gaining such an account and thus a low difficulty of exclusion.
- **Attributes of community**: the current customs and culture known in society and the financial sector. The financial sector requires a certain level of transparency towards clients. Clients are however free to do as they please within the confines of the law, some reluctant to always stick to it. The Dutch are also known as an avaricious and careful people regarding money. Social integrity consists luckily not of immutable values but is complacent to the beliefs of a group, trying to adjust regulations to it but also changing new behaviour (Nuijts, 2018), corresponding to Williamson's feedback loop.

The type of good resembling the service that banks provide is critical in understanding the environment and the interactions it spurs (Ostrom, 2010). The banking sector is under strict supervision, and stakeholders need to know what lies within their capabilities if performing financial activities. Being a criminal, unfortunately, is also deeply rooted in society as one of the oldest professions. Whereas before the age of the internet people would have to physically enter banks with illegal cash and try to deposit it, nowadays it is easier to mask the money with multiple deposits from different accounts to launder it.

Traditional banks are public instances known to be rigid in their organisational structure. There is a tendency for bureaucracy, and the complicated organisational structure makes it difficult to impose new ideas. The government bodies however are even transcendentally more stubborn in their rigidness. Previously, De Nederlandsche Bank (DNB) refuting the option to use AI for the bank's benefit to monitoring clients since it was not in line with their outdated guidelines is a good example (Banken, 2022). Humans are creatures of habit, which is hinted through in the slow innovative measures taken by the government. The embeddedness level, therefore, contains very slowly changing institutions due to deep-seated ideas.

A firm's purpose and strategy are also important in balancing culture and values, mainly determined by the leadership's role (Deloitte, 2018). De Nederlandsche Bank has set out 7 elements of an integer culture for financial institutions (De Nederlandsche Bank, 2009):

1. *Weigh concerns/ well-balanced acting*: All relevant interests should be acknowledged and should be visibly complied with.
2. *Acting consistently*: Act in line with objectives and choices.
3. *Negotiability*: Stimulating critical and constructing attitude of employees towards a discussion on decrees, perceptions, mistakes and taboos.
4. *Exemplar behaviour*: The directors should have personal integrity, including the prevention of (faking) conflicts of interest.
5. *Feasibility*: Setting realistic goals and removing temptations for acting improperly.
6. *Transparency*: Clearly communicate about goals and choices towards stake-/ shareholders.
7. *Enforcement*: All acts of non-compliance are bound with consequences by law.

The sense of responsibility a company is expected to have is encompassed in these 7 elements. To become a better cooperative bank, there should be a heightened sense of responsibility for transparency, being fully compliant with new regulations whilst trying to increase efficiency in internal processes (Groeneveld, 2016). The banks are responsible for reasonably showing they are capable to organise and control in a coordinated integer environment (Annink et al., 2006). Another cultural change that allows banks to properly address the developments regarding Anti-Money Laundering (AML) regulations is the shift of focus of the regulator. Anti-Money Laundering practices should become more risk-based according to De Nederlandsche Bank (Brits et al., 2022). This means that banks structurally should act more effectively with declining potential criminal clients, utilising data-driven technologies and cooperating throughout the sector (Brits et al., 2022).

L2 - *Legal environment*

The surroundings that stakeholders are allowed to act in are defined by Williamson (2000) as level 2, or "formal rules of the game", which delineates all the rules and regulations, or the "Rules-in-use", currently in play. The action situation for private banks is very restricted through legislation, thus much coordination is required between all stakeholders in this pre-determined, slowly changing environment. The FATF tries to ensure certain standards are met by all financial institutions to attain these objectives (De Nederlandse Bank, 2022).

Private banks are under the strict supervision of De Nederlandsche Bank and the Authority Financial Markets (AFM), and the Financial Supervision Act is the main pillar for the organisation of the financial sector (Overheid, 2006; Rijksoverheid, n.d.-b). Additionally, the Financial Supervision Act assigned both the Authority Financial Markets and De Nederlandsche Bank to be legally obliged to ensure banks and other stakeholders in the financial sector adhere to the Financial Supervision Act (Authority Financial Markets, n.d.-b; Rijksoverheid, n.d.-b). The regulators should aim to facilitate competition in some respects between banks since it results in lower chances of experiencing banking crises (Beck et al., 2006). Competition incurs a transition to a stable market-based banking system (Ryan and Horsewood, 2009).

