

# **Development and Evaluation of 100% Security Screening Concepts for Supplies at Amsterdam Airport Schiphol**

Applying and Evaluating the Collaborative Business Engineering Approach

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March 15, 2011





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## Development and Evaluation of 100% Security Screening Concepts for Supplies at Amsterdam Airport Schiphol

*Applying and Evaluating the Collaborative Business Engineering Approach*

### Master Thesis Report

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## Preface

During the past six months I performed my master thesis project at Schiphol Group. This thesis, complemented by a scientific article, is the final element of my master degree in Systems Engineering, Policy Analysis and Management at Delft University of Technology, Faculty of Technology, Policy and Management.

This project has been carried out in the context of an assignment of the Security Policy department at Schiphol Group. The project has resulted in a clear overview of feasible conceptual solutions and the effects of their implementation on logistics of the access points to SRA-CP, level of security, costs and effects for stakeholders. It has also resulted in a detailed project approach for similar projects in the future. Apart from the value for Schiphol Group, this thesis also has added value in the scientific field. The Collaborative Business Engineering approach has been applied to a new type of project with a number of adaptations. The scientific value of this project has also been described in the accompanying scientific article. This article will be submitted to the CRIWG Conference on Collaboration and Technology 2011, after adjustments from my supervisors, who will be co-authors.

Making this thesis scientifically viable, as well as valuable for Schiphol Group would not have been possible without great support and supervision. I would like to thank all the people at Schiphol Group that helped me, especially the colleagues at Security Policy - Access Control and Public Security, and above all my supervisor Rex van der Boom. I would also like to thank Berend Onnes from the Innovative Mainport Alliance (SIM) for the opportunity to perform this project. My first supervisor from TU Delft, Martijn Warnier, also deserves a big thank you for his support during the whole project. I would also like to thank Alexander Verbraeck and Coen van Gulijk for their invaluable advice.

I would also like to thank my parents for their moral support and input as external readers during this project. And of course, thanks to all those other people, especially Nick, that supported me, listened to me and believed in me.

Floor van Werven

Delft, February 2011

## Management Summary

An amendment of EU aviation security legislation prescribes 100% screening of airport and in-flight supplies before entering the Critical Part of Security Restricted Area (SRA-CP) of airports from April 29<sup>th</sup> 2012. Supplies for Amsterdam Airport Schiphol enter the SRA-CP areas through some of the staff filters in the terminal building, and through the vehicle access points at different locations on the perimeter fence. At the time of writing, a security check of supplies is performed on a random sample of the supplies. Increasing the screening level of supplies has a substantial impact on the screening time at access points, which will immediately affect the operations of the access points, security costs and processes of suppliers, recipients and other stakeholders. It is now the challenge for Schiphol Group, particularly the Security Policy department, to meet the new requirements before the deadline in 2012, taking into account the impact on logistics, the level of security, investment and exploitation costs and the effects for stakeholders.

All supplies are to be screened before being allowed into SRA-CP, unless security controls have been applied to the supplies by known suppliers and the supplies have been protected from unauthorised interference from the time these controls were applied until they are in the Security Restricted Area. Five requirements for known suppliers are known at the moment of writing, including security awareness training for all staff with access to the supplies, and prevention of unauthorised access to the property and supplies. It is expected that in the near future these requirements will be increased or fortified, as in the case of known shippers of cargo. Discussions with the legislators and regulators are necessary for further specification of this option. The willingness of suppliers to become a known supplier largely depends on this detailing. Because the final proportion of known suppliers is unknown and dependent on decisions in the future, different scenarios of the level of known suppliership are included in this study.

Executing 100% screening of supplies can be implemented in different ways and several concepts need to be taken into account. Due to the high impact on processes of many stakeholders, all main stakeholders are involved in the development and evaluation of conceptual solutions, applying the Collaborative Business Engineering approach. The stakeholders were asked for ideas after an extensive introduction to the issue during a workshop. The stakeholders also informed us of their main criteria for solutions, and have indicated their most favoured concepts. In a detailing phase a list of conceptual solutions has been analysed on the changes in the process of suppliers, operational performance of the access points, investment and exploitation cost and level of security. Feasible solutions were presented to the participants of the second workshop round. Their main concerns and positive feedback was collected per conceptual solution and processed for evaluation purposes. The overall evaluation of all concepts per scenario was based on the analysis of the concepts and evaluation with stakeholders.

Known suppliership as a solution to this amendment in the law would be a short term option, if accepted by suppliers. They run a substantial risk that requirements will be added or intensified in the future, following the example of other “known shipper arrangements”. Transferring the responsibility to the suppliers for this part of the security system may also be perceived as a security risk. If this option is chosen and accepted by suppliers, part of the supplies will still not be delivered by known suppliers. Some suppliers will not be able to comply with the requirements, and some are one-time-suppliers. For this group, one or more of the developed conceptual solutions for 100% screening should be implemented. The larger the group of unknown suppliers, the more radical the concepts have to be. Smaller changes, such as arrival planning or a dedicated supply screening access point, can be implemented with limited resources. Radical solutions require high investment, but synergies can cause benefits in the future. For example, a distribution centre for terminal supplies will create space in the terminal and decrease the disruption of the passenger process. It will also reduce the need for distribution centres of suppliers, and a reduction in traffic in the basement of the terminal building will improve the air quality to a reasonable level.

For Amsterdam Airport Schiphol, it is very important to have a high quality security system at their disposal. This is not only reflected in the accuracy of checks, but also in speed, perception of the subjects of screening, durability of the system and fit with other processes at the airport. It is crucial to stay ahead of developments in law, technologies and culture and to invest in a future-proof system.

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## 1 Introduction

The background of the research will be set out in this first chapter. The first section provides a basic introduction to aviation security. In paragraph 1.2, the company profile of Schiphol Group is described, as well as the organisation that is supporting the graduation internships: Samenwerking Innovatieve Mainport (Innovative Mainport Alliance). After this, the assignment and the research goals and questions are explained, after which the research approach is introduced in 1.5. The project plan is described in detail in 1.6 and the final part of this chapter consists of a reading guide for this thesis report.

### 1.1 Aviation Security

Due to the high concentration of people with many different nationalities in airports and aircrafts, airports are potential targets for crime and terrorism. It is the responsibility of aviation security to prevent terrorist attacks. Substantial parts of airports are therefore classified as security restricted areas. All people and goods entering these areas need to be security screened. This is why entries to these secured areas in the terminal building and the outside area of the airport are protected by security agents and different kinds of security technology. Passengers, employees, suppliers and vehicles are always checked when they pass an access point to a secured area. These security checks are performed to prevent potential attackers from bringing prohibited goods into an airplane, such as lethal devices and explosive substances. As Monte R. Belger of the US Federal Aviation Administration puts it [5]: “the goal of aviation security is to prevent harm to aircraft, passengers, and crew, as well as support national security and counter-terrorism policy.” Aviation is a vulnerable industry due to several characteristics [59]. The first one is the volume; billions of passengers are transported annually between thousands of airports worldwide and all these passengers and their belongings need to be screened [29]. The second characteristic is accessibility; large parts of airports are public places and easily accessible from highways and with public transport. Economic sensitivity is another issue; economies worldwide are partly dependent on the reliability of air transport. The trade-off between security and convenience and cost is a difficult issue. The fifth characteristic is the limited capabilities of existing detection technologies and the lack of available space at airports. Aviation security is not the same as border control. Border control is responsible for checking the identity of the passengers and screening for illegal goods going in and out of the country.

The best known security check at airports is where passengers and their carry-on luggage are checked for prohibited goods. Metal detectors, X-rays and explosives detection swipes are in place to help security agents perform these screenings before passengers are allowed to board the aircraft or enter a secured area. Passengers' luggage is screened after it is handed in at check-in desks with one or multiple X-ray machines. Cargo is delivered at special entrances to the airport and subjected to security procedures. But many more items and people access planes and secured areas, like airline crew, airport staff and suppliers, and in-flight supplies and airport supplies. To achieve higher levels of security, all these should be submitted to scrutiny.

After the 9/11 destruction of the World Trade Centre, security measures in the USA and globally have been intensified; the fear of terrorist attacks has grown [24]. Examples of these measures are the walk-through metal detection, security scanners that reveal to the security agents the location of an item on people's bodies, explosives detection swipes and the limited allowance of liquids and gels. Most of these measures have been introduced after specific incidents [26]. An example is the restriction on bringing liquids and gels into aircrafts. In August 2006 major terrorist attacks were prevented in the UK and those terrorists had plans to use liquid explosives. Many of the security measures are forced by law, originating from different institutions. The International Civil Aviation Organisation (ICAO) sets Standards and Recommended Practices that are adopted by the 188 member states [21]. The European Parliament and the Council publicise regulations and acts on civil aviation security. Airports are obliged to meet the requirements set out in these laws. In the Netherlands, the National Coordinator for Counterterrorism (NCTb) is responsible for developing all counterterrorism law in the Netherlands, which includes the European regulations. The NCTb is the government body responsible for supervising and monitoring civil aviation security in the Netherlands. Hence, the regulations the NCTb develops are most relevant to the development of security policy at Dutch airports. The royal military police (KMar) is the governmental body that monitors the execution of aviation security regulations.

More information on aviation security in general and at Amsterdam Airport Schiphol (AAS), and the regulative framework AAS operates in is presented in chapter 2.

## 1.2 Company Profiles



The national airport of the Netherlands is Amsterdam Airport Schiphol and this airport is operated by Schiphol Group. Schiphol Group is a company which is for 69.8% owned by the Dutch state. 20% of the shares is in the hands of the municipality of Amsterdam, 2.2% is for the municipality of Rotterdam and 8% is owned by Aéroports de Paris [42]. In the portfolio of Schiphol Group the most important airport is Amsterdam Airport Schiphol (AAS), but Schiphol Group also operates Rotterdam/The Hague and Brisbane Airport among others. More than 46 million passengers have been to AAS in 2009 and more than 400,000 transport movements were measured in that year [42]. There are four main business areas: Aviation, Consumers, Real Estate and Alliances & Participation.



This project is a part of SIM (Samenwerking Innovatieve Mainport or Innovative Main Port Alliance). This is an initiative by the most relevant parties from the Dutch aviation sector and two knowledge institutions that have the aim to position Schiphol as an innovative European mainport. The partners in SIM are Schiphol Group, Royal Dutch Airline (KLM), the National Aerospace Laboratory (NLR), the Dutch Organization for Applied Scientific Research (TNO) and Delft University of Technology (TU Delft) [56]. The knowledge and experience of all parties are combined, resulting in innovations regarding Schiphol. A major activity of this organisation is to develop thesis projects for Master students from Delft University of Technology.

### 1.3 Assignment from AAS

The initiator of this project is the Security Policy department of Schiphol Group. Within the business area Aviation the department of Safety, Security & Environment (A/SSE) is responsible for maintaining a legitimate level of safety, security and sustainability at the airport; their mission is to realise a safe airport. This thesis research is performed for the Security Policy group within A/SSE, which is responsible for policy development, contract and account management, and planning of the security of civil aviation at AAS. Security Policy makes sure that projects result in implementation of solutions that meet all legal requirements, are within budget and consider requirements of stakeholders, such as passengers, suppliers and airlines [54].

This project is about securing the access points for supplies into the Security Restricted Area – Critical Part (SRA-CP) inside and outside the Terminal of Amsterdam Airport Schiphol. SRA-CP in the terminal consists of all gates, the Schengen departure and arrival lounges and the luggage basement. Outside, SRA-CP is the whole area surrounding the runways and gates. A schematic overview of the areas is presented in Figure 1-1. Detailed maps of the terminal building and airside can be found in chapter 4. Currently, the security personnel at the access points outside scrutinize the vehicles and drivers that pass the gates for the presence of forbidden objects and substances. Inside the terminal, personnel and their personal belongings are screened. The goods that are transported into SRA-CP are checked based on random sampling. For instance, catering companies, aircraft maintenance and construction companies pass the vehicle checks with supplies. Inside the terminal supplies pass the security check transported in carts. This includes supplies for cleaning, maintenance, restaurants and shops. Cargo is not taken into account in this research; different screening points and different regulations apply for cargo.

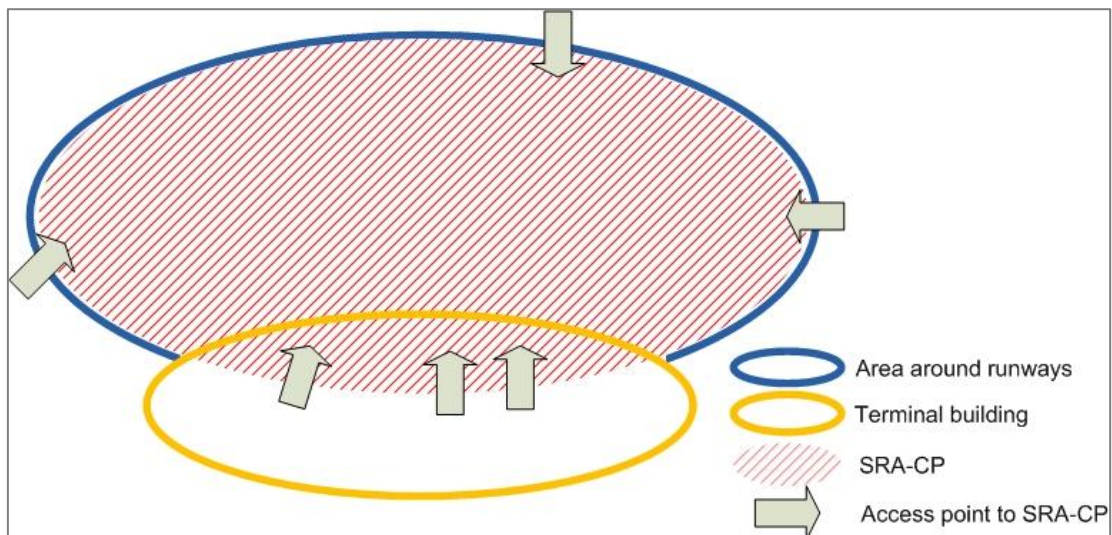


Figure 1-1 Schematic overview of Amsterdam Airport Schiphol

A new EU regulation will take effect from April 29<sup>th</sup> 2012, which obliges all European airports to perform 100% screening of all airport and in-flight supplies that are transported into SRA-CP. Airport supplies are all items intended to be sold, used or made available in security restricted areas of airports [12]. In-flight supplies are all items intended to be taken on board an aircraft for use, consumption or purchase by passengers or crew during a flight, other than cabin baggage, crew belongings and air carrier materials and mail. The intensified screening will have a huge impact on the supply of goods to the terminal and airside. The security checks take more time, which leads to longer waiting times for suppliers and staff, especially during peak hours. More people are needed to perform the checks and new equipment probably needs to be bought, such as X-ray equipment. All this increases the cost of security, and operations are slowed down and primary processes could be interrupted. Adding space to facilitate an expansion of the access points is difficult at AAS, especially in or around the terminal building. Available space can be found in other parts of the Schiphol site, though.

A fact that makes the problem outside the terminal complex is the size and transport mode of the supplies that pass these access points. Trucks full of sand or toilet paper are transported to security restricted areas every day. Checking all supplies in these vehicles is an impossible task for security agents with the current budget, technologies and time pressure. Another issue is the sensitivity or quality loss of some supplies; aircraft engines cannot be taken apart for security screening and trucks with warm asphalt or wet cement cannot be exposed to the air for a long period without quality loss.

The EU has introduced the possibility to make suppliers known suppliers of the airport. This is a construction that is similarly used for cargo and catering. Known suppliers deliver goods in a sealed load area or sealed units and these goods do not need to be screened by agents. The known suppliers are frequently checked by the responsible institution whether or not they still meet the legal requirements stated in the regulations on known suppliers.

Schiphol has decided to focus on the known suppliership option. All suppliers are given the opportunity to become known suppliers. But there will always be a part of the suppliers that is not known to Schiphol; for some suppliers it is impossible to meet all requirements and there are suppliers that do not come to Schiphol on a regular basis, or even just in one instance. The goods of these suppliers still need to be screened 100% for forbidden objects. The Security Policy department now faces the question how to develop a supply-screening system that meets all legal requirements, while keeping operations up to speed, keeping the costs within boundaries and keeping stakeholders involved and content. The success rate of known suppliership is unknown due to unclear requirements and unknown willingness from suppliers, so this research focuses on concepts of 100% supply screening for several scenarios of known suppliership.

## 1.4 Research goals and questions

There are several goals for this research and design project. The first goal is to analyse the current situation related to stakeholders, regulations, processes and procedures. It is also important to make a founded estimation of the current flows of supplies and vehicles passing security checks in order to later identify the effects on operational indicators. A design goal is to develop possible conceptual solutions for 100% screening of supplies and detail these. The identification of effects of these concepts for Schiphol Group and the main stakeholders in different future scenarios of known suppliership is the final product of this project. A higher level goal is to find an appropriate approach for this project, considering its characteristics. The evaluation of this approach and recommendations on how to use this approach in the future is the final goal of this thesis project.

The results from this research are very valuable for Amsterdam Airport Schiphol and can be used as input for a follow-up project. Other airports in Europe can also learn from this research, as all European airports need to comply with the new EU regulation in 2012. The project approach that is used can be valuable to other projects executed by Security Policy. The scientific contribution of this research is a case study of a project approach and an evaluation of this approach in this setting. The main question that will be answered in the thesis project is twofold:

- *Which approach should be used for the project on 100% screening of airport supplies at AAS and how can this project approach be used in the future, at AAS and in general?*
- *What conceptual solutions can be developed taking into account the project context and current situation, and what are their effects?*

The project goals mentioned earlier have been turned into the following research questions and design objectives.

### Domain specific research questions

1. What is the context in which the project is set, taking into account the characteristics of the security system, aviation security developments, regulations and stakeholders?
2. What is the current situation at the access points for airport and in-flight supplies at Schiphol Airport and how will the new regulation affect this?

### Generic research questions

3. Which approach can be used to develop and evaluate screening concepts, considering the characteristics of the project and its context?
4. What can be learnt from previous studies for Amsterdam Airport Schiphol, a benchmark at other airports and similar systems in use, such as baggage screening?
5. How did the chosen approach affect the process and results of the project? How can this approach be used again for similar projects, in general and at AAS?

### Design objectives

6. Which concepts can be developed, taking into account stakeholder input and previous studies and projects?
7. What are the effects of concepts in different scenarios on the stakeholder requirements, security level, operational performance indicators and cost indicators?



## 1.5 Research approach

Considering the complexity of the project and its context, with many interrelated organisations and processes and the dynamic environment of aviation security, a systems approach is essential. Technology, information and organisations and people are the main components of a security system and all components need to work together to provide an aviation security system that works. A systems approach to this project makes it possible to take a holistic view of the problem and to take into account all components of the security system [7]. The mix of components of the security system results in a layered interlinked defence system.

Technology is an important component in the security system. Technical appliances assist the security processes in different ways. Examples are innovative Explosives Detection Systems [57], X-ray machines and walk-through metal detectors. Technical innovations are introduced in aviation security constantly, which promise higher effectiveness rates of security checks and faster handling [8, 15, 30, 38 and 66].

The human element of security is often mentioned in literature to be crucial for the quality of the security [59, 38, 57 and 30]. Just a technical solution will not even come close to a working screening system. The people operating the security checks have to interpret the signals of the technology. For instance, the X-ray images need to be read by the agents; the X-rays can only partially signal dangerous objects. If the agent interprets the signal as a risk, the agent has to decide to act on this signal. The actions of the agents are tightly governed by external controls, namely procedures and regulations, and internal controls, namely knowledge acquired through training and experience [35].

Aviation security requires collaboration across organisations in multiple mission areas and locations [16]. Regulation developers decide on the required level of security. The airports interpret these regulations into policy and procedures. Security companies are hired by airports to execute the procedures. All these organisations need to be aligned to organise the security system well [34].

From the previous explanation it can be concluded that a systems approach can be applied for the (re)design of a security system. Two different kinds of systems approach are discussed in literature: a hard systems approach and a soft systems approach. The hard systems engineering approach is based on the idea that the current state and desired future state can be fully described using a quantitative model. This would mean that there is one optimal design or solution for the new or improved system [36]. This approach is used for the logistical part of the project. It is important to create a quantitative model of the supply flows and to test different concepts in these models. A set of feasible solutions in terms of logistics can be found using this approach. The level of security and an estimation of the costs can also be quantified. Soft systems approaches take different worldviews, qualitative factors and the human element in the system as a starting point [6]. An optimal outcome can not only be measured with numbers, but is also dependent on the commitment of stakeholders. The users and executors of the security system have to accept the new system, and effects of possible solutions for the stakeholders need to be taken into account. In order to deal with the politics present within Schiphol Group and with outside organisations a hard



systems approach is not sufficient. The relations between stakeholders, their interests and their processes need to be taken into account, so the soft systems approach needs to be incorporated. In this project, quantitative modelling will be complemented with stakeholder input.

This project can be described as the design of an organisational system. An organisational system consists of human elements, technical elements and informational elements [65]. In literature various arguments can be found for carrying out designs of organisational systems in groups instead of individual problem solvers [64]:

- Complexity; not one person can grasp all aspects, issues and processes of an organisational system due to complexity, knowledge of process owners is essential.
- Evaluation; a group of stakeholders is more capable of assessing the shortcomings of proposed ideas.
- Acceptance; involving the people affected by the future processes and system will increase the chance of being accepted.
- Interest; it is appropriate to involve people interested in the redesign of a system.

The above soft and hard systems engineering approaches and the group involvement aspect are combined in the Collaborative Business Engineering (CBE) approach [23]. This is a form of Business Process Reengineering (BPR) incorporating collaboration of stakeholders and simulation modelling [18]. The focus of the CBE approach is on facilitating a diagnosis and design process that will result in a satisfying and acceptable solution [18]. Participation of stakeholders in these projects leads to commitment from the stakeholders, reaching a shared understanding between stakeholders and better insight in tasks, views and goals of stakeholders [63]. CBE puts a strong emphasis on the analysis of the current situation, which is very useful in this case; a clear overview of the users, the flows of supplies and processes of users is lacking for this project. Empirical modelling is often used in these projects to analyse the current situation and test different scenarios or concepts. For these empirical models data from observation, experience or experimentation are used.

A Group Support System (GSS) is often used in the CBE approach to enable stakeholder involvement, and for this project we have Thinktank at our disposal, a GSS software from Delft University of Technology. GSS software runs on a network of computers, usually with a separate workstation for each participant. All participants can contribute simultaneously to the same shared objects on the computer, and these contributions are immediately visible to all participants [6]. Group Support Systems are used to make group meetings and group decision making more productive. From field studies and a large number of experiments it can be concluded that GSS meetings appear to be more efficient and more effective than traditional group meetings [6]. Another study has concluded that brainstorming with a group using a computer-based idea generation system outperforms nominal groups in idea-generating tasks [61]. Participants have proved to be more satisfied with the results and the process of GSS meetings [63]. The added value of GSS meetings can be seen in four attributes; anonymity, parallelism, group memory and group size. These four attributes are explained briefly below.

