Master's Thesis

Developing Qualitative Criteria for Assessing the Impacts and Acceptability of Border Control Technology

Benjamin Taylor

University of Tampere
School of Management
Master of Social Sciences
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International Relations
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Abstract:

Recent European proposals to broaden the use of automated border control (ABC) systems for non-European citizens are expected to lead to a significant increase in such technology. This Master's thesis aims to develop a set of qualitative criteria that can be used for assessing the impacts and social acceptability of ABC technology. While quantitative assessments of items such as cost are relatively easy to ascertain, the qualitative aspects of how a technology impacts on social participation or the privacy of an individual are much more difficult to assess. Taking into account a number of key findings from previous EU-level projects, along with the needs of the current research, a number of key areas of investigation were outlined. These included making the criteria more relevant to the current research, reducing the number of criteria, supporting the criteria with academic research and dividing the criteria into categories. Furthermore using a common scale of measurement, eliminating overlapping criteria where possible, and assessing whether some criteria could be emphasised as more important than others and assigned a minimum threshold were also areas to investigate.

The research utilises data from previous EU-level projects, along with other important literature to define a set of qualitative assessment criteria that can be utilised in combination with quantitative means such as Cost-Benefit Analysis and Risk Reduction Assessments. Using Q Methodology, a qualitative research method that allows results to be a combination of quantified data and qualitative interpretation, these criteria were then converted to statements and assessed by 25 stakeholders. An online Q Methodology programme was utilised to allow the stakeholders to rank the statements, on a 9-point scale of perceived importance whereby -4 equalled most unimportant and +4 most important.

The results of the research are thus two-fold. Firstly, they indicate that using such a method to develop a criteria set is feasible, even though it is difficult to address all of the areas of investigation satisfactorily. Secondly, the results of the empirical side of the research reveal three main groupings of stakeholder perceptions, each of which focuses on slightly different aspects of the given criteria. The findings emphasise a need for involving a wide range of stakeholders in any assessment of technology. Furthermore, the stakeholder views identified here are shown to be relevant for understanding the process of performing qualitative assessments of ABC technology. By combining these qualitative methods with quantitative ones, an interactive approach to technology assessment has the potential to bring wide benefits.

Keywords: impact assessment, technology, automated border control, Q Methodology

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Last, but most definitely not least, I would like to thank my wife and family for their encouragement, support, and understanding throughout this entire process.

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More information about the FastPass project can be found at:
www.fastpass-project.eu

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List of Terms and Abbreviations

Abbreviation	Description
ABC	Automated Border Control: A system which allows for an automated border passage, and which is composed of a self-service system and an e-gate[1].
CBA	Cost Benefit Analysis
D#	Deliverable number (e.g. D3.2) in EU projects
EC / EU	European Commission / European Union
EEA	European Economic Area
EES	Entry Exit System
e-gate	Infrastructure operated by electronic means where the effective crossing of an external border takes place[2]
EIA	Environmental Impact Assessment
IA	Impact Assessment
P#	Participant number (e.g. P1)
PESTL	Policy, Ethics, Society, Technology, Legal
QCA	Qualitative Criteria Assessment
RRA	Risk Reduction Assessment
RRI	Responsible Research and Innovation
RTP	Registered Traveller Programme
S#	Statement number (e.g. S1)
Self-service system	An automated system which performs all or some of the border checks that are applicable to a person[3]
SIA	Social/Societal Impact Assessment
TA	Technology Assessment
TCN	Third Country National: an individual who is not an EU citizen and does not enjoy the right to free movement within the EU[4]

1 European Commission,(2016a, p. 20) European Commission, 2016 (p. 20)
2 Ibid.
3 Ibid.
4 European Agency for Fundamental Rights (FRA 2014a, p. 14)

1. Introduction

1.1 Motivation

Recent proposals by the European Commission have noted the potential benefit of automated border control (ABC) systems for creating a more efficient border crossing experience. ABC systems can be described as technology which allows for an automated border passage, and which is composed of a self-service system for performing tasks such as a passport check, and an e-gate which controls the act of border crossing. Although different configurations exist, the e-gate generally consists of some form of physical barrier, such as twin glass doors, which only open once the mandated checks have been carried out successfully, or when the traveller is directed to further checks with a border guard (European Commission 2016a, p. 20).

Although European passport holders have been able to utilise such systems for some time now, the automation of processes for those carrying passports from countries outside of the European area, also known as Third-Country Nationals (TCNs), is rather new. ABC technology thus provides an opportunity for travellers and border authorities alike. With traveller flows expected to increase to 887 million external European Union border crossings by 2025 (European Commission 2016b), the introduction of self-service border control systems has the potential to alleviate the human capital costs associated with such increases. By 2020 travellers may be able to perform most, if not all, of their border crossing checks without direct contact with a border guard due to the increasing number of individuals possessing electronic passports which contain the holder's biometric information, thus allowing an automated system to perform identity verification (International Air Transport Association 2015b).

Additionally, automation of the border crossing process allows more border guard resources to be directed away from passport checks towards other security-related tasks such as performing more-thorough assessments of travellers. Indeed, so long as the process is adequately supervised by border authorities, it is not inconceivable that TCN travellers could perform many of their border crossing tasks without needing to present themselves to a border guard (European Commission 2016c). Automated checks using biometric identifiers such as facial images and fingerprints also have the potential to contribute to security, enabling the proper identification of legitimate document owners, and the detection of imposters.

What is new here then is the proposal to broaden the usage of ABC systems for border crossing, and the creation of a centralised database to store the entry and exit information of TCN travellers. However, concerns exist about the connection of such technology to European-wide databases, such

as the EES which gathers data for the purposes of identifying the length of stay within the EU for TCN travellers (Bigo et al. 2012; De Hert 2013). Such data collection is justified by the European Commission (EC) as essential to modernise the EU's borders, to help create a more efficient border crossing process in light of projected increases in traveller flows, to identify those who over-stay their visa period, and to bolster internal security and the fight against terrorism and serious crime (European Commission 2016c).

ABC technologies can thus be comprised of multiple components such as electronic barriers or gates; surveillance cameras; document readers; biometric capture devices such as fingerprint scanners, facial image cameras, iris scanners; information displays; hardware-and software for system management; as well as numerous sensors performing a multitude of tasks (Frontex 2015a, pp. 22, 6). These components individually might raise issues with those who perform impact assessments, but when in combination the effects are compounded (Atos 2013; European Commission 2014b, p. 33).

1.2 Aim and research questions

Due to this growing focus on implementing new border control technology within the EU, there is an increased importance on assessing the impacts such technologies might have on the individuals who interact with them. The FastPass (2013b) project is funded under the European Union's Seventh Framework Programme (FP7/2007-2013) and aims to establish and demonstrate a harmonized, modular approach for ABC gates.

This research contributes to the FastPass project by developing a set of qualitative criteria useful in assessing the social impacts and acceptability of ABC technology. In this sense, it contributes to the FastPass goal of *harmonisation* by proposing a method of harmonising the social and technological aspects of ABC systems through qualitative impact assessment. It will do so by utilising data from previous EU-level projects that aimed to perform similar tasks for policy decisions and security-technology decisions. While these previous projects focused on support in the decision-making process of security *policy*, this current research will focus on creating a criteria set which will contribute towards a decision-support tool for *technology* decisions such as for border control technology. The focus therefore is on border control technology in general and ABC technology specifically.

The first research question, which addresses the development of a set of qualitative criteria, can thus be formulated as:

(1) What are the important criteria to include in an impact assessment of ABC technology?

The thesis thus develops a "truncated" form of impact assessment which explores only qualitative impacts, that is questions regarding who and what is affected, in what ways, and why. This can be contrasted with asking quantitative questions such as those dealing with costs and values. However, it is important to be able to link the two forms of investigation, both quantitative and qualitative, in order to gather a more accurate picture of the impacts of a project, programme or policy.

Thus this set of qualitative criteria is intended as only one part of a three-part toolset composed of a Cost-Benefit Analysis (CBA), a Risk Reduction Assessment (RRA) and a Qualitative Criteria Assessment (QCA) as in the ValueSec project (2013) which aimed to develop a decision support tool for policy decision-makers. The first two components are inherently quantitative, while the latter is qualitative in nature. Utilising this concept of a three-pronged decision-support toolset, the current research aims to develop a set of qualitative criteria that are targeted at assessing the less-quantifiable impact of ABC technologies through qualitative interpretation of quantified data.

In order to address the first research question, a number of key issues first need to be considered. The first relates to ensuring the number of criteria is manageable. Secondly, the selected criteria should be justified using academic literature, or other documents of an official nature in order to show *why* they are important. Third, the new, concise set of criteria should be divided into categories to aid in the assessment process. Fourth, the criteria should be given a common scale of measurement so that all can be assessed at the same time and in the same way. Fifth, criteria which overlap with others should be reduced or otherwise accounted for. Sixth, the possibility of assigning a special status to certain criteria should be examined. These criteria would thus be assigned a minimum threshold value, which, if not reached, would terminate the assessment process. However, it must be stressed that the research does not aim to *solve* these issues, but rather investigate how they can best be addressed in relation to the research question. These issues are mainly addressed through the chosen research method, Q Methodology (Q), which is utilised to translate qualitative questioning and responses into a combination of qualitative and quantitative data.

In this research, Q is utilised as a research tool which supports the basic aims of this thesis. The steps involved in preparing and performing the Q research also overlap with the aims noted above. For example, one of the first tasks to perform in Q is to identify the relevant discourse on a topic in

order to develop statements which can later be ranked by research participants. This process of identifying literature ensures only relevant information is included, while also helping the research reduce unnecessary criteria.

Furthermore, by testing this set of criteria amongst stakeholders, the research aims to reveal the areas on which certain stakeholders place emphasis, and indeed whether stakeholders share certain views. Such results are important contributions when attempting to understand which stakeholders might object to certain aspects of the technology, thus allowing for a more inclusive and negotiated process.

The second research question can thus be formulated as:

(2) Do stakeholders differ in their perceptions of the subjective importance of the criteria?

In this research Q supports this stage by allowing stakeholders to rank the criteria according to how important, or unimportant they perceive the criteria to be. The end result being groupings of like-minded participants, and data demonstrating what each group emphasised over the others, what was common amongst all, and importantly for this research, the rank assigned to individual criteria by each group

Therefore this thesis presents two separate sets of results: firstly, those which describe how the six methodological issues were dealt with in the research, and secondly the final results of the Q process. The former are findings or recommendations relating to methodology (research question one). The latter are perhaps the more interesting for the FastPass project, and hint to three major perspectives among the participants of what is important to assess when considering ABC technology implementation. These perspectives, otherwise known as Factors in Q, are roughly described as Technologists, Humanists and Concerned Pragmatists.

The findings of this research contribute to a better understanding of what issues are important to consider when performing assessments of ABC technology. Indeed, while this thesis is specifically focused on ABC, there is no reason why the basic principles could not be extended to other similar technologies with some minor modifications. Understanding the perspectives of relevant stakeholder groups is essential when performing technology assessments and this research contributes to this understanding by revealing three such perspectives. It must be emphasised that these are not the only possible perspectives; they are just three of a currently unknown number. The research thus contributes to a better understanding of these three groupings by showing which criteria they emphasise, and which they do not. Knowing this is essential information when performing future assessments to ensure that minority views are also represented.

1.3 Structure of the thesis

After this first introductory chapter, the second section of this thesis begins by outlining the background of the research, noting the importance of previous projects in the area. It continues by introducing recent proposals by the European Commission to establish an Entry/Exit System, which would enable the greater use of ABC technology for crossing borders, whether those be in airports, seaports, or at rail crossings or land crossings. The discussion then moves into the social impacts of such technology before finishing with an introduction to common methods of impact assessment.

The third section of this thesis begins with an introduction of Q methodology. It continues by elaborating on the method used to conduct this research, explaining how a number of the research areas noted above were addressed. This section explains the usefulness of Q for the current research purposes, hinting at the overlaps that exist in preparing the research and the aims of the thesis. The third section describes how the statements were selected and constructed, how the participants were chosen, and how the research was performed using an online programme designed for Q tasks. This section also describes how the criteria were categorised. Tasks performed by the participants are also described in detail in this chapter.

The fourth section of this thesis discusses the results of the research process. It begins with an explanation of how the data was analysed and introduces the main participant data. This section describes how the participants' results were broken down and arranged in order to identify commonalities described as *factors*. The three factors identified are described, including details of the statements which the participants ranked positively, and those that they ranked negatively. Statements that were ranked similarly across all three factors are also described, together with a discussion about the implications of such rankings. The discussion then moves on to discussing the research results relating to the key issues not covered in the methodology section: an assessment of the scale of measurement, overlapping criteria and "killer criteria". The section then concludes with some discussion about the role of Q methodology in producing the desired results for the current and ongoing research, before giving a number of recommendations.

The final section of the thesis offers a discussion on the research objectives and gives an analysis of the overall findings before offering a number of final conclusions.

2. Background and literature review

The following sections introduce the aims and concept of the research before delving deeper into the important literature in regards to the project. The literature review is not necessarily a compare and contrast exercise, or an attempt to ascertain if one particular theory is better than another. In this research theoretical underpinnings of methods are not examined in detail, it is much more practical in nature. Indeed, the literature review reveals that much of the field surrounding this area of research is not only theoretical, but also, and more importantly, practical. This research is empirical in nature, and therefore much of the literature utilised is also of such a nature.

What this research does approach, however broadly, is the potential impact that policy, through the implementation of technology, may have on individuals and society. In an effort to minimise these potential impacts, this thesis attempts to firstly identify them, and then measure to what extent relevant stakeholders consider them important. The issue of European policy on border control is fundamentally grounded in discussions related to studies in International Relations. Furthermore, the topic at hand is extremely relevant to modern peace and conflict studies, especially those dealing with securitization, bordering, and the impacts of surveillance technology on the citizen (see for example Bigo et al. 2012; Burgess 2008b, 2012). The border control process is inherently discriminatory, that is, the purpose of performing the task is to ascertain who is, and who is not, allowed to cross certain spaces. How we define who is and who is not allowed to cross borders generally relies on a number of assumptions about the meaning of concepts such as what constitutes identity, nationality, the state, and internal and external security (see for example the discussions in Albert, Jacobson & Lapid 2001). Yet it is something which is expected for much international travel in the modern era, with few exceptions, such as that of the Schengen area in the European Union. The following sections introduce such topics, although not from their usual perspective. There are many issues and concepts such as security, ethics, risk, individual perception, technological processes, law and so forth, in this thesis that could be discussed *ad nauseum*. However, limitations on time and content, and the researcher's desire to refrain from such multi-faceted theoretical discussions in order to focus on the pragmatic mean that these conversations are left to others.

2.1 Background

As predictions that the number of travellers entering the EU is set to dramatically increase over the coming years, the effects this will have on the European Union's external borders is under increasing scrutiny. An official memo from the European Commission notes that border crossings

are expected to increase dramatically by 2030 (European Commission 2013). Add to this current economic troubles, security concerns and a push towards greater efficiency and it is no wonder certain security technology industries are expecting large revenue increases over the next 15 years (European Commission 2014b, p. 31). Due to this expected increase in travellers, and in an effort to manage border crossings in a more efficient manner, there has been a push towards automated border control (ABC) systems. These systems and the policy behind them are discussed in more detail below, for now it is simply worth noting this move towards automation.

This research is based on concepts developed in previous European Union-funded projects such as ValueSec (2013) and DESSI (Čas & Kaufmann 2012) which sought to develop decision-support tools for security, and policy decision-makers respectively. The ValueSec toolset consisted of three main parts, a Cost-Benefit Analysis (CBA), Risk Reduction Assessment (RRA) and a Qualitative Criteria Assessment (QCA). The latter is what this research concerns itself with, but nevertheless a brief introduction of the other two will help form a sound understanding of the task at hand.

CBA in essence, compares the costs of implementing (or not implementing) technology change with the benefits that that implementation may bring. In summary it "enables the decision maker to compare all direct and indirect positive and negative effects of the proposed decisions on an objective basis" (Pérez & Machnicki 2013a, p. 115). RRA on the other hand, looks at current risks and how these could be mitigated through technology implementation: "a level of risk is analysed for a situation as-is, i.e. without the implementation of a …measure, and compared to a situation/alternative situations, in which [the] measure was implemented" (Pérez & Machnicki 2013a, p. 28).

What is also needed here is a qualitative perspective. For example, neither a CBA nor RRA usually contain an analysis of whether the technology is ethically and socially acceptable, nor would they answer the question about what the end users of the technology actually think about using it. For example they could not necessarily answer what end user's concerns are, whether they think it is safe, respects dignity, or could potentially be used for purposes other than for which it was designed. In essence, the questions that QCA aims to address are the "soft criteria", that is, the human or ethical aspects of the technology: how we feel about it, how it makes us feel, and how that might change the way we interact with each other.

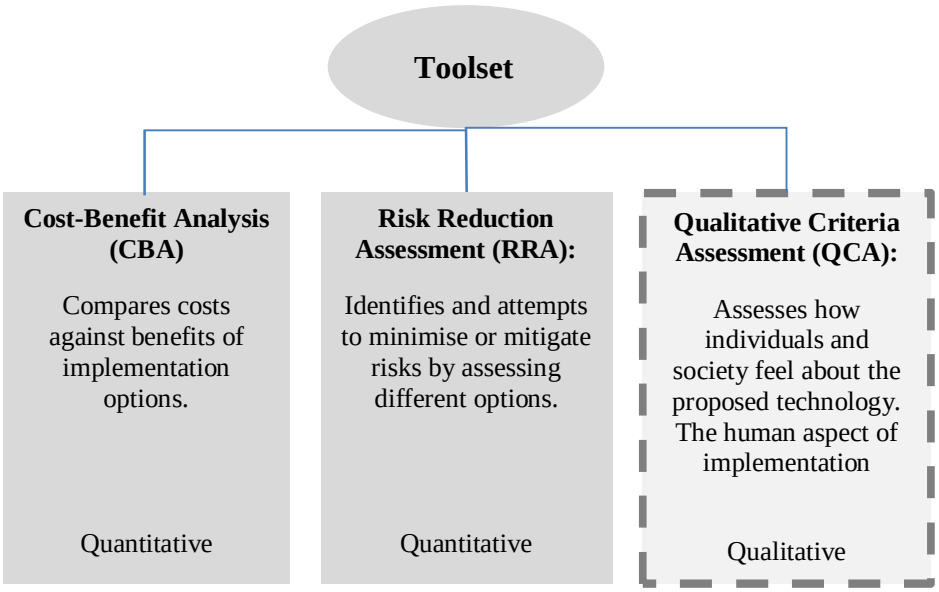

Figure 1: Illustration of the three components of the decision-support toolset. The QCA component is examined in this research.

These three tools (CBA, RRA, QCA) together make up the toolset for a decision-support tool (see Figure 1 above). This research focuses only on the QCA component of the toolset. While the overarching aims of the ValueSec project were to provide transparency and support in the decision-making process of security *policy*, this current research will focus on creating a criteria set which will contribute towards a decision-support tool for *technology* decisions, specifically ABC technology.

The ValueSec project developed a tool which combined the inputs from CBA, RRA and QCA in order to support policy decisions. The DESSI criteria set was developed for similar purposes, although without the input from CBA and RRA, and the main focus was *security investment* decisions. The former criteria numbered close to 100, while the latter numbered 46.

The current research therefore utilises the previous findings of these projects to develop a set of criteria to use in QCA aimed specifically at assessing ABC technology. Thus this research does not specifically take into account issues of risk assessment or analysing cost-benefits which are deemed outside of the focus of QCA, although as will be shown, there are a number of potential overlaps identified.

A security-related example of the importance of assessing technology for public use is the implementation of airport security scanners. The scanners in question utilized backscatter or millimetre wave technology and displayed a real-time image of the individual inside the device that was so life-like that the devices came to be known as “nude” or “naked” body scanners (Hempel et

al. 2013, p. 741; Kravets 2011). Indeed traveller backlash in America against the idea of airport security screeners being able to view these 'invasive' images of travellers ultimately led to some machines being removed and procurement contracts being cancelled. However, other versions of the same technology were able to remain in use as the passenger was represented on the security screener's display by an avatar rather than a live image (Nixon 2013). Furthermore, researchers have claimed that such scanners are not as effective at identifying security threats as previously thought (Mowery et al. 2014).

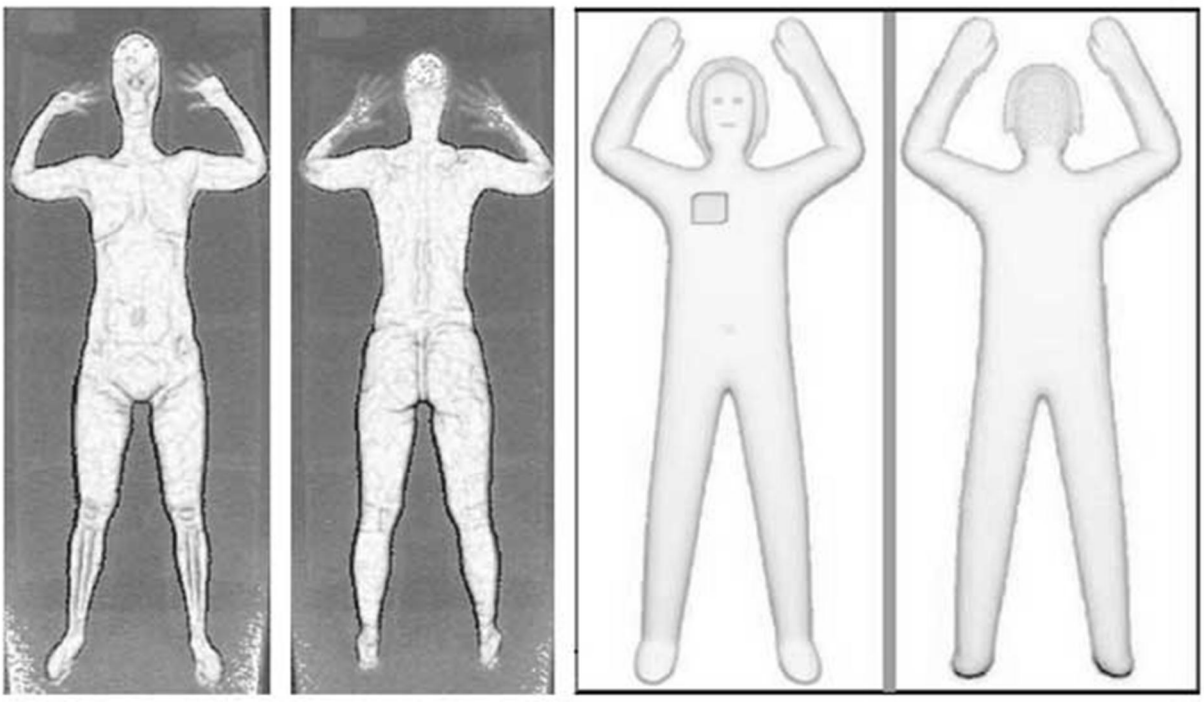

Image 1: Before (left) and after passenger representation was changed on backscatter scanner[5]

This brief example demonstrates the costs involved in not assessing the social impacts of technology implementation. While the implementation of such devices may technically be legal, as noted by Hempel and Lammerant (2015, p. 37) "an impact on a freedom which is considered legal can still be considered annoying by a traveller and therefore minimizing it can be important in order to improve acceptance." In this case, a much smoother implementation may have occurred had stakeholders such as travellers and their representatives, as well as external experts been more thoroughly consulted in the design and implementation process of this technology.

5 Image source: (AP Photo/Transportation Security Administration) http://www.timesunion.com/business/article/Some-airport-scanners-out-3982805.php

2.2 Increasing the use of technology at the border

The use of automated border technology is a rising trend across the world. A recent publication by the International Air Transport Association (IATA) (2015b) notes that three billion travellers were transported by the aviation industry alone in 2015, and that this number is expected to double in the next 15 to 20 years. This is supported by an official memo from the European Commission notes that border crossings are expected to increase by 80% on 2009 numbers by the year 2030 (European Commission 2013). Thus in an effort to increase security and efficiency in border control procedures, Automated Border Control (ABC) systems are expected to bring benefits of faster and smoother passenger flows without the need for an increase in border guards relative to passenger flows (International Air Transport Association 2015b). An ABC typically consists of a self-service module which the traveller utilises to perform tasks such as submitting passport information through a document reader and biometric (such as fingerprint or facial image) data using scanners or cameras, and an e-gate which controls the border crossing process (European Commission 2016a, p. 20). It is useful to note that these two parts of an ABC may be integrated as in Image 2 (FastPass 2013a) below, or it may consist of a separate, stand-alone kiosk for the self-service steps, with the e-gate being located a short distance away (see for example Frontex 2015a, p. 41). This can be contrasted to a "manual" process, where the traveller presents her/himself to a border guard who performs relevant checks on identity and eligibility to cross the border. These tasks are usually performed with the aid of computer systems connected to national and European databases, document readers, and biometric capture devices such as cameras and fingerprint scanners. The location, configuration and type of ABC systems utilised at a border crossing point will depend on the type of border. In general there are four main border crossing types or ports: air, sea, road and rail, and configurations must be arranged according to the space available, and the environment in which they will operate (Frontex 2015a, pp. 40-3).

