Tampere University

Adrien Hustache

GOING THROUGH HEL

Passenger-centric guidance for the transit security control point of Helsinki Airport

Faculty of Information Technology and Communication Sciences
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ABSTRACT

Adrien Hustache: Going through HEL: Passenger-centric guidance for the transit security control point of Helsinki Airport
Tampere University
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Millions of travelers pass through airport security every day. Since 9/11, increased screening technologies and stricter regulations are making air travel a highly safe means of transportation. At the same time, the added procedures are increasing the waiting time at airport security. Furthermore, the regulations and instructions are confusing and unknown to many passengers contributing to making the experience of the travelers unpleasant.

Previous research on the topic has been focusing on technologies to use or the behavior of the airport workers. In contrast, this thesis aims to study the behavior of the passengers traversing through the transit security control point of Helsinki Airport. After an in-depth investigation of the context, five different methods were used to collect both quantitative and qualitative data, including two rounds of observation, 38 interviews, and the analysis of four data sources.

The results of this thesis show that close to a quarter of all the trays screened requires additional inspection. The main category of items being rejected is liquids, due to the strict EU regulations and the lack of knowledge of the passengers about airport security regulations. Instead, the passengers rely on their previous knowledge of the procedures as they do not look at the screens with security instructions that are not noticeable enough. Another significant finding made relates to the large proportion of non-English speaking passengers that cannot be adequately instructed by the airport workers.

Four recommendations are made to the airport operator to improve their security checkpoint ranging from giving their worker more tools to instruct the passengers with little command of English to instructing the travelers while they are still inside the aircraft of their previous flight.

The results of this study emphasize the need for further research on the behavior of the passengers in airport security and encourage other scientific and airport operators to conduct more field studies.

Keywords and terms: airport security, security control point, passenger behavior, field study, passenger-centric design

ACKNOWLEDGMENTS

This thesis would have never come to life without the help and guidance of several individuals that I want to recognize.

From Tampere University, I would like to express my gratitude to my two supervisors, Markku Turunen & Jaakko Hakulinen, that advised me from the beginning of this long process and provided me great insights when I was in doubt. I did not understand why in other acknowledgments from theses in our faculty, the authors praised Markku and Jaakko for telling them to "*just start writing*". Now it makes total sense!

Another person that should be acknowledged is Matti Lehto, from Finavia. Thank you, Matti, for giving me a chance to work in this exciting and fascinating environment. I am grateful for the time and the resources you provided during this thesis. I also want to thank Antti Tikkanen and Ville Kaariaho that accompanied me at the transit security control point while I was conducting the field research.

This thesis has been a roller coaster of emotions, ranging from the delight of being at the airport to the fears and hesitations on how to proceed. Without the constant support of my family and friends both in Switzerland and Finland, I would not be writing these lines today, *merci* and *kiitos!*

This whole Finnish journey would have never been possible without my dear Veera. Thank you for believing in me and helping to overcome my limits.

Joensuu, 24.04.2020
Adrien Hustache

CONTENTS

1. INTRODUCTION

Airports are an integral part of air travel, ensuring that millions of passengers can fly around the world every day of the year. In 2018, a total of 31.5 million planes took off, with only five of them resulting in a fatal accident, making air travel one of the safest means of transportation in the world (Boeing, 2019). This reliability of travel is the result of many different actions taken by the industry, one of them being related to security. After the terrorist attacks of 9/11, airport security measures have been significantly more effective thanks to the extensive studies made in recent years (Air Transport Action Group, 2014). However, it has been shown that because of the introduction of these new measures to mitigate security threats, the amount of time spent at the airport and the inconvenience for the passengers have increased alongside the complexity of technical and human infrastructure related to airport security (Coughlin et al., 2002). One key component of this human infrastructure is the screeners who must ensure that the passengers' belongings and body are free of any hazardous objects, using their experience and screening technology to assist them (Skorupski & Uchroński, 2015).

Recent studies have focused on the work and reliability of these screeners or the security improvement that technology could bring to eliminate threats (e.g. Buser et al., 2019; Chavaillaz et al., 2019; Chung et al., 2017; Halbherr et al., 2013; Kierzkowski & Kisiel, 2015; Knol et al., 2019; Michel et al., 2007). In the meantime, the passenger behavior and their well-being while operating in this stressful environment received little interest. This thesis aims to fill this gap in literature by using a human-centric approach to study how passengers perform while being at the security in the airport and how to instruct them better about the different measures and regulations they must comply with.

The context of research of this thesis is the 1952-built Helsinki-Vantaa Airport, the largest airport in Finland both by passenger numbers and size, located 17 km north from Helsinki city center (AIP SUOMI / FINLAND, 2020). The operator of the airport and mandator of this thesis is the state-owned company Finavia, which also manages 20 other airports around the country (Finavia Oyj, 2020).

Helsinki Airport contains security control points the passengers must go through in order for them and their luggage to be screened. Almost 40% of the passengers at Helsinki Airport pass through the transit control point, also called Security Checkpoint 9 (Finavia Oyj, 2020). This security must operate efficiently to allow passengers to connect to their next flight promptly. The security regulations are presented by screens located next to the screening lane. Unfortunately, the passengers appear not to see them because many items require additional screening, extending the time they must spend in the security control point. Screeners are also trained to instruct the passengers about the rules. Because of the

variety of destinations served at Helsinki Airport, many travelers do not speak English, making it difficult to comply with the regulations.

These challenges are significant and not only harden the work of the screeners but also make the journey of the travelers less pleasant. This situation sparks a reduction of the overall passenger satisfaction, a key metric for Finavia in such a competitive market to ensure that passengers connect through Helsinki Airport.

This thesis has two research questions based on the context introduced in this chapter. The first question is defined as "**Are the passengers aware of the security instructions and regulations in place in the transit security control point of Helsinki Airport?**". This question is the foundation of this thesis, used to understand what the current situation is and to confirm that the passengers are not aware of the instructions. The second question complements the research as follows "**What technological and human-centric improvement could be implemented for helping the passengers at the security control point in order to reduce the number of items being rescreened?".** This second question opens the possibility for creative thinking and the development of one or multiple passenger-centric and cross-cultural designs to reach the objective introduced in the question.

This document is outlined as follows: The next chapter introduces the background research, including previous works carried in the domain of public display in airport context, attention-grabbing techniques, aviation screening tools, and cross-cultural design. The third chapter introduces the context of the study. In the fourth chapter, the different methods used during this research are explained at length, including observations, interviews, and surveys both in their methodology and the results they produced. Chapter 5 introduces the results, recommendations, limitations, and future work of the study. The final chapter 6 concludes the document by summarizing the whole thesis.

2. BACKGROUND

Before starting the field research, it is essential to understand the current situation of the literature on this complex challenge. Because of the number of factors to consider, six different topics were addressed, ranging from airport security screening technologies to cross-cultural design. The summary section exposes the areas where limited research has been conducted.

2.1. Airport environment

Airport terminals have significantly expanded in the past years because of the high demand for air transportation. For example, Instabul inaugurated a new airport in 2019 that can already serve 90 million passengers and, when fully operational, will host up to 200 million travelers (CAPA, 2020). The competition for getting the highest number of passengers in these new airports is intense because the travelers now have several routing choices to travel to their destination. Already in 1994, Passenger satisfaction has been established as a critical metric for an airline to maintain its market share (Morash & Ozment, 1994). However, the importance of the airport itself should not be neglected.

Airports can be a stressful environment for passengers, and more than twenty years ago, research was already discussing the impact of the "airport tumult" on travelers (Rayman, 1997). In that regard, recent studies have been focusing on the passenger experience while being at the airport. It has been demonstrated that the most significant expectations of the passengers towards the airport are high efficiency and reliability (Popovic et al., 2009). Furthermore, Bezerra & Gomes (2020) have stressed that passenger behavioral attitudes should be measured to understand what their real needs are. This research used the airport in its globality and did not focus on the airport security itself, which is the topic of the next section.

2.2. Airport security control point

Airport security control points are one of the key components of airport safety. It combines the advanced screenings technologies and the experience of a screener to ensure that both passengers and carry-on baggage are free of forbidden items.

Research related to airport security control points has been focused mainly on the sophistication of screening technologies (as presented in the next section), or the behavior analysis of the screeners (e.g. Buser et al., 2019; Chavaillaz et al., 2019; Chung et al., 2017; Halbherr et al., 2013; Kierzkowski & Kisiel, 2015). Furthermore, one study has discussed the external factors in play at the security control point. Indeed, Wetter et al. (2010) found that the number of luggage and seasonal factors, which influence the number of clothes passengers wear, both affect the speed of the screening procedures.

In the meantime, only one article discusses the behavior of passengers at airport security. While he focused on the cost of airport security, Kirschenbaum (2013) also classified from observations passengers by the responses they gave to the screeners and found two groups, the experienced passengers and the uninformed ones. The latter group spent significantly more time in the security area because the screeners found out that these uninformed passengers carried forbidden items, 85% of them being oversized liquids. Unfortunately, this study did not carry out further investigations on why the passengers were carrying these forbidden items. No other empirical studies of the passenger performance or their knowledge of the airport security rules were found. Another unresearched topic relates to quantification and the classification of rejected trays.

2.3. Screening technologies

Hijackers and criminals have targeted aircraft for more than a hundred years (Baum, 2016). The events of 9/11 sent shockwaves through the commercial air transport industry, and since then, airport security and its development have received a considerable amount of investment. In 2014 alone, 35% of airport operating costs were accounted for by security, including 470,000 employees (Air Transport Action Group, 2014). However, these costs could be reduced with further investments in relevant technologies.

Fortunately, researchers have been studying ways to make airport security more efficient and reliable. One area of research that has been under scrutiny recently is the screening technology for detecting explosives in hold luggage. The reason for developing this technology is due to several planes being brought down because of a bomb located in the hold of an aircraft inside a suitcase. One example from 2015 is Metrojet Flight 9268, which exploded while midair with 224 passengers on board (Baum, 2016). The most common technology used to detect if a suitcase contains a bomb is 2D imaging (Caygill et al., 2012). A new type of technology has emerged recently, which uses computer tomography (CT) to generate 3D images. Unfortunately, these images have a lower quality than the 2D-generated ones (Mouton & Breckon, 2015). Surprisingly, further research revealed that despite the lack of clarity, the screeners found more threats using 3D images than 2D ones (Hättenschwiler et al., 2019). For this reason, the European Commission improved its regulation for allowing the use of 3D-based technology in airport security from 2020 onwards (Jentsch, 2018).

Another aspect of airport security that is of significant interest is liquid detection because of the security threats it poses as liquids could potentially contain explosives. A recent study reveals a technical breakthrough in liquid detection by using 3D computed tomography (CT) baggage inspection imagery (Chermak et al., 2015). Thanks to this method, the researchers estimated that the liquid detection rate was between 85 and 98%. This technology could be appealing not only for the security aspect point of view but also for passenger comfort because it means that they would not have to remove their liquid

from their belongings, which would speed the whole screening process up. Indeed, it was shown that a large number of passengers are not aware of the rules concerning liquids, which causes delays. One example from Manchester Airport in 2014 shows that more than 4000 hand luggage had to be rescreened because of a liquid (Kitching, 2014).

However, to implement a solution in Europe where liquids could stay inside the belongings of the passenger, the screening equipment must comply with regulations set up by the European Civil Aviation Conference (ECAC). The ECAC evaluates all the airport security equipment using laboratory testing to create a Common Evaluation Process (CEP). This CEP provides trustworthy information on the equipment to all its member states (ECAC, 2020a). The ECAC has defined three different standards (C1, C2, C3) for the equipment that detects explosive in cabin luggage, presented in Figure 1 below (ECAC, 2020b). The Standard C1 requires the liquids and electronics to be separated from the tray, as it is the case at the moment in Helsinki Airport. The C2 standard allows laptops and large electronics to stay inside the luggage while the C3 standard also allows liquids to remain inside as well.

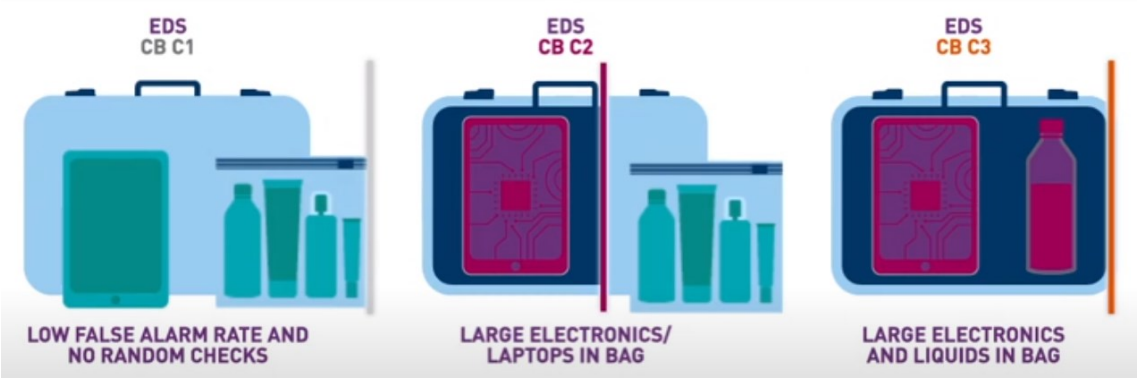


Figure 1: Comparison of the three ECAC standards of Explosive Detection Systems (EDS) for Cabin Baggage (CB). Adapted from Smiths Detection (2019)

The ECAC publishes public information about the certification of the equipment and the standard they achieved. As of 25 March 2020, 25 types of equipment for cabin luggage were certified with C1 standard, 43 with standard C2, and 28 with C3 (ECAC, 2020). Major airports like London Heathrow, Amsterdam, or New York JFK have been trailing the solution in the past years, while Eindhoven Airport has recently implemented it. (Parveen, 2018; Vanderlane, 2020). However, one major obstacle for more of these advanced screening technologies to be implemented is their high unit cost, which is also the reason why they are not available in Helsinki Airport (CHS Engineering Services, 2017).

2.4. Airport display

Displays are present in numbers at every airport nowadays. Have displays brings multiple benefits to the airport operator, from making the traffic in the terminal smoother to increasing passenger satisfaction (Marks et al., 2015). Fewings (2001) researched how to use airport displays for wayfinding more than fifteen years ago already. More recently, along with the human-centric mindset interest, researchers have started to think of ways to use these displays to create a more passenger-centric experience at the airport. In their article, Milbredt et al. (2017) suggest that displays should be both static and dynamic and emphasize the importance of their placement. These screens should be visible only when and where the passenger needs them. However, this research was conducted in an artificial terminal and did not take into account the possible architectural restrictions of existing spaces.

Public displays are screens visible in public spaces that convey information to a broad audience. Recent studies, started by Müller et al. (2010), have been focusing on making these screens interactive to provide a more immersive experience to the passer-by. The advantages brought by interactive public displays are multiple; for example, they lead to an increase of multiple simultaneous public interactions promoting group action and cooperation (Ardito et al., 2015). Alt & Vehns (2016) have studied the application of public display in the airport environment by installing an interactive food station inside an airport terminal. They have found that the location and the easiness of the information displayed on the screens are key criteria for a successful implementation inside an airport. Unfortunately, their paper focuses on the areas near the luggage claim, and the research of integrating public display in the specific context of airport security point control is inexistent.

2.5. Attention-grabbing

In the area of attention-grabbing, size matters; bigger the object is, more likely it will grab attention (Proulx, 2010). When this knowledge is combined with the fact that screens attract people, it makes airports interested in having large displays to convey information to their passengers. As an example, McCarren Airport in Las Vegas installed two large 84-inch screens to provide directions to passengers after smaller displays were unsuccessful at performing this task *(Grabbing passenger attention with a massive LG 84-inch ultra HD display*, 2013).

