Unravelling the Complexities of AI Implementation in Customs Controls: A Technology Enactment Framework Analysis of Automated Detection Projects

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Gül ÖZTÜRK

MSc. Public Administration: International and European Governance

Leiden University, The Hague

Supervisor: Asst. Prof. Dr. H.I. HUANG

Second Reader: Dr. J. REIJLING

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Abstract

This study uses the Technology Enactment Framework (TEF) to explore how the Customs administrations of Türkiye and the Netherlands design and implement AI technology in their automated detection pilot projects to facilitate legal trade and detect illicit trade at border crossing points. It also displays what organizational elements can be learnt from the two cases to add to the limited literature in AI applications in the public sector. At the end of the research, AI Technology Enactment Flowcharts for the two administrations, a Comparison Table and a Proposed Extended AI TEF for Customs were developed. Validating the TEF, the research also identified AI-technology specific organizational forms, institutional arrangements and project processes facilitating or impeding the pilot projects in the two customs administrations.

Key Words: Artificial Intelligence, Customs Controls, Disruptive Technologies, Customs Detection Technologies, Automatic Image Interpretation, Illicit Trade, Smuggling, Technology Enactment.

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ACXIS: Automated Comparison of X-Ray Images for Cargo Scanning

AI: Artificial Intelligence

CAN: Customs Administration of the Netherlands

CAT: Customs Administration of Türkiye

CDTPG: Customs Detection Technologies Project Group

DGCE: Directorate General of Customs Enforcement

EU: European Union

IoT: Internet of Things

ML: Machine Learning

NII: Non-Intrusive Inspection

PEN-CP: Pan-European Network of Customs Practitioners

TEF: Technology Enactment Framework

TEG: Technical Expert Group

TÜBİTAK: The Scientific and Technological Research Council of Turkey

UFF: Unified File Format

WCO: World Customs Organization

WTO: World Trade Organization

1. Introduction

1.1. Background Information

Technological advancements have permeated every aspect of life: Automation technologies revolutionizing the production process, the internet redefining access to information, and digitalization transforming record keeping and data processing methods. Accordingly, governments are embracing digital transformation by adapting their operational procedures to augment service provision, bolster efficiency and effectiveness, and achieve objectives related to transparency, interoperability, and citizen satisfaction (Mergel et al., 2019).

Over the past few years, public organizations have recognized the growing importance of Artificial Intelligence (AI) as more of their operations are being driven by the AI (Mikalef et al., 2023). Although the private sector has been ahead of the public sector in implementing AI, the public sector aims to quickly close the gap (Berryhill et al., 2019). Governments have come to acknowledge that incorporating AI into their operations is imperative to provide high-quality services to citizens and stakeholders, and respond to rapidly changing operational environments (Mikalef et al., 2023).

Today, we also inhabit a world characterized by increased mobility compared to previous eras. The accelerated movement of goods, individuals, and services across national boundaries has expanded the frontiers of states, posing new challenges for border authorities in terms of surveillance and control. Historically, border control concentrated on military and political power; however, it has been fortified to protect public resources, cultural heritage, populations, and social security in time (Rahman, 2021).

While varying in organizational structures, public organizations responsible for conducting checks at border crossing points are typically represented by the Customs authorities. The Customs have held a critical role in collection of duties and protection of the public, with contemporary additions to their responsibilities such as facilitating legal trade and global supply chains, preventing illicit trade and timely responses to pandemics or natural disasters (Matsudaira and Koh, 2022). As such, the role of technology is quite crucial for the Customs to keep the trade flow going while detecting criminal activities.

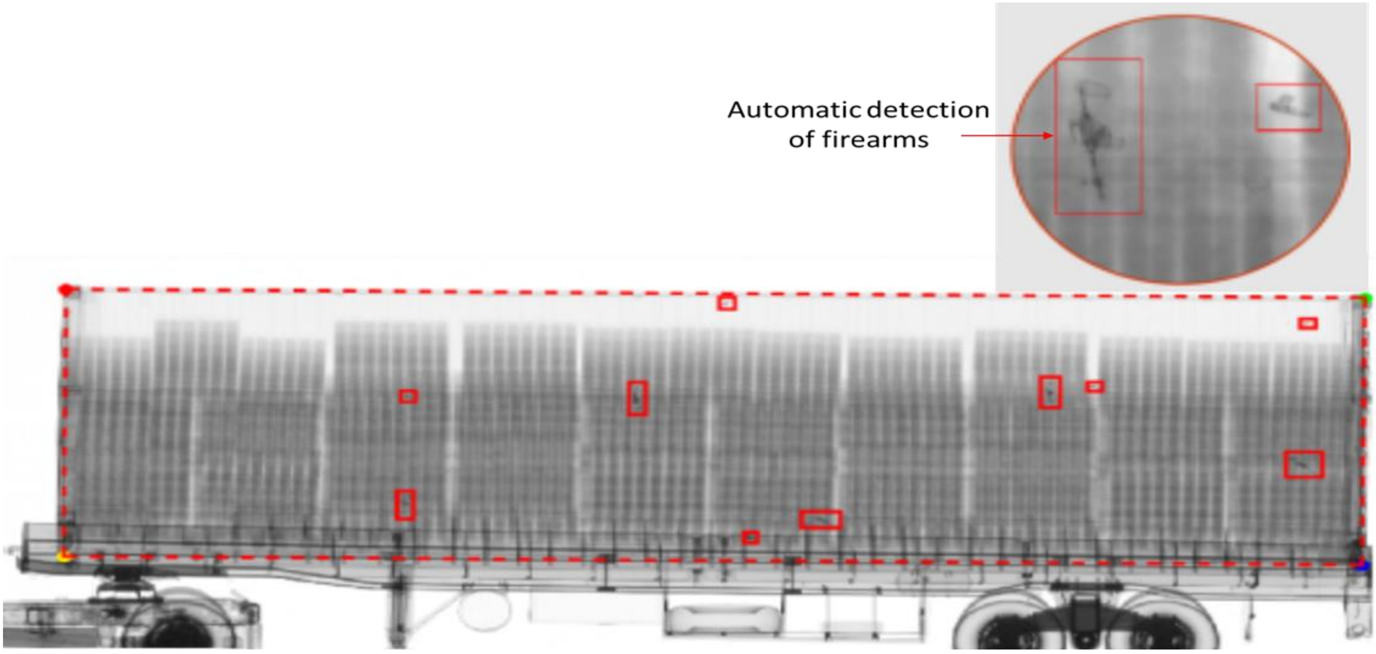
Nowadays, the global trade volume is approximately 45 times greater than what was observed during the early years of the General Agreement on Tariffs and Trade, signifying a 4500% growth from 1950 to 2022 (WTO, 2022). This substantial increase in cross-border traffic renders border crossing points potential hotspots for illegal activities. Illicit trade, encompassing smuggling, counterfeiting, human and wildlife trafficking, and other forms of unlawful conduct, undermines the global development agenda, inflicting an annual loss exceeding US$2 trillion on the global economy and accounting for an estimated 3% of the world's economic output (UNCTAD, 2020).

Besides illicit trade, other forms of cross-border organized crime including terrorism are alarming for the Customs. Inquiries conducted by law enforcement agencies have established a connection between organized crime and terrorism. For example, drug trafficking can be executed to finance terrorist organizations and drugs are used by the perpetrators of terrorism for consumption purposes (UNODC, 2007). The 9/11 was a turning point paving the way for the development of "customs supply chain security paradigm", introducing additional customs policies and standards, including the importance of using Non-Intrusive Inspection (NII) scanning equipment, to deter the conduit and delivery of violent extremism via international trade (Ireland, 2009).

Scanning is the second phase of the three-phase customs control procedure in broad terms: (i) *screening* means the initial evaluation of a container's risk, (ii) *scanning* means using NII technologies, commonly known as the X-Ray scanners, to generate the images of the container's content, and (iii) *physical inspection* means opening a container and manually examining a sample or the entire content (Martonosi et al., 2006). Following the selection of the risky cargo, containers/trucks are checked to see if there is any prohibited good inside through the scanners. In the scanning phase, the role of the *image analysis operator*, also called as the image interpreter or the X-Ray operator, is crucial.

Today, the ability to identify and detect forbidden items like drugs, arms, cigarettes, etc., in X-Ray images still relies heavily on the skill and expertise of human operators (Michel et.al, 2014). However, given the above-mentioned increasing challenges in customs controls, in the past few years, integrating ML as a form of AI is becoming more prevalent in the image analysis process to detect the prohibited good automatically. Basically, the model is designed to warn the operator by showing the place of the prohibited good on the image and saying that the cargo contains drugs with, for instance, 80% probability. Figure 1 presents a simple illustration of automatic detection in an X-Ray image.

Figure 1: An Illustration of Using Automatic Identification on an X-Ray Image



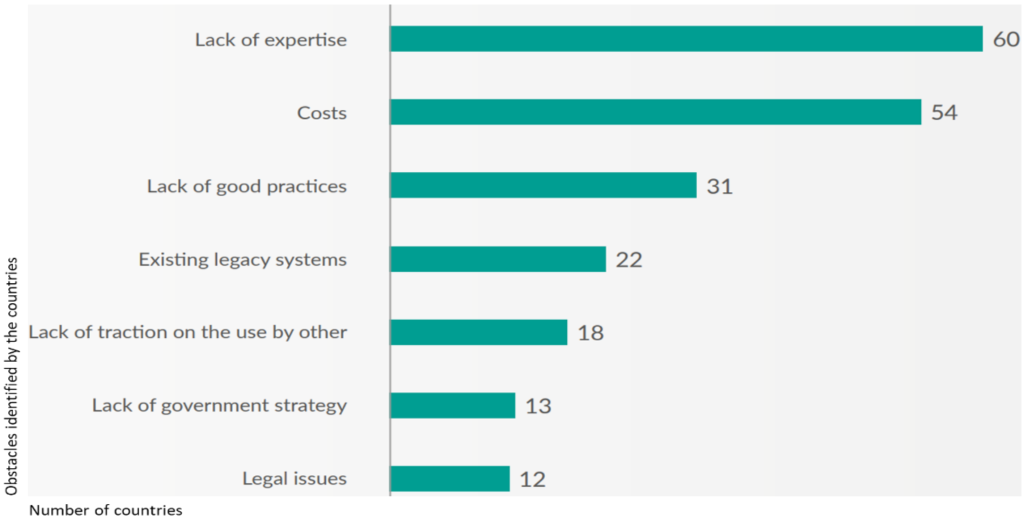
Source: (*Rapiscan, 2023. Retrieved from*
https://www.rapiscan-ase.com/products/software/insight-operator-assist-tools)

1.2. Problem Statement

The AI is an emerging technology and the customs administrations have different strategies regarding the adaptation of AI technologies, despite the standardization efforts at the international level via the World Customs Organization (WCO) or the European Union (EU). In other words, despite the common challenges faced by customs administrations and their willingness to adopt AI technologies, their level of adaptation of these technologies differs from one administration to another (WCO & WTO, 2022).

The survey of 94 customs administrations (see Figure 2) reveals that the main obstacles for AI adaptation are the lack of the following: expertise, good practices, existing legacy systems, traction by others, government strategy, other legal base and high costs (WTO & WCO, 2022). The success of the AI projects, therefore, are dependent on many factors.

Figure 2: Survey Results on the Main Obstacles to Adopting Big Data, Data Analytics, Artificial Intelligence and Machine Learning in Customs



Source: *(WTO & WCO, Study Report on Disruptive Technologies, 2022, p.73)*

Although limited in number, customs administrations have engaged in efforts to integrate automated detection into their image analysis process, which will have consequences for the customs control procedure. Yet, the existent literature focused mostly on the technological challenges of automated detection projects while a thorough analysis of the other possible challenges of implementing automated detection projects are yet to be conducted and their possible policy implications wait to be discovered.

1.3. Research Aims and Research Relevance

This research will pursue an organizational level analysis to reveal the complexities of AI projects in a specific public sector and two country settings. It will study the two customs administrations to explore how these public organizations under different country contexts are enacting the AI pilot projects in the area of automated detection. One case is the Customs Administration of Türkiye (CAT) and the other case is the Customs Administration of the Netherlands (CAN).

Accordingly, the two main **research questions** are:

Question 1:

How does the Customs Administrations of Türkiye and the Netherlands enact AI technology in the automated detection projects?

Question 2:

What organizational elements could be learned from the two cases in accordance with technology enactment?

From theoretical, practical and societal relevance perspectives, the research aims to contribute to the limited literature of AI applications in public organizations and provide a proposed framework that customs administrations can learn from when deploying AI technologies. The research findings are expected to benefit the society because good practices of AI would facilitate customs controls for traders and passengers, and help the detection of contraband goods, protecting the safety of the public and preventing tax loses.

1.4. Theoretical Framework

The main theoretical framework guiding the research is Jane Fountain's (2001) Technology Enactment Framework (TEF). TEF mainly proposes that the technology is dependent on "what individuals within the organization make out of it" (Mergel, 2019, p.2). Accordingly, it makes a distinction between objective technology and enacted technology, the former being the technology itself and the latter the ways this technology is perceived, designed, implemented and used (Fountain, 2001). To Fountain, enacted technology should be studied together with the (i) organizational forms, (ii) institutional arrangements, and the (iii) outcomes, as they are interacted in mutual relationships.

The employment of TEF is regarded as a substantial contribution to achieving a holistic and structured understanding of IT projects within the public sector (Schellong, 2007). Thus, it could help reveal how different organizational approaches to AI result in varying levels of technology adaptation, and address or surmount the AI associated challenges.

The structure of the thesis will be arranged as the following. Section II will be a literature review on theoretical approaches and existing studies regarding AI implementation in the public sector and the customs domain. Section III will introduce the research design and methodology. Section IV will be on the analysis of the research findings. Section V will be the discussion and Section VI will conclude the thesis.

2. Literature Review

2.1. AI Implementation in the Public Sector

AI typically means the development of an intelligent system imitating human abilities such as learning, reasoning, planning, perception, and natural language processing. Machine learning

(ML) is an AI technique employing learning algorithms to extract insights from data, allowing it to learn new skills, identify patterns, and make decisions with little human assistance. ML can be thought of as a data analytics approach automating predictive modelling whose precision and rational output enhances as the volume and the quality of data grows (Matsudaira and Koh, 2022).

The investigation of AI within academic literature is a nascent phenomenon, as the applications of AI have recently become pervasive (Wirtz et al., 2021). Moreover, there is a need to differentiate leveraging AI technologies in public organizations from the ones in private organizations because the former might be impeded by political, legal and policy challenges (Dwivedi et al., 2021). Therefore, more empirical research is needed to identify the aspects enabling or hindering AI implementation in the public sector (Janssen et al., 2020).

The initial literature on AI applications merely concentrated on the technology itself and its direct impacts. Nowadays, the governance aspect of AI is becoming a salient concern, as it appears that society will ultimately adapt to it (Wirtz et al., 2022). The preliminary AI implementations have demonstrated that governing the technology presents challenges due to its intricate and dynamic nature, and the unpredictability of its development phase. That is, the multifaceted application domains and the black box characteristics of AI render it quite difficult for governing entities to comprehend (Wirtz et al., 2022).

Both its technology-driven challenges and non-technological challenges demonstrate that there is a need to evaluate the AI implementation in the public sector from a holistic point of view by looking at approaches to AI at different levels, including the macro, meso- and micro-levels. The relevant literature will be discussed as the following.

2.1.1. Macro-Level Approaches to Understand AI Implementation

The macro-level approach to AI broadly means to understand it as an ecosystem of its own where the technology, actors and functions are intermingled. Due to the complexity and the evolving nature of this digital technology, some propose a system-thinking approach to govern AI (Corbett, 2017). At the macro level, the most significant questions of AI governance are related to how the "AI ecosystem" can be managed to ensure that society benefits from it and who is responsible for AI governance at the state and organizational level. To Wirtz et al. (2022), AI is not just a technology, but also "a way of thinking" about what technology is capable of to fully grasp its implications. In that sense, Wirtz et al. (2022) adopts a holistic risk and challenge-oriented approach to AI governance and provides an AI ecosystem framework composed of the AI system, the governance challenges, the multi-stakeholder governance process, the mechanisms and the governance policy. Similarly, Dwivedi et al. (2019) proposes an AI governance approach by which responsibilities are outlined and AI-related risks are continuously assessed. Dafoe (2018) asserts that the need to analyze AI governance including the *strategies*, *policy solutions*, *global rules*, *public policies* and the *institutions* is urgent. Another macro level perspective prioritizes the legal grounds of AI and the necessity of a new thinking on law, regulation and policy in relation to it (Gasser and Almeida, 2017).

2.1.2. Meso-Level Approaches to Understand AI Implementation

Besides the aforementioned comprehensive perspectives, another type of research concentrates on AI at meso-level, encompassing an organizational-level analysis. Being one of these scholars, Bullock (2019) has a positive but a cautious approach to AI. He argues that it would improve the quality of the administration as a whole as the AI increases the quality of decision-making. However, the success of AI is contingent on the legal and organizational frameworks that underpin it, particularly the allocation of different tasks based on their complexity and unpredictability. Holmström (2022) presents an organizational level AI readiness framework with four key dimensions: technologies, activities, boundaries, and goals of the organization. Mikalef et al. (2022) assert that a comprehensive organizational planning is essential for accommodating AI-enabled changes, and this planning must extend beyond resolving technical challenges. Recently, the concept of "AI capability" has been introduced in literature, referring to "an organization's capacity to effectively use AI technologies to achieve their objectives." (Mikalef & Gupta, 2021). The notion of AI capability posits that to realize returns on investments in AI, organizations must cultivate additional AI-related resources that are complementary to the technology itself.

From an academic research perspective, there is still a lack of theory-driven knowledge about how public organizations develop the capacity to effectively use key technologies such as AI and how internal and external factors shape these capabilities (Schaefer et al., 2021; Mikalef, 2022). At the same time, from a practical perspective, public organizations are under increasing pressure to improve efficiency and service quality, especially through the use of new digital technologies (Urbach & Röglinger, 2018).

As such, in order for government agencies to successfully deploy AI technologies, it is essential to understand the main drivers of deployment and provide support for the process (Mikalef, 2022). This underlines that an AI capability goes beyond picking the right AI or conforming to it but also encompasses the capacity to "bring AI related projects to fruition." (Mikalef, 2022). This capacity refers to the AI-related tangible, intangible and human resources that an organization harbours (Mikalef and Gupta, 2021). Tangible resources include the data necessary for AI algorithm development, the technological infrastructure to support the data storage and process other basic resources like financial flows (Desouza et al., 2020; Wirtz et al., 2019; Mikalef et al., 2022). The intangible resources include the capability of organizations to facilitate interdepartmental coordination, to initiate and carry out organizational change, and the propensity to engage in high-risk high-return projects (Davenport and Ronanki, 2018; Sun and Medaglia, 2019). AI-related human resources refer to the capability of a firm to balance technical and management skills. The technical skills refer to skills necessary to handle data and implement AI projects and managerial skills are the skills required to understand the necessary domain knowledge and having a vision for future application areas (Dwivedi et al., 2021).