Travellers can make use of these systems, which allow a smaller number of border guards to monitor and process a larger number of travellers, thus freeing up other border guards for essential duties. This does not mean that the border guard role is becoming obsolete, on the contrary, it has been argued that ABC systems enhance security in general as border guards are now able to focus on other potentially higher-risk travellers (International Air Transport Association 2015b). The issue of risk in terms of border crossings is a contested one as the subjectivity and terminology of who and what constitutes risk is continually debated (see for example Bigo et al. 2012; Burgess 2008a, 2008b). However, my intention here is not to delve into such complex topics, but rather to note that such classifications are used when discussing border crossing (see FRA 2014a, p. 20). In

this way, the greatest benefit of ABC systems would go to low-risk frequent travellers, airports, and border control agencies, however the discussion below looks at some of these issues in relation to the European Union's Smart Borders proposal.

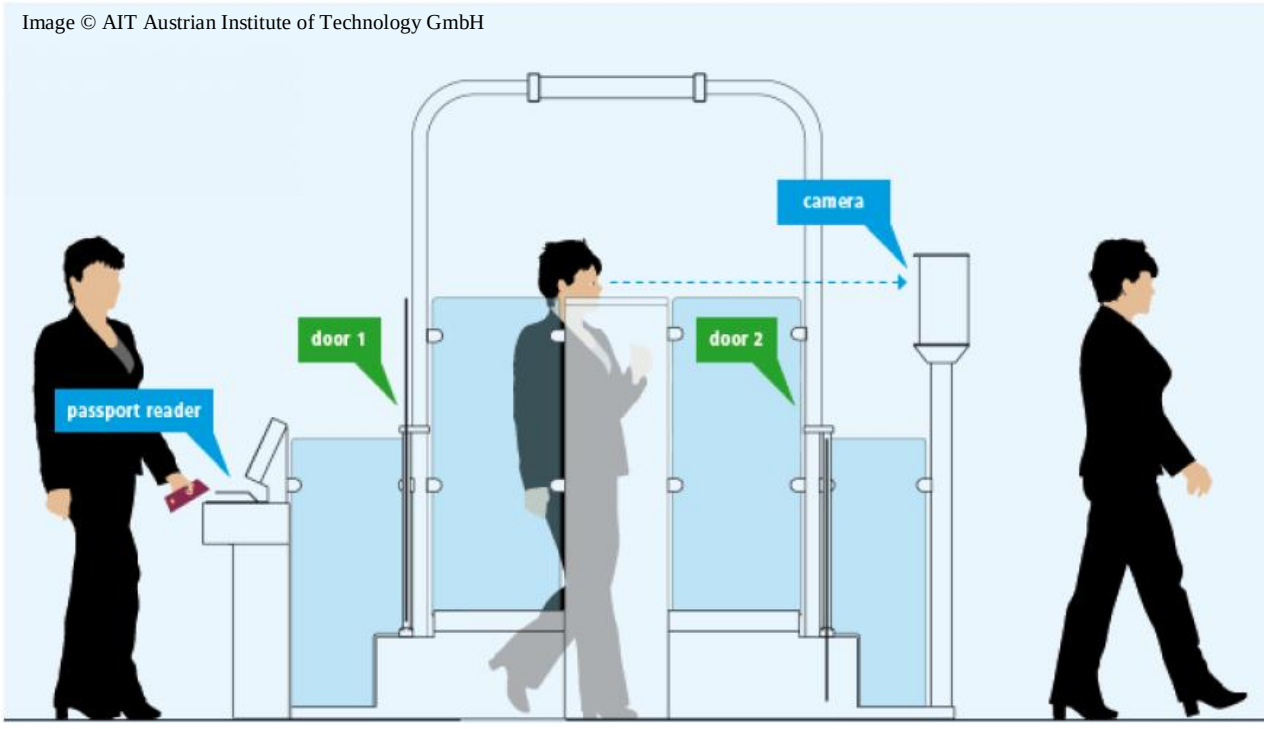

Image 2: An example of an integrated ABC workflow[6]

The European Union's 2016 "Smart Borders" (SB) proposal envisages a modernised border management procedure through automated border checks and improved entry and exit information regarding non-European passport holders (European Commission 2016c, 2016d). It is similar in many respects to a previous proposal in 2013, except for the elimination of the Registered Traveller Programme (RTP) (European Commission 2013; European Parliament 2016). ABC systems allow the electronic stamping of passports of Third Country Nationals (TCNs) when they enter or exit the external borders of Schengen member states through a system known as the Entry/Exit System (or EES). It would also allow travellers—providing they hold a biometric or 'e-passport' to perform border control checks using ABC systems which, at the moment, are generally[7] reserved for European Union (EU), European Economic Area (EEA) and Swiss (CH) biometric passport holders. The newest proposal recommends that TCNs be able to perform a "pre-check" process at a

[6] Image used with permission, sourced from FastPass (2013a).
7 Some ABC system implementers such as Helsinki-Vantaa Airport also allow specific TCN passport holders to utilize the automated passport control; however, manual passport stamping is usually performed by a border guard immediately after exiting the ABC. See for example, https://www.finavia.fi/en/helsinki-airport/terminals/border_control/

stand-alone kiosk, before moving on to a manual process where their data is checked to ensure authenticity (European Commission 2016a, pp. 27-8). Additionally, when automated exit gates (e-gates) are available, the proposal seems to make allowance for their use by TCNs, providing they are adequately supervised, and the pre-check process has already been performed for those who do not hold residence permits, cards, or other long-term visas (European Commission 2016a, pp. 24-7, 9-30). Furthermore, the proposal also retains the possibility of Member States enacting their own RTPs for pre-vetted frequent travellers, which might allow TCNs to utilise ABC systems without performing pre-checks on every entry. Thus the move towards greater automation of border control systems is argued to benefit not only EU/EEA/CH passport holders, but also TCN passport holders. This has the potential to massively increase the number of ABC systems in use in ports and borders around the European Union. However, it seems too early to say exactly how many member states will implement such systems, as the proposal, if passed in its current form, will only come into force in 2020.

In essence, the SB proposal is in response to predictions that the number of travellers entering the EU is set to dramatically increase over the coming years. Put succinctly, in order to deal with this expected increase in traveller flows, the latest SB proposal notes that: "The proposed Entry-Exit System will allow for the effective management of authorised short-stays, increased automation at border-controls, and improved detection of document and identity fraud" (European Commission 2016d).

Thus at both entry and exit the data of TCNs such as name, travel document information, date and time of entry/exit, and biometrics such as face and fingerprints will be recorded and stored in order to perform verification of identity and duration of stay (European Commission 2016c). The new proposal also provides for member states to be alerted when an individual has stayed longer than their allowed duration (European Commission 2016b, p. 11 Article 1). On the other hand some critics of the former proposal, which did not allow for such notification, argued that overstays could only be detected once an individual attempted to *exit* (or re-enter) the Schengen area, as this is the point when the time-stamps are compared and duration of stay calculated (Bigo et al. 2012, p. 33). However, it should be noted here that in this author's interpretation, the EES system will only *alert* member states when an overstay occurs. Thus it may still be the case that even though those who overstay are *identified* through these EES alerts, they will not necessarily be *apprehended* until they either attempt to cross a controlled border, or come into contact with authorities through other methods.

Furthermore, the current proposal will also require Third Country Nationals (TCNs) not subject to visa requirements to submit biometric data in order to enrol in the EES (European Commission 2016a, p. 28). Despite reassurances that such a system will be safeguarded and overseen to ensure privacy and data protection, data protection and rights organisations such as EDRi (Naranjo 2015) have argued that the 2013 proposal failed to meet the tests of whether it is necessary, proportional, or effective. As yet, the newest proposal has not received such criticism, but it is still early days.

The European Commission (2013) argued for the original proposal on grounds of long-term efficiencies and cost saving-the investment was expected to save up to 250 million Euros per year. These savings were to be achieved through reducing the number of border resources needed, along with an increase of automated technologies such as ABCs. The most recent proposal has a more modest budget: since dropping the RTP, the expected costs have more than halved to 480 Million Euros, however there is no clarification if the initial estimate of 250 million Euros per year is still valid (European Commission 2016c). The reduced costs of the new proposal, along with the proposed wide-spread usage of ABC systems for pre-checking may even allay common concerns about ABC systems in general-that the cost of the systems, along with a lack of data on the benefits, low passenger volumes, and legislation makes their implementation unattractive (International Air Transport Association 2015a).

One could, and many have, argued that the ongoing securitization of Europe's borders involves not only security from a political perspective, but also from an economic perspective (Chalfin 2012; Wright et al. 2014). With implementation of the SB proposal, along with other border technologies aimed at tackling illegal migration, the winners appear to be not only the citizens of Europe, but also (and perhaps mostly) defence and security industry contractors (Boulanin & Bellais 2014; Proctor 2015). This is an interesting development, as the EC itself has previously noted the societal challenges which new security technologies raise, including negative consequences, societal conflicts and loss of investments (Hempel et al. 2013, p. 741). An EC opinion paper (European Commission 2014b) notes that some technologies in the area of security and surveillance, such as surveillance systems (CCTV) seem to be looking for problems to solve, rather than responding to a genuine need. This brings to mind the questions of proportionality and necessity mentioned earlier. A warning from Burgess (2008a) also notes that technological solutions to security must address the human at the centre of the security-insecurity intersect or else risk being self-defeating. Security technology then, along with the discourse and policies that surround it, may very well create *insecurity* in the sense that they heighten fear and uncertainty (Burgess 2012; Kreissl 2014, p. 660). Once fear and uncertainty are increased, it is easy to attempt to reduce these with technological

solutions, thus setting in motion a vicious cycle. Of importance in this discussion, therefore, are questions of privacy, security, social cohesion, conflict and unintended consequences of technological innovation in border management.

The increasing number of security-related technologies also raises the concern that EU citizens could come under increased surveillance. Bigo et al. (2012, p. 34) raised this concern in their paper in 2012, and in late 2015 there was indeed a proposal tabled to enforce mandatory entry and exit database checks at Schengen borders for EU citizens (European Commission 2015c). Indeed, the issue of privacy is perhaps one of the biggest concerns in the area of border management, especially when biometric information is involved (Campisi 2013b). Others argue that biometric data is some of the most sensitive data about an individual which could be processed as it involves uniquely identifying an individual, and thus it is important that Data Protection Impact Assessments are undertaken (Dmitrova 2016). The issues of how technologies collect, store and transmit information is the subject of EU data protection regulations (European Commission 2012b) and thus is enshrined in law. However, the EC also encourages technology developers to actively engage society in research and innovation, promoting systems that utilise a 'privacy by design' method, that is, prioritising privacy throughout the entire design process (European Commission 2012a). The same document also commits the EC to make societal impact testing an obligatory part of all its future security research projects (European Commission 2012a, p. 11). This might be easier said than done, as while technology is under development, it is difficult to predict and control the negative impacts it might produce, however, once the technology is implemented and there is enough data to demonstrate the impacts, it may be costly and slow to control these impacts (Sollie & Düwell 2009a, p. 2). This leads back to issues of uncertainty, and the unpredictable, unforeseen and unanticipated nature of complex technology development trajectories discussed earlier.

It should be noted however, that the implementer of a technology, in this case a national border authority, will often describe their needs and requirements to the technology developer (Frontex 2012a, pp. 29,32, 55, 2012b, pp. 14, 37). While these requirements must comply with relevant EU and national regulations on privacy, data protection and the like, the specific requirements of the implementer may involve a combination of technology interactions which are outside of the control of the developer. In this sense, an ABC gate may be combined with existing IT systems, or databases controlled by a third party (Kamara et al. 2015). All this is to say that despite the fact the ABC developer may operate by a privacy by design principle, when the technology is implemented, specific end-user requirements may require it to operate, or interact with other technologies that do not- or have not been designed to- adhere to this principle. This could create the situation where a

'black box' is inherited, that is, a closed system which the implementers have little or no understanding of how it functions (Sollie 2009b, p. 146). Thus there is a need to not only look at the individual technologies, but also how they are combined to form systems. This is where impact assessments come into play, but first an introduction to the policy environment is in order.

Policy at a European level has led to an ever-increasing digitalisation of Europe's borders. Systems such as the Schengen Information System (SIS), Visa Information System (VIS), and EURODAC (the EU database for identifying asylum-seekers and ensuring the proper implementation of the Dublin Regulation) are now routinely utilised by law enforcement agencies, despite the fact that some are now being used beyond their original purpose (De Hert 2013, p. 387; Gonzales Fuster & Gutwirth 2011). This is a fundamental element of what is referred to as "function creep" and is seen as a major threat to privacy and project legitimacy. Function creep occurs when the scope of use of a technology (or the data collected by the technology) is gradually expanded beyond the original statement of purpose, which ultimately leads to privacy loss (Bigo et al. 2012, p. 46; Campisi 2013a, p. vi; De Hert 2013, p. 390). Such gradual, or incremental changes often take place quietly, unobtrusively and as an administrative convenience, yet the human consequences are generally unknown, ignored or downplayed (Ball et al. 2006). Function creep was introduced here as an example of how policy may have unintended consequences on society leading to ever-increasing securitization, and is another factor to add to the list of impacts given above, namely privacy, security, and social cohesion.

While this all seems doom and gloom, it is also essential to note that the EU also actively funds projects that aim at reducing the impact of such security technologies mentioned here. In fact, some argue that in the past there has been a strong focus in most of the EU funded projects in security foresight on the dangers and negative effects of such technologies, rather than their benefits (Burgess 2014). Furthermore, there are EU agencies such as the European Union Agency for Fundamental Rights (FRA) which regularly produce papers analysing, for example, the situation at certain external border crossing points (FRA 2014a, 2014b). The following sections begin by examining the tools available to identify and mitigate negative technological impacts as best as possible, it is in no way an exhaustive list, but the main tools of relevance to this study are included. The section then continues with further examination of how these tools are utilised in the European projects in the area of impact and technology assessment.

2.3 Impact Assessments

Rapid advances in technology have often forced change upon people and societies without an adequate assessment of harms and benefits, impacts on social and cultural values, and whether or not these changes are even desired or needed, and if so, by whom (Nissenbaum 2010, p. 161). The QCA method which this research focuses on has similar objectives to those Nissenbaum discusses above (Blobner 2013b, pp. 44-5; Kaufmann 2012, p. 30), however, much of the work of assessing impacts of policies, projects or programmes is attributed by another name, Impact Assessment. Impact Assessments (IA) have been common in some shape or form since the mid-1970s, whereby they were usually encountered in the form of Environmental Impact Assessments (EIA), which also may have included some form of Social Impact Assessment (SIA) (Baines, Taylor & Vanclay 2013, p. 255; Esteves, Franks & Vanclay 2012, p. 34; Vanclay 2015, p. iv). SIA is broadly described as "analysing, monitoring and managing the social consequences of development" (Vanclay 2003, p. 6). However, these early SIAs were usually of limited scope and did not take into account broader social issues. Indeed, it was eventually realised that broader social issues other than simply biophysical ones relating to EIAs were also of importance and deserved to be assessed in their own right (Vanclay 2015, p. iv). The field of SIAs thus emerged in its own right in order to assess how society was affected by the implementation of policy. Writing in a document titled 'Guidance for Assessing and Managing the Social Impacts of Projects' Vanclay (2015, p. 2) notes that there are a number of important differences between EIAs and SIAs: notably that while environmental impacts usually only occur at the sod-breaking stage of a project, social impacts may occur at the first rumour of a proposed project. This tends to make SIAs far more complex than EIAs, as many more factors need to be taken into consideration.

Esteves et al. note that there are some broad fundamentals to performing 'good' SIA, namely that:

> it is participatory; supports affected peoples, proponents, regulatory and support agencies; increases their understanding of how change comes about and increases their capacities to respond to change; and has a broad understanding of social impacts (2012, p. 40).

Thus, SIAs are designed to help not only implementers of policy, but also those who will be affected by the policy implementation. It is a process which may occur from the inception of a project or policy, through the research, development, and implementation phases onwards to assess the ongoing impacts (Prainsack & Ostermeier 2013, p. 6). Therefore, SIA is an ongoing process; it is something that involves monitoring and managing as noted by Vanclay (2003) above. Thus, it differs slightly from other forms of impact assessment in terms of its scope and duration.

Related to SIAs are what is called a Surveillance Impact Assessment (Ball et al. 2006, p. 85). Surveillance IA is noted to include an examination of the impacts of surveillance on a range of issues that includes, but also transcends privacy. However, when compared with SIA, Surveillance IA scopes a slightly narrower range of issues, impacts and stakeholders, with a focus on the *societal* impacts of surveillance (Hempel & Lammerant 2015), rather than SIA's focus on impacts of the technology as a whole (Wright & Raab 2012). Thus, the Surveillance IA includes normative and regulatory questions of surveillance, but also incorporates questions of issues and impacts similar to those of SIAs.

Another form of assessment that is generally encompassed in an SIA and a possibly also Surveillance IA, but may also occur independently, is a Privacy Impact Assessment (PIA). These assessments analyse the impact a policy, program, plan or project has at a privacy level by identifying and evaluating privacy risks, checking compliance to privacy legislation, and considering how risks can be avoided or mitigated (Hempel et al. 2013). These risks might be directed at the individual or societal level. Compared to SIAs then, PIAs have a much narrower scope that is usually defined by specific legal frameworks and discourses surrounding data protection (Hempel et al. 2013, p. 743).

Technology Assessments (TA) are applied processes that consider the implications which technological change has on society (Russell, Vanclay & Aslin 2010, p. 113). TAs can come in a number of forms, but the most relevant to this discussion is Constructive TA (CTA). CTA is a method which aims at including important stakeholders from the earliest stages of the design process, and that the development of technology is influenced by interests and values of all individuals who participate in its design (Schot 2001). Participatory TAs are often seen as normative judgements, however, it is important to realise that while TAs may provide expertise to underpin judgement, they do not make these judgements themselves (Russell, Vanclay & Aslin 2010, p. 110). TAs should recognise that normative judgements are political actions, and thus should be left to political actors: the role of TAs should be seen as more providing clearer pictures of social context and changes on the societal level that occur with the associated technology. Thus TA should inform discussions and decisions about technological changes and about social futures associated with them (Russell, Vanclay & Aslin 2010, p. 113). Improving the understanding of the social context of technology will not always result in 'better' decision-making, but it should reveal the underlying political and ideological rationale for decisions. This in turn should lead to increased transparency and accountability, in the decision-making process.

Assessments such as those listed above are often viewed as devices aimed at bringing rationality to decision making processes. However, it is also important to understand that each of these processes is influenced by how, and by whom differing definitions are made (Hempel & Lammerant 2015). This is because there are also inherent premises, assumptions and limitations of such assessments, and thus it is important that these are also identified (Abrahamsen et al. 2015; Russell, Vanclay & Aslin 2010; Schot 2001). Impact assessments are generally seen as early warning systems and often follow basic risk assessment procedures; however, defining 'risk' is a process involving moral judgements, involving social and culturally constructed ways of looking at the world (Hempel & Lammerant 2015, pp. 129-30; Kreissl 2014, p. 660). Impact assessments therefore involve inherently moral decision-making processes, and as such have become more common when assessing social issues surrounding development projects. Such impact assessments are not 'magic bullets' which will transform a bad technology into a better one, neither should they simply be used as 'tick box' exercises to gain approvals or certifications for a project (Ball et al. 2006, p. 92). Rather, the decisions about policy or projects made by the select few individuals should be analysed to ascertain their impact as these decisions hold the potential to affect broad collectives of people who are impacted on many levels, by technological systems development. In short, human decisions impact technological development, technological development shapes societal values, and societal values impact human decisions in an iterative and ongoing fashion (Carew & Stapleton 2014, p. 150).

Additionally, Verbeek (2009) argues that because technologies shape the moral actions of human beings, thus designers should consider their responsibility for the moral dimension of their designs. Thus such assessments have also come to be associated with ethical research and policy implementation (Baines, Taylor & Vanclay 2013; Vanclay, Baines & Taylor 2013). Thus using morals and ethics as a base, IAs (and SIAs in particular) attempt to create an environment where both the intended and unintended social impacts -which might be positive or negative – of planned interventions can be adequately identified, analysed, monitored and managed (Schot 2001, p. 44). The goal of these processes is to bring about a sustainable and equitable result for both the human and biophysical environment (Vanclay 2003, p. 6). In this sense IAs are also somewhat related to the concept of Responsible Research and Innovation (RRI) which aims at a transparent and interactive innovation process which includes consideration of the ethical acceptability, sustainability and social desirability of innovative technologies (Owen, Macnaghten & Stilgoe 2012). The EU has adopted such an approach as part of its Horizon 2020 Framework Programme for Research and Innovation noting that RRI is a process which aligns research and innovation

processes and outcomes with the values, needs and expectations of society (European Commission 2015b). To summarize this, the aim is to reduce the future effects of technology by engaging users, stakeholders, and other citizens in the technology design process. This allows for pre-emptive identification of potential issues in the design process, rather than a reactionary problem solving approach post-implementation which must rely on feedback from (usually negative) market signals and social effects (Schot 2001, p. 43).

This brief introduction to the different forms of Impact Assessments and Technology Assessments directs us to how these tools are utilised or discussed at relevant policy-making levels within Europe. To begin with the European Commission's (2009b) Impact Assessment Guidelines detail the importance of IA in ensuring Commission initiatives and EU legislation are undertaken in a transparent and effective manner. The guidelines include a section which specifically details the relevant areas an impact assessment should focus on, which are split into three main tables: economic, social, and environmental impacts (European Commission 2009b, pp. 33-8). It is important to emphasise, however, that these guidelines are designed to help at an EU policy-level, that is, not everything is necessarily applicable to the current research. Even so, they are a relevant reference point to determine what the important aspects of IA are, and as such are generally utilised by EU-level projects.

There are a number of EU-level projects that have utilised and furthered research in the field of Impact Assessment. For example, the DESSI project developed a set of criteria that were used as input into a tool designed to provide support for security decisions (Čas & Kaufmann 2012). The system of criteria from the DESSI project were also utilised in a later project called CRISP in its aims to develop "a robust methodology for security product certification" in Europe (CRISP 2014; Kamara et al. 2015, pp. 18-26). Another project, SIAM (2011) aimed at creating a decision support system for security technology investments and developed an approach that was also later utilised by CRISP (2014). The ValueSec (2013) project also aimed to develop a toolset, but this time to support policy decision-makers. The PACT Project (Atos 2013) aimed to develop a framework with the purpose of supporting decision-makers at the policy, design and development levels to enable security technology decisions in a transparent and rational manner. The PRISE project (PRISE 2009) also identified criteria that could be utilised for the assessment of privacy and security technologies and utilised PIA in their work. Meanwhile the SAPIENT Project (2011), which aimed to develop a Privacy Impact Assessment (PIA) framework for surveillance technologies (Wright & Raab 2012, p. 614).

It is also worth noting that some of the individuals involved with a number of these EU projects are also experts who produce 'state of the art' literature in the field. It is a very 'hands-on' field where the experts actively participate in EU funded projects in these areas. For example, Wright and Raab co-authored a paper in 2012 on surveillance impact assessments, Wright was also involved in the SAPIENT (2011) and ASSERT (2013) projects, and Raab was a co-author on the Surveillance Society report to the Information Commissioner of the United Kingdom (Ball et al. 2006). Leon Hempel (Hempel & Lammerant 2015; Hempel et al. 2013) was involved in the SIAM, ASSERT, and CRISP projects (CRISP 2014; SIAM 2011). Thus, the experts are heavily involved in past and ongoing EU-level projects regarding the areas of impact assessments.