What the participants in the action situation need to keep in mind is especially the Money Laundering and Terrorist Financing prevention Act (MLTF) (Overheid, 2008; Rijksoverheid, n.d.-b). It is based on European Anti-Money Laundering Directive and requires banks to actively prevent financial crimes of any kind (European Union, 2015a). Banks, subsequently, are expected to dive a lot deeper into the data to monitor their clients properly. Transaction data is the critical facet by which authorities can distinguish regular clients' behaviour from money launderers. However, it is up to banks to also know clients' behaviour to be the actual behaviour of the client, and not a farce to mislead banks to be able to launder money. The law's magnitude is not impressive, and statements are very much open to interpretation. This gives all stakeholders the ability to implement the regulations freely, however, this also increases difficulty with misaligned perspectives.

There are several other national laws relevant to the banking sector (Rijksoverheid, 2019). The Dutch Sanction Act of 1977 is still relevant for imposing financial institutions' punishments or reprimands if they are not compliant judged by the regulator's assessment (Overheid, 1977). The law on supervising trust offices 2018 entails the conveyance of the management to another corporation, supervised by the De Nederlandsche Bank (Overheid, 2022b). All regulations on taxes, and thus tax evasion, are documented in the General law on State taxes (Belastingdienst, n.d.). The Public Administration Probity Screening Act (or Bibob in Dutch) protects the public from permits being abused and prevents the facilitation of criminal activities (Overheid, 2022a). The trade register law contains the compulsory administration of any company in the records of the government, so also companies that are constructed solely to launder money (Overheid, 2007). To operate as a bank they need a specific licence that is decreed in the Capital Requirements Regulation, which defines banks and allows them to perform banking activities (De Nederlandsche Bank, 2017a). For Financial Technology (FinTech) some other laws are important such as the European Payment Service Directive 2 (European Union, 2015b). These laws play a lesser role in this thesis but are important nonetheless.

An entangled web of stakeholders and their interrelations is surrounded by an equally tangled set of laws and regulations that limit these interactions. For example, if a transaction is considered unusual by banks they are sent to the Financial Intelligence Unit. Only they have access to every unusual transaction made by any client from any bank (Financial Intelligence Unit, n.d.). The Anti Money Laundering Centre, Financial Information and Investigation Service, and police are empowered by law to do physical searches with a warrant if necessary, or investigate the case with additional authorisations. But there is a downside, as the Financial Intelligence Unit is not allowed to share clients' personal data with other enforcers, which makes it difficult sometimes to follow up on a case. The lack of communication between parties and wrongful interpretation also limits good cooperation between government bodies and thus hinders investigations, at the cost of national safety.

Banks are keen to cooperate to deal with financial crimes and have set up Transaction Monitoring Netherlands, an initiative with as objective of jointly monitoring transaction data on clients. This opens up a lot of opportunities for sharing knowledge and data, which also helps enforcers such as Financial Information and Investigation Service, Financial Intelligence Unit, and the Anti Money Laundering Centre to find money launderers. Multiple experts swear by the proper implementation of the platform and think the benefits outweigh the costs. However, the Authority Personal Data is critical of the idea as collecting data in one database brings about huge privacy risks (NOS, 2022a).

Client data in every layer is protected by the Dutch Implementation Act of the General Data Protection Regulation (GDPR), as European Directive 2016/680 dictates (European Union, 2016b; European Union, 2016a). For means of privacy, the European Parliament has set out in the General Data Protection Regulation that ensures the individuals' protection of personal data according to a binding regulation (European Union, 2016a; European Union, 2016b). The Dutch government can interpret the European guidelines and alter them to a certain extent. The Authority Personal Data (APD) is responsible for the correct execution of the national law and is allowed to change it as they see fit (Authority Personal Data, n.d.). All stakeholders are under its jurisdiction, with no exceptions.

Risks are tied to Artificial Intelligence such as discrimination, sensitivity for cybercrime, privacy issues, and unverifiable decision-making (European Commission, 2020). Therefore, the European Commission has set out a proposal for the Artificial Intelligence Act (AIA), which is on regulating all AI solutions across different sectors (Fritz-Morgenthal et al., 2022). This proposal aims to present a balanced course to implement Artificial Intelligence in society minimising the required measures for risk and other issues without harming other future technological advancements (European Commission, 2021). The incorporation of these factors is crucial to any Artificial Intelligence technique aspiring legal implementation. However, the Artificial Intelligence Act is not in use, meaning there are no binding rules to accommodate yet. Any institution should account for this law before employing Artificial Intelligence technologies.

L3 - *Action Arena*

In the third layer of Williamsons' (2000) framework, the coordination and correlation between stakeholders are of interest, being "the play of the game". It should be noted that interactions between stakeholders also very much depend on the kind of agreements/ contracts they engage in, but too specific and private to incorporate in this study.