2.1.3. Micro-Level Approaches to Understand AI Implementation

Despite the growing popularity of AI in organizational settings, its influence on individual structures within organizations has not been subject to extensive scrutiny (Rodko et al., 2021). Thus far, the impact of AI on organizational structure focused mainly on technological or decision-making perspective and a limited number of research consider the role of new digital technologies as catalysts for organizational and structural transformation (Bullock, 2019). Within organizational contexts, the term "individual structures" encompasses both various departments and sub-units of the organization, and the individuals constituting them. Although it is not possible to draw bold lines between the meso- and micro-level analysis, this section will present the concerns of the individual level studies on AI.

First, AI is expected to alter the ways labour is organized in an organization, which would transform the classical Weberian type of bureaucracy (Bullock et al., 2022). Mohanty and Vyas (2018) contend that the use of AI, in conjunction with the advancement of the IoT and blockchain technology, will result in an increase in decentralized autonomous organizations. Studying the impact of AI projects on organizational transformation in the private sector, Fountaine et al. (2019) expects that AI will cause a shift from working in isolated units to engaging in interdisciplinary cooperation, leading to the emergence of cross-functional teams with varied skills from different functional areas. As such, teams with diverse backgrounds can effectively assess the operational changes required for the successful implementation of new AI applications. Second, algorithms-based decision-making will raise questions on the hierarchy principle (Rudko et al., 2021). Thus, a shift from a leader-driven to data-driven decision making would reduce the need for a superior decision maker to give orders (Fountaine et al., 2019). Third, AI could impact the span of control principle, yet the current literature lacks specific accounts of how this change could be (Rudko et al., 2021). Moreover, the rise in external risks and uncertainty can prompt organizations across all sectors to embrace more flexible and adaptable organic structures, leading to less formal but more dynamic ones that are better equipped to respond to environmental challenges (Burns and Stalker, 2011).

Second, personnel capability is a concern of micro-level analysis, which can be considered as a sub-component of personnel planning for AI-related human resources in the meso-level analysis mentioned before. Tan and Crompvoets (2022) put forward that this new digital era necessitates a change both in human resources and managerial skills. The technical staff assumes a prominent role in the new era as data is ubiquitous across the organization, with their role shifting from purely providing support in IT services to data management, necessitating new skills such as data literacy (Tan and Crompvoets, 2022).

Among the other employees, managers are crucial in the process of leveraging technological change. There are various challenges brought by the new era to managers, including both non-technical challenges such as hiring new types of digital talents and integrating the new digital tools to daily work, and technical challenges originating from the characteristics of the technology (Tan and Crompvoets, 2022). Unless such challenges are fully comprehended by the managers, it is likely that they oversimplify the AI project process and expect rapid outcomes. This could cause organizations' encountering challenges in scaling up from pilot projects to broader initiatives and in shifting from addressing particular business issues to more significant business challenges (Fountaine et al., 2019) Thus, considering it as a "plug-and-play technology" would disappoint the managers expecting numerous benefits from AI (Fountaine et al., 2019, p.64).

Third, individuals' willingness to adapt to AI is another concern since AI tools may encounter resistance unless they are adequately acknowledged (Deloitte, 2021). Steiner et al. (2021) argue that individuals are not passive bystanders in the face of structural changes, rather, they can substantially shape this process. As such, resistance to change, triggered by the fear of losing jobs, can hinder deployment of new technologies. Rudko et al. (2021) created a model categorizing responses to AI into four groups: skeptics, doubtful skeptics, optimists, and doubtful optimists. They found doubtful optimists to be key in setting positive organizational trends, influencing skeptics and doubtful skeptics. Attitudes towards AI can also differ from one actor level to the other. Huang et al. (2022) investigated the potential discrepancies in the evaluation of AI driven process innovations between managers and staff members, and found that managers demonstrated a greater inclination to endorse AI as a decision support instrument in comparison to the staff. Here, an innovation culture potentially facilitates adaptation of individuals to new technologies (Fountaine et al., 2019; Grimmelikhuijsen and Feeney, 2017).

Fourth, micro-level analyses focus on decision making. Despite the increasing government interest in incorporating AI technologies, their potential extent and impact remain uncertain (Zuiderwijk et al., 2021). Indeed, the growing prominence of AI in governmental contexts stems from its anticipated impact on the public policy cycle, specifically the transformation of decision-making processes (Valle-Cruz & Sandoval-Almazán, 2022). As such, Young et al. (2019) proposes a framework to study the impacts of AI on the administration by differentiating artificial discretion from human discretion.

Indeed, the AI is not expected to entirely eliminate job positions but remove specific tasks within those positions (Volini et al., 2020; Sampson, 2021; Brynjolfsson et al., 2018). There will be an increase in the competencies of human operators with the exactness and discernment of "simulated minds" (Daugherty and Purdy, 2017; Bullock and Kim, 2020). To McKendrik (2018), the involvement of machines and computers in automating certain tasks increases the efficiency and excellence of workers by supplementing their skills, enabling them to concentrate on more crucial components of their job requiring their attention. The suitability of employing AI for specific tasks is dependent on the degree of discretion necessitated for the successful completion of those tasks (Bullock, 2019; Young et al., 2019).

Prior research also showed that AI is not a substitute for human but reflects an integrated common effort of machine and human. A Deloitte survey acknowledged that the collaboration between technology and people is not an "either-or" but rather a joint effort requiring both parties to work together, a "both-and" partnership (2021, p.25). As such, the concept of a "super job" and "super teams" were introduced in the 2020 and 2021 Deloitte Global Human Capital Trends reports respectively, referring to the idea of combining the tasks of different conventional jobs by utilizing a synergistic partnership between human operators and AI to achieve better results. The co-performance of the real and simulated minds is associated with the term "diversity bonus" in organizational psychology, meaning that incorporation of AI into a team leads to a distinct type of "thinking" and that this combination can generate diversity bonuses, exceeding the benefits obtained by teams comprising only humans (Page, 2017; Guszcza et al., 2020).

2.1.4. Interactions Between the Macro, Meso- and Micro Levels

Upon examining different levels of analysis in AI, it becomes evident that these levels are interrelated and cannot be delineated by sharp boundaries. For instance, the implementation of AI projects by an organization is influenced by the national AI strategy within a country, subsequently impacting the organizational structures and eliciting responses from its employees. This influence is not always unidirectionally top-down but can also occur as bottom-up. As such, individual experiences with AI at personal level can exert influence on higher levels, resulting in organizational or systemic changes.

This thesis research will primarily focus on the analysis of AI projects undertaken by two customs administrations, predominantly focusing on an organizational (meso) level analysis. However, since organizational-level analysis inherently encompasses the effects of both macro and micro levels, it is expected to yield a comprehensive analytical framework to articulate a holistic perspective.

2.2. Theoretical Framework of the Research: Technology Enactment

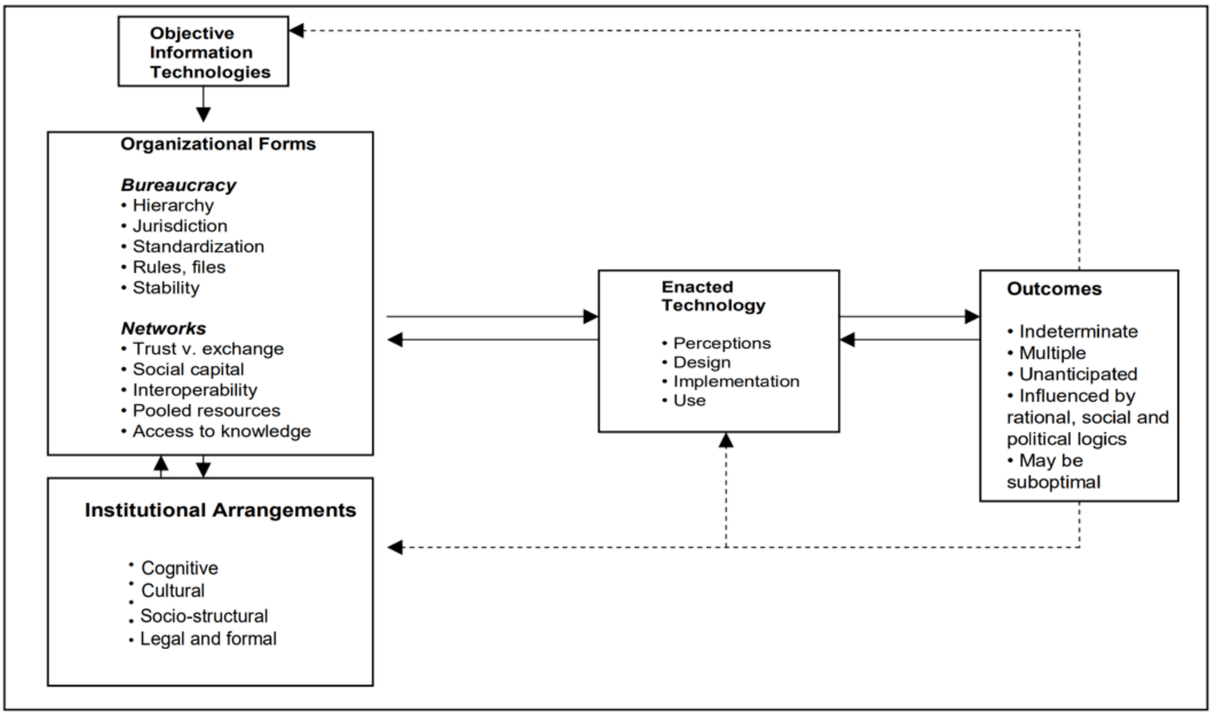
2.2.1. Overview of the Technology Enactment Framework

The reviewed literature showed that assessment of AI implementation at the organizational level offers the advantage of thoroughly examining an organization's AI capabilities in terms of available resources for implementing AI projects. It also revealed how these resources impact each other and what kind of results they lead to. Consequently, this research will be based on the Technology Enactment Framework (TEF) of Jane Fountain (2001), which provides a theoretical foundation for conducting an organizational level analysis of technology adoption in the public sector.

Development of theoretical frameworks for explaining digital transformation in government coincided with the increase in the digitalization efforts of governments, necessitating a change in the organizational structures, processes and procedures regarding how governments handle certain tasks. Critical of the institutional theories due to their focus on institutions' stability and constraining power on action, Fountain (2001) tended to explain change rather than continuity in institutions. Her contribution is the introduction of the term "enacted technology" and differentiating between objective and enacted technologies. The objective technology is the technology itself and its material components: the internet, hardware and software. Having a broader scope, enacted technology involves the users' perceptions of objective technology and its applications in certain settings (Fountain, 2004), in particular, how the objective technology is perceived, designed, implemented and used (Fountain, 2001).

The TEF is extensively used for studying technology related projects of public organizations as it offers many advantages. To begin with, it allows for gaining a detailed and structured understanding of IT projects in a public organization (Schellong, 2007). Omar et al. (2016) determined that TEF's technological focus within institutional theory is suitable for investigating digital transformation in the public sector. In a similar vein, Cordella and Iannacci (2010) surveyed frameworks used to analyze motivators for technology adoption in the public sector concluding that the TEF is widely appreciated for its insight into the organizational and institutional effects of technology deployment. More recently, the TEF has been adopted for investigating digital transformation in the public sector in different country-settings. For instance, Tassabehji et al. (2016) examined the role of managers as 'institutional entrepreneurs' in enabling digital transformation in the US public organizations and Gong et al. (2020) instrumentalized TEF to conduct a cross-level study, from the provincial level to country level, to explore the flexibility of organizational forms granted by digital transformation in China.

Figure 3: Technology Enactment Framework (TEF)



Source: *(Fountain, 2001, p.91)*

The TEF has three key components (see Figure 3) which are organizational forms, institutional arrangements and the outcomes, as the mediators of enacted technology. Regarding the first factor, (i) organizational forms, Fountain (2001) states two kinds of organization forms: traditional bureaucratic structures and, more flexible, network structures. While many public organizations still work within a single agency or department where such principles as hierarchy and standardization dominate, collaboration across different agencies through networks is also becoming prevalent. Networks can be helpful in breaking down hierarchies and crossing boundaries, but they should rely on high levels of trust and social capital among participants, and a culture of information sharing. The second factor is the (ii) institutional arrangements like legal, formal, cultural, cognitive norms. Third, the (iii) outcome is the final stage of TEF. It may take a considerable amount of time before the consequences of implementing a technology become apparent. The outcomes can have an impact on the other elements of the TEF like organizational structures, institutional set-ups, enacted and the objective technology. Also, they can manifest in diverse ways including uncertain, multiple, and unexpected (Fountain, 2001).

The reasons why this research is grounded on TEF are three-fold. First, it enables the researchers to identify the different approaches of the organizations. To Fountain, objective technology would have a little practical value to an individual or an organization "unless or until knowledgeable agents use them". (Fountain, 2001, p. 2) In that sense, the technology is dependent on "what individuals within the organization make out of it" (Mergel, 2019, p.2). Since this research aims at revealing how different customs administrations leverage AI technology, TEF provides a good ground to identify their different design and implementation logics. Second, it provides the flexibility to explore other possible factors influencing technology enactment, which already led to extended versions of TEF by other scholars. Third, despite its broad scope and the flexibility it provides to explore new factors, TEF classifies the factors influencing technology enactment into three main categories as explained above, which enables the researcher to carry out a guided process of explanation and exploration. Moreover, as TEF outlines a dynamic process rather than outcome-focused, the interplay among the factors can be displayed in a reciprocal relationship.

2.2.2. Critiques of the Technology Enactment Framework

Despite the aforementioned strengths of the TEF, it has been previously subjected to criticism due to its limitations. Firstly, TEF is criticized for neglecting the theory of socio-technical systems, i.e., the human factor in technological transformation (Norris, 2003; Grafton, 2003). Although TEF was born out of comprehensive empirical studies on how career public officials and political nominees design and utilize technology in the government sector (Fountain, 2004), this aspect was not evidently represented in her model (Schellong, 2007). This means that it ignores the impact of different actors in the organization in the technology enactment processes (Okumura, 2004).

Secondly, other scholars criticize TEF for ignoring the internal forces and dynamics driving transformation. For example, it fails to account for the organization's evolution through the adoption of technology (Mergel et al., 2019). Another criticism suggests that TEF insufficiently elaborates on organizational structures. That is, TEF falls short of delineating how an organization can maintain equilibrium between network and bureaucratic organizational structures amidst a changing strategic landscape (Raisch, 2008), in such a way to grant flexibility to the organization (Gong et al., 2020). Furthermore, there is a lack of knowledge about how inter-organizational relationships are established and preserved (Faro et al., 2022).

Thirdly, the TEF is criticized for ignoring the external factors. It is said to overlook the significance of political factors, an area that has been examined by Kraemer and King (1986) for a considerable period.

Fourthly, the TEF is criticized for perceiving technology as impartial by differentiating objective technology from enacted technology. However, research conducted by Cordella and Iannacci (2010) in the UK demonstrated that technology can bear transformative purposes of government policies. Thus, it can hardly be entirely neutral. In relation to this, another critique puts forward that the case studies from the US provide insufficient evidence to endorse the TEF or its implementation on an international scale (Norris, 2003; Dawes, 2002; Yildiz, 2007).

Lastly, some critiques contend that TEF overlooks the fact that while a certain feature of a technology may fail, the core technology could persist at the same time (Garson, 2003). Thus, objective technology could have sub-features and cannot be taken as one indivisible unit.

- **Proposed Extensions to TEF**

Many scholars attempted to extend TEF to respond to these critiques. These extensions include showing actor's involvement in the framework (Okumura, 2004), adding communication element to enacted technology and evaluating the organizational forms and institutional arrangements together (Schellong, 2007), and providing a clearer picture for the inter-organizational elements (Faro et al., 2022).

This research aims to provide similar suggestions by using Fountain's original framework as the basis to explore the interplay among the key TEF elements in the Customs' AI projects. Despite based on the original TEF, this research also borrows one small suggestion of Schellong's extended version (2007) which is grouping organizational forms and institutional elements as a unified category while showing the impact of the objective or enacted technology on the organizational forms and institutional arrangements. To clarify, this is done because the adoption of the objective technology may not necessarily cause a direct change in the organizational forms first, followed by the change of institutional arrangements. Rather, it is also possible that they first impact the institutional arrangements or these two happen simultaneously.

The next section will explain the use of the disruptive technologies in Customs and familiarize the reader with the concept of automated detection.

2.3. AI as a Disruptive Technology Used in Customs Controls

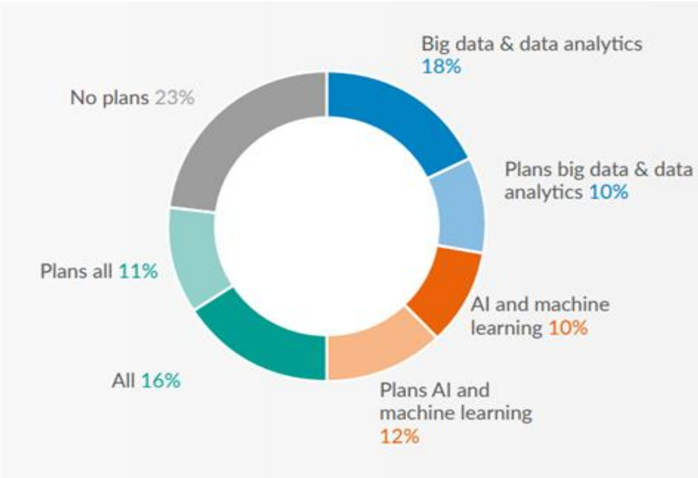
In parallel to the increasing trade volume, fighting against cross-border criminal activities has become a major concern for the Customs. The Customs have implemented IT systems worldwide, starting from the 1980s (Dias, 2009; Mikuriya and Cantens, 2020). Currently, although there are technological differences between them, all customs administrations have digitalized some, if not all, of their processes (Mikuriya and Cantens, 2020). These processes include the digitalization of the customs declaration, risk-analysis, intelligence, foreign trade statistics and accounting/payment procedures (UNCTAD, 2011).

In recent years, the use of disruptive technologies is becoming widespread in Customs as well. According to Christensen et al. (2016), the phrase "disruptive technology" refers to a technology replacing an existing one and causing a disturbance in the industry. It also refers to an innovative product creating an entirely new industry. WCO and WTO (2022) classifies the disruptive technologies in Customs into seven groups as follows: Blockchain, IoT, AI and ML, biometrics, drones, virtual, augmented and mixed reality, and 3D printing. AI is distinctive among all, as it has the capacity to replace customs officers in certain processes by being capable of "targeting" or "detecting" in their place.

The utilization of AI for customs and border controls offers numerous benefits for facilitation of cross-border movements. With the vast amounts of data generated by such movements, AI has the potential to make sense of this ever-increasing volume of data. AI allows for data processing, pattern detection and risk prediction with greater accuracy than humans in shorter time. Its main benefits to customs controls include better risk management, profiling, fraud detection, grater compliance, facilitating customs audits and anomaly identification, predicting future trends, improving facilitation, revenue collection, and X-Ray imaging and visual search (WTO & WCO, 2022).

Despite the common challenges in threat detection faced by customs administrations and their willingness to adopt AI technologies, level of adaptation of these technologies differs from one administration to another. A WCO survey showed that 44% of Customs authorities are presently employing either data analytics, AI/ML, or both, while 23% have indicated no intentions of utilizing these technologies, which can be deduced from Figure 4 (WCO & WTO, 2022).