2.4 Relevance to current research

In this vein, the current research aims to use qualitative methods to develop a framework for identifying potential issues relating to border control technology. In no way does this research attempt to create an "ethics of technology" in the sense which Sollie and Düwell (2009b) request, but it attempts to create a framework which will assess the impact a technology may have on society in a more narrow sense. The focus of the task is narrow, as are the analysed aspects of the technology. The aim is to produce a set of criteria that may be used in a decision support tool. However, it is important to note that the tool is not an IA comparable to SIA, Surveillance IA, PIA, or TA, but it does utilise many of their key elements and concepts. Furthermore, this set of criteria is not expected to replace these other forms of IA; on the contrary, it is more of a precursor to such assessments. In that sense, this research develops somewhat of a *pre-IA-assessment* which could be performed on a group of selected technologies to determine which best fits the implementer's needs. The aim is to improve decision-making in order to identify the potential impacts of technology and direct attention to the issues an implementer may face. Once these issues have been highlighted, it is expected that further investigation would take place where necessary. However, in this research only the criteria set will be assessed, the other functions of the tool are outside of the scope of the thesis. Thus only which criteria are to be included and excluded, why and how they were chosen is the process that is described in this thesis.

3. Research Methods

The research for the thesis is divided into two main parts, both of which are integral to the chosen research method, Q Methodology (Q). Firstly, there was a process of identifying and developing criteria through literature research; and secondly, testing the usefulness of the criteria to stakeholders using an online version of Q research software. The first part relates to the aspect of identifying and defining the *concourse* (or statements of communication) in preparation for a Q study, and the second is the empirical process of performing an assessment of the concourse, which produces the research results. The following sections describe in greater detail the methodology of the study, beginning with an introduction to Q and followed by an explanation of how Q was utilised in this study.

Q Methodology was first developed by a British physicist-psychologist William Stephenson in 1935 (Brown, Steven, Danielson & van Exel 2015, p. 524). The purpose of Q is to enable a researcher to "discern people's perceptions of their world from the vantage point of self-reference" (McKeown & Thomas 2013, p. 1). Q allows a researcher to investigate subjectivity, and does so in an efficient way compared to other methods, as Q research is often able to produce results using small numbers of respondents, and allows the use of online resources. Q also facilitates the convergence of qualitative and quantitative research, by assigning the inherently qualitative (subjectivity) a quantitative value. Thus, Q enables the assessment of the criteria sets from the perspective of individual stakeholders.

3.1 Q Sample

In Q, the researcher identifies the area of operation and looks into the background of the subject, known as the 'concourse'. This might include academic literature, newspaper articles, televised news interviews, opinion pieces, anything that basically constitutes "the flow of communicability surrounding any topic" which might manifest in "ordinary conversation, commentary and discourse of everyday life" (van Exel & de Graaf 2005, p. 4). The gathered material should represent the opinions and arguments that exist on a topic, and could be the representative views of politicians, companies, organisations, lay people, professionals, or scientists to name just a few (van Exel & de Graaf 2005, p. 4). The concourse should contain the relevant discourses that exist on a topic. These discourses, once identified, are turned into statements and are referred to collectively as the Q Sample.

3.1.1 Identifying the data (Concourse)

For this research, the main sources of data consisted of documents produced by EU-level projects such as ValueSec (2013) and DESSI (2013) among others, as well as other academic, organisational, and EU-level policy documentation. The qualitative criteria sets from the ValueSec and DESSI projects formed the main structure of the data, with the latter documents providing support and justification for the inclusion of the criteria into the final data set. The following paragraphs introduce the importance of the ValueSec and DESSI data for this research.

Qualitative, or "soft" criteria can be defined as "criteria of relevance for a decision which cannot be quantified by a certain physical or logical dimension in the way costs or quantities of damages can be quantified" (Pérez & Machnicki 2013a, p. 91). Simply put, qualitative criteria discuss factors of how individuals think, feel or believe. The list of criteria in the ValueSec and DESSI projects numbered close to 100 for the former, and just over forty for the latter. One major concern for stakeholders involved in the ValueSec project was that while the concept of a criteria assessment was extremely promising, the large number of criteria meant the process had the potential to become very complex and time-consuming (Blobner 2013b, p. 43). Thus, one of the main tasks of this research is to produce a criteria set of a 'workable' number: approximately 35-50.

The overall goal of ValueSec was "to develop a tool-set to support **policy** decision makers in balancing decisions with overall policy objectives, political and ethical values, and societal concerns" in relation to security decisions. This current thesis proposes to create a set of criteria that will also aim to contribute to the development of such a toolset; however, this toolset is focused more towards **technology decisions**. This refocusing of the criteria set is not seen to be overly problematic, as Blobner (2013a, p. 22) notes that the criteria list is 'fully customizable, so that new categories/criteria can be added and currently present can be deleted'. This last point is especially important as it confirms that it is necessary to adjust the criteria sets in order to ensure a relevant assessment process.

The original list of ValueSec criteria also contains so-called "killer criteria" which are assigned a minimum threshold. Designating a particular criteria as "killer" means that it is essential to satisfy this threshold (for example: legal requirements being fulfilled) in order to move past the planning stage. A failure to meet the threshold in the given example would lead to a suspension of the assessment, as the legal requirements would prevent the implementation of the policy. Once these killer criteria are assessed to be above the threshold, other "soft criteria" can be assessed.

The ValueSec (Kaufmann 2012, p. 30) list of soft criteria included the following:

- society (groups, including the meso-level),
- individuals (personal level),
- law and regulations,
- rights and ethics (which are structurally different from law and regulations),
- politics, economics (indirect effects),
- technology and science,
- the environment, understood as built environment, living environment and natural environment in the classic sense.

The current research considers whether all of these categories are necessary, and attempts to implement some key findings of the ValueSec Project in regards to the QCA. Specifically, the importance of making the criteria selection process transparent by supporting them with academic literature; ensuring that overlapping criteria are reduced or accounted for in other ways; implementing a common scale of measurement for all criteria; and allowing certain criteria (e.g. legal) to be weighted more heavily (Blobner 2013a, pp. 22-7). These, along with reducing the total number of criteria, and applying them to technology implementation, are the challenges this research will attempt to address.

Additional sources of information also provided support for the inclusion of statements into the concourse, such as EU-level projects in the field of IA, whether it be focused specifically on surveillance, society, privacy or technology in particular. Documents such as the EU Charter of fundamental rights (Official Journal of the European Union 2012), European impact assessment guidelines (European Commission 2009b), publications by the Fundamental Rights Agency and the EU border control agency Frontex, as well as academic literature on ethics and IA are also utilised. The concourse included areas surrounding social impacts, fundamental rights, legal frameworks, economic impacts (CBA) and risk assessments, however even though these aspects form part of the discourses in the field, they are considered in the CBA and RRA sections of the tool to which this research will contribute. Therefore, although these latter two issues were apparent in the wider concourse, they were not included in depth in the Q Sample. This was a decision made to ensure the final Q Sample was within the aims of the project (concise, yet covering the relevant areas).

Thus, the Q sample was drawn from relevant academic literature as well as the existing criteria sets of the ValueSec and DESSI projects. The role of the academic literature was to support the inclusion of the DESSI and ValueSec criteria in the new criteria set through multiple reference points, and to contribute to areas relevant to ABC technology that were not covered by the existing

criteria sets. This was seen as important as there was little public information available about the criteria selection process for those projects.

3.1.2 Q Sample construction

A Q sample generally consists of 40 to 50 statements drawn from the discourses found in the concourse, and is more 'art than science' according to Brown (in Van Exel 2005, p.6). Paige and Morin (2014, p. 6) describe this as the 'inductive' or 'unstructured' method to creating a Q sample, where the researcher must select the relevant statements when no pre-existing theory exists. Thus, themes that emerge from a review of the concourse become the basis for the selection of statements. The alternative to this would be the 'deductive' or 'structured' approach, whereby statements are chosen based on theoretical considerations. In the deductive approach, a matrix is used to define relevant criteria, usually dictating the number of statements allowed in each section. For this research, such an approach was seen to be more limiting, as it was difficult to precisely define the necessary factors, and it was felt that this may restrict the inclusion of some statements. A note on terminology is useful here. While the main components of QCA are *criteria*, the process of Q utilises *statements.* For the purposes of this research, the two are essentially the same. The Q statements simply represent the concept of the QCA criteria as identified in the literature (see Appendix B).

In essence, the inductive method means that the researcher is generally able to decide themselves which statements should be included or excluded. Thus, it is likely that two different researchers looking at the same concourse could select different statement to assess in their Q sample. This is not necessarily seen to be an issue as the aim of constructing a Q sample is to produce something which is representative of the diverse range of views that exist on the topic (van Exel & de Graaf 2005, p. 5). Additionally, it is the participants who give meaning to the statements through their sorting and ranking process, creating the relationships between statements and giving a view of their perspective (van Exel & de Graaf 2005, p. 5). Van Exel (2005) argues that even when different researchers draw different statements from the concourse, it has been demonstrated that the overall results identified in the resulting studies still converge on the same perspectives: that is, the same perspectives are usually still recognised in each.

Q samples are usually created through a process involving interviews and literature research (McKeown & Thomas 2013, p. 18), however, in this research much of the data for the Q sample was already presented in the form of the ValueSec and DESSI deliverables. The purpose of interviews in arranging a Q sample is normally to define the important issues that exist around the topic. However, in the current study there was no need to interview stakeholders to ask what the

important aspects of technology assessment were: this task had, in effect, already been completed through the research and stakeholder workshops organised in the DESSI (see European Commission 2014a) and ValueSec (see Blobner 2013a, 2013b) projects. Both criteria sets had been developed using stakeholder participation and feedback. Therefore attention could be placed on the criteria sets, as well as other important reports, deliverables, articles and conference papers relevant to the issue at hand. In this sense the process was towards more of an 'adapted' Q sample which may contain items of a more factual nature (McKeown & Thomas 2013, p. 20).

Once I had identified the relevant literature, I focused my attention on the different qualitative or 'soft' criteria that were presented in the ValueSec and DESSI projects. First of all I compared these two and noted that the DESSI (Čas & Kaufmann 2012) criteria were much more concise, with 42 compared with 124 criteria for ValueSec (Kaufmann 2012). It is important to note that these are only the criteria available in public deliverables, in one of the latter ValueSec project documents it is noted that the criteria total 98, and that there had been an active effort to reduce the number of criteria (Pérez & Machnicki 2013b). Unfortunately, I was not able to access the restricted deliverables and thus I had to rely on the publicly available information. With the two sets of criteria, I began to look at how these were justified or supported in the deliverables. The ValueSec deliverable offered little in the way of methodological framework when it came to why or how these specific criteria were chosen. The DESSI deliverable did however offer some justification, as most of the criteria were presented in categories that were briefly described and supported using a number of references. However, individual criteria themselves were not supported, nor was there any explanation of methodology presented in the public deliverables for how the criteria were selected.

As mentioned earlier, a Q sample should consist of a manageable number of statements. McKeown and Thomas (2013, p. 23) note that a Q sample does not need to include all possibilities, but rather they should be a 'comprehensive but manageable representation of the concourse'. For this reason it was decided to limit the Q sample to a range of 35-45 statements, which is within the range suggested by Ward (2010, pp. 77-8). Thus the concourse consisted of at least the 42 DESSI and 124 ValueSec criteria (many of which overlapped), plus other discourses from relevant literature. Ockwell (2008, p. 271) noted that from 304 identified concourse statements in his research, only 36 were eventually selected for inclusion in the Q sample demonstrating that my task was indeed achievable.

Initially I began by creating an excel sheet which listed the DESSI and ValueSec statements side-by-side. I then went through these criteria and marked the criteria that were applicable to the

current research green, which were potentially applicable orange, and those that were not applicable were highlighted in grey. For example, the DESSI criteria 'Private life' and the ValueSec criteria 'Privacy, personal data and liberty' were marked green as these issues are relevant to technology assessments involving border control technology. However, criteria addressing cost-benefit analysis and risk reduction were marked grey as these issues are not relevant to this current research. The ValueSec criteria 'Aesthetics (sensual: sight, smell, sound)' was also marked grey as it is generally understood that there are impacts on sight, smell and sound of any technology implementation, but not on the large scale that something like a dam, or security fence might impose.

Once the criteria had been assigned a colour, I began reading through the literature, looking at whether such criteria had been mentioned as important, or included in other impact assessments of security technology. In some cases, I also identified issues that were not covered adequately by neither the DESSI nor ValueSec criteria. Usually these were related more specifically to border control technologies and were identified through documents such as Frontex Operational Guidelines, or supported by statements in recent conference papers or reports on Smart Borders. As an example, issues of technology availability and reliability with ABC systems were added, as these are essential to consider according to the Technical Study on Smart Borders (European Commission 2014c), and the Smart Borders Final report (EU-LISA 2015, p. 13), and the Frontex Best Practice Operational Guidelines (Frontex 2012a, p. 28).

Other literature was also sought to provide a wider range of input into the document. For example, searching the EBSCO Academic search complete journal databases for "impact assessment of technology" returned Hempel et al.'s (2013) article entitled "Towards a social impact assessment of security technologies: A bottom-up approach". This article was written as part of the SIAM (2011) project, and through this article and contact with Dr Hempel I was able to locate more material relating to EU projects in the field of impact assessment. Some of these projects included CRISP (2014), PACT (Atos 2013), PRISE (2009), and SAPIENT (Wright et al. 2014). By utilising these resources I was able to tailor my approach to the concourse to include relevant information from not only DESSI and ValueSec, but also from these projects. In a similar way I was also able to follow the trail of citations and references to discover other relevant literature.

From this literature I attempted to support each criteria statement with at least one reference. As an example,

Table 1 shows six of the criteria which have been developed. Many of these criteria also could be supported using the ValueSec and DESSI criteria, however, I chose to not to add those references to ensure the statements were not self-referential.

Table 1: Examples of statements with supporting references

ID	Criteria Name	Statement	Reference
2	Definition of purpose	It is important that the technology's purpose and scope of use be clearly defined by implementers in order to clarify what the technology will be used for, what kind of information will be gathered from whom, and who will own and have access to this information.	(Atos 2013, p. 63; European Commission 2014b, p. 81; Kindt 2013, p. 345; Wright et al. 2014, pp. 38-9; Wright & Raab 2012, pp. 619, 22).
10	Employment	It is wise to consider whether the technology implementation has an impact on the number and quality of available jobs.	(European Commission 2009a, p. 7, 2009b, p. 35)
14	Politics/ democracy	It is wise to identify whether the technology implementation and policy supports or undermines democratic participation or national political culture	(Sollie 2009a, p. 201; Wright et al. 2014, p. 38; Wright & Raab 2012, p. 619)
16	Procurement	The tendering process should be clearly defined and state the roles and expectations of the implementer and the technology providers, including ownership, maintenance and supply of hardware, software, data and services.	(Frontex 2012a, pp. 14, 29-30; Lodge 2013, p. 312)
23	Availability/ reliability	It is essential to ensure the technology meets an extremely high level of operational availability, and fall-back options are developed to deal with any unexpected unavailability.	(EU-LISA 2015, p. 13; European Commission 2014c, p. 250; Frontex 2012a, pp. 24, 40-1; Kindt 2013, p. 356)
37	Privacy by design	A vital aspect of assessing the technology is whether it has been developed using the 'privacy-by-design' principle: the privacy of the individual is considered essential, and is integrated into the system design process from concept planning through to the final product.	(European Commission 2012a, p. 12, 2014b, p. 32; Kindt 2013, pp. 363-6)

Table 1 shows a selection of statements including their identification numbers, critera names, and references. Criteria names were given based on the key aspect which the literature addresses. As a further description, statement number 2 (S2) ‘Definition of Purpose’ was supported through the following excerpt from literature “it’s important to justify why and how the dataveillance techniques are appropriate for the collection and processing of personal data” (Atos 2013, p. 63). Additionally “The purposes for which personal data are collected should be specified…and the subsequent use limited to the fulfilment of those purposes or such others as are not incompatible with those purposes and as are specified on each occasion of change of purpose” (European

Commission 2014b). While these statements refer more to data protection issues, others pertain more directly to the policy itself: "Who is being surveiled by whom and for what purpose?" and additionally "Who will have access to the data gathered by a surveillance system and how will such data be used?" (Wright et al. 2014, p. 38). Including aspects of data protection in a criteria labelled as 'Definition of purpose' and not under 'Data Protection' was a decision made to try to 'package' related issues into one criteria. Of course, these could be separated, but questions of *why* an individual's data is being surveilled or assessed demands an answer of *purpose* related to the *policy*. Thus this statement responds to the questions "what will it do and how will it do it?" as opposed to the question which would be asked of the Data Protection criteria: "Does it meet specific data protection requirements?" which is a *legal* requirement of the system. Moreover the Definition of purpose criteria is one which is referred to multiple times. For example, in order to assess if a particular technology is the best choice in terms of addressing the problem at hand, one must refer back to the purpose to see if it fulfills all of the required aspects.

As can be seen, many of these criteria have some minor overlaps. One of the aims of this research was to minimise the amount of overlaps in the criteria, however, this has proven far more complex than anticipated. As such, it is expected that the reduction of overlapping features will be an ongoing part of the project.

The process noted above for the selection of supporting literature for each statement can be extrapolated for the remainder of those listed in

Table 1, and for the remaining statements as well. It should be noted that a small number of statements have very "thin" supporting references, for example, the statement regarding impacts on employment has only two supporting references outside of the ValueSec and DESSI criteria. These two references are more related to recommendations for EU policy-level assessments, and thus their inclusion is only weakly supported. Nevertheless, the criteria is included in order to gauge stakeholder perception of this issue.

3.1.3 Pretesting workshop: Piloting the Q Sample

On the 8th February 2016, I held a workshop session at VTT Tampere to perform initial testing of the statements and the Q sorting procedure. Five colleagues with varying backgrounds in risk management, engineering and anthropology attended the workshop. The information given to the participants was that there were a number of aims of this workshop: firstly, to perform an initial assessment of a technology using the statements developed so far in order to assess the functionality of the statements. Second, to assess how participants responded to a 'forced' distribution ranking

procedure. Third, to develop categories into which the criteria can be organised. Finally, to identify any potential "killer criteria". The assessment of statements during this stage is an important part of what Watts and Stenner (2005, pp. 75, 87) call 'piloting'. Piloting is usually done by a small number of participants, including some individuals with subject-specific experience, whose role is to assess the statements to ensure clarity, identify duplicity and redundancies, and to assess the balance of the statements (Watts & Stenner 2005, p. 87). As such, this process is an important part of the method of performing Q, and thus is included here in the method section, not in the results.

The workshop began with an introduction of the aims of the research and about the tasks which were about to be performed. Large paper (A1 size) sorting templates and 46 statements printed on paper and cut into 5cm by 10cm cards were given to three participants, while two other participants performed the Q sort using the computer-based application.

The participants were given stakeholder roles in order to help identify other viewpoints that may cause the statements to be interpreted differently. The roles were border authority, ethics researcher, security researcher, technology manufacturer, and public/civil society organisation. The first task given was to perform the Q sort using the method of instruction provided by the HTMLQ application (described below in 3.3). This initial Q sort template consisted of seven columns ranked as simply "-" on the far left, to "+" on the far right (see the screenshot of the sorting table in Image 3 below), as suggested in personal correspondence with Steven Brown (2016).

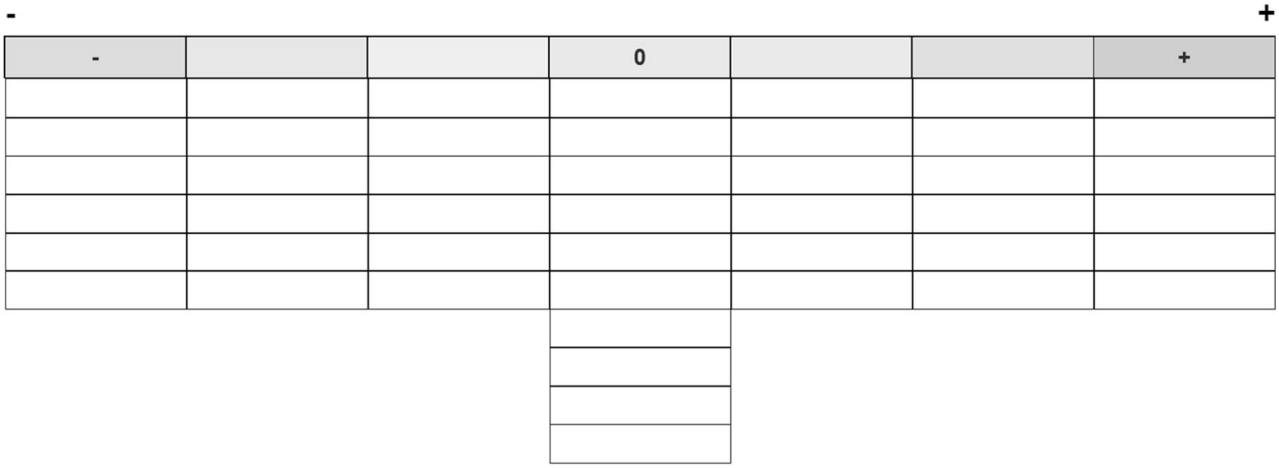

Image 3: Pre-test sorting table from HTMLQ application. A paper version was hand-drawn on A2 graph paper.

The next task given to the participants was to organise their 46 statements into groupings or categories that they felt were natural. The participants were simply asked to create four to six groups that included criteria that were related in some way. They were also asked to give their categories a title and to try to identify any criteria that they think might be "killer criteria" (Kaufmann 2012, p. 56), that is, criteria which should have a minimum threshold (such as legal or

security provisions being met), and to highlight any statements which seemed to overlap, or were not clear enough

3.1.4 Pilot Results and feedback

Initially, one participant who was using the computer-based application was unable to get it to function correctly, and so they switched with another participant who was doing the paper sorting. The issue seemed to be due to internet browser incompatibilities (the application would only work on the Firefox browser, not Chrome or Internet Explorer) when running the application straight from a .zip file, however this issue had no effect on the online version of the application.

In hindsight, assigning stakeholder roles may have complicated the goals of the workshop, as individuals found it difficult to think about these abstract statements from a viewpoint that may not have been natural to them. Nonetheless, it also produced some interesting results that demonstrated that each participant understood the statements in a slightly different way, with some really going into depths about how their stakeholder role might understand a certain statement.

Interestingly the first person to complete the sorting task was a participant using the application, taking around 26 minutes to perform the initial sorting, final sorting and ranking, and then answering the background questions on the final page (the full process of sorting is described below in chapter 3.3). The second participant using the application took almost twice as long to completed the process, however this individual also left the room numerous times to answer phone calls. The three other participants who completed the paper versions had much more difficulty following the condition of instruction, even though the instruction was given verbally and displayed on a large screen in the room. This can be contributed to the fact that each individual was completing the sort at a slightly different pace, and so giving the instructions once to all three of them was not as effective as if I was able to give them individual instruction before they began each step. On reflection, it should be noted that these Q sorting tasks are usually performed one-on-one, not in groups. This process took the paper sorters between 35 and 45 minutes. Once participants had completed their sorting, the entire paper was photographed.

In regards to the first and second aims of the workshop performing an initial assessment and feedback about ‘forced’ distribution, all except one participant had difficulty performing the ranking stage of the Q sort. This is the stage where the statements are ordered according to those that the sorter finds most unimportant to most important. The main feedback was that the participants would like to rank more of the statements on the positive side, as they felt many of the statements were almost “norms”. Participants also noted that by using the labels “+” and “-“, they

also felt as if anything they placed under the "-" must be something which they viewed negatively. This type of feedback was not unexpected, as the sort contains mostly rather objective statements, and it is difficult to decide whether human rights issues are more important than security issues for example. In order to clarify further the purpose of the sorting procedure, the condition of instruction for the final questionnaire was modified to include a paragraph that reiterated what the sorting process was meant to achieve:

> Placing a statement in the "-" column (or any of the other pink columns) does not necessarily mean you disagree with, or find that statement unimportant (or even negative) by itself. What it indicates is that when you compare it with the other statements, you find this particular statement less important than those you place to its right.

An alternative to forced distribution (as exampled in Image 3 above), would be to allow "free" distribution. This is just what it sounds like: participants are allowed to place the statements wherever they wish. However, a number of academics have noted that there is almost no difference between forced and free ranking in Q except that forced distribution reduces unnecessary work on the part of the researcher and is more convenient for participants (see Brown, S 1985; Cottle & McKeown 1980; Watts & Stenner 2005, p. 77). Due to this fact, forced distribution is retained for the final study. As a further note, the HTMLQ application (see below) requires each column to contain a heading in order to display a participant's results accurately in the submission report. In Image 3 above there are only headings in the far left and far right columns ("-" and "+" respectively). Because of this the participant's scores are returned as, for example: |-| |+|0|-|+| | |- , whereby Statement 1 was placed under the "-", Statement 2 two was placed under one of the four unnamed columns, Statement 3 under the "+" column and Statement 4 under the 0. Thus, it was not possible to determine which statements were placed under the columns without a heading. In this regard I was not able to follow Brown's (2016) advice to use only "+" and "-" symbols in the extreme columns. Thus I reverted to more "traditional" numbered column headings with a "-4" to "+4" distribution, also creating a 'flatter' distribution by moving from five to seven columns. This is in line with recommendations from van Exel and de Graaf (van Exel & de Graaf 2005, pp. 6-7), and also from McKeown and Thomas (2013, p. 29), who note that when participants are expected to have strong opinions about the topic, or when strong beliefs or emotions are involved, a flatter distribution is preferable. For this study it is expected that participants will have strong opinions, but on the other hand, there still needs to be room in the middle of the distribution for ambiguity or indecisiveness (Van Exel & de Graaf 2005, pp. 6) and thus a -4 to +4 distribution is preferred over a -3 to +3 or a -5 to+5.