- Anonymity. All participants can enter ideas, comments and votes anonymously. All participants can have their say in the discussion. Shy participants have as much possibility to ‘talk’ as the more confident participants. It is also possible to bring up difficult issues that usually cause a lot of discussion. Ideas can be judged on their value instead of presentation or personality. It is also unknown whether an idea comes from a manager or an operational employee, which makes it more likely that ideas are valued more objectively.
- Parallelism. Participants do not have to wait to come up with an idea until another participant has explained his idea. Everyone can enter ideas simultaneously. During workshops participants often forget an idea they had, because they are forced to listen to another participant. This is not the case with GSS. Participants can also decide to enter ideas in different categories if these are present. This means that different discussions can take place in parallel. It is proven that more ideas are generated using GSS than traditional brainstorm techniques. It can also be concluded from research that more ideas lead to a larger number of high quality ideas [61].
- Group memory. During the GSS meeting, all ideas, comments and votes are stored electronically and can be reproduced in different formats. These minutes of the meeting are not subjective, which can happen if someone is responsible for making the minutes. The completeness can be guaranteed and nothing can be forgotten. The record of the meeting is also more extensive than traditional ones. The whole discussion can be depicted, instead of just the most important conclusions. Another advantage of the GSS is the possibility to return to a comment or idea in a later stage. They are all saved in the system and visible for all participants.
- Group size. Previous research suggests that GSS has a positive impact on groups of 8 members or more in terms of productivity and participant satisfaction [10].

The CBE approach is especially useful in strategic decision making, which has a large impact on the operational level. The participants of the process are confronted with design choices at an operational level. This detailed insight in possible designs will result in a better evaluation of alternative designs [27]. Participation of the stakeholders in such projects is important for various reasons; participation leads to commitment from the stakeholders, it leads to gaining better insight in the stakeholders’ work and creating a shared understanding between the participants [63].

When the CBE approach is used to deal with a problem situation, the following process has been suggested by De Vreede [62]. The first step of the process is the conceptualisation of the current situation and/or the problematic situation. Then, an empirical model is created of this situation and the situations are analysed and diagnosed. The third activity is seeking alternative solutions and presenting them in some prescriptive models of the solutions. These models can be compared and evaluated in order to study the effects of the different solutions. The choice of a solution is made based on this evaluation and the preferred solution is then implemented. A group of critical stakeholders is actively involved in many activities of this approach.

## 1.6 Research Plan

In the following paragraphs, the plan for this project is described, which is an adaptation to the CBE project approach that was described before. An important part of the research consists of analysis of the current situation and the context of the project. Involvement of stakeholders is used in different phases of the project. Modelling of the flows and queues in front of the access points will be used to get more insight in the current situation and the different solutions. The result of this project will be an overview of feasible concepts and the effects of these concepts on several criteria. The actual decision for one solution will depend on different factors, such as the level of acceptance of known suppliership, the weight of criteria and the decision of higher management, which is out of scope for this project.

In the projects in which CBE was applied the number of involved stakeholders was relatively small and usually from within the company and it is advised not to invite too many participants [18]. In this case, a larger group of participants is involved in the project, which changes the way of working considerably. The organisational system that needs redesigning concerns many stakeholders from within the company and outside Schiphol Group. The interests and goals of these stakeholders differ, even within defined groups. Many stakeholders are interdependent, so changes cannot be made without consulting these parties. The solution to this issue of too many stakeholders was found in two levels of involvement. A high level of involvement in the project is requested from the problem owners at the Security Policy department of Schiphol Group. They are experts on the regulative and financial boundaries for the project and they possess knowledge on the procedures at the access points and processes of users. This group will be involved in the building of conceptual and empirical models, validation of models and the selection of concepts that will be detailed for evaluation. The large group of stakeholders, including representatives of relevant departments of Schiphol Group, suppliers, recipients, security companies and airlines, will be involved to gather conceptual data, to provide input on ideas for future systems, criteria for future systems and the evaluation of feasible concepts.

The different phases, their results and input are depicted in Figure 1-2. From this figure it can be concluded that the process is not linear due to the feedback loops. Analyses are adjusted when new information is retrieved from a later performed analysis. The plans for the different phases are described in the following sections.

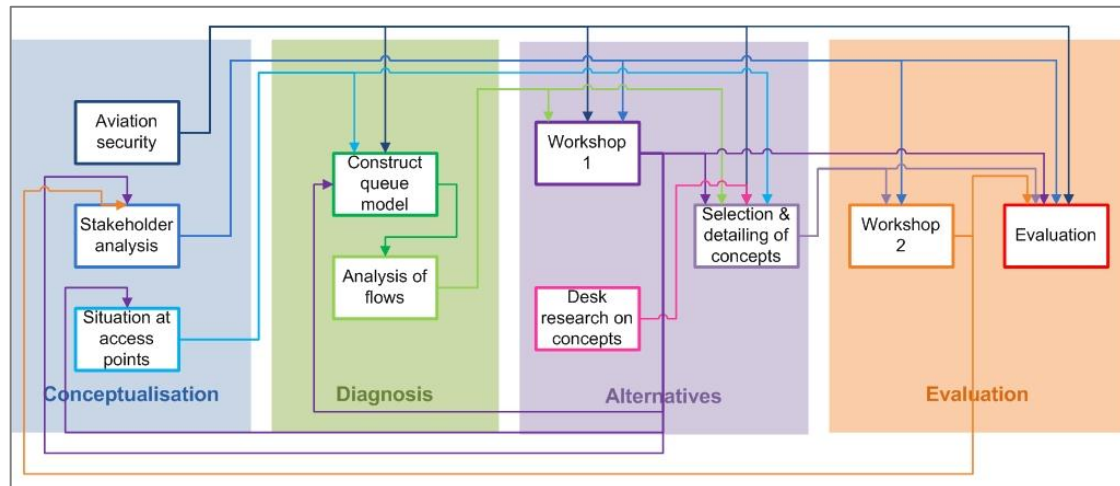


Figure 1-2 Overview of project plan

### 1.6.1 Conceptualisation

The Conceptualisation phase consists of a few steps to come to a better understanding and conceptual models of the current and future situation and the project context. First, background information and the history of aviation security and the regulative framework in which Schiphol Group operates is analysed. The current level of security at Schiphol will be analysed and the possible future changes in regulation are presented. Desk research on the law text and security theory and interviews with employees from security departments are the methods used.

A stakeholder and network analysis will be performed to create an overview of the stakeholders involved, their responsibilities, interests and goals and their relations. For this purpose, interviews with stakeholders are planned. This analysis results in an overview of stakeholders and their interests, and a list of stakeholders that will be involved further in the project.

These interviews are also used for the analysis of the current situation at the access points. Maps of Amsterdam Airport Schiphol will be shown and discussed and the current processes at the gates are described with an event-sequence diagram. These processes can be retrieved from the interviews and field research at the access points. The main users of the access points to SRA-CP and the categories of supplies are also defined in this stage. The process of a typical supplier is another part of the analysis of the current situation and is presented in an IDEF0 diagram (Integration Definition for Function Modelling). This is a method to visualise processes, which is often used to model current and future activities and processes around a product [17].

### 1.6.2 Diagnosis with a model

During the next phase of the project a queue model is constructed. Excel is used for this part of the analysis, as available data are not detailed enough to create a meaningful extensive simulation and animation model. The necessary data are gathered from the Management Information System on access points, relevant previous studies and the problem owners of Security Policy. The structure and assumptions for the models are constructed in cooperation with the group of problem owners from Security Policy. Output from the model

of the current situation is graphs with the current characteristics of the system. An analysis of queues if the supply screening is raised to 100% with the current processes in place will also be a part of this phase.

Validation and verification tests are run in order to test the operation and accuracy of the model. The model and its outcome are also validated during a workshop with relevant stakeholders.

### **1.6.3 Alternatives**

During the first workshop with the stakeholders the current situation and changes in the future are explained. A brainstorm takes place to collect solution directions for the 100% screening, using Thinktank: a Group Support System software. After the collection of many different solution directions, the participants are asked to write down all their criteria for the new security system. Then, a voting takes place to find out which ideas are most popular.

In order to create a complete overview of possible solutions, previous studies for AAS security systems are taken into account, as well as notions from comparable systems.

A selection of solutions is worked out in detail. This selection is performed partly during the workshop and partly afterwards with the problem owners of Security Policy, determining which solutions can meet the legal requirements and are feasible. New conceptual situations are described in IDEF0 diagrams and the different concepts are simulated in the Excel model, with necessary adaptations. These models are validated and verified with experts and during the second workshop. An overview of the possible costs is also part of the detailing. The resulting detailed concepts are alternative solutions, worked out to a conceptual level.

### **1.6.4 Evaluation**

During the second workshop the detailed concepts are evaluated with the large group of stakeholders. An overview of the changes in the supplier processes, logistical effects on the access points, possible costs and impact on the security level is provided. All participants are asked for feedback on all concepts, in order to collect the effects of potential solutions for the stakeholders. A few scenarios based on the percentage of supplies brought in by known suppliers are introduced for evaluation, because this influences the effects and feasibility of the concepts. The effects per concept and per scenario of known suppliership are presented. This evaluation will be validated with the group of problem owners from Security Policy.

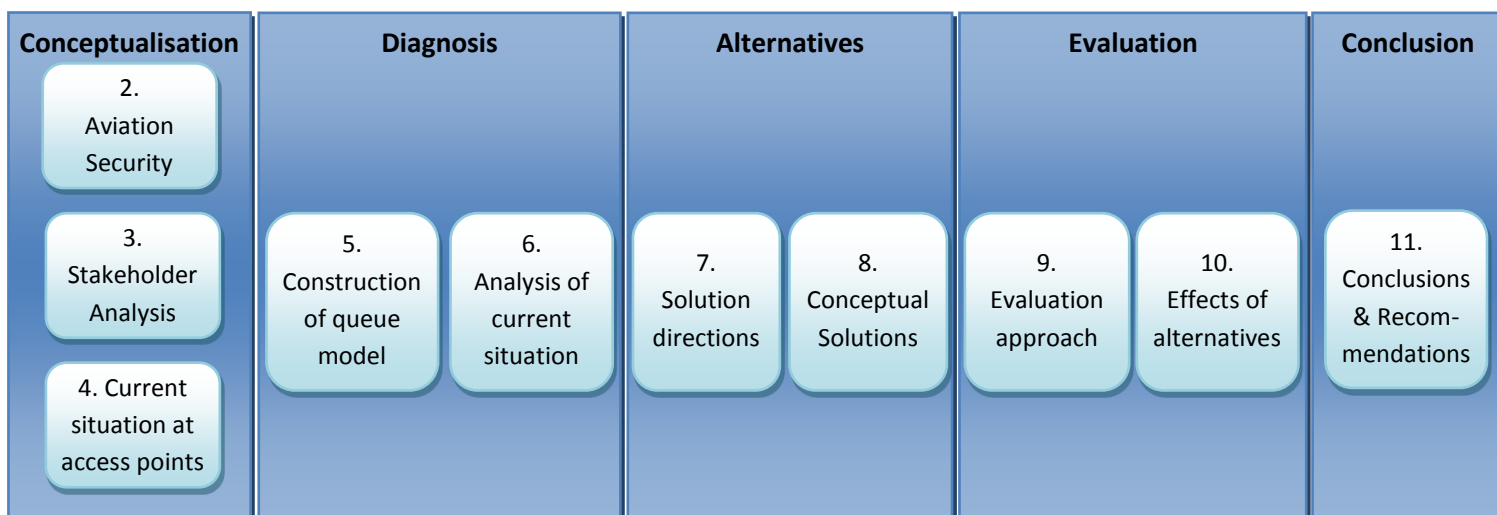
### **1.6.5 Conclusion**

In this part of the conclusions of this project will be presented. The applied CBE approach is evaluated and observations during the process are described, which represents the scientific value of the project. The added value of the research for Schiphol is presented and recommendations for the future are presented. Recommendations for further research are also described in this part of the thesis report.

## 1.7 Outline of report

This report is organised into the five parts as described above. The first part is the Conceptualisation of the current and future situation. In chapter 2 the background on aviation security and the legal framework are presented. Chapter 3 describes the main stakeholders and their interests and goals. Models of the relations and interests result in a better insight. A list of the stakeholders that should be involved in the subsequent phases of the project is another outcome of this chapter. The current and future situation at the access points is presented in chapter 4 with process models, maps and lists of suppliers and supplies. In the Diagnosis part the construction of the queue model in Excel is described in chapter 5 and its outcomes are presented in chapter 6. In the Alternatives part the collection of solutions is described in detail. In chapter 7, the workshop with the brainstorm is discussed and the previous studies and similar systems follow. In chapter 8 detailed descriptions of a selection of concepts can be found. The method of evaluation and the actual evaluation of the solutions in different scenarios will be described in the Evaluation part in chapter 9 and 10. Conclusions and recommendations can be found in the last chapter of this thesis report. After this, appendices are added that support the thesis report.

A reduced overview of the contents of this thesis is presented below.



# Conceptualisation

## 2 Aviation Security

This chapter describes the context of this project. It deals with definitions and explanations of important concepts from security and risk management. The last section of this chapter focuses on the regulative context in which AAS operates, and discusses the regulations currently effective for the access points to SRA-CP and the planned amendments. A short section focuses on the expected changes in regulation and changes at AAS that will affect the procedures at the access points. Desk research consisting of law texts, articles and books on security and interviews with experts provided input for these analyses. The problem owners from Security Policy collaborated in conducting these analyses. This analysis will lead to a better understanding of the field the assignment is set in and the cause for this project.

### 2.1 Security

A definition of security is given in the Security Risk Management Body of Knowledge as the condition of being protected against danger or loss; this condition is achieved through the prevention of the intentional and non-legal actions of others [60]. Security is a concept often confused with safety, and research has been dedicated to this ambiguity [31]. In the practice of risk management these two terms have different meanings. Safety deals with threats as an unwanted side effect of something else and is often associated with incidents and accidents. Security deals with intentional malicious acts, such as sabotage and terrorism [4].

A high level of security leads to a safe environment and this is one of the main sources of motivation for people. Abraham Maslow wrote a paper in 1943, 'A Theory of Human Motivation', on the needs of human beings to perform satisfactorily. The basic physiological needs have to be satisfied first, such as hunger, thirst and sex [28]. After these basic needs the need for self-preservation and avoidance of injury follows; these are the safety needs [9].

Civil aviation security is focused on preventing criminal activity on aircrafts and airports. These criminal acts include hijacking aircrafts, damaging of aircrafts or airport areas and jeopardising the people in aircrafts and airport territory. Preventing smuggling activities and illegal travelling is not the focus of aviation security, but is the responsibility of the border police.

### 2.2 Security risk management

The British Health and Safety Executive [20] defines risk as the likelihood that a hazard will cause its adverse effects combined with a measure of the effect. A hazard is defined as something that can cause adverse effects, e.g. water on a staircase and the presence of dangerous objects in security restricted areas. Security risk management has been defined in the SRMBOK as "the culture, processes and structures that are directed towards maximising benefits and minimising adverse effects associated with the intentional and unwarranted actions of others against organisational assets"[60, p.36]. Potential sources of security risks are criminals, terrorists, foreign intelligence services, competitors and malicious individuals. In the case of aviation security foreign intelligence services and competitors are not



important sources of risk. Aviation security focuses on intentional acts, often with political impact as a desired result.

Security involves making trade-offs. Security decisions often include a range of costs as well as compromises to privacy, convenience and speed. Often, a trade-off between perceived risk and actual risk is necessary as it is not always the case that managing the actual risk mitigates the perceived risk. Sometimes it is more important to demonstrate that something is done to mitigate a risk, than mitigating the actual level of a risk. Such measures reassure travellers and consumers to continue purchasing a product or ticket. These issues of perceived and actual risk are largely subjective and vary depending on risk appetite and understanding, as well as personal or organisational agendas. It is in the airline's interest that risk perception of air travel is as low as possible, more than the level of the actual risk of hijacking. An actual hijack is a very rare event with dramatic consequences, but a high perceived risk of hijack can result in low passenger numbers and will impact the revenue of airlines drastically [60].

Security decisions are often guided by a trade-off between costs and quality of risk mitigation. An often used concept in the UK is that risk should be As Low As Reasonably Practicable. Appropriate application of resources reduces exposures to the point where overall risk is ALARP. ALARP is a level of risk that is tolerable and cannot be reduced further without the expenditure of costs that are disproportionate to the benefit gained or where the solution is impractical to implement [60]. When risk reaches intolerable high levels, it is expected that the risk will be reduced or the risky activity will be terminated, unless the cost of this reduction or termination is disproportionate to benefits gained by accepting that risk. When risks are already at a tolerable level, risk reduction only occurs when benefits exceed the costs of this reduction.

The ALARP concept can clearly be described by the point in the following graph where the trade-off between cost and benefit has reached its optimal value and costs for further risk reduction increase disproportionately. Risk reduction should be considered when marginal gains exceed marginal costs [22].

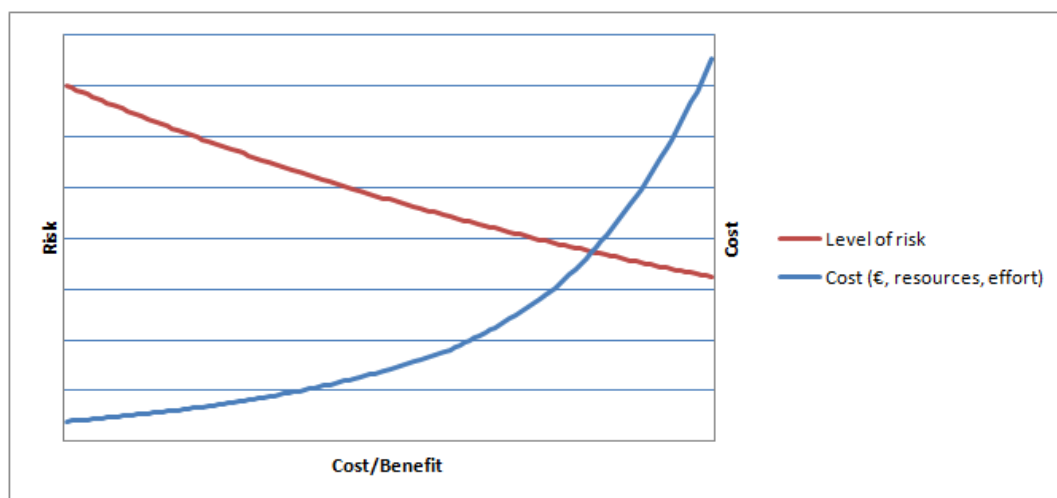


Figure 2-1 ALARP Cost/Benefit Trade-off [60]

The ALARP principle sounds logical in theory, but in practice many companies and organisations are reluctant to reduce risks beyond legal limits [22]. Costs for risk reduction are not immediately earned back by the investor, and returns are difficult to measure. ALARP is therefore also known as the lowest security level allowed, just being compliant with the legal requirements: security As Low As Regulations Permit.

From best practice in security risk management it is suggested that a security-in-depth approach to asset protection provides the greatest security. Independent layers of security measures will provide multi-layered security of the asset. The security-in-depth concept provides a graphic depiction of existing countermeasures and other threat mitigation systems available. Six categories of controls have been identified, that can be used to mitigate threat [60]:

1. Elimination. Complete removal of the threat and elimination of the risk. For instance, if the risk is an explosion of the aircraft flying from Amsterdam to Munich, elimination would mean that the plane does not fly from Amsterdam to Munich.
2. Substitution. Replacement of a hazardous substance or work process with a non-hazardous or less hazardous one. Staying with the previous example, substitution would mean that all passengers take the train instead of the plane.
3. Isolation. Separation of the risk from people or objects by distance or use of barriers.
4. Engineering controls. Modification of tools and equipment, using enclosures, barriers or automation.
5. Administrative controls. Introduction of work practices or procedures that reduce risks.
6. Protect the asset. Last line of defence at the asset

An example of the security-in-depth approach is presented in Figure 2-2. In appendix A the analysis of Schiphol security of the security restricted areas is depicted using the security-in-depth approach.

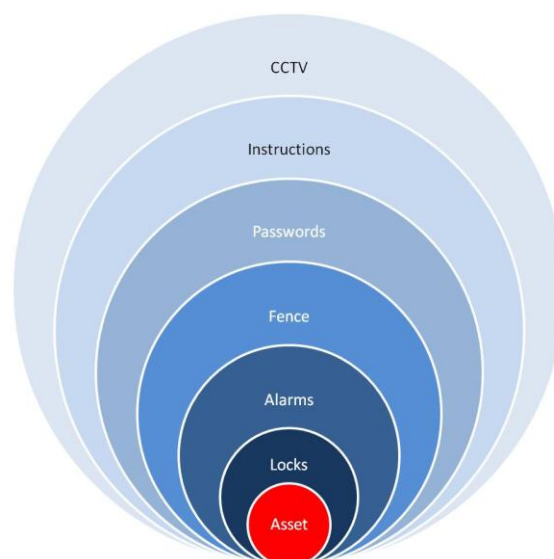


Figure 2-2 Example of Security-in-Depth analysis

There are five SRMBOK practice areas:

1. Security management. Conceptual, administrative management and virtual SRM arrangements
2. Physical Security. Protection of physical assets as well as physical measures designed to protect intangible assets or capabilities
3. Information Security. Protection of information and Intellectual Property from loss or compromise by human actors
4. ICT Security. Protection of ICT systems and information stored in ICT systems from loss or compromise
5. People Security. Controls for protection from security risks associated with people

In aviation security physical security and people security play the biggest roles. Information and ICT security also play a role, but are not as heavily present at airports.

Physical security involves the physical protection of personnel, hardware, property, networks and data from deliberate acts and events. A physical security system must provide the capability to detect, assess, communicate, delay and respond to a suspected physical breach of security. A physical security system includes access control systems, such as barriers, security staff, lighting and restricted access areas.

People security consists of two elements. The first is security associated with protection of humans, the second element of people security is where people are the key element in applying or breaching security. Personnel security is the process that enables only suitable people to obtain and retain access to sensitive or security restricted resources. Screening of people needs to be done previous to granting access but also needs to be reviewed. The issue of security-related items such as keys, codes, badges and passwords needs to be registered. To create and maintain an awareness of security responsibility for all employees, training programs should be set up. Access badges and computer access codes should be provided to all employees. Badges need to contain personal and badge information and should visually indicate the type of access privileges. The human factor in the security system can be very complex but directly affects the success or failure of the security system and needs to be taken seriously. Human error is a determining factor in many accidents in large systems [34].

## 2.3 Barriers

Barriers are installed to prevent security risks. A proposed classification of barrier systems is the nature of barriers and the following four categories can be used [19]. It is possible to combine barriers from several classifications of barrier systems.

- Physical or material barrier systems. These barriers physically prevent an action from being carried out or an event from taking place. Examples are buildings, walls, fences, railings, gates etc. There is an actual physical hindrance for the transportation of mass, energy or information between two points. It might not prevent it under all circumstances, but it will at least delay it or slow it down.