However, screens might not be the only solution for providing information in airports. Careless (2015) found that passengers at airports might not pay attention even when they are queueing for the security gates. In his article, he showcases a possible solution for this problem used at Texas' San Antonio International Airport (SAIA), where they installed a holographic employee that provides the passengers some advice about what they should do before being screened. This system called AVA has a motion detector, meaning that

the employee will not start talking until someone is coming close to it. The passenger can also use a nearby screen that contains frequently asked questions, and the hologram answers them in spoken words. The operator of the airport also explains in the paper that the hologram catches the attention of the passengers. They are listening to the hologram, and the lines are moving faster in the lanes where it is present. However, no quantitative research was performed in this article, making the results of this experiment hard to measure accurately.

Measuring attention towards displays is valuable in this thesis because it could help differentiate the effectiveness of different prototypes. Alt et al. (2016) have already been able to establish that presence of a face is the most accurate feature to measure the audience's attention. Narzt et al. (2018) completed this area of research by discovering that the actions taken by the display to grab the attention depend on the amount of attention already being paid by groups of passers-by. Using all the previous knowledge, Sugano et al. (2016) have developed a concrete implementation using one camera attached to a display to measure the attention of passer-by both in space and time. This technology could be interesting in this study to pinpoint the areas where the attention of the passengers towards the screen is the highest.

Unfortunately, no research took into consideration the impact of the information displayed on the screen, which could make a significant difference in the context of airport security. This impact of the information could be measured by having several sets of airport security instructions on display and individually measure the amount of attention of the passengers. Comparing the measurements would allow revealing which of the instructions was the most attractive.

2.6. Cross-cultural design

Culture is a term hard to define precisely. Kroeber & Kluckholn (1952) reported more than 300 different definitions of culture. More recently, Hofstede, a prominent researcher in this field, defined culture as “the collective programming of the mind which distinguishes the members of one group or category of people from another” (Hofstede, 1984). In their book, Stewart & Bennett (2011) take the definition of culture further by separating it into two different layers. The objective layer of culture relates to social and material elements such as customs and language. In contrast, the subjective layer of culture contains psychological elements such as the values and expectations of society. In order to understand the distinctness of each culture, several modes have been defined. For example, Hofstede created a theory called “National Dimensions of Culture” (Hofstede, 1984). It categories countries using six different dimensions, which are (i) Power Distance, (ii) Masculinity/Femininity, (iii) Uncertainty Avoidance, (iv) Long/short-term Time Orientation, (v) Individualism/Collectivism, and (vi) Indulgence/Restraint. This model allows

having a precise understanding of the culture at a country-level. The choice of this scale is, however, questionable because many sub-cultures exist in highly populated countries.

Based on all the knowledge accumulated from the study of different cultures, the notion of cross-cultural design emerged. Because of the globalization of society, adapting technology for multiple cultures has become an increasingly common need (Shen et al., 2006). Researchers have been researching this topic in many different fields. One of them, which could be of interest in the context of this thesis, relates to the cross-cultural online instruction design. In their article, Rogers et al. (2007) reveal the importance of understanding the difference in language and symbols of the targeted users. This knowledge, in particular, should be applied if new instructions are designed for a security control point of the airport.

With direct connections to 55 different countries, Helsinki Airport hosts passengers with a great diversity of cultures. Therefore, it is crucial when designing a solution for the airport to include cross-cultural design considerations to be able to communicate with every passenger properly. One possible communication technique is to use cross-cultural pictorial symbols. Airports already contain many different standardized signs to instruct the passengers about regulations, wayfinding, or services, for example. Without text, the icon on the signs should be self-explanatory to all the passengers, which is not always the case because of cultural differences (Biedermann, 1994). A recent study has developed the idea of "intelligent icons", displayed on cross-cultural websites, that change automatically depending on the location of the internet user (Heimbürger et al., 2012).This solution could help mitigate the cultural difference in the icon interpretation, but unfortunately, the security control point screens display the same information for all the passengers. No further research on cross-cultural signs in the context of airport security was found.

2.7. Summary

This chapter reveals that 3D screening technologies could be beneficial for the airport security control points of Helsinki Airport, but its high price makes it inapplicable. Different techniques to measure the attention of the passengers towards displays have also been presented. At the same time, this chapter revealed a lack of research on several relevant topics. The most important one relates to passenger behavior at the security control point, which received close to no interest. While public displays have been extensively studied, their application in the context of airport security is unknown.

3. CONTEXT

The leading airline at Helsinki-Vantaa Airport is the flag-carrier Finnair, which uses the airport as its hub and has flights to over 130 destinations spread in 38 countries. In 2019, 70% of the passengers at Helsinki Airport traveled with Finnair (Finnair Plc, 2020). Helsinki is located almost precisely on the flight path of many western-European cities on their way to Asian metropolitan areas. This strategic geographic advantage has been one of the critical strategies of Finnair, reflected in their route plan with 21 destinations in Asia and over 100 more in Europe (Finnair Plc, 2020). The role of the Finnish's capital airport is crucial for ensuring that passengers can connect quickly between their European and Asian flights. In practice, Finnair uses the operational model called "hub-and-spoke" in which it feeds Helsinki Airport with banks of flights originating from Europe and later combines the travelers onto outward flights to Asia (Button et al., 1999).

One key aspect that makes this strategy successful is the low minimum connection time (MCT) implemented at the airport. The MCT is the shortest amount of time in which passengers and their luggage can connect between two flights at a given airport and can vary depending on the origin and destination of the flights, whether it is a domestic or international flight within or outside of the Schengen area (Choi et al., 2019). At Helsinki Airport, the MCT varies between 35 to 40 minutes, which is short by comparison to other central European airports (Finnair, 2020). To respect this MCT, the airport operations must be efficient, including fast access through security for passengers before walking to the gate of their next flights.

During the year 2019, 21 million travelers roamed in HEL, of which 38.6% were international transit passengers (Finavia Oyj, 2020). The passengers that are transferring within the Schengen area do not need to be screened while the passengers outside this area must go through a security control point (Finavia, 2019). One exception to this rule is the passengers traveling from a non-EU country that is part of the "one-stop security" scheme. This scheme was developed by the European Parliament to recognize certain countries that achieve security standards similar to the EU ones, such as the USA or Canada (European Parliament, 2008). At Helsinki-Airport, there is one security control point meant for transiting passengers, also known as **Security Checkpoint 9**. It is located in the Non-Schengen area of the airport (see Figure 2 for detailed location) and was opened in 2019 as part of the development program of the airport. This program is an ongoing 1.2 billion EUR project that aims to make the airport ready to serve 30 million passengers with a high level of customer experience (Finavia Oyj, 2020).

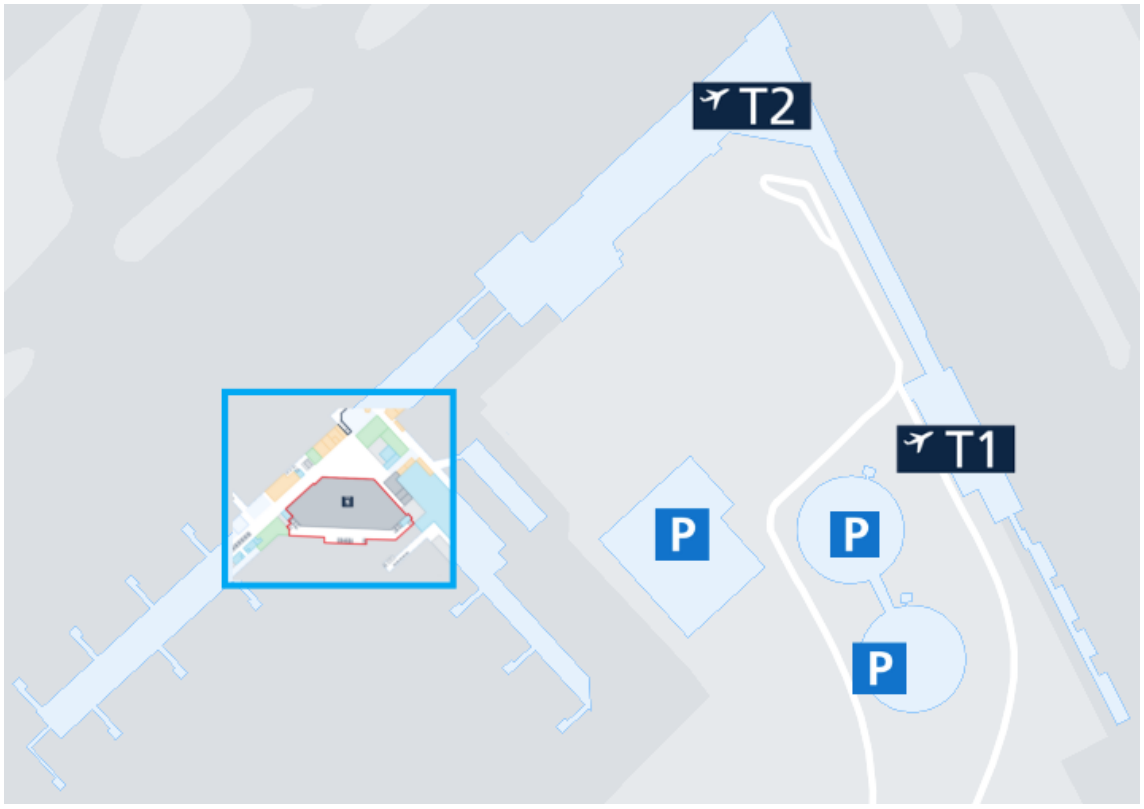


Figure 2: Location of the Security Checkpoint 9 (in red) at Helsinki Airport

The thesis will focus primarily on this transit security control point for several reasons. First of all, no other security control point of the airport has accurate data about passenger flow or the amount and category of the trays requiring additional inspection. This lack of data complicates the analysis of the current situation and limits the possibility to see pattern changes if a design solution is implemented. Second, from the experience of the personnel at Finavia and the airport screeners, this security point has the highest rate of trays requiring additional inspection. Third, for business reasons, Finavia has a higher interest in improving Security Checkpoint 9 to be the most efficient security control point in order to facilitate the MCT of the passengers. Fourth, the checkpoints in the landside of the airport see only Finnish residents and some tourists. At the same time, the variety of destinations and the more diverse ethnicity of the connecting passengers of the Security Checkpoint 9 offers a better context for a cross-cultural design that might be crucial to achieving the goals of this thesis.

Figure 3 presents the three main sections of Security Checkpoint 9. First, the passengers arrive from the extremities of the green section and walk to the middle of the concourse. There, they must place their boarding pass on the e-gate reader to access the orange section. This second section colloquially called “the maze”, where the passengers are waiting in line before moving towards one of the ten screening lanes, represented in blue in Figure 3.

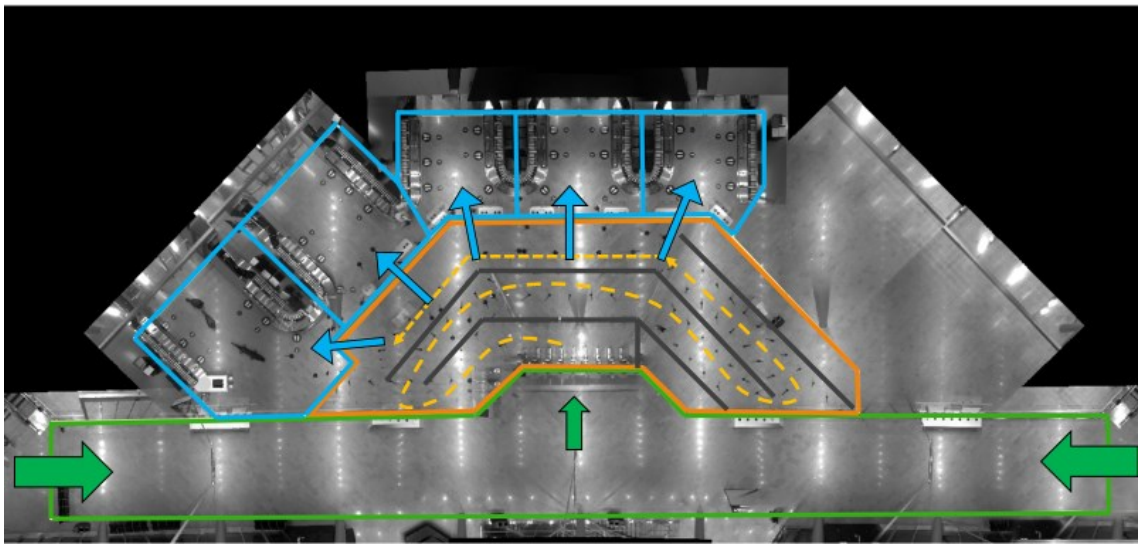


Figure 3: The three main sections and passenger flow of Security Checkpoint 9

At the screening lane, the screener greets the passenger before asking them to remove their belongings and put them in a tray. This area is also called the “divesting area”. Along with the newest implementation of security control points, the trays of Security Checkpoint 9 are equipped with an RFID tag, scanned by the screener before the trays go through the x-ray machine. This implementation provides the ability to identify every tray individually, which offers better data analysis. It also requires that every personal item of the passenger, including suitcases, must be put into an individual tray. After the tray went through the machine, it slides on the other side where the passenger can pick it up and get out of the security checkpoint. However, if the tray contained a noncompliant element, it moves into a queue of trays waiting to be inspected. An analyst picks up the tray and calls the passenger to move into an “inspection area”. Depending on the situation, the analyst has three different ways to handle the tray; he can make it compliant, rescreen the items of interest, or simply return the belongings to the passenger. Making the tray compliant involves either item confiscation or a visual assessment of the item before returning it to the passenger. Re-screening usually happens when an item left inside a suitcase needs to be screened in a separate tray. The flowchart in Figure 4 summarizes the possible outcomes for the belongings of the passenger after they go through the x-ray machine.