A possible means to facilitate the decentralised banking system is a polycentric governance style. It is characterised by constituent organisations being governed by a set of regulations, aiming for the higher objective of financial stability through aligning different stakeholders' incentives and information (Salter and Tarko, 2019). The Ministry of Finance would need to trust the system, as this type of governance would entail regulations being created endogenously by stakeholders, not exogenously by regulators (Salter and Tarko, 2019). Cooperating with other banks, regulators, and enforcers sharing information on transaction behaviour or anonymous client data, and creating alliances thrusting system performance to the next level is the ideal outcome. With more knowledge of potential fraudulent clients across different banks, there are increasing opportunities to catch them, since some criminals use multiple banks to hide their traces. The possible action set of these actors will now be discussed:

Banks
One of the primary stakeholders is the public/ private banks, operating their organisation with legislation in mind. Banks have individual goals such as sustainability or being profitable. Even though banks are separate institutions, cooperation in the field of Anti-Money Laundering lies in their interest. Sharing knowledge is paramount to collectively prevent money laundering and to create more effective policies. This does need the approval of the Authority Personal Data and regulatory bodies need to be convinced of the benefits. Not every bank has the means to sway from their traditional operations to utilise Artificial Intelligence technology immediately, an iterative process is necessary to optimally implement such techniques. Also, the measures need to lie within the confines of the possibilities regarding the laws.

Regulators
The tasks of Authority Financial Markets and De Nederlandsche Bank are to supervise the activities of all financial stakeholders. Specifically for banks, they can guide banks or fine them if they do not uphold the regulations. If a bank wants to provide financial services, they are required to ask for permits from the regulators, which they are expected to grant or deny on pre-determined grounds (De Nederlandsche Bank, n.d.-e). To collectively prevent fraud, they can impose their ideas to a certain extent. Many international regulators are exploring the best possible set of standards and norms covering all bases of financial risks (Financial Stability Board, 2020; De Nederlandse Bank, 2022). These are supporting to understanding risks and what practitioners need to focus on assessing them.

Enforcers
The enforcers' ability to act on suspicious transactions is only required if the Financial Intelligence Unit has enough evidence on the Anti-Money Laundering case to classify it as potentially fraudulent and to defend it in front of a court of law. The Anti Money Laundering Centre specifically is specialised in Anti-Money Laundering cases and tries to analyse the transactions, clients and case specifics inside and out. They can get the help of the Financial Information and Investigation Service or the police if companies or individuals have been caught or suspected in previous cases.

Clients
Clients are also playing an important role in the game because their behaviour is subject to analysis. A very large portion of clients is honest individuals trying to find the best bank to store their money in, aligned with their own preferences. There is enough competition from traditional banks or Financial Technology banks for a client to pick from. However, the small portion of clients laundering money is the bad but also the most intriguing group, whose actions necessitate measures.

Government bodies
Although the regulators and enforcers are all government bodies, they play a different role than the actual government. In the end, the Ministry of Finance is responsible for properly enacting the regulatory roles of the Authority Financial Markets and De Nederlandsche Bank. The Ministry should report to the House of Representatives and is internationally accountable for its visions on policies, but also justify its views on the approach of the regulators. If improvements are possible, the Ministry is allowed to propose new regulations or adjust existing laws to the House for official revision. The House of Representatives, in turn, votes to pass or deny the proposal. They are also allowed to erect new independent regulatory institutions overseeing all specific AI or banking-related activities.

Independent bodies Independent parties are checking regulators, banks and even the government on their activities and behaviour. The Dutch Banking Association is acting in the interests of national and international banks in the Netherlands. They can lobby for the fair treatment of banks' rights and pressure stakeholders to do their bidding. Supporting international banks is a way of incentivising globalisation, being advantageous to economic growth (C.-C. Lee et al., 2020). This is also strengthened by the international organisations sharing information and setting precedents/ standards to inspire stability. The Authority Personal Data however has a societal role of protecting every stakeholder's personal data from falling in the wrong hands. Anything substantive regarding the General Data Protection Regulation, the Authority Personal Data are responsible for it and have authoritative power to alter it. This often clashes with the drive for innovative data-driven solutions that banks are trying to realise.