- Functional barrier systems. A functional barrier system works by preventing the action to be carried out. One or more preconditions are set up that have to be met before an action can be carried out. A lock that needs a key, a password or identification are examples.
- Symbolic barrier systems. These systems require interpretation of the recipient in order to reach their objective. Visual and auditory signs and signals, such as warnings by text or symbol and visual demarcations are examples of symbolic barriers.
- Incorporeal barrier systems. An incorporeal barrier is not physically present in the situation where it is applied and depends on the knowledge of the user to achieve its purpose. Examples are rules, guidelines, safety principles and laws

Barriers can also be classified by function. The basic purpose of a barrier is to stop something from happening, but functions can differ per barrier and are often related to the barrier system. Some examples of barrier functions are protecting, preventing transport, preventing movement, keeping together, separating, hindering actions, dampening, regulating actions, indicating system status or condition, permission or authorisation, communicating, complying and prescribing [19]. In appendix A examples of barrier systems at AAS are presented with their nature and function.

## **2.4 Regulative framework**

Security policies, procedures and installations at Amsterdam Airport Schiphol are focused on preventing sabotage, unlawful seizure of aircrafts and terrorist attacks. The security systems at Schiphol are largely based on security aviation regulation. AAS has to comply with the Dutch regulations on aviation security set by the National Coordinator for Counterterrorism (NCTb), which are based on the EU aviation regulations. The Dutch security aviation law is also influenced by the standards and recommended practices from ICAO (International Civil Aviation Organization). An amendment in the current EU regulation on screening all supplies before entering SRA-CP is the main cause of this research. Due to the amended security regulations major changes are necessary at the SRA-CP access points for vehicles and staff with supplies for the security restricted areas of Amsterdam Airport Schiphol. Therefore it is important to understand the aviation security regulations that are currently effective for these access points, the planned amendment and amendments that can be expected in the future. These will be discussed in the subsequent sections.

### **2.4.1 Currently effective EU regulation for supplies and access points**

EC Regulation No 300/2008 is the currently effective regulation on civil aviation security. A number of Commission Regulations are written to enforce detailed measures for the implementation of the common basic standards on aviation security from No 300/2008. The most important ones are 272/2009 and 185/2010. Parts of these implementation details are not publicly available. They describe the processes and procedures in such detail that it could give potential intruders too much insight.

At airports the following areas have to be established: landside, airside, security restricted areas (SRA) and critical parts of security restricted areas (SRA-CP). In the map of Schiphol that can be found in chapter 4 these different areas are marked. Different regulations on access control apply for these areas. In order to enter SRA-CP a person has to have completed a background check before an identification card, authorising unescorted access, is issued. All persons and items carried by these persons shall be screened for prohibited objects when entering SRA-CP. Vehicles entering SRA-CP are also examined to prevent prohibited objects from being introduced into these areas. Supplies to be sold or used in SRA-CP (airport supplies) and supplies for aircrafts (in-flight supplies) are subjected to security controls on a basis of random selection in order to prevent prohibited objects from being introduced in these areas.

Prohibited objects are items that can be used to commit an act of unlawful interference that jeopardises the security of civil aviation. There are six categories of objects prohibited in security restricted areas and in aircrafts [13]:

- (a) Guns, firearms and other devices that discharge projectiles – devices capable, or appearing capable, of being used to cause serious injury by discharging a projectile;
- (b) Stunning devices – devices designed specifically to stun or immobilise;
- (c) Objects with a sharp point or sharp edge – objects with a sharp point or sharp edge capable of being used to cause serious injury;
- (d) Workmen's tools – tools capable of being used either to cause serious injury or to threaten the safety of aircraft;
- (e) Blunt instruments – objects capable of being used to cause serious injury when used to hit; and
- (f) Explosives and incendiary substances and devices – explosives and incendiary substances and devices capable, or appearing capable, of being used to cause serious injury or to pose a threat to the safety of aircraft.

In order to screen for prohibited articles in vehicles, cabin baggage and supplies the following methods can be used to perform the screening [13]:

- (a) Hand search;
- (b) Visual check;
- (c) X-ray equipment;
- (d) Explosive detection systems (EDS) equipment;
- (e) Explosive detection dogs; and
- (f) Explosive trace detection (ETD) equipment.

### 2.4.2 Stricter supply screening

In Part H of Regulation 272/2009 it has been determined under which conditions supplies moving into SRA-CP need to be screened from April 2012. Airport supplies shall be screened before being allowed into security restricted areas, unless security controls have been applied to the supplies by a known supplier and the supplies have been protected from unauthorised interference from the time that those controls were applied until they are in the security restricted area. All other supplies need to be screened 100% with one of the methods described before, such as visual check or X-ray equipment.

Known suppliers of in-flight and airport supplies shall be designated by the appropriate authority. In order to be registered as a known supplier of airport supplies, the authority shall ensure that the prospective known supplier provides information on aviation security standards and shall make a validation.

A known supplier of airport supplies shall [14]:

- (a) appoint a person responsible for security in the company; and
- (b) ensure that persons with access to airport supplies receive security awareness training before being given access to these supplies; and
- (c) prevent unauthorised access to its premises and airport supplies; and
- (d) reasonably ensure that no prohibited articles are concealed in airport supplies; and
- (e) apply tamper-evident seals to, or physically protect, all vehicles and/or containers that transport airport supplies.

### 2.4.3 Possible future changes affecting regulations

The regulation on becoming a known supplier is applicable for the supplier that actually takes the supplies across the border to SRA-CP. This supplier receives its goods often from other suppliers. These suppliers do not need to be known, if the main supplier can guarantee in a reasonable way that there are no prohibited objects in these goods. This means that the final supplier is obliged to screen the goods that are supplied to him. It is to be expected that this regulation will intensify in the future, and the NCTb or EU might decide to make known suppliership obligatory further in the supply chain. This means that the suppliers supplying goods to the Schiphol suppliers have to pass security requirements. This is exactly what happened in the past for cargo shippers. The regulation started off with the light version of known suppliers such as prescribed now for airport supplies, but was intensified after a few years. The suppliers of the cargo shippers also have to be known suppliers, and are obliged to screen their goods. Else, all cargo needs to be screened before it can be loaded on the aircrafts, which is very time consuming. Cargo brought in by known shippers is still randomly screened for prohibited objects and smuggled goods. It needs to be taken into account in this project that airport and in-flight supplies could face these stricter regulations in the future. According to the expert on Quality and Compliance, it is probable that additional security requirements will be added to the current five requirements for known suppliers [48].

The amended regulation is applicable to all supplies moving into SRA-CP. This area in the terminal now consists of lounge 1 and the small lounge 4. Lounge 2 and 3 are areas that can be entered with just a passport control; the security screening for crew and passengers occurs at the gate. There are plans to enlarge the security restricted area in the terminal in 2015. The idea is to centralise security screening for all departing passengers before they move into the lounges. This means that lounge 2 and lounge 3 will be added to Schiphol SRA-CP. The supplies for shops, restaurants, cleaning and maintenance in this area will need to be screened, as well. The flow of goods that need screening inside the terminal will be more than double the size compared to the current situation due to this development.

## 2.5 Conclusions

Security can be defined as the protection against danger or loss. Aviation security is focused on intentional malicious acts by individuals or groups focused on aircrafts, airports and the present people, often with political impact as a result. Aviation security does not deal with smuggling of goods or living beings; this is the responsibility of border police. A trade-off between risk mitigation and costs is difficult. A concept that stems from the UK is ALARP; the risk level should be As Low As Reasonably Practicable and should be mitigated until the cost to decrease the risk becomes disproportional to the decrease of risk achieved. A security-in-depth approach offers a graphic depiction of a multi-layered security system. Most important aspects of aviation security are physical security and people security. The security system at AAS consists of several barrier systems that prevent intentional malicious acts to aircraft or airport.

The focus of aviation regulation is currently on the stricter screening of supplies that are taken into SRA-CP. The requirement in April 2012 will be that all these goods are 100% screened or delivered to SRA-CP by known suppliers, who comply with the set of requirements. In the near future the SRA-CP area of Schiphol will be enlarged. The flows of supplies that need to be screened inside the terminal will be more than double within a few years. Stricter requirements for known suppliers can be expected, and this will affect the cost and effort needed to become a known supplier and therefore the feasibility of this 'solution' in the future.

The context and immediate cause of this project has been defined in this chapter. An introduction into aviation security and risk management has been provided, and the legal structure AAS operates in is sketched. The most important regulations that apply for the access points to SRA-CP at the moment and the changes for the future are identified, and some considerations for possible solutions are outlined. This part of the study has led to a better understanding of the context of the project. In the following chapter all relevant parties will be analysed and an overview of their interests will be presented, resulting in a list of stakeholders that will be involved in the project.



### 3 Stakeholder and Network Analysis

In this chapter the main stakeholder groups of this project are described. The responsibilities of the actors are documented and their interests in this project are described. In appendix O the stakeholder analysis is described in detail in a table. Their values, goals, problem perception and possible solution directions can be found there, as well as stakeholder criticality and the formal relations between stakeholders. An interest diagram shows the main interests of the stakeholders and the relations between these. From interviews with people from different companies, organisations and departments of Schiphol Group, information is retrieved to perform this analysis. The discussions with stakeholders followed an inside-out movement. The first interviews were held with people from the Security Policy group, then other departments of Schiphol Group followed, after which some outside organisations were contacted. The selection of stakeholders was based on desk research and on suggestions from interview partners, and guided by the problem owners at Security Policy. An overview of interests, responsibilities and relations is crucial for the selection of participants of the subsequent project phases.

#### 3.1 Stakeholder responsibilities and interests

In this section of chapter three the main stakeholders in this project are mentioned. Their responsibilities, goals and interests are described in the following seven paragraphs.

##### 3.1.1 Problem Owner: Schiphol Group - Security Policy

Security Policy is a group within Safety, Security & Environment from the Business Area Aviation. Security Policy deals with cases around security. Often, regulations around security are intensified and Amsterdam Airport Schiphol needs to adapt to these changes to stay compliant with the regulations. The Security Policy group is responsible for the correct interpretation of these regulations into the security policy and security operations of Schiphol. SP takes into account the wishes of Schiphol's passengers and airlines, costs and current logistical processes at the airport. It is the goal of Security Policy that the security level of Amsterdam Airport Schiphol is compliant with the EU aviation regulations, and that costs and stakeholder effects are taken into account.

##### 3.1.2 Other Schiphol Group departments

Overall, Schiphol Group is striving to make Amsterdam Airport Schiphol the most preferred airport of Europe, for passengers and airlines, offering all of its visitors a pleasant and inspiring environment for travel, work or visit. The perspective of the passengers and other users of Schiphol Airport is therefore key. The following brand values have been identified for Amsterdam Airport Schiphol: hospitable, efficient, reliable, inspiring and sustainable [42]. Schiphol has developed the Airport City formula, which is aimed at the integral development of aviation and non-aviation activities. Schiphol aims to be a leading efficient airport that can offer all required services to its visitors and enterprises 24 hours a day and 7 days a week. In the next paragraphs the involved departments and groups within Schiphol Group are discussed. In appendix D an organisation chart is depicted which shows these departments and groups.



The group Quality & Compliance within Safety, Security & Environment is responsible for keeping all security processes at the appropriate level. It is their responsibility that Schiphol is compliant with the current regulations. This department checks the quality of security with Mystery Guests and reports the level of security companies to the account managers within Security Policy. The Quality & Compliance group also deals with the KMar and NCTb on the interpretation and execution of the regulations. It is important that these institutions trust this department. For this particular case it is very important that the level of supply screening is not raised before 2012 [48].

The group Control is responsible for keeping the costs of Safety, Security & Environment at a reasonable level. Costs for security are covered by the security charges paid by passengers and landing fees paid by airlines [45]. A raise of these charges is not desirable, so the solution should be cost efficient and if possible have a positive business case.

At the department Airport Operations Airside a small group is responsible for the facilitation of building projects on airside within the operational procedures, Construction & Maintenance Control. Building projects and operational processes should be least interrupted as possible. A building project is often working on a tight schedule, but airside operations are also on a tight schedule, so this is a challenge as it is [44]. Extra waiting lines at access points to airside will make the management between the projects and airside operations even more difficult. Quality loss of supplies as a result of lengthy screening is also a concern.

A group of buyers is responsible for all contracts with maintenance and construction contractors. These buyers are very worried about the known supplier arrangement. They are sure that extra costs for suppliers will eventually be paid by Schiphol Group, because these companies will add an extra fee to the bill [51]. This department is also afraid that the advantage reached by outsourcing the project realisation to main contractors will be levelled out; the group of sub-contractors a main contractor can choose from will be smaller, and market forces will be in disorder, due to extra requirements for these sub-contractors. If supplies are needed fast, a main contractor will have to use a known supplier, who might not be the cheapest or best for the job. The buyers prefer the option that Schiphol invests into screening measures.

The Business Area Consumers, and especially the department Retail, is responsible for keeping the concessionaires of Schiphol satisfied. The group of concessionaires consists of all shops, restaurants and cafes that operate in the terminal, in secured and public areas. These concessionaires pay a fee to Consumers for selling their products to passengers. It is of great importance that continuity and high profitability is possible in the terminal [50]. A large part of Schiphol's income depends on these fees. For Consumers it is very important that the suppliers of shops and restaurants are not disturbed in their usual processes.

### **3.1.3 Governmental Bodies**

The National Coordinator for Counterterrorism (NCTb) is responsible for developing all counterterrorism law in the Netherlands and including the European regulations into Dutch law. The NCTb is the government body responsible for civil aviation security and this organisation also monitors civil aviation security execution. Hence, the regulations the NCTb develops are most relevant to the development of security policy at Dutch airports [48]. The royal military police (KMar) is the governmental body that inspects the execution of aviation security regulations.

### **3.1.4 Security companies**

The security tasks at Amsterdam Airport Schiphol are contracted out to different security companies. These security companies are responsible for fulfilling the operational security tasks, such as checking passengers, employees, baggage, vehicles and supplies. A planning is made every week at the Security Policy group, and the security companies fill these in with their agents. For these companies a workable schedule is one of their interests [46]. This means the schedule should be predictable and not volatile. Continuity of the contract is also important, so these companies do their best to meet the requirements from the contracts. The work they do needs to be enabled and made easier by the supply of the right technological resources and organisation of the access points and filters. Long waiting lines result in a less pleasant working situation, because the suppliers will not be cooperative.

### **3.1.5 Users of access points**

Suppliers of goods to SRA-CP are responsible for delivering the goods on time and with the right quality. It is their responsibility or the responsibility of the recipients of the supplies that they have access to SRA-CP. They need a valid personal Schiphol pass and in case of a vehicle they need a vehicle pass, as well. The main group of users with supplies of the access points in the terminal comprises the shops, restaurants, maintenance and cleaning companies. At the vehicle access points examples of users with supplies are maintenance and construction companies, suppliers to offices on SRA-CP, aircraft cleaning companies and catering.

It is in the interest of the suppliers and the recipients that the process at the access points and filters occurs smoothly and fast. Some supplies are perishable, such as asphalt or fresh sandwiches and waiting in line or checking of the supplies will ruin the products [44]. Suppliers are usually organisations that are in business to make a profit. If additional costs need to be made to become a known supplier or have the supplies checked, this is not an appealing solution. Costs and delays for the suppliers and recipients of supplies should be at the lowest level possible.

### **3.1.6 Airlines & passengers**

Airlines and passengers are the end-users of the airport, and Schiphol has adopted hospitality towards airlines and passengers as a key goal. Airlines can also play the role of suppliers and recipients, but this role is covered in the former paragraph. Airlines' and passengers' main interests are low costs and high efficiency in the ground handling operations. Security measures slow operations down and increase costs for both parties. On the other hand, airlines and passengers are also interested in safe and secured airports and aircrafts. They expect Schiphol to be compliant with the current regulations and even more.

### **3.1.7 Residents and employees of surrounding areas**

The habitants of surrounding areas of Schiphol are affected if Schiphol is not sufficiently secured. A disaster at the terminal or the crash of an aircraft can cause a dangerous situation for habitants and employees. It is in their interest that Schiphol is a very safe and secured airport, and terrorist attacks are prevented.

## **3.2 Relations between stakeholders**

The relations between the different stakeholders are complex. The formal relationships are presented in a formal mapping in appendix C. Also, the organisation chart of Schiphol Group with the relevant divisions and departments can be found in the appendices. The stakeholder environment can be compared with the stakeholder environment in a city centre. Schiphol Group can be seen as a city council with its own goals but also the responsibility to make the whole airport an appealing place for entrepreneurs, such as shops and restaurants, visitors, such as aircraft and train passengers and the working society. Different departments of Schiphol Group have different sub-goals that often represent interests of the different groups present at the airport, and these do not all match.

In Figure 3-1 the interests of the different stakeholders are visualised. All interests from external parties are also represented within Schiphol Group. This is interesting, because it makes the number of external stakeholders to include in the process a lot smaller, but it also means that Schiphol Group departments can hinder each other. During the interviews this became evident, due to the diverse problem perceptions and interests. Different departments within Schiphol Group have different goals and work hard to accomplish the best results for their department. During the interviews, it became clear that the different departments only cooperate if an inter-departmental project is formally set up. Compliance with regulations and safety of the airport is not a goal of every department, but if compliance and security are not guaranteed, Amsterdam Airport Schiphol will be classified as an Article 15 airport. This means that the security level is not appropriate and the airport cannot function as usual. If the security level is not improved, the airport can be shut down; all divisions will be affected if this measure is taken.

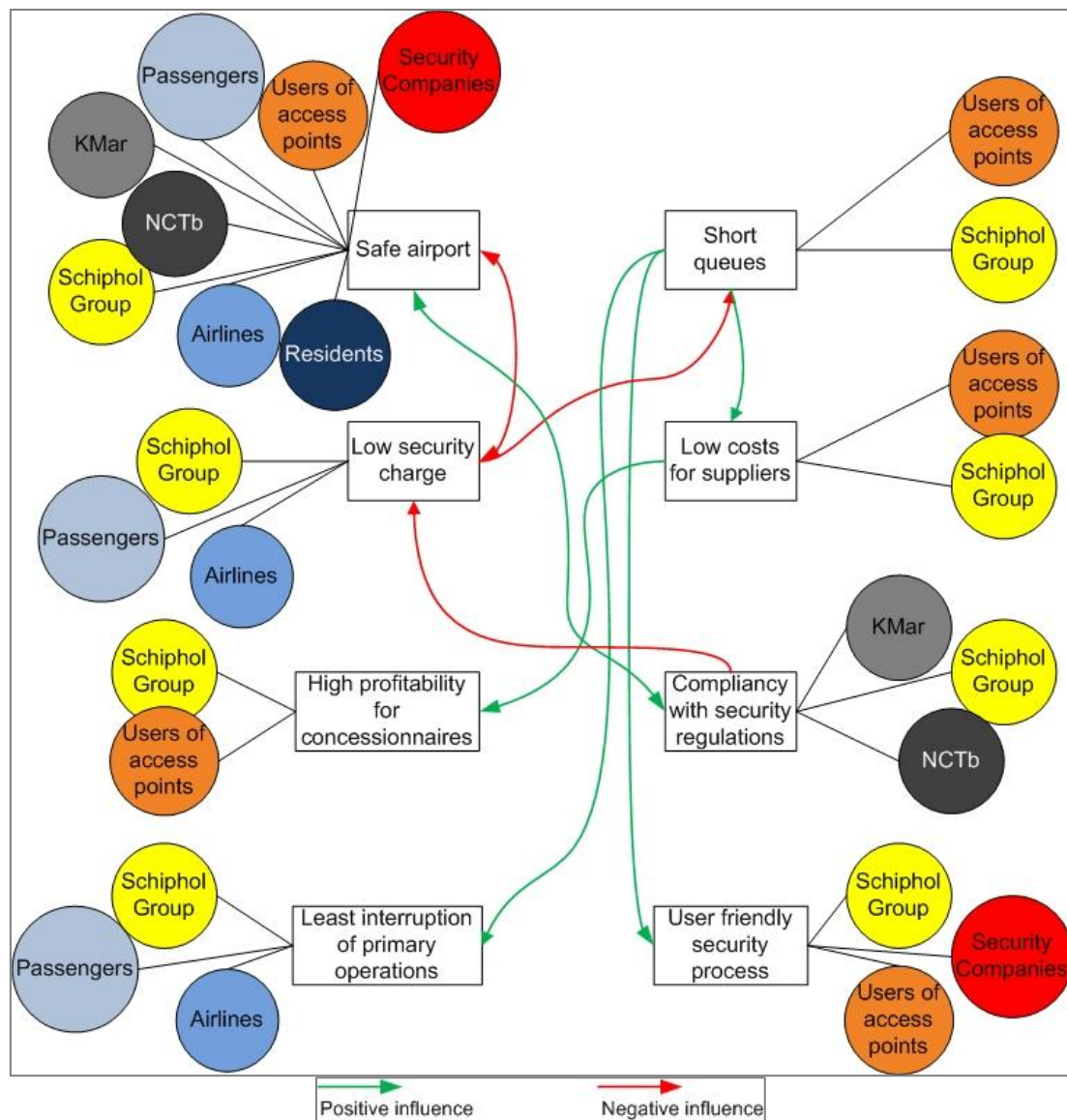


Figure 3-1 Interest diagram

In appendix E a list of stakeholders can be found that were held interviews with. It is also apparent in this list which stakeholders are present at the two workshops later in the project.

### 3.3 Conclusions

From the stakeholder analysis it can be concluded that many departments of Schiphol Group are involved in this issue with different interests. The users, clients, regulators and executors of the supply screening process are other important stakeholders. Many interests of stakeholders outside Schiphol Group are represented by one or more departments within Schiphol Group. This means that not all external stakeholders have to be invited for the workshops. The final invitation and attendance list can be found in appendix E.

The realisation of the invitation list for the workshops was a long process, due to the unfamiliarity with Schiphol Group previous to this project. Due to the dependency on input from interviewees, the balance of participants at the first workshop was off. There were more participants representing the users of the access points in the terminal compared to the vehicle access points. However, this also represented the level of interest in the project. Some departments or invited organisations did not show much interest and offered no availability. The selection of participants is of great influence on the further process and results of the project, as important input for the project is generated during the workshops. This analysis has been extended when new knowledge was acquired later in the project, especially from the two workshops.

In chapter 4 the current situation at the access points to SRA-CP is analysed. Procedures, locations, users and their processes are described to conclude the conceptual analysis.

## 4 Current Situation at Access Points to SRA-CP

In this chapter the current situation at the access points into SRA-CP for people and vehicles is described. First, the outside access points have been analysed and after that the access points inside the terminal are analysed. Of both situations a map is shown in which the access points that are taken into account and the different categories of areas are marked. Then, the process that takes place at these access points is described. An overview of the users of the access points and their processes are presented in the last section. This overview of the current situation provides further demarcation and focus of the project and insight in the current procedures. The analyses have been performed based on site visits, desk research and expert interviews, in cooperation with the problem owners at Security Policy. These analyses have been improved after feedback on conceptual models during the first workshop and better insight in the processes when gathering data for the queue model.