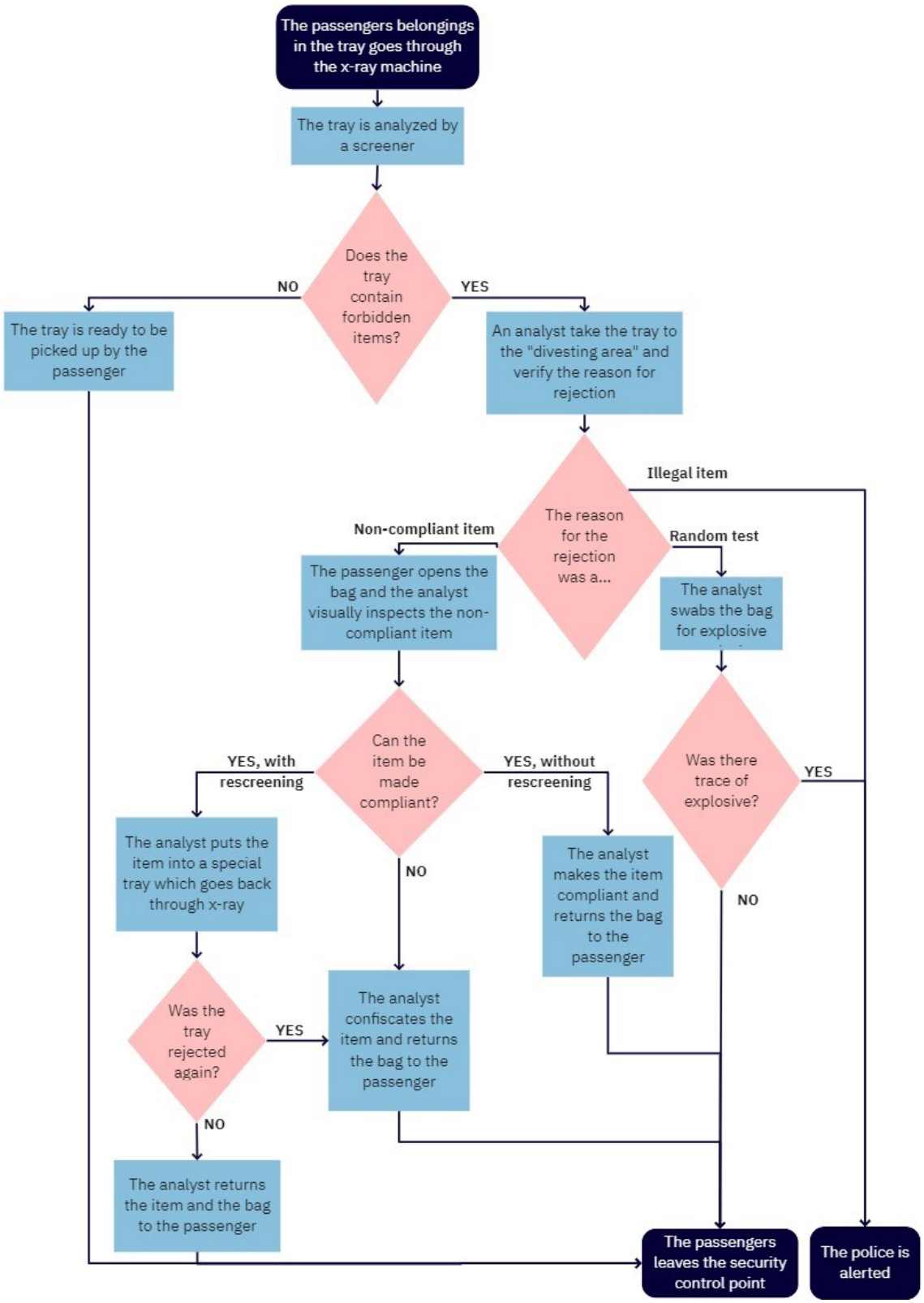


Figure 4: Possible outcomes for the belongings of the passenger after going through the x-ray machine

Screeners can require trays containing items that are not compliant with the airport security regulations to go through an additional inspection. This decision is taken regularly and reduces the passenger flow because they must wait at the end of the screening line to get their trays inspected instead of merely walking out. The complex and detailed airport security regulations are the same in every EU country. In the context of this thesis, the essential rules relate to liquids and electronic items. At the airport security, the definition of a liquid is anything that can be spread, for example, cosmetics or toothpaste. The regulations dictate that liquids taken through airport security must be placed in containers of less than 100 milliliters. Furthermore, the containers with liquids must fit in a one-liter plastic bag. Special categories of liquids, such as medicine, baby food, or special dietary liquids, can be taken through security because a test for explosives can be done using additional screening measures. Another type of accepted liquids is the duty-free items that are in a *security tamper evident bag*, a heavy-duty bag that must remain sealed. Figure 5 summarizes the EU security regulations regarding liquids. (Finavia, 2020)

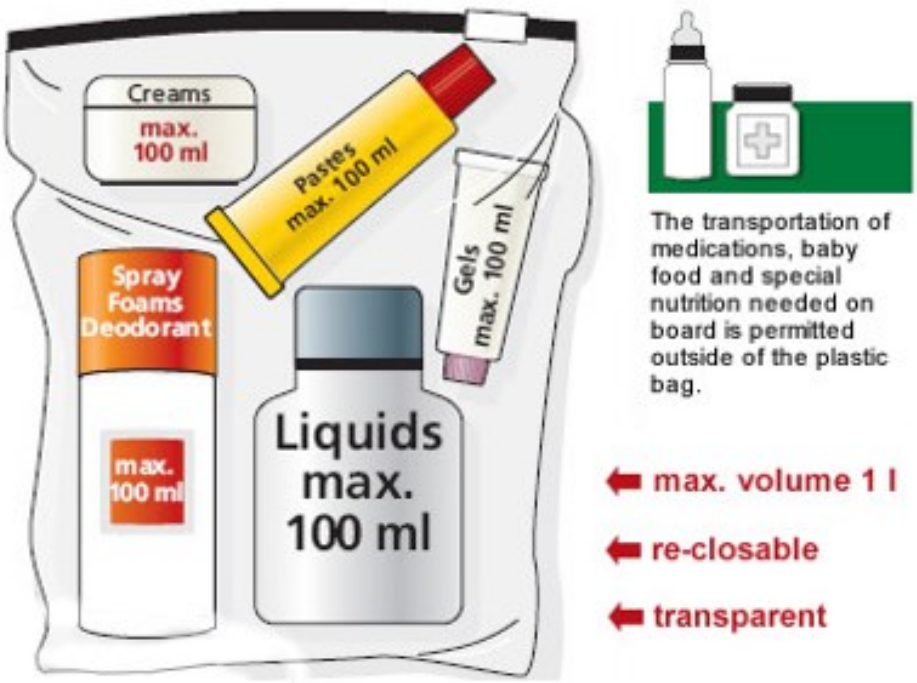


Figure 5: EU security regulations regarding liquids. Adapted from Zadar Airport (2020)

The regulations about electronics focus on items with batteries. Laptops, tablets, and other large items must be taken out of the bag while small devices such as smartphones or car keys can remain inside the luggage. (Finavia, 2020)

4. METHODS

To understand the root cause of the problems experienced by the passengers, five methods were applied and are presented in this chapter. The methods were conducted consecutively, starting from the knowledge of the context. For each method, the most significant results, bolded in the text, were considered when designing the following method.

4.1. Infrastructure analysis

The previous chapter detailed the three sections that separate Security Checkpoint 9. In each of these sections, some screens display information to the passengers. This section focuses on analyzing the screens both in terms of placement and content visibility. In the first section, before the passengers enter the maze, they can recycle their trash in bins located next to the boarding pass e-gate readers. This area also contains two screens with videos giving security instructions, placed to catch the attention of the passengers when they are discarding their trash (see Figure 6). Unfortunately, in practice, the bins are rarely used because the passengers proceed as fast as possible towards the e-gate readers to have their boarding pass read and go through screening. Consequently, only a handful of passengers watch these two screens with instructions that are not visible while waiting in the maze.

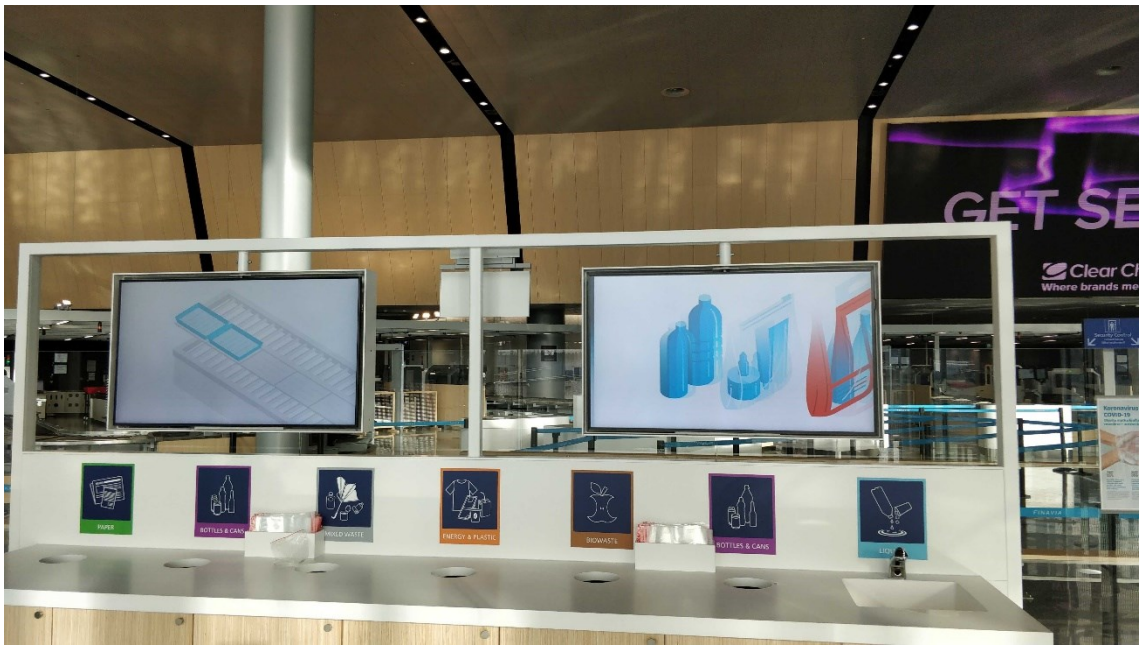


Figure 6: Screens located next to the boarding pass e-gate readers of Security Checkpoint 9

The second section, the maze of the security control point, is located after the e-gate readers and before the passengers arrive at a screening lane. The time spent in the maze depends on the length of the queue. A long queuing time should offer a chance to catch the attention of the passenger to prepare them for the screening process. However, apart from the massive ad, the current implementation does nothing to use this potential, with five screens only showing a static image of the position of the screening lane (see the red rectangle in Figure 7). This information is useful, but the screens could impact the passengers significantly more, again by showing important security instructions.

Figure 7: Displays showing the position of the screening lane at Security Checkpoint 9

The third and final section of Security Checkpoint 9 is reached when the passengers select a screening lane. A small queue around the “divesting area” may appear, but generally, the passenger quickly places their luggage and the items inside the tray before proceeding towards the x-ray machine. As per the other sections, screens are present, in this case, one for each screening lane. The position of these screens is somewhat unusual, rather than facing the passengers at the screening lane, it is located on the top corner of the lane, which might reduce the attention it raises in the passengers. The green rectangle in Figure 8 illustrates the position of the screen. Notice that the display from the previous section, in the red rectangle, is attached to the same pole.

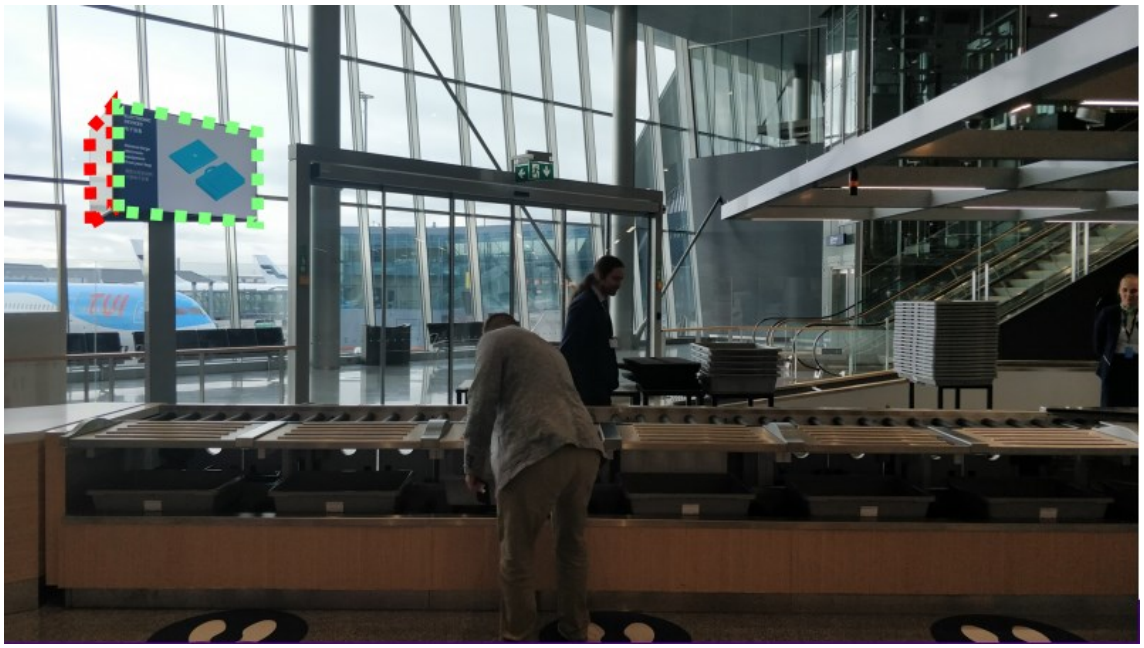


Figure 8: Display with security instructions next to the screening lane at Security Checkpoint 9

In summary, Security Checkpoint 9 is well-designed space for the passenger to navigate towards a screening lane, with three efficient sections and state of the art screening and x-ray technologies. Each section also includes informational screens that need improvements both in the content displayed and their positioning. When the passengers transit through the security control point, the chances are that **the only opportunity to receive instructions and information about the regulations relies on the last screens located directly at the screening lanes**. However, most probably, **the passengers will not even notice these screens because of their poor placement**. Furthermore, the screens located before the screening lanes are not giving meaningful information either. This situation gives room for design improvement to grab the attention of the passengers and inform them better.

4.2. Sensor data analysis

While most of the security control point at the airport do not have accurate data report available, the newly built Security Checkpoint 9 is equipped with a variety of sensors and machines that collects valuable data. As part of this thesis, I was able to obtain internal reports and raw data spanning from 1.10.2019 until 31.12.2019 from my contact at Finavia to be interpreted. These data sources are summarized in Table 1 below.

Table 1: Summary of the data sources received from Finavia

Name of the source	**Description**	**Data fields**
Flight list	All the flights with passengers required to go through Security Checkpoint 9 if transiting in Helsinki.	Date/Time of arrival, Airline, Airport, number of passengers, delay
Security access gate stamps	All the boarding passes read in the gates of Security Checkpoint 9.	Timestamp, destination, time before next flight
Xovis queuing data	Amount of waiting time at Security Checkpoint 9 with 1-minute precision.	Timestamp, waiting time (in seconds)
Screening machine data	Information about all the trays going through Security Checkpoint 9 and the actions taken on for each of them (disclaimed, made compliant, no threat found).	Timestamp, accept/reject tray, reason for rejection, waiting time before tray was searched, action afterward

Individually, each data source provides some information to understand the situation at Security Checkpoint 9. Still, most importantly, these sources should be combined to find underlying relations between them, crucial for helping to improve the passenger's experience at the security control point. The data also provides some key metrics about the scale of this security checkpoint, summarized in Table 2 below.

Table 2: Key metrics from the data

Metric	**Absolute number**	**Min / Max / Avg per day**
Arriving flights	3390	25 / 44 / 37
Countries of originating destinations	32	10 / 17 / 14
Transiting passengers	243 915	701 / 3872 / 2651
Cumulative waiting time [h]	420	1.8 / 9.8 / 4.6
Trays requiring additional inspection	65 199	12% / 29% / 21%

To give significance to this data, it was further analyzed by combining different elements. The first element that I calculated is the number of passengers passing through the security checkpoint per minute. I computed this by grouping the boarding pass related timestamp per minute. I took this information further by calculating the cumulative waiting time per passenger (calculated by dividing the waiting time data by the number of passengers per minute). Using Power BI software, I created a line chart, visible in Figure 9, that plots two lines, one is the number of passengers, and the other is the cumulative waiting time per passenger (in seconds). The X-axis represents the whole day in a 1-minute precision.