The feedback regarding the initial sorting of statements gave a good indication that there were a number of statements which were either unclear, unnecessary, or redundant. Following the workshop, I reviewed the comments from the participants and modified a number of statements to correct the issues. A total of seven statements were either removed, or modified and incorporated with similar statements, and one statement was added, bringing the new total to 40.

One participant suggested the wording of the statements should be changed to ensure 'should' is not used, as this created the feeling that the participant had to either agree or disagree with the statement (instead of agreeing more or agreeing less). For example, "Technology should be assessed to identify compliance with laws" could be rephrased as "It is wise to assess new technology to ensure compliance with laws". This was seen to be a statement that is more easily ranked, and is in line with feedback received from Steven Brown (2016).

The category creation exercise produced interesting results with each participant producing a slightly different set of categories and thus criteria groupings. The participants divided the statements into three, four, five, six and eight categories. These were quite diverse categories, and although there were similar headings such as 'policy' and 'privacy', the statements in each category varied from participant to participant. The groupings demonstrate that each individual will assign relationships between the different statements according to their understanding of the statements.

Finally, the task of identifying killer criteria also produced mixed results. Some participants did not fully complete the task and thus the results are of little use for developing the killer criteria at this stage. This issue will however be discussed later in the results section.

3.1.5 Finalising the Q sample

Once the initial process of identifying the data, developing an initial version of the Q sample and performing a pilot had been completed, the Q sample could be finalised and organised.

The sample was organised according to a rough range of categories that followed a modified PESTLE (Politics, Economics, Society, Technology, Legal, Environment) or STEEPLE (a different order and the addition of Ethics) approach[8]. However, this research does not specifically take into account economic factors other than those included in the Society dimension, and only one environmental factor is included. Thus, the statements can be sorted into the following four categories: Policy, Ethics, Society, Technology and Legal (*PESTL*). The PESTLE (or in this case *PESTL*) approach is usually utilised in strategic analysis, or risk management (Tovstiga 2013) and

8 For more information see http://pestleanalysis.com/steep-and-steeple-analysis/

is basically a framework for organising identified factors into their relevant groups for assessment. In this thesis, I only use the PESTLE approach for the organising of statements into their respective categories.

The organising of the criteria into groupings is somewhat of a subjective process. Following on from the subjectivity involved in selecting statements to include, the process of grouping is also impacted by the researcher's interpretations of where the statement best fits. This is most apparent in the Social and Ethical categories. For example, should assessing whether a technology has a negative social, cultural or economic impact on third countries be considered a social or ethical issue? It is not an issue which affects the society of the implementer, but rather, most likely that of a non-EU country. These are considered 'social' impacts by the European Commission's Impact Assessment Guidelines (2009b, pp. 33-7), however, they also deal with the morality of decision-making and its effects on others, and thus could also be considered under the Ethical category. Wright and Raab (2012, p. 617) note how the categories of impacts and issues are not mutually exclusive in their Surveillance IAs, that is, although they are placed under one heading, they could very well be placed under another as well.

3.2 P Sample

The next step of the process is to select participants (P sample) to whom the Q Sample is administered. The participants rank-order the statements in a table and produce what is called a Q sort. Once the desired number of Q sorts have been completed, the researcher performs factor analysis to identify the different correlations that exist between the results of the P sample. When participants rank statements in a similar fashion, they are noted as sharing a similar perspective or viewpoint on the topic. Thus the strength of Q is that it takes subjective questions (how or what the participant feels, thinks, agrees or finds important about the topic) and allows participants to "indicate their reactions to a defined subject area within their own terms" (Ockwell 2008, p. 270).

Human subjectivity is defined by McKeown and Thomas (2013, p. 2) as "the communication of a personal point of view" which is "inherently expressive and tied to the human capacity for sharing impressions through language and other sensory means". Q as a research method asks respondents to produce an empirical representation of their personal viewpoint of the issue at hand (McKeown & Thomas 2013, p. 3). In this sense Q is the perfect fit for assessing the qualitative impacts of technology-an essential aspect of this research-, as it allows the respondents to translate "their feelings into rankings" (Brown, Steven, Danielson & van Exel 2015, p. 532). Yet Q respondents

are not simply asked to rank statements on a scale of one to ten as one would a Likert scale. Instead the respondent is asked to compare each statement with the others in a rank-ordering procedure (the Q sort) which "forces participants, consciously or subconsciously, to reveal their personal choice, feelings, and underlying beliefs" (Paige & Morin 2014, p. 2). Q thus takes advantage of the human desire to "structure stimuli, ascribe meaning, or offer a viewpoint" (Ward 2010, p. 75) on the topic at hand.

When it comes to participant selection, Q again allows the researcher to select the sample according to his or her needs. As there is no attempt at producing results representative of society at large, there is no need for a representative selection on the basis of age, sex, income, religion and so forth. The researcher may select participants on theoretical (their relevance to the study) or pragmatic (anyone will suffice) grounds (McKeown & Thomas 2013, p. 32). In dit Dariel, Wharrad and Windle's (2010) study on views towards the use of technology in nurse education, theoretical considerations governed the selection as experts in nursing and nurse education were approached to participate. Van Exel and de Graaf's (2005, pp. 15-6) example was less specific and approached non-captive/choice travellers, in other words, as long as the respondents could answer the questions about travel and commuting, they were able to participate. In Ockwell's study of perspectives on Australian fire management policy, stakeholders from local Aboriginal groups, government scientists, wildlife management, pastoralists, tourists, and share-hold landowners were approached. Thus while the desired type of participant is usually quite specific, there may still be cases where the view of non-experts is useful and provides an alternative perspective, as demonstrated in Ockwell's inclusion of tourists. However, initial feedback from the pilot workshop indicated that individuals without much background knowledge of at least some of the areas discussed in the questionnaire may find it very difficult to respond. In this sense, members of the public were not consulted, but their representatives were asked to contribute. In particular, traveller representative and societal organisations were selected to represent the public in general.

3.2.1 Selection of participants

In order to maximise the benefit from the questionnaire, specific respondents were targeted to contribute to the research. A stakeholder can be defined quite broadly as 'individuals or groups who are impacted by, or can impact, the work or its outcomes at this particular time in the lifecycle of the work'(Bourne 2012). However, Cuppen et al. (2010, p. 579) give a slightly more focused definition: "a stakeholder is defined as an actor involved in, affected by, knowledgeable of, or having relevant expertise or experience on the issue at stake". Although both of these definitions emphasise the ability of a stakeholder to be involved in and impact the process, the definition of

Cuppen et al. notes the importance of knowledge, expertise or experience in relation to the topic at hand. As Russell, Vanclay and Aslin (2010, p. 114) point out, each stakeholder not only has different informational needs, but they are able to offer specific insights into the different aspects of a technology-a key requirement for this research As this research deals with quite complex topics, the majority of stakeholders were selected for these attributes of knowledge, expertise and experience.

Stakeholders can be broken down into groups such as those who are "affected by the policy,…who will have to implement it…[or] who have a stated interest in the policy" (European Commission 2015a). Schot (2001, p. 41) also notes that there are 'roughly' three major types of stakeholders who contribute to technology assessments: technology actors who invest in and maintain technology development programs; societal actors who experience the impact of the technology, such as users, citizens, and workers; and regulators who develop the rules and represent a general interest. In certain processes, such as constructive technology assessment, another actor is also usually involved: the dialogue facilitator and modulator (ibid.). Russel, Vanclay and Aslin (2010, p. 110) mention three similar categories: technology developers, decision makers, and users.

Technology developers and those who invest in technology must be included in any stakeholder list, as they often directly shape the impact of the technology through their decisions in the design, manufacture and production of technology. Likewise, decision-makers will often choose certain aspects of a technology which are required and which are not. As Schot and Rip (1997, p. 257) have argued "impacts are not just passive effects of a given technology on its environment, but are actively sought (or avoided) by technology producers, users, and third actors such as governments, unions, and pressure groups alike." Thus, any actor that is involved in the decision-making process of the technology implementation has an opportunity to affect that technology's impact on society.

In this regard stakeholders were divided into three main groups: Decision Makers (or implementers), Users/Society (or those affected and their representatives), and Industry (or those who have a stated interest in the policy). These categories were placed in a table and then actors were added in each category according to their roles (see Table 2). As noted by Schot (2001, p. 41), these categories are useful for analytical purposes, and actors could often be placed in numerous boxes. For example, in Table 2 below Border Authorities could also be listed in the in the column under 'Invest and Maintain' as they may also invest in technology development. However, the table is designed as a guide to ensure relevant stakeholder areas were covered, not as a catchall, exhaustive list. As another example, stakeholders representing the natural environment are not

explicitly listed here. As the ABC technology itself will usually be placed within existing infrastructure, and not in the natural environment (unlike a dam, a power plant, or a military base), the expected immediate impact on the environment is lower, and as such no environmental groups are listed as stakeholders. However, environmental issues are still covered in the criteria set as some implementations of ABCs may be outdoors in port areas (sea ports and land border crossings).

Table 2 Stakeholder Identification

EC 2015a	Implement the Policy		Affected by the Policy		Stated Interest in Policy	
Russell et al. (2010)	*Decision Makers*		*Users/Society*		*Technology Developers*	
Schott (2001)	*Regulators & General interest*		*Experience the impact of tech.*		*Invest & maintain tech*	
Government	Policy Level					
Border Auth.		Border Mgmt.	Border Guard			
Citizens			Travellers	Civil Soc.		
Research/Academia			Rights/legislation	Ethics	Tech Innov.	
Manufacturers					Tech. Design	Tech. Develp.
Port Operator					Investors	Owner

Definitions in grey boxes, Main stakeholder groups for this research in blue, and more focused groups/tasks in pink.

After the table of stakeholders was developed, a list was created which included actors from each of the pink squares in Table 2. From the 'Implementers' column, policy makers from national- and EU-levels, as well as border management authorities were added to the list. The 'Affected' stakeholders included representatives from border guard, police and customs authorities (the user level), while civil society organisations researchers focused on rights, ethics and legislation. The 'Travellers' themselves could be represented by either individual members of the public or traveller organisations. The third column, those with a stated interest in the policy, included representatives from technology researchers and developers, as well as port operators.

Due to privacy and data protection reasons, the list organisations, or names of individuals is not published in this document. However, the initial list of potential participants numbered close to 100 individuals. Most of these were participants in either the FastPass (2013b) or BODEGA (2015) projects, but there were also a number of others from outside of these two projects. In order to gain useful results from this questionnaire, it was preferred that respondents would number at least 20,

but preferably 30. As mentioned earlier, Q Methodology does not require a large number of respondents, only enough to illuminate the potential factors, therefore only around five or six participants for each expected factor is suggested. In this sense after a certain point, there is little or no correlation between the number of respondents and the quality of the data. This is one of the reasons why Q Methodology was chosen as a research method, as it was expected that it would be difficult to get a large number of respondents as required by traditional surveys. Secondly, if there were more respondents from a particular actor type than another, it is not expected to be an issue, as Cuppen et al. (2010, p. 581) argue, although stakeholders may be selected by their affiliation type, this does not necessarily mean they will represent a diversity of perspectives. That is, despite the fact that stakeholders can be divided into stakeholder groups, the expected perspectives may not necessarily follow these lines, what is important here is to have diversity in stakeholders, and to assess their perspectives through empirical analysis.

In order to introduce the participants a short 150 word 'cover letter' was drawn up which introduced the research. This cover letter was included in the body of the email that was sent to stakeholders, along with a 'Research Information Sheet' (RIS) as an attachment. The RIS is a two-and-a-half page document that contained a more detailed explanation of the research on the first page, and the consent information on the second. At the bottom of the consent page was the internet address for the online questionnaire along with the user (login) code. The consent form noted explicitly that by navigating to the link, and entering the user code, the stakeholders were giving their informed consent to participate in the research.

The stakeholders were contacted either by individual, or by group emails. Recipients were given the freedom to pass on the email to their colleagues to complete as well. Over the course of the questionnaire being live, a number of 'reminder' emails were sent to try to boost participation rates.

3.3 Assembling the questionnaire using the *HTMLQ* application

The Q sorting process can be performed in a number of ways. Previously the most common way was using statements printed on cards which the participant would sort on a large score sheet. Participants might perform an initial, or 'pre'-sort by dividing the cards into three piles depending on the condition of instruction, for example: Most negative, Neutral, Most positive. Following this, the participant is instructed to sort the cards in their order of preference on the score sheet. In many cases, the researcher would be in the room; however, it has been noted that because Q requires little in the way of instruction, the sorting process can be performed without the researcher being present. Thus van Exel and de Graaf have conducted Q sorts via mail, while Paige and Morin (2014)

followed up their P sample's experiences with phone interviews. Thus, there is the possibility to perform the sorts in person, or by correspondence with the participants. The alternative method is to perform the sort via an online application. This implies that the researcher is not present, but it does not mean there is less ability to follow up with participants. The following sections describe the application that was utilised for this research.

The Q sorting tool HTMLQ is a HTML5 version of FlashQ, a now outdated Q sorting tool that runs on the Flash multimedia and software program. HTMLQ was chosen as it has a number of benefits over FlashQ, the major one being that FlashQ does not seem to have been updated since 2007 (Hackert & Braehler 2007), and due to the fact that it therefore contains an outdated version of Flash which had a number of known security vulnerabilities (Adobe 2007). HTMLQ is based on the FlashQ code with only a few minor differences in functionality, namely the ability to function on Apple operating systems that do not utilise Flash (Approxima 2015). HTMLQ is available for anybody to use free on an Open Source licence and is distributed by "aproxima (sic) Gesellschaft für Markt- und Sozialforschung Weimar" (Society for Marketing and Social Research Weimar) (2015).

Using the HTMLQ application required editing the default settings that are provided in the download package. A more detailed description of this process is given in Appendix C. Once the application was edited and the information and questions relevant to the current research were inserted, it was tested by a number of work, and student colleagues. The feedback received from these individuals helped to improve the instructions and operation of the application. The main issues identified by these colleagues were generally to do with punctuation and clarity of the instructions and statements, but there were also concerns about whether individuals without background knowledge in the field would be able to give useful responses. This was one reason why only relevant stakeholders with a background in the field were invited to participate.

For privacy and data protection reasons, the questionnaire had a universal user code, which participants utilised to log in and perform the sorting task. This meant that there was no way to connect a response with an individual person, unless they chose to leave their information in the feedback section of the questionnaire. Anonymity of responses was seen to be a priority, especially as individuals from border control agencies and other formal institutions were being asked to respond. In this way, individuals could respond however they wished without fear of being connected to the data. Of course, this also presented a number of challenges such as not being able to know which of the stakeholders had completed the questionnaire, and which had not. This

complicated the process of sending ‘reminder’ invitations, which asked those who had not already completed the questionnaire to do so if they had time. The alternative to this, however, was to retain a list of emails and unique user codes that could be used to check off which individuals had completed the questionnaire. Due to the way HTMLQ is coded, implementing this latter process would also mean that the questionnaire could not have a login page which effectively allows only users with a code to perform the questionnaire. Thus, the more anonymous process was chosen, despite its drawbacks.

3.3.1 The online Q Sort process

To perform the assessment the participant was required to navigate to the questionnaire web page that was accessible on VTT’s public servers until April 2016. After navigating to the web address, participants are greeted with a welcome message (see the screenshot in Image 4 below) informing them they are at the right location.

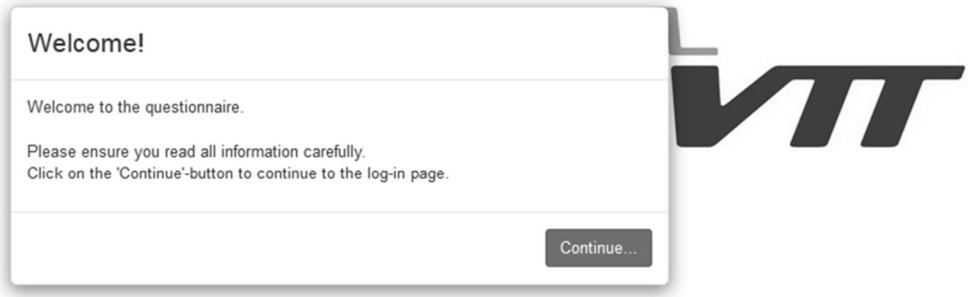

Image 4: Welcome page

After clicking on the Continue button as prompted, the participant was asked to give their consent to participate in the research by using a login code (see Image 5). This page requested that the participant read the Research Information Sheet (RIS) that contains a brief introduction to the research, a description of what data would be gathered and stored, and the information on consent. By entering a universal user-code provided in the consent information, the participant was effectively consenting to participate in the research according to the information given in the RIS.

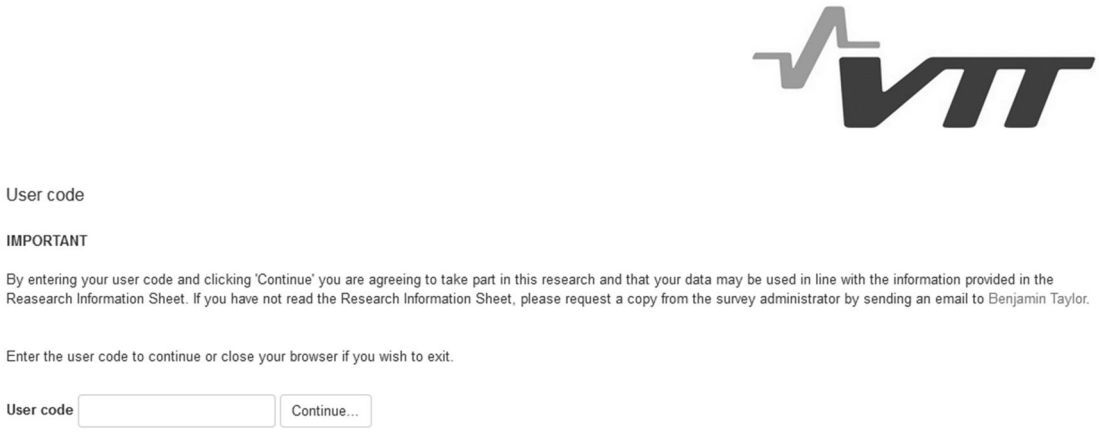

Image 5 Login page

Before the first step of the sorting process, an information page is displayed which gives an overview of the research and what is being asked of the participant. Much of this information was also provided in the RIS (see Image 6).

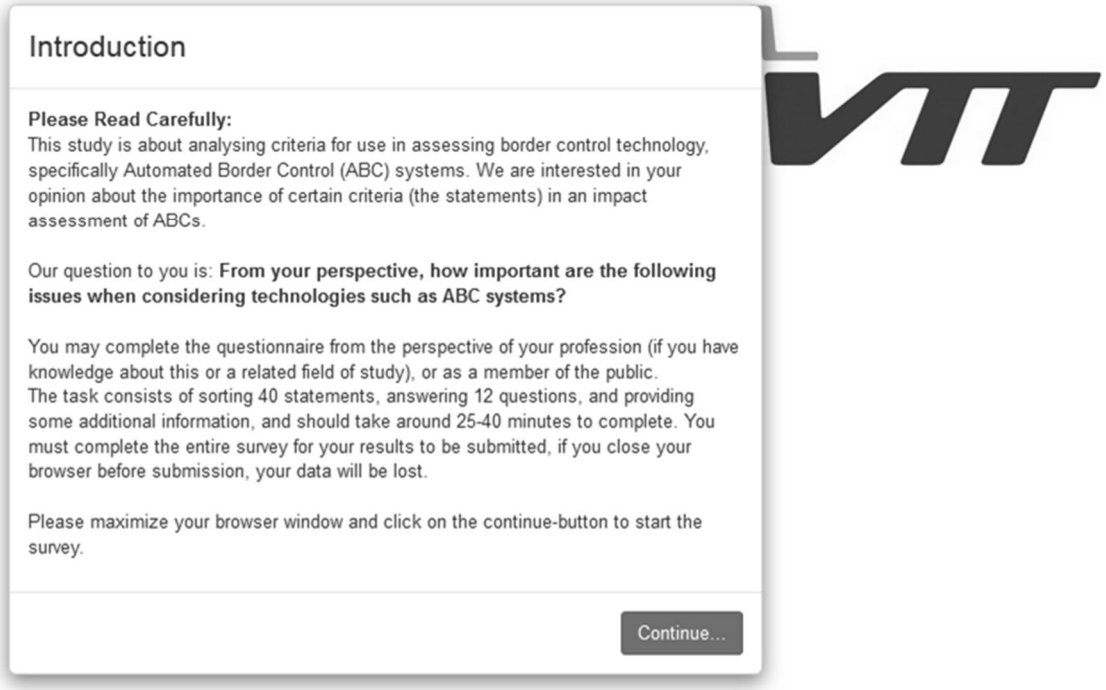

Image 6: Introduction page

At the start of every task, an information window is displayed explaining how to perform the necessary tasks for each step (see Image 7 below). The first step consists of 'pre-sorting', that is, viewing the forty statements, one at a time, and sorting them into three categories, or 'piles' labelled 'Most Unimportant', 'Neutral' and 'Most Important' by dragging and dropping them, or by using the 1,2, or 3 buttons on the keyboard (see Image 7 below). The card appears in the centre of the screen (white card), and then the respondent places it in one of the three boxes using the method described above. The cards change colour according to which box they are assigned: pink for 'Most Unimportant', grey for 'Neutral', and green for 'Most Important'.

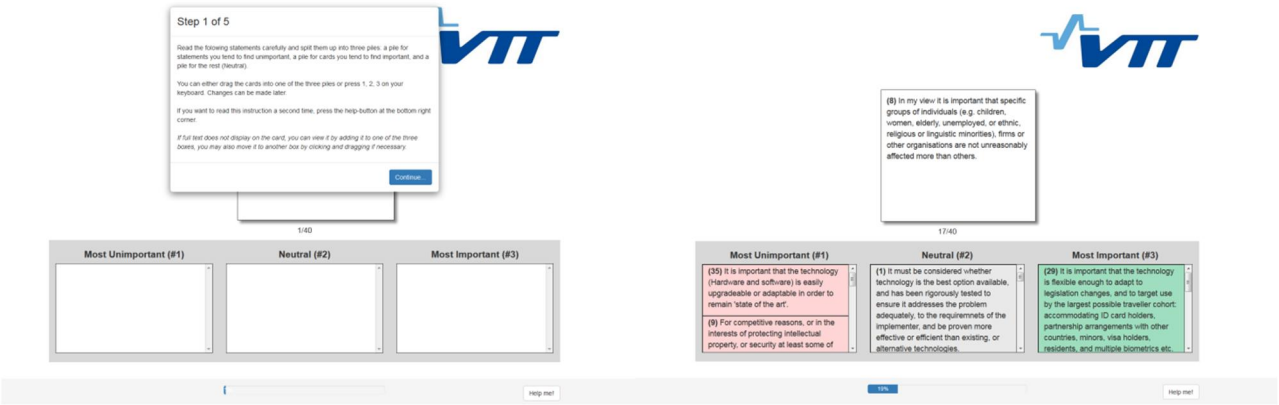

Image 7: Step 1 of the sorting process- condition of instruction (left), and an example of how the task might look during the process (right).

The bottom of the screen contains a 'progress bar' which tells what percentage of the entire process is complete, and to the right of this is a 'Help Me!' button which can be pressed to see the instructions once more.

Step 2 is the main sorting stage where the participants are asked to read through the statements again, beginning with the 'Most Important' pile, and place the four statements which they found to be most important in the '+4' column, then to do the same for the 'Most Unimportant' pile, placing the statements in the '-4' column (see Image 8 below). This process of moving back and forth from the opposite ends of the sorting table is repeated for the '+3' and '-3' columns, and then again until all the statements from the three piles have been placed into the table. The purpose of completing the polar opposites first is that participants are expected to be able to identify these statements with greatest ease, as these are the ones they feel most strongly about, as they move towards the centre they thus have fewer statements remaining in their piles and are able to compare these more easily.