Figure 4: Customs Administrations Adopting Big Data, Data Analytics, AI and ML in Percentages

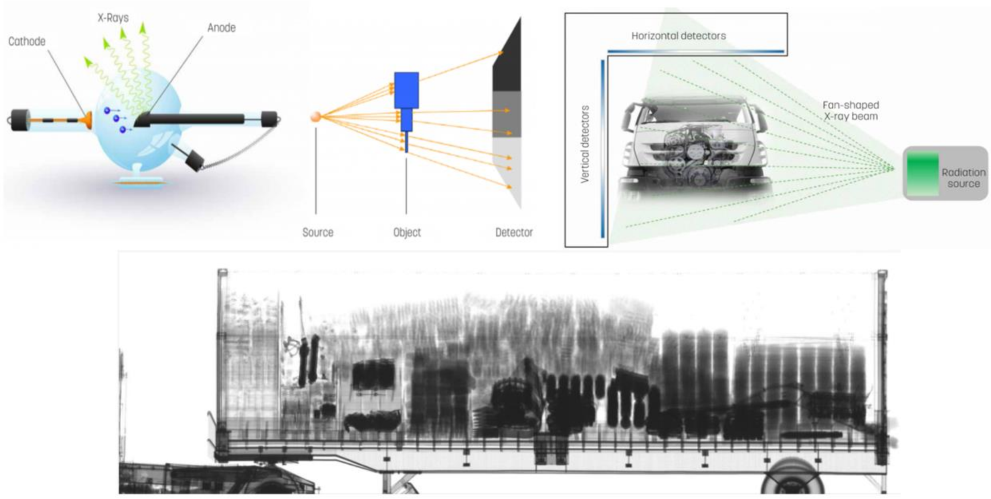


Source: *(WTO & WCO, 2022, p.72)*

2.3.1. Automated Detection Projects

Automated detection projects are launched to facilitate the image analysis process in the scanning phase of customs controls. Scanners are used to detect illicit goods in a cargo without the need to conduct physical inspection. Modern X-Ray technology creates a flow of electromagnetic radiation that interacts with an anode located inside the X-Ray tube of the machine. The resultant X-Rays from the tube are subsequently aimed at the subject of interest to create an image (Bracceschi, 2021), as indicated in Figure 5.

Figure 5: Working Principle of Scanners



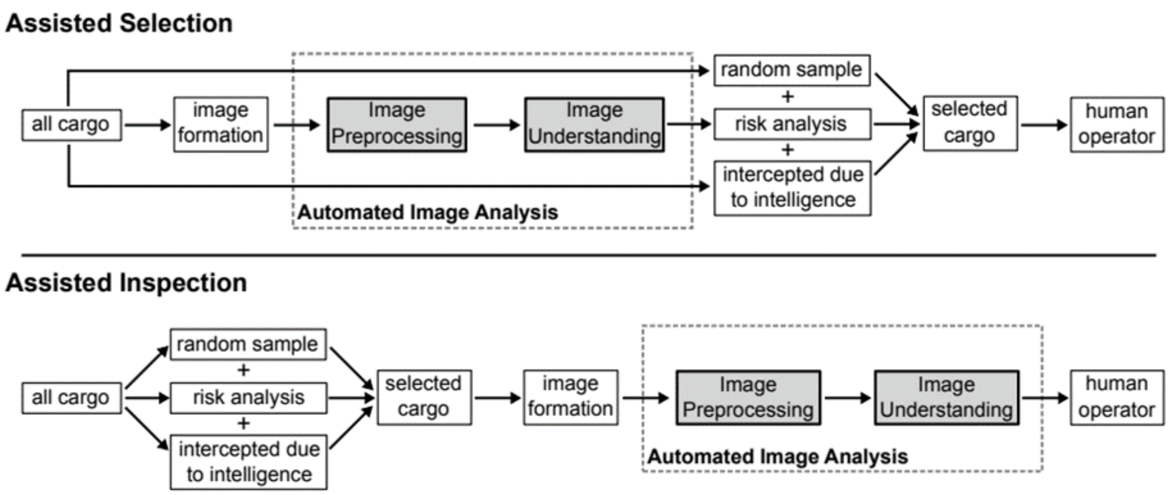
Source: *(Bracceschi, 2021. Retrieved from* *https://mag.wcoomd.org/magazine/wco-news-96/the-challenges-of-X-Ray-image-analysis-and-the-value-of-training/)*

While a typical X-Ray scanner can scan around 35 to 50 containers per hour, the following step, the analysis of the produced image, is a challenging task even for experienced image analysts. The analysis time vary depending on many factors. This is because the scanned images are often cluttered and contain other objects which can closely resemble the targets of interest. Moreover, the image analysis process becomes complicated for containers where the goods vary in kind, causing the image being composed of overlapping and differing shades. Given this complexity, the likelihood of undetected illicit cargo may rise due to human factors, further aggravated by the eye fatigue of the operator (Matsudaira and Koh, 2022).

Studies on the performance of X-Ray operators and the cognitive processes affecting their decision-making behaviour date back to 1988, initially in the aviation security sector and later extending to Customs. The prior research indicated that humans are not proficient at repetitive tasks, and the performance of X-Ray screeners can deteriorate after only 10 minutes, declining exponentially with time and ending up in a 22% failure rate in detecting weapons placed in carry-on bags. It also showed that repetition, complacency, non-compliance, low training, low wages, and attention fatigue can lead to human errors, resulting in the idea of automating this process. Recent studies have also focused on whether operators trust the decisions made by the algorithm and showed that they tend to trust automatic systems more when they receive an explanation for potential automation failures (Vukadinovic and Anderson, 2022).

Automated detection has the potential to facilitate the image analysis process, allowing for a more swift and precise analysis of scanned images. Figure 6 illustrates the process of cargo inspection and potential applications of automated image analysis, namely assisted selection and assisted inspection. With assisted selection, image analysis is used for risk evaluation, leading to more precise cargo selection for examination, thereby lessening the load on human operators. In assisted inspection, annotations such as bounding boxes with associated confidence scores, determined during the image understanding phase, are included in the image. This allows operators to identify potential threats more efficiently.

Figure 6: The Two Main Areas Where Automatic Image Analysis Is Used



Source: *(Rogers et al., 2016, p.4)*

This figure also explains the technical components of automated detection which are image pre-processing and image understanding. Image pre-processing involves applying various techniques to an image to assist both humans and algorithms in comprehending it, and encompasses image manipulation, correction, denoising, material discrimination, segmentation, and threat image projection. The image understanding pertains to decision-making processes based on the contents of the image, which is sub-divided into automated threat detection and automated contents verification (Rogers et al., 2016).

Although the assisted selection aims at using automated image analysis to inform the risk analysis used for cargo selection, it requires to scan all containers at high throughput rates. Currently, most research has focused on assisted inspection. To build an assisted inspection model, algorithms are developed to support operators by annotating images with region-of-interest. The model alerts them of the potential security or customs-related threats (Rogers et al., 2016).

The process of developing such a model involves three main steps: “image collection, the learning process for recognizing characteristics of images, and auto detecting & flagging suspicious characteristics as inspection targets.” (Matsudaira and Koh, 2022). In relation to achieving automated detection, Customs authorities are considering a central image analysis center to consolidate scanned images from borders and pool skilled analysts, supported by international cooperation efforts. To serve this end, within the coordination of the WCO Technical Experts Group on NII (TEG-NII), a Unified File Format (UFF) for X-Ray images has been created by major scanner manufacturers to support a centralized scanned image database. This facilitates the application of ML tools on large quantities of images to build threat detection algorithms. In addition to the UFF, Automated Comparison of X-Ray Images for Cargo Scanning Project (ACXIS) of the EU was a prominent effort which was designed to explore the possibilities of automated detection for customs controls. However, the scarcity of threat cargo images versus non-threat images still presents a challenge, affecting the accuracy of these automatic detection algorithms (Matsudaira and Koh, 2022).

2.4. The Research Gap

Public sector requires more research to understand what supports and hinders the AI applications (Janssen et al., 2020). Particularly, more theoretical and practical insights are needed to explore the ways of developing the organizational ability to leverage AI technologies (Schaefer et al., 2021; Mikalef et al., 2022), bolstering efficiency through AI (Urbach & Röglinger, 2018), individual structures enabling AI (Rodko et al., 2021) and the AI’s transformative power on institutional and organizational structures (Bullock, 2019).

AI applications in the public sectors of healthcare, transportation and security have become subjects of academic research (Berryhill et al., 2019). Yet, despite the increasing AI efforts of the Customs, studies on AI implementation in customs controls focused mostly on the experimental exploration of the technology’s capabilities. As such, prior research falls short of revealing the organizational and institutional foundations of the project design and implementation processes, which raises the necessity of looking at AI project applications in the customs administrations with a holistic view. Therefore, this research aims to understand the myth in the process of AI project trials by explaining how the Customs design and implement the innovative AI tool to benefit the core tasks.

Thus, the two main research questions and the sub-questions of the research are as follows:

- **Question 1:** How does the Customs Administrations of Türkiye and the Netherlands enact AI technology in automated detection projects?
    - **The sub-question:** How do the Dutch and Turkish Customs design and implement AI technology, specifically, in the automated detection projects?
- **Question 2:** What organizational elements could be learned from the two cases in accordance with technology enactment?
    - **The sub-questions:**
        - During the enactment process, what organizational forms and institutional arrangements can be observed to support technology enactment?
        - Which challenges are encountered in AI projects and how are they overcome?

3. Methodology

3.1. Selection of the Cases

The research employs the qualitative methodology to study the Customs Administrations of Türkiye (CAT) and the Customs Administration of the Netherlands (CAN). The responsible body for the automatic detection projects in Türkiye is the Directorate General of Customs Enforcement (DGCE or *Gumrukler Muhafaza Genel Mudurlugu-GMGM*), which is embodied under the Ministry of Trade (DGCE, 2023). In the Netherlands case, the automatic detection projects are carried out by the Directorate General for Customs, which is embodied under the Ministry of Finance (CAN, 2022). For the purposes of simplicity and coherence, these Directorate Generals will be referred as the Customs Administration of Türkiye (CAT) and the Customs Administration of the Netherlands (CAN) respectively.

The research adopts a qualitative comparative research methodology for the two cases for the following reasons. First, qualitative research methods enable researchers to provide descriptions of topics, interpret and explain them using various frameworks (Hammarberg et al., 2016). Moreover, comparisons are prevalent means for analyzing different cases and making general conclusions (Toshkov, 2016). Although within-case analysis helps addressing causal questions at the individual level, the answers obtained may not always be applicable to broader causal relationships. Therefore, they may fail to provide guidance for further analysis. Conversely, employing comparative designs for fewer cases enables formulating hypotheses based on the knowledge gained from each case and drawing potential causal relationships. Furthermore, the comparison of fewer cases has the strength of being mixed designs, which borrows from both within-case and cross-case analysis (Toshkov, 2016).

This research aims to understand how different customs administrations apply AI technology, particularly in the automated detection projects, with a view to disclose their technology adaptation approaches and the technology related and other (organizational, institutional, etc.) challenges they face in the enactment process. Thus, the qualitative research for few cases is helpful in identifying the similarities and differences among the cases and also the specific characteristics of each case.

The reasons for selecting Türkiye and the Netherlands cases are explained as follows:

- **Türkiye**

Türkiye is an EU candidate country since 1999 and a member of the Customs Union since 1995. Accordingly, Türkiye is expected to harmonize its legislation and practices with the EU acquis on customs and border controls, as its borders will be the future EU borders once it becomes a member. The EU-Türkiye cooperation in the security related fields has been so crucial that even when the accession negotiations were effectively frozen in 2018, migration, security and counter-terrorism dialogues continued because Türkiye was considered a key strategic partner in these areas (Council of the EU, 2018).

Nonetheless, it ranks highly (12th out of 193 countries) on the Global Organised Crime Index, making it a country of considerable interest concerning various priorities of the European Multidisciplinary Platform Against Criminal Threats, including firearms and drug trafficking, human trafficking, migrant smuggling, high-risk criminal networks, environmental crime, organized property crime, counterfeiting, criminal finances, money laundering, and asset recovery. Türkiye also continues to serve as a significant transit and destination country for human trafficking and remains a critical drug transit route between Asia and Europe. In 2021, Turkish law enforcement agencies executed various operations leading to the seizure of high quantities of illicit goods and migrants (European Commission, 2022). Therefore, automated detection technology is considered as a remedy to respond to the problem of illicit trafficking at border crossing points of Türkiye by Turkish Customs.

Projects Analyzed: Since 2020, the Customs Administration of Türkiye (CAT) has initiated two AI projects called “Improving the Detection Capacity of Turkish Customs Enforcement” and the "Scanners' Network" projects (GMGM, 2023). The first one is about using big data analytics for more efficient targeting of the risks and the second one is about the automatic detection of anomalies in the X-Ray images. This research will study the second project, the Scanners' Network Project, which is in its pilot phase[1]. Considering the high volume of trade traffic[2] in Türkiye's border crossing points, automated detection has much attention by the government and is expected to facilitate the control procedures considerably.

- **The Netherlands**

Customs Administration of the Netherlands (CAN) consistently ranks within the top-three in international assessments of logistics and top-five in customs handling (World Bank, 2023), earning a reputation as one of the world's premier customs agencies. Moreover, it assumes a prominent role in technical expert groups and research projects both at the EU and WCO level (WCO, 2019; PEN-CP, 2021). Notably, it is one of only two customs administrations having participated in the EU-funded project ACXIS, a pioneer in automated threat recognition (European Commission, 2015). The Netherlands also harbours the port with the highest volume of traffic in the EU, Rotterdam (CAN, 2022), where automatic image analysis would significantly transform the customs controls.

Projects Analyzed: The CAN initiated three automated detection-related efforts. One is about the automated interpretation of the X-Ray images, and the other two are about the better filtering of structured data and use of external data (CAN, 2022). This research focuses on the automatic interpretation of X-Ray images. There are two projects in this area. The first project is the detection of anomalies in the X-Ray images of the postal packages, called as the pills pilot. The other is similar to the first project but is specialized for the container images. The pills pilot started in 2021 and was followed by the containers pilot in 2022, both of which are in their early stages of implementation at the time of this thesis research.[3]

Overall, to compare a good-practice EU customs administration with an EU candidate country customs administration as Türkiye, which will constitute the future borders of the EU, would reveal the strengths and weaknesses of each case and disclose the needs and gaps of CAT in its

[1] https://www.dailysabah.com/business/2019/10/20/vehicles-passing-through-customs-gate-to-be-scanned-via-ai

[2] In 2022, customs control processes were conducted for 130.3 million passengers, 4.8 million trucks, 4.4 million passenger cars, 7.7 million containers, 688 thousand aircraft, and 101 thousand ships (GMGM, 2023.)

[3] https://mag.wcoomd.org/magazine/wco-news-99-issue-3-2022/automated-detection-dutch-customs/

journey to further align with the EU acquis, and help develop a framework for the Customs administrations planning to implement AI projects.

In the analysis, the Dutch Customs can be seen as a reference case because it has a faster progress and a longer experience with automated detection projects, which provides the review of the Turkish case a relative benchmark to reflect on its current development. Additionally, it is premature to make a definitive judgment about which case is more successful, as both are still in the experimental stages and have yet to be implemented officially on a larger/nationwide scale.

3.2. Collection of the Data

This research uses two types of data for analysis, including the archival data (i.e., the public documents) analysis and the interview data.

- **Public Documents**

Public documents are collected and analysed to acquire information about the organizations' AI efforts and, specifically, discover what is officially made public about the AI projects of the organizations. The three main documents reviewed for explaining the Dutch case are: (i) the Multi-Year Strategic Plan of Customs (2020-2025)[4] (CAN, 2021), (ii) 2021 Annual Activity Report (Dutch Customs in 2021) of the Dutch Customs[5] (CAN, 2022) and (iii) the EU research group Pan-European Network of Customs Practitioners' (PEN-CP) 2021 Report.[6] (PEN-CP, 2021). This study also reviews government and international association websites. The website of the Directorate General for Customs is used to explain the "pushing boundaries",[7] "layered enforcement" and "innovation"[8] approaches of CAN. The World Customs Organization's website is used to display the progress of the automatic detection projects of the Dutch Customs[9].

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[4] Summary points available at: https://www.aboutnetherlandscustoms.nl/latest/articles/customs-articles/2022/smarter-supervision-with-the-help-of-ai-models-and-autodetection. Full report available in Dutch at: https://open.overheid.nl/documenten/ronl-9c52bf23-637b-49e3-9fe0-181243a4d28e/pdf

[5] https://www.government.nl/documents/annual-reports/2022/06/30/dutch-customs-in-2021

[6] https://www.pen-cp.net/_files/ugd/8fecfb_0543a8c65aad48f0bce6cfec486652f5.pdf

[7] https://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/customs/about-us/how-we-work/pushing-boundaries/pushing-boundaries

[8] https://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/customs/about-us/how-we-work/innovation/

[9] https://mag.wcoomd.org/magazine/wco-news-99-issue-3-2022/automated-detection-dutch-customs/

As for the Turkish case, the three main documents used for analysis are: (i) the Multi-Year Strategic Plan of the Ministry of Trade (2019-2023)[10] (Ticaret Bakanligi-Ministry of Trade, 2022), (ii) the 2021 Annual Activity Report[11] (GMGM, 2022) and 2022 Annual Activity Report[12] of Directorate General of Customs Enforcement (GMGM, 2023; DGCE, 2023).

Such documents are analyzed to find out the organizational forms and institutional arrangements supporting the design and the implementation phases of technology enactment. Mainly, in terms of organizational forms; the departments, interdepartmental cooperation mechanisms, the international level technical expert groups that the country is a member of and the personnel involved in the project design and implementation are extracted from these documents and websites. Regarding institutional arrangements; the two organizations' approaches to AI as a disruptive technology, how they present AI technologies in their targets and through which institutional mechanisms, such as innovation agendas or cooperation protocols, they leverage AI projects are derived from these policy documents and websites.

- **Semi-Structured Interviews**

This research also interviewed experts and informants to gain insights, in-depth reasons and challenges of the AI enactment processes. Semi-structured interviews were conducted with customs officials at the headquarters, the X-Ray operators at the front-line, and with the program developers. One AI manager from the Netherlands and three experts from Türkiye, including one customs expert, one X-Ray operator, and one program-developer were interviewed. The interviews were conducted between March-May 2023. Information about the interviews (i.e., interviewees' job positions, institutions, means and duration of the interviews) and the interview questions are presented in Appendix I and II respectively. During the interviews, the conversation mostly followed the basic questions, but additional questions could be triggered when interesting issues or viewpoints were raised by the interviewee.