Councyl
Councyl is a company like any other, trying to generate profits by providing a service that sets itself apart from others. Company strategy, however, is part of the action set of stakeholders and outlines the way a company is doing things differently from the competition (Porter, 1996). Porter (1996) went on to describe the productivity frontier, which can be interpreted as a trade-off between the relative cost position to competitors, and the added value of a company. The productivity frontier is depicted in Figure E.1, the idea is that each company is trying to move toward the frontier, but this frontier is continuously shifting outward due to innovations and management approaches (Porter, 1996).

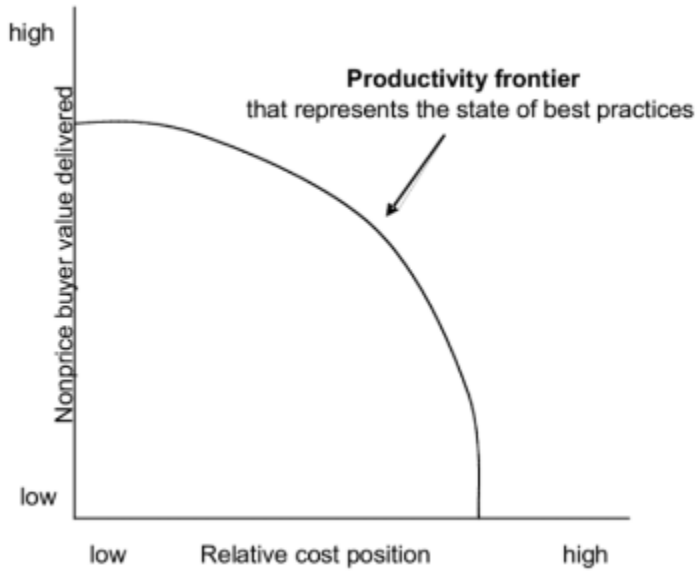

Figure E.1: Productivity frontier, adapted from Porter (1996)

L4 - ***Contracts in resource allocation layer***

A further belief of Williamson (2002) is the re-conceptualisation of the firm as a governance structure. Firms such as banks should not be organised at the hand of choices but dissected by contracts. Economics is not solely based on choices but also on contractual thinking forming the rules of the game. As Buchanan (1987) stated that in the field of public finance, the situation is too complex to ensure safety for every stakeholder based on simple market exchanges between individuals that collectively try to secure their private objectives, a situation in which contracts pose a solution.

Within a bank, employees are allocated to their tasks. Coordination efforts in top-level management decide the contents, documented in contracts. A wide range of activities can be performed by employees all for the greater cause. BAIT tries to simplify each activity, by supporting decision-making or making decisions insightful. Analysts, experts and team leads can rearrange their activities to more meaningful projects, learn and be faster in the process.

Effect of institutional characteristics and levels on BAIT

Every layer of institutions is discussed with its respective characteristics that benefit fitting BAIT in the financial sector. The institutional analysis forms the basis of the theoretical background, supported by insights from the literature review.

Characteristics of the embeddedness level

To achieve successful cooperation and coordination between countries, international financial institutions are needed (Moshirian, 2003). The brittle banking sector has been exposed by the recent global Economic Crisis, although the indicators have been present long before it hit (Mourlon-Druol, 2020). To deter another Crisis, strong prudential supervision, an airtight legal environment, a solid macroeconomic equilibrium, and installing new global financial institutions such as the Financial Action Task Force to maintain financial stability are required (Dungey and Gajurel, 2015; Mourlon-Druol, 2020; Milic, 2021).

Globalisation also induces competition, with more entities being able to provide their services in the financial market. Competition is accepted in many sectors as a good solution to achieve market stability, provided the market is non-monopolistic. It is also often perceived as kindling for economic growth, as new market entries are diversifying activities, requiring existing players to improve. Competition and globalisation need well-organised regulations and supervision, but this is also opposite to the concept of liberalisation and deregulation stimulating the two factors, thus a very adept balance should be defined between the two (Prakash, 2001; Engerman et al., 2002; Brei and von Peter, 2018). For example, financial deregulation causing competition has had a positive effect on a bank's efficiency (Chortareas et al., 2012). Unfortunately, there is little consensus on increasing regulation and supervision indeed contributing to a better environment for growth and stability for banks (Barth et al., 2004).

International financial activities are presently well-established within society but also give rise to criminality. It is possible to send multiple sums of money through different channels via a VPN connection in one country by depositing them all via another country and into various accounts in the Netherlands for example. One can see that it becomes more and more difficult to monitor these types of transactions or clients that legitimately work like this. Also, the risk of sensitive data falling into the wrong countries' hands might be a serious concern on why globalisation is no longer the holy grail of economic growth.