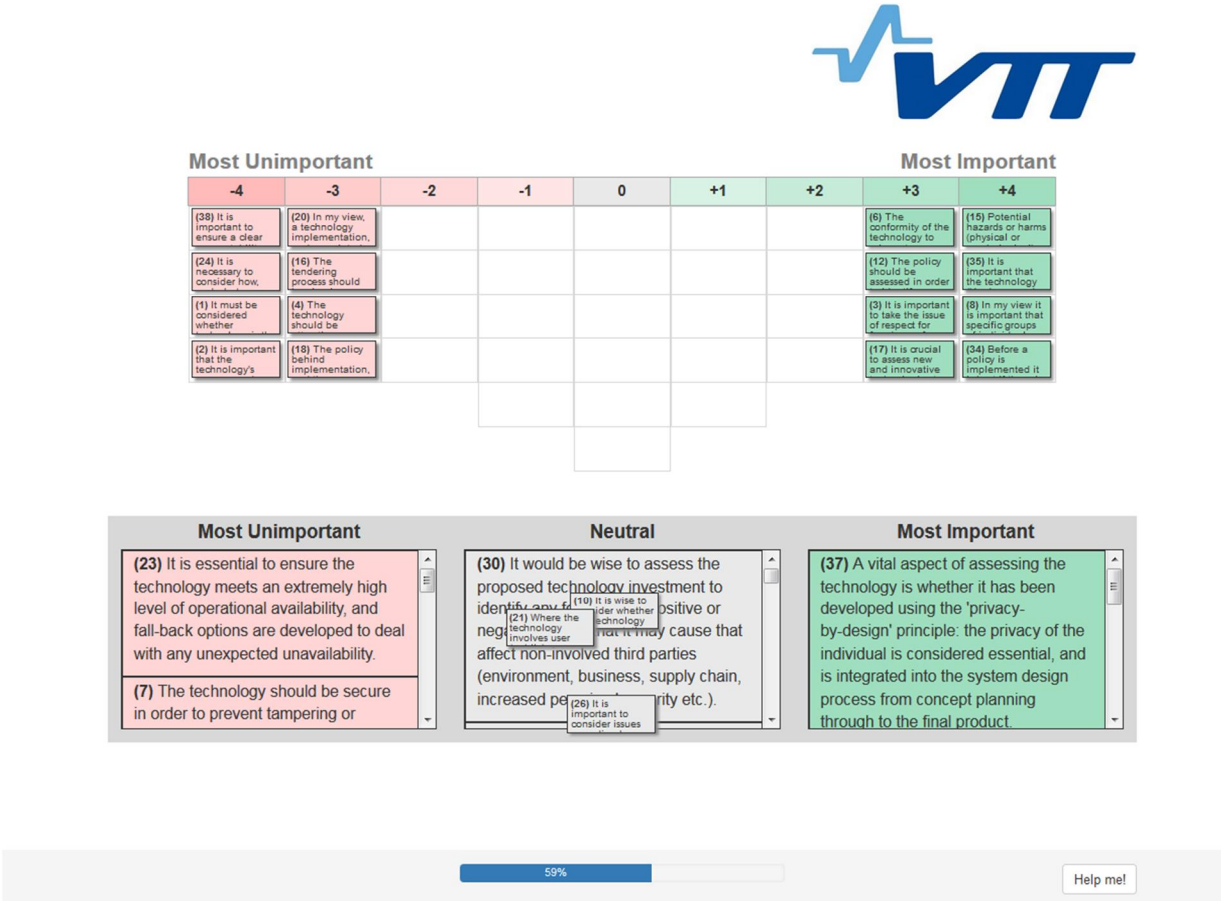

Image 8: Step 2-the Q Sorting process

Once the sorting is complete, the ‘Continue’ button appears and allows the participants to move forward. After clicking on the ‘Continue’ button, the instructions for Step 3 (see Image 9 below) are shown. In this step, the participants are given the opportunity to double-check that they are happy with the way they have sorted statements, and are able to rearrange statements if necessary. Once they are happy with their sort, they click continue.

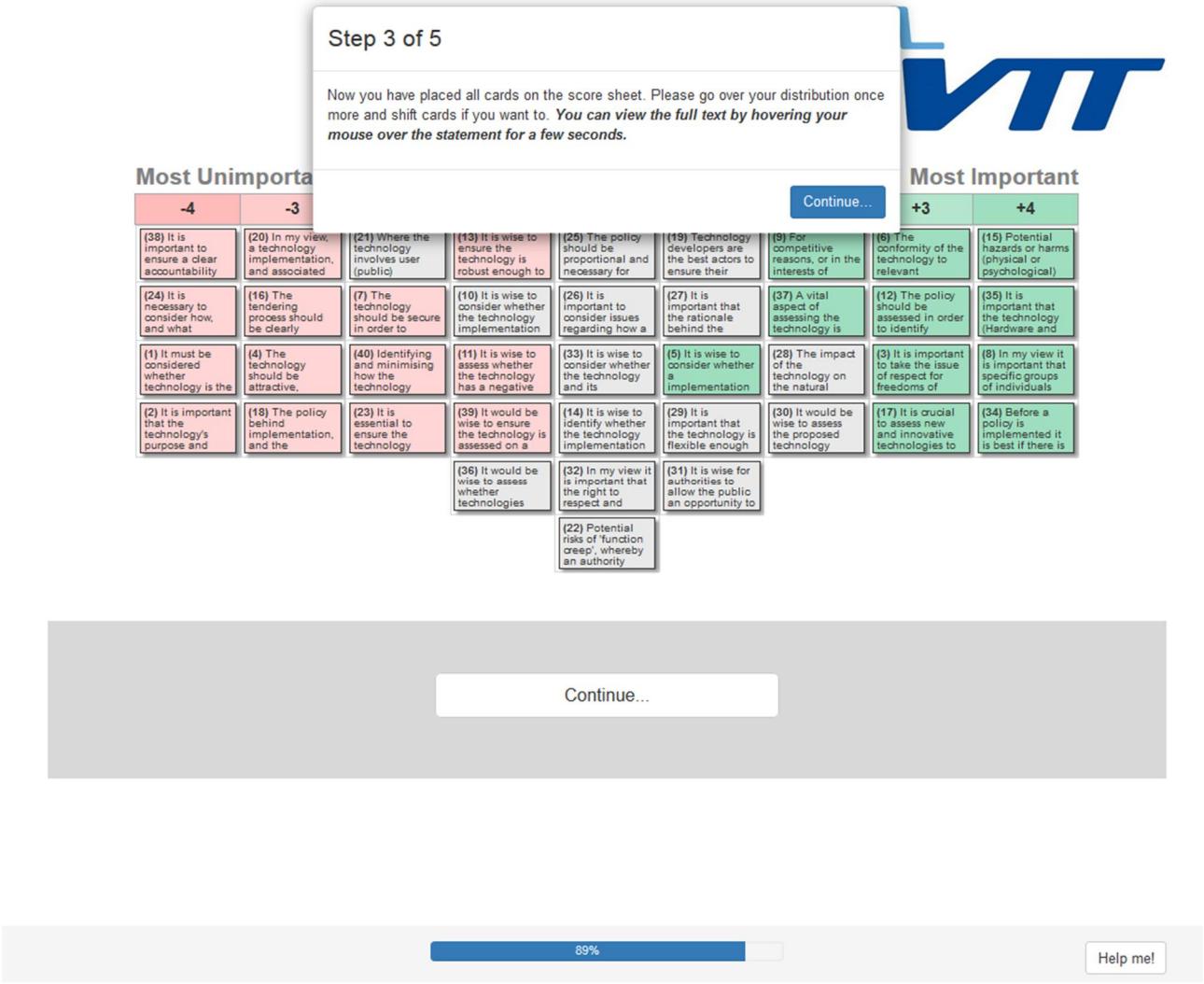

Image 9: Step 3- An opportunity to double-check the sort before moving on

Step 4 (see Image 10) asks the participants to explain why they selected the particular statements they placed under the '1' and '9' columns. Participants are asked to give open answers justifying their selections. Once complete, the participants again click on the 'Continue' button.

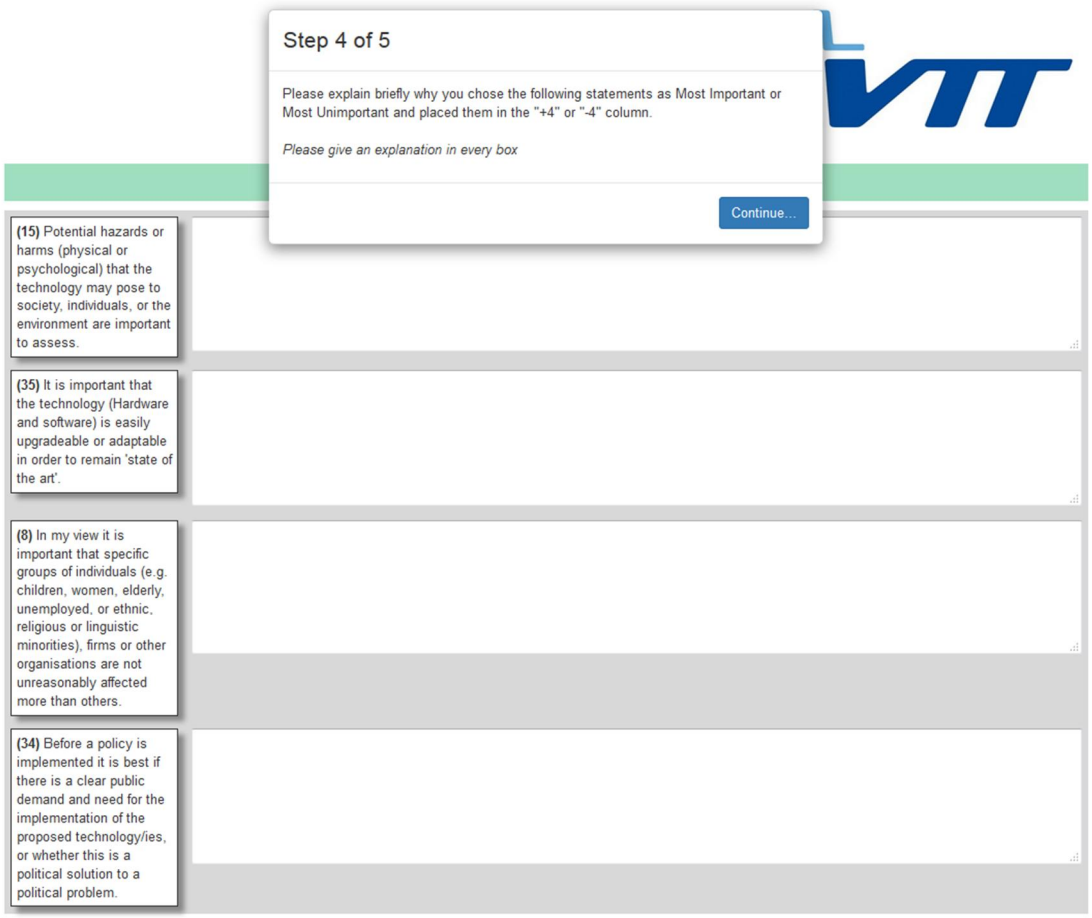

Image 10: Step 4- Participants are asked to give further information as to why they chose to place particular statements under the -4 and +4 columns.

Step 5 contains questions relating to the background of the participant and their experience with the questionnaire. Question 1 asks the participants to indicate whether they are male or female in order to help to assess the final distribution of participants. In Question 2 they are asked to rank on a one-to-five (disagree-to-agree) scale five statements. These are: In my view the questionnaire was interesting; I felt I have the experience to rank the statements; It was difficult to decide in which order I should rank the statements; I thought there were some important aspects which were not covered; I thought some statements overlapped each other. These statements are not expected to contribute to the overall results, but rather give feedback to the researcher about how the participants viewed the exercise. Question 2.a allows participants to comment further on any of these issues in the provided text box should they wish. Question 3 asks about the capacity in which they have answered the questionnaire: either as a professional, or a member of the public. The distinction is made in order to clarify to which stakeholder group the participant belongs, although admittedly it does require self-reporting and self-assessment of one's own "qualifications" in terms of experience. Members of the public are not asked to detail their profession, but Question 4 asks 'Professionals with experience in the field' to identify what 'field' they work in (their profession)

using a drop-down list. Question 5 asks how they would describe their employer using the same method. If the individual feels their profession and/employer are not covered by these categories, they can select 'Other' and give more information in a text box in Question 6. In this final question, participants are also asked to give more information such as the country in which they operate, clarifying comments on their profession (for example, someone who chose 'Researcher' may clarify their research focus), the name of their organisation, and any other comments they wish to leave.

Only Questions 1, 2, and 3 are marked with an asterisk denoting that they are mandatory for all participants, while 'Professionals' are strongly encouraged in the instructions to give responses to 4 and 5. Question 6 is noted as being optional, as some professionals may not wish to disclose their country of operation or organisation's name. In reality, the HTMLQ application contains a number of bugs in regards to Step five, and thus the only questions that must be filled before the participant can move on to the Submit Data page are Questions 1 and 3.

After completing the mandatory sections in Step 5, the participant again clicks continue and is directed to the 'Submit Data' page where they click on the 'Submit' button to send their completed questionnaire to the researcher. Should the submission fail from some reason, a failure message is displayed with other options for submission: by email, or by printing.

3.3.2 Discussion of Q Methodology

Once the participants have been selected and the Q sort completed, the results of the sort are analysed. The analysis correlates the participants by the way they think, and through factor analysis they are then grouped together with others who share similar ways of thinking (Paige & Morin 2014, p. 3). In this way, Q produces a result that demonstrates the correlation and number of viewpoints on the topic of hand, *not* the number of people who share these viewpoints. This is one major reason why it is not necessary to interview a large number of respondents in Q, as Brown notes:

> If you wish to examine the differences in color between a tub full of green and a tub full of red paint, for instance, a thimble of each will do and buckets full from the same tubs will only provide redundant information. Similarly, in Q: If you are interested in examining the differences between the thinking of factor A vs. factor B, three or four of each will do and buckets full will not advance understanding markedly (Brown 1996, in Ward 2010, pp. 76-7).

Thus with a small sample size it is possible to analyse and bring coherence to issues which are socially contested and complex in nature through the process of asking exploratory questions (Ward 2010, p. 76). Therefore, Q is seen as the most functional method of investigation for the purposes of the current research. It allows the quantitative analysis followed by qualitative interpretation, of

qualitative questioning, and provides a 'hard' measurement for the 'soft' and difficult-to-measure criteria from the ValueSec and DESSI projects.

Q is not without its limitations however. For example, with such small sample sizes there is no possibility to assess the number of individuals in general who may hold the perceptions identified through the study. In other words, the results are not statistically representative of society in the sense that X number of people hold perspective A. Indeed, Q makes no attempt to perform such tasks, as these are solely quantitative. What Q does is identifies that X number of perspectives exist within the population of the sample, and thus can generalise that these views also exist in society. As Ockwell (2008, p. 273) notes: "the patterns revealed by a Q study can be considered to reflect the discourses that exist in wider society". Furthermore, McKeown and Thomas (2013, p. 32) note that Q does not claim to be exhaustive in its identification of attitudes on the selected topic, after all, the participant sample is highly selective-thus if the researcher feels as if a perspective may be missed, he or she simply needs to widen the participant sample. The P sample for this initial research was adequately broad, however the time given to the participants to respond was lengthened from three to four weeks in order to allow more time for more respondents to perform the sorts. This is a downside of utilising an open-invitation style of contacting participants where they can participate should they choose, rather than contacting beforehand and *confirming* the participant's desire to contribute. The approach used in this research, as noted earlier, involved invitation emails to selected participants at first. However, very few of these individuals responded confirming their intention to participate, so further reminder emails were sent to individuals, then to organisations, then project-wide reminders. A mixed approach was thus utilised here, but still very few participants responded to the emails and confirmed participation, thus the ever-widening P sample. All of these individuals still fell within the stakeholder map as described earlier; however, a number still responded that they had limited prior knowledge of the issues discussed in the research.

This now leads us from the discussion of methodology into the results of the Q sorts. The following section discusses the final results of the participants' sorts, focusing on the number and type of participants, as well as the factors that were discovered from the analysis of the Q sorts.

4. Results and Discussion

4.1 Participants

In total 25 Q sorts were received back from the about 100 individuals who were invited to participate in the research. As the end of March approached only 15 sorts had been performed, and thus the research period was extended by around ten days to allow more sorts to be gathered. Due to the inbuilt features of the questionnaire that prioritised privacy (discussed above), it was difficult to determine exactly which individuals had completed the sorts. However, over the research period a number of individuals contacted me to note they had performed the sorting process, and I was also able to ask if they would allow me to ask a number of further questions about their sort, and experience. In total four participants gave permission to do so.

It should also be noted that one border authority who was invited to participate declined to do so citing lack of proper research authorisation on my behalf. As the research permission application process was too time-consuming to pursue during the allotted research timeframe, the invitations to the members of that organisation were withdrawn by the organisation itself, and to the best of my knowledge, no Q sort results from that organisation were received. No other invitees expressed concern over lack of research permission; however, it may also be the case that they may have done so by simply not responding to the questionnaire, as approximately 75% of invitees did not respond. Another individual promised to complete the questionnaire if I would in turn pay membership to join a particular organisation that s/he represented; however, I thanked the individual for the offer, but declined to do so. Unfortunately, the HTMLQ application is not able to gather data on how many individuals began the sorting process, but did not follow the process through to the data submission page.

Due to the limitations of HTMLQ and privacy concerns noted above, there were a number of forms in the final feedback section of the questionnaire that were optional. Participants were encouraged to complete optional sections about their profession, managerial responsibilities and employer, and the majority did so, however, more than half did not note their country of operation. The countries of operation that were given are listed in Table 3 below.

Table 3: Countries of respondents

	Belgium	Italy	Finland	France	Greece	UK	Romania	Switzerland	NG*	**Total**
No.	1	1	3	2	1	2	1	1	13	**25**

**NG= Not Given*

Because many participants are known to each other through working relationships in different EU projects, the country data that the participants self-reported is separated from the rest of the participant information. Additionally, the roles of participants in terms of management responsibility were also separated. The latter is reported in Table 4 below.

Table 4: Participants by managerial role

Role	Number
No supervisory responsibility	8
Work leadership of one or more employees	9
Assistant manager over supervisors or a small department	1
Manager of one department	1
Manager of more than one department	1
Other[9]	2
Not Given	3
Total	**25**

4.2 Analysing the Q Sort results

Once all sorts had been received they were loaded into a data analysis computer programme for Q studies called PQMethod, which was developed by Peter Schmolck (2015). The programme is capable of performing factor analysis using Centroid or PCA, and allows factors to be rotated analytically using Varimax or by 'hand' by making use of two-dimensional plots. In order to gain the most accurate results it is often necessary to perform these tasks a number of times with different combinations. To determine the threshold for statistically significant results I utilised the formula in Brown (1986, p. 64) noted as: Standard Error rate ($SE_{r)}$ = 1 / √n, where n = the number of statements. In this case the number of statements was 40 and thus SE_r = 1 / √40 = 0.15. For loadings on any particular factor to reach a significance level of $p < .01$ they must reach (0.15*2.58) (SE_r) = ± .41. Thus, a loading of ±.41 is statistically significant at the $p < .01$ level.

A number of different combinations of Centroid or Principle Components Analysis (PCA) with Varimax or/and judgemental rotation were experimented with. In Q, the aim of performing these tasks is to try to get as many participants as possible to "land" on a factor, and thus a factor is simply a grouping of participants with shared views. In the end, similar factors were produced, but for the results given here the combination of PCA and judgemental rotation, using three factors in the PQMethod programme gave the strongest factor loadings. This method produced a result where

9 Both participants reported as being consultants

fourteen participants landed on Factor 1, four on Factor 2, four on Factor 3, one loaded on two factors, and two did not load significantly on any factor. The factor loadings, along with other data of the participants are given in Table 5 below. Note that there are loadings that are negatively correlated with a factor. In Q Methodology, this is referred to as a "bipolar factor" (Brown, S 1986, p. 60; Watts & Stenner 2005, p. 88). In such factors, a negative loading indicates a reversal of the values that positively define a factor (McKeown & Thomas 2013, p. 12). An example of this is P18 on Factor 2 (see Table 5), whereby a loading of *-0.61* demonstrates a rather strong reversal of the positive values of that factor. This bipolarity and its implications on the interpretation of Factor 2 is discussed further when examining the results shown in Table 8.

Following the table of factor loadings, an explanation of the defining characteristics of the three factors is presented, showing the defining statements in each factor. Although it has already been said above, it is again worth noting that Q methodology does not analyse statements independently. Thus when assessing the statements below in Table 7,Table 8 and Table 9 which have been assigned to the lowest rank (-4), it must be remembered that these have been ranked according to their relationship with other statements. Therefore, although a negative statement of Factors 1 and 3 is statement *28 "The impact of the technology on the natural environment should be considered"*, this *does not* mean that the impact of the environment is unimportant. What it means is that individuals in Factors 1 and 3 generally assigned *less* importance to this statement than to other statements that they considered to be more important.

The final row of Table 5 deserves a brief explanation here. Although in Q total Explained Variance (EV) is not always regarded as a relevant measurement, it is included here for reference sake. As noted by Cuppen et al. (2010, p. 584):

> In regular R (not Q) factor analysis a total variance explained of 46% is considered low… In Q methodology however, variance explained is not considered a relevant measure, since one is not interested in the question what the percentage of a perspective in the population is, but Q methodology is developed to show that various factors exist, and what the similarities and differences between these factors are. If the variance explained of factor A is higher than that of factor B, it only means that there are more people of factor A in the sample.

However, in this research the fact that these three factors together represent 44 percent of the EV indicates that there is yet much to discover on this topic. It means that there are issues that may not be fully understood yet, and points towards a need for further research.

Finally, the correlations between factor scores matrix, demonstrating how each factor is related to the others is presented in

Table 6.

Table 5: Factor (F) Loadings and other Participant information

P#	F1	F2	F3	Employer [A]	Profession [B]	Male/Female
P1	0.26	-0.40	**0.50**	CSO	RA	F
P2	0.04	**0.62**	0.22	GOV	BA	M
P3	**0.63**	-0.14	-0.15	UNI	RA	F
***P4**	0.39	-0.22	**0.64**	CO	-	M
P5	**0.54**	0.24	0.17	EU	GOV	M
P6	**0.63**	-0.24	-0.24	Oth	(C)	M
P7	**0.59**	-0.33	0.29	CO	TMD	F
P8	0.19	**0.58**	-0.16	UNI	RA	F
P9	**0.62**	0.17	0.39	Oth	(C)	M
P10	**0.41**	-0.06	-0.23	GOV	BA	M
P11	**0.73**	-0.19	0.29	GOV	BA	M
P12	**0.41**	-0.31	0.06	CO	SEC	M
P13	**0.65**	-0.13	0.27	CO	SEC	M
P14	**0.59**	0.29	0.04	NP	RA	M
P15	0.15	0.10	**-0.44**	CO	IT	M
P16	-0.07	**0.67**	0.28	NP	RA	F
P17	**0.57**	0.00	**-0.44**	IC	PO	M
P18	0.37	**-0.61**	-0.02	CSO	PO	M
P19	**0.57**	0.13	0.38	NP	RA	F
P20	**0.70**	0.19	0.06	CO	RA	F
***P21**	**0.64**	0.40	0.12	-	-	F
***P22**	0.00	0.14	0.35	CO	RA	F
P23	**0.58**	-0.31	0.21	NP	Oth	F
P24	-0.11	0.30	**0.43**	CO	PO	F
P25	0.36	-0.00	-0.20	CO	(RA+IT)	F
%EV	**24**	**11**	**9**			

Key: Bold values under Factor headings are significant (p< .01).
A simple hyphen "**-**" in a cell denotes where information was not given, an * denotes where the P self-reported as not having significant background knowledge in the covered topics.
%EV: Explained Variance
A: Employer (CO= Company, CSO=Civil Society Org., EU=European Union, IC= Independent Consultant, GOV= Government, NP= Non-Profit/Association or Organisation, UNI= University, Oth=Other).
B: Profession/Expertise (BA= Border Authority/Police, C= Consultant, IT= Information Technology, PO= Port Authority, RA= Research/ Academia, SEC= Security, TMD= Technology Manufacturing/Development). Results in brackets e.g. (BA) indicate where the P responded 'Other' and clarified further their role. The latter have been assigned according to the researcher's understanding.

Table 6: Correlations Between Factor Scores Matrix

	F1	F2	F3
F1	*1.00*	-0.08	0.22
F2	-0.08	*1.00*	-0.03
F3	0.22	-0.3	*1.00*

4.3 Interpretation of results

In this section, the results of the Q sorts will be interpreted to provide a narrative about the views of each Factor group. The discussion focuses mostly on the defining statements for each factor, that is, those that have been ranked uniquely compared to other factors. However, other statements ranked towards the extreme poles are also included where it aids interpretation. The entire table of statements with their factor Q sort values is shown in Appendix A. The interpretation also discusses statements that were ranked similarly, otherwise known as Consensus Statements, before looking at a number of issues identified with the statements.