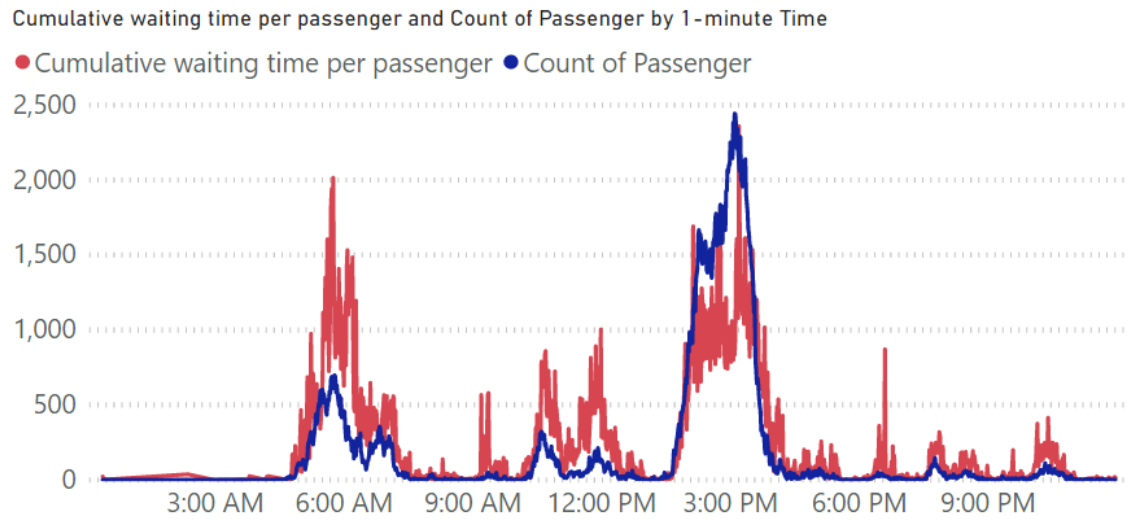


Figure 9: The number of passengers and the corresponding waiting time during the day at Security Checkpoint 9

Two main observations can be made from this line chart. The first one is that **the security control point has three peak times at 6.00, 11.00, and 15.00**. The 15.00 peak is by far the one with the most significant number of passengers, for example, 2443 passengers at 15.06 alone. The second observation is that while the two morning peak times have fewer passengers than the afternoon one, their waiting time per passenger is higher. This phenomenon is explained by one key element not present in the data; the number of screening lanes opened. During the morning, only one or two lanes are operating while during the afternoon peak, seven or eight lanes are open to ensure that the passengers can quickly proceed to their next connecting flight.

The previous chart used the cumulative waiting time to show its relationship with the number of passengers over time. Another important information is the average waiting time per passenger during the day that must stay low to keep the transiting passenger relaxed. Figure 10 presents the average waiting time per passenger in second at the security control point. Throughout the day, the waiting time stays brief, and even during the afternoon peak time, the passengers are on average waiting less than 20 seconds.

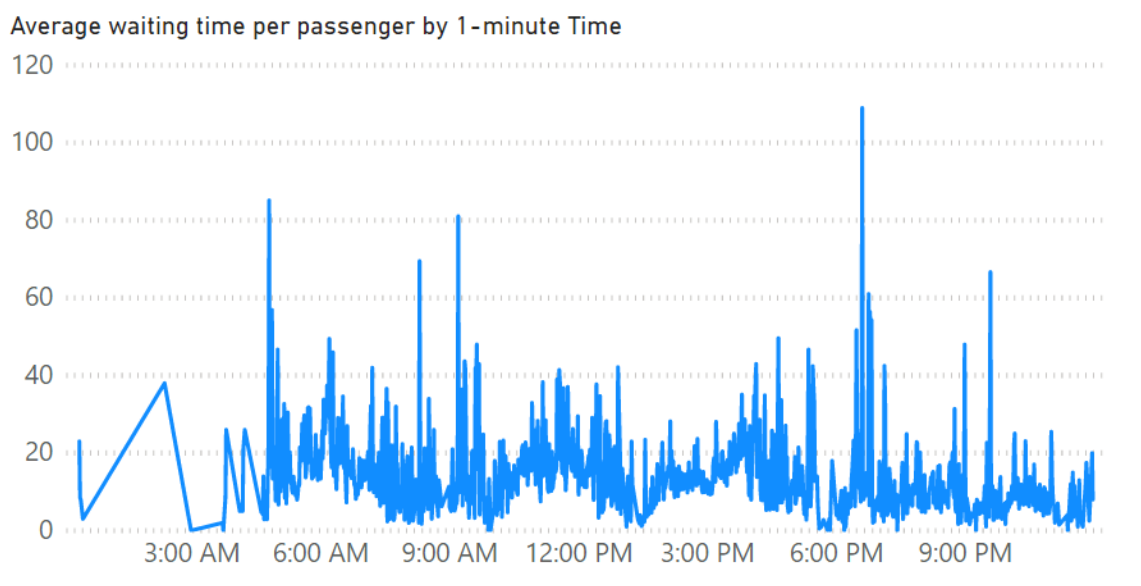
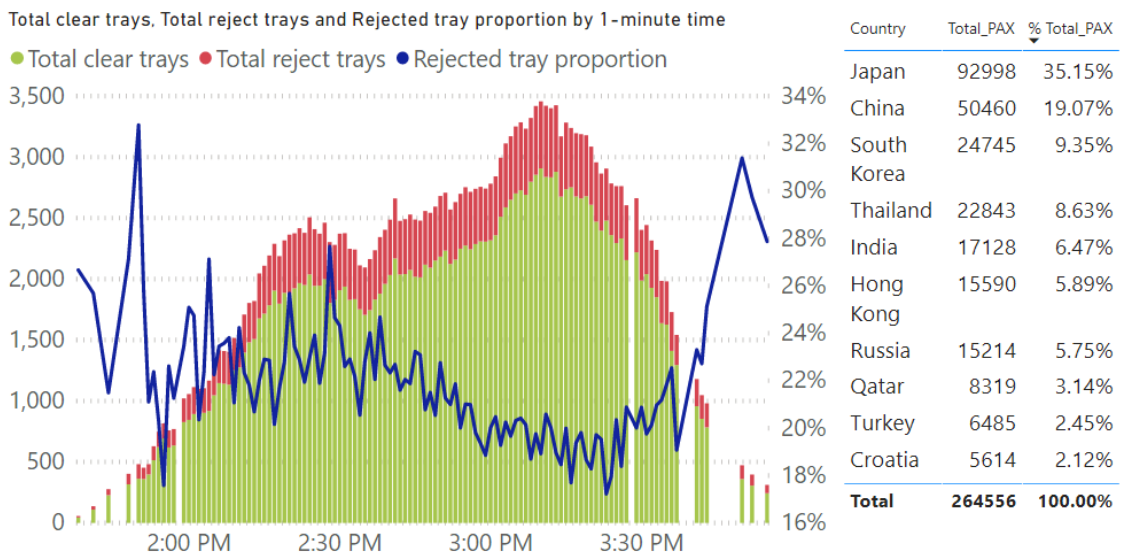


Figure 10: The average waiting time per passenger (in second) at Security Checkpoint 9

The last data source not yet analyzed is the one containing information about the trays going through Security Checkpoint 9. As presented above in the key metric table, **the average daily percentage of trays requiring additional inspection is 21%, which is relatively high**. Figure 11 below shows the evolution of this rejection rate during the 15.00 peak-time. The rejection rate seems to diminish over time, even though the number of trays is getting higher slightly. The other relevant information on the right side of Figure 11 summarizes the flights with passengers transiting to the Security Checkpoint 9. Most of the passengers are arriving from Asian countries. In more detail, the flights from Japan represent 35% of the passengers during this peak-time while flights from China and South Korea have respectively 19% and 9.32% of all the passengers. Interestingly, when reducing the time range even further towards the beginning of the peak-time, when the rejection rate is higher, the proportion of Chinese and South Korean flights increases also. In contrast, the end of the peak-time with a lower rejection rate sees more Japanese and Thai flights and close to none South Korean and Chinese flights.



Country	Total_PAX	% Total_PAX
Japan	92998	35.15%
China	50460	19.07%
South Korea	24745	9.35%
Thailand	22843	8.63%
India	17128	6.47%
Hong Kong	15590	5.89%
Russia	15214	5.75%
Qatar	8319	3.14%
Turkey	6485	2.45%
Croatia	5614	2.12%
Total	**264556**	**100.00%**

Figure 11: Number of trays being accepted and rejected during the afternoon peak time in Security Checkpoint 9 and the number of passengers per country

To further understand why so many trays are rejected, the data source provides valuable information. The first important information is the *inspection waiting time*, which indicates how long did the passenger have to wait between the moment when the tray with their belongings was rejected and when they were able to collect their belongings after the screener inspected them. During the afternoon peak, the average *inspection waiting time* is 2 minutes, which is a relatively short time. The other meaningful information from the tray data source is the type of item that has required additional inspection, which could help me understand if a specific group of items is more problematic than others. Figure 12 clearly shows **liquids (64%) are by far the biggest category of items requiring additional inspection**, followed by unspecified reason (16%) and laptop (10%).

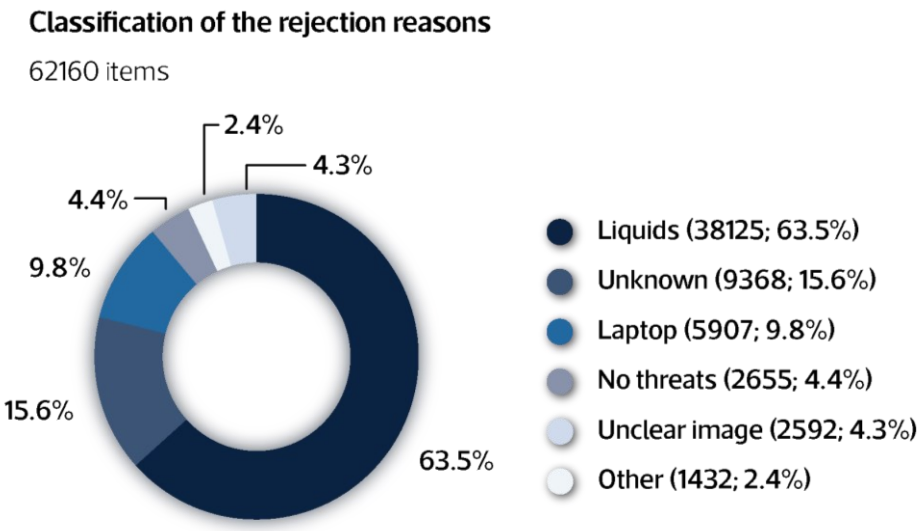


Figure 12: Classification of the rejection reason

Figure 13 focuses only on trays requiring additional inspection caused by a laptop or liquids. This graph shows that the rejection rate follows the previously discovered peaks, but also that the laptop rejection occurs more towards the end of the afternoon peak.

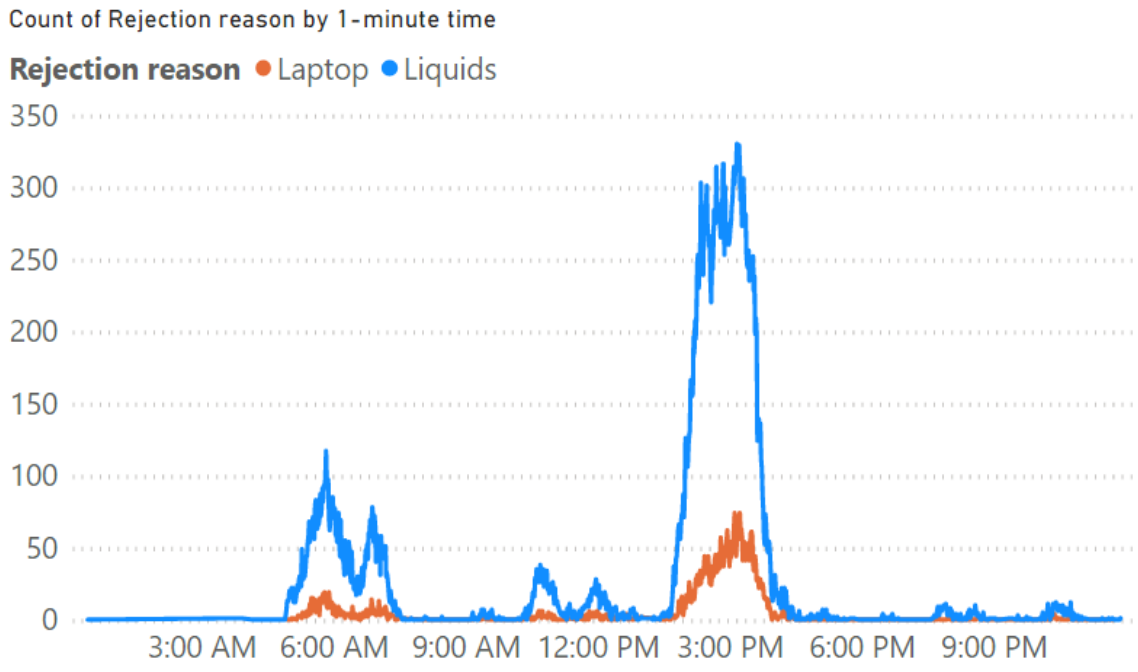


Figure 13: Proposition of trays containing laptop and liquid rejected during the day

In summary, the four data sources have provided a great overall picture of the current situation at Security Checkpoint 9. There are three peak times, and **the period between 13.30 and 15.30 sees the highest number of travelers, mainly coming from Asian destinations**. While passengers do not experience long waiting times, about a fifth of the trays is rejected, with liquids being by far the most significant reason. The data does not provide a reason why so many passengers have these uncompliant liquids meaning that other research methods are necessary to understand this issue better.

4.3. Observations

After examining the different data sources in the previous section, it was essential to go on the field and see the situation from my own eyes. To do so and to undercover categories of problems encountered by passengers in this space, I decided to conduct observations. Monitoring the activities of the passengers in real context allows taking note of the possible issues they might have but also of special or interesting situations that might be uncommon yet noteworthy (Hofstede, 2001).

During this work, two observation sessions took place at different times and locations. For both these observations, a shared form used for reporting the actions of the passengers was created. It focuses on the actions of the passengers **after** they pass through the boarding pass e-gates (see Appendix 1). Initially, it was also planned to document actions happening **before** the boarding pass e-gates. However, a preliminary visit to the airport revealed that passengers are presenting their boarding pass and promptly proceed without paying any attention to the surrounding security screen, which echoes the findings made by Careless (2015). The questions in the form used for the observation were designed to provide both quantitative and qualitative information. The quantitative questions undercovered the attention paid to the information screen, the number of trays used, and whether the belongings were inspected or rescreened. The qualitative questions detailed the items brought by the passenger and which ones were rescreened.

The first observation occurred on 30 January 2020, in the offices of Finavia, located on the second floor of Terminal 2. Figure 14 shows the location of this observation, a fixed position inside the office offering a bird's eye view of the first part of the Security Checkpoint 2, the busiest security control point for passengers starting their journey from the Finnish capital.

Figure 14: View of the Security Checkpoint 2 during the first observation

During this observation, I reported the actions of 28 different passengers using the pre-mentioned form. Although the window made the conversation between the screeners and the passengers inaudible, this first observation revealed that close to **no passengers removed their belongings before being at the line**. When looking at the set-up of the security control point, one can easily understand why. The first part consists of the "maze" where passengers are queuing before getting to a specific lane. Although the line in the maze might be at a standstill when the congestion is high, most of the time, people are continually moving forward a few steps. Because of this movement, removing personal belongings from one's bag is challenging and unpleasant; the person must put their bags on the floor and start searching inside it while continually checking if the queue has moved. On the contrary, when the security checkpoint is empty, there is no maze, and the passengers can go straight to a gate and start removing their items there. Without queue, the passengers operate in a more peaceful environment in which they can take their time to place their items in the tray. Simultaneously, the screener can ask more questions and make sure that all the items are inside the tray, reducing the need for a screen with instructions.