### 4.1 Situation at vehicle access points outside the terminal

For this project, three vehicle access points (VAP) are taken into account. These are the access points where suppliers of airport supplies enter SRA-CP, among other vehicles. The layout of a vehicle access point is depicted in Figure 4-1 and 4-2. The locations of the three VAPs can be found in the map of Schiphol in Figure 4-3 [41]. All three of these access points are open 24 hours a day and 7 days per week. The first access point is the G-passage or access point 60; 5 vehicle lanes are available here. The second access point is the R-passage, also known as access point 90, where 4 lanes are available. The last access point in scope is Tunnel South-East or access point no. 43, where two lanes are available for vehicle security checks.



Figure 4-1 Design drawing of VAP60 [52]



Figure 4-2 Design drawing of vehicle screening lane [52]

#### 4.1.1 Process at vehicle access points

At the vehicle access points all vehicles, drivers and passengers are 100% screened. This means that all vehicles need a Schiphol vehicle pass and a security check is performed on the vehicles. All drivers and passengers have to be in possession of a personal Schiphol pass. In order to receive a Schiphol pass a background check is performed and biometric data is loaded on the pass. The drivers and passengers are put through a screening process, similar to the security screening process for aircraft passengers. The 100% check for personnel was introduced in 2008.



In appendix F the current process at the vehicle access point is visualised, for the situation that all goes well and is approved. Vehicles and supplies carried in the vehicle are screened parallel to the travellers. There are many possibilities in the process for failure. If there is an error, such as a Schiphol pass not providing access, a process is usually repeated before other actions are taken. If the metal detection is alarmed, people are asked to move through it again without any personal belongings. It is also possible that something suspicious is recognised. Then, the person or car is taken out of the process and treated separately by the security agents or even the military police (KMar).

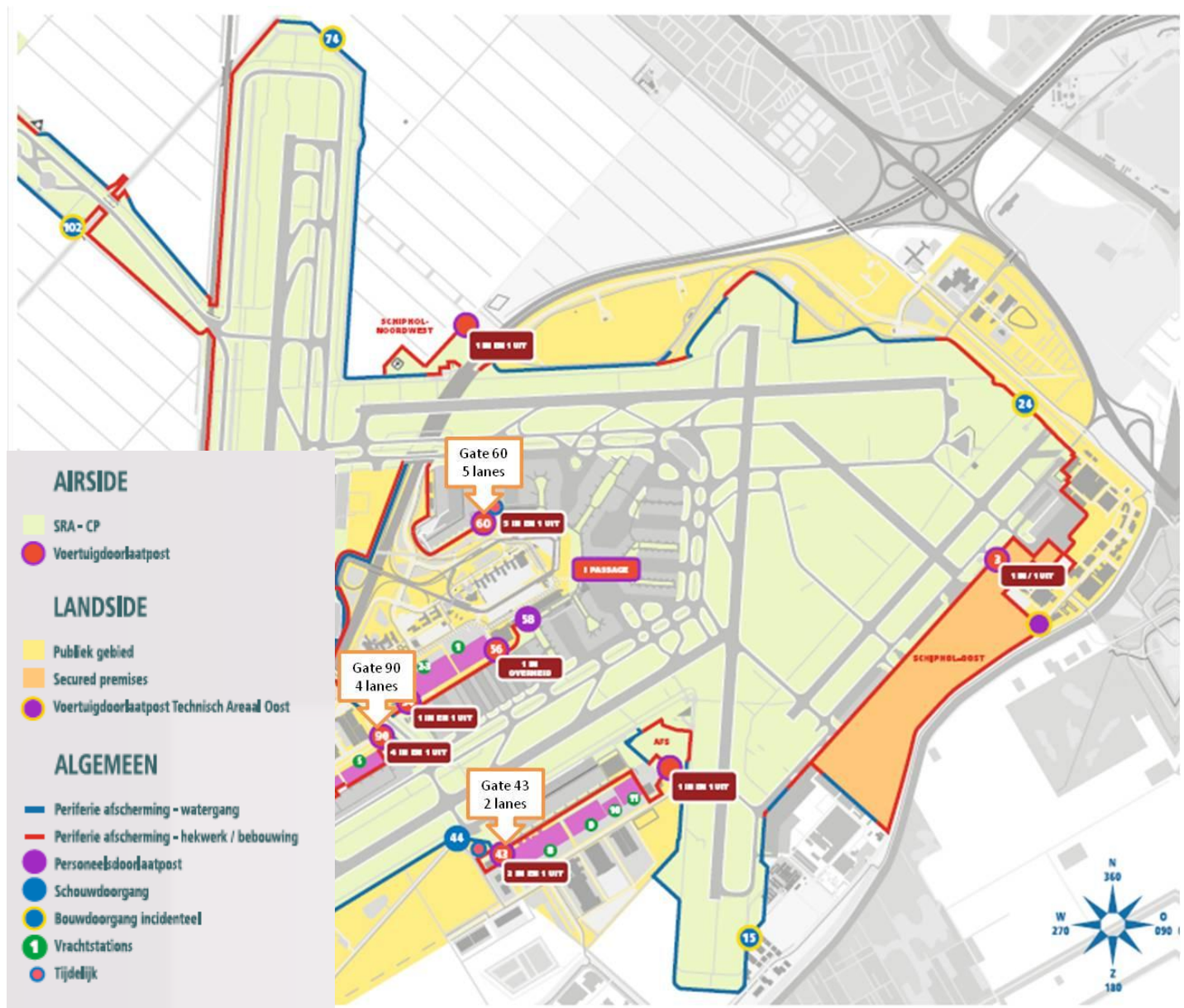


Figure 4-3 Map of Amsterdam Airport Schiphol [41]

#### **4.1.2 Suppliers using the vehicle access points to SRA-CP**

An overview of all users of the vehicle access points is available due to constant registration. The Management Information System (MIS) registers all pass presentations to the pass readers at access points. The MIS data are used to analyse the number of vehicles on airside and the duration of their stay, the duration of screening and the capacity of access points. From the Management Information System a long list of companies that have crossed the border into SRA-CP can be retrieved. In the MIS it is not defined whether or not these vehicles carry supplies. From expert interviews and field research it can be concluded that the main suppliers come for building or maintenance projects and to deliver supplies to the aircrafts and companies that are located within SRA-CP. In appendix G a short overview of the main users and the supplies they bring can be found.

A typical process of a supplier to the outside SRA-CP area is shown in appendix H. The process is depicted using an IDEF0 diagram, as explained in paragraph 1.6.1. The process starts at the moment that goods are ready to be transported from their last origin before the border to SRA-CP. The goods are loaded in a vehicle and the vehicle drives to the supply lane of one of the vehicle access points. At the access point a vehicle screening and a person screening is executed. A random sample of the supplies is screened, as well. After these procedures the vehicle can drive to SRA-CP and deliver its supplies to the destination.



## 4.2 Situation at staff entrances inside the terminal

Supplies for the terminal are delivered to the two delivery passages ‘Expeditiestraat’ and ‘Transportstraat’ under the terminal. This area can only be entered by vehicles with a Schiphol vehicle pass, but security screening does not take place before entering this area. Supplies for the public area and the security restricted areas of the terminal are delivered here. Some suppliers bring the supplies to the destination in the terminal, in secured or public areas. But many concessionaires and maintenance/cleaning companies own a storeroom in the basement of the terminal, and supplies are delivered here. Suppliers often put the supplies in the storeroom and goes to the next destination. Employees take the supplies in carts up in the elevators and pass security filters before moving into SRA-CP. In Figure 4-5 the map of the terminal with the different categories of areas is shown [43]. The staff entrances are represented in the map. The three entrances into SRA-CP that are used for supplies are emphasised. In Figure 4-4 pictures taken at the staff entrances are shown.



Figure 4-4 Entrances to SRA-CP for staff and supplies [52]

### 4.2.1 Process at staff entrances

Supplies are moved into SRA-CP through staff entrances. There are several of these staff entrances, leading to different areas in the terminal. The supplies are sometimes taken to SRA-CP by the suppliers, but often they are collected from the storerooms by the receiving parties such as concessionaires and maintenance companies.

Supplies are transported in pushcarts or roll containers from the basement into an elevator to the floor of destination. If the supplies need to be transported into SRA-CP, the person needs to pass a security filter. This person is in possession of a valid Schiphol pass. At these security filters the process is similar to the passenger security process. In appendix F the process at these security filters is visualised and described in detail. Supplies are screened in the X-ray that is also used for the personal belongings.

### 4.2.2 Current suppliers using personnel entrances

There are 9 concessionaires supplying their shops and restaurant in SRA-CP passing through access points. In appendix G these concessionaires and the objects they sell can be found [2]. In total, 27 concessionaires are active at AAS. These are not taken into account here, because they do not use the terminal access points to SRA-CP. Most of the concessionaires have a distribution centre outside AAS and a storeroom under the terminal. Often, the concessionaires take the supplies into SRA-CP. Sometimes, their suppliers deliver the supplies in the shop or restaurant.

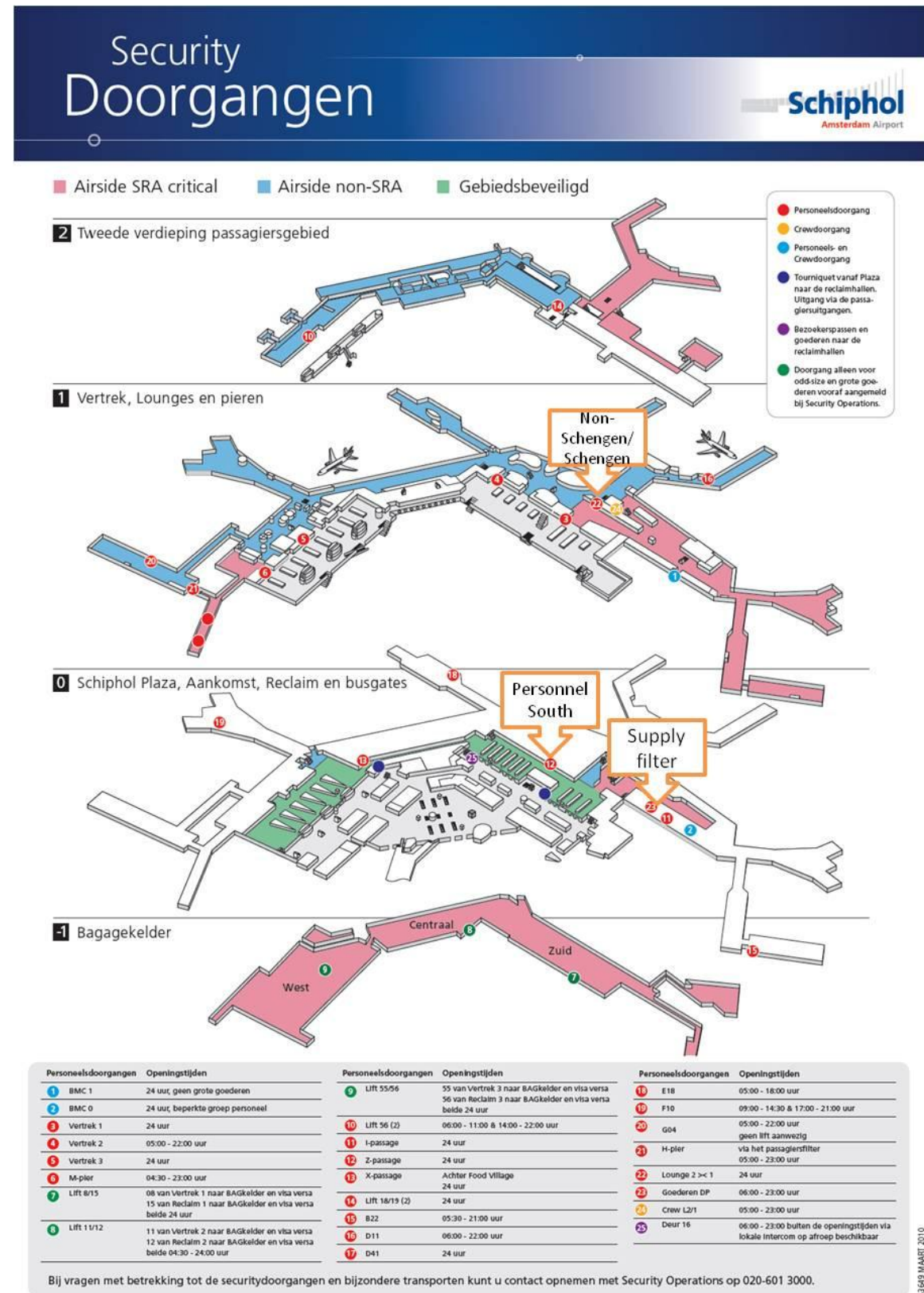


Figure 4-5 Map of Schiphol terminal building with area classification and available entrances [43]

The terminal is in constant need of maintenance. This maintenance is partly planned and partly ad hoc. A broken light or door needs to be fixed as soon as possible. These activities are performed by a known group of maintenance parties, unless a very specific job needs to be done. In addition to maintenance, cleaning is an important activity in the terminal for which supplies are needed. Different cleaning companies perform the different cleaning activities in the terminal. An overview of the maintenance parties and cleaning companies can be found in appendix G [2]. They have a store room in the basement of the terminal and employees of these companies are responsible for transporting the supplies over the border to SRA-CP.

A typical process of a supplier to the terminal is depicted in an IDEF0 diagram, which is a technique commonly used to depict processes, and can be found in appendix H. Variations of this process also occur, but according to an expert and the participants of the first workshops, this is the most usual process [46, 69]. The process starts when goods are ready to be transported to the terminal. The goods, often packed in carts, are loaded in vehicles. The vehicle drives to the terminal and delivers the supplies to the store room in the terminal. An employee of the recipient transports the supplies to an access point to SRA-CP. Currently, the person is screened with his personal belongings and a random sample of the supplies is screened. After the security check the person can transport the supplies to its destination in the terminal.

### 4.3 Conclusions

The current situation at the SRA-CP access points has been analysed. An overview of the locations, procedures, users and their processes is provided. An important conclusion from this analysis is that the procedures and users of the gates vary considerably inside and outside the terminal. Inside the terminal most supplies are transported on carts in relatively small quantities. The amount of suppliers is also relatively small and known by the airport. Outside the terminal, different kinds of vehicles cross the border to SRA-CP with many different kinds of supplies, not necessarily packed in carts. These supplies are transported there by many different suppliers that are not all under contract of Schiphol. It is clear that further analysis and solution finding should be done separately for inside and outside the terminal.

The conceptualisation phase is now completed, comprising an overview of the security field, the regulative environment, the involved stakeholders and insight into the current situation at the SRA-CP access points. This phase provides a detailed overview of the project context and scope. In the diagnosis phase, a model of the current arrival behaviour at the access points is constructed and the effect of the increase of supply screening is analysed. The model can also be used to evaluate different concepts later in the project.



# Diagnosis

## 5 Construction of the queue model

After a description of the project context and scope, a quantitative diagnosis of the current situation and the effects of the planned changes needs to be performed. The expectation is that if supply screening is increased at the access points, the access points will become a major bottle neck for traffic entering SRA-CP. This will result in lengthy queues in front of the access points. A simulation model is used to test this hypothesis and analyse the current and future state of the access points. A simulation can be defined as a computer model used to evaluate a system numerically [25]. In this case, static queue models are constructed in Excel; one for the vehicle access points and one for the terminal access points. These models are based on available data of the current situation from desk research, field research and discussions with process experts.

In the following sections the goal of the model is described, followed by the structure of the model and the used data. The assumptions made and the foundations for them will be mentioned and in the last section the verification and validation of the model is described.

### 5.1 Goal of the model and structure

This model is built because more insight into the current flows of supplies is needed. There is no clear overview of the flows of supplies at the moment. This insight in the size of the flows is necessary to be able to say anything founded about problems that may arise when the screening percentage is increased to 100%. The length of queues in front of the access points is used as performance indicator, because this takes into account the number of entities and the screening process duration.

The model can also be used for evaluation purposes, calculating effects on queue length of different concepts. This model only shows the logistical side of the issue, and will not be the only evaluation criterion for concepts. Level of security, costs and effects for stakeholders are other very important criteria for the concepts. Operational performance of the access points is an important part of evaluation, because this influences costs and affects all stakeholders that use the access points. Operational performance is however not the most important criterion. The level of security needs to be guaranteed, which highly affects the available measures to increase operations. Simply speeding up the screening process will almost certainly decrease the quality of the security process.

In Figure 5-1 a simplified visualisation of the structure of the model is presented. Such a model is made for each access point separately, as most input data is access point specific. The length of queues at the access points is the output variable of the model. In the Service Level Agreement with suppliers and customers it is stated that there will not be a queue longer than 10 minutes before the security process will commence [46]. The length of the queues is calculated by comparing the necessary access point capacity to the available capacity. The required capacity can be calculated if the arrival pattern and the screening process times are known. It is possible to decrease the necessary capacity, by shortening the screening processes, adding security agents or installing new techniques that speed up the process. The available capacity is based on the total capacity of access points, the number of

open lanes and opening hours. It can be increased by opening the access points for a longer period and opening more lanes per access point, up to the currently available maximum. The model will be used to assess the future situation, so growth of the flows and percentage of known suppliers are of influence to the required capacity in the future.

The effect of the new regulation focuses on supplies, so a division of the flows is necessary based on whether supplies are brought in by that entity or not. The screening process time of these supply checks is based on measurements and assumptions.

For the different concepts and the effects of 100% screening it is desirable to work with the expected flows of supplies for the future. Investment decisions are made based on longer term forecasts, in order to make sure the investments will be sustainable. The future point used in this project is 2020. 10 years is often used by the airport, because this is a sufficient period to depreciate investments, and forecasts are available for this period [46].

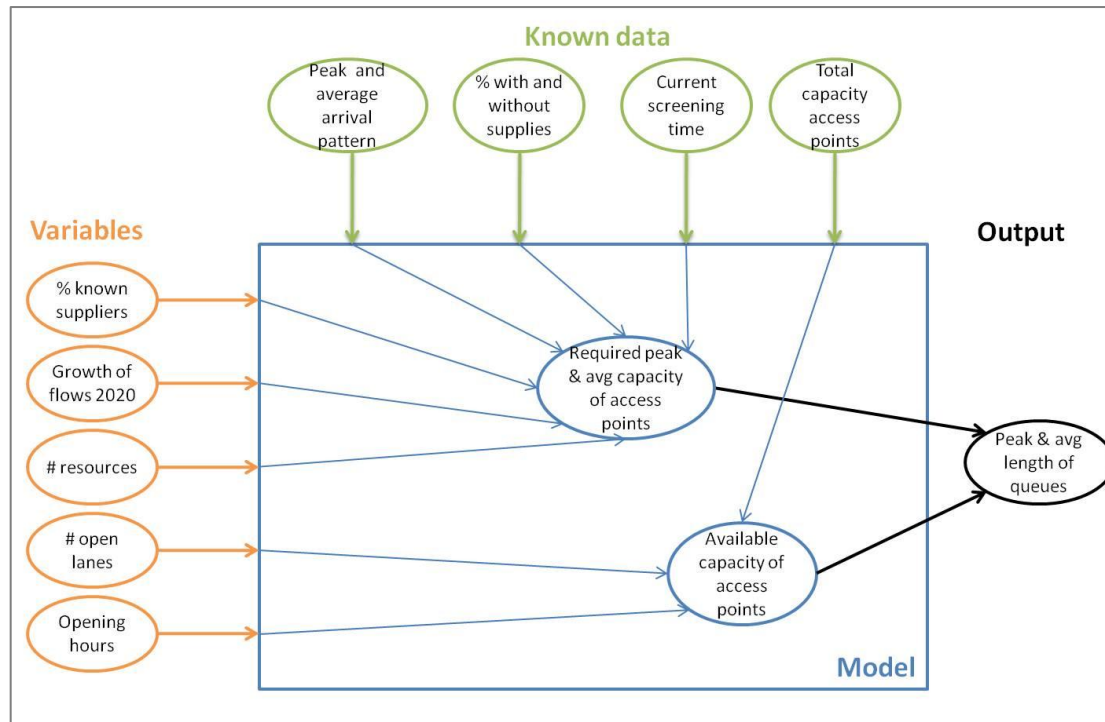


Figure 5-1 Visualisation of model structure

Three situations will be the output of the model. The current situation is reproduced in the model, with the current level of supply screening and the corresponding process times. In the other two situations 100% supply screening has been implemented. Because of the uncertainty of the exact effect on screening time, a range of screening times is included. Hence, the second situation is based on the minimum screening time and the third situation is based on the maximum screening time. These minimum and maximum increases are based on discussions with process experts.



## 5.2 Available data

A search for available data led to the Management Information System that was already discussed in chapter 4. The data from this system can be used for the vehicle access points. For the access points inside the terminal previous studies are used, as well as some measurements executed especially for this project.

### 5.2.1 Available data for the vehicle access points

There is a Management Information System (MIS) which holds a lot of information on the flow of vehicles through the vehicle access points 43, 60 and 90. The MIS is used to evaluate the screening process and make the planning for the access points. The data come from the Schiphol pass readers that are installed at the access points. Every time a pass holder presents a Schiphol pass to a reader, this is registered in the system. Due to this detailed registration, the number of entrances per quarter of an hour per access point can be extracted from the system, as well as the average screening time of a vehicle and its passengers. Even the number of handled vehicles per lane at the different access points can be retrieved from the MIS. Because there is a division of lanes for vehicles with supplies and without since September 1<sup>st</sup>, it is possible to extract from the Management Information System the division of vehicles with and without supplies. From the MIS the average flow of vehicles in the last year can be retrieved and a peak flow can be found as well.

### 5.2.2 Available data for supply access points to Lounge 1

Inside the terminal, lounge 1 is the most important SRA-CP destination for airport supplies. Lounge 4 is also a security restricted area; this is a small area, though, so not many goods enter this area. Lounge 1, however, is a very large area where all passengers from Schengen countries arrive and depart from. Many shops need to be provisioned and a lot of maintenance and cleaning activities take place in lounge 1. Lounge 2 and 3 are non-security restricted areas; passengers and personnel can enter these areas with a valid identification, but without passing a security check.

In the Management Information System the number of entrances is measured at the personnel access points. It is not registered if these people transport carts. There is an overview of which company this person works for, but it cannot be concluded from that information who carries supplies and who does not. Hence, it is impossible to use input data from the MIS.

In March 2010 a measurement of cart screenings took place under the graduation project of Krijn van Aken [2]. His study focuses on finding a solution for the bad air quality in the supply streets under the terminal, taking into account the intensified supply screening regulations for airport supplies. For two weeks the number of carts per hour at the three supply access points to lounge 1 was counted. Van Aken also describes an estimation of the capacity of the access points in 2012 with a 100% screening. For the duration of one morning (approximately 4 hours) this assumption was tested by measuring the process times of screening the currently required sample of the supplies on carts, which was not required when Van Aken did his research. This showed that the capacity of the access points will be much lower than expected by Van Aken. Van Aken also collected information on the future growth of cart movements in the terminal. This information was checked and discussed with



Van Aken and experts to determine the usability for this study. The information Van Aken collected is very valuable for this project and the growth information is used as input data for the model of the future situation at the access points to SRA-CP.