4.3.1 Factor 1: Technologists

The defining statements from Factor 1 are shown below in Table 7. Scores for the defining statements are shown under the Factor 1 (F1) column below, with Factors 2 and 3 shown in italics for comparison. The PESTL categories are also shown under "Cat." column, while an explanation of the categories is given below the table. The discussion of defining factors takes place below.

Table 7: Defining statements for Factor 1 in order of ranking, including PESTL Categories

Statement	**Cat.***	**F1**	*(F2)*	*(F3)*
1. It must be considered whether technology is the best option available, and has been rigorously tested to ensure it addresses the problem adequately, to the requirements of the implementer, and be proven more effective or efficient than existing, or alternative technologies.	T	+4	*-1*	*-4*
2. It is important that the technology's purpose and scope of use be clearly defined by implementers in order to clarify what the technology will be used for, what kind of information will be gathered from whom, and who will own and have access to this information.	P	+4	*+2*	*-1*
7. The technology should be secure in order to prevent tampering or manipulation by unauthorised users and operators, including hacking, tailgating, trespassing, spoofing etc.	T	+4	*-2*	*1*
4. The technology should be attractive, ergonomic, intuitive and easy to use for all user groups (operators, end users), preferably utilising universal user interfaces, symbols and guidance.	T	+3	*-3*	*+4*
29. It is important that the technology is flexible enough to adapt to legislation changes, and to target use by the largest possible traveller cohort: accommodating ID card holders, partnership arrangements with other countries, minors, visa holders, residents, and multiple biometrics etc.	T	+3	*-3*	*0*
17. It is crucial to assess new and innovative technologies to identify areas in which they lack according to law, regulation, standards, or best practices.	L	+2	*-1*	*-3*
31. It is wise for authorities to allow the public an opportunity to comment, criticise or request clarification about the technology implementation/policy	P	-2	*+3*	*+2*
3. It is important to take the issue of respect for freedoms of thought, conscience, religion, expression and information into account when assessing	E	-3	*1*	*2*

the impact of technology.				
10. It is wise to consider whether the technology implementation has an impact on the number and quality of available jobs.	S	-3	*0*	*+3*
11. It is wise to assess whether the technology has a negative social, cultural or economic impact on individuals in third countries.	E	-4	*+1*	*+1*
36. It would be wise to assess whether technologies might have a negative impact on the social cohesion and solidarity of members of society.	S	-4	*+3*	*0*

**PESTL Categories: Policy, Ethics, Society, Technology, Legal.*

As shown above, Factor 1 weighed heavily on aspects of technology at the positive level. Statements (S) 1 and 7 both fall within the category of Technology in the PESTL categorisation of statements (see Appendix B for full PESTL categorisation). Statement 2 refers to what the technology can be used for and why, and is located in the Politics category, however, it is still very technology relevant. Furthermore, Factor 1 loads negatively on statements in the Ethical and Social categories. However, again this does not necessarily mean they find these statements to be unimportant. As one participant in Factor 1 responded to a statement regarding assessing the impact of technology on social cohesion and solidarity (S36):

> *It may be wise and I am not saying this should not be done but if I would have to prioritize my resources I would put these kinds of cards to the lowest priority basket. It would most probably not affect the basic functionality. And it is very difficult to assess reliably!*

As such I will label Factor 1 as the "Technologists", as their primary focus seems to be on ensuring that ABC technologies are implemented in a way that will let them operate with the greatest amount of success. These Technologists are by far the largest factor grouping and number 14 individuals, six females and eight males, representing border authorities, technology researchers, consultants and security experts. They see high reliability (S23) and security (S7) of systems, as most important, they want to ensure there is a clear purpose (S2) for the technology and that this specific technology is the best choice to achieve this purpose. As another participant (P12) noted:

> *It is important to know for which needs the implementer would like to install ABC in order to identify which is the best technology for the needs (including security aspects).*

It may also be interesting for the reader to note that these Technologists also placed importance at the +3 level on the technology being flexible enough to adapt to changing legislation and to enable a large range of users (S29). Aspects of the technology being attractive, ergonomic and intuitive (S4) were also ranked at the +3 level. The negative loadings hint at a lower importance of Ethical aspects, with impacts in third-countries (S11) and trust in manufacturers (S19) ranking at the lowest level (-4), along with the Societal aspects of environment (S28) and social cohesion and solidarity (S36). Furthermore, these technologists do not give as much importance to public participation (S31) as the other two factors, but they do place a slightly higher emphasis on assessing new and

innovative technologies for compliance to standards, legislation and best practices (S17). Thus, the Technologists are most likely the individuals who are pushing for technological change and a greater use of ABC systems. They rank S1 and S2 at the highest level, and this is important, as these two statements are inherently linked[10] by the fact that S2 regards the purpose of implementing the technology in the first place (policy level), and S1 refers back to that purpose to ensure the technology itself is the best available to achieve those aims. This concludes the discussion of Factor 1. More information about how Factor 1 performed the ranking of statements can be found in 6.Appendix A.

4.3.2 Factor 2: Humanists

The defining statements from Factor 2 are shown in Table 8 below. Note that there are four participants that land on this factor, but interestingly one (P18) has a *negative* correlation with the defining statements of this factor. The three positive-loading participants are from fields such as research and academia, with one being from a border authority, while the negative-loading participant represents a port authority.

As noted above, a negative correlation means that this factor is *bipolar*. Therefore, where other participants in the factor may have ranked the statement concerning how upgradable a technology is (S35) towards the *lowest* level (-4), P18 ranked this statement at the *highest* level (+4). In other words, P18's responses are generally reversed compared to the other participants in Factor 2. This factor should thus be interpreted in two ways, firstly from the point of view of those who loaded positively, and secondly from the view of P18 who loaded negatively.

The positive view of Factor 2 places an emphasis on areas of Society as demonstrated by the loadings on issues of assessing impacts on democratic participation (S14), investigating potential hazards to society, individuals and the environment (S15), and ensuring there are no negative impacts on the social cohesion of the population (S36). Furthermore, there was also a defining statement at the Policy level (S18), which notes that a policy should be defendable, proportional, acceptable, and justifiable by implementers. The defining statements which were ranked negatively here refer mostly to aspects of the technology such as secureness from tampering (S7); the attractiveness and ease of use of the technology (S4); flexibility to adapt to legislative changes (S29), the clear definition of roles during the tender and procurement processes (S16); as well as issues of upgradeability (S35); and assessing the technology on a fully-costed basis (S39). Here it

10 The fact that these two statements are numbered consecutively is pure coincidence and the result of the random numbering of the statements during the Q sample construction phase.

becomes clear that S29 and S35 are somewhat related and thus this might explain their low ranking. However, the overall picture that develops when looking at Factor 2 is that there is a greater emphasis on the human impacts of the technology. The picture becomes clearer when looking at the other statements which were ranked positively for this factor (but were not necessarily defining statements) such as data protection (S24), and ensuring legislative conformance (S33). Therefore, Factor 2 could be described as the "Humanists" due to their overall emphasis on the welfare of society over the performance of the technology. Their positive focus on Societal issues is in direct contrast to Factor 1, and indeed Factor 2 has a negative correlation with Factor 1 (-0.08). This indicated that the two factors are indeed not related, or indeed compatible.

Table 8: Defining statements for Factor 2 in order of ranking, including PESTL Categories

Statement	**Cat***	**F2**	*(F1)*	*(F3)*
15. Potential hazards or harms (physical or psychological) that the technology may pose to society, individuals, or the environment are important to assess.	S	+4	*0*	*-1*
18. The policy behind implementation, and the technology's effects on users and their behaviour should be morally defendable; the specific technology systems and processes implemented should be proportional and acceptable to addressing the problem; and the results of these efforts should be justifiable.	P	+4	*0*	*-1*
14. It is wise to identify whether the technology implementation and policy supports or undermines democratic participation or national political culture.	S	+3	*-3*	*-3*
36 It would be wise to assess whether technologies might have a negative impact on the social cohesion and solidarity of members of society.	S	+3	*-4*	*0*
7. The technology should be secure in order to prevent tampering or manipulation by unauthorised users and operators, including hacking, tailgating, trespassing, spoofing etc.	T	-2	*+4*	*+1*
4. The technology should be attractive, ergonomic, intuitive and easy to use for all user groups (operators, end users), preferably utilising universal user interfaces, symbols and guidance.	T	-3	*+3*	*+4*
29. It is important that the technology is flexible enough to adapt to legislation changes, and to target use by the largest possible traveller cohort: accommodating ID card holders, partnership arrangements with other countries, minors, visa holders, residents, and multiple biometrics etc.	T	-3	*+3*	*0*
16. The tendering process should be clearly defined and state the roles and expectations of the implementer and the technology providers, including ownership, maintenance and supply of hardware, software, data and services.	P	-4	*0*	*0*
35. It is important that the technology (Hardware and software) is easily upgradeable or adaptable in order to remain 'state of the art'.	T	-4	*+2*	*+3*
39. It would be wise to ensure the technology is assessed on a cost basis (of purchase, operation, personnel, maintenance, availability of parts and services, side costs, lock-in effects etc.) to ensure that value for money is being received over the product lifetime.	T	-4	*0*	*-2*

**PESTL Categories: Policy, Ethics, Society, Technology, Legal.*

The negative view of this factor is of course the complete opposite. Thus if the positive view (Humanists) seem to prioritise people over technology, the negatively correlated view focuses on the importance of ensuring the technology is functional. This means assessing the technology on the basis of costs (S39) is important. Likewise ensuring the technology can remain state-of-the-art (S35) and the attractiveness and ease of use. Indeed, while one participant from the Humanist perspective noted about S4 "*[t]his is actually quite important. However, it is less important compared to the other points*", P18 noted about S4 "*[e]asy to use* (sic) *is the most important issue to [get] the full benefit out of the system*". However, issues of democratic participation (S14), and impacts on social cohesion (S36) and identifying hazards (S15) are seen as less important than these technological aspects. Therefore the negatively correlated view of this factor has some commonalities with Factor 1, for instance ranking statements about usability (S4) and security (S7) at the (+4) level. Yet this negative view still places an emphasis on different statements such as S35 dealing with upgradeability, which was not loaded significantly at all in Factor 1.The discussion now turns to the third and final factor.

4.3.3 Factor 3: Concerned Pragmatists

The defining statements for Factor 3 are listed in Table 9. Note that Factor 3 is also a bipolar factor (see Table 5: Factor (F) Loadings and other Participant information), with three participants loading positively, and one negatively, thus this factor is *mildly* bipolar. Participant number 17 also loads negatively on this factor, however this same participant also loads significantly on Factor 1, and therefore that participant's results are not included here. Participants who load positively on this factor represent research and academia, a port authority and a company, while those who load negatively work with IT, while another represents a port authority. To examine how this makes sense we will first look at the majority positive view of Factor 3. This Factor is by far the most complex and despite its small size mandates a broader exploration than the first two factors in order to clarify its focus.

Table 9: Defining Statements for Factor 3 in order of ranking, including PESTL Categories

Statement	**Cat***	**F3**	*(F1)*	*(F2)*
5. It is wise to consider whether an implementation respects: the rights for a citizen to be heard before any adverse decision is taken, the obligation for the administration to give a reason for its decision, and the citizen's right to an effective remedy.	E	+4	*0*	*-2*
10. It is wise to consider whether the technology implementation has an impact on the number and quality of available jobs.	S	+3	*-3*	*0*
26. It is important to consider issues regarding how a technology or policy respects the rights of equality, including non-discrimination (on the basis of sex, race, colour, ethnic or social origin, language, religion, political opinion,	E	+3	*+1*	*-1*

minority group affiliation, sexual orientation and so forth), as well as respecting cultural, religious and linguistic diversity, the rights of the child, the elderly and the disabled.				
8. In my view it is important that specific groups of individuals (e.g. children, women, elderly, unemployed, or ethnic, religious or linguistic minorities), firms or other organisations are not unreasonably affected more than others.	S	+2	*-1*	*-2*
25. The policy should be proportional and necessary for addressing the problem	P	-3	*+1*	*+1*
40. Identifying and minimising how the technology could possibly be used for negative purposes other than those for which it was designed and implemented is essential.	S	-3	*0*	*0*
1. It must be considered whether technology is the best option available, and has been rigorously tested to ensure it addresses the problem adequately, to the requirements of the implementer, and be proven more effective or efficient than existing, or alternative technologies.	T	-4	*+4*	*-1*
21. Where the technology involves user (public) interaction, the user should be given the opportunity to provide informed consent on whether they allow their data to be used for the explicitly stated purpose. Alternatives should be offered to those who do not consent.	L	-4	*-1*	*-1*

**PESTL Categories: Policy, Ethics, Society, Technology, Legal.*

Issues regarding the rights of individuals to be heard before adverse decisions are made about their situation (S5), and respect for the right of equality (S26) are loaded positively in Factor 3. Both of these issues come under the PESTL category of Ethics. The issue of the impact of a technology on the availability of jobs (S10) also ranks positively here, as does the statement regarding ensuring that the particular technology does not address impacts towards certain members of society rather than others (S8). One participant in particular noted that:

> *It is important and crucial when you implement new technologies to study which changes … [it] will have on the operational jobs of the people who will use the new technology.*

The positive focus of Factor 3 is not yet clear simply by looking at the defining statements. Therefore, it is also worth noting the non-definitive statements that were ranked at the highest level (+4). These include issues of usability such as attractiveness and ergonomics (S4), ensuring high-levels of operational reliability and fall-back options in case of failure (S23), and an emphasis on assessing whether technology has been developed from conception to deployment using a "privacy by design" approach (S37).

Meanwhile statements which were ranked negatively include issues of necessity and proportionality (S25), identifying how the technology could be misused by members of the public (S40), whether this is the best technology for the job (S1), and giving the user the opportunity to provide informed consent (S21). To help explain these low-ranking statements some feedback from the participants is perhaps useful. In regards to ensuring the technology is the best fit for the job (S1), one

participant noted "*Should a technology be rigorously tested, it will be outdated before implementation. Pilot testing yes, clinical testing no*". Thus, the participant is advocating that technology must be the best fit for the job, however they believe in a process that enables a technology to be implemented in an expedited fashion. In regards to statement 21 concerning consent, it must be noted that this statement contains an internal contradiction in the sense that it contains multiple propositions:

> Where the technology involves user (public) interaction, the user should be given the opportunity to provide informed consent on whether they allow their data to be used for the explicitly stated purpose. *Alternatives should be offered to those who do not consent.*

The section in italics is indeed a second-although related-proposition that creates a situation where someone may agree with the first, but disagree with the second part of the statement. As one participant from Factor 3 who ranked S21 negatively noted "*sometimes it is not possible to provide alternatives*". Such dual-proposition statements may make interpretation of results more difficult and thus, according to some researchers, should be avoided (Watts & Stenner 2005, p. 87). However, this statement somehow managed to slip by the researcher's attention in both the piloting and the final pre-check of the statements, and was only noticed after the first two Q sorts had been received. Yet it is again worth noting that negatively ranked statements simply imply less importance compared to others. In this case, it may be that obtaining consent is important, but providing alternatives is not. The statements ranked negatively at the lowest level (-4) which were *not* defining statements included impacts on the natural environment (S28), and assessing whether the technology has unintended effects on non-involved third parties (S30).

Factor 3 thus seems to be mixed, yet there is a strong focus on some rights such as the right to be heard before an adverse decision is taken (S5), and equality (S26), there is a focus on protecting privacy through ethical design practices (S37), safeguarding jobs (S10), and ensuring society groups are not disproportionately affected by the technology (S8). With this in mind, it is possible to say that Factor 3 represents individuals with a focus Societal and Ethical aspects, but also a minor emphasis on aspects of Technology. They are a completely different group in comparison with Factor 2 (correlation of just -0.03: see

Table 6), yet they do have some similarities with Factor 1 (correlation of 0.22), however this is still a low correlation that demands a factor in its own right. Factor 3 could possibly be described as a grouping of "Concerned Pragmatists". They are pragmatic in the sense that they emphasise the importance of the functionality of the technology, but yet are concerned with ethical and social

issues such as rights, and privacy. This can be seen in one participant's comments about the privacy-by-design (S37) principle:

> *If the technology is built with privacy-by-design, it not only enables the end-users (travellers) to trust the technology, but enables the authorities to not misuse the systems by accident (or, in a worst case, on purpose).*

Moreover, in regards to S4 on the usability aspects of technology such as attractiveness and ergonomics: "*if the technology can't be easily used it won't be used*".

The picture of this group is now somewhat clearer; however, there are also the two participants who have the reverse view of this bipolar factor. Participant 15 loaded negatively on this factor and thus holds a view which prioritises ensuring the technology is the best one for the job (S1):"*It is appropriate to strive to 'get it right first time' and avoid unnecessary delays or failures*". Although this same statement was ranked at opposite ends of the extremes (-4 for the positive view and +4 for the reversed view) this is not actually directly contradictory the positive view, as previously noted by one participant's comments on ensuring technology is piloted rather than clinically assessed. The difference here comes down to the level of testing. Getting it right the first time means thorough testing, but this is also the point of piloting a technology. The reversed view of Factor 3 would also place less emphasis on ensuring society groups are not disproportionately affected by the technology (S8), and less emphasis on issues of equality (S26) and the privacy-by design principle (S37). They do, however, load more positively on issues of consent (S21) and assessing whether the technology could be misused by members of the public (S40).

Factor 3 is thus a bipolar factor that deserves further exploration. The views expressed here seem somewhat contradictory on first examination, yet when the feedback statements of the participants are taken into account, more clarity is obtained. The participants loading positively on this factor seem to have interpreted and ranked statements quite strictly. This does however mean that there is a greater need to explore not only their ranking scores, but also their feedback.

4.3.4 Participants who did not load significantly on any factor

There were also two participants, P22 and P25, who did not load significantly on any factor at the $p>.01$ level (see Table 5 above). One of these participants noted that they did not have much background knowledge of the issues covered by the research, and thus this may explain their non-loading. However, it is quite common in Q Methodology that a minority of participants do not load on any of the factors. This simply means their responses were so different from all the others that the only way for them to land on a factor was if they were the only participant in that factor. This however, would not have very good explanatory value. Further research with a wider sampling

may reveal that these individuals do in fact fall into certain factors; however, this is outside the scope of this thesis.

This concludes the explanation of the three factors as identified in this research. In summary these three factors have been described as: Technologists who emphasise the importance of functionality; the Humanists who emphasis human impacts and the welfare of society over functionality of technology; and finally the Concerned Pragmatists who are concerned with both social and ethical issues such as rights and impacts on employment, but are also focused on ensuring the technology does what it needs to do. It must be noted that these are rough categorisations based on the data at hand, and are subject to interpretation. However, I believe that this is the best description of these groups at this point. Further research should aim to clarify these viewpoints.

4.3.5 Participants and Factors

It is interesting to note that although this study examined individuals who self-reported as performing similar tasks, not all of these participants landed on the same factor. For example, only two of the three individuals who reported as a border authority landed on Factor 1. The three individuals who reported themselves as working for a port operator landed in two different factors, one in Factor 1, and two in Factor 3. However, one in Factor 3 was positively correlated with that factor (P24), while the other was negatively correlated (P17). What this demonstrates is that although individuals may self-report as being from similar professional backgrounds, their subjective views can often be quite different.

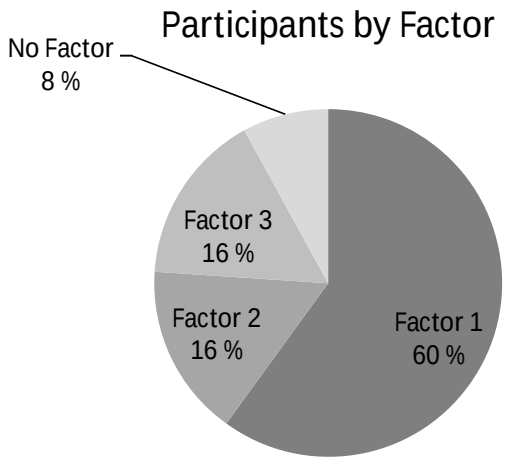

Figure 2: Pie chart illustrating participants per factor as a percentage

Furthermore, the pie chart in Figure 2

Figure 2: Pie chart illustrating participants per factor as a percentage gives an indication of the number of participants in each factor. This is an important illustration to take into account when considering the relative weights of each factor. It should be noted that this may not necessarily be representative of society as a whole. As mentioned earlier, Q does not aim to provide statistically representative results that can be generalised across a population; it only aims to illuminate what perspectives might exist within a population. What can be said is that in this study around 60 percent of participants loaded significantly on Factor 1, while only 16 percent loaded on Factors 2 and 3[11]. Additionally, some of those loading on Factors 2 and 3 loaded negatively, which again means their views were the inverse of the positive view of the factor. Although this may not be statistically relevant when extrapolated across a larger group of stakeholders, caution should nonetheless be taken when aiming to develop balanced stakeholder interactions such as workshops, especially if social and ethical issues are to be taken into account.

4.3.6 The Statements: a discussion

Consensus statements

There were also a number of statements that were ranked similarly across all three factors. These four statements, shown below in Table 10, indicate that there were levels of agreement between the different factors, and were *non-significant* at p>.01. The most notable statements are those regarding data protection (S24) which was ranked positively, and public demand (S34) which was ranked negatively.

Table 10: Consensus statements

Statement	Cat*	F1	F2	F3
6. The conformity of the technology to relevant compliance standards and certifications (health and safety, security, environment, privacy, technical etc.) is important to assess.	L	+2	+1	+1
20. In my view, a technology implementation, and associated processes, should abide by the right to respect for private and family life, home and communications.	E	-1	*0*	*0*
24. It is necessary to consider how, and what personal data is gathered, stored and transmitted by the technology, and whether this is according to regulations pertaining to the protection of data; and whether individuals will have the right of access and rectification of data.	L	+3	*+4*	*+2*

11 The results of P17 who loaded on two factors (positively on Factor 1 and negatively on Factor 3) have only been included in Factor 1.

34. Before a policy is implemented it is best to assess if there is a clear public demand and need for the implementation of the proposed technology/ies, or whether this is a political solution to a political problem.	P	-2	*-2*	*-2*

**PESTL Categories: Policy, Ethics, Society, Technology, Legal.*

Statement 6 was shown to be only mildly important, despite one participant's lengthy response:

> *Standards and certifications are crucial in any technological deployment. Efforts to ensure conformance in a constructive and consolidated manner can help to ensure consideration of relevant areas and are therefore worthwhile in themselves. They also breed trust and transparency in any development. Furthermore, conformance can aid harmonisation, important in ABC system design. Some standards may also become legally binding even if not so at the time of deployment, and hence conformance from the beginning of deployment efforts is a good goal.*

Statement 20 on the other hand was ranked far more neutrally, which was surprising considering this is a freedom as noted in Article 7 of the Charter of Fundamental Rights of the European Union (Official Journal of the European Union 2012). However, this may have something to do with the positive ranking of S24.

In terms of data protection (S24), one participant noted:

> *It is important that the individuals remain at the core of the process. Therefore, the impact of the technology on their data and the way it will be used shall be considered.*

While another simply said: "*Big brother or not…that is the question"*. The emphasis on data protection over privacy was an interesting one. However, it could simply be that participants assume that if data protection regulations are followed, then concerns related to privacy will be minimised. Nissenbaum (2010, pp. 104-5) in her seminal work on privacy, notes that while a lot of individuals claim they want privacy, when given options between privacy and other goods, people almost always choose the other good. These goods usually focus on providing convenience, efficiency, financial savings, connectivity, and safety (Nissenbaum 2010, p. 105). Thus, perhaps these results indicate that individuals are willing to forego privacy for convenience, just so long as their personal data is protected. The other alternative of course is that participants see no privacy concerns involved with ABC systems that process personal and biometric data. However this position would be strongly debated by the contributing authors in Campisi's (2013a) book "Security and privacy in biometrics". Some common arguments are presented in the book, such as that biometrics, unlike passwords, cannot be changed if compromised (Campisi 2013a, pp. v-vi). Furthermore, the use of some forms of biometrics may reveal sensitive information about an individual's health or personality (ibid.). The use of one biometric may also lead to others being gradually increased such as identifying an individual by gait, or tracking individuals through spaces using facial recognition, all of which may occur without explicit knowledge or consent (ibid.).

Such minor changes are related to the concept of function creep (S22), and also flow into the issue of the level of desirability and need for technology, which leads us to the next statement on public demand.