The form contained questions that were undeterminable in this first observation due to my positioning. The gaze of the passengers was too far to analyze the attention paid to the screens. The other question left unanswered related to the inspection of the bags by the screener, which was impossible to determinate because the view of the second part of the security checkpoint was obstructed.

The second observation happened on 20 February 2020, this time at the Security Checkpoint 9. During this occasion, I was located behind the machines, next to the screeners that converse with the passengers. Figure 15 shows this point of view but also the display with the security instructions (in the green rectangle). Compared to the previous observation, I was able to navigate in the security control point. For example, I could "follow" trays from the loading of belongings by the passengers until the end of the process. This possibility permitted to quantify the number of rejected trays and the reason.

Figure 15: The point of view of the 2nd observation in Security Checkpoint 9 and the security instruction screen (in green)

The second observation and the reported actions of 21 passengers provided meaningful information. The results of this observation echoed the findings from the data, with 33% of luggage inspected, mainly because of liquids. The observation revealed that **the most common reason for rejected liquids being the passengers forgetting to remove them from their luggage**. Another common mistake made by the passenger is the omission of wrapping the liquids in the mandatory one-liter plastic bag. The screener can make the liquids compliant, and the trays do not need a second screening. Another frequent mistake is the passengers leaving their large electronics inside the luggage. These must be placed in another tray to be rescreened, extending the waiting time for the passenger. **The regulations seemed to be unfamiliar as many passengers questioned the screeners about the maximum allowed size of the liquid or the need for a plastic bag**.

As predicted in the infrastructure analysis of the security control point**, the position of the screen providing security instructions, placed inconveniently far from the lane, received marginal attention from the passengers**. The screeners seemed to compensate for the lack of information by asking questions from the passengers related to the items that require specific actions. In many cases, this communication proved effective, but during specific situations, it became problematic. For example, when the queue of passengers waiting at the security lane grows, the screener must proceed faster and converses less with each passenger. Another intriguing discovery from the observation also related to communication is **the recurrent language barrier between the screeners and the passengers with no or little command of English**. This situation greatly complicates the work of the screener that cannot instruct the passengers properly.

While the first observation took place in a different security control point, it still yields significant results that are useful for this thesis. The primary learning is that when no queue is formed, the passengers proceed faster to the gate and have less time to read instructions. The role of the screener in this situation is crucial, and they must communicate with the passenger to ensure that the regulations are followed. The second observation also undercovered that some passengers lack knowledge about security rules, with a significant number of rejected trays and questions raised about the regulations. Although the screeners try their best to provide the necessary information to the passengers, situations with too little time or language barrier complicate the communication substantially. Furthermore, the screens supposed to support the work of the screeners by providing security instructions do not attract the attention of the passengers, making them useless. The combined results from both observations are visible in Appendix 2. The next crucial steps in the process are to understand why passengers are unaware of the regulations and how significant is the language barrier.

4.4. Interviews

The observations undercovered a multifaceted problem about the security instructions at the Security Checkpoint 9. On the one hand, the passengers are often unaware of the rules, and the screens supposed to explain them are not visible enough. On the other, the screeners alone have a significant impact on reducing the rejected trays by communicating with the passengers. However, there are situations when this discussion can not take place properly, mostly because of language issues.

Another research method was needed to go deeper into the understanding of this problem, and interviews proved to be the best method to do so. Interviews offer the possibility to discuss several topics of interest with the necessary depth while providing unique and individual insights (Kuniavsky, 2003). They can also validate the results found in the observations. I decided to interview passengers and screeners because they both have a tremendous impact on the performance of the security control point. While not in a formal

fashion, other security personnel at Finavia were interviewed, and their insights have been integrated when conducting the thesis.

The interviews of both target audiences shared the same methodology using a semi-structured format, including specific questions and more global themes. Most questions used an open-ended format, but some closed-ended ones were also formulated to obtain both quantitative and qualitative answers. The laddering technique was used to understand the root cause of the problems brought up by the interviewees (Reynolds & Gutman, 1988). One aspect differing significantly depending on the target audience was the expected completion time of an individual interview. The screeners are present at the Security Checkpoint 9 long before the start of the afternoon peak time with no task to perform. This undemanding period offers the possibility to have extended interview time with each screener. Furthermore, the interviews can happen in their place of work, encouraging possible contextual insights. On the other hand, passengers transiting in the security control point must proceed to their next flight, sometimes without delay. Even travelers with longer connection time might feel stressed by the airport environment and be unwilling to spend any extra time being questioned. For this reason, the mandatory interview questions must be focused, and the frame can include some additional themes that can be discussed with the passengers with extra time.

The interviews took place during two consecutive afternoons on 4-5 March 2020 in Security Checkpoint 9. The interviews started with the screeners before the arrival of the peak-time flights. The screeners were not selected beforehand. Instead, when approached while being at their work position on the screening lines, they voluntarily agreed to be interviewed. The passengers were interviewed after they had completed the screening procedures, but before they were already out of the security control point. The selection of the passengers was made so that the selected passengers would originate from various destinations, giving a more diverse panel of answers. Furthermore, both passengers with and without belongings requiring additional screening were interviewed.

All the interviews have been recorded, and the consent of the participants was asked orally. The interviews were conducted in English, apart from passengers sharing my native French language. The interviewees received a wrapped chocolate candy as a token of gratitude for their time and help. In total, **11 screeners were interviewed** with an average length of 8 min. Additionally, the **27 interviews of the passengers** lasted 2 min on average. The passengers' interviews are discussed in the next section, followed by the interviews of the screeners. In these two sections, both the interview questions and the results are explained.

4.4.1. Passengers

The interview frame for the passengers contained ten questions, listed in Appendix 3. The first question was open-ended about their feeling of going through security. Depending on their answer, a follow-up question could be formed to ask more reasons for this feeling. The second question asked the passengers to define which belongings they had put in the trays. The goal of this question was to see if the passengers are remembering putting their liquids and other items that have a high rejection rate or not. On the other hand, the question helped to define which items are less likely to be omitted in the tray, since the passenger remembered putting them in. The third question tried to understand the source of regulations knowledge of the passengers by asking them how did they know which belongings they should put in the trays. The fifth question was a closed-ended question that revealed whether the passengers had seen the security instructions screen or not. The sixth question followed up by asking the opinion of the passengers about these instructions. The seventh question determined whether the belongings of the passengers had been searched or rescreened, while the eighth question followed up asking the passengers the reason for this additional inspection. The ninth question categorized the passengers by asking them how often they travel per year. The tenth and final question was an open question that allowed the passengers to share more remarks or details if they wished to.

Before discussing the results of these interviews, it should be noted that the impact of COVID-19 on the aviation industry was already high at the time with a significant number of canceled flights. This situation was also experienced by the passenger when they answered how they felt about Security Checkpoint 9, as some told that it was quieter than usual. Nevertheless, **passengers were, in general, pleased by their journey through the security control point**. They praised the efficiency and speed of the whole process. **Passengers commented on the work of the screeners, praising their courtesy and professionalism**, in contrast to the workers from their originating destination.

The passenger reported 26 different types of belongings that they had placed in the trays at the “divesting area”. Figure 16 below summarizes the most commonly reported items of the passengers. These items have also been grouped into categories.

Category	Count of Item
Electronics	37
Personal item	14
Clothing	12
Liquids	11
Total	**74**

Item	Count of Item
Liquids	10
Mobile phone	10
Laptop	8
Jacket	6
Electronics	5
Tablet	5
Wallet	5
Belt	4
Camera	2
Passport	2
Watch	2
Bag	1
Battery	1
Book	1
Chargers	1
Total	**74**

Figure 16: Summary of the reported belongings that the passengers put in the trays

While individually, liquids were reported the most frequently, there was little variety in answers about which type of liquids they were. Only one interviewee specified taking out duty-free items. In the meantime, electronics were not only the most prominent category to be mentioned but also the passengers provided much more variety of answers for this category. The lack of knowledge about security procedures can be seen in different ways. First, some participants reported taking out their belt, which is not necessary at Security Checkpoint 9. Second, the participants could not detail which liquids they took out and why. Third and most importantly, **when they were asked how did they know which items to take out or not, 18 participants responded that it was based on their previous experience**. In the meantime, only one told that he saw the instructions, two others looked at other people, and the screeners instructed five more. **Because the passengers rely on their previous experience, they are less likely to pay attention to the instruction screens and will make more mistakes.**

Out of 27 passengers, only three noticed the security instructions given on the screens. **With only 11% of the interviewees noticing the instruction screens, this is another confirmation that they are not attractive enough to the eyes.** Many were completely surprised to hear that there were screens about the instructions in the first place. The three passengers that noticed the instructions all reported to have seen them while being next to the “divesting area”. They found the instructions to be “quite good (**Pax4**)” and “informative (**Pax23**)”.

The passengers had different experiences with their belongings, but the majority went through additional inspection, as shown in Figure 17. This statistic is also the result of the selection of the passengers, ensuring a variety of passengers.

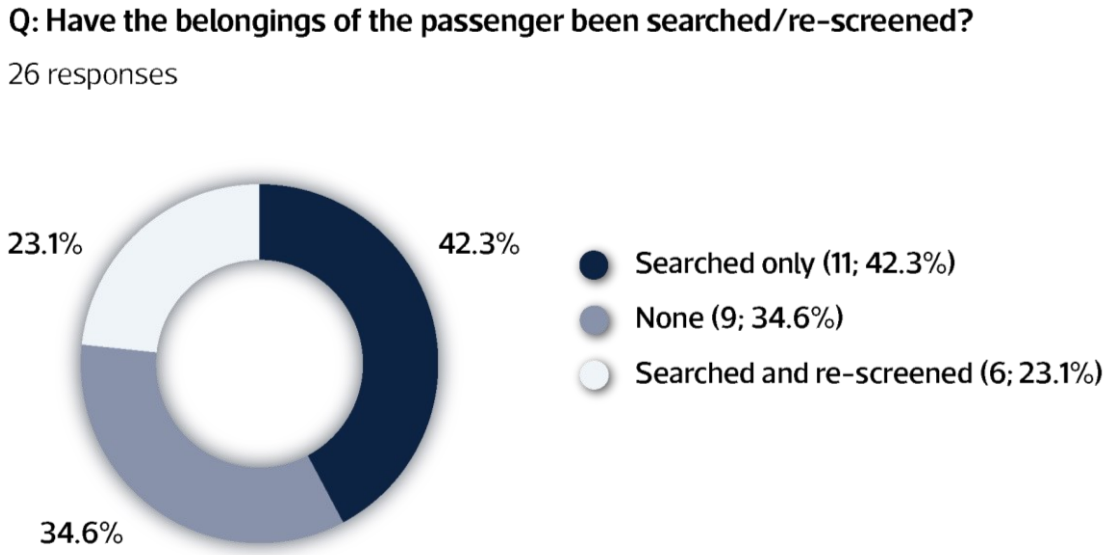


Figure 17: Statistic about additional screening needed for the belongings of the passenger interviewed

Interestingly, the passengers had reasons for their items to be inspected that were not found in the previous observation or the data source. Some examples of these items are edibles, lighters, and organic materials. However, the majority of the passengers reported liquids as the reason for the inspection, including cosmetics, bottles, duty-free items, and medicines. Some passengers explained that they were not aware of the regulations. Others stated forgetting having the item in their belongings which were not checked at the security in the originating destination, as illustrated by a passenger below:

Pax21: "*I had a hand sanitizer in my backpack, and when the employee asked if I had any liquids, I didn't remember it because it was there a few hours ago already and no one asked me anything when I went through the airport in India you know..*"

Figure 18 shows the travel frequency of the passengers that varied greatly, with 10 of them traveling less than 3 times a year while 8 others traveled yearly more than 15 times. Unsurprisingly, **the passengers that had belongings requiring additional screening were unfrequent travelers** while the more seasoned ones passed through the security quickly.

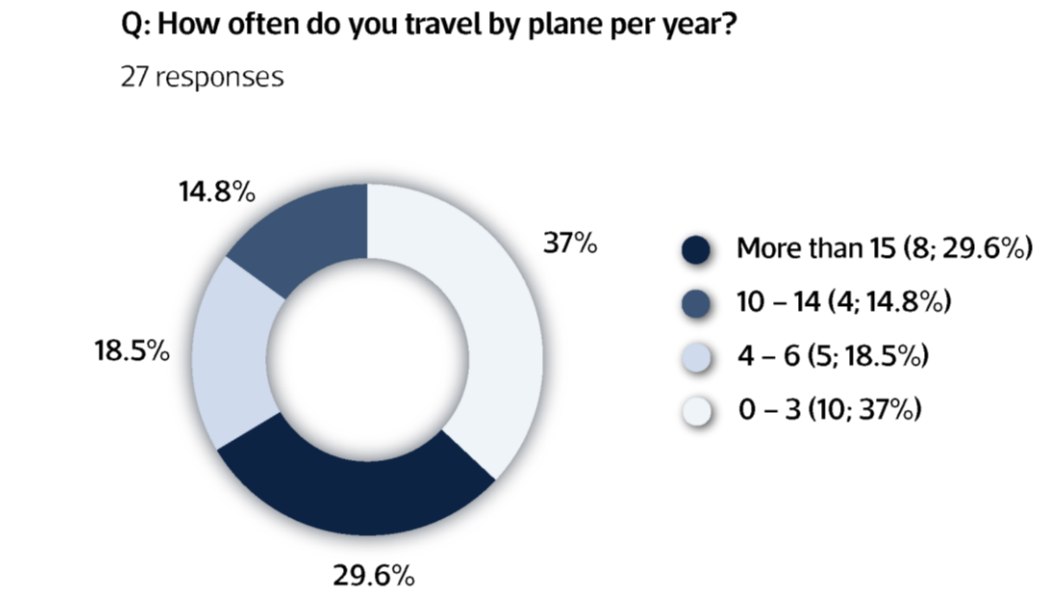


Figure 18: Travel frequency of the interviewed passengers

While no precise count was made, there has been a high number of passengers not wanting to be interviewed because of their lack of time, further demonstrating the stress they experienced to connect to their next flight. The observations had already exposed the language barrier experienced by the staff while talking to non-English speaking passengers. However, these interviews revealed the magnitude of the problem. Again, no precise count was made, but **a significant amount of the passengers approached seemed to have no command of English at all**. It should be noted that many of the passengers were coming from Asian countries, especially South Korea and Japan, where people are not too extroverts. This type of personality could mean that some passengers had a better command of English than they have led to be perceived but were too shy to be interviewed.

4.4.2. Screeners

The interview frame for the screeners contained nine questions, listed in Appendix 4. The first two questions related to their experience both as an airport employee and as a screener. With this information in mind, I could later ask the more experienced worker to reflect on their whole career, which could bring interesting insights. The questions and the problems of the passengers were the topics of the third and fourth open-ended questions. Based on the answer given, several unscripted follow-up discussions could take place. With the fifth question, the screeners were asked if they have noticed any patterns of behavior in certain passenger groups. This question should not be treated as discriminatory, and this was also mentioned to the interviewee. Instead, the purpose of this question was to determine if specific problems or questions are culture-specific, which could be useful when thinking about design solutions. The interview continued by discussing

in the sixth question the items that must be searched or re-screened. The seventh question started in a closed-ended format to assess whether the screeners believe that the passengers see the security instructions. The second part of that question was used as a follow up to get more detail about their answer. The eighth question came back on the topic of items being rescreened and asked for suggestions on how to reduce this number. Not everyone was expected to have a ready-made solution, but the experience of the screener should not be neglected when making the final recommendations. The ninth and final question was an open question that allowed the screeners to share more comments or details if they wished to.

The work experience as a screener of the interviewees varied greatly, from one month to dozens of years, as shown in Figure 19 below. This diversity of experience offers different perspectives. Recently hired screeners remembered specific experience vividly while seasoned workers had a better understanding of the overall picture and could categorize passenger problems as well.