The interviewees were reached out by e-mailing the customs administrations' public web-mails. Then, the interviewees were suggested by the organization which fit better with the purpose of

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[10] Updated version. Available in Turkish at: https://ticaret.gov.tr/yayinlar/stratejik-plan
[11] Available in Turkish at:
https://muhafaza.ticaret.gov.tr/data/5d31b1ee13b876092c062161/faaliyet%20raporu_2021_.pdf
[12] Summary version available in English at:
https://muhafaza.ticaret.gov.tr/data/5d31b1ee13b876092c062161/2022%20Annual%20Report.pdf.
Full report available in Turkish at:
https://muhafaza.ticaret.gov.tr/data/5d31b1ee13b876092c062161/2022%20YILI%20GMGM%20FAAL%C4%B0YET%20RAPORU.pdf

this study. This process is a purposeful sampling aiming to contact/interview the personnel taking part in the automated detection projects. This study interviewed people holding different job positions to explore the different personnel perceptions on AI vis-à-vis their job positions.

Nevertheless, some difficulties were faced during the interviews. It was not possible to interview with equal number of people and holding equal positions in each country. This was both due to the time limitations and business of the personnel, and because the interviewees were designated by the organizations. Therefore, data on actor level perceptions was not able to be collected firsthand but was transmitted by another actor. However, the interviews improved the insights that were gained by analyzing the documents due to the following characteristics they have.

First, in case study research, it is not always possible to verify the incentives that various actors face, the information or the beliefs they hold. However, it is possible to probe assumptions and reveal a more realistic picture of actors' ideas through interviews (Toshkov, 2016). Using the TEF as the theoretical framework, this thesis aims to explore different approaches to AI technology within each organization and how these approaches affect the organizational and institutional forms. Therefore, interviews are considered a suitable method to elicit actor and organization level approaches and positions vis-à-vis AI projects, and help gain a detailed understanding of how AI is enacted.

Overall, interviews helped interpret the potential impact of organizational forms and institutional arrangements on the design and implementation phases of technology enactment, reveal new factors, and gain a more in-depth comprehension of the elements presented in policy documents and websites.

3.3. Coding and the Analysis of the Data

The data analysis employed a combination of grounded theory and theory-driven approaches for coding. The grounded theory approach (Glaser & Strauss, 2009) typically involves three phases of coding: open, axial, and selective coding (Strauss & Corbin, 1998). It is commonly used to develop theories or explanations for a given phenomenon. The choice of this approach is suitable for this research because grounded theory enables the exploration and discovery of previously undisclosed factors or relationships within established models. It is especially useful for this thesis since this thesis aims at exploring the factors enabling or hindering technology enactment in the two cases.

Following the general principle, this thesis starts the initial stage with open coding by systematically breaking down data (reviewing both government documents and interview data) into separate elements and assigning specific codes. The subsequent phase, axial coding, involves recognizing the connections and associations among these codes, organizing them into meaningful categories that serve as the basis for developing explanations. Finally, in the selective coding phase, the researcher combines and integrates these categories to construct a unified and well-founded theory or explanation that is firmly rooted in the underlying data.

Originally, the purpose of grounded theory was to bypass preconceived assumptions or the influence of preexisting theories to maintain objectivity during the coding process (Glaser & Strauss, 2009). Yet in reality, it is difficult to completely eliminate preconceived notions that researchers might have. Consequently, some of the newly emerging concepts tend to resemble phrases and ideas found in previous literature (Wang, 2014). Thus, in this study, grounded theory was employed as a combination of deductive and inductive approaches to analyze the data (Charmaz, 2006). As such, the predefined set of thematic codes was derived from the initial model introduced by Fountain (2001, p.91) as the Technology Enactment Framework (see figure 3). The sample results of open and axial coding are given in the Codebook (see Annex III). The results of the selective coding led to the development of a proposed extended version of TEF for AI technology in Customs (see figure 9). These results are explained in detail in Chapter 4 (Analysis of the Research Findings).

As regards the reliability and validity, the research harbours some drawbacks, too. First, the limited timeframe prevented the inclusion of a greater number of participants in the interviews. Moreover, interviewing with the personnel from various positions in both organizations (i.e. managers, operators, etc.) was not possible because the interviewees were designated by the related organization. Second, an inter-coder could increase the reliability, which was not used in this study due to the time limitations and the low number of the participants. Third, conducting a longitudinal study could have provided additional value to explore other factors and enhance reliability (Guttman, 1945). This could have been useful especially after the largescale implementation (the ‘use’ case) was realized to understand the changing viewpoints of the personnel, if any.

Despite these limitations, the study’s validity and reliability was ensured by using the policy documents as the main source of data whilst the interviews were used as the supplementary sources of data. Such a combined analysis method provided a cross-check mechanism between the two sources and helped enriching the information gained through the document analysis.

The next section will analyze the results of this study. The flow of the data analysis will begin with discussing on the institutional arrangements and organizational forms supporting the technology enactment. First, the institutional arrangements laying the foundations of AI projects will be presented, followed by the organizational forms, that is, the departments and networks, which are responsible for AI projects.

Since the projects are still pre-mature, the third element of TEF, the outcomes, are difficult to be analyzed, as will be explained below in more detail while explaining the reason why the thesis does not include the 'use' case. However, the interview data showed that even in the pilot phase, where the model is implemented at a small scale, there are some immediate results of the models (Interviewee of the Netherlands, Interviewee of Türkiye-1). Accordingly, the thesis will still evaluate on the possible factors impacting the AI model to yield successful outcomes in the pilot phase. Yet, it will not touch upon how successful the complete model is and its overall impact on the customs control procedures.

The two elements of technology enactment, design and implementation, will be evaluated simultaneously in explaining how they relate to the institutional arrangements and organizational forms. The 'use' and 'perceptions' elements of technology enactment will not be presented separately because of the following reasons. First, as stated above, the projects are in their initial phases of implementation, disabling a thorough analysis of the use-case. Second, the literature review (WTO & WCO, 2022) showed that the reasons why customs administrations want to use AI is similar: for facilitating trade and detecting illicit trade in a faster and more precise way. Therefore, it is not feasible to clearly differentiate between the AI perceptions of the organizations with respect to their expectations from the technology. However, perceptions could manifest themselves in the form of over-arching goals of the projects which are laid down in the institutional arrangements, in the organizational forms guiding this process, or in actors' attitudes towards the AI technology. In other words, perceptions are ubiquitous in the technology enactment process. Thus, this research will draw organizations' perceptions by analyzing institutional arrangements and organizational forms in project design and implementation phases.

4. Analysis of the Research Findings

4.1. Analysis of the Two Cases

This section will conduct a case-by-case analysis of the two organizations in line with the TEF by unpacking the institutional arrangements and organizational forms influencing automated detection projects' enactment. In doing so, this section will provide a response to the first research question, how the Customs Administrations of Türkiye and the Netherlands enact AI technology in automated detection projects, by presenting the Technology Enactment Flowcharts for the Dutch Customs (Figure 7) and Turkish Customs (Figure 8).

The analysis will begin with the Dutch case due to their accelerated progress in pilot projects and more extensive experience with implementing AI solutions. Thus, it is positioned as a reference case, symbolizing a pioneering effort, but not necessarily the superior one. Next, the Turkish case will be examined as the secondary case.

4.1.1. The Customs Administration of the Netherlands (CAN)

This section identifies the main institutional arrangements and organizational forms in AI project design and implementation at Dutch Customs, based on the official reports, websites and the information provided by the interviewee of the Netherlands, hereinafter referred as the IoN. First, it analyzes institutional arrangements according the TEF's 'formal and legal' institutional arrangements element. Institutional arrangements are classified into two general categories as the high-level policy documents/visions/approaches, and the innovation-specific policy documents. While the former sets the general goals of the organization with respect to disruptive technologies, the latter introduces specific procedures for AI projects' design and implementation.

The primary high level policy document is the Multi-Year Strategic Plan of Dutch Customs (2020-2025), putting "becoming a data-driven organization" *(Data-gedreven organisatie)* as one of the main goals of the organization (CAN, 2021, p.16). Second, the Pushing Boundaries Vision *(Visie grensverleggend)* and the Layered Enforcement Approach *(Gelaagde handhaving)* stress that facilitation of trade is as equally important as detecting threats, thereby rendering automatic detection as one of the targets of the organization to speed up the customs control process (CAN, 2021, pp.11-12; CAN, 2022, p.15; CAN, n.d.[13]).

The innovation-related institutional arrangements are found to be the Triangle Approach to Innovation, Innovation Themes, the Innovation Agenda, and the Project Plans. The Triangle Approach to Innovation aligns strategy and technical innovation with social innovation, increasing the organization's resilience to respond to new technologies together with its

[13] https://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/customs/about-us/how-we-work/pushing-boundaries/

qualified personnel (PEN-CP, 2021, p.79). The Innovation Themes refer to the eight areas including AI, blockchain, IoT, etc., that set up the frame for innovation projects whereas the Innovation Agenda involves the concrete projects that are decided to be implemented by the Innovation Coordination Group (PEN-CP, 2021, pp.77-79; CAN, n.d.[14]). As a project becomes a part of the Innovation Agenda after the conduct of impact assessments and the proof-of-concepts, the AI project plan, displaying which algorithms to be prioritized, is implemented (PEN-CP, 2021; IoN). Apart from the organizational level institutional arrangements, the EU Regulations (i.e. GDPR and EU AI Act) influence this process as they attribute a responsibility to the organization to design AI initiatives as transparent, explainable and trustworthy (IoN).

This section also identifies the main organizational forms supporting technology enactment at Dutch Customs in accordance with the TEF's organizational forms: bureaucracy and networks. Bureaucracy refers to the units responsible for AI projects within the organization, and networks are the inter-agency cooperation mechanisms. The primary organizational form supporting AI technology enactment is found to be the dedicated Data Science Unit, where data scientists work as the AI experts. This unit is active both at the design and the implementation phases. The existence of a dedicated Data Science Unit empowers the organization to develop AI models itself, independently from the market (IoN). Second, the Innovation Coordination Group, composed of the experts from different departments (e.g., IT, information management, purchasing, enforcement), deciding on which innovation projects will be prioritized (PEN-CP, 2021), is worth mentioning as it is the group responsible for the project design. Following the design phase, project implementation phase is conducted as a joint effort of various departments under the coordination of the Project Implementation Group. Working together, the Customs Laboratory, the Data Science Unit, the Field Units, the Business Operations and the Information Management Directorates carry out the project implementation phase (WCO, 2022; IoN).

Networks constitute the second type of organizational forms in TEF after the bureaucracy. The research found two types of networks with key roles in AI enactment: national and international networks. In AI technology enactment, both the national (i.e. with academia) and international level (i.e. the EU's CTDPG and WCO's TEG-NII technical expert groups) cooperation via networks have been intensified to cope with the challenges of the AI projects. Such cooperation

[14] https://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/customs/about-us/how-we-work/innovation/

mostly impacts the project design but can also continue at the implementation phase (WCO, 2022; PEN-CP, 2021; IoN).

All in all, the technology enactment of Dutch Customs can be considered as a product of a strong relationship between the institutional arrangements and organizational forms, which are specifically generated to support AI projects. The following section will present a more detailed picture of these elements at the design and implementation phases of technology enactment for Dutch Customs.

- **Institutional Arrangements**

The institutional arrangements guiding technology enactment at CAN are visions, approaches and strategy papers presenting AI-related goals. Firstly, the CAN aims at becoming a data-driven organization and structure its efforts around this ultimate goal (CAN, 2021, p.16). Emphasizing that "innovation is in their DNA" (CAN, 2022, p.5), the Dutch Customs has a long-term vision for innovation. The IoN also adds that the Dutch Customs is ambitious but also realistic in achieving goals about integrating AI into their work and want to do this in an effective and holistic way.

The principal institutional arrangements supporting the AI project design are the Multi-Year Strategic Plan of Customs (2020-2025), the Pushing Boundaries Vision, Layered Enforcement, Triangle Approach to Innovation, The Innovation Themes, and the Innovation Agenda. The Strategic Plan sets the roadmap for the upcoming years upon which various innovation projects are developed and implemented in accordance with the CAN's responsibilities (CAN, 2022, p.15). Pushing Boundaries is a vision of the CAN, whose main idea is to adopt policy solutions to strike a balance between the supervision and facilitation of trade (CAN, 2021, p.11). There are two main components of Pushing Boundaries which are the Layered Enforcement and Auto-Detection. To clarify, the Layered Enforcements indicates that the objective of the CAN is to implement stringent controls to govern operations, while keeping bureaucratic obstacles and government monitoring of businesses at minimum (CAN, 2021, p.12; CAN, 2022, p.15). As such, the controls are increased gradually starting from the most trusted traders to the least, from green flow to blue flow, respectively (CAN, 2022). Hence, the Auto-Detection via AI is presented as a solution to facilitate customs control procedures. It is classified into auto-detection of cargo and auto-detection of data, which are sub-divided into three groups of AI goals as (i) better filtering of structured data, (ii) use of external data and, as this research focuses on, the (iii) automatic interpretation of X-Ray images (CAN, 2022, p.17).

Another key institutional arrangement is the Innovation Themes. By incorporating the elements of the Pushing Boundaries Vision, the Dutch Customs determined eight innovation themes and accordingly, compiles its Innovation Agenda, which concretely comprises the innovation projects to be focused. Among the eight themes are various disruptive technologies, i.e., AI, IoT, blockchain, and also "social innovation", meaning, to achieve change by involving people. Social innovation is also an element of the Triangle Approach to Innovation, which aligns (i) strategy, (ii) technology, and (iii) social innovation (PEN-CP, 2021, pp.77-79). This social innovation component has direct consequences for the organizational structures, which will be explained in the Organizational Forms part below. Following the design phase, the project implementation phase is guided by the Project Plans.

- **Organizational Forms**

Clear goals on innovation solidified in institutional arrangements of the Dutch Customs lead to the transformation of organizational forms, and vice versa, fostering both 'inter-departmental' and 'inter-agency' cooperation. These are classified in TEF as the transformations within the 'bureaucracy' and 'networks', respectively. The organizational forms involved in AI projects and the accompanying personnel reforms are discussed below.

  - **Bureaucracy**

The first key bureaucratic change of the organizational forms in the Dutch Customs is to increase inter-departmental collaboration. The Innovation Coordination Group, operating as a cross-functional entity, is composed of specialists with diverse occupational backgrounds (including IT, information management, procurement, and enforcement) (PEN-CP, 2021) and is tasked with the design of the technology projects. In line with the Innovation Themes, the group decides which projects will be put on the Innovation Agenda, upon assessing projects' feasibility through impact assessments and testing proof of concepts to evaluate the repercussions of introducing a new method within a specific control process (PEN-CP, 2021). Such collaboration both ensures that project ideas are decided in a participatory manner and reduce the risk of project failures and the unpredictability of the project outcomes.

The implementation phase begins after the project idea is put into the Innovation Agenda. To understand the organizational forms responsible for this phase, it is critical to explain the Automated Comparison of X-Ray Images (ACXIS) Project[15], funded under the 7th Framework

[15] https://cordis.europa.eu/project/id/312998

Programme of the EU, which ran from 2013 to 2017, because most organizational forms, the Data Science Unit being the most important one, are the products of this project's lessons-learnt. ACXIS led to the creation of the initial ML model capable of identifying threats and anomalies in maritime containers. When the AXCIS project ended in 2017 as the project term terminated, the participating partners failed to sustain their relationships, leading to each one retaining the components they worked on.[16] Using the collective knowledge obtained from this project, Dutch Customs initiated its independent efforts towards automated image interpretation in 2021, leading to further organizational transformations within the Dutch Customs (WCO, 2022). The first transformation was the foundation of a dedicated Data Science Unit to build a storage of X-Ray images with their associated data and develop machine learning models. Other efforts involve the modification of the existing IT infrastructure, collaboration with vendors to conduct experimental tests of the models together with X-Ray operators, and ensuring that personnel using X-Ray technology are apprised of the latest technological developments (Flisch, 2017; CAN, 2022).

The change in the organizational structures can be better understood by explaining the roles of the personnel working at these units who undertake the technical steps in the implementation phase. First, the X-Ray operators were responsible for data collection to create the image database. Going forward, these officers would be responsible for image annotation, which means providing a description of the content of the image. During the trial phase, however, the Customs Laboratory personnel undertook the data annotation task. Subsequently, the Data Science Unit created detection and classification AI models. In conjunction with the Business Operations Directorate, the scanner suppliers implemented the models on the X-Ray equipment. Lastly, the Information Management Directorate built the IT infrastructure necessary for transitioning from the trial phase to the operational stage (WCO, 2022).

Such an organizational transformation rendered the roles of three job categories the most crucial for the AI projects: The data scientists, X-Ray operators, and managers. First, the data scientists' role is crucial for two reasons: They make the organization capable to develop tailor-made

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[16] Besides the Dutch Customs, the Project brought together the Swiss Federal Laboratories for Materials Science and Technology (EMPA), the French Alternative Energies and Atomic Energy Commission (CEA), the Fraunhofer-Gesellschaft research organization, Smiths Detection, APSS Software & Services and Switzerland Customs; each of which were responsible for different components such as data collection, annotation or developing the ML model (Flisch, 2017).

technology solutions. Also, they can communicate the needs of the organization and pick the most efficient technological solution already available in the market (IoN).

Second, the X-Ray operators play a crucial role in project implementation. As the ML algorithms perform better when fed by correct data, the role of the operators becomes critical because the algorithms are fine-tuned based on the feedback of the operators on the model's true and false alarm rates. This step is called the supervised training and testing. Here, the operator needs to give the right feedback by recording whether the algorithm works successfully after checking the postal package or the cargo physically upon receiving an alarm from the automated detection program. IoN states that;

> *"You really need human. For instance, you get an alarm and it looks like it has pills, but it doesn't have pills. The action of the operator is to type it in. So, somebody needs to fill it in properly and you have to collect that information."*

Another task of the operators is to be able to differentiate between the alarms, that is, to correctly record for which threat the alarm has been triggered, since receiving an alarm does not always mean that the system works the way it should, as the IoN exemplifies as follows:

> *"Operators open the package upon an alarm and they find big buckets of cocaine. They may say the program works but, no, it doesn't work because it was a pills alarm, not cocaine."*

Third, the success of innovation projects is influenced by the managers' attitudes. The CAN proposes that the responsibility of contriving innovation ought to be borne by management, given the likelihood that the working floor's proclivity is geared towards 'optimizing' the existing procedures, as opposed to 'innovating', being different paradigms (PEN-CP, 2021). The goal of the Dutch Customs is to raise awareness among the managers on the capabilities of the new technologies and render them the leaders of technological change (CAN, 2021). Thus, training of higher-level personnel now includes technology related topics, IT, business process mapping and logistics (PEN-CP, 2021).

The personnel's importance in the Dutch Customs indeed stems from its Triangle Approach to Innovation (PEN-CP, 2021). The term "social innovation" in the Triangle Approach pertains to the customs administration's potential to modify its operational procedures by involving people in the technological transformation process and equipping them with the know-how required for innovation projects. As one CAN manager mentioned in an interview conducted by the PEN-CP:

> *"You can come up with the best ideas, the smartest ideas, when the people do not accept them, or when the people do not believe in them, then they will never work."* (PEN-CP, 2021, p.78).

The involvement of the personnel in the pilot implementation is important because the implementation phase is considered the most challenging aspect of innovation, accounting for nearly 70% of failures in achieving innovations (PEN-CP, 2021). One manager explains how they involve staff in pilot project implementation in an interview conducted by the Dutch Customs as follows:

> *"In pilot phase, we are not looking only at the technology. We also want to involve all colleagues in these developments. We have already done some other tests on the shop floor with the help of colleagues from the scanning teams. That immediately gave them a clear image of the technology."* (CAN, 2022, p.17).