It is almost impossible to change certain aspects of human behaviour and rid ourselves of criminality altogether. Therefore, there are no interventions to change humans to stop them from laundering money. The best solution is to try and diminish the number of crimes by changing rules and regulations that might alter criminal behaviour. Compulsory banking regulations or better legislation on the use of for instance AI could be the push banks need to break off their traditional ways. The other way around, if banks reasonably show their new ways of monitoring transactions are beneficial for society, the regulators and government might change their stance on the topic of using AI in banking. Councyl and therefore BAIT could potentially benefit from current developments surrounding AI in banking, but also from globalisation inducing diversifying activities. Banks might want to try BAIT to distinguish them from the competition.

Characteristics of the institutional level

The banking sector is naturally heavily regulated, having several purposes such as maintaining financial stability, protecting participants, creating robustness and integrity, and integrating markets across the globe (Andenas and Chiu, 2014). Having an independent regulator is a condition that positively influences faith in the proper governance of innovations such as AI (European Commission, 2020). BAIT slightly differs from typical AI models, by using no historical and fewer data, but also unable to capture a lot of different variables and too complex situations. But this does entail that regulators and policy-makers have a better overview of the decision-making of banks, and banks might be allowed to use algorithms to become more efficient.

The Dutch government is directed by the European Commission (EC) to a new path of working securely towards fitting AI in society, where a regulatory framework is required (European Commission, 2020). Currently, there are no external supervisors appointed in the government for inspecting the performance of AI (European Commission, 2020). Since AI is relatively novel, national governments should be allowed to experiment with executing algorithms under supervision (Frissen et al., 2019). Implementation of BAIT is closely related to the acceptance of AI but is also reliant on the internal organisation of banks. The country's governance style is shifting towards a more generous environment for AI technologies to thrive in (Brits et al., 2022). The effectiveness of policies, rule of law, and regulation benefiting scalability of policies are especially important factors of country governance that impact the development of revolutionary tools.

Another condition is the centralisation of transaction data to be able to collaborate more easily. Liberalisation should positively affect the amount of competition in the financial sector, provided that proper governance prevents monopolies. However, the current decentralised sector is not beneficial to smooth cooperation between financial institutions, with FinTechs and non-banks interfering in the market. Larger banks functioning in a less concentrated system tend higher efficiencies (Chortareas et al., 2012). The wishes of the regulators are not aligned with the capabilities of the banks, and legislation hinders the merging towards the wanted outcome. BAIT can be seen as a functional bridge between the two opposing views, consisting of features that adapt the wishes of both sides in the model.

Characteristics of the governance level

A good corporate governance structure is crucial for the development of the bank. A thoughtful view of company strategy can go a long way in business and making the right decisions to please the social image (de Graaf and Herkströter, 2007). The governance structure is a composition of the identity and culture, other stakeholders' demands, government bodies' regulations, and company characteristics. Thus, companies have to keep interrelations between actors in mind, to maintain themselves in the market. Many different theories on financial performance and corporate social responsibility have been examined, none determining the exact relationship or perfect balance between the two (de Graaf and Herkströter, 2007; Djalilov and Hartwell, 2022).

Financial reform is important in more than one facet for banks to develop. An example of Rabobank refusing to make decisions on internal organisational and governance structure caused them to fall behind on fundamental transformations to get back in line with the new regulatory environment (Groeneveld et al., 2018). Their issues with Customer Due Diligence are eventually what hurt their image and reputation, and resulted in a huge fine. This new shift in Know Your Customer regulations becoming more strict could also be advantageous to Councyl, as the banks are desperate for a quick solution for this huge problem parallel to their long-term plans.

Furthermore, the implementation of innovative solutions, provided that they comply with rules and regulations, is left to individual predilections. AI is widely regarded as a very promising technique in almost any sector if properly applied, including banking. Many different uses can be thought of for AI, but in banking, certain specifics need to be kept in mind. AI is not allowed to be the sole decision-making entity in banking, thus the use of a decision-support tool like BAIT would be preferable. The transparent properties of BAIT make it an interesting opportunity for banks to incorporate the use of BAIT in decision processes. BAIT can help in making banks more efficient, as explained through the following three basic economic mechanisms at the allocation level.

Characteristics of the resource allocation level

Banks are in charge of their internal operations regarding for instance Know Your Customer practices. The allocation of their personnel and resources is imperative in the organisation of financial activities. Economies of scale, Economies of scope and Network effects should be attained by implementing BAIT if it wants to create efficiency.