Statement 34 regarding public demand was also ranked surprisingly low, with a number of comments justify the ranking in this way:

> *Public demand does not always go hand in hand with changes/developments necessary for society, especially if 'society' refers to multi-nation community such as European Union.*

In addition:

> *Public demand is not a valid driver for border security, and I also see many other reasons than public demand or political problem* (sic).

Therefore, there are some important lessons here about what all three factors agreed on. Although the Frontex Best Practice Operational Guidelines (Frontex 2012a) note the dangers of politically driven ABC deployments, the results of this research do not necessarily denote this as an important aspect to consider. Furthermore the importance of assessing whether a technology is "simply looking for problems to solve, rather than responding to a genuine need" has been expressed by a number of experts (see European Commission 2014b, p. 30). However, as shown by the comments to this statement, a number of participants clearly believe that certain aspects of security should be above the level of public demand. This may come back to a distinction between what seems to be a related cycle between security research and the social environment. Burgess (2012) notes that security professionals work within a field of social assumptions, structures and values, and their work aims to develop solutions for the perceived threats and dangers which exist in that environment. Technological change, however, directly influences change in the social environment, that is, in structures, customs and values, and thus while new technologies may overcome old problems and fears, they also bring with them new fears and risks (Burgess 2012). Although the statement about public demand (S34) was ranked quite low, the statement about public engagement (S31, see Appendix A) was ranked higher (-2, +3, +2 in F1, F2, and F3 respectively). There are numerous ways to interpret this information. For example, it might be that individuals feel that the relevant authority should be able to propose to implement a technology, just so long as the proposal is subject to a period of public debate. The authority may be seen as the best actor to determine need, not other societal actors. However, it may be pertinent to realise that not all societal actors are represented in public engagement. Discourses on certain topics may favour certain outcomes and be dominated by certain perspectives; such an issue is identified by Russell, Vanclay and Aslin who note that there is:

> a tendency to regard technology as essentially linked to 'progress', without acknowledging the political nature of progress and how implicit social goals that underpin technology development are associated with particular interests and actors (Russell, Vanclay & Aslin 2010, p. 110).

Furthermore, Nissenbaum (2010, p. 161) writes that changes due to transformations in information systems and technologies are often thrust upon people and societies "without a careful evaluation of harms and benefits, perturbations in social and cultural values, and whether and by whom these changes are needed or wanted". Furthermore, she likens these gradual changes like the slow but constant movements of the hands on a clock, nearly imperceptible in real time, yet become obvious over a longer period (Nissenbaum 2010, p. 161). An approach that links security research with societal needs helps to overcome these issues, and ensures that there is a link between the needs of society and the security of the state. As Hempel et al. (2013, pp. 742-3) argue, security decision making is based on normative values, and thus "how decisions are made impact on how societal and ethical implications unfold". A decision-making process therefore, should be as inclusive as possible and involve not only security experts, but also other societal actors. That being said, this research involved numerous stakeholders from varying backgrounds, and yet only seven participants ranked this statement (S34) at +1 or above, and only one of these ranked it at the +4 level. This participant provided the following explanation:

> *Because it should be first assessed whether the new technology is necessary and whether the issue it is supposed to solve cannot be solved differently, e.g. with existing technologies or personnel.*

In summary, these consensus statements show that there were similarities between the three identified factors, some of which are quite interesting. Further investigation using a wider participant sample may reveal these to be endemic to the population, or simply related to individuals involved with security research.

Other issues

Aside from the issue of dual propositions discussed above in the explanation of Factor 3, another interesting issue was noted with the statements. The initial purpose of S19 *"Technology developers are the best actors to ensure their products are compatible with existing laws and ethical norms from conception to the final stages of production and implementation"* was to represent the concept of responsible technology development, which is linked to the concept of Responsible Research and Innovation (RRI). However, this statement was not described sufficiently, and thus became somewhat of a reversed statement whereby a negative response indicates agreement with the concept of RRI. The RRI concept aims for a transparent and interactive innovation process which includes consideration of the ethical acceptability, sustainability and social desirability of innovative technologies, from inception, through design, and into production (Owen, Macnaghten

& Stilgoe 2012). RRI is a process which aligns research and innovation processes and outcomes with the values, needs and expectations of society, and should be seen as an interactive process (European Commission 2015b). However, the majority of participants in the study ranked S19 towards the lower end of the spectrum, thus resulting in a -4, 0, -4 loading on Factors 1, 2 and 3 respectively. Therefore, while the intention was to provide a statement that the researcher anticipated to rank positively, the reality was that participants viewed this statement quite negatively due to how the statement was worded, and many of them noted in the comments section that they do not trust technology manufacturers to make ethical decisions. However, even though the statement was not ranked positively, it still performed its desired function as a negatively ranked or reversed statement. As one participant noted "*Based on personal experience, technology developers may not be interested in ethical norms nor regulation at all (unless they have a clear impact in their business).*" A number of participants agreed to further discuss their results, and when given a short paragraph explaining the concept of responsible technology development they were asked if this knowledge would change how they ranked S19. The paragraph given was the following:

> … during the design process it has to be made sure that technology is designed in a way that does not hinder or preclude certain legally compatible organisational options. Quite the contrary, the producer should work towards promoting certain organisational options which benefit basic rights….it is imperative that producers concern themselves with organisational aspects and possibilities of the later use on the level of technical objectives and account for them in the development process (SIAM 2011, p. 15).

One individual, after reading the paragraph noted that he would probably now rank S19 around +3. Another also decided that they would adjust the ranking from -2 to +1. No results were actually modified, the main point here is that the interpretation of different statements is very subjective, and can change according to a given context. What we end up with however is a ranking for S19 that demonstrates a lack of trust in technology manufacturers to design products in an ethically and legally sound manner. The responses overwhelmingly pointed to technology developers were not the best actors to ensure their products conformed with laws or norms, they were not objective, or perhaps they did not have the legal expertise to understand the implications of their technology. The statement indeed performed its task in revealing perceptions on responsible technology development, but just not in the way it was originally intended. If anything became clear from the results of this statement, it is that there must be a greater transparency in technology development, including interactive processes with multiple stakeholders along the entire design, manufacturing and deployment chains.

The discussion here draws attention back to the way statements must be carefully worded and described in Q Methodology. Although the researcher understands the context in which s/he wrote the statement, the participants are usually without such context. Indeed, one participant mentioned that they would have appreciated more context along with the statements in order to rank them more efficiently. This could perhaps have been done by providing truncated statements along with a paragraph explaining the context behind each. However, this would also have increased the Q sort duration. Nonetheless it is worthy of consideration for future studies which may involve non-experts, as another participant noted "*the survey would be too tricky to an[s]wer for an "average traveller" if that would be necessary*". Therefore, the statements could be made less complex if they are accompanied by short, context-giving paragraphs. In this way, non-experts could possibly perform the Q sort process, which would also provide the traveller's perspective.

Furthermore, it should be noted that while certain statements may have been ranked negatively, they are still important to assess. For example, respect for certain rights such as privacy is important to consider, despite its low ranking here. The illustration of backscatter, or "naked", body scanners in airports given in the introduction to this thesis, is a clear example of how a failure to consider issues of privacy can be extremely expensive. Furthermore, just because an issue is considered necessary due to legal reasons or certain norms, it does not mean its impact should not be assessed. As noted by Hempel and Lammerant (2015, p. 37) "an impact on a freedom which is considered legal can still be considered annoying by a traveller and therefore minimizing it can be important in order to improve acceptance."

4.4 Using the results to assess key issues

The key aims of reducing the number of criteria, supporting the selection with academic literature, and developing a more concise categorisation of criteria have already been addressed above through the methodology of Q. In this section, I will look at the remaining three key issues, which are: developing a common scale of measurement, reducing overlapping criteria and allowing certain criteria to be weighted more heavily (so-called killer criteria).

4.4.1 Common scale of measurement

In this study I utilised the bipolar (-4 to +4) scale of measurement common in Q Methodology. A key issue in the ValueSec project revolved around complex value functions, designed to translate qualitative assessment into quantitative results (see Blobner 2013a, p. 22). This research attempted to overcome this issue by utilising a research methodology (Q) whose strength lay in performing just such tasks. In this research, all criteria could be assigned whichever value the Q sort participant

deemed appropriate. This works well in such research, however, it must be noted that the aims of the ValueSec project were far more complex. The issues of the complexity of value functions persisted despite the participation of numerous experts in fields such as quantitative research and risk management. In short, I do not claim to have solved the issues which ValueSec faced, I simply note that for the current purposes a common scale of measurement was utilised effectively to convert qualitative assessments into quantitative data, which are then able to be interpreted in a qualitative narrative. The usefulness of these results in contributing towards a toolset is yet to be seen, and is a topic to be applied in further research

4.4.2 Minimising overlapping criteria

The issue of overlapping criteria has previously been discussed in Chapter 3.1.2. However, a further discussion relating to the feedback received from the questionnaire is also beneficial here. To briefly recap, minimising overlapping criteria was explained to be quite a difficult task. Many of the criteria have some minor overlaps, but these sometimes occur at different levels. For example the statements given below referrring to the security of the techbology (S7) under the category of Technology, and the statement regarding misuse (S40) under the category of Society are inherently related:

> 7. *The technology should be secure in order to prevent tampering or manipulation by unauthorised users and operators, including hacking, tailgating, trespassing, spoofing etc.*
>
> 40. *Identifying and minimising how the technology could possibly be used for negative purposes other than those for which it was designed and implemented is essential.*

The first of these looks specifically at security requirements of the technology to ensure it is safe and secure once it is implemented. This is directly related to the aims of the second (S40) however, in that this second statement aims to address other possible areas where that particular technology could be utilised by members of the public for negative purposes. In a sense, the identification and minimisation performed in S40 should determine the security response in S7. This is a subtle difference, and perhaps requires further consideration about whether both statements are necessary. However, it is also sometimes the case in Q that two similar, but slightly different statements are included in a Q sample to test reliability. Additionally, the following statement from the Society category is inherently linked with the former two, but yet addresses slightly different issues:

> 15. Potential hazards or harms (physical or psychological) that the technology may pose to society, individuals, or the environment are important to assess.

With so many criteria addressing slightly different aspects of the technology, it is important to understand that overlapping areas are always going to persist. The main objective should be to reduce the amount of overlapping, or at least understand which areas overlap. However, as

previously mentioned, Q can handle a certain amount of overlap in statements. Thus understanding which statements overlap and how this might influence the impact assessment process should be examined further.

The assessment of overlapping criteria will continue beyond the timeframe of this thesis. It is important that the criteria are able to be assessed for overlap also in terms of the contents of the remaining tools in the toolset: CBA and RRA. There are a number of criteria that may also overlap with these areas, for example issues of cost-effectiveness (S39) and ensuring the technology is secure (S7) overlap with CBA and RRA respectively. However, these can also be seen as important issues where qualitative responses may contribute towards better understanding. Rather than just a quantitative process of assessing these two issues, qualitative feedback from stakeholders about their perceptions may contribute to a better understanding of whether or not the technology is really acceptable at the assessed levels. As noted by Karafyllis (2009, p. 94), there is an important distinction to be made of the quantitative or analytical assessment for feasibility, and the qualitative assessment for desirability. One involves statistics, and data, the other takes into consideration social dynamics and psychology. Both are useful, and both should be used. Other items with potential overlap with RRA are issues of privacy (S20) and data protection (S24) to which Hempel and Lammerant argue about impact assessments:

> Impact assessments in the area of data protection, privacy and surveillance require an interdisciplinary cooperation for obvious reasons. The developments at stake are too complex to follow one single approach (Hempel & Lammerant 2015, p. 138).

Thus, multiple approaches to such important issues are needed. The interaction of multiple stakeholders provides multiple perspectives, and in turn results in what Hempel & Lammerant (2015) "negotiated knowledge". This negotiation of perspectives and opinions from stakeholders and experts in turn should provide better outcomes for technology assessments. However, challenges still remain:

> The challenge with the integration of perspectives is to avoid turning them into a hierarchy with one dominant perspective and the second as auxiliary, and to make sure that both perspectives inform the assessment methodology and complement each other (Hempel & Lammerant 2015, p. 139).

Criteria from QCA that overlap with other areas of the toolset should not therefore be seen as a negative duplication of the assessment process, but rather as an opportunity to provide complimentary feedback on the related issue. However, in order to keep the QCA process as user-friendly as possible the number of complimentary overlaps should be considered thoroughly. The process of identifying overlapping criteria is expected to also be case-specific, and thus the

researcher suggests further examination of the criteria in the context of the technology being assessed.

4.4.3 Killer Criteria and negotiating the importance of impacts

The final task in developing the criteria set was to identify whether any criteria were of such importance that if not addressed adequately, they could potentially lead to a termination of an assessment. In other words, when translating the statements developed in this research into criteria to assess a technology implementation, one could perhaps assign a minimum threshold to criteria dealing with legal obligations, or possibly adherence to fundamental human rights. If, after the assessment of the proposed implementation has taken place the thresholds have not been met, the assessor would recommend termination of the project, hence the name killer criteria.

During the research planning phase there was the hope that the final results of the Q sorts could be used as somewhat of a gauge to determine whether any such killer criteria existed. The thinking was that any criteria that was consistently ranked positively, or for example, had an overall average ranking of +2 or above could potentially be marked as a killer criteria. An average of +2 would mean that a large majority of participants would need to rank the statement positively, and thus there would be somewhat of a consensus that the particular statement was important. However, again it must be remembered that Q Methodology ranks statements according to their relationship with each other, and thus determining one that is more important than another can be problematic, as the statement would be taken out of its participant-ranked context. Additionally, it must be emphasised that calculating the average ranks of statements is *not* a method commonly used in Q Methodology. That being said, the only statement that even came close to an average of +2 was S7: "*The technology should be secure in order to prevent tampering or manipulation by unauthorised users and operators, including hacking, tailgating, trespassing, spoofing etc.*" with an average of +1.96. The next statement to come close was S23: "*It is essential to ensure the technology meets an extremely high level of operational availability, and fall-back options are developed to deal with any unexpected unavailability*" with an average of +1.64. However both of these statements refer to criteria (Security and Availability respectively) which are generally covered by best practice technical and operational guidelines such as those developed by Frontex (Frontex 2015a, 2015b). Both aspects are also thoroughly discussed in the recent Smart Borders pilot (see for example European Commission 2014c).

Therefore, the recommendation here is that killer criteria may be an option left to either the implementer or the assessor. Different technologies in different environments for different implementers may lead to vastly different requirements, and thus it may be best to assign such

minimum thresholds on a per-case basis. After all, as Hempel and Lammerant (2015, p. 125) note about performing impact assessments:

> The knowledge produced, i.e. the final assessment output, is not a simple truth about an impact of a considered project. It itself is a result of the widespread negotiations on what has been seen and conceptualized as a relevant impact in the first place. It is thus an outcome of value discussions and interests.

As such assessments are negotiations; it may be better to allow the good judgment of the assessing party to determine what is and is not an acceptable level of impact. Not only that, but the method of assessment as advocated by this research and others noted above in chapter two involve active stakeholder involvement in the assessment process (see Hempel & Lammerant 2015, p. 137; Russell, Vanclay & Aslin 2010; Schot 2001; Schot & Rip 1997; Vanclay 2003). Thus it is not only the assessor and technology developer who need to negotiate on what would constitute killer criteria, but ideally, *all relevant stakeholders* should be involved in giving their opinion over what is and is not an acceptable level of impact, and whether the technology in question falls within the acceptable limits.

4.5 General discussion

Throughout this thesis, the importance of including relevant stakeholders in any assessment of technology has been noted. I would like to conclude this analysis of results with a discussion on the usefulness of such impact assessments and make recommendations as to how to go forward. It has been noted above that using qualitative assessments of technology should be an interactive process involving multiple stakeholders. This research attempted to identify the perceptions that exist surrounding ABC systems, and did so by inviting multiple stakeholders to participate. Although based on a review of the literature, the statements developed for the Q sorting phase of this research were noted to be subjective. In further assessments it would be wise to look at the criteria to ensure relevant areas have been covered, and to add to the list of criteria if needed. It is well noted that the ability of participants to contribute to such research is perhaps limited by what they are given to work with, as Schot and Rip (1997, p. 43) describe: "when questionnaires ask only about comfort, speed and acceleration, consumers seem to want only more comfort, speed and acceleration capacity in new cars." Therefore, it would be wise to consider whether other relevant issues (criteria) need to be accounted for.

4.5.1 Using Q and HTMLQ

Q Methodology provides an output for the issue of identifying other factors in the sense that participants are also asked to describe *why* they performed sorting tasks the way that they did,

giving the opportunity to provide further feedback. Participants are also encouraged to rank statements in the way they interpret them. It was noted earlier that the Q sorting process can be performed either in person or remotely, and that a number of tools exist to support the remote performing of Q sorts. In this research, the online Q sorting programme HTMLQ was utilised. This had the benefit of being accessible to all participants whenever they were available to perform the task. Furthermore, it reduced the time the researcher needed to spend instructing participants during the sorting process. However, there were also a number of issues identified with utilising an online programme. Firstly because of the way the programme operates, it was possible for participants to skip certain important steps such as the feedback process (why they ranked statements under the +/- 4 columns). Despite being marked as mandatory, the HTMLQ programme could not differentiate whether a participant had given a detailed response or whether they had simply hit the spacebar once in each feedback box and moved on to the next step. Such blank responses, while unhelpful, were not totally unexpected. It must be noted however that only three participants left all eight feedback boxes empty, while three others completed only half. Individuals these days are time-poor, and responding in detail to why you ranked a particular item in such a way requires effort. An interesting piece of data is that the average time for performing the entire HTMLQ process was 58 minutes, with the quickest sort being performed in less than 20 minutes, while the longest took almost three hours. However such a long duration is not necessarily indicative of the amount of continuous effort involved with performing the sort, the participant could very well have been distracted or busy with other tasks and completed different steps of the sort between other tasks.,

Overall, the reduction in costs of performing an online versus in-person Q sort may not necessarily be useful if participants do not complete the entire feedback process. In this research the selection of participants was performed using somewhat of an "open-invitation" method whereby they were asked to participate if they so wished. In some other Q studies participation is confirmed beforehand, and thus the researcher knows exactly who will participate, and possibly even when they will perform the Q sort. If utilised with an online sorting process, the latter method would undoubtedly contribute to both a reduction in costs and greater feedback. Ensuring the researcher is able to follow up on Q sorts when they are performed online is beneficial to the research; however this must also be balanced with privacy concerns. In this thesis, participants were given the option to contribute anonymously, and many chose that option. However, a small number did contact the researcher and offer to provide extra feedback if needed. The balance between obtaining reliable results that are able to be followed up and ensuring privacy is a tricky one, especially when the participants might be known to each other due to a close working relationship. This was the case

here, as many participants work within the FastPass and BODEGA projects, and this is also why the country data is not connected with other participant information in the data analysis section.

As for Q itself, the ongoing use of this methodology for building upon the current research should be considered. The method may be able to contribute to providing a translation of qualitative feedback from stakeholders about the impact of technology, into quantitative data. Q might allow technology assessments to become more interactive and complimentary with other tools such as CBA and RRA. However, the process of forced sorting in Q may need to be reconsidered for such processes. Participants should be allowed to rank statements in any order and at any rank they wish to ensure their specific view of the technology at hand are accurately represented. This is entirely acceptable within some schools of Q, but it remains to be seen whether another ranking method would provide results in a more efficient manner.

4.5.2 Recommendations for using the criteria described in this research.

In order to advance further in developing a toolset for assessing technology implementation it is wise to consider the existing literature on the topic. One of the themes that keeps appearing in this research is that any assessment of technology must involve a wide range of stakeholders. The involvement of multiple stakeholders ensures varying viewpoints are taken into account through acts of negotiation and renegotiation, preferably throughout the design phase of a particular technology. That being said, not all assessments of technology are performed during these stages, many are performed only before a planned implementation. It is the latter case where the criteria defined in this research are most suited. A number of cautionary remarks should be added to this, reflecting what a number of authors (Ball et al. 2006; Hempel et al. 2013) have already noted about such assessments. Firstly, such assessments should not simply be check-box exercises performed to improve public image and give a score at the end (Ball et al. 2006). Doing so could possibly be more dangerous, both for the assessor and for the one being assessed, should it be revealed that there is an underlying problem that should have been detected but was not. It should therefore be more than a "philosophical exercise" (Hempel et al. 2013, p. 752), it should be a genuine attempt to understand the impact of the technology on society. Additionally, these types of assessments cannot be viewed as a "one-size-fits-all" process; there is a need to tailor each assessment to the specific technology (Ball et al. 2006, p. 92; Hempel et al. 2013, p. 752). Finally, the approach described in this thesis is not designed to replace other forms of Impact Assessments (IAs); on the contrary, it is designed to support more intense forms of impact assessment by creating a link between the qualitative and quantitative aspects of the assessment. It is more than likely issues will

be raised during this initial process that may warrant a more thorough investigation, and such issues should be comprehensively explored.

Ideally, however, such assessments should be taking place alongside technology development:

> there needs to be a greater consideration of the social issues associated with technological developments, and that this understanding of the social context of technology needs to occur alongside the development of the technology, and not as a post-hoc assessment of the social consequences of technology (Russell, Vanclay & Aslin 2010, p. 115)

With this in mind, the results of this research provide a starting point for a discussion on what particular actors place an emphasis on in assessments of new technology. The results have shown that there are a number of different perspectives that exist, and it is possible that this understanding can be beneficial when developing a plan for assessing a particular technology. For example, knowing that there is a perspective that emphasises certain criteria at a certain level may help identify where a particular technology may not reach that particular threshold, and thus where improvements may need to be made. However, in doing so it would be wise to use the highest existing threshold, not the lowest. Common sense and good judgement must also abound in such assessments, after all, the assessor's role is to mediate the negotiation and renegotiation of knowledge between stakeholders (Hempel & Lammerant 2015), not to simply perform a task for a client.

The set of criteria developed in this research is by no means exhaustive. It is expected that the process of defining and developing the criteria will be an ongoing one. The criteria could be developed further by rephrasing the statements into questions, and using these questions in stakeholder groups to assess a particular technology. Furthermore, a focus on a slightly different technology may require a consideration of whether other criteria should be included in the assessment process.

5. Conclusion

5.1 Research objectives: Summary of key areas of investigation

This thesis aimed to develop a set of criteria to be used in assessing automated border control technology. These criteria were to be developed from previous work performed in EU projects, but with a focus on border control technology. To address this task the current research was broken down into six key areas of investigation, namely:

1. Review and reduce the number of criteria, ensuring criteria are relevant to the current research topic
2. Support criteria selection with academic literature
3. Develop concise categories for criteria
4. Implement a common scale of measurement for all criteria
5. Reduce overlapping criteria
6. Allow certain criteria (e.g. legal) to be weighted more heavily (killer criteria)

These areas were not firm problems that required solving, but rather areas that were noted as key concerns from the original project that required further investigation.

Areas number one and two were approached through the research method utilised in the project. Q Methodology (Q) required an identification of relevant discussions surrounding the topic, which also meant an investigation of the relevant academic literature. Using the criteria sets available in public deliverables from the ValueSec and DESSI projects, the researcher set about identifying which of these were observable in the relevant literature. The criteria were translated into statements for the purposes of assessment with Q. This process resulted in a preliminary criteria set of 46 statements, which was later refined to 40 through a pretesting or "piloting" of the Q sorting process with colleagues from VTT.

The third key area was also addressed through the piloting process; however, it became obvious that assigning the criteria to categories was quite a subjective process as each participant created different categories and relations between the statements. Therefore, the PESTLE approach was modified for the purposes of this research, resulting in the categories of Policy, Ethics, Society, Technology and Legal (*PESTL*). These categories, and the way the criteria are organised within them, are in no way perfect, yet they performed the functional task of organising the criteria, and assisted in the interpretation of research results.

The fourth area was addressed through the research methodology. Q allowed the researcher to assign almost any value to the Q sorting template, yet the requirements of the research demanded a

scale from negative to positive. Initially, scales of -3 to +3, 1 to 7, and simply "-" to "+" (for the extreme poles) were considered, however, each of these had drawbacks and after the piloting phase a scale of -4 to +4 was selected. The method of instruction was to rank the statements in the order of importance, from negative to positive respectively: Most Unimportant to Most Important. This scale was chosen to ensure a "flatter" distribution of nine columns rather than seven in the previous options. Using a negative to positive scale did have its drawbacks, requiring detailed explanation that ranking a statement negatively did not mean it was unimportant by itself, but rather that the statement was simply less important than another placed to its right. The common scale of measurement used in Q allows the qualitative nature of the participants' ranking processes to be converted into a quantitative value, thus allowing the researcher to analyse the data with computer applications. The scale of measurement used in this research worked extremely well for the aims, however, this is not to say the same method would necessarily solve the problems identified in the ValueSec project. It is however an option worthy of consideration.