In the pilot implementation, the importance of social innovation reflects itself in a reciprocal relationship between the operator's willingness to embrace the new technology and the AI model's success. Operators put more effort in improving the success of the model as they know more about the technology. Yet, low success rates, which can also result from poor operator effort, can decrease their willingness to use the end product, either. Accordingly, low levels of accuracy may lead to the customs officer to make a comparison between themselves and the algorithm, as emphasized by the IoN:

> *"The officer checking the postal packages may say I'm better. I sniff in an envelope. That's much more reliable. I have held to the light. So, you need to convince them. Here, the learning loop is extremely important."*

Accordingly, the CAN recognizes the shift from the old versions of customs controls, dominated by physical inspections and having a good eye, to a more statistics-driven and risk-based one. The mutual relationship between the X-Ray operator's correct feedback and the outcomes of the project is stated as follows by the IoN:

> *"The old school, the classic customs official was the one who sniffed differences. The modern customs official is the one who can work with the tools, who can feed them with a good feedback so that the AI algorithm becomes really good. And if you don't feed it*

properly, it becomes bad. You need a team that really wants the system to work and to feed it, not one trying to prove that the tools are wrong."

With this evolving mindset, the CAN adjusts its Strategic Staffing Program to upskill its key personnel to respond to new technologies (CAN, 2022, p.20). This program involves maintaining the learning loop and providing existing staff with re-training opportunities to use new technologies. Also, the new recruits are selected considering the mathematical and analytical skills (IoN).

The reason why CAN attributes importance to social innovation is not only that personnel's contribution is precious for the AI project's success. Also, the Dutch Customs expects that the role of the human will be more important as AI develops (IoN). That is, AI will facilitate the customs control process and make it more reliable but not necessarily reduce the human resources costs. Indeed, it may actually rise because the need for a more qualified staff, such as data scientists, will increase. As a public organization, its data-driven approach also makes it appealing in the job market. The IoN states that;

"There's much skills, knowledge, experience developed here in the Dutch Customs."

Overall, the CAN recognizes that customs will remain a human job at least for the near future and put forward that it implements AI not because algorithms are better than people, but they are faster in decision-making than people (Männistö et al., 2021).

- **Networks**

The Dutch AI projects intensified the inter-agency collaboration networks, including partnerships at the national and international levels. The primary partnerships encompass the ones with the academia, the industry and the international technical expert group networks, bringing multiple benefits to the organization to tackle the complexities of the AI technology.

First, over the past decade, a significant development has been the increased collaboration between the customs administration and academic institutions, including research institutes and universities. This partnership has led to the realization that contemporary customs officials require knowledge beyond that of law enforcement and legislation (PEN-CP, 2021). For the specific case of the AI projects, partnerships with the academia helps explore the feasibility of the technology solution in question (IoN). Another partnership is with the scanner suppliers as the 'natural partners' because the algorithms are deployed by the scanning companies on the scanners' software when developed by the Dutch Customs' own data scientists.

However, different partnership models for innovation projects are still available including purchasing off-the-shelf products from the market. As the IoN indicated, the Dutch Customs' general approach is to develop programs inhouse unless they are available in the market or it is more efficient to do so. For instance, while it is possible to purchase the automatic firearms detection algorithms off-the-shelf since companies are able to produce a database of firearms, this would not be the case for drugs because the companies cannot own them legally to produce a database. For that, the developer needs to have the images of drug seizures of enough number and variety, which is developed mostly as inhouse by the Customs.

Another category of inter-agency cooperation, the international networks, are mostly dominated by the WCO and EU expert groups networks and by the cooperation with other customs administrations. In the EU, for any new technology to be considered beneficial, it must have a favourable effect on the SMART borders concept, which emphasizes being "Secure, Measurable, Automated, Risk-Management Based, and Technology-Driven" (European Commission, 2021, p.87). To this end, the EU plays a critical role as one of the primary platforms enabling partnerships via research projects and expert networks. EU research and innovation funding programmes [17] building cooperation among member state public organizations, research institutes and the industry are efficient ways both for combining budget and developing tailor-made products (IoN). The most prominent of these research projects can be exemplified by the Automated Comparison of X-Ray Images for Cargo Scanning (ACXIS) Project, Customs Detection Technologies Project Group (CDTPG), Project PROFILE and the Project Pan-European Network of Customs Practitioners (PEN-CP) (European Commission, 2021). Such collaboration also produces academic studies to help the Customs to better deal with the complexities of AI technology. For instance, the Expert Report: "EU AI Act & What Customs can and cannot do with AI" was prepared lately by the PEN-CP (Harison, 2023). The EU also provides a common ground of legislation and practices on AI for the member countries, which can be exemplified by the General Data Protection Regulation and the EU AI Act (IoN). In addition, the WCO, being the only organization for international level customs cooperation, has a leading role for technology adaptions as illustrated by the TEG-NII expert group (WCO, 2021).

Collaboration with the other customs administrations is another category of networks, developed mostly to overcome the image data-base scarcity problem. Both the number of the

[17] Such as the Framework Programme for Security, Customs 2020 and the Horizon.

images and the variety of anomalies in them, such as images showing the anomalies in different places of the container and different concealment methods, is necessary for the development of algorithms with high precision rates. For that, CAN built collaboration with the other customs administrations to acquire seizure images including Australian, Belgian, and Brazilian Customs (WCO, 2022).

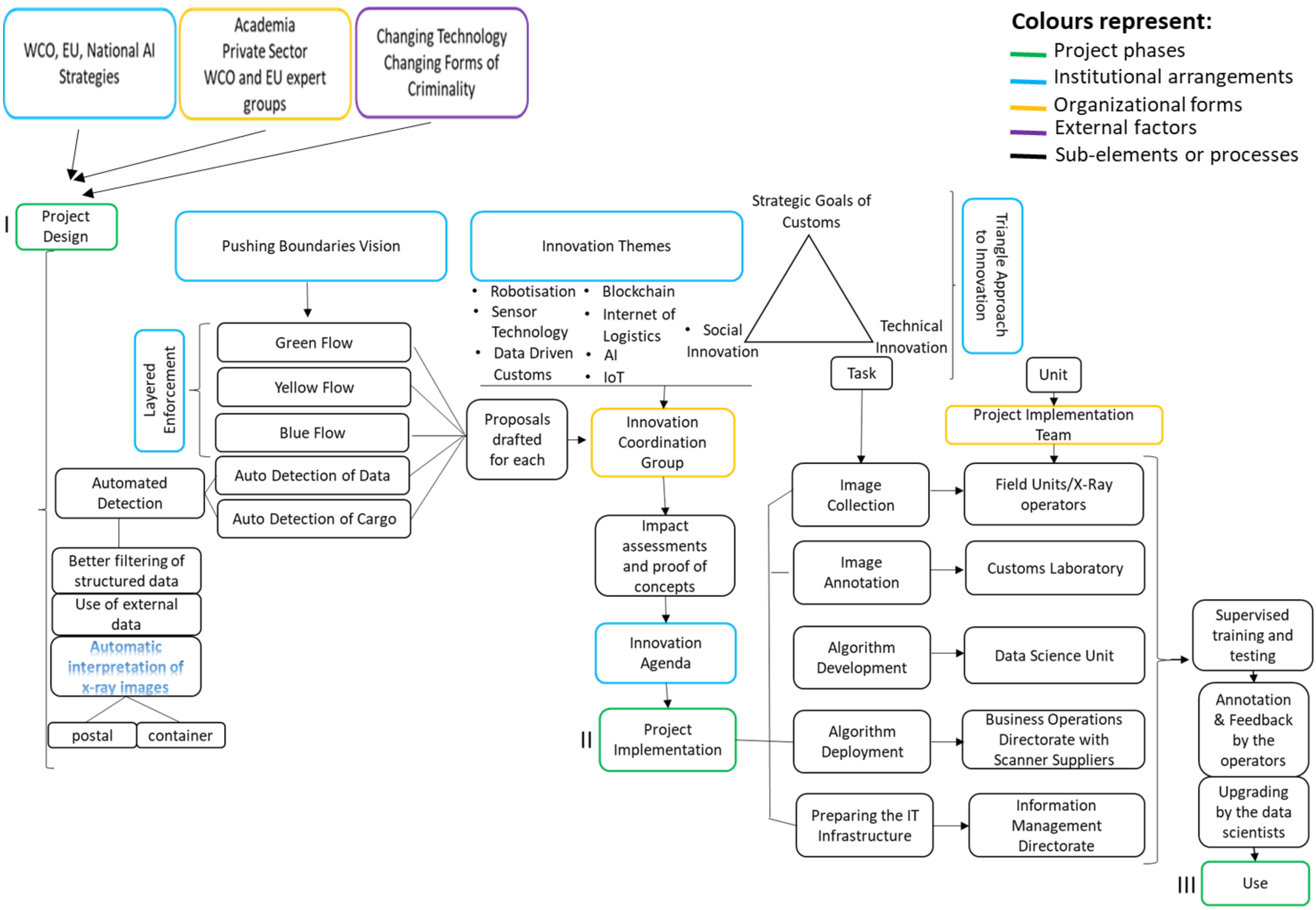
There are also some other factors found to influence technology enactment process in addition to the organizational forms and institutional arrangements. First one is the budget, the availability of which produces two positive consequences. CAN is of the opinion that they can allocate the budget needed for technology projects. This is sourced from the government' support, as the Netherlands, despite being a small country, play a key role in EU trade through Rotterdam Port, being the busiest port in Europe (IoN; CAN, 2022). First, apart from the project implementation budget, the CAN allocates a small budget for impact assessments and proof of concepts in the design phase, reducing the unpredictability of project results (PEN-CP, 2021). Second, the budget enables the Dutch Customs to choose the most appropriate solution from among the technology solutions available. Given this, the next factor influencing the technology enactment process can be said to be the government mentality. The government's attitude toward innovation at Dutch Customs can be defined as supportive but also cautious because it attaches great importance to the protection of personal data. Protection of privacy is valued highly while using personal data, which the interviewee (IoN) called as "*a very Dutch attitude.*"

Based on the policy documents and interviews from the Dutch case, the AI Technology Enactment Flowchart for the CAN is presented in Figure 7. Drawn from the TEF, the flowchart summarizes the three enactment actions during different project phases- (I) design, (II) implementation and (III) use for the automatic interpretation of X-Ray images projects. The 'use' case is included only for making the flowchart complete. Because the Dutch AI projects studied in this thesis are still in their early development phases, this research is not able to provide a deeper analysis for the use phase.

The flowchart describes the interplay between different organizational, institutional and external factors and how they impact the design and implementation enactment processes. How to read the chart can be illustrated as follows: The WCO and EU Strategies as institutional arrangements, inter-agency networks as organizational forms and the changing forms of criminality as the external factors influence the design. The Pushing Boundaries Vision (having five components) the Layered Enforcement Approach (as a sub-component of the Pushing Boundaries and referring to the three control levels as green, yellow and blue), Triangle

Approach and eight Innovation Themes constitute the institutional arrangements impacting the design phase. Auto-detection is a technology solution supporting the Pushing Boundaries Vision. The Innovation Coordination Group is established to be in charge of carrying out the impact assessments and testing proof of concepts at the design phase as the main organizational form. The project's implementation starts once the idea is put on the Innovation Agenda. It is composed of five phases (i.e. the image collection, image annotation, algorithm development, etc.), each of which are carried out by five organizational units (i.e. Customs Laboratory), constituting the Project Implementation Team. Before the official use, the research found that CAN will have to conduct supervised trainings and testing, receive feedback from the operators and upgrade and fine-tune the model.

Figure 7: The AI Technology Enactment Flowchart for the Customs of the Netherlands



Source: *(Developed by the author)*

4.1.2. Customs Administration of Türkiye

This section identifies the main institutional arrangements and organizational forms supporting AI technology enactment at Turkish Customs by analyzing the data in the policy documents, websites and provided by the interviewees of Türkiye, hereinafter referred as the IoT-1,2,3. First, it analyzes institutional arrangements according to the TEF's 'formal and legal' institutional arrangements element. The main institutional arrangement affecting the innovation projects in Turkish Customs is the Five-Year Strategic Plan of the Ministry of Trade (2019-2023) which, transmits the national-level goals stated in the Annual Program of the Presidency and the New Economy Program on combatting smuggling to the organizational level goals. In the latter two documents, "Using big data analytics and sophisticated technologies to facilitate trade and efficiently combat smuggling" is stated (Ticaret Bakanligi-Ministry of Trade, 2022, p.59) as the target for the law enforcement institutions, thereby rendering the Directorate General (DG) of Customs Enforcement responsible for introducing technological initiatives for "easy and secure customs controls." (Ticaret Bakanligi-Ministry of Trade, 2022, p.15). In line with this goal, the DG of Customs Enforcement signed a Cooperation Protocol with the national research institute, TÜBİTAK, to develop an AI model for the automatic detection of illicit cargo (DGCE, 2023, p.49). The primary motivation of the organization for initiating such AI projects is to sustain to be a modern customs administration and catch up with the recent developments in customs detection technologies (GMGM, 2023).

Regarding the bureaucratic organizational forms, the department responsible for technology related projects is the Projects and Technical Systems Department, which initiated and coordinated the automatic detection project and the big data analytics project. However, recently, a new Data Analysis and Targeting Department was established in May 2023 as the organization recognized the need to treat future AI and big-data related projects with special expertise (IoT-1). The personnel working in automated detection projects are the customs experts, not data scientists, unlike the Dutch case. The project was managed by the Project Implementation Group, coordinated by the Projects and Technical Systems Department, involving customs experts from the Headquarters, X-Ray operators from field units, data scientists from TÜBİTAK, X-Ray suppliers and the Directorate General of IT of the Ministry.

As regards the inter-agency networks forms, the cooperation with the research institutes and the private sector has been intensified via the AI projects. Besides, the international level expert groups of the WCO and the EU play a role in Türkiye's prioritizing technology solutions by providing a conducive ground for sharing experiences and best-practices (IoT-1).

The main challenges in technology enactment are found to be the lack of data scientists, lack of innovation-specific institutional arrangements, overloaded workplans, ensuring inter-departmental cooperation and the size of the organization, alongside the scarce image data-base. The following section will present a more detailed picture of these elements.

- **Institutional Arrangements**

The Customs Administration of Türkiye (CAT) has a long tradition of adopting innovative technologies. Following customs detection technologies closely since the emergence of the X-Ray technology for cargo controls, the CAN has deployed scanners at all of its border crossing points as of the beginning of 2000s (IoT-1).

Acting to follow the recent developments and customs detection technologies and remain as a contemporary customs administration (GMGM, 2022), the CAT has the institutional foundations of innovation projects' design in the Annual Program of the Presidency and the New Economy Program at the national level and the Strategic Plan of the Ministry at the organization level. The first two government documents impose the mission of "using big data analytics and sophisticated technologies to facilitate trade and efficiently combat smuggling" to the Ministry of Trade (Ticaret Bakanligi-Ministry of Trade, 2022, p.59). Accordingly, The Ministry's Strategic Plan puts, "easy and secure customs controls" as its goal and the Directorate General of Customs Enforcement plans its innovation projects to facilitate legal trade and prevent illicit trade via using up-to-date technologies (Ticaret Bakanligi-Ministry of Trade, 2022, p.15). As such, the automatic image interpretation project is launched within the scope of the cooperation protocol signed with the Scientific and Technological Research Council of Türkiye (TÜBİTAK), the national research institute of Türkiye embodied under the Ministry for Industry and Technology (DGCE, 2023, p.49).

- **Organizational Forms**
    - **Bureaucracy**

In terms of the organizational forms, there are bureaucratic changes in the Turkish case, too, yet, to a lesser degree. Both the design and implementation of the innovation project have been coordinated by the Projects and Technical Systems Department, which is a dedicated department responsible for tracking technology related developments, implementing capacity building projects, conducting gaps analyses and proposing technology solutions. However, in May 2023, a new Analysis and Targeting Department was established which is dedicated to contributing to the big data and AI efforts of the CAT (IoT-1). Although an interdepartmental innovation coordination group, as in the case of the Dutch Customs, does not exist in Turkish Customs for the design phase, the project working groups can be established for the implementation, enabling the participation of customs experts from relevant departments and facilitating cross-functional collaboration.

The automated detection project to be analyzed in this section was designed by the Projects and Technical Systems Department with a view to fulfilling many targets alongside the automated detection of four anomalies: drugs, cigarettes, firearms and migrants. It also aims at exchanging of images among X-Ray operators, transferring of the images to the centre (the headquarters) and the analysis of images in a unified format. The main motivation to initiate the project was to keep up with the Unified File Format project of the WCO and the automated anomaly detection efforts worldwide (DGCE, 2023, p. 49). The project was first initiated in the five pilot seaports and land border crossing points, for which a project working group was formed, involving the customs experts, X-Ray operators from the pilot sites, data scientists of TÜBİTAK, experts from the IT Department of the Ministry and X-Ray suppliers (IoT-1).

The AI technology enactment process is better understood in the Turkish case by closely looking at the challenges faced during the project's pilot implementation. Despite the commitment of both the headquarters and the pilot sites, the project team faced both technology-related and other challenges. The first challenge was related to the collection and annotation of the images. The images were collected and annotated by the X-Ray operators at the headquarters with the support of the field units' X-Ray operators. The annotation was carried out by using the software provided by the program developer, TÜBİTAK (IoT-1, IoT-2). Here, the lack of data regarding the seizures aggravated the data collection problem. Although the image database was quite high considering the number of the borders in Türkiye, unlike the Dutch case, which focused solely on drugs first, Turkish pilot was designed to detect the anomalies of many illicit goods (drugs, firearms, cigarettes) and migrants, making the data collection and annotation even harder (IoT-1).

The second challenge was the workload of the project team and the lack of personnel. That is, the department responsible for the technical management of the project was also responsible for all other components including administrative, financial and stakeholder management. Additionally, the personnel were exclusively customs experts and the absence of data scientists adversely influenced the project management process. As IoT-1 (Customs expert) indicated, both the design and the pilot implementation phases could have been improved with increasing the number of the staff and employing data scientists;

> *"You need images and also operators to annotate them to be given to the program developer. More time needs to be allocated before the implementation to calculate how many images you need and how many people should annotate them. It was hard because at the same time we coordinated the other aspects like spendings, relations with the program developer, meetings..."*

The third challenge was sourced from the overloaded project plan including many components. Unlike the Dutch pilot focusing solely on AI model development, the Turkish pilot project involved an automated detection module, unified file format and image analysis module, administration and statistics module (GMGM, 2022). The tight project schedules constituted an additional factor exerting pressure on the project team (IoT-1).

The research also found that interdepartmental coordination was challenging, causing delays in the implementation of the project. Collaboration with the busiest department of the Ministry, the IT, both at the headquarters and the pilots, was needed for the generation of the testing environment and updating the IT infrastructure. Furthermore, cooperation with the field units was needed as the X-Ray operators' involvement was necessary for the data collection, annotation and feedback. As some of the pilot sites were already quite busy and the operators were responsible for the image analysis task at the same time, data collection and cooperating the operators at the headquarters for image annotation on the previous seizure images increased their workload. Moreover, they were required to give feedback as new versions of the program were released (IoT-1, IoT-2).