### 5.3 Assumptions and foundations

In the following paragraphs the assumptions on which the models in Excel are based are mentioned and explained. First, the assumptions for the vehicle access points are treated, after which the assumptions for the model on the access points in the terminal are discussed.

#### 5.3.1 Assumptions on vehicle access points

The input for the **average arrival distribution** at the outside access points is the overall average arrivals per 15 minutes from the past year, from the 1<sup>st</sup> of October 2009 until September 30<sup>th</sup> 2010. The **peak load** is determined by selecting the week in the past year with the highest average arrival load, after which the day of the week is chosen that shows the largest overall arrivals per day. The selected peak weeks and days of the week are different per access point.

The **differentiation between vehicles with supplies and without supplies** is based on the assumption that all vehicles with supplies are handled in the specified supply lanes at the access points. One agent is responsible for directing the vehicles to the right lane and signs at the lanes show which lanes are specifically for vehicles with supplies. This separation has been installed 1<sup>st</sup> of September 2010. So data have been analysed from September 1<sup>st</sup> until October 21<sup>st</sup> because that was the date when the collection of input data started. The average division of vehicles over the lanes per access point at times that all lanes were in use is input for this calculation. The percentages of vehicles with supplies as a share of all vehicles differ per access point.

The **screening time of vehicles** can be gathered per access point only, not per lane. In order to find the screening time for vehicles with and without supplies, some assumptions have been made. The screening time for vehicles without supplies is the average screening time of vehicles up to September 1<sup>st</sup> 2010. Vehicles with and without supplies were handled equally until that date. After September 1<sup>st</sup>, the average screening time increased because of increased screening measures for vehicles with supplies. It is assumed that this increase was caused by the vehicles with supplies, because nothing else changed according to experts [46]. Since it is known what the percentage of vehicles with supplies is, and if it is assumed that the screening time for vehicles without supplies stays equal, the screening time for vehicles with supplies can be calculated, using the following formula:

$$(Avg \text{ screening time Sept-Oct}) = (\text{percentage vehicles with supplies}) * (\text{screening time with supplies}) + (\text{percentage vehicles no supplies}) * (\text{screening time non supplies before Sept})$$

The underlined unknown factor can be calculated using the other known factors. This is the screening time for vehicles with supplies with the currently effective screening percentage. If we look at the process description in appendix E, it is noticed that the supply screening is a parallel process to the process of vehicle screening, and an extra security agent is placed to perform this check. It can be concluded that the screening of supplies is the critical process, based on interviews [46] and field research. The whole screening time with supplies can be allocated to the supply screening process. If one wants to calculate the screening time for another screening percentage, it should be taken into account that after the vehicle search is finished the supply screening can be done by two security agents. This line of thought was supported by a process expert [46].

If there are **queues at the moment**, this is not visible in the model outcome, since this is not registered in the MIS. A vehicle is registered at the moment the Schiphol pass is offered to a pass reader. It is possible that a queue evolves before this registration point. From information of the process owners it can be concluded that queues are never very long, and the agreed service level is managed. It is agreed that a vehicle has a maximum waiting time of 10 minutes [46]. This 'mistake' in the model can be ignored for the analysis of the current situation, but should be noted when interpreting the behaviour of the model in the future situations; queues could be longer than presented in the model. The model is used to make an estimation of the length of queues and to make a comparison of effectiveness between concepts, and is anyhow not completely accurate.

The **growth of the flow** of vehicles for 2020 is set to 34%. This percentage represents the expected growth of passengers for 2020. The vehicle flow is indirectly influenced by the passenger growth, but also by the maintenance planning and construction project planning. There is no forecast for this growth, so the passenger growth is used. During the first workshop this percentage was tested with the stakeholders and owners of the process. They agreed that this was the best factor to use [70].

### 5.3.2 Assumptions for terminal access points

The assumptions in Van Aken's study on the supply flow in the terminal have been analysed and discussed with experts from the Security Policy department. Most of them can be used in this project, as well.

Supplies in the terminal are quantified by the number of carts. A fluctuating number of boxes or other objects is carried on these carts.

Van Aken assumes that the growth of the number of carts transported into the secured area is dependent on the number of passengers. This assumption holds, as long as the number and size of shops does not change. There have not been any major changes in Lounge 1 and Lounge 4 since Van Aken's research, so this assumption still holds [46].

It is also assumed that Lounge 4 is so small, and still houses only one shop and one Grab & Fly, that the number of carts transported in and out of this area is very small. The screening process will not cause a bottleneck at the entrance to this Lounge.

## 5.4 Verification and Validation

During the verification phase the coding for the model is checked. Also, the interpretation of the conceptual models into the empirical model needs to be verified. The input data are checked for consistency with real-life. At the vehicle access points and the supply access points in the terminal field research has been performed to check the data that were accessible from the Management Information System and previous studies. The screening time at the vehicle access points was distilled from the Management Information System, based on some assumptions. So, verifying this input was important. Field research at the vehicle access points showed that the used data represented the true screening times.

Expert validation was used to determine the validity of the model. The model has been reviewed with several people from the group of problem owners from Security Policy, who are better informed on the processes at the access point. Input and output has been discussed during these reviews. After some changes, the model was approved by them [46]. The model was explained to the group of stakeholders in the first workshop and some output graphs were shown to this group. They approved that the right assumptions were used and that this was a realistic model of the situation [69]. A structural validation has been executed. The input data were adjusted to see whether the model reacts as expected. For example, the number of open lanes was reduced, which should cause major queues, due to a lower capacity per access point. The process time was increased and decreased and the number of carts and vehicles was changed. All these changes caused the expected changes in the output of the model.

From the results of these tests it can be concluded that the model can be used to estimate the current flows, and concepts can be tested in the model to see what the effect on the queue length at access points will be.

## 5.5 Conclusions

A model has been built to simulate the arrival of vehicles and carts at access points, and to see the differences in queue length as a result of operational changes of the access points. The model input is based on field and desk research, complemented with expert input. The model has been verified and validated with experts.

The Collaborative Business Engineering approach often uses discrete event simulation models with animation possibilities. This makes sharing with stakeholders and showing the effects more tangible. The fact that analysis of the current situation and evaluation of concepts is not solely about the operational performance of the access points, but other criteria need to be taken into account, resulted in a relatively simple static queue model. The results of the queue model were found to be very useful to show the effect on the length of queues without animation, as will be described in the next chapter.

The building of the model was an iterative process. The problem owners at Security Policy were involved in the set up and building of the model. Many changes were made relying on their knowledge and advice. The model was also changed after the verification and validation tests. Adaptations in the model were also necessary to enable testing of the different concepts later in the project.

## 6 Analysis of current situation and 100% screening

In this chapter the outcomes of the models of the current situation and problem situation are presented. First, a diagnosis of the current flows of supplies passing the access points is presented in graphs. This analysis is done to get a quantitative overview of the current situation at the access points. In the second half of the chapter the queues at the access points can be found for the situation when the supply screening is increased to 100%. This analysis will indicate how substantial the issue is when supply screening is introduced, and to what extent common measures and known suppliership can ease the situation.

### 6.1 Current flows of supplies moving into SRA-CP

In appendix I a full overview of the quantitative analysis of the current situation can be found. In Figure 6-1a an overview is presented of the current number of vehicles passing the Vehicle Access Points (VAP) per 15 minutes on an average day. In Figure 6-1b the current number of carts passing the three access points in the terminal per hour can be found.

A first observation is the peak behaviour in the arrival of vehicles and carts. Vehicles and carts tend to arrive mainly between 06:00 and 14:00, with the biggest peak in the early morning. At the supply filter in the terminal some of this behaviour can be related to the opening hours of this access point, but the arrival is not spread evenly over the opening hours, either.

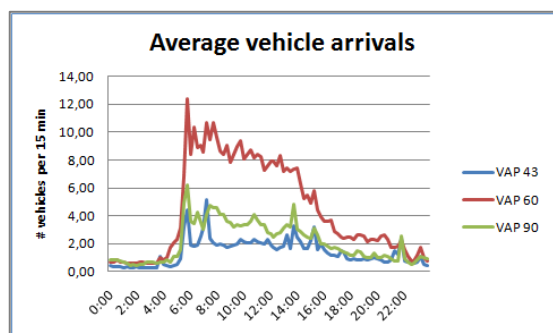


Figure 6-1a Current vehicle arrivals

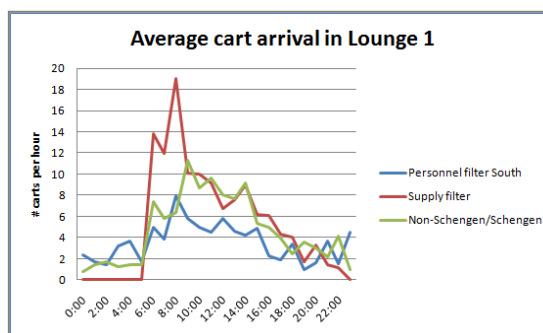


Figure 6-1b Current cart arrivals

From the analysis it can also be concluded that the stream of vehicles and carts is not distributed evenly over the different access points. Inside the terminal the available capacity per access point is equal, but the use of the access point differs. At the vehicle access points the number of lanes per access point needs to be taken into account; this determines the available capacity. If you take into account the number of lanes at the vehicle access points, the average arrival rate at gate 60 is almost double the arrival rate of the other two gates during the busy hours from 06:00 until 14:00. This analysis can be found in appendix I.

As mentioned in the previous chapter, there are currently no queues at the vehicle access points visible in the model, because queues are not registered in the Management Information System.

## 6.2 2020 situation with 100% screening

In the model, which imitates the current situation, the screening level is now increased to 100%. This means that all supplies moving into SRA-CP have to be screened using the same procedures as is now the case for the sample of supplies. All resources are kept at the same level as available at the time of writing, except that all vehicle access points are used to their full capacity, so all available lanes can be used. The number of access points, the available lanes per access points and the number of security agents per lane stay at an equal level.

Now, the model is adapted to show the queues in this future situation. The different concepts need to be tested in a future situation, in order to make sure that investments are made in durable concepts. The supply flow is expected to have grown 34% in 2020 compared to the current supply flow. This assumption is explained in chapter 5.

In the model the length of the queue at the end of the measuring time is the output. For the vehicle access point the measuring interval is 15 minutes, for the terminal access points the queue length is reported at the end of every hour. The queues are presented for flows on average days and for flows on a peak day. A range for the expected screening time is used, which results in a low and a high estimation of the queue lengths. In Figure 6-2a the expected queue length for the supply filter of the terminal is shown. In Figure 6-2b the expected queue lengths are presented for Vehicle Access Point 90 (VAP 90). In appendix J all graphs of queues can be found. At all access points queues are the result of the increase of the screening percentage of supplies.

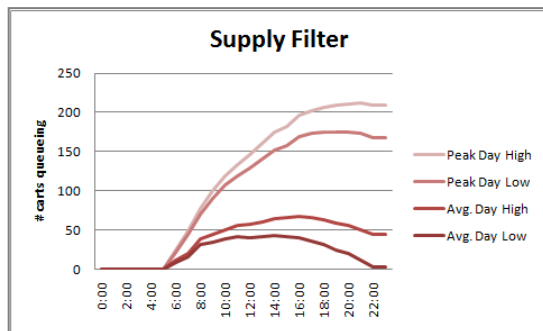


Figure 6-2a Queues at Supply Filter

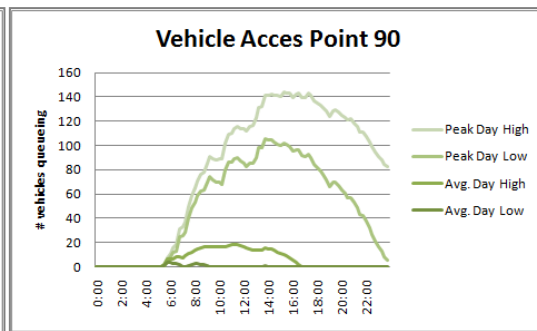


Figure 6-2b Queues at VAP 90

The increase of the screening percentage of supplies affects the length of the queues due to the increased screening time necessary per vehicle and cart. The estimated vehicle screening time increases from 3.5 minutes on average to 30 minutes on average, fluctuating between VAP's. The estimated cart screening time increases from 50 seconds to 7 minutes on average.

If known suppliership is introduced, fewer supplies in vehicles and carts need to be screened. A known supplier is handled equal to a vehicle or person without supplies at the access points. The seal of the supplies will have to be checked, but this process is so short that it can be neglected in the modelling. So a high percentage of known suppliers will result in quicker handling of the screening process and shorter queues in front of access points. In the model the percentage of supplies brought in by known suppliers can be adapted. But even if 95% is delivered by known suppliers, queues will be formed. Apart from the remaining queues, the vehicle screening time of 30 minutes is unacceptable.

### 6.3 Results of increase of resources

The performance of access points is measured all the time by Schiphol. If the service level is below the promised quality, resources are added to meet the preferred level of handling. In the situation described above, the full capacity of the vehicle access points is used; all lanes are open. A simple solution to a longer process time or more arrivals at the access points is adding security agents to speed up the process. This ‘easy solution’ can be implemented in the terminal and at the vehicle access point. At the terminal access point adding security agents is not directly linked to the process duration. Suppliers have to unload and load their carts themselves. But if something is suspected by the X-ray image reader, more agents can open the suspected goods to check them visually. This speeds up the screening process in the terminal in some cases but not in all. At the vehicle access points the screening process time is more directly linked to the number of agents. Supply screening is done visually, so deploying more agents results in more parallel checking of the supplies which results in shorter screening process times.

It must be taken into account that one extra security agent on a continuous basis results in a notable raise of the exploitation costs. Already, by using the vehicle access points to their full capacity, more security agents need to be added and exploitation costs are much higher than currently.

The number of agents for the vehicle screening process is a variable that can be adapted in the model. If the number of agents is doubled, the average screening time per vehicle is reduced. But still, queues are the result at all vehicle access points, as is shown in Figure 6-3.

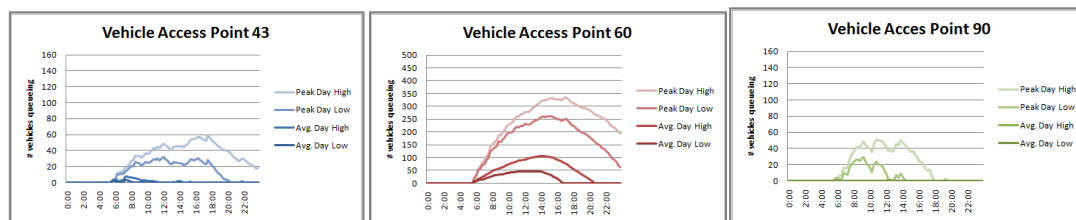


Figure 6-3 Expected queues with double amount of agents

### 6.4 Conclusions

The analysis of the current situation at the access points shows the peak behaviour of the arrival of carts and vehicles. An increase of the screening percentage results in high screening process times and lengthy queues at all access points, inside and outside the terminal. The hypothesis that queues will be the result of an increase of the supply screening level has been proved in this diagnosis phase. Even if access points are used to their full capacity, security agents are added and known suppliership is introduced, queues will be the result at the access points. From this analysis, it is clear that more radical solutions need to be found for the queues and the increase in process time. If the effects of the change could be solved with some more resources, further research would have been less urgent. The diagnosis phase has shown how crucial it is to look for other screening concepts, even if known suppliership is implemented. In the next part of this thesis the search for alternative solutions will be described.

# Alternatives

## 7 Solution Directions

After the future complications are diagnosed, the search for solutions is started. Two strategies are used to find relevant solutions. First, the group of stakeholders, selected after the analysis in chapter 3, is brought together to brainstorm about solutions. The set up and results of this workshop are discussed in the first section of this chapter. The second method to find alternative solutions is to analyse previous studies on security solutions at AAS and solutions at other airports and for similar systems. Some of these studies were consulted following suggestions from the workshop. The most relevant studies and situations are discussed in the second section of this chapter. The workshop and studies combined will result in a long list of possible concepts to realise 100% screening of supplies.

### 7.1 Workshop

First, the workshop setup is described and after that, the results from this workshop will follow. One of the goals of this workshop is to obtain a mutual understanding between the stakeholders of the current situation and the future changes and complications at the access points. The models, its structure and assumptions are explained and the validity of the model is checked with the stakeholders and actual users of these access points. After this, a brainstorm will commence to generate as many ideas to perform the 100% screening at the access points or somewhere else. Their criteria for a future solution are collected and after this, the stakeholders are asked to choose five favourite ideas from the list. Results of this workshop are: mutual understanding between stakeholders of the issue, commitment to the project, a long list of ideas, a long list of criteria for the ideas and a first selection of the ideas.

#### 7.1.1 Workshop Setup

On November 03 2010 a workshop is organised where 20 stakeholders are present for a 3 hour session. The session starts with a short introduction of all participants, because not all participants have met each other before. In appendix E an overview of the backgrounds of the participants is included. After this, a short presentation follows on the current situation at the different access points. The demarcation of the issue is also explained. The project deals with in-flight supplies and airport supplies that are transported into SRA-CP. In the terminal the three entrances to lounge 1 are analysed, and outside three vehicle access points are taken into account as described in chapter 4. At the moment all persons and vehicles are screened completely. The supplies they transport are currently screened based on a random sample. The future situation, when 100% of the supplies needs to be screened or delivered by a known supplier, is clarified. The known suppliership is explained and questions can be asked, because it is currently the aim of Schiphol to make as many suppliers known as possible. Then, the situation at the access points is explained if 100% screening is introduced with no changes at the access points. This situation was also modelled and big queues in front of the access points are the result, as is described in chapter 6. The model is explained to the participants, as well as the assumptions used in the model. The reaction of the group indicates the value and usability of the model. If no



problems are raised, the model can also be used to analyse the effects of different concepts on the queues at access points.

The second part of the workshop consists of the brainstorm. For this part the Group Support System (GSS) is introduced. Every participant has a laptop in front of them and logs in to Thinktank, GSS software. The laptops and software are provided by Delft University of Technology. The advantages of using Group Support Systems can be found in chapter 1.

It is the first time for all participants to use a Group Support System, so the session starts with a practice brainstorm. This makes the participants comfortable with the system and questions can be asked, before the real session commences.

After the exercise and a break, the participants start brainstorming about solutions for 100% screening of supplies moving into SRA-CP. They can decide for themselves to join the brainstorm on the vehicle access points or the terminal supply access points. Different categories are set up to give the participants some direction. These categories are organisational solutions, use of resources, technical solutions, location and moment of screening, set up of access points, complete solutions and a category for remaining ideas. An example per category is given, to give the brainstorm a kick start. When the flow of ideas slows down, the participants are directed to take a look at the ideas for the other access points (outside or terminal) to see if this will give them some more ideas. They can also suggest ideas in this category.

Following the brainstorm on solutions, a brainstorm on criteria is introduced. The participants are asked to come up with clear criteria for the solutions from their point of view. This results in an overview of stakeholder criteria. But it also adds value to the votes that will be cast in the next exercise. Their minds are set on evaluation of ideas from their point of view.

The next part consists of the voting. The participants have 10 checkmarks they can distribute over the ideas they find most promising. 5 checkmarks can be placed at ideas for vehicle access points and 5 checkmarks for the access points in the terminal. When everyone has cast their votes, the highest scoring ideas are copied to a next screen, where the participants can comment on these ideas. Digital conversations can take place here. Participants can react on each other and a first idea of the value of such an idea should be the result.

Finally, the laptops can be shut down and the afternoon is evaluated. All participants are asked to comment on the session. Then, it is explained that in December there will be a next workshop in which some of the ideas are discussed in detail with the relevant stakeholders to come to a first evaluation.

### **7.1.2 Workshop Results**

The current and future situation was clear to all participants, after some questions were answered. The model and its assumptions required some explaining, but the participants agreed with the level of detail and the used assumptions and average numbers.

The understanding of the software went very fast, and the brainstorm could start. Every participant cooperated really well, and most of them were enthusiastic about the program. Some computers had difficulty to connect, so a few participants worked together on one laptop.

The results are very useful. In appendix K an extensive report of the workshop can be found. In Table 7-1 the most important and interesting ideas are summarised.

Airside	Terminal
Central transshipment points for supplies	Distribution Centre
Planning of arrival times	Collective screening location
X-ray installation for vehicles	X-ray installation for carts
Separate access points for supply screening	Separation of flows of supplies and personnel
Expansion of access point capacity	Expansion of filter capacity

Table 7-1 Results from brainstorm on 100% screening concepts

The feedback after the workshop was very positive. They agreed that the Group Support System was a valuable tool for this kind of sessions. They were very curious about the results and eager to join a next session in which some of the solutions will be discussed further.

## 7.2 Previous studies and similar systems

In the following paragraphs some studies that have been performed previously for Schiphol are discussed. There is also an introduction of similar systems of which could be learnt in this project. These ideas are added to the solutions from the workshop or used to detail the given solutions. Learning from other airports on this exact issue is not possible, because most comparable airports are not progressed any further than AAS on this matter [1].

### 7.2.1 Terminal distribution centre from Krijn van Aken

Krijn van Aken performed a graduation research project starting from the problematic air quality of the supply streets underneath the terminal building [3]. He also took into account the new regulations on airport supply screening. Van Aken analysed the objectives and policies of AAS and the flows and processes of the supplies for the terminal. He designed different concepts that centralise the flows, and the Schiphol Distribution Centre (SDC) is the concept that scores highest on some key performance indicators and total costs. Supplies for the security restricted area are delivered at the SDC by suppliers and screened by security agents and stored in sealed crates. Concessionaires can keep storage at the SDC and when goods are required by them, they are picked from the SDC by distribution centre employees in sealed crates. They collect different crates on carts, based on their destination. Trucks bring the carts to the terminal and the crates are distributed to their destination. The carts are brought to restaurants or shops to collect waste, after which full carts with waste are taken back to the distribution centre. A cart reduction of 26% in the terminal is realised, and vehicle movements underneath the terminal building are reduced. Due to efficiency in the security screening process security costs can be reduced compared to the current situation. Electric trucks can be used for transporting the carts from the SDC to the terminal, which results in a pollution reduction for AAS [3]. A Retail Consolidation Centre like this is in place at Heathrow Airport and is operated by DHL. DHL mentions benefits for concessionaires such

as more reliable supply chains, better product availability through delivery frequency and onsite storage, less logistics staff and increased security of stock. Benefits for supplies can be single point of delivery and short turnaround time, no vehicle size restrictions, larger quantities, out of hours delivery, cost savings due to no registration of employees and vehicles [11].

### 7.2.2 Next Generation Security Screening concept from Marianne van Scherpenzeel

Marianne van Scherpenzeel conducted a research for Amsterdam Airport Schiphol on next generation security screening concepts in 2006 [39]. A planned amendment in the EU regulation was the reason for her research focus. Security checks at vehicle access points were going to be upgraded to 100%. Van Scherpenzeel analysed the current situation and performed a benchmark study at other airports. She investigated different technologies and solutions that could be applicable in the screening process for persons and vehicles, such as backscatter X-ray, millimetre wave and aerosol detection, and conveyor belts, speed-gates and biometric information. In her final concept the vehicles enter a moving conveyor belt. The driver and passengers leave the vehicle and enter the persons screening building. An iris scan and a pass check are performed, as well as a body scan. The vehicle moves through the vehicle screener which is based on gamma or X-ray radiation, such as shown in Figure 7-1. Images of the vehicle scan are analysed by an operator. An additional vehicle search by security guards can be requested. Marianne concluded that the use of technology could reduce the number of security employees and process time for vehicle screening. This means that exploitation costs would be lower and suppliers would be given access quickly, resulting in a more competitive position for AAS.