The fifth and sixth areas were an ongoing process throughout the entire research. Indeed, from start to finish these two areas were constantly being assessed. However, ultimately they are both rather subjective processes and very much task dependent. The fact that criteria overlap is quite obvious in the results above. However, it is difficult to define strict boundaries between these criteria, and in a sense, the overlaps help to cover different levels of concern. For example, ensuring that a technology is secure (S7, Technology) is related to protecting society from misuse of that technology (S40, Society), which is related to identifying the process of function creep (S22, Policy), which ultimately refers back to the original stated purpose of the technology (S2, Policy). Indeed, it is likely that this process could go on and link a majority of the statements.

Allowing criteria to be weighted more heavily was noted to be technically possible. However, it is recommended that the assessor, in consultation with stakeholders, performs this process in order to ensure the relevant criteria are selected as the so-called minimum threshold "killer criteria". Furthermore, this task may be complicated by the involvement of multiple actors who have varying opinions of what constitutes a minimum threshold for particular criteria. As the results of the research demonstrate, there are only a small number of statements that all three factor groupings ranked similarly.

In summary, all six key areas of investigation have been addressed by this research. The findings demonstrate that Q is a useful tool for such a process, as it allowed a number of tasks to be performed as a part of the standard research methodology. The following section is a summary of the results obtained through the Q research process.

5.2 Research results: Summary of findings

The previous section summarised the findings related to the key areas of investigation for this research. This section will summarise the research results and subsequent findings, before concluding with recommendations for future investigation.

In total 25 participants performed the sorting of statements using the online Q sorting programme HTMLQ. These participants were shown to be from numerous professional backgrounds including border authorities, consultants, researchers in multiple areas, non-profit groups and companies. An analysis of the Q sort data with the PQMethod application utilising Principle Components Analysis (PCA) and the researcher's own judgement in rotating scores, three main Factors were identified. Participants in Factor 1 were described as "Technologists" due to their positive emphasis on the functional aspects of the technology, and the Legal considerations pertaining to those functions. These technologists placed a lower importance on issues of Ethics and Society as defined by the PESTL categories. Factor two were described as the "Humanists" due to their greater emphasis on issues falling under the Society and Ethics categories, and their negative emphasis on aspects under Technology. Factor 3 was named as "Concerned Pragmatists" who seem to be emphasising similar aspects under the Technology category as Factor 1. However, they also place importance on areas of Ethics and Society that were overlooked by Factor 2. Factors 2 and 3 were also bipolar in nature, meaning that at least one participant had the *reverse view* of the factor. It was noted that the factors were not even in the number of participants which they contain, and thus while caution must be taken when interpreting the statistical significance of this; it is perhaps a key point to remember when developing stakeholder interactions discussing social and ethical issues.

The results of the research also demonstrated that a number of statements were ranked similarly across all three factors. These were interesting because they exposed what appeared to be subtle contradictions. While all factors ranked the statement concerning data protection relatively high, the statement concerning the individual's right to privacy was ranked rather low. Furthermore, ensuring a public demand for a policy was seen to be unimportant, yet public engagement in the policy-making process was ranked positively. Such contradictions could be explained by stakeholder values, or possibly even endemic views in the wider population, however, given the contrast to much of the literature on impact assessments further investigation of these issues would be prudent.

Indeed the results produced in this research indicate some interesting perceptions of the important factors to assess when implementing ABC technology. Further research could focus on a method to simplify and give the statements more context in order to reduce the amount of background

knowledge needed to perform the sorting process. This would also allow a wider participant sample to be selected, including travellers with little knowledge of the systems they use. It is possible that the current criteria and statements could be modified to aid in such a task.

Future research should also aim to further understand stakeholder perceptions of the relevant issues to consider when assessing border control technologies such as ABC. It may very well be the case that further stakeholder perceptions are identified, or that the three factors presented here are clarified. Additionally, further research should be performed to harmonise the criteria developed here with additional tools such as Cost-Benefit Analysis and Risk Reduction Assessments. By doing so, a more comprehensive view of impacts will be gained, potentially leading to greater benefits for all stakeholders.

The FastPass project and future projects focusing on border technologies may benefit from the current results by understanding the relative importance of certain issues surrounding ABC implementation. For example, the positive emphasis on data protection, but a low importance on issues of public demand. Projects could also benefit by understanding the particular areas of focus of the factors identified here in order to understand which stakeholders might need to be consulted about improving certain aspects of the technology in question. For example, the results could be used to develop minimum acceptable thresholds for certain criteria, although this should be used as an estimate only. It may also be useful to notice the bias of participants towards Factor 1, which demonstrates the importance of including experts on social and ethical issues in such projects. Understanding that such differences in opinion exist is important, but perhaps of greater importance is an understanding of to what extent the factors differ, both in terms of perception and number of stakeholders.

The results of this research demonstrate the importance of engaging a wide range of actors when assessing technology. This becomes even more important when considering the impacts of surveillance and security technologies on society. Although areas of international relations and peace studies were not explicitly described in this thesis, the results of this research do indeed point to the interaction of the state and the citizen, and also state and state. The bordering process is inherently discriminatory, that is, the aim of the process is to ascertain who is and is not allowed to cross from one space into another. The increasing use of technology allows such tasks to be performed in new and innovative ways, yet it must still be considered how these new methods might impact individual users, and also society in general.

Recent and upcoming proposals in the European Union place a heavy emphasis on self-service technologies to enable accelerated and more-efficient border crossing process. With an ever-

increasing focus on automated technology systems to assist the border crossing process, it is increasingly vital that implementers and developers understand the impacts of these technologies. In an attempt to increase the understanding of these impacts, this thesis aimed at creating a set of criteria to assess border control technologies, specifically ABC technology. It must be repeated that these criteria are not designed as a stand-alone tool, nor should they be utilised in a rushed check-box process of superficial assessments. Rather, they are designed to be incorporated with other tools such as Cost-Benefit Analysis and Risk Reduction Assessments to provide a more holistic analysis. Additionally, this criteria set could very well be modified to assess other relevant border control technologies, so long as due care is taken to assess whether the criteria are relevant, or whether some minor additions or subtractions are in order. Furthermore, this research places a strong emphasis on the involvement of multiple stakeholders representing a wide range of perspectives. Such processes are intended to open dialogue about the potential impacts of the technology on the widest range of society. The process should involve negotiations and renegotiations between all of the actors to ensure negative impacts are reduced as far as possible. Only when technology assessments are performed in such a way can the results truly benefit society as a whole.

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Appendix A. Factor Q Sort Values for each statement

#	Statement	Factor 1	Factor 2	Factor 3
1	It must be considered whether technology is the best option available, and has been rigorously tested to ensure it addresses the problem adequately, to the requirements of the implementer, and be proven more effective or efficient than existing, or alternative technologies.	+4	-1	-4
2	It is important that the technology's purpose and scope of use be clearly defined by implementers in order to clarify what the technology will be used for, what kind of information will be gathered from whom, and who will own and have access to this information.	+4	+2	-1
3	It is important to take the issue of respect for freedoms of thought, conscience, religion, expression and information into account when assessing the impact of technology.	-3	+1	+2
4	The technology should be attractive, ergonomic, intuitive and easy to use for all user groups (operators, end users), preferably utilising universal user interfaces, symbols and guidance.	+3	-3	+4
5	It is wise to consider whether an implementation respects: the rights for a citizen to be heard before any adverse decision is taken, the obligation for the administration to give a reason for its decision, and the citizen's right to an effective remedy.	0	-2	+4
6	The conformity of the technology to relevant compliance standards and certifications (health and safety, security, environment, privacy, technical etc.) is important to assess.	+2	+1	+1
7	The technology should be secure in order to prevent tampering or manipulation by unauthorised users and operators, including hacking, tailgating, trespassing, spoofing etc.	+4	-2	+1
8	In my view it is important that specific groups of individuals (e.g. children, women, elderly, unemployed, or ethnic, religious or linguistic minorities), firms or other organisations are not unreasonably affected more than others.	-1	-2	+2
9	For competitive reasons, or in the interests of protecting intellectual property, or security at least some of the components or processes of the technology need not be subject to an impact assessment if they involve sensitive or secretive components or processes.	-3	-4	0
10	It is wise to consider whether the technology implementation has an impact on the number and quality of available jobs.	-3	0	+3

#	Statement	Factor 1	Factor 2	Factor 3
11	It is wise to assess whether the technology has a negative social, cultural or economic impact on individuals in third countries.	-4	+1	+1
12	The policy should be assessed in order to identify substantial changes in perceived (person feeling secure) and objective (assessed) security of relevant stakeholders.	-1	+2	+3
13	It is wise to ensure the technology is robust enough to handle the expected throughput, environmental and operational conditions in which it will operate for a minimum of 5 years.	+1	-3	-2
14	It is wise to identify whether the technology implementation and policy supports or undermines democratic participation or national political culture.	-3	+3	-3
15	Potential hazards or harms (physical or psychological) that the technology may pose to society, individuals, or the environment are important to assess.	0	+4	-1
16	The tendering process should be clearly defined and state the roles and expectations of the implementer and the technology providers, including ownership, maintenance and supply of hardware, software, data and services.	0	-4	0
17	It is crucial to assess new and innovative technologies to identify areas in which they lack according to law, regulation, standards, or best practices.	+2	-1	-3
18	The policy behind implementation, and the technology's effects on users and their behaviour should be morally defendable; the specific technology systems and processes implemented should be proportional and acceptable to addressing the problem; and the results of these efforts should be justifiable.	0	+4	-1
19	Technology developers are the best actors to ensure their products are compatible with existing laws and ethical norms from conception to the final stages of production and implementation.	-4	-3	-2
20	In my view, a technology implementation, and associated processes, should abide by the right to respect for private and family life, home and communications.	-1	0	0
21	Where the technology involves user (public) interaction, the user should be given the opportunity to provide informed consent on whether they allow their data to be used for the explicitly stated purpose. Alternatives should be offered to those who do not consent.	-1	-1	-4

#	Statement	Factor 1	Factor 2	Factor 3
22	Potential risks of 'function creep', whereby an authority approves the use of the technology, system, or data for additional purposes other than those which were originally stated and considered socially, ethically and legally acceptable, are essential to clearly identify and prevent.	-1	+2	+1
23	It is essential to ensure the technology meets an extremely high level of operational availability, and fall-back options are developed to deal with any unexpected unavailability.	+4	0	4
24	It is necessary to consider how, and what personal data is gathered, stored and transmitted by the technology, and whether this is according to regulations pertaining to the protection of data; and whether individuals will have the right of access and rectification of data.	+3	+4	+2
25	The policy should be proportional and necessary for addressing the problem.	+	+1	-3
26	It is important to consider issues regarding how a technology or policy respects the rights of equality, including non-discrimination (on the basis of sex, race, colour, ethnic or social origin, language, religion, political opinion, minority group affiliation, sexual orientation and so forth), as well as respecting cultural, religious and linguistic diversity, the rights of the child, the elderly and the disabled.	+1	-1	+3
27	It is important that the rationale behind the technology implementation, and its function and estimated costs be clearly stated and be open for public scrutiny.	-2	+1	-1
28	The impact of the technology on the natural environment should be considered.	-4	0	-4
29	It is important that the technology is flexible enough to adapt to legislation changes, and to target use by the largest possible traveller cohort: accommodating ID card holders, partnership arrangements with other countries, minors, visa holders, residents, and multiple biometrics etc.	+3	-3	0
30	It would be wise to assess the proposed technology investment to identify any foreseeable positive or negative effects that it may cause that affect non-involved third parties (environment, business, supply chain, increased perceived security etc.).	-2	-1	-4
31	It is wise for authorities to allow the public an opportunity to comment, criticise or request clarification about the technology implementation/policy.	-2	+3	+2
32	In my view, it is important that the right to respect and protect human dignity, the right to the integrity of the person, including the level of vulnerability of the user are considered when considering a technology implementation.	+2	+3	-1

#	Statement	Factor 1	Factor 2	Factor 3
33	It is wise to consider whether the technology and its operation/procedures are in conformity to relevant national, EU, and international laws.	+3	+4	+1
34	Before a policy is implemented it is best to assess if there is a clear public demand and need for the implementation of the proposed technology/ies, or whether this is a political solution to a political problem.	-2	-2	-2
35	It is important that the technology (Hardware and software) is easily upgradeable or adaptable in order to remain 'state of the art'.	+2	-4	+3
36	It would be wise to assess whether technologies might have a negative impact on the social cohesion and solidarity of members of society.	-4	+3	0
37	A vital aspect of assessing the technology is whether it has been developed using the 'privacy-by-design' principle: the privacy of the individual is considered essential, and is integrated into the system design process from concept planning through to the final product.	+1	+2	+4
38	It is important to ensure a clear accountability structure exists which includes who is responsible for the assessing, implementation, proper functioning, and also for failures of the technology.	+1	0	0
39	It would be wise to ensure the technology is assessed on a cost basis (of purchase, operation, personnel, maintenance, availability of parts and services, side costs, lock-in effects etc.) to ensure that value for money is being received over the product lifetime.	0	-4	-2
40	Identifying and minimising how the technology could possibly be used for negative purposes other than those for which it was designed and implemented is essential.	0	0	-3

Appendix B. PESTL categorisation

Cat.	S #	Short name (criteria)	Statement
Policy	2	Definition of purpose	It is important that the technology's purpose and scope of use be clearly defined by implementers in order to clarify what the technology will be used for, what kind of information will be gathered from whom, and who will own and have access to this information.
	16	Procurement	The tendering process should be clearly defined and state the roles and expectations of the implementer and the technology providers, including ownership, maintenance and supply of hardware, software, data and services.
	18	Defendable, proportional, acceptable, justifiable.	The policy behind implementation, and the technology's effects on users and their behaviour should be morally defendable; the specific technology systems and processes implemented should be proportional and acceptable to addressing the problem; and the results of these efforts should be justifiable.
	22	Function Creep	Potential risks of 'function creep', whereby an authority approves the use of the technology, system, or data for additional purposes other than those which were originally stated and considered socially, ethically and legally acceptable, are essential to clearly identify and prevent.
	25	Proportionality and necessity	The policy should be proportional and necessary for addressing the problem.
	27	Transparency	It is important that the rationale behind the technology implementation, and its function and estimated costs be clearly stated and be open for public scrutiny.
	31	Public Engagement	It is wise for authorities to allow the public an opportunity to comment, criticise or request clarification about the technology implementation/policy.
	34	Demand	Before a policy is implemented it is best if there is a clear public demand and need for the implementation of the proposed technology/ies, or whether this is a political solution to a political problem.

Ethics	3	Freedoms	It is important to take the issue of respect for freedoms of thought, conscience, religion, expression and information into account when assessing the impact of technology.
	5	Administration	It is wise to consider whether an implementation respects: the rights for a citizen to be heard before any adverse decision is taken, the obligation for the administration to give a reason for its decision, and the citizen's right to an effective remedy.
	9	Secrecy	For competitive reasons, or in the interests of protecting intellectual property, or security at least some of the components or processes of the technology need not be subject to an impact assessment if they involve sensitive or secretive components or processes.
	11	Third Country impact	It is wise to assess whether the technology has a negative social, cultural or economic impact on individuals in third countries.
	19	Responsible Technology	Technology developers are the best actors to ensure their products are compatible with existing laws and ethical norms from conception to the final stages of production and implementation.
	20	Privacy	In my view, a technology implementation, and associated processes, should abide by the right to respect for private and family life, home and communications.
	26	Equality	It is important to consider issues regarding how a technology or policy respects the rights of equality, including non-discrimination (on the basis of sex, race, colour, ethnic or social origin, language, religion, political opinion, minority group affiliation, sexual orientation and so forth), as well as respecting cultural, religious and linguistic diversity, the rights of the child, the elderly and the disabled.
	32	Dignity and Integrity	In my view it is important that the right to respect and protect human dignity, the right to the integrity of the person, including the level of vulnerability of the user are considered when considering a technology implementation.
	37	Privacy by design	A vital aspect of assessing the technology is whether it has been developed using the 'privacy-by-design' principle: the privacy of the individual is considered essential, and is integrated into the system design process from concept planning through to the final product.

Society	8	Addressee	In my view it is important that specific groups of individuals (e.g. children, women, elderly, unemployed, or ethnic, religious or linguistic minorities), firms or other organisations are not unreasonably affected more than others.
	10	Employment	It is wise to consider whether the technology implementation has an impact on the number and quality of available jobs.
	12	Security Gain or Loss	The policy should be assessed in order to identify substantial changes in perceived (person feeling secure) and objective (assessed) security of relevant stakeholders.
	14	Politics/democracy	It is wise to identify whether the technology implementation and policy supports or undermines democratic participation or national political culture
	15	Hazards	Potential hazards or harms (physical or psychological) that the technology may pose to society, individuals, or the environment are important to assess.
	28	Environment	The impact of the technology on the natural environment should be considered.
	30	Externalised effects	It would be wise to assess the proposed technology investment to identify any foreseeable positive or negative effects that it may cause that affect non-involved third parties (environment, business, supply chain, increased perceived security etc.)
	36	Solidarity	It would be wise to assess whether technologies might have a negative impact on the social cohesion and solidarity of members of society.
	40	Misuse	Identifying and minimising how the technology could possibly be used for negative purposes other than those for which it was designed and implemented is essential.
Technology	1	Applicability	It must be considered whether technology is the best option available, and has been rigorously tested to ensure it addresses the problem adequately, to the requirements of the implementer, and be proven more effective or efficient than existing, or alternative technologies.
	4	Usability	The technology should be attractive, ergonomic, intuitive and easy to use for all user groups (operators, end users), preferably utilising universal user interfaces, symbols and guidance.
	7	Security	The technology should be secure in order to prevent tampering or manipulation by unauthorised users and operators, including hacking, tailgating, trespassing, spoofing etc.

	13	Robustness	It is wise to ensure the technology is robust enough to handle the expected throughput, environmental and operational conditions in which it will operate for a minimum of 5 years.
	23	Availability/reliability	It is essential to ensure the technology meets an extremely high level of operational availability, and fall-back options are developed to deal with any unexpected unavailability.
	29	Flexibility	It is important that the technology is flexible enough to adapt to legislation changes, and to target use by the largest possible traveller cohort: accommodating ID card holders, partnership arrangements with other countries, minors, visa holders, residents, and multiple biometrics etc.
	35	Adaptability	It is important that the technology (Hardware and software) is easily upgradeable or adaptable in order to remain 'state of the art'.
	39	Cost effectiveness	It would be wise to ensure the technology is assessed on a cost basis (of purchase, operation, personnel, maintenance, availability of parts and services, side costs, lock-in effects etc.) to ensure that value for money is being received over the product lifetime.
Legal	38	Accountability	It is important to ensure a clear accountability structure exists which includes who is responsible for the assessing, implementation, proper functioning, and also for failures of the technology.
	6	Standardisation and certification	The conformity of the technology to relevant compliance standards and certifications (health and safety, security, environment, privacy, technical etc.) is important to assess.
	17	Innovativeness and compliance	It is crucial to assess new and innovative technologies to identify areas in which they lack according to law, regulation, standards, or best practices.
	21	Consent	Where the technology involves user (public) interaction, the user should be given the opportunity to provide informed consent on whether they allow their data to be used for the explicitly stated purpose. Alternatives should be offered to those who do not consent.
	24	Data Protection	It is necessary to consider how, and what personal data is gathered, stored and transmitted by the technology, and whether this is according to regulations pertaining to the protection of data; and whether individuals will have the right of access and rectification of data.
	33	Legislation	It is wise to consider whether the technology and its operation/procedures are in conformity to relevant national, EU, and international laws.

Appendix C. HTMLQ: initial setup and customisation

The Q sorting tool HTMLQ is a HTML5 version of FlashQ, a now outdated Q sorting tool that runs on the Flash multimedia and software program. HTMLQ was chosen as it has a number of benefits over FlashQ, the major one being that FlashQ does not seem to have been updated since 2007 (Hackert & Braehler 2007), and due to the fact that version of Flash had a number of known vulnerabilities (Adobe 2007). HTMLQ is based on the FlashQ code with only a few minor differences in functionality, namely the ability to function on Apple operating systems that do not utilise Flash (Approxima 2015). HTMLQ is available for anybody to use free on an Open Source licence and is distributed by "aproxima (sic) Gesellschaft für Markt- und Sozialforschung Weimar" (Society for Marketing and Social Research Weimar) (2015).

To begin, the .zip file containing the application was downloaded from approxima's (2015) GitHub page. There are two main ways of running HTMLQ, firstly the Offline version allows participants to complete questionnaires and return them via email, but it also requires the entire .zip package to be emailed out to participants. Secondly, if HTMLQ is hosted online, the participants can login and complete the questionnaire without the need to download anything, and the results are stored on the server, or emailed directly to the researcher. This research utilised the online method and thus the FlashQ PHP backend files were also downloaded.

Next the four main .xml files were located and edited as needed. These files consist of the main components of the 'web site' the language, the amount and text in the information panels, cards and instructions, as well as the configuration of the sorting map. For example, to change the amount of cells for sorting distribution to reflect the number of statements (40 in this case) the map.xml file was opened and edited in the following way:

- four extra 'column id' lines were added to make the new total 9
- the "column ids" were changed from *-2, -1, 0, +1, +2* to *-4, -3, -2, -1, 0, +1, +2, +3, +4*
- the number of rows in the columns (left to right) was changed from *2, 3, 4, 3, 2,* to *4, 4, 4, 5, 6, 5, 4, 4, 4*
- the colour scale was changed to show more of a sliding scale using the hex colour codes. The original file used the same red/pink for all the negative columns, and green for the positives. The final version has the original pink/green on the outermost columns and gradually lighter shades towards the centre.

Table 11: Comparison of original and edited files

Original file	Final file
<map version="1.0" htmlParse="false"> <column id="-2" colour="FFD5D5">2</column> <column id="-1" colour="FFD5D5">3</column> <column id=" 0" colour="E9E9E9">4</column> <column id="+1" colour="9FDFBF">3</column> <column id="+2" colour="9FDFBF">2</column> </map>	<map version="1.0" htmlParse="false"> <column id="-4" colour="FFBABA">4</column> <column id="-3" colour="ffcccc">4</column> <column id="-2" colour="FFD9D9">4</column> <column id="-1" colour="FFE5E4">5</column> <column id="0" colour="E9E9E9">6</column> <column id="+1" colour="d9f2e6">5</column> <column id="+2" colour="c6ecd9">4</column> <column id="+3" colour="b3e6cc">4</column> <column id="+4" colour="9FDFBF">4</column> </map>

Original "map.xml" file on left, edited file on right.

The config.xml file contains some of the operating code for the application. In this file one can change the order of steps in the questionnaire, or even turn some of them off altogether. This file also contains the code for the participant information section. Thus to add, remove or edit which questions the participants see after they have finished the sort on edits this document.

The language.xml file contains all of the text in the document which could possibly be translated, such as the information and instructions given before, during and after each step, and also the text on the different buttons. In order to modify the instructions to reflect the fact that the Q sort now consisted of seven columns, I changed the text:

> Take the cards from the "AGREE"-pile and read them again. You can scroll through the statements by using the scroll bar. Next, select the two statements you most agree with and place them on right side of the score sheet below the "+2".

To the following:

> Take the cards from the "Most Important"-pile and read them again. You can scroll through the statements by using the scroll bar. Next, select the statements you most agree with and place them on the right side of the score sheet below the "+4".

The language file also contains the section where one can choose the data transmission mode. The options given are sending the data via email, or automatic data transfer to the server. For this research the data was stored on the server.

The final file is the statements.xml file which stores the statements the researcher wants sorted by participants. The statements are given an id, which is then followed by the statement itself and

capped by the end statement markers: “<statement id="1">Public transport is often crowded</statement>”. Statement two would begin with “<statement id="2">” and so forth.

The entering of data took numerous hours of work, especially as there were issues with the server storage space and getting the right information for the automatic data storage actions. The server space was made available by the IT department at VTT using Apache, but I was responsible for transferring all of the content myself and double-checking that the questionnaire was operating correctly. To perform the transfer of files from my computer to the remote server I utilised the tools putty.exe[12] which is an ssh client, and WinSCP[13], an SFTP/FTP client which adds a nice user interface to allow easy transferral of content from my local drive to the remote server. These tools, what they do and how they work are a mystery to me as I have very little background in IT. They were, however an important part of organising the online questionnaire, and as such deserve an honourable mention.

12 The putty ssh and telnet client can be downloaded from http://www.putty.org/
13 The WinSCP FTP client can be downloaded from https://winscp.net/eng/index.php