In relation to this, it can be expected that the operators were unwilling to participate in the pilot project, which was not the case. Despite their workload, the operators' attitude was supportive for the AI project for several reason. First, operators are the responsible agents to decide whether to detain or release a cargo. Working for long hours at a busy border and under stress in an operator cabin, a minute of destruction may cause tons of drugs to enter or leave the country, damaging public health, causing lost revenues, perpetuation of organized crime networks and a bad reputation of the country. Therefore, this AI tool can support them in taking decisions about releasing or detaining a cargo. Accordingly, IoT-2 (the X-Ray Operator) states that;

> "*We are also human. It is something psychological. Even knowing that somebody else is analyzing the image, I mean, the AI, would comfort me."*

Second, the automatic interpretation is expected to help especially the new operators. Image analysis performance of an operator improves through experience. Currently, the shift schedules of the new operators are structured to accommodate collaborative work with a senior operator; nevertheless, operators may still experience a sense of discomfort or inadequacy during the initial months of their work (IoT-2).

Third, the automated detection would assist the operators in detecting contraband goods concealed by the methods that are unfamiliar to them. Given the size of Türkiye and the variability of potential threats across different border crossing points, operators may encounter a greater frequency of specific types of goods at one border, leading to a greater degree of familiarity with that particular image (IoT-2). However, the new program will allow for access to a more extensive database of images which enable image comparisons across borders together with anomaly alerts.

As the operators want to use this technology, they are willing to participate in the supervised trainings and testing because they want the end product to become successful. As the IoT-2 put forward;

> *"Our involvement is important because we will be using it. There are lots of criteria to consider in the image analysis process. I need to test it. It was thought that it is only to change the image format to a unified format but it is not."*

Yet, if the AI proves ineffective, as the IoT-3 (the program developer) put forward, the operators may resist using it and stick to traditional analysis methods, believing that they are misled by the algorithms.

- **Networks**

The Turkish Customs is influenced by the inter-agency networks established on national and international platforms when designing and implementing AI projects. The auto-detection project has been the product of a cooperation between the CAT and the national research institute of Türkiye, TÜBİTAK. This project produced additional benefits for the Turkish Customs alongside the automated detection program. As the IoT-3 mentioned;

> *"Such partnerships are useful not only to develop the end-product but also, in working together, the organizations learn the importance of data, how to keep, store and use it, which would have positive implications for the future big data and AI projects of the organization."*

In addition to intensifying inter-agency cooperation at the national level, the AI project was indeed influenced by the international level networks Türkiye was a party. The Unified File Format project undertaken by the WCO's TEG-NII and the EU-level technical expert groups played a crucial role in shaping the innovation project ideas of CAT (IoT-1). Thus, fostering such partnerships is expected to positively impact the future AI efforts of the organization (IoN-1). Yet, while Türkiye was a member of the Customs Detection Technologies Project Group as an EU-candidate country, it did not become a member of the Pan-European Network of Customs Practitioners, which could have further enhanced its AI implementation capacity.

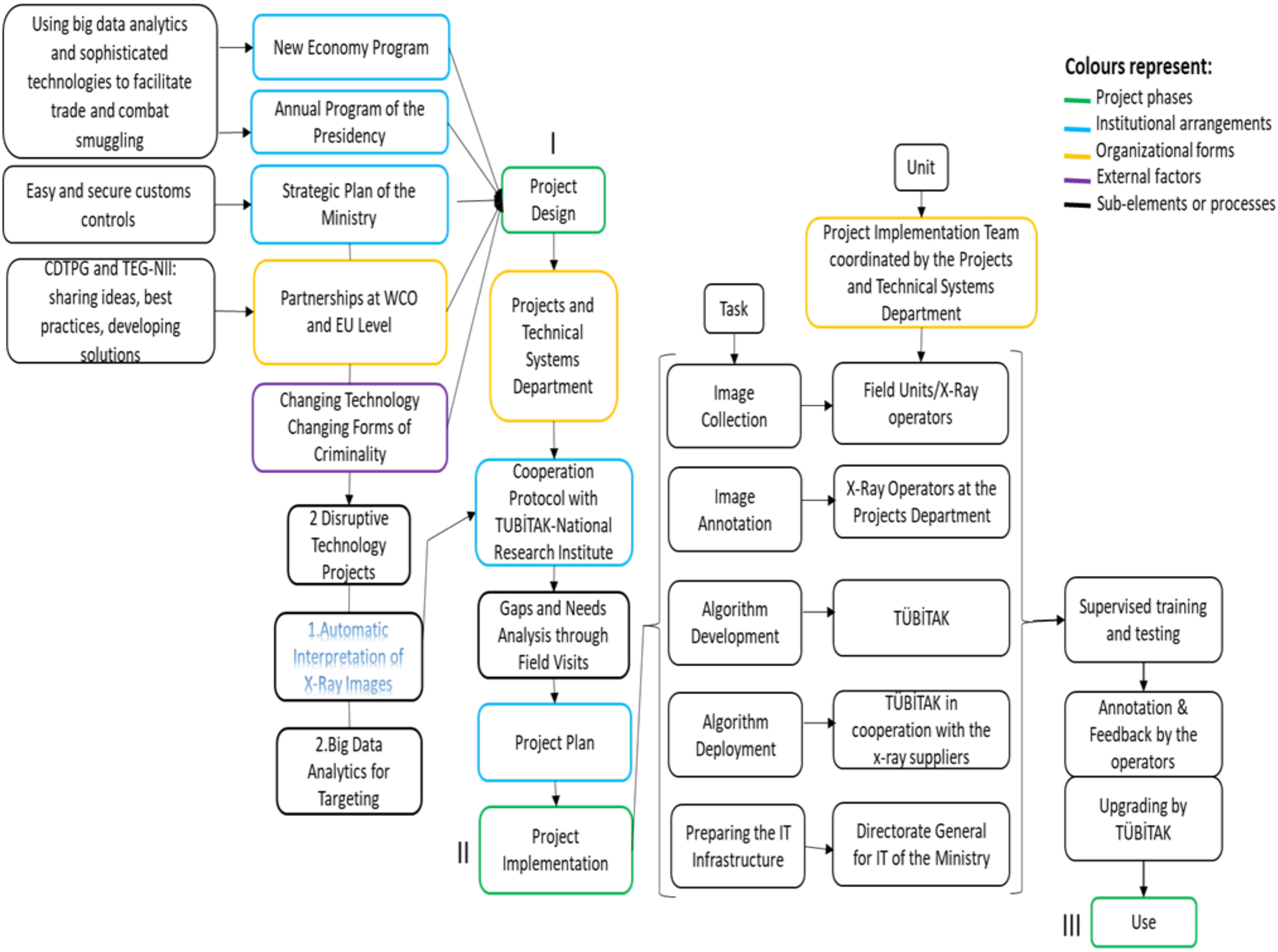
In addition to the already existing partnership models, the National AI Strategy (2021-2025) of Türkiye foresees the establishment of the new ones. According to the strategy, TÜBİTAK will establish "Sectoral Joint Development Laboratories" within its AI Institute for the shared use of the AI ecosystem for the whole public sector organizations. These laboratories will be supported with infrastructure and data-hubs, specifically provided to develop and test multi-stakeholder sectoral AI applications. It is expected that these laboratories will support organizations in defining problems, creating usage scenarios, sharing and labelling data, and bringing together field experts and industry representatives (The Presidency, 2021). However, the effect of this strategy and the data hubs on the public organizations' AI efforts are yet to be seen.

In the light of the CAT's case analysis findings, the AI Technology Enactment Flowchart for the CAT is developed and illustrated in Figure 8. Adopted from the TEF, the flowchart indicates the three project phases, (I) design, (II) implementation, (III) use, for the automatic interpretation of X-Ray images project and how institutional arrangements, organizational forms and the external factors impacted technology enactment. Again, the 'use' case is included only to complete the flowchart.

The flowchart is to be read following the same logic with the flowchart for the Dutch case. For instance, the design of the two disruptive technology projects, automatic image interpretation and big data analytics for targeting, is the outcome of the Strategic Plan of the Ministry, influenced by the Presidency's Annual Program and the New Economy Program, as the main institutional arrangements, the WCO and EU level partnerships as the network organizational forms and the changing forms of criminality as an external factor. The automatic image interpretation pilot project was realized via a Cooperation Protocol with the national research institute. The implementation phase began following the preparation of a project plan after the field visits conducted for gaps and needs analysis. The Projects and Technical Systems

Department is responsible both for the design and implementation phases. Just as in the Dutch case, the tasks involved in and the units responsible for the implementation phase, and the steps prior to the use case (i.e. supervised training) are presented in the flowchart.

Figure 8: The AI Technology Enactment Flowchart for the Customs of Türkiye



Source: *(Developed by the author)*

4.2. Comparative Analysis of the Two Cases

This section will analyze the two cases by presenting the similarities and differences in their technology enactment processes and conclude with a Comparison Table (see table 1), which responds to the second research question about the elements to be learned from the two cases in accordance with technology enactment. The main goal of this comparison is to reveal which adaptations in the two cases could be seen as applicable or challenging. First, regarding their similar points, both cases experienced the same technology-related challenges such as the scarce image data-base in developing the AI model. Second, they recognized the importance of qualified AI-aware personnel like data scientists who are able to develop AI solutions and understand the AI associated challenges for the success of AI projects. Third, both entities acknowledged that AI projects necessitate extra stages in project design (i.e. proof of concepts) and implementation (i.e. data collection, feedback), distinguishing them from buying a turnkey technology solution. However, despite engaging in AI efforts caused organizational and institutional transformations in both organizations, these transformations show differences, which will be discussed below.

To begin with, regarding the institutional arrangements, the main difference is that the Dutch Customs has innovation specific policy documents like the Innovation Themes, Innovation Agenda and the Triangle Approach to Innovation while in the Turkish case, innovation related goals are stated only in high-level policy documents. Second, as regards the bureaucratic organizational forms, the Dutch Customs has a dedicated Data Science Unit active in the project implementation and an inter-departmental Innovation Coordination Group in the design phase. In Turkish Customs, these processes are carried out by the already existing Projects and Technical Systems Department. Moreover, while both organizations benefit from the technical expert group networks, the Dutch Customs is able to cultivate more extensive partnerships with the EU technical expert groups as a member state.

The details of these similarities and differences for each case will be discussed below. In each category, the most significant difference is also identified in the heading.

- **Institutional Arrangements – Innovation Specific Policy Documents & EU Regulations**

The two countries' organizational level institutional arrangements show two main differences which are innovation-specific documents and the EU's impact on regulations. First, the CAN states in its Multi-Year Strategic Plan (2020-2025) that it has a vision to become a data-driven organization (CAN, 2021, p.16) while Türkiye' goal is primarily driven to keep pace with the latest international technological advancements and maintain its status as a contemporary customs administration (GMGM, 2023). As such, this research found that the goal of becoming a data-driven organization led to more detailed innovation-specific policy documents (i.e. Innovation Agenda) and more novel changes in organizational forms (i.e. Data Science Unit and Innovation Coordination Group) in the Dutch Case. On the other hand, the innovation targets are regulated only in high level policy documents in Türkiye (i.e. Multi-Year Strategic Plan) and the projects are initiated by the existing departments (Projects and Technical Systems).

Among the innovation-specific arrangements, the Social Innovation Approach of the Dutch Customs emerges as the most significant difference between the two cases. As a common element of both the Innovation Themes and the Triangle Approach to Innovation, social innovation emphasizes that technological transformation should be accompanied with a transformation in personnel strategies (PEN-CP, 2021). Accordingly, the Strategic Staffing Program of the Dutch Customs (CAN, 2022, p.18) aims at aligning personnel capabilities with the technology's requirements (i.e. hiring data scientists), keeping the learning loop at pace (i.e. training the X-Ray operators on AI technologies), and training the managers about innovation (PEN-CP, 2021; IoN). Thus, it can be concluded that the problems experienced in the Turkish case, such as the lack of data science expertise, tight project schedules and overloaded work plans, could be overcome by introducing a social innovation approach. Overall, social innovation is favoured for its potential positive impact on the personnel's understanding and acceptance of new technologies, and it eases the adaptation process.

The second difference is related to becoming an EU member. The EU legislation plays a role in shaping the institutional arrangements in the Dutch Customs, mostly by contributing to putting the ethical, transparent, trustworthy and explainable AI principles on the agenda of the Dutch Customs' priorities, as, for instance, the EU AI Act foresees (Harison, 2023; IoN). Also, as customs administrations deal with sensitive/personal data while implementing big data analytics and AI projects, EU regulations like the General Data Protection Regulation set additional standards for EU public organizations on personal data protection (IoN).

One other comparison can be made based on the National AI Strategies. These countries are similar as both have a National AI Strategy ensuring standardized means for AI implementations at the national level (European Commission, 2019; The Presidency, 2021). Yet, the effects of this strategy have not been reflected in the regulatory framework at the organizational level in Turkish Customs yet. Therefore, this comparison category could not be further evaluated.

- **Organizational Forms**
  - **Bureaucracy – Data Science Unit & Innovation Coordination Group**

Despite showing some similarities, two organizations differentiate on the basis of having a dedicated Data Science Unit and Innovation Coordination Group. Firstly, both customs organizations established a dedicated department dealing with AI projects. In the Netherlands, this bureaucratic transformation happened *prior/in parallel* to the implementation of big data and AI projects while in Türkiye, the already existing Projects and Technical Systems Department implemented the pilot. The Analysis and Targeting Department was established *following* the pilots, indeed, towards their end, in May 2023 (IoT). This difference directly impacts the personnel working in AI projects. The Dutch Customs undertook the projects with the data science experts while this was done by the customs experts in Türkiye, who has the field knowledge on customs but not data science knowledge.

The second difference of the bureaucratic organizational forms relates to the inter-departmental collaboration. In the Netherlands, the initiation of innovation projects are products of joint efforts of an Innovation Coordination Group guiding inter-departmental cooperation at the project design. In Türkiye, however, technology projects are initiated/planned independently by the related individual departments (mostly the Projects and Technical Systems Department). The project working groups are formed to foster interdepartmental coordination at the headquarters or field units only in the implementation phase.

  - **Networks – EU Level Technical Expert Groups**

Looking at the inter-agency networks in the two cases, some similarities and differences can be seen. Both organizations have multiple ways to obtain AI technologies as purchasing off-the-shelf products from the market, developing or outsourcing. The automatic detection algorithms were developed as tailor-made in both countries. Yet, while the model of the Netherlands was developed by the data scientists of the Dutch customs, that of Türkiye was developed by the national research institute, TÜBİTAK (PEN-CP, 2021).

In addition to national level inter-agency partnerships, international networks have impacted the organizations' AI efforts. For instance, the Unified File Format Project of WCO was the primary motivator behind Türkiye's initiation of the automated detection project (GMGM, 2023). Additionally, the EU-level networks, like the CDTPG, is another motivator for candidate country Türkiye's innovative projects. Yet, as expected, The EU has a more considerable impact on the Netherlands' efforts as a member state than Türkiye. Through research and innovation funds and detection technology expert groups (i.e. PEN-CP, ACXIS), the EU plays a critical role in steering the direction of the CAN's innovation efforts (IoN), which emerges as the most significant difference regarding inter-agency networks.

- **Project Processes – Projects' Design and Scope**

The two organizations considerably differ with respect to how they design AI projects and their pilot projects' scope. First, at Dutch Customs, the project design involves impact assessments and testing of the proof of concepts through which repercussions of introducing a new technique within a specific process is evaluated, reducing unpredictability (PEN-CP, 2021). In the Turkish case, preparatory studies are undertaken, too, but they are conducted to identify the technical gaps and needs for the project and do not offer a comprehensive projection for the effect of the new AI tool on future customs controls (IoT-1). Despite they are more similar with respect to the implementation phase, they differ as regards the teams taking part in this process. That is, the laboratory unit, in collaboration with the data scientists, took part in the image annotation, increasing the chances of more accurate annotation in the Dutch case. This was, however, merely conducted by the operators in Türkiye.

Second, the scope of the project plans of the two cases is worth-mentioning. One difference is related to the illicit goods for which the model is developed. In the Netherlands, the pilot projects were initiated only for the drugs while in Türkiye, four different illegal items (drugs, cigarettes, weapons and also migrants) were covered under the pilot. This deteriorated the problem of data-scarcity further. Second, In the Dutch case, expert personnel were assigned to each project component requiring special expertise. Yet, in Türkiye, the project team composed of customs experts were responsible for coordinating all project components (image analysis, data visualization, statistics etc.) and type of work (technical, financial, human resources management, etc.) in the project management process, which increased the workload of the project team further.

In the light of this analysis, a comparison table for the AI technology enactment in the two administrations is presented in Table 1.

Table 1: A Comparison of AI Technology Enactment at Different Phases in the Customs Administrations of the Netherlands and Türkiye

Organization	Institutional Arrangements, Organizational Forms and Outcomes		Design	Implementation
Customs Administration of the Netherlands	**Institutional Arrangements**	Legal & Formal	1. Publish high level policy documents including innovation goals: the Multi-Year Strategic Plan, Pushing Boundaries Vision, Layered Enforcement 2. Also publish innovation-specific policy documents: Innovation Themes, Innovation Agenda, Triangle Approach to Innovation (including social innovation) 3. Influenced by the EU legislation 4. Has a long-term vision to become a data-driven organization	Realized via Project Plans
	Organizational Forms	Bureaucracy	1. Establish the Data Science Unit prior/in parallel to AI and big data projects 2. Form an Innovation Coordination Group 3. Personnel: Data scientists have the central role	Form a Project Implementation Team composed of Field Units/X-Ray operators, Customs Laboratory, Data Science Unit, Information Management Directorate, Business Operations Directorate (with Scanner Suppliers)
		Networks	1.National level: Cooperate with research institutes and private sector 2.International level: -Participate in research projects through EU technical expert groups (as a member state) -Participate in the WCO technical expert groups. -Cooperate with other customs administrations for expanding the image database	Same as the design phase
	Outcomes			Maybe unpredictable but uncertainties are reduced by following certain steps in the design (i.e. proof of concepts) and implementation (i.e. supervised training) phases and applying a social innovation approach.

Customs Administration of Türkiye	**Institutional Arrangements, Organizational Forms and Outcomes**		**Design**	**Implementation**
	Institutional Arrangements	Legal & Formal	1. Publish only high-level policy documents including innovation goals: the Strategic Plan of the Ministry (in line with the New Economy Program and the Annual Program of the Presidency) 2. Realize projects via a Cooperation Protocol with TÜBİTAK 3. Has a goal to sustain to be a modern customs administration	Realized via Project Plans
	Organizational Forms	Bureaucracy	1. Has a dedicated Projects and Technical Systems Department (for all innovation projects*)* 2. Established an Analysis and Targeting Department to realize future AI and big data projects 3. Personnel: Customs experts have the central role	Form a Project Implementation Team composed of customs experts, X-Ray operators, TÜBİTAK, IT department, X-Ray suppliers
		Networks	1.National level: Cooperate with the research institutes and the private sector 2.International level: - Participate in the EU (as a candidate state) & WCO technical expert groups. - Cooperate with other customs administrations for sharing practices.	
	Outcomes			Maybe unpredictable and negatively affected from tight schedules, workload, lack of expert personnel but uncertainties are reduced via a pilot phase.