Figure 7-1 Vehicle screening with Gamma ray VACIS Portal [37]

After an interview with Van Scherpenzeel it was clear that the vehicle screening concept cannot be executed yet as it is described in her thesis report [40]. The main issue with this concept is the vehicle scan; the available technology is not able to locate all prohibited objects that are mentioned in the EU law. Even if it was possible to see these objects in the X-ray images, the reading and interpreting of the images would be too time-consuming. In Marianne's concept 40 seconds is allowed for vehicle screening, which is not feasible. According to Van Scherpenzeel the interpretation of the images takes at least 10 minutes [40].

### 7.2.3 Construction Consolidation Centre Heathrow

The Heathrow Construction Consolidation Centre is a distribution centre for construction materials and equipment that are used on construction projects at the airport. In Figure 7-2 visuals from this consolidation centre are shown.



Figure 7-2 Impressions of the Heathrow Consolidation Centre [68]

There is a covered space that is used for goods such as plasterboard, cement and fire alarms, and an outside space for materials such as bricks and glass [68]. The main goal of the consolidation centre is to guarantee an efficient flow of construction material from the different supply chains of suppliers to actual building sites or maintenance projects. The old and new situation is visualised in Figure 7-3.

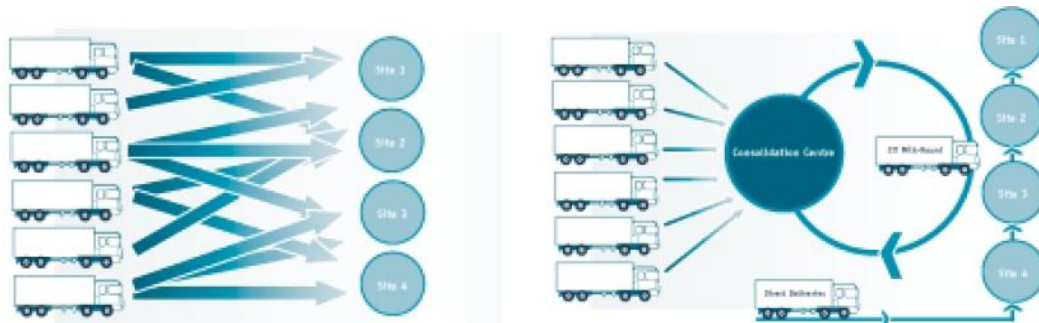


Figure 7-3 Old situation of construction traffic and new situation with consolidation centre, Heathrow [68]

Construction goods are delivered in relative large quantities and checked by employees of the centre for quantity and condition. Supplies are stored for a maximum of seven days and delivered to the sites of use in the quantities at the time it is wanted; a just-in-time approach is used for the distribution of the goods. Goods from different suppliers are consolidated based on the point of delivery, which maximises the efficiency of the distribution vehicles. A substantial reduction in number of vehicles on airside can be obtained, which minimises congestion and vehicle queues at access points, which results in a reduction for overall airport pollution. Project costs and delivery costs for suppliers can be reduced, planning and productivity of the construction and maintenance products are improved and unused or re-usable material can be used for other projects [68]. The consolidation centre makes it possible to perform security checks on the supplies after they are delivered and only known vehicles from the consolidation centre enter SRA-CP.

#### 7.2.4 Toll gate systems

The vehicle access points show many similarities to toll gates on highways; vehicles have to pass these gates to drive to their destination, a process takes place at the gates and vehicles queue to pass the gates. The design of toll gate plazas is subject of many research papers and there are companies specialised in toll road management and engineering. The main design factors are number of open toll gates and type of toll gate, which influences the process duration [33]. Manual gates, semiautomatic and gates which use Automatic Vehicle Identification are the main categories of gates [32]. The more automation used in the design of the gate, the shorter the gate process. Different types of gates can be used at one toll gate plaza. The optimal design of the mix and the total number of gates depends mainly on the traffic flow and available space and budget. In Figure 7-4 a mixed lane concept is shown.



Figure 7-4 New Jersey Turnpike Toll Gate [67]

The design variables taken into account for the next step of the concept development for the access points are the total number of access points and lanes per access point and the use of these access points. Some lanes can be dedicated as fast lanes; other lanes can be used for vehicles or personnel that need to endure longer processes.

#### 7.2.5 Screening of Baggage

All baggage that is checked in by passengers at Amsterdam Airport Schiphol is screened before it is loaded in the aircraft. A transport system moves the baggage through large X-ray scanners that detect explosives. If the scanner suspects the presence of such material the baggage is transported through a scanner that produces 3D images of the baggage [47]. These images are interpreted by security trained personnel in parallel. There is a time limit for this interpretation because the luggage needs to be taken off the belt before it is transported further through the system [47]. The screening system of AAS is of a very high level of quality and consists of several very expensive machines. One of such screening machines is shown in Figure 7-5.



Figure 7-5 Hold-baggage screening system [2]

### 7.2.6 City centre suppliers policy

The similarity of Amsterdam Airport Schiphol with a city centre is easily established. Shops and restaurants are situated at the airport, many businesses are operating at and around AAS and people are moving in and out of the airport and around the airport. The main difference is that there are no permanent residents at AAS and that part of the area is restricted for unauthorized access. But the similarity holds when the supplier processes are taken into account. Many different suppliers deliver goods to the airport, and enter and leave the 'city' constantly. This affects other traffic in and around Schiphol. Many city centres in the Netherlands close the areas during busy hours in the centre, such as visualised in Figure 7-6. In this example the city centre is open for suppliers every day between 6 pm and 11 am. Such a concept can also be applied to Schiphol, in order to realise less impact of supply processes on the primary processes at the airport.



Figure 7-6 Access restriction to city centre

## 7.3 Conclusions

The first workshop with a group of stakeholders was very successful. The brainstorm to collect ideas for 100% screening of supplies entering SRA-CP resulted in a long list of different ideas. This brainstorm and the collection of criteria for solutions gave insight in what is important for the stakeholders and how they would like to see this issue solved. Some of this input provided by the stakeholders was used to improve the stakeholder analyses from the third chapter. A quick voting exercise showed which ideas are most popular with the workshop participants. The desk research of previous studies for AAS security and comparable systems added to the ideas from the workshop.

The decision to gather ideas from users and stakeholders of the supply screening process has resulted in many incremental ideas for change and solutions to other issues at the access points. This is the downside of participants in a brainstorm workshop that are very close to the issue discussed. Therefore, the study of similar systems and other airports added to this list. A brainstorm with people not acquainted with the screening procedures at access points may have resulted in more radical concepts, but the probability of feasibility of such concepts is much lower than these proven concepts. In the next chapter the ideas are structured into detailed concepts for 100% screening of supplies entering SRA-CP.



## 8 Conceptual Solutions

A selection of the ideas from the brainstorming workshop and desk research was made based on the voting exercise during the first workshop, elimination of unfeasible concepts and a discussion with process experts [46]. In this chapter 10 concepts in total will be discussed in detail.

In order to create an overview, the different solutions for screening are shown in the supply chain, between the origin and destination of the supplies in Figure 8-1. The origin of the supplies could be as far as a factory in Belgium or as close to the border as a supplier's storage in the AAS terminal building; the origin is the place where the products are packed to be transported to the border to SRA-CP. The destination of the supplies can be a shop, a building site or an office in the security restricted areas. The known supplier is also depicted to give full oversight, but this option is not further worked out in this project. 1.1 refers to the screening location for the outside supplies and 2.1 refers to the screening location for the terminal supplies, between the origin and border. A distribution centre is the second solution that is explored, which can be located between origin and border or on the border. The next options are located on the border, at the access points. The last option for screening for the supplies in vehicles is at the destination of the goods. This option means that a security trained person accompanies the goods from the border to the destination, and this person checks the goods when they are unloaded at their point of destination.

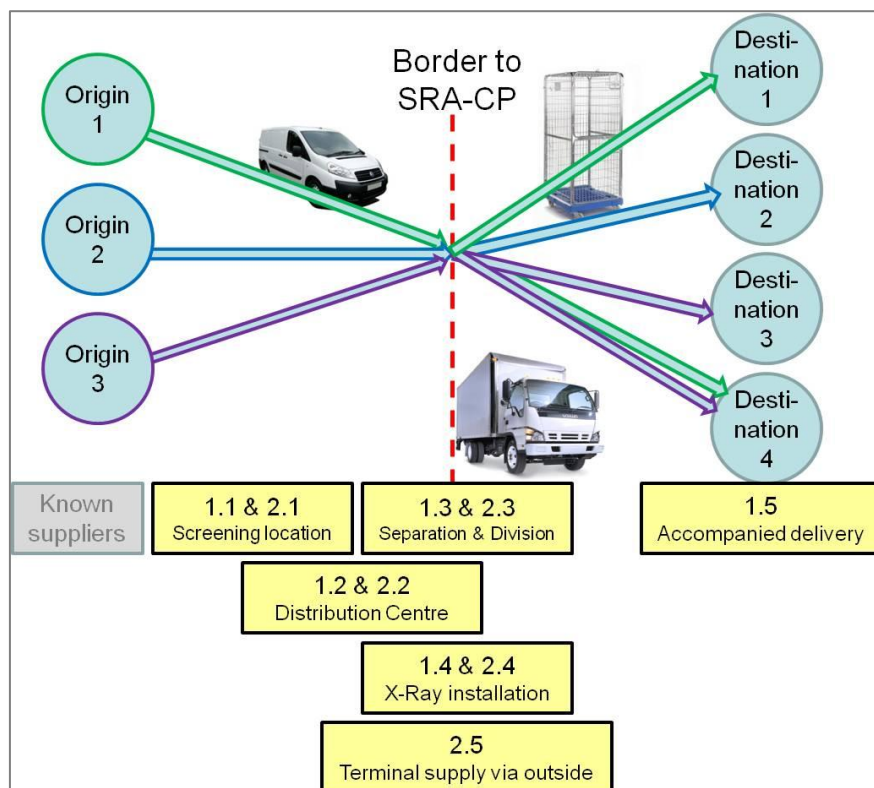


Figure 8-1 Overview of concepts, depicted in the supply chain

The first section discusses five concepts for screening of the supplies that enter SRA-CP outside through the vehicle access points. The subsequent section of this chapter discusses the concepts that can be implemented for terminal supplies. There is some overlap between these concepts, but the details and effects are different in these situations. For each concept an introduction is given and a small process diagram is presented in the text. In appendix L the full IDEF0 process diagrams on which the small process diagrams are based can be found. The logistical consequences for the access points are discussed and graphs of the analysis are placed in appendix M. An indication of investments and exploitation cost is presented. The security level is presented ranging from 1) not compliant with future regulations, 2) As Low As Regulations Permit and 3) As Low As Reasonably Practicable. These two ALARP principles have been discussed in detail in chapter 2. Security level 2 means that the concept is compliant with regulations, but substantial security risks can be defined. Security level 3 means that the concept complies with regulations and no substantial security risks can be defined. An overview of the concepts is provided in the Conclusions section of this chapter. The detailing of the conceptual ideas has been performed based on desk research and results from the queue model, as well as expert input; all in close cooperation with the problem owners at Security Policy.

## 8.1 Screening concepts for vehicle access points

The following concepts are designed for the supplies that are brought in through the vehicle access points. The first concept is the screening location between origin and border, the second concept is the distribution centre which can be built on different locations. The third concept described option for the division of the different flows of vehicles at the access points and in concept 4 the idea of a pass through X-ray installation is detailed. The last concept is about accompanied delivery.

For all concepts the process of a typical supplier is discussed. An IDEF0 diagram is created for all applicable concepts. The IDEF0 diagram for the current situation with 100% screening is shown in Figure 8-2. The full process of a typical supplier is depicted. The IDEF0 diagrams for the concepts can be found in appendix L.

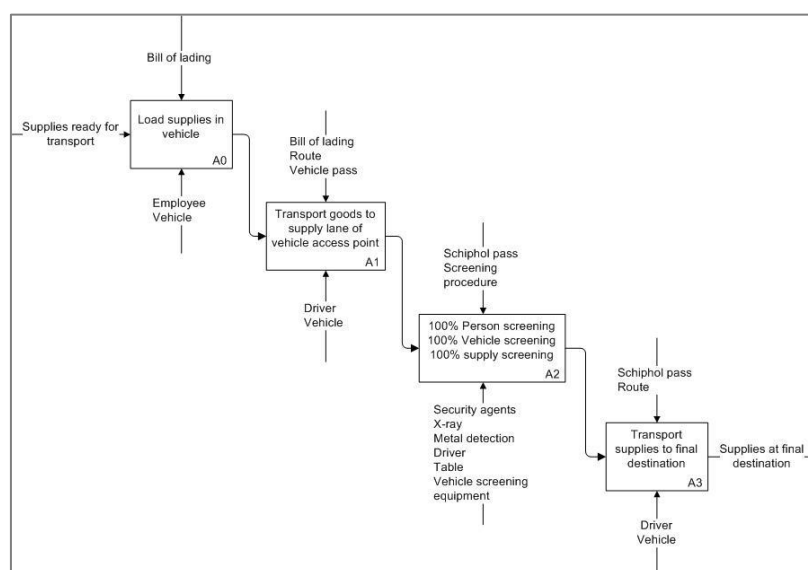


Figure 8-2 IDEF0 diagram of supplier process with 100% screening



In the text a simplified process diagram can be found per concept. The simple process diagram for suppliers of the situation with 100% screening and no adaptations to the procedures is presented in Figure 8-3. The colours in the process diagrams of the concepts represent changes in the process. If processes are coloured orange, this means the process is added or takes more time. If a process is coloured green, the process now takes less time. If the process is grey, this process is handled by other employees than from the suppliers or recipients, so is out of scope for the supplier.

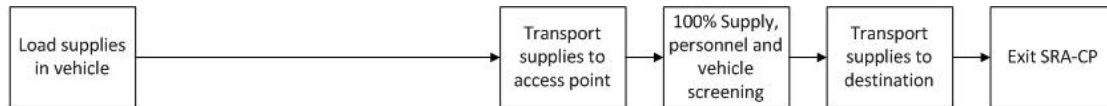


Figure 8-3 Simplified process diagram of supplier process with 100% screening

### 8.1.1 Screening location

A screening location can be built in the surroundings of Schiphol. Suppliers drive to this screening location and have their supplies security screened by security agents. These agents seal the supplies or the vehicle with tamper-evident seals and produce a certificate of security screening. The suppliers can continue their route to the vehicle access point of their choice and there the certificate and seals are checked. The vehicle screening and person screening is performed as usual. The suppliers can enter SRA-CP and deliver their supplies as they are used to.

This concept can be used in combination with known suppliers, who are handled the exact same way at the vehicle access point.

In Figure 8-4 the process is depicted. Two extra steps are added to the process, and the process at the access point is reduced in time.

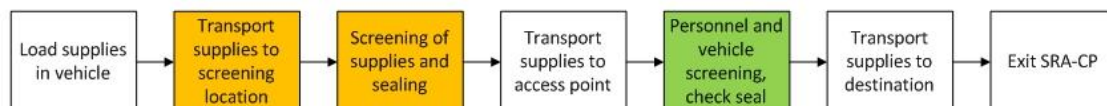


Figure 8-4 Process depiction for screening location

At the vehicle access points not much is different compared to the situation prior to September 1<sup>st</sup> 2010. All suppliers can be handled equally, whether they are known or have had the screening done at the screening location. The checking of the seal and certificate should not take long, especially if technical solutions are introduced, such as change of the code on the Schiphol pass. In the queue model a calculation is performed with the expected growth of the supply flows, and the current capacity of the access point is sufficient to prevent queues at the vehicle access points.

In Table 8-1 Overview of costs for screening location, the most important investments and exploitation costs are mentioned.

Investments	Exploitation Costs
Construction of screening location	Maintenance of screening location and equipment
Equipment for screening	Security agents at screening location
Equipment for sealing	Additional training for supply screening
ICT investment	
Communication	

Table 8-1 Overview of costs for screening location

A few security risks have been identified in this concept. Screening of supplies at a distance from the border to SRA-CP enables manipulation of the supplies en route. This is dependent on the quality and procedure for sealing of the supplies. If the screening location is not owned by Amsterdam Airport Schiphol, but by a private party, the focus of the employees could be more on speed and efficiency than on accuracy and security. This concept is compliant with regulations but shows several security risks, so the security level is 2.

### 8.1.2 Distribution Centre

A distribution centre, also known as a consolidation centre, is a more radical change compared to current procedures than the last concept. A construction consolidation centre has been in place at Heathrow Airport for some years now, and has shown positive effects, as described in paragraph 0. A consolidation centre can be located between origin and border or on the border to SRA-CP. For the suppliers, there is not much difference between these two options; the main difference is the distance from their origin to the DC. These two options result in different processes at the access points and different costs and benefits.

#### *a. DC between origin of supplies and border to SRA-CP*

For the first option, the supplier delivers the supplies at the consolidation centre in the surroundings of AAS. At the centre, the supplies are unloaded, after which the supplier can drive off to a next customer or back home. At the DC the supplies are screened by security agents, sealed with tamper-evident seals and stored until they are requested for delivery at a location in SRA-CP. DC employees transport the supplies in a truck to the nearest access point and pass the vehicle and person screening. The seals and bill of lading are checked by a security agent and the truck transport the supplies to the destination. After delivery, the truck can return to the consolidation centre to pick up more supplies. The process is visualised in Figure 8-5.



Figure 8-5 Process depiction for DC between origin and border

This concept will result in less pressure on the vehicle access points than currently. Only vehicles without supplies, vehicles from the consolidation centre and possibly known suppliers will pass the access points. Because of a higher fill rate of the trucks and planning from the consolidation centre the vehicle access points will handle less vehicles at peak times. After a calculation in the model, it can be concluded that the current capacity of the vehicle access points is sufficient if this concept is implemented.

In Table 8-2, the most important investments and exploitation costs are summed up.

Investments	Exploitation Costs
Construction of consolidation centre	Maintenance of consolidation centre, vehicles and equipment
Equipment for screening	Security agents at screening location
Equipment for sealing	Additional training for supply screening
Equipment for storage and transportation	Logistical employees at DC and trucks
Trucks for transport between DC and SRA-CP	
ICT investment	
Communication	

Table 8-2 Overview of costs for DC between origin and border

The security risks are similar to the risks mentioned in the previous concept. Screening of supplies at a distance from the border to SRA-CP enables manipulation of the supplies en route. It is less probable due to the smaller number of people in contact with the supplies, though. If the consolidation centre is not operated by Amsterdam Airport Schiphol, but by a private party, the focus of the employees could be more on speed and efficiency than on accuracy and security. The security level is similar to the previous concept and assessed as a level 2.

#### *b. DC on the border to SRA-CP airside*

In the second option for a consolidation centre, the location is changed to the border to SRA-CP. The short process is shown in Figure 8-6. Goods are delivered by suppliers, who can turn around after delivery. The goods are screened by security agents and stored in the secure DC. Sealing is not necessary in this case, as screened goods are in a secured area and will stay there. The exit of the DC leads to SRA-CP. The goods can be delivered to the final destinations by DC employees, but it is also a possibility to let people in SRA-CP pick up stuff from the DC.



Figure 8-6 Process depiction for DC on border

The vehicle access points are even less busy if this option is implemented. No supplies pass the access points. Known suppliers (if any) can deliver their supplies at the DC and store them in the secure environment.

Investments and exploitation costs are roughly equal to the other option. But the construction of the DC will be costlier, due to the high land value of Amsterdam Airport Schiphol.

Security risks are smaller than in the first option, if the consolidation centre can really be a secure environment. Screening of personnel needs to be of a high quality. The security level will then be at level 3.

### 8.1.3 Separation of flows

Three options are discussed that can divide the flows of vehicles. This is an option that is similar to the design of toll gate plazas. Vehicles are separated according to form of payment, which influences the process times: payment with a special pass, credit card or cash. Separating the flows of vehicles with supplies and without supplies at access points is the first option for the division of flows. Part of the lanes is marked for vehicles with supplies that need to be screened, and the fast lanes are meant for vehicles without supplies or known suppliers. In the second option whole vehicle access points are meant for vehicles with supplies that need to be screened, and at other access points supply screening is not possible. The third option divides the flows of vehicles in time. An observation of the current situation in chapter 4 is the strong peak behaviour of vehicle arrivals; in this option vehicle arrivals are spread over 24 hours a day.

#### *a. Separation of flows per lane*

In the first option the process for suppliers stays the same as in the current process. An



Figure 8-7 Separation of flows per lane at VAP

indication above the lanes is necessary so drivers can choose the right lane, as shown in Figure 8-7. Different arrival routes are necessary to make sure that vehicles with a fast process are in a different queue than vehicles with a slower process due to the supply screening.

If this solution is chosen for all vehicles with supplies, without adding resources or technical measures to speed up the process

time of screening all supplies, this option is not feasible; lengthy queues in front of the vehicle access points will be the result.

In Table 8-3, expected investments and exploitation costs are shown. The costs for this concept are less than for previous concepts.

Investments	Exploitation Costs
Construction of arrival routes	More security agents
Equipment for screening	Additional training for supply screening
Communication	

Table 8-3 Overview of costs for separation of flows per lane

The most important security risk that needs to be taken into account is the possibility that suppliers will get very impatient if the screening time is very high. This might result in hasty and less careful screening procedures. This concept is compliant with regulations but shows a big security risk, so the security level is 2.

### *b. Separation of flows per vehicle access point*

In the second option the access points are divided in special supply access points and non-supply access points; a complete access point is dedicated to one kind of vehicles. The process for suppliers does not differ from the current process. The only difference is that suppliers are not free to choose all access points. This might lead to longer distances from origin to access point and from access point to the final destination in SRA-CP. This option is visualised in Figure 8-8.

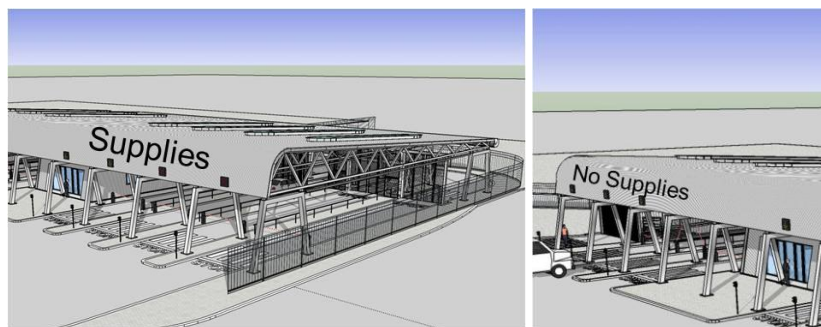


Figure 8-8 Separation of flows per VAP

This option is more difficult to work with than the last option, considering logistics. If only the three current access points can be used, it is difficult to find an optimum. In this option it is necessary to shorten the supply screening process time, as well, by adding security agents or investing in technology. If all suppliers have to be screened this way, more lanes per access point or more access points should be added.