Economies of scale are exploited if the production of a certain investment can lead to amortising the costs over a larger customer base. Banks often have invested drastically in back-office systems and physical distribution locations to link with customers (Feyen et al., 2021). It can lower the marginal cost of risk-taking to serve a wider range of customers with better prices (Mester, 2010). This is not so easy to achieve by banks if they use BAIT. This product is widely deployable in diverging departments due to the model's flexibility. The core of BAIT is the ability to capture human expertise based on choice experiments, which means a problem analysis must be impeccable to produce the best version of BAIT. Once it is included in the decision process, it is suitable for other processes or types of decisions, but every time a new model needs to be built.

Economies of scope have a similar mechanic, not dedicated to a larger client base, but through the collection of interdependent financial services utilising the same physical or digital systems (Feyen et al., 2021). By offering multiple services such as asset and liability products, synergy arises reducing costs. So, economies of scope are easier to acquire. A large magnitude of different applications can be thought of with this BAIT technique, but do need separate models. However, once one model is built, tested, and validated, it can be brought through the same digital interface for different decisions to support.

At last, network effects occur if there are more users on the network. Having clients that are both businesses as well as consumers makes it more efficient to connect the two and transfer payments (Feyen et al., 2021). AI can improve personalised products and services from banks to clients (Bredt, 2019). Moreover, it could give more insight into potential fraudulent transactions if client data from both ends is readily available. Network effects are not relevant for BAIT, as the demand side has no network. If a department has incorporated BAIT more employees dealing with exactly the same decisions can also make use of the same model, but it is irrelevant that another person is part of the network. As mentioned, divergent decisions require specific models, thus no network of users can grow or be exploited.

Appendix F - Interview responses summary

In this Appendix, the interview format is detailed, and the responses during the interview are written down in the original yet recapped state. The reason for this is that interviews are also held in Dutch. Not every question has been inquired during interviews, but the most important/ recurring questions are enumerated to give a short overview of the semi-structured questionnaire. The responses to each question are logged manually by typing along with their story, and (re)writing statements of the interviewee. This causes some things to be lost in translation or not entirely copied 1 on 1 but the most important takes are retrieved. All respondents approved their answers to be used in the thesis, with a remark that none of their exact quotes could be linked to either them or their organisation. Some respondents were interested in the copy of their remarks, some were more interested in the end result and some have never been heard of again.

Contents per interview

Depending on the job title or the domain they worked in, the function and issues that arise in daily operations diverged. But in general, many of the employees mentioned the lack of integrated data structures within banks, but also to external public data centres except for the Chamber of Commerce. The overarching IT landscape is not up to par to deal with all the intricacies of building a case based on many different types of information. Also, some departments have difficulties in dealing with the huge workload, especially Anti-Money Laundering as determined in the study, due to a lack of educated personnel and tightened regulation. In other departments, this is less of an issue.

For most institutions, lack of communication between regulators and banks and also misinterpretation of guidelines or regulations are causing issues for each party, including friction. Whilst regulators do not see their statements in most cases to be a perfect truth, however, banks abide by them so. On the other hand, banks feel guidance is not specific enough and they are instructed that they need to change but not instructed how, in turn, regulators feel they should be open to interpretation. There is a misalignment between the views, and pointing fingers is the defensive approach. Luckily, many initiatives have started such as Transaction Monitoring Netherlands, focus groups with the Dutch Banking Association and De Nederlandsche Bank and other knowledge-sharing platforms.

Why these issues are not yet resolved because of the complexity of each of these situations. There are too many aspects to take into account, too many different and unique situations that require another point of view or strategy. All stakeholders are looking for solutions and encounter the same issues as before, or concerning building models for decision automation, it gives rise to new trade-offs that are hard to make. But although the problems are complex, they are not impossible to crack and mostly take time. Some more generic issues are given, such as the data legacy banks have, which is causing problems in catching up on old work and keeping up with new cases at the same time.

Many rules and regulations are present in this environment, but the Money Laundering and Terrorist Financing prevention Act and more generally Financial Supervision Act are the main laws playing a role. These are of course supported and complemented by other more specific regulations, such as Capital Requirements Regulation, Bibob, etc., not all directly affecting operations for these specific activities. But it shows many laws should not be forgotten. The legislative environment was not discussed more in-depth in the interviews but was stressed nonetheless.

More specific questions

This part differs for each expert that was interviewed, depending on the previous responses and their specific function within a bank. It relates to their specific expertise and their views on BAIT's feasibility in the banking sector.