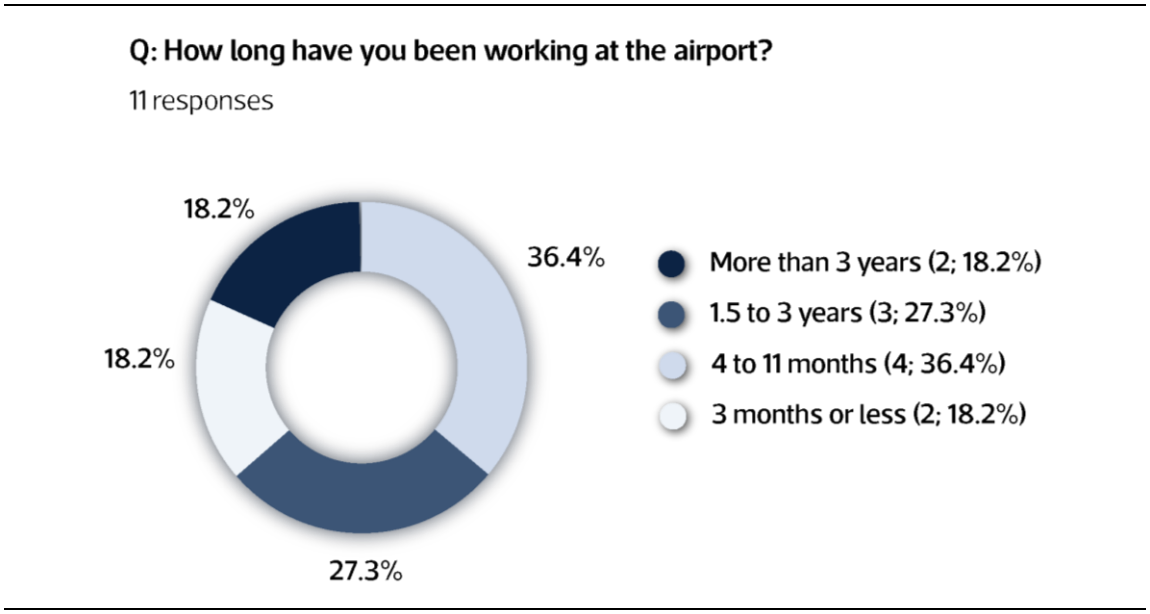


Figure 19: The experience of the interviewed screeners

In the opinion of the interviewees, regulation-related questions were the most commonly asked by the passengers. In particular, they asked why specific items must be taken out. The screeners have been trained to rightfully answer that this is the result of regulations and not their own rules. They can furthermore quickly explain the regulations if needed. The passengers reacted mostly well to these explanations even though the screeners also noted that in certain occurrences, some passengers are feeling personally targeted. Another type of question asked by the passengers was directions to their next gate, which also shows the importance of the screeners because they are the first human contact for passengers arriving at Helsinki Airport.

Passengers not knowing the regulations is the most common problem in the eyes of the screeners, who provided several explanations for this lack of knowledge. First, the passengers already went through security once at their originating destination, and the regulations there might be different from the ones in Security Checkpoint 9, which can be confusing. Second, they noted that some passengers are looking to the actions of their peers when in doubt. This behavior can have beneficial or disastrous consequences depending on the regulation knowledge and performance of the other passenger. Third, the majority of the screeners considered the screens to provide unclear information.

The screeners unanimously reported liquids as the most common items they must search, which further validates the findings made from the data and the observation. They noted that the passengers were confused about the definition of a liquid as it differs from ordinary language, with the example of cosmetics being considered a liquid. The interviewees also raised a structural problem related to the "inspection area", which can only accommodate four inspections at a time, resulting in queues of passengers waiting for their belongings to be picked up by a screener. The other types of items reported to be re-screened were laptops and tablets, especially the later ones because passengers do not consider them as large electronic items that need to be taken out of their bags.

Some patterns of behavior were reported, especially among Asian and Russian passengers. The main issue with these passengers relates to language. As found in the observation, **the screener reported dealing with a language barrier daily**. The solutions to go around this problem were noteworthy. The screeners often used their hands to communicate with the non-English passengers and also used actual objects to illustrate the items to take out. For example, they had a bottle of water next to them that they could point at when they wanted to talk about liquids. These methods were somewhat effective in the opinion of the screeners but took extra time, which reduced the passenger flow. One screener explained:

Scr8: "*Sometimes, it is simply impossible to make them understand, and we just let them through the x-ray machine, we know we will have to search the liquids at the end of the line.*"

On the other hand, they noted that some passengers are part of a group that includes a guide that speaks both English and the language of the passengers. They can explain to the unexperienced passengers the EU regulations, and this significantly reduced the number of items requiring additional inspections in the eyes of the screeners.

Out of the eleven screeners, only one believed that the passengers looked at the instruction screen. In particular, the interviewees thought that the screens provided unclear information and could not be read by the passengers while they were queuing. The other reasons given for this uninterest complemented the ones found earlier in this research. Indeed, the interviewees explained that screening procedures are already stressful

for passengers, but in Security Checkpoint 9, the situation was worse because they must promptly connect to their next flight. Because of that, the passengers were sometimes in their bubble and did not pay any attention to their surroundings. One interviewee resumed the mindset of the passengers at the security control point:

Scr3: "*[The passengers] don't read anything; they just want to get through as fast as possible."*

The screeners also explained that **screens are not the only artifacts that the passengers are paying attention to**. Specifically, at the end of the screening line, three large labels are asking the passengers to put their trays on top of the pile. The label, translated into five languages, is shown in Figure 20. One could think that these labels would grab the attention, but according to the screeners, they simply leave their trays on the line (which can lead to the line being too full of trays and not allowing more trays to be screened). This lack of compliance confirms the mindset of passengers "that just want to leave (**Scr5**)" because they "are in a rush to go to their next flight (**Scr7**)".

Figure 20: Label asking the passengers to put their trays on the pile

The screeners had several ideas on how to improve the situation at Security Checkpoint 9. They would like the airline to get more involved and inform the passengers about the security instructions while they are still in the airplane. This idea could work exceptionally well if Finnair were participating as it carries the vast majority of the passengers. Another exciting idea raised by one of the screeners comes from London Heathrow airport. There, the screeners have a laminated paper that includes images of the items that are must be taken out of luggage. The implementation of this idea in Security Checkpoint would seem beneficial as it would help reduce the language barrier. However, to ensure that every passenger understands them, the image must be carefully selected to be cross-cultural.

4.5. Survey

While the interviews of the passengers and staff brought additional valuable findings, only English and French speakers were interviewed, leaving the passengers that are speaking another language, a large proportion of the overall, unquestioned. To close this gap, a survey was created as an additional method to obtain more information from non-English speaking passengers. The survey was first formulated in English and later translated into Russian and Japanese by native speakers. Korean and Chinese language should have been added as well, but no flights from these destinations arrived in Helsinki Airport anymore due to COVID-19.

The twelve questions from the survey, listed in Appendix 5, resembled the ones used during the interviews. However, modifications were made to include only a few open-ended questions and keeping the other ones closed-ended. These changes were done primarily to limit the required time for the passenger to complete the survey. Some open questions were still left in because they leave the possibility for the respondent to express their feeling in their mother tongue, as shown in Walsh et al. (2013). Some open-ended questions from the interviews were transformed into scaled questions. For example, the first question of the survey asked the passenger to rate their experience at Security Checkpoint 9 on a scale of “Excellent” to “Very bad”. On the other end, the second question was open-ended and asked the passenger to describe what was noteworthy about the security process. The third question categorized the security instructions knowledge of the passenger by asking them how did they know which items they took out on the trays. The fourth question was used to quantify the number of passengers that saw the security instructions. The following fifth, sixth, seventh questions respectively scaled the quality of the instructions, allowed the passengers to describe the instructions in their own words, and determined when did they saw the instructions. The eighth question was binary and used to know whether the belongings of the passengers were searched by a staff member or not. The ninth question used pre-selected answers to categorize the reason for the belongings to be searched. The tenth question asked explicitly the reason why the passengers had an item still in their bag if it was the case. The eleventh question categorized the passengers by asking them how often they travel per year. The twelfth and final question was open-ended and allowed the passengers to share more remarks or details if they wished to.

A tablet was given to the passengers to allow them to answer the survey. As per the interviews, the participants were awarded a wrapped chocolate candy for their contribution. The passengers were more targeted this time. An emphasis was made on the ones that had belongings requiring additional inspection, in an attempt to get more information about this rejection. Despite having written an introduction text in their mother tongue explaining the motivation of the survey and the reward they could receive, the recruitment

of the passengers was more complicated than during the interviewees for several reasons. First of all, some passengers dismissed me straight away when I arrived next to them. Some others seemed not interested in sharing their experience after reading the introduction text. Because of the language barrier, it was challenging to find a good opening sentence, and not being able to explain some questions proved to be a problem as well.

Nevertheless, 26 passengers responded to the survey during the afternoon of 12 March 2020. The complete results are visible in Appendix 6. Because of the reasons listed above, most of the respondents (17) answered in English while only eight and a single one completed it in Russian and Japanese, respectively.

Some of the results from the survey echoed the findings made during the interviews. For example, the experience of the passengers at Security Checkpoint was rated as "Good" (42%, n=11) and "Excellent" (57%, n=15). One passenger noted, however, that the security control point is "very strict on the rules regarding liquids (**Res10**)". **Most of the passengers (58%, n=15) knew from previous experience which items to put in the tray** while staff members instructed nine other passengers, as shown in Figure 21.

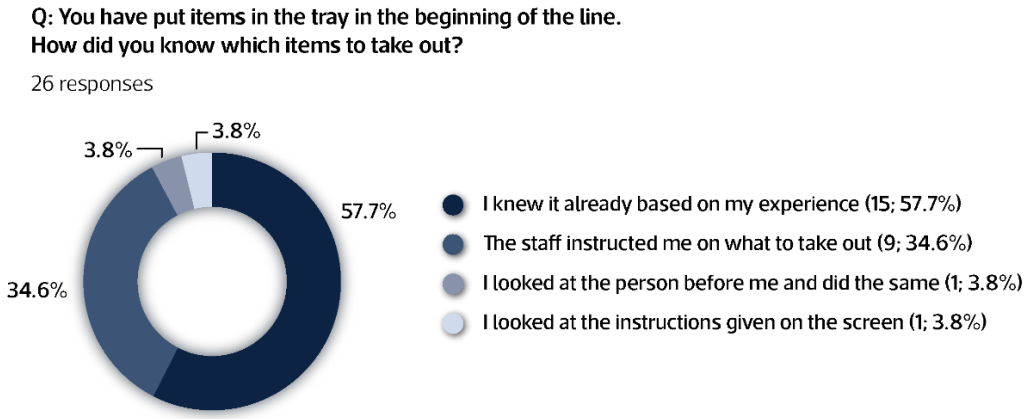


Figure 21: The passenger's source of knowledge about the items to be taken out

In contrast with the results of all the other methods, (38%, n=10) of the passengers saw the security instructions, while (50%, n=13) did not, and (11.5%, n=3) were not sure. For three reasons, I believe this result to be invalid. First, after discussing with the translators of the text, they told me that "security instructions on the screen" is a hard term to translate in Russian and Japanese. Second, the question did not include any picture, this was done on purpose to avoid biases, but because they are several screens in the Security Checkpoint 9, the respondents might have mixed up the screens they looked at. The third and most evident clue to dismiss these results comes from the seventh question that asked the participants when did they look at the instructions. Half of them (n=5) responded "when queuing BEFORE the [screening] lane", which is not possible because the screens are not visible from there. For all these reasons, the results of this topic will be dismissed and not analyzed further.

The high number (77%, n=20) of respondents having their belongings searched by a screener is, on the other end, valid and explained by my selection of the respondents. As presented in Figure 22, the reasons for this additional inspection varied. Interestingly, (25%, n=5) of the respondents did not know why their belongings were searched. This lack of explanation could have been due to the language barrier, but only one non-English respondent chose that option. **The main reason for the additional search was still due to a liquid item (40%, n=8),** echoing the results from other methods. In the following open-ended question, two respondents detailed that they thought that a cream paste and baby food were not considered a liquid.

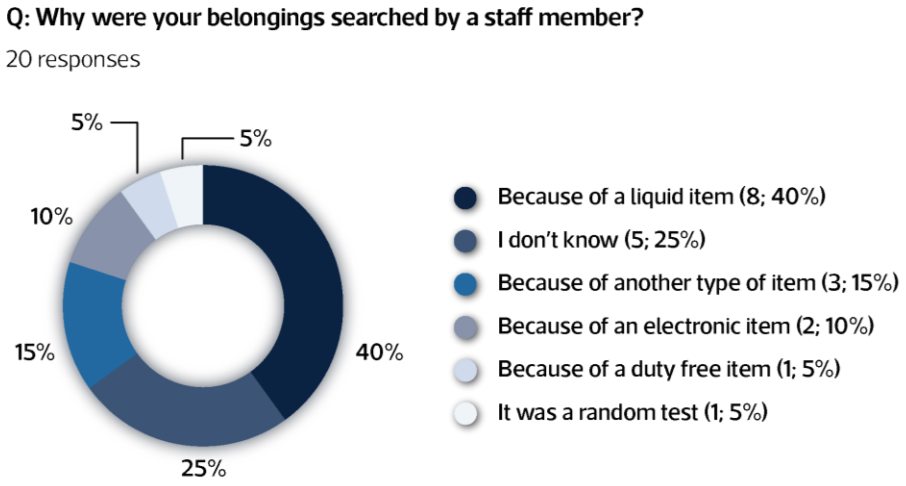


Figure 22: Reasons for the belongings of the respondents to be searched

Contrary to the interview participants, the survey respondents traveled less often, with the majority (52%, n=13) less than three times a year, as shown in Figure 23. This result might be due to the selection process of the passenger because, as shown in the interviews, the less seasoned travelers are more likely to have belongings requiring additional inspection.

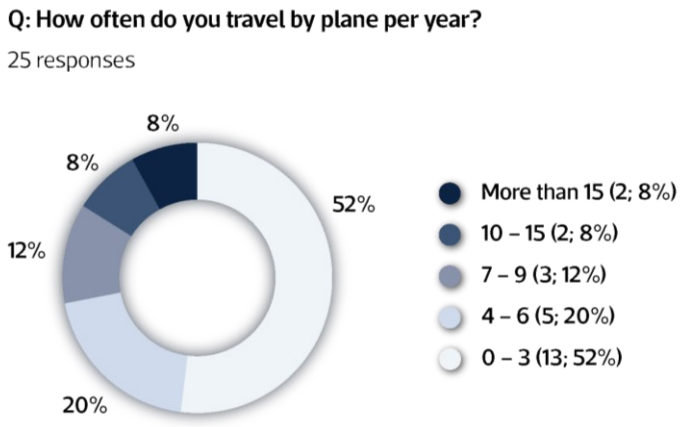


Figure 23: Travel frequency of the respondents

5. DISCUSSION

The five methods used in this thesis revealed several critical problems that should be addressed, one of them being the high number of items requiring additional screening, especially liquids. This chapter begins with a list of the findings made during this thesis and their implication. Based on them, several recommendations are made, from a design perspective but also a technological one. This thesis includes limitations, such as the lack of interviews of non-English passengers and the impact of COVID-19. They are discussed, along with the requirements for future work at the end of the chapter.

5.1. Key results

This thesis aims to understand the behavior of the passengers while they are at the Security Checkpoint 9 of Helsinki Airport. Based on the understanding of the context and the previous work, five different methods were carried out during this work. They undercovered many results, and the most significant ones are discussed below.