The costs are depicted in Table 8-4. The investments are not very large but exploitation costs are substantial.

Investments	Exploitation Costs
Equipment for screening	More security agents
Communication	Additional training for supply screening
Potentially expansion of access points	

Table 8-4 Overview of costs for separation of flows per VAP

The security risks are equal to the last concept, so the security level is 2, as well.

### *c. Spreading of flows in time*

The third option to separate flows is to create an arrival planning for the vehicles. Analysing the current arrival rate, visualised in Figure 8-9, the peak behaviour of arriving vehicles is very clear. By making a planning the vehicle arrivals can be spread more evenly, which enables a more efficient use of the full capacity of the access points. The arrival behaviour can be flattened by using a planning, decreasing the peak arrival rate early in the morning. This concept increases the ability of the access points to handle the supplies, and queues will be less.

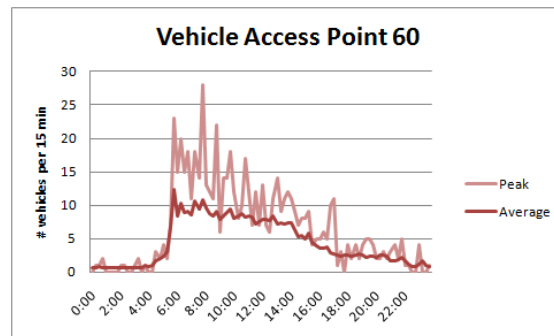


Figure 8-9 Current arrival behaviour at VAP60

The main cost for this option is organisational and communications cost. It needs to be defined which suppliers can be included in this regulation option, and how this regulation will be controlled. Will there be fines when suppliers arrive outside their time schedule or will suppliers receive some kind of incentive to arrive outside the peak hours. The costs of this concept will depend on these decisions. The security level is similar to the previous concepts and is assessed as level 2.

#### **8.1.4 X-ray installation**

Two kinds of X-ray installations will be discussed in this section. The first one is meant for whole vehicles and in the second option supplies are taken out of the vehicle for screening in a smaller X-Ray installation.

##### *a. Vehicle X-ray installation*

A popular concept during the first workshop was the X-ray installation for complete trucks and vehicles. The process for suppliers will not change much. A vehicle is driven onto a moving conveyor belt or another mechanism that moves the vehicle. X-ray images of the whole vehicle can be produced, while moving the vehicle through the X-ray installation. At the same time the person and his personal belongings are screened. The X-ray images of the vehicle are sent to monitors and screened by trained security agents. A vehicle X-ray system is visualised in Figure 8-10. If the interpretation of the images can be done fast, this could result in a major improvement of process time. This technique is commonly used by border control authorities to intercept contraband. Currently, the estimated time it takes to interpret the X-ray images is 10 minutes [40].



Figure 8-10 Vehicle X-ray system [55]

Investment costs for such an installation are substantial, and Schiphol will probably need more than one installation to handle all traffic into SRA-CP. An overview of potential costs is shown in Table 8-5. An advantage is that it makes the vehicle screening process unnecessary.

Investments	Exploitation Costs
Vehicle X-ray installation	Maintenance of installation
Communication	Additional training for X-ray image reading
ICT costs	

Table 8-5 Overview of costs for vehicle screening installation

Security risks for this concept are substantial. The objective of the security screening of supplies is to prevent prohibited objects from entering SRA-CP. The prohibited objects include small weapons and it is very difficult to identify these objects in X-ray images of whole vehicles. This is mainly due to the size of the objects, but also due to the material that is comparable to material used in vehicles. This concept is not compliant with regulations, because dangerous objects cannot be found, so security level is assessed as 1.

### *b. Supply X-ray installation*

Another option that was derived from the previous concept is an X-ray installation for supplies only. An X-ray machine exists through which an object can be moved with the size of 1.30m x 1.30m. This X-ray is approved by the EU to be sufficiently accurate for security screening [49]. Pallets with supplies could be screened with the machine in Figure 8-11. Such an installation is very similar to the baggage screening concept. Baggage is transported through large X-ray machines and images of the baggage are interpreted by trained employees. The dimensions of the supplies are probably bigger than the dimensions of an average piece of baggage.

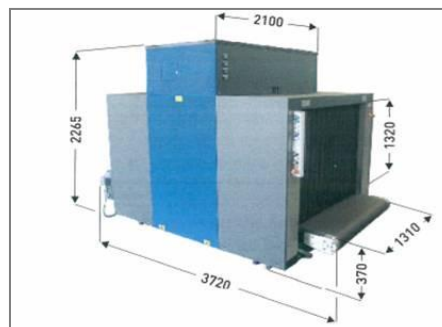


Figure 8-11 Large X-ray machine [58]



The process for suppliers would become longer due to the unloading and reloading of supplies from the vehicles, as can be seen in Figure 8-12, but the process time for supply screening will decrease due to the use of the X-ray. It also needs to be taken into account that the larger the screened objects, the more likely it is that the X-ray images are unclear and supplies need to be unpacked and visually checked anyway.

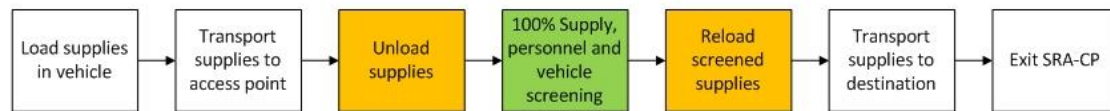


Figure 8-12 Process depiction for Supply X-ray installation

Security risks for this option are similar to the last option, but smaller. It strongly depends on the content's material characteristics how visible prohibited objects are. The 1.30x1.30 machine is approved by EU regulators, so the concept is compliant. Risks are still substantial, so the security level is assessed as level 2.

### 8.1.5 Deliver supplies with security agent

The last concept that is detailed is the guided delivery of supplies. Screening takes place on the destination of the goods. This option is especially useful for bulk goods, which cannot be unpacked or scanned at the border. The supplier comes to the access point and the person and the vehicle is screened as usual. A security agent accompanies the vehicle to its destination and watches the process of delivery. After this the vehicle can exit SRA-CP. The process for suppliers is depicted in Figure 8-13.

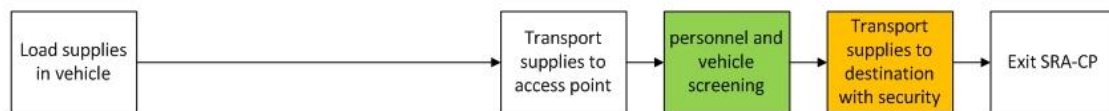


Figure 8-13 Process depiction for accompanied delivery

The process at the vehicle access point is shorter than currently, if a security agent is available immediately to guide the vehicle to its destination. A planning is needed to guarantee a short waiting time. This concept is not meant for all supplies, especially bulk goods and very large items are eligible.

There are no large investments necessary for this concept, as can be seen in Table 8-6. But exploitation costs need to be considered; a planning needs to be made and security agents need to be hired and trained to perform the screening on destination. An idea from the first workshop is to train safety officers that are already present at large building sites, which could reduce the extra costs.

Investments	Exploitation Costs
Communication	Extra security agents
	Additional training for agents
	Planning

Table 8-6 Overview of costs for accompanied delivery



There is a risk that prohibited objects are not found at delivery. It is difficult to see whether or not a knife is hidden in a big pile of sand. Compliancy with regulation has to be checked, because this concept cannot be tested with the currently available law texts. Screening before entering SRA-CP is currently the law. For the time being this concept is assessed as a level 2, but cannot be implemented without consulting the right institutions.

## 8.2 Screening concepts for access points in the terminal

The following concepts are designed for the supplies that are brought into SRA-CP through the access points in the terminal building. The first concept is the screening location between origin and border, the second concept is the distribution centre which can be built on different locations. The third concept describes options for the division of the different flows of personnel at the access points and in concept 4 the idea of a pass through X-ray installation is detailed. The last concept is about combining all supply screening from the terminal and outside at the vehicle access points.

For all concepts the process of a typical supplier is discussed. An IDEF0 diagram is created for all applicable concepts. The IDEF0 diagram for the current situation with 100% screening is shown in Figure 8-14, in which the full process of a typical supplier is depicted. The IDEF0 diagrams for the concepts can be found in appendix L.

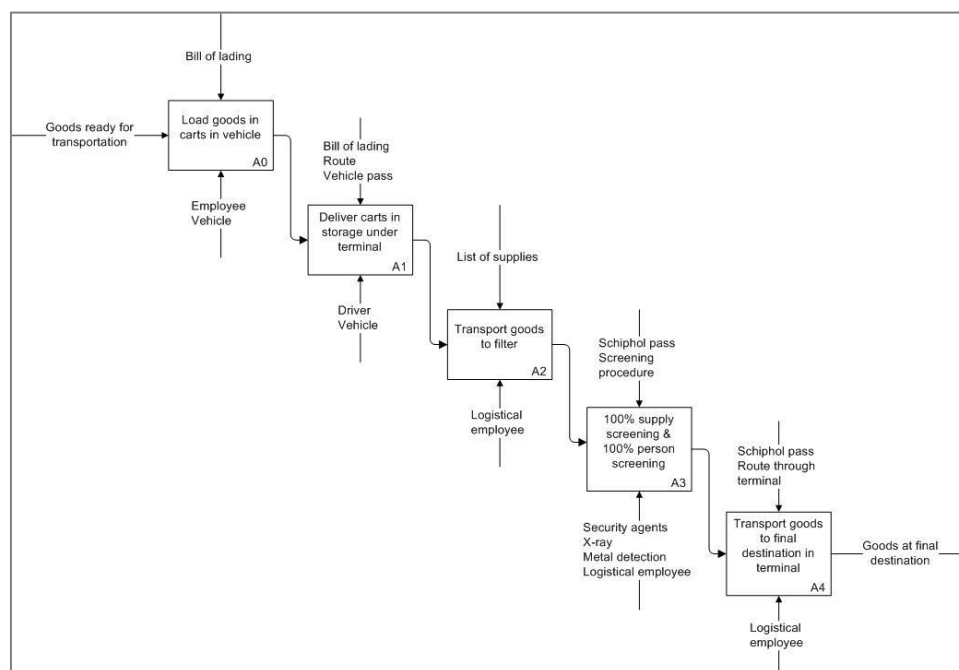


Figure 8-14 IDEF0 diagram of terminal supplier process with 100% screening

In the text a simplified process diagram based on the IDEF0 diagrams can be found. The simple process diagram of the situation with 100% screening and no adaptations to the procedures is presented in Figure 8-15. The colours in the process diagrams of the concepts mean changes in the process. If processes are coloured orange, this means the process is added or takes more time than in the starting situation. If a process is coloured green, the process now takes less time. If the process is grey, this process is handled by other employees than from the suppliers or recipients.

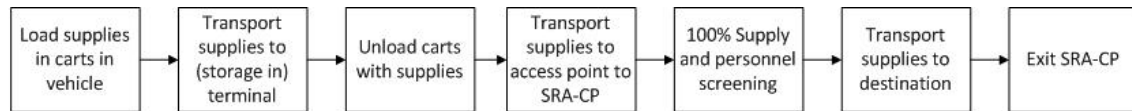


Figure 8-15 Simplified process depiction for 100% screening

### 8.2.1 Screening location

The screening location mentioned in 8.1.1 can also be used by suppliers of goods for the terminal. Suppliers drive to this screening location and have their supplies checked and sealed by security agents. The suppliers can continue their normal route to the terminal and follow the usual procedure. At the entrance to SRA-CP the seals and bill of lading is checked and the supplier can enter SRA-CP in the terminal and deliver their supplies as they are used to.

In Figure 8-16 the process is depicted. Two extra steps are added to the process, and the screening process at the access point is reduced in time.



Figure 8-16 Process depiction for screening location

At the access points to SRA-CP in the terminal not much is different compared to the situation prior to September 1<sup>st</sup> 2010. All suppliers can be handled equally, whether they are known or have had the screening done at the screening location. The checking of the seal and certificate should not take long, especially if technical solutions are introduced, such as change of the code on the Schiphol pass and barcode scanners for the seals. In the queue model a calculation is performed with the expected growth of the supply flows, and the current capacity of the access point is sufficient to prevent queues at the vehicle access points.

In Table 8-7, the most important investments and exploitation costs are mentioned.

Investments	Exploitation Costs
Construction of screening location	Maintenance of screening location and equipment
Equipment for screening	Security agents at screening location
Equipment for sealing	Additional training for supply screening
ICT investment	
Communication	

Table 8-7 Overview of costs for screening location

A few security risks have been identified in this concept. Screening of supplies at a distance from the border to SRA-CP enables manipulation of the supplies en route. This is dependent on the quality and procedure for sealing of the supplies. If the screening location is not owned by Amsterdam Airport Schiphol, but by a private party, the focus of the employees could be more on speed and efficiency than on accuracy and security. This concept is compliant with regulations but shows several security risks, so the security level is 2.

## 8.2.2 Distribution Centre

As explained in 7.2.1 a distribution centre can be set up for central delivery of the supplies, organise centralised security screening and distribute the goods to their destination. Such a retail consolidation centre is also in place at Heathrow Airport. The distribution centre needs to accommodate the storage and fast handling of perishables. A consolidation centre for terminal supplies can be located in three locations; between origin and border, on the border to SRA-CP on airside or underneath the terminal. For the suppliers, there is not much difference between these options; the only difference is the distance from their origin to the DC. These three options result in different processes at the access points and different costs and benefits.

### a. DC between origin and border

For the first option, the process is visualised in Figure 8-17.

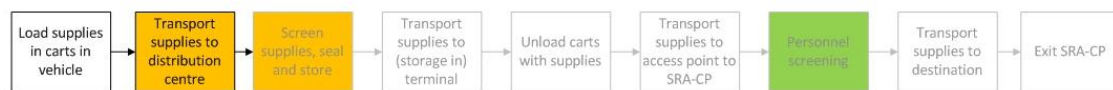


Figure 8-17 Process depiction for DC between origin and border

This concept will result in less pressure on the access points than currently. Only personnel without supplies and personnel with sealed supplies will pass the access points. The current capacity of the vehicle access points is sufficient if this concept is implemented.

In Table 8-8, the most important investments and exploitation costs are summed up. This concept can be implemented with logistical employees in the terminal. If this results in an impossible situation for the concessionaires, the sealed supplies can also be delivered to storages of the recipients in the terminal. The recipients coordinate the final delivery themselves.

Investments	Exploitation Costs
Construction of distribution centre	Maintenance of DC, vehicles and equipment
Equipment for screening	Security agents at DC
Equipment for sealing	Additional training for supply screening
Equipment for storage and transportation in DC	Logistical employees at DC and in trucks
Trucks for transport between DC and terminal	Logistical employees in terminal
ICT investment	
Communication	

Table 8-8 Overview of costs for DC between origin and border

The security risks are similar to the risks mentioned in the previous concept. Screening of supplies at a distance from the border to SRA-CP enables manipulation of the supplies en route. If the consolidation centre is not operated by Amsterdam Airport Schiphol, but by a private party, the focus of the employees could be more on speed and efficiency than on accuracy and security. This concept is compliant with regulations but shows several security risks, so the security level is 2.

### *b. DC on border to SRA-CP airside*

In the second option for a distribution centre, the location is changed to the border to SRA-CP somewhere on airside. This means that the border to SRA-CP is somewhere inside the DC. Goods are delivered by suppliers, who can turn around after delivery. The goods are screened by security agents and stored in the secure DC. Sealing is not necessary in this case, as screened goods are in a secured area and will stay there. The exit of the DC leads to SRA-CP. The goods can be delivered to the destinations in the terminal by DC employees, but it is also a possibility to let people in SRA-CP pick up stuff from the DC. The process is depicted in Figure 8-18.

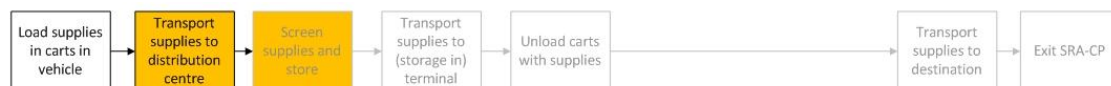


Figure 8-18 Process depiction for DC on border to SRA-CP

The access points are even less busy if this option is implemented. No supplies will pass the access points. Known suppliers (if any) can deliver their supplies at the DC and store them in the secure environment.

Investments and exploitation costs are roughly equal to the other option. But the construction of the DC will be costlier, due to the high land value of Amsterdam Airport Schiphol.

Security risks are smaller than in the first option, if the consolidation centre can really be a secure environment. Screening of DC personnel needs to be of a high quality. The security level is assessed as a level 3.

### *c. DC under terminal building*

A third option quite similar to the second one is a distribution centre underneath the terminal building. No transport with trucks from DC to terminal is necessary; the supplies are delivered close to their destination. The even shorter process is shown in Figure 8-19.

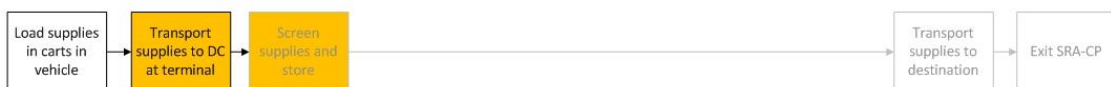


Figure 8-19 Process depiction for DC under terminal building

The terminal basement has to be reconstructed to enable this concept to work. All storages and other rooms need to be emptied and a central screening point for supplies should be installed. Concessionaires can still have room for storage, but this will be in SRA-CP.

Costs are roughly the same as the other options, except that no new building needs to be built. But reconstructing the terminal basement will be an expensive project, as well.

Security risks are low, if the distribution centre is well secured; SRA-CP is enlarged and upon entering this area, all supplies are screened. The security level is assessed as a level 3.

### 8.2.3 Separation of flows

The flows of suppliers with supplies to be screened and people with no supplies that need screening now use the same filters. The separation of these flows is the concept discussed in this paragraph, first physical separation and second separation in time.

#### a. Separation of flows at filters

Screening of the supplies in the terminal has an average estimated duration of 8 minutes per cart. A person without supplies can pass an access point in less than a minute. Such a person does not want to wait behind a person with supplies that need to be screened, so separation of the different flows is an option that needs to be considered. At the terminal access points to SRA-CP there is only one lane, so separation of the flows is not really possible within the filters, unless reconstruction is performed. An additional X-ray would have to be installed, for which unavailable space is needed. It is possible to mark the current filters as specific supply filters and personnel filters. The process of suppliers stays equal, except for the distance between origin and border and between border and destination. The distances could be longer when the nearest filter is dedicated to personnel.

In Figure 8-20 the separation of flows is visualised.

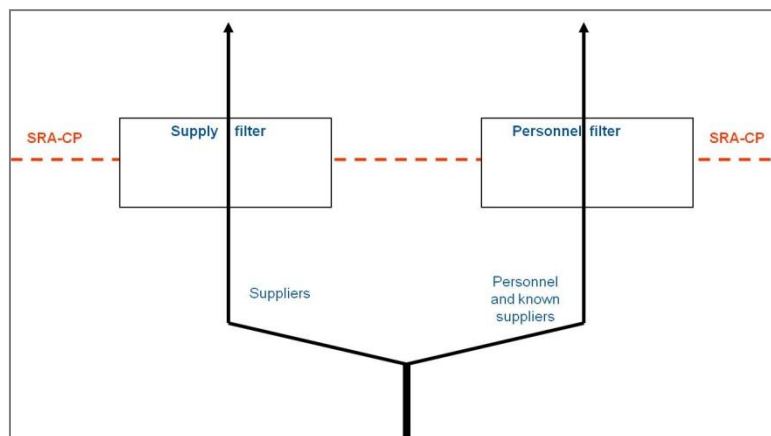


Figure 8-20 Separation of flows in terminal

The investments for this concept are not very high, if no filter needs to be reconstructed. Larger X-ray machines could be purchased to speed up the screening process. An overview is found in Table 8-9.

Investments	Exploitation Costs
Equipment for supply screening	Additional training for supply screening
ICT investment	
Communication	

Table 8-9 Overview of costs for separating the flows

This concept is compliant with the regulations, but has some security risks. Due to long process times agents can become less thorough in their inspections. Suppliers will be impatient, which does not improve the working conditions. The security level of this concept is assessed as a level 2.

### *b. Spreading of flows in time*

Another option to separate the flows of personnel with and without supplies is to plan the arrivals of different categories. This can guarantee a spreading of the arrivals and lower the peak arrival rates that currently occur. The current arrival behaviour of carts at the Supply filter is presented in Figure 8-21. This arrival behaviour can be flattened by using a planning, in order to get rid of the peak arrival early in the morning. This concept increases the ability of the filters to handle the supplies, and queues will be less.

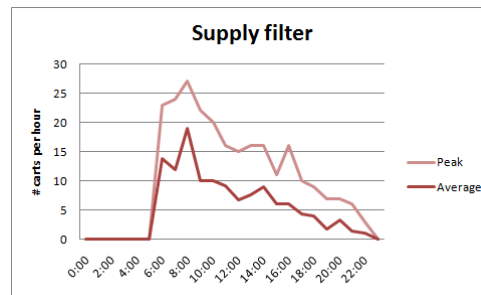


Figure 8-21 Current arrival behaviour Supply Filter

The main cost for this option is organisational and communications cost. It needs to be defined which suppliers can be included in this regulation option, and how this regulation will be controlled. Will there be fines when suppliers arrive outside their time schedule or will suppliers receive some kind of incentive to arrive outside the peak hours.

The security level is similar to the previous concept. The concept is compliant with regulations but security risks are present, especially due to long process times. The security level of this concept is assessed as a level 2.

#### 8.2.4 X-ray Installation

A popular idea during the first workshop was a large X-ray installation that can screen whole carts at a time. Such an X-ray system can be very similar to baggage screening. The process for suppliers does not change much. If carts can be moved through the X-ray easily and if the X-ray images can be interpreted quickly, this installation will speed up the screening process. The supplier does not need to unload the cart and load it again. The carts that are used have to be adapted to the approved X-ray, which means that suppliers need to buy new carts. The largest currently approved X-ray machine can screen objects of 1.30m x 1.30m (Figure 8-22).

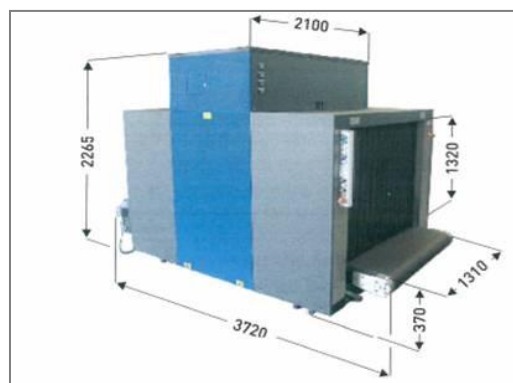


Figure 8-22 X-ray machine [58]

The main costs for this concept are the acquisition of the X-ray(s) and the installation and reconstruction around the machines. Computers need to be linked to receive the images, and the maximum size of carts and containers needs to be communicated to the suppliers. An overview can be found in Table 8-10.