Activity related questions
Decision processes are generally similar for each bank for similar activities. Some sort of system triggers a transaction/ client for a certain activity, and an analyst takes care of the evaluation of such a case. If nothing is out of the ordinary, the case is regarded as handled. If there is suspicion of potential fraud or other criminal activity, the case is scaled up to a different team or individually handled.

The experts are inquired about their view on the current issues and possible solutions regarding Know Your Customer principle. They are all agreeing that there are two challenges in adhering to the regulations in the Netherlands: quality and quantity. On the one hand, banks need to have a certain standard in their reports. There are many quality assessors within banks, whose job is to ensure quality as a measure, but this also increases the time required. On the other hand, the teams need to deal with a certain quantity of cases and deal with them within an established time frame. Quality vs. quantity are closely related and banks have sought certain solutions to deal with them, such as hiring personnel.

Employees working in the teams dealing with these cases as well as their supervisors are seeing a shift in the type of personnel being hired. More and more people are required for these tasks, thus a less strict hiring policy is wielded. Not only people trained particularly for Anti-Money Laundering cases are let on, but also people that have some college degree or an intermediate vocational education are hired to fill the positions. This is one possible way to deal with the increasing workload. However, it is not a very viable or scalable solution as it increases cost and does not deal with the underlying issues.

Some banks however are already trying to automate and leave as much work to algorithms to do the work. Some use certain frameworks, some use decision rules and others use full Machine Learning models that are trained to find patterns within the data and decide which cases have the most potential to be fraudulent. External experts are asked how they see banks struggle with the issues, and how they help the banks when they come to them with their problems. The regulatory/ authoritative side of the issue is examined in those interviews. The process an Anti-Money Laundering case goes through from the bank to a court of law is investigated and it is studied in what part of the process inefficiencies/ issues arise and how to solve them. The external perception is that banks are struggling in the Anti-Money Laundering department, but have the tools to deal with them. However, once a report has been sent to the Financial Intelligence Unit, they have almost no feedback on their work, making it harder to establish good rules without proof. Once a legal case needs to be made, origins from reports are often diluted and it all just compromises the case if no one is knowing where information is from.

Similar insights have been given by CDD/ KYC employees. They see that there is no specific problem with determining risks with existing models. However, there are too sensitive risk models that trigger too many cases, and there are ways to reroute cases to the right person on a risk-based approach. Furthermore, automation can help them a lot in administrative tasks, and integrating systems with decision-support would relieve the heavy burden of investigations. For instance, if a tool could already automatically fill in the hand-made report analysts have to write, this would help in decreasing their time to work on the reports, which sometimes are redundant.

No employees that work in generic banking activities/ retail were responsive for an interview, however, some other experts have given their perspective of BAIT for these activities. Many existing tools automate decision/ business processes partially or even fully, mostly on administrative tasks. Incorporating expert considerations in these tasks might however be useful for more accurately determining the height of a loan, the risk of a mortgage or other decisions in this particular field. Even simpler, smaller or more repetitive decisions are suitable for BAIT once a choice model is developed. It would have been better to get confirmation from an expert actually working daily on these activities, notwithstanding their opinions might reaffirm these findings.

An ex-expert in wholesale/ corporate banking has also given its view on BAIT applying to this specific field. Large corporations and other organisations are in your clientele, and decisions are not to be made lightly. This requires more than a mere model to come to decisions, working in larger groups and communicating more requirements and performance indicators. However, there are always some smaller tasks that could use automation but not actual decisions specifically.

A Sustainable investing expert has been inquired on his take for BAIT and immediately shrugged off the possible application in his field. The decisions are too delicate, variable and complex to create a single thread through the storyline. No other experts were tracked for this activity as a result.

BAIT related questions
At last, almost all experts were asked for their opinion if a behavioural decision support tool such as BAIT would work in their respective field, or the banking sector in general. They all agreed it was an interesting tool, and most employees within the same activities reacted enthusiastically or were interested in the idea of automating decisions as a complement to manual assessment. Mainly because the model is transparent, they thought it would be especially beneficial, and basing it on expert judgements also was deemed advantageous.

Experts within banks could see the application, but whereas big banks might not have the ability to study it currently, similar approaches and solutions are naturally pursued. Smaller banks also are intrigued and have fewer resources to comply with legislation thus are behind in that respect, and see the added value in such a tool. However, newer banks are also looking for in-house-produced tools to achieve similar things, as they have smaller organisations and thus easily can switch from ideas. But for every bank, the practical use for BAIT would need to be found, whilst some of them were interested to see a project plan on how to set up an experiment, none of them followed through.