Source: *(Developed by the author)*

5. Discussion

5.1. Discussion of the Research Findings

This section will point out which organizational form and institutional arrangement changes are observed that support technology enactment in the two cases, by linking the research results with the literature.

Most of the research findings echo with the existing literature on the AI applications in the public sector and customs but also introduce some new perspectives, creating room for further exploration. Overall, as Fountain (2001) asserts, the research acknowledged that there is a mutual relationship between how organizations enact technology, that is, *between* their project design and implementation approaches *and* organizational forms, institutional arrangements and (pilot) project results. Accordingly, the research findings are in line with Wirtz et al. (2022) in the sense that AI should be viewed not just as a technological tool, but also as "a way of thinking" about the possibilities and potential consequences of its implementation. As such, the research showed that the AI projects of both organizations carry the same purpose which is trade facilitation and more precise threat detection, yet their motivation slightly differed. Turkish Customs emphasizes the need to catch up with the recent developments as a modern customs administration (GMGM, 2023) while the Dutch Customs puts becoming a data-driven organization as their overarching goal (CAN, 2021, p.16). In this context, it can be inferred that the Dutch Customs recognizes technological transformation as an endeavour coming *from-within* the organization. This ultimate goal is found to have led to more novel forms of institutional an organizational transformation in Dutch Customs.

First, the research highlighted that the institutional arrangements of an organization impact its AI design and implementation. As Bullock (2019) asserts, AI applications are determined by the legal and organizational structures that support it. In other words, AI initiatives are dependent on the existing frameworks and regulations that govern its usage within a particular context. Similarly, the research indicated that the national and international obligations such as the EU regulations on AI or national AI strategies influence AI practices of the organization (IoN). In addition to such primary legislation, organizational level regulations specific to technology management play a guiding role in AI enactment, which supports Mikalef et al.'s (2022) assertion that an all-encompassing organizational planning is crucial to accommodate the changes enabled by AI, and such planning must encompass more than just addressing technical hurdles. For instance, the Innovation Themes play a crucial role in the project design phase and the Innovation Agenda in the project implementation phase (PEN-CP, 2021, pp.77-

79; CAN, n.d.) whereas the Triangle Approach to Innovation, involving Social Innovation, ensures the alignment between the strategic goals, technology and human resources at Dutch Customs (PEN-CP, 2021, pp.77-79). The Turkish Customs has also acknowledged the importance of incorporating AI technology into customs control procedures, which is highlighted as a goal in their 2019-2023 Multi-Year Strategic Plan (Ticaret Bakanligi-Ministry of Trade, 2022, p.15). However, the themes and agenda for innovation have found not to be solidly institutionalized yet (IoT-1).

Among the innovation-specific documents, the Social Innovation Approach of Dutch Customs deserves a closer look because of its positive impact on the personnel's attitudes towards new technologies. This supports the standpoint of Grimmelikhuijsen and Feeney (2017) and Fountaine et al. (2019) that the existence of an open and innovative culture receptive to change impacts an organization's capacity to adopt innovative solutions. Furthermore, it conforms to the proposition of Mikalef and Gupta (2021), who put forward human resources as one of the three types of resources impacting an organization's AI capability alongside tangible and intangible resources. This fining is also harmonious with the argument of Jaiswal et al. (2021) that organizations should proactively implement upskilling programs to ensure that their employees are proficient in comprehending and utilizing new intelligent technologies.

Regarding the organizational forms, the research echoes with the anticipation of Bullock et al. (2022) that AI will bring significant changes to the traditional bureaucratic structures. AI projects fostered inter-departmental cooperation within the bureaucratic structures, resulting in the formation of decentralized, cross-functional teams with diverse expertise and perspectives from various departments (Mohanty and Vyas, 2018; Fountaine, 2019). As such, it also acknowledges the significance of intangible resources for AI projects' success, as suggested by Mikalef and Gupta (2021). Intangible resources refer to the organization's capacity to facilitate collaboration across its different departments, initiate and execute organizational changes, and willingness to undertake high-risk, high-reward projects. Such changes can be exemplified by the Innovation Coordination Group in the Dutch case and the Project Implementation Teams in both cases. These cross-functional teams are likely to change how the principle of hierarchy is exercised in the long run.

In addition to the principle of hierarchy, this research has implications for Weberian (1947) bureaucracy's span of control principle. As such, it partially responds to the question raised by Rudko et al. (2021) about the effect of AI on the span of control, which they deemed further research necessary to explain the causality between them. In both cases, the possible positive impact of AI on the field operators' decision-making abilities is likely to reduce the need for more control. Currently, the shifts of fresh operators are arranged in such a way that they work in the supervision of a more experienced operator so that they are able to consult when needed (IoT-2). Although it is too early to state, both the need for a superior and the number of the personnel under one superior is likely to decrease as the model achieves higher success rates, causing a shift from leader-driven to data- driven decision making, as Fountaine et al. (2019) suggests.

Nevertheless, one should approach with caution to this argument because it may cause the opposite when combined with other types of disruptive technologies such as the IoT or blockchain. In addition to the automatic image interpretation efforts, customs administrations, including the Dutch and Turkish Customs, implement projects to get these images produced in a unified format, increase the systems' interoperability and centralize their image analysis stations (DGCE, 2023, p.49; WCO, 2019). This enables that the image scanned at the border is accessible and operators' analysis result can be seen simultaneously from the centre/the headquarters. This may have consequences like increased surveillance from the central bureaucracy.

As regards the network organizational forms, the research indicated the importance of stakeholder management for AI projects as a form of inter-agency cooperation, which was already presented in Wirtz et al.'s (2022) AI ecosystem framework's 'multi-stakeholder governance process'. It is demonstrated by the research that strong ties with academia and research institutions are becoming prevalent ways of cooperation for AI projects which especially benefits assessing the feasibility of the project. In addition, expert groups at the EU and international level (i.e. CDTPG and TEG-NII) are conducive for sharing knowledge and exploring the possible future promises of AI, as in the case of project ACXIS. It appears that, given the novelty of the technology and the need for comprehensive feasibility studies prior to the implementation, collaborations with research institutions will potentially increase. Furthermore, cooperation is necessary to build the database, because both cases proved that the image database of a single country is unlikely to suffice for successful model development (WCO, 2022).

This research also attempted to wear micro-level lenses to study the roles and viewpoints of different actors participating in the AI project implementation. To begin with, three roles emerged as the most significant: The managers, the data scientists and the X-Ray operators. Their roles are crucial for AI projects as these projects (i) are time and resource-intensive, necessitating managerial backing (Fountaine et al., 2019; PEN-CP, 2021, p.79), (ii) require feedback from X-Ray Operators (WCO, 2022; IoN; IoT-1,2), which demands their endorsement and comprehension of AI's potential; and most importantly, (iii) need the data scientists (Tan and Crompvoets, 2022; WCO, 2022) who are competent in crafting models.

Moreover, the research adheres to the findings of Rudko et al. (2021) and Huang et al. (2022) that individuals within an organization may be embracing or skeptical to innovative change and that these perceptions also differ according to the positions of the personnel, necessitating to take a closer look to the actor-level technology perceptions. X-Ray operators are in favour of automated detection as a psychological support mechanism, especially for the new operators lacking enough expertise (IoT-2). However, there are also skeptics in both cases stating that they can hardly trust AI (IoN; IoT-1,2,3). Those who support the program have expressed that AI would be desirable in terms of responsibility sharing between the AI and the them. This is because the operators are held accountable if they are unable to detect the anomaly on an image, especially if the anomaly is clear to detect. Therefore, it is yet to be seen how AI will affect the operators' responsibility and accountability obligations in the future. Furthermore, it is unknown how their perspectives would change if the existing legal regulations were made more lenient towards operators when they fail to detect anomalies. Hence, the expectations placed on AI can be associated with the current regulations defining the extent of the operators' responsibility.

In relation to the above discussion, the research has contributions for human-machine interaction as well. The research findings echo with the arguments in the literature that AI is not a substitute for human capital. Rather, it reflects an integrated common effort of the machine and human and will lead to an increase in the performance of the operators (Deloitte, 2021; Daugherty and Purdy, 2017; Bullock and Kim, 2020; McKendrik, 2018) since automated detection will enable them to focus on the tasks requiring their attention more (IoT-2), leading to diversity bonuses (Page et al., 2017; Guszcza et al., 2020). Both institutions emphasize that the Customs will remain a human job but the control procedures can be facilitated to a great extent with the help of AI.

The research also disclosed the changes in the project management processes introduced by AI projects. These are the impact assessments and testing the proof-of-concepts in the design phase and supervised training and testing steps in the pilot implementation phase, which are not required for a product purchased as off-the-shelf. Such steps are necessary for a successful model development and also reduce the risks of unexpected outcomes, which is known as the most challenging aspect of innovation, accounting for nearly 70% of failures in achieving innovations (PEN-CP, 2021). Although both organizations follow similar steps, the Dutch Customs conduct more comprehensive impact assessments in the design and also the supervised data production is supported by the data scientist in the implementation. Therefore, it can be inferred that allocating resources and time for design and pilot implementation yields more successful results. Otherwise, as Fountaine et al. (2019) suggests, if these steps are poorly comprehended and rapid outcomes are expected, organizations can face challenges when they scale up from the pilot to full implementation, and can hardly go beyond addressing particular business challenges with AI.

The research also has results that are related to applying AI specifically within the public sector. It recognized that the implementation of AI in the public sector suffers from problems that the private sector may be immune to. Thus, the research findings are compliant with Dwivedi et al.'s (2021) suggestion that distinguishing between public and private organizations is necessary, as the former may encounter obstacles such as political, legal, and policy challenges. In this sense, the Turkish case interviews depicted that AI projects are situated as the ambitious goals of the government to enhance public services. Therefore, their completion may be considered a performance indicator for the governments, which exerts pressure on the project team. Hence, it is important for the public sector to understand the complexities of implementing AI projects and differentiate them from projects which harbour less risks in terms of timely completion.

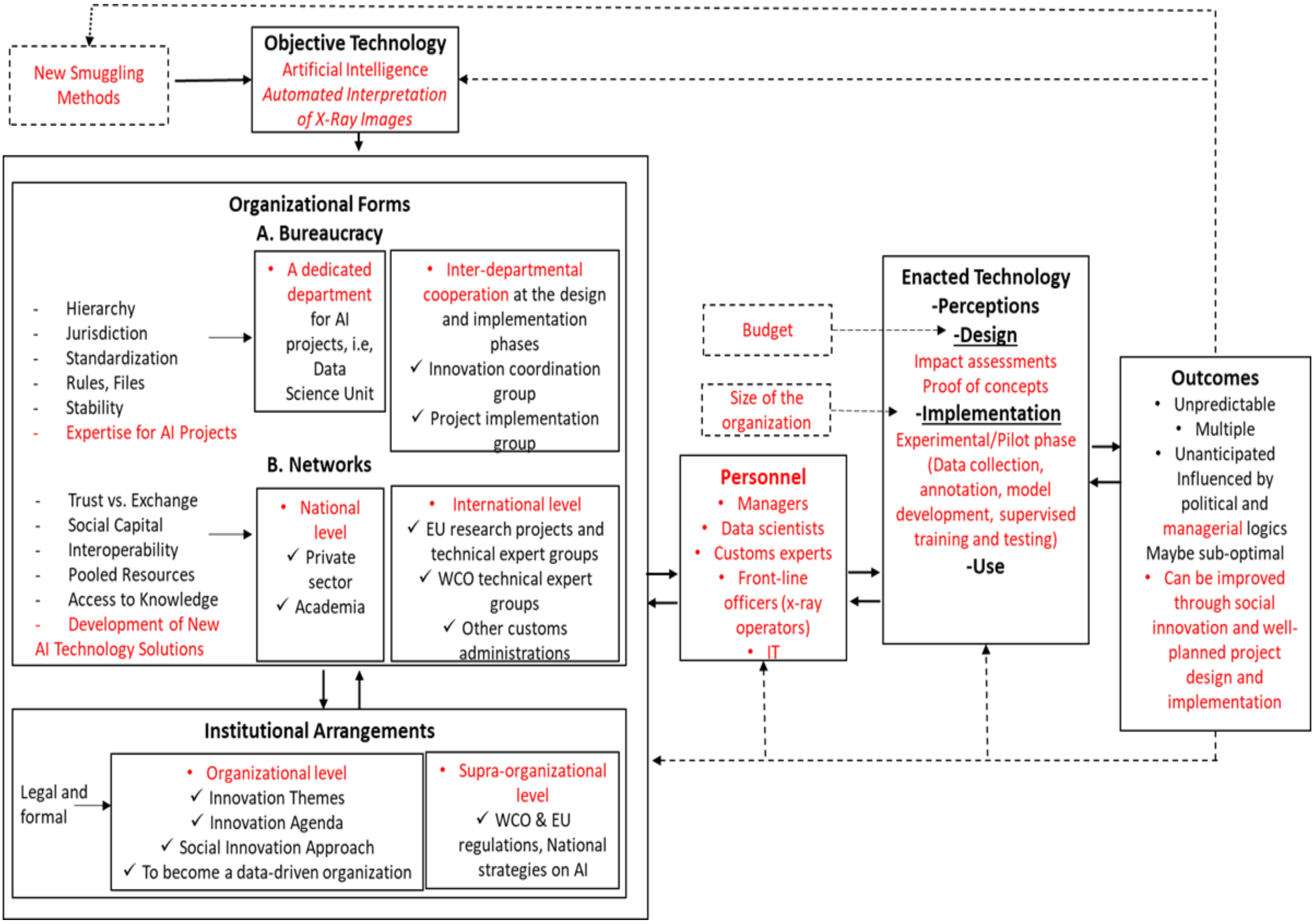
Finally, the research has customs sector specific findings. The research matches with the already identified difficulties by WCO & WTO of adopting AI in the customs field, which are the lack of expertise, costs, lack of good practices, existing legacy systems, lack of traction by others, lack of government strategy and other legal issues (2022, p.73). However, the research revealed that these problems can be remedied through transforming the organizational forms and institutional arrangements of the organization. The solutions include innovation-specific policy documents, developing a social innovation strategy, establishing data science units, fostering partnerships with the research institutes and expert group networks functioning at the international level.

Overall, the research naturally resulted in the development of a proposed extended version of TEF for the public sector, which will be discussed in the following section.

5.2. Proposed Extended AI Technology Enactment Framework for Customs

TEF, as an organizational level theory, provided a conducive ground for thoroughly analyzing the interplay among the organizational and institutional dynamics impacting the design and implementation phases of technology enactment in the two customs administrations' automated detection projects. However, as discussed in Chapter 2.2 of this thesis, TEF is also criticized for some of its limitations, which requires either an extension or improving some elements' visibility in the framework. Therefore, based on the findings of this research, an extended version of TEF for the AI technology enactment in the customs field is proposed, as illustrated in Figure 9. This proposed version also responds to the second research question about what elements can be learnt from the two cases.

Figure 9: Proposed Extended AI Technology Enactment Framework for Customs



Source: *(Developed by the author)*

Figure 9 is based on the conclusions from both cases and is proposed as a guide for customs administrations to be used in their AI project efforts. The extensions of the framework are shown in red colour and the figure is explained below.

- **External Factors**

The new smuggling methods is identified as an external factor impacting the project design. Customs authorities closely follow the trends in criminal activities, such as smuggling routes and smuggling tactics (i.e. concealment methods) to revise their combatting strategies. The technology developers also follow these methods to generate corresponding technology solutions. Thus, the new smuggling methods is found to impact the development of a new AI solution as a form of objective technology.

- **Organizational Forms**

Regarding the organizational forms within the bureaucracy, the study confirms that the already existing principles of bureaucracy in TEF, i.e. hierarchy and standardization, has the potential to facilitate the project implementation since they allow for a rules-based approach. Moreover, the research adds that bureaucratic forms, such as Data Science Unit and Innovation Coordination Group, provide “expertise for AI policies”, which is the most important prerequisite for successful AI projects. Thus, it is added as a new factor to the characteristics of bureaucratic organizational forms.

As for the networks, the research adds “development of new AI technology solutions” to the already identified benefits of inter-agency cooperation like the pooled resources and access to knowledge. For AI projects, inter-agency cooperation both at the national and international level not only allow for the exploration of AI challenges but also provide conducive grounds for tackling those challenges via developing new technology solutions with the contributions from practitioners, private sector and academia.

- **Institutional Arrangements**

Within the institutional arrangements, a distinction between the organizational level and supra-organizational level institutional arrangements is made to differentiate between the AI regulations at the organizational, national and international levels. Such a differentiation also responds to the critiques that the TEF ignores external effects (i.e. that of the international organizations like the EU). Here, organizational level arrangements refer to strategies and plans for AI developed by the organization while the supra-organizational level institutional arrangements cover the ones either at the national or international level. At the organizational level, innovation-specific policy documents are found to ease the AI applications. To name a few, Innovation Themes, Innovation Agenda, Social Innovation and the overarching goal to become a data-driven organization are found to facilitate AI technology enactment. At the national level, the national AI strategies provide a common ground for AI developments across the country and foresee the establishment of formal partnerships among the public/private organizations. At the international level, the EU regulations and WCO recommendations help countries in regulating their national AI strategies and practices.

- **Personnel**

Learned from both cases, personnel is presented as a new category to make the importance of the actors (Okumura, 2004) involved in AI projects more visible. This is particularly to show that in the AI projects, new actors such as the data scientists emerge as the most crucial personnel category. Besides, the roles and responsibilities of the existing actors, i.e. the upper-managers and the X-Ray operators, have transformed in this new digital era (Tan and Crompvoets, 2022; Fountaine et al., 2019) because the managers' support and the operators' feedback in the supervised training impact the pilot projects' outcomes positively.

- **Enacted Technology**

The design and implementation phases of technology enactment are extended in such a way to identify the project steps involved in these phases of automated detection projects. The project design involves conducting impact assessments and testing the proof of concepts while the implementation is composed of image annotation, collection, model development and a supervised training and testing. These two phases are also influenced by the availability of the budget and the size of the country respectively. Additional budget allocated specifically for the project design, as in the Dutch case, allows for comprehensive feasibility assessments. On the other hand, the size of the organization (i.e. the number of borders) is a factor that can complicate the process of IT infrastructure preparation and the personnel trainings, as in the Turkish case. Thus, these elements should be incorporated in the project plans for a smoother scaling up from the pilot implementation to the use case.

- **Outcomes**

Lastly, although not being the core focus of this research, the project outcomes are expected to be unpredictable due to the nature of the AI. Yet, the project's unpredictable results can be reduced via following the steps involved in the project design and implementation phases as explained above. Furthermore, involving the related personnel in the pilot implementation via a social innovation approach can increase the personnel's enthusiasm to understand and adopt to the new AI tool.