The first finding, discovered even before stepping into the security control point is that **many trays are requiring additional inspections by the screener**. During the last two months of the year 2019, the daily rate for these trays was 21%, which increases the workload of the screener and reduces the passenger flow, an essential metric to ensure that the passengers can connect to their next flight on time.

There are many types of items that are being inspected, but **the main category is liquids**. The explanation for these items to be the most prominent ones are multiple. First of all, the EU regulations regarding liquids are restrictive, requiring the passengers to place them into a specifically sized container itself inside a plastic bag outside of their luggage. Second, the definition of a liquid can be confusing because, in the context of airport security, it means anything that can be spread, including toothpaste, for example. Third, these regulations differ from the ones practiced at many airports of the originating destinations of the passengers in Security Checkpoint 9. Fourth and most importantly, **the security regulations are unfamiliar to passengers**, which leads them to forget their liquids and other items in their personal belongings.

The passengers not being aware of the security regulations are caused both by their actions and external factors. Security Checkpoint 9 is equipped with several types of screens. The most important ones in this context are located next to the screening lanes and show a video about the security instructions. Unfortunately, it was found out that **the screens with the security instructions are not attractive enough** both because of their appearance but, most importantly, because they are placed in a way that the passengers can not notice them well. **Passengers** are also not aware of the security regulations because they **rely on their previous experience in a security control point**. When they arrive at Helsinki Airport, **the passengers have gone through security at least once,**

are stressed, and need to connect promptly to their next flight. For all these reasons, they do not pay any attention to their surroundings and only remember the most familiar belongings to take out of their luggage, such as electronics and personal items.

The role of the screeners to ensure that the security regulations are followed is immense. Screeners compensate for the lack of knowledge of the passengers and their inability to notice the security instructions on the screen. To ensure that all the required items are taking out of the belongings, they ask questions to the passengers. This technique is successful but takes time and requires excellent communication between the screeners and the passengers. One example of this communication being unsuccessful is when the passengers do not have a good command of English.

The language barrier between non-English speaking passengers and screeners is a recurrent problem. These passengers cannot be adequately instructed and are likely to have belongings that need an additional inspection, making their journey through Security Checkpoint 9 more prolonged and tedious. With more and more intercontinental destinations being added, this issue will not go away without a change.

Finally, even with all the issues raised previously, **the passengers are satisfied with Security Checkpoint 9**, praising it compared to other international security control point. The data confirms that the average waiting time is low, and the passenger consistently said that the screeners are courteous and professional.

The role of the screeners had been extensively researched previously. However, these studies focused mainly on their ability to detect threats and their compliance with the rules. In the meantime, only one research concluded that the most common forbidden item were oversized liquids. For these reasons, **all these results are highly significant because most of them were never treated in any published literature before**.

5.2. Recommendations

The results brought in the previous section reflected several areas where improvements could be made to make Security Checkpoint 9 have fewer items to be rejected and instruct the passengers better. This section discusses the several possible recommendations that could be implemented to achieve this goal.

Have more tools for the screeners to communicate with non-English speaking passengers. At the moment, the only options for the screeners are to use their hands or an object as an example when they want to indicate which items should be taken of the passenger's belongings. One option to improve this situation would be to show the passengers icons of the items that the screeners are talking about. With 32 countries of originating flights and at least as many cultures, the risk of the icon being misunderstood is high (Biedermann, 1994). One way to mitigate this risk would be to develop different sets of icons that are culture dependent. Using a tablet (or several sheets of paper), the screener could select the correct set of icons accordingly, depending on the origin of the passenger.

The screener must be able to know which is the culture of their interlocutor, but the screeners are aware of the origin of the arriving flights, so this should not be too difficult.

Change the design and the position of the displays with security instructions. These displays are currently positioned just before the screening lanes and at an unconventional angle that makes them practically invisible. However, simply moving them closer to the "maze" will not change anything because the passengers would not look at them there either. Instead, they need to be more eye-catching. There are several ways to achieve this goal. The first one is to add an attention-grabbing element, such as a blinking LED strip around the display. This solution would likely make the screens more visible, but it would certainly not be pleasant to have a light strobing at the passengers while they are queuing. Another less intrusive solution could be to add a motion detector on display. This technology, coupled with the data from the boarding pass e-gate readers, could make the screens to give personalized information when they approached by someone. However, the anonymity of the passengers should always be maintained. Furthermore, using an attention measurement technique similar to what Sugano et al. (2016) have developed, several iterations with different content could be tested to find the best set-up possible. Finally, as shown by Proulx (2010), the size of the object matters in attention-grabbing. If no other solution could be implemented, at least the screen could be enlarged.

Inform passengers about security regulations while they are still in the airplane. 80% of the passengers transiting through Security Checkpoint 9 arrived from a Finnair flight. The national carrier would be, therefore, a natural choice for implementing this recommendation. All the passengers from Security Checkpoint 9 are sitting in an aircraft for a duration of time varying from one hour to half a day. During this time, the airline could provide valuable information about the security procedures that the connecting passengers must undergo. The time of these announcements are critical, doing them too early during the flights would likely mean that the passengers would not remember them. If Finnair refuses to include an additional message from Finavia, a paper containing information about the screening procedures could be inserted in the seat pocket. Unfortunately, the same is done for the safety procedures of the airline, and rare are the times I saw anyone looking at them while being in the air. For all these reasons, the difficulty of this recommendation lies in successfully grabbing the passengers' attention.

CT scanning technology could also prove to be a valuable addition for Security Checkpoint 9, as it would remove the need for passengers to separate their liquids and large electronics from their bags. This technology would result in much fewer trays being rescreened and higher passenger throughput. Without a doubt, the passengers would also welcome this improvement and have a better experience at the airport. However, because of the cost involved, this technology cannot be implemented at the moment at Helsinki

Airport. Furthermore, the adoption of this new technology would also require communicating the updated regulations to the passengers.

5.3. Limitations and future work

This thesis has some limitations. The most significant one comes from the impact of COVID-19. During the entire duration of the work, no Chinese passenger was present in the Security Checkpoint 9, which is significant when remembering that during the afternoon peak, they accounted for 19% of all the passengers (as shown in Figure 11). Furthermore, flights to South Korea were canceled when the survey was conducted. In general, rather positively for the passengers still present, the queues were shorter, and this could have contributed to the satisfaction level of the passengers interviewed. Finally, the day after conducting the survey method, Finavia informed me that I could not have access to the Security Checkpoint 9 anymore because of the virus. For this reason, no further field research nor evaluation of the proposed recommendations were possible.

Another limitation to consider is that while a small amount of non-English speaking passengers were surveyed, none have been interviewed. This lack of qualitative data limits the understanding of the root cause of their problems. Nevertheless, some issues experienced by the non-English speaking passengers were clear enough to be discovered anyhow. The final limitation worth mentioning relates to the implementation of a new solution. Any structural change in an airport is complicated, and in the case of Security Checkpoint 9, the validation of not only Finavia but also the security authorities are required. Therefore, if the desire is to change the situation quickly, the chosen implementation should not be too disruptive.

As shown in the literature review, there is little research about the behavior of the passengers while being at security control points. The future work to be carried in this research are to choose and test one of the proposed recommendations. Criteria for success should be determined, and they could be, for example, a decrease of some percent of the daily average of items requiring additional screening. Without a doubt, similar passenger-centric research could be carried out in the security control point of other airports in Europe, which could bring more findings of this topic. At the same time, while attention-grabbing with public displays has been discussed at length, no investigation where this would have been adapted to airport security was found. The context of security control points could limit the application of the technologies researched because of the high level of regulations present. For this reason, more research should be conducted to validate the techniques of attention-grabbing for public displays in airport security.

6. CONCLUSION

This thesis followed a human-centric approach by using both quantitative and qualitative methods to understand the journey and problems of the passengers going through the transit security control point of Helsinki Airport, also called Security Checkpoint 9. Five methods were used consecutively, building from the knowledge of the previous one.

The first method was the infrastructure analysis of the security control point, focusing on the position and attention-grabbing qualities of the screens present there. The analysis undercovered screens to be placed in a way that the passengers are not likely to see them. Furthermore, no eye-grabbing techniques are implemented on the screens for capturing the attention of the passengers. The analysis of several data sources from Security Checkpoint 9 was used as the second method of this thesis, which produced valuable quantitative findings. The majority of the flights and passengers arrive from Asian destinations during an afternoon peak of two hours. During this time, a high number of trays require additional inspections by the screeners. By far, the most recurrent category of the items present in these rejected trays is liquids. The third method was observations, which confirmed that the passengers are paying marginal attention to the screens providing security instructions. Two more noteworthy discoveries made at this point were that many passengers are questioning the screeners about the liquid regulations and that a language barrier was present between the screeners and the non-English speaking passengers.

The first research question of this thesis was, "*Are the passengers aware of the security instructions and regulations in place in the transit security control point of Helsinki Airport?*". Already at this point, it was clear that the passengers are not aware of these instructions and regulations. More methods were needed to get a more detailed understanding of this lack of knowledge from the passengers.

Interviews of both the passengers and the screeners were conducted and brought more valuable insights about the situation at Security Checkpoint 9. From interviewing the passengers, it was discovered that the majority of them rely on their previous experience when deciding which items they should put in the trays. For this reason, and because of the stress they have to connect to their next flight, there are fewer chances that the passengers look at the security instruction screens. Furthermore, these screens are noticed by only a fraction of the passengers, further confirming the lack of attractiveness of the screens. Another noteworthy finding is that the frequency of travel influences the performance of passengers; the more seasoned ones have their belongings inspected less often. Finally, it was confirmed that a significant number of passengers seems to have no command of English at all. The interviews of the screeners revealed how they are dealing with these non-English speaking passengers, often resulting in using hand gestures for the lack of a better solution available. The screeners also explained that the actions of the passengers are due to the stress of promptly connecting to their next flights.

Additionally, a multilingual survey targeting the non-English speaking passengers was created to be the last method of this thesis. The results of this survey confirmed that similarly to other passengers, the non-English speaking ones are also not aware of the instructions.

The second research question of this thesis was, "*What technological and human-centric improvement could be implemented for helping the passengers at the security control point in order to reduce the number of items being rescreened*." Based on the results presented above, four technological and human-centric improvements were proposed to be implemented to achieve the goal stated in the research question. The first improvement suggests integrating more tools for the screeners to communicate with non-English speaking passengers. Concretely, several culture-specific sheets with icons of the items to be taken of the trays could be a solution. The second improvement focuses on the screens of the Security Checkpoint 9. Their position should be changed so that the passengers could see them earlier. However, this solution is not enough and should be coupled with advanced and attention-grabbing technologies such as motion detectors. All the passengers arrive from a previous flight and are spending a significant amount of time sitting in the airplane. The third improvement leverages this shared characteristic by suggesting to inform the passengers about the security regulations while they are still in the airplane. The fourth and final suggestion for improvement relates to the CT scanning technology, which removes the need for the passengers to separate their liquids from their bags. Indubitably, fewer trays would require additional inspections, but the technology is too expensive to be implemented at Helsinki Airport at the moment.

Before this thesis, no published scientific research focused specifically on the behavior of the passengers while being at the security control point of an airport. The magnitude of the findings made during this work suggests that this topic should be further researched. Commercial aviation has been an essential part of society for close to a hundred years. It connects billions of passengers and has a considerable cultural and economic impact throughout the world. Undoubtedly, airports will continue to play a vital role in this industry for years to come, and this thesis could be used as a basis for other airports to conduct their analysis of their security control point. With millions of passengers going through airport security every day, improving both their journey and the work of the screeners could be a determining factor when the travelers are deciding their connecting airport when they are traveling to their next destination.

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APPENDICES

Appendix 1 – Observation form – Questions

Observation - After SAC

1. Where did the PAX remove items from his belongings

Check all that apply.

- [ ] Before the SAC
- [ ] While queuing in the "maze"
- [ ] While queuing next to a screening lane
- [ ] While at the screening late

2. Did the PAX pay attention to the information screens?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

3. How many bags did the PAX have with him?

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

4. What were the items being pulled out of the bag?

Check all that apply.

- [ ] Laptop
- [ ] Other electronics
- [ ] Phone
- [ ] Wallet
- [ ] Liquids
- [ ] Make up
- [ ] Sharp object
- [ ] Coat
- [ ] Belt
- [ ] Watch

Other: [ ] _____

5. How many trays did the PAX use for his belongings?

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

6. Were the PAX bags inspected

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

7. Were the PAX belongings re-screened?

Mark only one oval.

- Yes
- No
- Maybe

8. What were the item(s) being re-screened?

Check all that apply.

- Laptop
- Other electronics
- Phone
- Wallet
- Liquids
- Make up
- Sharp object
- Other: _____

9. Remarks / something noteworthy

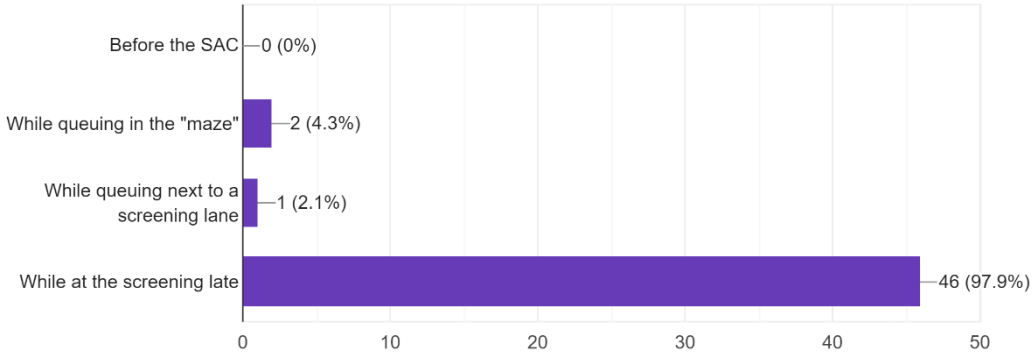
_____

_____

Appendix 2 – Observation form – Results

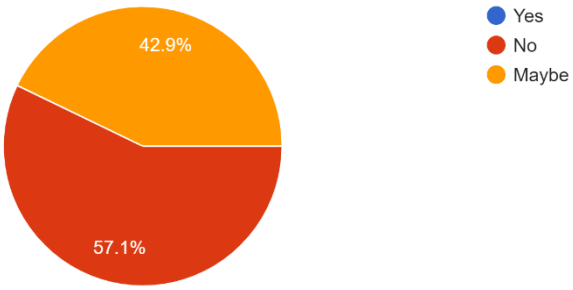
Where did the PAX remove items from his belongings

47 responses



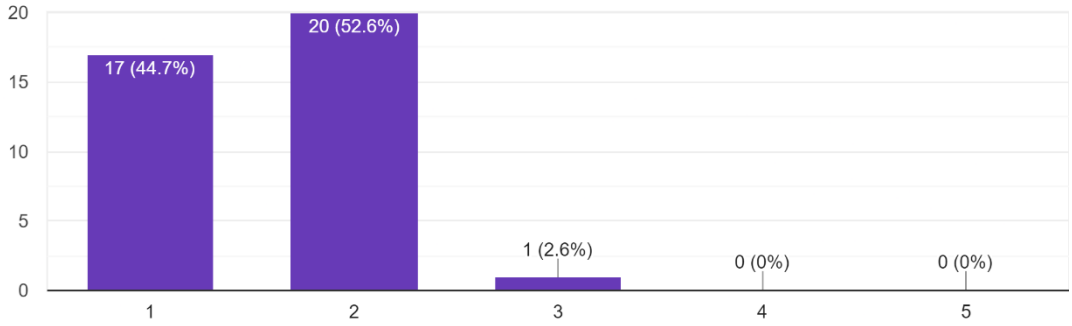
Did the PAX pay attention to the information screens?