Why there are no follow-up studies can be designated to a mixture of speculations. Banks might not be interested to perform this study with a graduate student, or have no time, resources or power within the organisation to do so. Some might also not be interested in the model altogether due to various reasons. The complexity of the sector and the pressure people experience might also play a role in not starting up new projects at this moment in time, but might be available later if things are cooling down.

Appendix G - Informed consent form

Delft University of Technology
HUMAN RESEARCH ETHICS
INFORMED CONSENT

You are being invited to participate in a research study titled *"Fitting Behavioural Artificial Intelligence Technology in the banking sector: a market research study"*, because you are suggested as an expert on this topic. This study is being done by Guus de Ronde from the TU Delft in collaboration with Dr. Eric Molin, Dr. Ir. Rutger van Bergem from the TU Delft, and Nicolaas Heyning from Councyl.

The purpose of this research study is gaining a deeper understanding of the issues in the banking sector and providing a possible solution with the unique Artificial Intelligence tool Councyl has to offer. It will take you approximately 30 minutes to complete. The data will be used for the master thesis of mr. de Ronde, and potentially used as input for the market study being conducted for Councyl. We will be asking you to provide insights on open ended questions regarding recurring problems in the banking world.

To the best of our ability your answers in this study will remain confidential. Personal data such as name, email address, and occupation will be known by the executor of the interviews (Mr. de Ronde) and safely stored on TU Delft OneDrive. The interview will be audio-recorded if permitted, and transcribed. An anonymous summary of the interview will be produced and will be shared with for review. The summary that is produced is used in a master thesis and will be publicly available in the repository of the Technical University of Delft. All the personal data collected (recordings, transcripts) will be deleted after the completion of the master thesis. The result of the study might be used by Councyl B. V. for product development.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. Below the informed consent form for this research is stated. Please fill in the appropriate boxes to consent, or alternatively these statements can be affirmed verbally during the interview.

Please, if any questions arise, feel free to contact me at g.deronde@student.tudelft.nl or at +31 6 54 34 73 03. The contact details of the responsible supervisor are:

Dr. E. Molin
e-mail: e.j.e.molin@tudelft.nl

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information above [*DD/MM/YYYY*], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves: • An in any way audio-recorded interview conducted through Zoom, Microsoft Teams, or another appropriate manner. • The interview will contain open-ended questions • The audio-recording will be transliterated to (edited) written text directly. This is performed by listening to the recording and tweaking the originally spoken words to written text. Direct quotes will be denoted as such. • The recording of the interview is stored on the personal computer of Mr. de Ronde and destroyed after completion of the study.	☐	☐
4. I understand that I will not be compensated in any way for my participation.	☐	☐
5. I understand that the study is planned to end February 2023		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves the following risks: • Risk of leaked information • Risk of reputational damage through leaked information. I understand that these risks will be mitigated by anonymisation of the interviews and the personal data of the subject of the interview. The information gathered in the interview will not be made public yet is visible for the thesis supervisors. No personal data specifically will be made public to anyone other than Mr. de Ronde and is safely stored until completion of the thesis. The subjects are free to stop at any given moment.	☐	☐
7. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) (name, age, contact information, occupation) and associated personally identifiable research data (PIRD) with the potential risk of my identity being revealed, with risk of loss of personal or professional reputation.	☐	☐
8. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically political viewpoints, or confidential company data.	☐	☐
9. I understand that the following steps will be taken to minimise the threat of a data breach, and protect my identity in the event of such a breach: Completely anonymous interviews; No personal data published; data destroyed after research.	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
10. I understand that personal information collected about me that can identify me, such as name or contact information, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed. Approximately February 2023 this study has ended and the data is removed.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study the de-identified information I provide will be used for the following: • The results of the analysis for the master thesis which is publicised at the TU Delft repository: (https://repository.tudelft.nl/). • An appendix within the thesis will include the anonymous response of the interviews. The results of the study may be used by Councyl to determine possibilities to provide its services to companies in the financial sector. • At last, the results of the study could lead to scientific publication.	☐	☐
13. I agree that my responses, views, or other input can be quoted anonymously in research outputs.	☐	☐
14. I agree that my real name can be used for quotes in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
15. I give permission for the de-identified information that I provide to be archived in the TU Delft repository so it can be used for future research and learning.	☐	☐
16. I understand that access to this repository is openly available on the internet.	☐	☐

Signatures

_____	_____	_____
Name of participant	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Guus de Ronde	_____	_____
Researcher name	Signature	Date

Study contact details for further information:

Guus de Ronde

g.deronde@student.tudelft.nl

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