To conclude, it should be clarified that this extended version does not overlook the elements in the original version or the previous extended versions but adds new perspectives in an attempt to respond to the critiques of TEF. Moreover, it adjusts the original TEF for the AI technology as a form of objective technology and for a specific public sector, the Customs. Yet, it can also be used as a guiding framework by other public sectors utilizing the same technology. However, it may also have some limitations for broader applications because it is developed for a specific type of AI, which is ML, and for the automatic image interpretation projects in the Customs sector. Other types of AI, and even other specific versions of ML, would probably require minor changes within TEF. For instance, the requirements of a pilot phase would change whether the model is developed based on supervised or unsupervised trainings. Therefore, more sector and technology specific studies could broaden the applicability of the framework.

6. Conclusion

6.1. Summary of the Research Findings

This research aimed at contributing to the limited literature on AI applications in the public sector by focusing on the automated detection projects in the Customs Administrations of Türkiye and the Netherlands. It pursued an organizational level analysis and enabled to draw detailed policy implications due to its sector-specific and country-specific approach. Utilizing the TEF as a guide, a comparative analysis was performed to investigate the dynamic relationships among the TEF elements within the automated detection projects of the two customs administrations. Yet, the combination of theory-driven and grounded theory approaches helped identify new categories of relationships in the technology enactment process and expand the already existing ones. The study considered the Dutch Customs as a standard reference, offering a comparative yardstick for assessing the current progress of the Turkish Customs.

In concrete terms, this thesis research resulted in the development of a Codebook for analzying the technology enactment processes of the two customs administrations (Annex-III), the Technology Enactment Flowcharts for Türkiye and the Netherlands Customs (Figure 7 and 8), a Comparison Table showing the similarities and differences of the two cases (Table 1) and a

Proposed Extended AI TEF for the Customs Sector (Figure 9). The answers to the two main research questions are summarized below:

1. ***The Technology Enactment Flowcharts for Türkiye and the Netherlands Customs (Figure 7 and 8) can be used to answer the first research question: how the two customs administrations enact AI technology in automated detection projects***.

Overall, the thesis showed that AI projects led to organizational and institutional transformations in both cases. The specific case of the automated detection projects illustrated that both organizations established dedicated departments for managing AI projects and intensified collaboration with technical expert group networks both at the national (i.e with the research institutions) and international level (i.e. with the EU and WCO) to deal with the complexities of AI. Furthermore, both recognize that AI projects should be managed differently comparing to purchasing an off-the-shelf product because AI models are developed inhouse and introduce new project steps like data collection, annotation and feedback.

Nevertheless, the two cases also show differences in the organizational and institutional forms they adapted to design and implement AI projects. Specifically, the Dutch case is observed to design AI projects more detailly in institutional arrangements. That is, in addition to the high-level policy documents like the Multi-Year Strategic Plan, there are innovation-specific documents like the Innovation Themes, Innovation Agenda and Triangle Approach to Innovation supporting the technology enactment process. Moreover, the Dutch Customs has introduced more novel bureaucratic organizational forms for AI technology enactment, which can be exemplified by an Innovation Coordination Group and a Dedicated Data Science Unit. In the Turkish case, however, the AI projects are mostly regulated via the high-level policy documents and did not cause major organizational changes. To exemplify, the AI projects are carried out by the already existing Projects and Technical Systems Department and by the customs experts, not data scientists. Yet, an Analysis and Targeting Department has been established recently to carry out big-data and AI related future projects, whose impact is yet to be seen.

Another difference concerns the projects' scope and corresponding personnel planning. AI project implementation performs better when the personnel planning is done taking into account the workload of the project plan in terms of the required personnel number and expertise. That is, appointing expert personnel to each task category in project management (administrative, technical, financial, etc.) and diversifying the expertise in each field (data collection, annotation, model development, testing, etc.) is likely to facilitate project implementation, as the Dutch case proved. Yet, these tasks were carried out by the same department in the Turkish case.

2. *The Comparison Table showing the similarities and differences of the two cases (Table 1) and the Proposed Extended AI TEF for the Customs Sector (Figure 9) responds to the second research question: what elements in accordance with the technology enactment framework could be learned from the two cases.*

The key takeaways from the two case studies to tackle the AI-related challenges can be encapsulated as follows:

- **Institutional arrangements: Concrete goals to become a data-driven organization and innovation-specific policy documents facilitate AI technology enactment.**

In addition to the AI goals stated in the Multi-Year Strategic Plans, as in the case of both countries, innovation-specific regulations, i.e., Innovation Themes, Innovation Agenda, Triangle Approach to Innovation, facilitate AI projects because they align the organization's over-arching targets with the existing and future AI efforts, helping more efficient management of financial and human resources.

- **A social innovation approach: Technological transformation should involve the personnel.**

Among other institutional arrangements, social innovation approach of Dutch Customs is worth mentioning separately because it emerges as the most significant difference between the two organizations. It means realizing technological transformation together with the people within the organization, rendering the organization and people more receptive of new technologies. The key personnel for AI projects are found to be the managers, the data scientists and the X-Ray operators. Examples of social innovation includes employing data scientist, trainings on new technologies and involving the X-Ray operators in the project starting from the pilot.

- **Organizational forms: AI created a need for a dedicated Data Science Unit and intensified inter-departmental and inter-agency cooperation.**

The existing organizational forms fall short of responding to the requirements of the AI projects in terms of project planning and expertise. Thus, the Dutch Customs coordinates the innovation efforts through an Innovation Coordination Group and a Dedicated Data Science Unit.

Although such units did not exist in the pilot phase of the Turkish case, they now recognize the need for data scientists for the future projects (IoT-1). Moreover, the complexity and novelty of the AI applications intensified the need to cooperate with the academia and private sector, and fostered experience sharing in the international expert group platforms in both cases.

- **Project outcomes: Project success is contingent upon a well-planned project design and implementation.**

The AI models are likely to yield more successful detection rates when the design and implementation steps are rigorously followed. These steps include impact assessments and proof of concepts for the design and data collection, annotation and supervised training for the implementation. The research revealed that despite both countries follow similar steps, the design phase is more comprehensive for the Dutch Customs and both the design and implementation are supported by the data scientists.

- **Other factors: New smuggling methods, budget and the size of the organization**

Three additional factors are found to impact the AI technology enactment process. First, new smuggling methods impact this process as AI technology solutions are offered to tackle with the emerging threats (i.e. new concealment methods). Second, the availability of budget creates better project designs by enabling more comprehensive feasibility assessments, as in the Dutch case. Third, the bigger the organization (i.e. high number of border crossing points), the more difficult it is to prepare the IT infrastructure or train the personnel involved in implementation, as in the Turkish case.

- **Implications for the use case: Hierarchy and span of control principles**

The design and pilot implementation phases provide potential clues for the use case of the projects. The integration of AI within the customs control process is expected to alter some fundamental principles of the Weberian bureaucracy (1947), namely, hierarchy and the span of control. This assumption stems from the prospect of X-Ray operators attaining greater autonomy in decision-making by using AI as a decision support system, which is likely to diminish their dependency on more experienced operators in the long run.

However, it is still too early to make such assertions because of two reasons. First, the projects are in their early phases of implementation. Second, the AI can have unforeseen effects when combined with other disruptive technologies like the IoT and blockchain. These technologies foster heightened interoperability and facilitate real-time access for the central authority to border checkpoints. Consequently, this could inadvertently bolster centralization in an extended timeframe. Thus, it would be better to examine the long-term repercussions of disruptive technologies on bureaucratic structures within a particular sector, not by analyzing one technology's individual impact but the joint impact of different technologies that are simultaneously used.

6.2. Research Strengths and Limitations

- **Research Strengths**

The research focused on the deployment of AI, a contemporarily relevant technological advancement, within the realm of public sector, specifically the Customs, a sector known for its extensive utilization of technology to combat cross-border crimes. An organizational level analysis enabled a thorough examination of the role of the organizational forms and institutional arrangements in the design and implementation phases of automated detection projects in the two organizations in a comparative way. These two organizations exhibited similarities in some aspects of applying AI solutions, while diverging in others, despite facing similar challenges. Consequently, technology enactment flowcharts for the two organizations, a comparison table and an extended version to the TEF on AI technology enactment for Customs were proposed.

- **Research Limitations**

Despite these contributions, the research faces some limitations. First, compared to the large-N case studies, this research has two cases from different contexts. This may cause generalizability problem for the research because the problems faced in AI projects could differ in other contexts. Second, the number of the interviewees is low in both cases. It was possible to interview with one AI manager in the Dutch Customs while one customs expert, one X-Ray operator and one data-developed were interviewed from Turkish Customs. Furthermore, it was not possible to acquire first-hand actor level perceptions because the interviewees showed differences between countries in terms of their positions at the organization. For instance, the X-Ray operators' viewpoints were obtained by interviewing with the AI manager, not with the operators themselves, in the Dutch case. Nonetheless, this limitation was tried to be mitigated by using the documents as the main source of analysis and using the interviews as the supplementary source to explain the enactment processes of the cases. The third limitation is the lack of pilot projects' performance data. As the projects were in their early phases of implementation, their effects on the customs control process, for instance, on the duration of image analysis or the seizures, could not be presented. Consequently, it was possible only to conduct an analysis for the project design and implementation phases, leaving out the use case.

Lastly, this research is pretty dominated on the organizational level analysis. The organizational level analysis is a conducive mechanism to understand the strengths and weaknesses of an organization in different phases of AI technology enactment. Yet, a systems-thinking approach could be combined with such an analysis, especially for the public sector, by which such factors as the political choices, the country's AI strategies, technological capacities, and international obligations on AI could be handled more deeply.

6.3. Theoretical and Practical Implications

- **Theoretical Implications: Avenue for Further Research**

The limitations of this research are conducive to inspire further research efforts for studying AI in the public sector. First, one finding of this research is that the actor level perceptions differ among the personnel with respect to AI. Since this research was unable to conduct interviews with all personnel of different positions involved in the project, research focusing solely on actor-level perceptions might be useful for revealing the possible personnel-related challenges to be faced before and in the aftermath of the project implementation. Second, the research had to focus mostly on the AI project design and implementation and leave aside the use case because the projects were in their primitive stages of implementation. Therefore, follow-up research on the use case can address the issues that were unable to be covered within this research. For instance, this research could cover the projects' long-term influence on the principles of Weberian bureaucracy, (i.e. the span of control), on the quality of law enforcement function (i.e. smuggling detection rates) and the provision of customs services (i.e. customs control duration). Third, further research in different geographical contexts could increase the research's generalizability and add more factors to be considered for customs authorities implementing AI projects. Fourth, this research investigated only the automated detection projects and there is a potential that each kind of AI/ML technologies' requirements could differ at technology enactment phases, which could be evaluated in further studies. Fifth, there may also be a need to conduct more sector-specific studies within the public sector because just like each technology comes with its unique opportunities and challenges, each sector, be it Customs, health or transportation, will have its own characteristics requiring a unique investigation. Lastly, the fact that the research conducted an organizational level analysis leaves future study to fill the gap by studying other levels, macro and micro, in more detail. In short, there is a need for more sector-, context- and technology-specific research to understand AI project management process in the public sector.

- **Practical Implications: Policy Recommendations**

AI is becoming a promising solution in the Customs for the detection of illicit trade more swiftly and precisely. The policy recommendations based on the findings of this research for the public organizations in general and customs administrations in particular to cope with AI-related challenges are presented below.

  - **A Dedicated AI Department and Data Scientists for AI Project Implementation**

Both cases showed that AI projects require special expertise in data science, the existence of which facilitated the pilot applications in the Dutch case and lack of which caused delays in the Turkish case. Hence, there is a need for expert staff who is able to develop the models or pick the most appropriate technological solutions available in the market. Data science expertise is important for the AI projects because explainable AI is also a concern for the end-users. Thus, this research suggests opening a dedicated data science unit and hiring data scientists for a more successful AI project implementation process.

  - **Innovation Coordination Group for AI Project Design**

The Innovation Coordination Group in the Dutch Customs is composed of personnel from departments (i.e. data science, enforcement, procurement, etc.) responsible for innovation projects. In line with the Innovation Themes, this group decides which projects to be put into the Innovation Agenda, following feasibility assessments. Establishment of an Innovation Coordination Group is suggested as it would ensure that different expertise required for AI project design are brought together and the new project idea is feasible, both mitigating the risk of AI project failures.

  - **Innovation-Specific Policy Documents**

The Dutch case taught that innovation-specific policy documents such as the Innovation Themes, Innovation Agenda and Triangle Approach to Innovation facilitate AI projects as they align the existing project ideas with the thematic priorities and strategic goals of the organization stated in the high-level policy documents, and provide concrete roadmaps to realize these goals. Despite the enthusiasm of the managers to implement AI projects (IoN; IoT-1), unless well-planned, public organizations can make inefficient technological investments whose compatibility with institutional strategies and needs is unclear and which hardly complement each other, leading to the loss of public money. Thus, they are suggested to develop innovation-specific policy documents.

- **A Shift from Product 'Procurement' Mentality to Product 'Development' in Project Management**

The AI has introduced new steps to design (i.e. impact assessments) and implementation phases (i.e. supervised trainings), because the AI model is developed, which is different than purchasing a readily available product. These processes require additional resources in terms of time, budget and personnel. Therefore, the public organizations are suggested to recognize that AI projects require new phases and resources for AI model development. This also necessitates managers' support by granting enough time to the project team for project trials and put novel performance targets which are different from procurement projects. Otherwise, the project can result in malfunctioning AI systems that are hardly be corrected later due to their black-box nature.

- **Developing a Social Innovation Approach for AI Projects**

Both cases proved that personnel's support (managers), expertise (data scientists), and feedback (X-Ray operators) is utmost required in the AI projects. The Dutch case showed that a Social Innovation Approach, a part of the Triangle Approach to Innovation, facilitates innovation projects because it involves training the personnel, including the managers, about new technologies, managing personnel expectations about technology's capabilities, adjusting the personnel strategy in accordance with the needs of the new digital era, and involving the related personnel in the pilot projects from the beginning, all increasing the organization's capacity to adapt to new technologies. Thus, public organizations are suggested to focus not only technical but also techno-social aspect of innovation projects by developing a social innovation strategy.

- **Fostering Inter-Agency Cooperation**

Both organizations acknowledged that technical expert groups at the national and international levels (i.e. EU and WCO) serve as platforms for advanced research and cooperation on AI. Bringing together experts from the academia, the private sector and practitioners, such networks assist organizations in addressing their AI needs and enhancing their understanding of the solutions that the AI technology can offer. Moreover, cultivating partnerships with other customs administrations contributes to the expansion of the database, which is the lifeblood of AI projects. For instance, although both organizations suffered from a limited data-base, the

Dutch Customs was able expand the number of the images by cooperating with the Customs of Australia, Belgium and Brazil. Thus, the Customs planning to initiate automatic image interpretation projects are suggested to participate in the EU and WCO level expert networks and also develop partnerships with their counterparts.

In conclusion, alongside the technical characteristics of AI projects, it is critical for public organizations to consider a multitude of peripheral aspects for the success of AI projects. These include the repercussions on existing operational processes, potential alterations to the responsibilities of staff across various roles, congruence with the organization's other strategic technological investments, compliance with national AI strategies and international organizations' recommendations. Such considerations should be comprehensively addressed, assessed, and duly documented alongside the project's execution trajectory.

Appendix I: Information on the Interviews

No	Role	Country	Institution	Language	Date of the Interview	Via	Duration (hour)
1	Manager	The Netherlands	Dutch Customs-Headquarters	English	11.04.2023	Teams	1.28
2	Customs Expert	Türkiye	Turkish Customs-Headquarters	Turkish	19.04.2023	Teams	1.45
3	X-Ray Operator	Türkiye	Turkish Customs-Field Unit	Turkish	24.04.2023	Phone Call	1.10
4	Program Developer	Türkiye	TÜBİTAK	Turkish	09.05.2023	Teams	1.30

Appendix II: Interview Questions

1- Can you briefly introduce yourself?

2- How does your administration manage AI projects in general and the automatic image interpretation projects in particular?

3- Which departments guide this process?

4- On which institutional arrangements do you base your work on?

5- How do you tackle the problems you encounter during project design and implementation?

6- How do you think the existing organizational structure impact project design, implementation and outcomes?

7- What are the other factors influencing the project design, implementation and outcomes?

Appendix III: The Codebook

No	Category	Initial codes	Examples of Original Statements
1	**Objective Technology**	Challenges stemming from the characteristics of the AI technology in automated detection projects	Lack of database, training and testing of the material, lack of qualified personnel, need for operators' feedback complicate the project management process.
2	**Organizational Forms**	Departments/Teams responsible for AI project management	
2.1.	Bureaucracy	Departments/Teams *within* the organization responsible for AI projects	Dedicated Data Science Unit, Innovation Coordination Group, Project Implementation Team facilitate this process. We need to collaborate with the IT, x-ray suppliers, X-Ray operators. We need to work with the field units more.
2.2.	Networks	Cooperation with the organizations/groups *outside* the organization. Inter-agency cooperation at the national and international level	WCO-level and EU-level technical expert groups, bi-lateral cooperation with other customs administrations, research institutions and private sector enable sharing best-practices and discussing new technology solutions. These projects fostered cooperation with the research institutes as we develop the model, not directly buy it from the market.
3	**Personnel**	The roles and the responsibilities of the personnel involved in AI technology management and their attitude towards the AI technology	Managers, data-scientists, customs experts, X-Ray operators play crucial roles in AI project management.
3.1.		Managers	A change in their mentality is needed. They support the process but also put tight deadlines. They should be able to understand what AI can offer.
3.2.		Data Scientists	Data scientists develop the models. It would have been better if we have experienced personnel in data science.
3.3.		X-Ray Operators	They are embracing the technology as it will ease their decision making. They may also resist to change in case of low success rates of the algorithms. AI shares responsibility with the operators.
4	**Institutional Arrangements**	Organizational, national, international level formal documents, visions, approaches and goals on AI	Multi-Year Strategic Plan, Pushing Boundaries Vision Innovation Agenda, Innovation

			Themes, Triangle Approach to Innovation, Social Innovation, EU AI Act guide our process of AI project design and implementation. We have a goal to become a data-driven organization. We want to catch-up with the new technologies, not stay behind. We have a Cooperation Protocol with TÜBİTAK.
5	**Outcomes**	Project results, success of the models to detect anomalies	The algorithm needs to get better upon feedback from the operators. Outcomes might be unpredictable but we conduct supervised trainings and testing. Before the project, we conduct impact assessments. Managers are ambitious but it should be understood that for the model to get better, time is needed. When the project is overloaded in terms of project components, the project team is really busy.
6	**Enactment Phases**	Design and Implementation phases of the AI projects	Impact assessments, proof of concepts, experimental/pilot phases, data collection, annotation, model development, supervised training and testing, feedback are the main steps followed.
7	**Other Factors**	Other factors found to influence the whole process of AI technology enactment	
7.1.	Changing forms of criminality	New smuggling methods such as concealment methods	It is a dynamic field, smugglers are trying new ways. The operator can see something in the operator cabin but this can be tricky because the major part of the illicit good can actually be concealed in the cargo.
7.2.	Financial	Availability of budget	We have a small budget for impact assessments and testing proof of concepts before we start a project.
7.3.	Size of the organization	The field units where the project will be implemented	IT department needs to prepare the technical infrastructure in all border crossing points and the project team needs to coordinate this.

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