42 responses



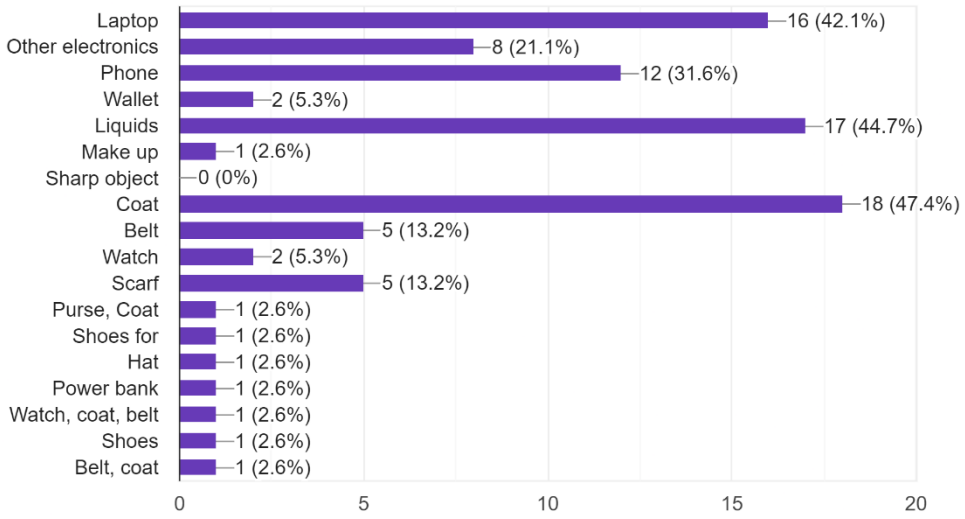
How many bags did the PAX have with him?

38 responses



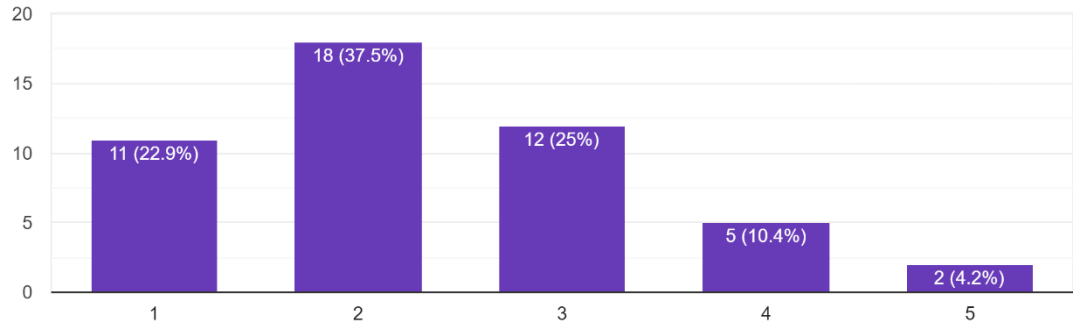
What were the items being pulled out of the bag?

38 responses



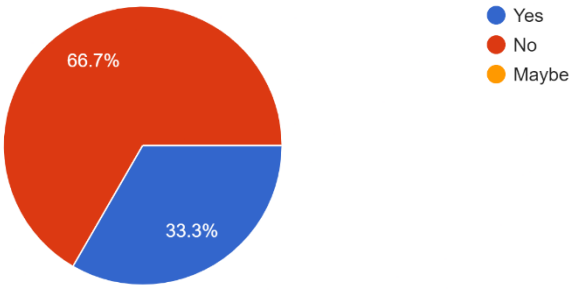
How many trays did the PAX use for his belongings?

48 responses



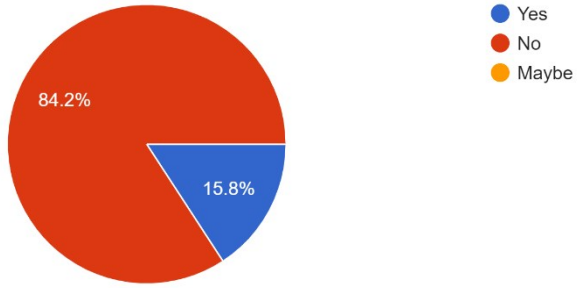
Were the PAX bags inspected

12 responses



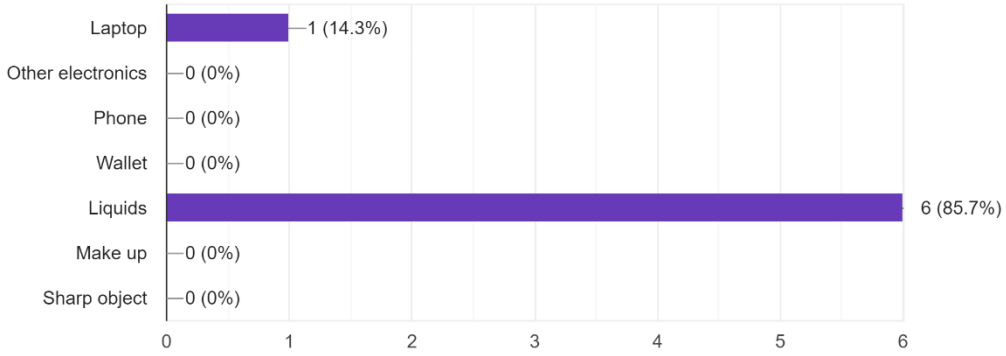
Were the PAX belongings re-screened?

38 responses



What were the item(s) being re-screened?

7 responses



Appendix 3 – Interview frame – Passenger

Q1: How did you feel going through security?
Q2: What belongings have you put in the trays?
Q3: How do you know which belongings you should put in the trays?
Q4: Have you seen the security instructions given on the screens?
Q5: When did you look at the instructions?
Q6: What did you think about the instructions?
Q7: Have the belongings of the PAX been searched / rescreened?
(If belongings searched or re-screened) Q8: Why were your belongings searched or re-screened? (+ follow-up about this)
Q9: How often do you travel by plane per year?
Q10: Do you have other comments regarding the security process?

Appendix 4 – Interview frame – Staff

Q1: How long have you been working at the airport?
Q2: How long have you been working as a screener?
Q3: What are the most common questions asked by PAX?
Q4: What are the most problems encountered by PAX?
Q5: Have you observed any patterns of behavior in certain PAX groups?
Q6: What are the most common items that must be searched / re-screened?
Q7: Do you think that PAXs see the security instructions? Why?
Q8: What would you do to reduce the number of items being rescreened?
Q9: Do you have any other comments / remarks?

Appendix 5 – Survey form – Questions

Q1: How was your experience at the security in Helsinki Airport today?

- ◯ Excellent
- ◯ Good
- ◯ Neither good or bad
- ◯ Bad
- ◯ Very bad

Q2: What was noteworthy about the security process?

Q3: You have put items in the tray at the beginning of the line. How did you know which items to take out?

- ◯ I knew it already based on my experience
- ◯ I looked at the instructions given on the screen
- ◯ I looked at the person before me and did the same
- ◯ The staff instructed me on what to take out

Q4: Have you seen the screens giving you security instructions?

- ◯ Yes
- ◯ No
- ◯ I don't know

Q5: How clear/helpful/informative were the security instructions on the screen?

- ◯ Excellent
- ◯ Good
- ◯ Neither good or bad
- ◯ Bad
- ◯ Very bad

Q6: Could you describe the instructions? For example, was there something confusing or clear?

Q7: When did you look at the security instructions on the screen?

- ◯ When queuing BEFORE the lane
- ◯ When queuing AT the lane
- ◯ While I was removing item from my bag
- ◯ I don't remember

Page 4

Q8: Were your belongings searched by a staff member?

- ◯ yes
- ◯ no

Q9: Why were your belongings searched by a staff member?

- ◯ Because of an electronic item
- ◯ Because of another type of item
- ◯ I don't know
- ◯ It was a random test
- ◯ Because of a liquid item
- ◯ Because of a duty free item

Q10: If it was because of an item, why was it still in your bag?

Page 6

Q11: How often do you travel by plane per year?

- ◯ More than 15
- ◯ 10 - 14
- ◯ 7 - 9
- ◯ 4 - 6
- ◯ 0 - 3

Q12: Do you have other comments regarding the security process?

Appendix 6 – Survey form – Results

Q1: How was your experience at the security in Helsinki Airport today?

Number of participants: 26

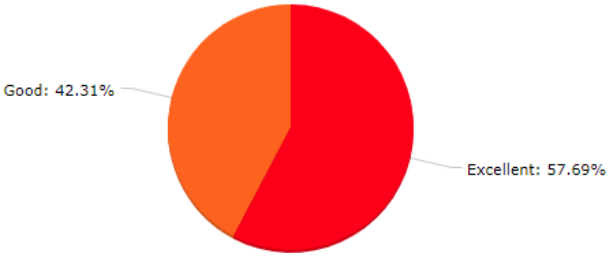
15 (57.7%): Excellent

11 (42.3%): Good

- (0.0%): Neither good or bad

- (0.0%): Bad

- (0.0%): Very bad



Q2: What was noteworthy about the security process?

Number of participants: 4

- Как обычно все вроде
- Very strict on the rules regarding liquids
- It was quick enough to clear the security check
- I didn't find anything so cool

Q3: You have put items in the tray at the beginning of the line. How did you know which items to take out?

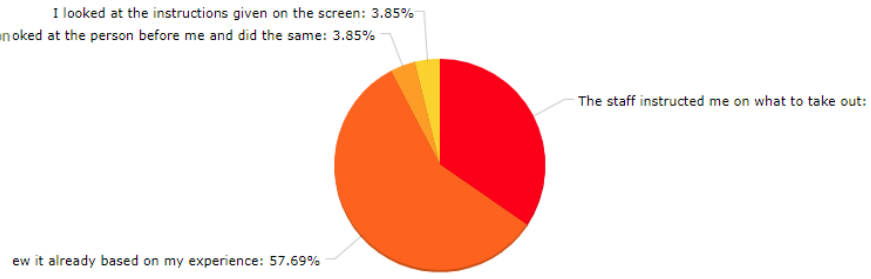
Number of participants: 26

9 (34.6%): The staff instructed me on what to take out

15 (57.7%): I knew it already based on my experience

1 (3.8%): I looked at the person before me and did the same

1 (3.8%): I looked at the instructions given on the screen



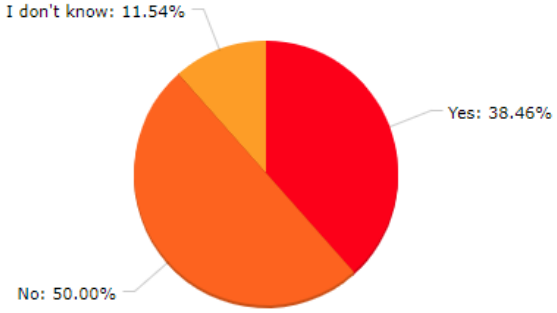
Q4: Have you seen the screens giving you security instructions?

Number of participants: 26

10 (38.5%): Yes

13 (50.0%): No

3 (11.5%): I don't know



Q5: How clear/helpful/informative were the security instructions on the screen?

Number of participants: 10

2 (20.0%): Excellent

7 (70.0%): Good

1 (10.0%): Neither good or bad

- (0.0%): Bad

- (0.0%): Very bad

Q6: Could you describe the instructions? For example, was there something confusing or clear?

Number of participants: 4

- Все ок
- Нам было все понятно
- The clear signs were mentioned properly at the required spots
- Easy way

Q7: When did you look at the security instructions on the screen?

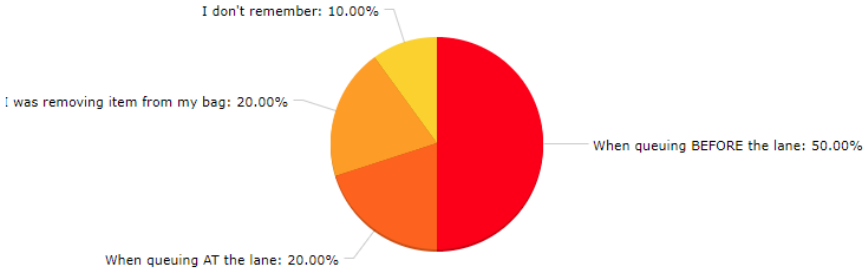
Number of participants: 10

5 (50.0%): When queuing BEFORE the lane

2 (20.0%): When queuing AT the lane

2 (20.0%): While I was removing item from my bag

1 (10.0%): I don't remember

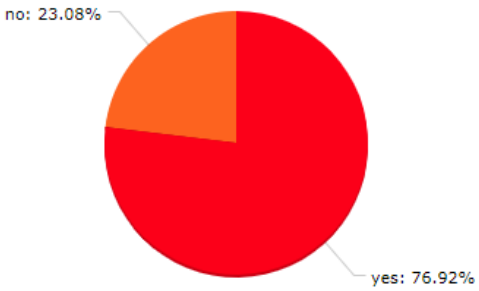


Q8: Were your belongings searched by a staff member?

Number of participants: 26

20 (76.9%): yes

6 (23.1%): no



Q9: Why were your belongings searched by a staff member?

Number of participants: 20

1 (5.0%): It was a random test

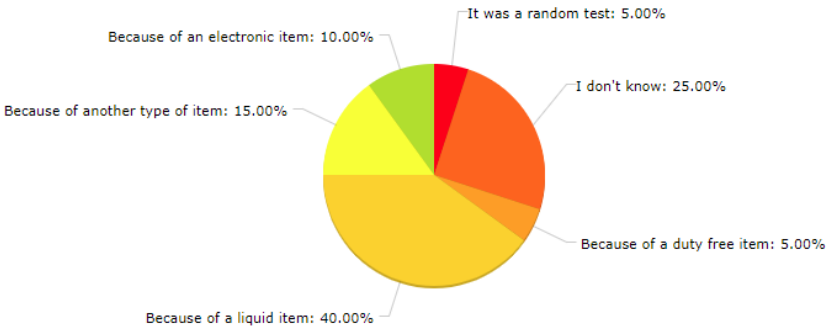
5 (25.0%): I don't know

1 (5.0%): Because of a duty free item

8 (40.0%): Because of a liquid item

3 (15.0%): Because of another type of item

2 (10.0%): Because of an electronic item



Q10: If it was because of an item, why was it still in your bag?

Number of participants: 6

- Книга
- Я забыла в рюкзаке одну упаковку детского пюре
- It was solid security thought it's liquid
- I tell them before and they said it's ok
- Lol that is my laptop
- It's was a medicine tube which was not liquid but cream paste for an infant kid.

Q11: How often do you travel by plane per year?

Number of participants: 25

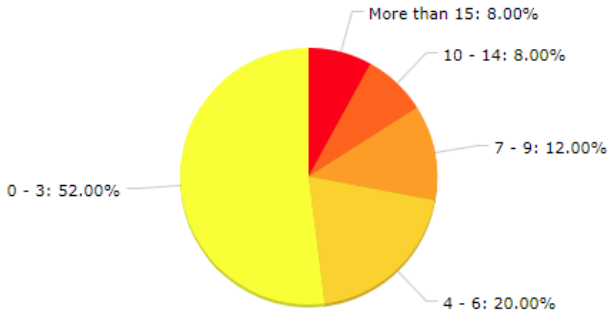
2 (8.0%): More than 15

2 (8.0%): 10 - 14

3 (12.0%): 7 - 9

5 (20.0%): 4 - 6

13 (52.0%): 0 - 3



Q12: Do you have other comments regarding the security process?

Number of participants: 3

- Нет
- Everything looks fine for me.
- Fast