Investments	Exploitation Costs
Acquisition and construction of X-ray installation	Maintenance of X-ray installation
ICT investment	Additional training for supply screening
Communication	
Adapted carts	

Table 8-10 Overview of costs for X-ray installation

The main security risk in this option is the visibility of all prohibited objects. The visibility strongly depends on the content and the material characteristics of the supplies. The 1.30x1.30 machine has been approved by EU regulators, so this concept is compliant. The level of security is assessed as a level 2.

### 8.2.5 Combine all supply screening at vehicle access points

A screening location and a distribution centre can be solutions for both flows of supplies, to the terminal and to airside SRA-CP. Another option to combine the flows is to perform all supply screening at the vehicle access points. In the terminal space is very limited, at the outside borders more can be built. The process is depicted in Figure 8-23. The main disadvantage of this idea is that the vehicles of these suppliers are screened as well, which is not necessary in the current situation.



Figure 8-23 Process depiction for terminal supply through VAP

The main costs for this concept are summed up in Table 8-11.

Investments	Exploitation Costs
Expansion of vehicle access points	More resources at vehicle access points
Create entrances from airside to terminal	
ICT investment	
Communication	

Table 8-11 Overview of costs for terminal supply through VAP

Security risks for this concept are hard to define, because it is not a fully developed concept. Changes of vehicle access points are necessary to handle the extra flow of vehicles. If no major changes take place, the security level is assessed as a level 2.

### 8.3 Conclusions

Ten concepts for screening of supplies have been discussed in detail in this chapter. Some of these concepts overlap, as they are nearly equal for supplies meant for the terminal and outside destinations. The different concepts are not all on the same level and do not exclude each other. A combination of a few concepts could be the most fruitful solution to the issue. All concepts have their advantages and disadvantages that need to be weighed against each other. An overview of all concepts and their characteristics can be found in the tables below. In Table 8-12 an overview of the concepts is presented for supplies with a destination outside the terminal. In Table 8-13 the overview of concepts for terminal supplies is presented. The colour green has a positive meaning, red is negative and orange is near the middle. The costs are split up in investments and exploitation costs and are separately mentioned. The queue effect describes the effect this concept will have on the length of queues in front of the access point outside or inside.

Vehicle Access Points	1 screening location	2a DC between origin & border	2b DC on border airside	3a separation of flows per lane	3b Separation of flows per VAP	3c spreading of flows	4a Vehicle X-ray installation	4b Supply X-ray installation	5 Accompanied delivery
Level of security	2	2	3	2	2	2	1	2	1/2
Changes in supplier process									
Queue effect									
Investments									
(Re)Construction	High	High	V. high	Medium	Med-high		V. high	Medium	
Screening equipment	x	x	x	x	x		x	x	
Sealing equipment	x	x							
ICT	x	x	x				x	x	
Communication	x	x	x	x	x	x	x	x	x
Equipment in DC		x	x						
Trucks		x	x						
Exploitation									
Maintenance	x	x	x				x	x	
Security agents	x	x	x	x	x				x
Training	x	x	x	x	x		x	x	x
Extra employees		x	x			x	x		x

Table 8-12 Overview of all concepts for the outside supplies



Terminal supplies	1 screening location	2a DC between origin & border	2b DC on border airside	2c DC under terminal	3a separation of flows	3b spreading of flows	4 X-ray installation	5 Supply through VAPs
Level of security	2	2	3	3	2	2	2	2
Changes in supplier process								
Queue effect								
Investments								
(Re)Construction	High	High	V. high	High			Medium	x
Screening equipment	x	x	x	x	x		x	x
Sealing equipment	x	x						
ICT	x	x	x	x	x		x	
Communication	x	x	x	x	x	x	x	x
Equipment in DC		x	x	x				
Trucks		x	x					
Adapted carts							x	
Exploitation								
Maintenance	x	x	x	x			x	
Security agents	x	x	x	x				x
Training	x	x	x	x	x		x	
Extra employees		x	x	x		x		

Table 8-13 Overview of all concepts for the terminal supplies

For further evaluation it needs to be taken into account that certain measures can increase the success of a concept. Larger storage facilities on SRA-CP can for instance reduce the need to deliver just-in-time. It could also reduce the number of deliveries per supplier, because the size of deliveries can be larger. This can result in less pressure on the access points. An increase of resources can result in shorter process times. In chapter 6 it was concluded that such a solution is not sufficient on its own, but a combination with one of the concepts discussed above can result in a successful solution.

The detailing of these concepts has been done up to a certain level. More in-depth analysis per concept is necessary before a choice for a solution can be made. Especially the financial analysis should be performed more rigidly. Due to the large amount of concepts and the limited time available this analysis was not part of the detailing and should be performed after a further selection of concepts is made. This level of detail did provide sufficient input for further evaluation of the concepts with a group of stakeholders, which is performed during the second workshop. The presentation of the concepts, reactions and evaluations resulted in some adjustments and improvements of these detailed concepts. The Alternatives phase has resulted in ten concepts that are worked out to a conceptual level. The Evaluation phase will be described in the subsequent chapters, starting with the evaluation approach.

# Evaluation

## 9 Evaluation setup

The evaluation approach for the concepts from chapter 8 is discussed in this chapter. The overall evaluation is based on the previous detailing of the concepts and the evaluation workshops with stakeholders. The group of participants has expanded since the first workshop, and separate workshops on terminal supplies and outside supplies are organised. In the first section, the evaluation method and the different steps in this process are discussed. The setup of the workshop and a short evaluation follows in the subsequent section of this chapter.

### 9.1 Evaluation Method

The evaluation of the different solutions is performed under three different circumstances or scenarios of known suppliership. The percentage of supplies brought in by known suppliers of the complete number of supplies is the feature of change. At the moment this is an unknown factor that influences the feasibility of concepts, because it has a large influence on the quantity of supplies that will need screening.

The known suppliership percentage in the terminal is based on the number of carts, at the vehicle access points the percentage is based on the number of vehicles with supplies. In Table 9-1 the percentages per scenario are shown. Scenario 1 is a scenario in which Schiphol does not use the possibility of known suppliership. Different causes can be found for such a decision: suppliers are not willing to invest to become known, the regulation is changed over time and it is no longer feasible, or Schiphol decides to collectively set up another arrangement and no longer offers the possibility to become a known supplier. Scenario number 3 is the currently expected possible rate of known suppliership in 2012. This percentage was discussed with experts on the different processes [46&53]. For the terminal, the expected number of known suppliers is very high. This is caused by a low number of suppliers who are responsible for a large share of the total supplies. The suppliers at the vehicle access points are much more diverse and do not supply as regularly as suppliers in the terminal, as was also concluded in chapter 4. In addition, the suppliers of goods on airside are expected to have more difficulty with the requirements for known suppliership. For instance, large construction materials and bulk goods cannot be easily sealed en route to the border, which is one of the requirements for known suppliers. The middle scenario is constructed as the average of scenario 1 and 3; this can be the result if Schiphol offers a good alternative solution to known suppliership or if regulations for known suppliers are intensified.

	Scenario 1	Scenario 2	Scenario 3
Terminal access points	0% known suppliership	50% known suppliership	95% known suppliership
Vehicle access points	0% known suppliership	40% known suppliership	80% known suppliership

Table 9-1 Overview of scenarios of known suppliership

The logistical impact of the solutions on the access points is calculated in the queue model where possible. In appendix M the results of these tests can be found. For every scenario the resulting queue length is calculated in the model. The level of security is the second input for the evaluation, which is already discussed in the previous chapter. If these two criteria do not meet the minimum target, the solution is not considered further in that scenario of known suppliership. Some concepts are excluded from further evaluation in the third scenario, because they are not feasible for small quantities of supplies. An example is the distribution centre.

During two 2-hour workshops the solutions as described in chapter 8 are presented to the group of stakeholders and they fill in evaluation forms on the solutions. Using these forms and the stakeholder criteria from the first workshop, the effects of the solutions for the main stakeholders are depicted. The effects a concept can cause and the criteria mentioned earlier are presented in a scorecard per scenario. They present the main effects for unknown suppliers, security agents, airlines and Schiphol departments. Qualitative comments per effect are mentioned and colours are used to clarify the positive or negative direction of the effect.

## 9.2 Workshop 2 setup and evaluation

The second workshop with the stakeholders was planned on December 2<sup>nd</sup> 2010. The workshop consists of two separate parts; the treatment of the concepts for the supplies to vehicle access points and the concepts for the supplies to the terminal. Some stakeholders are invited for both parts of the workshop and some stakeholders come to one part of the workshop. The list of attendants can be found in appendix E.

The goal of this workshop is to conduct a stakeholder evaluation of the concepts. Detailed information on the conceptual solutions is presented and the stakeholders are asked to react on these concepts from their own perspective. The main criteria for stakeholders can be depicted from this workshop and an impression of the effects of concepts on these criteria is retrieved. It is important to retrieve this information non-anonymously, because it is important to know who the owner is of the criteria. Reaction on each other's criteria is not the goal of this workshop, so the use of a Group Support System is not necessary. It was decided to use questionnaires to collect the reactions of the participants. An example of such a questionnaire can be found in appendix N. A short discussion is used to clarify some of the comments.

Each part starts with a short introduction of all attendants, because some stakeholders have not attended the first workshop. The previous process is explained and the setup of the workshop is described. The first 40 minutes are filled with the presentation on the different conceptual solutions. The process diagrams, as can be found in appendix L, are used to explain the concepts. The impact on the logistics at the access points is described and lists of possible advantages, costs and other disadvantages are presented. Possible security risks of the concepts are also discussed. Clarification questions can be asked during the presentation. After the presentation a hand-out of the presentation is distributed over the participants, as well as a questionnaire that can be found in appendix N. Questions per concept are answered on the strengths and weaknesses of the concepts, among other

questions. After answering all the questions by the participants, the answers are quickly read with employees from Security Policy. Vague answers and interesting notions are discussed with the group of participants, after which the workshop ends. All participants are thanked for their cooperation and the future process is explained. A formal project is started on the issue using all the input from this project and the workshops. The participants of the workshops will be asked for input during this project and shall be informed on the project progress.

The workshop was executed as planned. All participants filled in the questionnaires and the results of this input can be found in appendix N. The participants did not fill in all questions due to a lack of time, but this forced them to focus on their main objections and positive points of the concepts.

### **9.3 Conclusions**

The evaluation workshop was set up differently than the first workshop and was not supported with a Group Support System. It would have been possible to use the software to collect the evaluations and this would have eased the processing of the evaluation results. But the submissions would have been anonymous and participants would have been influenced by each other. It was considered more important that all opinions are reflected in the evaluation than that a consensus was reached. And for the future project it was considered important that the main objections per stakeholder were known.

The group for this second workshop was larger and it was decided to split the group for evaluation. In the first half of the workshop the concepts for the outside supplies were discussed and evaluated. After that some of the participants left and others entered, after which the concepts for the terminal access points were discussed. This resulted in more focussed groups and the attention was evenly divided over both areas.

After this evaluation workshop all necessary information to perform an analysis of the effects of the conceptual solutions is gathered. The criteria mentioned in the first workshop, the detailed information on the concepts from chapter 8 and the input from the stakeholders will be combined to perform this evaluation, and the results can be found in chapter 10.

## 10 Evaluation results

This chapter discusses the results of the evaluation of the conceptual solutions. This evaluation is based on the stakeholder criteria from the stakeholder analysis and the first workshop, the detailed concept descriptions, results from the queue model and the evaluation workshop. The performed evaluation is validated with experts from the project board [53].

The complete overview of the scored effects and the evaluation score cards can be found in appendix O. The first two rows of the table represent the main criteria for the solutions: security level and length of queues. The level of security is defined as a level 1, 2 or 3. Level 1 means that the security level is not sufficient to meet legal requirements. Level 2 means that the solution meets legal requirements, but substantial security risks exist; ALARP as an abbreviation of security level As Low As Regulations Permit. Level 3 represents a high level of security; ALARP as security risk As Low As Reasonably Practicable. If a concept is not compliant with regulations (level 1), this concept is not discussed further. The other criterion is the length of the queues that occur in front of an access point. If a concept does not solve the queues to a low level in a certain scenario of known suppliership, this concept is not taken into account in that scenario. The full results of the tests in the queue model are located in appendix M. The effects for stakeholders are mainly retrieved from Workshop 2 and partially from the stakeholder analysis and Workshop 1. The results of the evaluation of the concepts in Workshop 2 can be found in appendix N.

In section 10.1 the main points from the evaluation of the solutions for the vehicle access points are discussed and in paragraph 10.2 the evaluation for the solutions for terminal supplies follows.

### 10.1 Evaluation of solutions for the vehicle access points

A summary of all effects of the concepts for vehicle access points in different scenarios is depicted in Figure 10-1.

In the first scenario (no known suppliers) concept 3a, 3b and 3c are excluded from further analysis, as well as the X-ray installations. The separation and spreading of flows simply does not result in a sufficient reduction of queues. The vehicle X-ray installation is excluded in all scenarios due to the security risks and the interpretation time of the images; this is not a feasible solution at the moment. The supply X-ray installation does not lead to a large reduction in process time, due to the extra processes of unloading and reloading the vehicles.

The screening location is taken into account in all scenarios and has a negative impact on several effects. The flexibility of the suppliers' planning is reduced and current procedures are changed. The supplier has to make a detour to pass the screening location and this process takes time. An urgent delivery is not as easy as previously, because a supplier has to pass security at the separate location first. This solution does not work for all supplies. Bulk goods and large materials cannot be sealed easily. A positive effect of the screening location is that AAS can potentially control the supplier process more, by determining location and

opening hours of the screening location. At the access points a uniform process for all suppliers is the result.

The two options for distribution centres have similar effects. A DC reduces the flexibility of the suppliers' planning; a strict planning is probably made by the DC operator. The suppliers' processes are changed, and suppliers and recipients can no longer control the process of delivery; the responsibility of the products is handed to the DC operator. Urgent deliveries can be difficult, unless the DC employs a separate procedure. The distance driven by suppliers is probably reduced, because the process is much shorter. It is not necessary to deliver products in SRA-CP, so no vehicle check is necessary. This also results in less traffic on airside roads and quieter access points. Only DC trucks and non-suppliers still pass the vehicle access points. A distribution centre on the border is probably more expensive but results in very quiet access points with only vehicles without supplies.

Accompanied delivery can be arranged for a small percentage of the supplies, such as bulk and very large building materials. The suppliers are not very flexible; the moment of delivery is dependent on the available time slots. There will be many different processes at the access points, because this solution only works for part of the supplies.

Scenarios	Concepts	Security level	Main effects
0% known suppliership	1. Screening location	2	uniformity at vaps extra process step
	2a. DC origin and border	2	efficiency reduced flexibility & control
	2b. DC on border	3	centralisation high costs
	3a. Separate lanes	2	NO GO
	3b. Separate access points	2	NO GO
	3c. Spreading in time	2	NO GO
	4a. Vehicle X-Ray installation	1	NO GO
	4b. Cart X-Ray installation	2	NO GO
	5. Accompanied delivery	1/2	control of bulk labour intensive, planning
40% known suppliership	1. Screening location	2	extra process step uniform process at vaps
	2a. DC origin and border	2	efficiency reduced flexibility & control
	2b. DC on border	3	centralisation high costs
	3a. Separate lanes	2	NO GO
	3b. Separate access points	2	NO GO
	3c. Spreading in time	2	NO GO
	4a. Vehicle X-Ray installation	1	NO GO
	4b. Cart X-Ray installation	2	NO GO
	5. Accompanied delivery	1/2	control of bulk labour intensive, planning
80% known suppliership	1. Screening location	2	uniformity at vaps extra process step
	2a. DC origin and border	2	NO GO
	2b. DC on border	3	NO GO
	3a. Separate lanes	2	NO GO
	3b. Separate access points	2	NO GO
	3c. Spreading in time	2	no peak behaviour strict planning, inflexible
	4a. Vehicle X-Ray installation	1	NO GO
	4b. Cart X-Ray installation	2	shorter process unloading & reloading
	5. Accompanied delivery	2	control of bulk labour intensive, planning

Figure 10-1 Summary of evaluation per scenario of concepts for Vehicle Access Points



In the second scenario with 40% known suppliers the same concepts are excluded from further analysis for the same reasons as in the first scenario. The effects are also similar. The positive effect on the traffic on airside roads and uniform processes at the access points is less due to the number of known suppliers.

In the third scenario (80% known suppliers) the distribution centres are excluded from further analysis. Setting up a distribution centre is worth the effort if a large part of the supplies is handled in the distribution centre; otherwise the advantages become too small. The separation of flows is still not sufficient to solve the queues. Combined with a resource increase these options do become feasible. The effects of the screening location remain as discussed and the same is applicable for the last concept, accompanied delivery. The ideal situation of spreading the flows evenly now becomes a feasible option. The suppliers will have to obey the strict planning, which reduces the flexibility for suppliers. By spreading the flows evenly, different kinds of vehicles pass all access points and the process is adapted per vehicle. The X-ray installation for supplies can become feasible; more research is necessary to know more about the process time with this installation. The route for vehicles is not different, but extra process steps are added. The unloading and loading of the vehicle is potentially time consuming. This solution is only applicable for smaller packed supplies.

## 10.2 Evaluation of solutions for the supply to the terminal

In Figure 10-2 a summary of the evaluation of screening concepts for terminal supplies is depicted. In appendix O the complete scorecard of the effects can be found, which is based on the analysis in the queue model from appendix M and the results of the evaluation workshop in appendix N. For the terminal supplies a few more effects are taken into account compared to the concepts for the vehicle access points. Effects on the terminal, such as air quality under the building, passenger experience and efficient use of the terminal basement are some of these effects.

Terminal Access Points	Scenarios	Concepts	Security level	Main effects	
	0% known suppliership	1. Screening location	2	uniformity at filters	extra process step
		2a. DC origin and border	2	efficiency	reduced flexibility & control
		2b. DC on border	3	centralisation	high costs
		2c. DC under terminal	3	organised terminal	reduced flexibility & control
		3a. Separate flows	2	NO GO	
		3b. Spreading in time	2	NO GO	
		4. Cart X-Ray installation	2	shorter process	adapted carts, space needed
		5. Supply through vaps	2	organised terminal	vap expansion, change
	50% known suppliership	1. Screening location	2	uniformity at filters	extra process step
		2a. DC origin and border	2	efficiency	reduced flexibility & control
		2b. DC on border	3	centralisation	high costs
		2c. DC under terminal	3	organised terminal	reduced flexibility & control
		3a. Separate flows	2	NO GO	
	95% known suppliership	3b. Spreading in time	2	NO GO	
		4. Cart X-Ray installation	2	shorter process	adapted carts, space needed
		5. Supply through vaps	2	organised terminal	change, vap expansion
		1. Screening location	2	uniformity at vaps	extra process step
		2a. DC origin and border	2	NO GO	
		2b. DC on border airside	3	NO GO	
		2c. DC under terminal	3	NO GO	
		3a. Separate flows	2	uniformity per filter	change, distances
		3b. Spreading in time	2	no peak behaviour	strict planning, inflexible
		4. Cart X-Ray installation	2	shorter process	adapted carts, space needed
		5. Supply through vaps	2	no queues inside	vap expansion, change

Figure 10-2 Summary of evaluation per scenario of concepts for terminal supplies

The different concepts were tested in the queue model and for scenario 1 and 2 the solutions on separating and spreading the flows are eliminated due to the lengthy queues. The effects of the remaining solutions are similar in the first and second scenario. The screening location results in an extra process step for suppliers and increases the total delivery time. Urgent deliveries are therefore more difficult. At the access points all suppliers arrive with screened and sealed supplies. Air quality under the terminal building is not reduced. The three distribution centres have equal negative effects; the flexibility for suppliers is reduced and the control over the process is in the hands of the DC operator.

Urgent deliveries are difficult and suppliers that bring goods for security restricted areas and public areas suddenly have to split up the products and change their operation. Advantages are shorter total delivery time, organised cart logistics in the terminal, more efficient use of the terminal basement and better air quality. An X-ray installation for carts needs more research on the effects of the use and effectiveness. Some negative effects are the need to use adapted carts, the large space needed for installation and no improved air quality. The last concept is centralisation of supply screening at the vehicle access points. This results in positive effects for the terminal, such as better air quality, more efficient use of the terminal and quieter access points. The suppliers on the other hand have to change their procedures and pass a vehicle check. Investing in the vehicle access points is a requirement for this concept.

For the third scenario with 95% known suppliers the distribution centres are excluded from further analysis; the number of suppliers using the DC makes this concept unfeasible. Effects of the screening location, X-ray installation and centralised screening at vehicle access points are similar to the other scenarios. There are less advantages for the terminal, though, due to the high rate of known suppliers that keep operating as currently. The separation and spreading of flows become feasible solutions. The separation changes the procedures of all suppliers, because entrances to SRA-CP are specifically meant for certain suppliers. Longer distances with carts are the result, which means that the passenger experience in the terminal is decreased; more carts move through the passenger flows. Spreading of flows affects the flexibility of suppliers' planning negatively.

### 10.3 Conclusions

This evaluation exercise does not result in one best solution per scenario, but provides an overview of the feasible concepts per scenario and their expected effects on operational processes at the access points, costs, level of security and effects for stakeholders. Before a best solution can be chosen, a weighing of the criteria needs to take place. And some concepts need to be analysed further before their feasibility can be ascertained. For instance, the delivery under security guidance has to be approved by the NCTb before it could be implemented. It is also important that a more extensive cost benefit analysis of the concepts is performed. The division of costs among involved parties and the potential benefits of concepts are left out of scope during this study, but are important for final decision making.

The Evaluation phase has resulted in an overview of feasible conceptual solutions in different scenarios of known suppliership, and a depiction of the effects of these concepts for the main stakeholders. In spite of the qualitative and conceptual level of the final result, the results of this study will be used as input for the official Schiphol project on this subject. In the last section of this thesis report, the conclusions are discussed. All research questions shall be answered and the final recommendations will be discussed.

# Conclusion

## 11 Conclusions and Recommendations

In this chapter the conclusions of this thesis are presented. The research questions from the first chapter are repeated and answered in the following sections. In the first section, the project plan as presented in the introduction is evaluated and adjustments are discussed. Then, the conclusions on the project content will be discussed, in particular answering the research questions on the current situation and environment of the project, the results from the benchmark study and the questions regarding the design objective. Some limitations of the project are discussed in the subsequent part. The fourth section discusses the research questions on the project approach, including the choice of Collaborative Business Engineering approach, and the evaluation of the application of CBE. The following paragraph of this chapter focuses on recommendations for Schiphol Group, a part of it for the project board of the 100% supply screening project in particular, and the last part for the Security Policy department in general. The final section deals with recommendations for further research in the CBE field.

### 11.1 Evaluation of the followed process

The project plan as described in chapter one (Figure 1-2) has been adapted during this project. The main activities have remained the same, as well as the order of activity execution. The plan to perform the different aspects of the conceptual analysis in parallel was very successful. The necessary information was gathered from different sources, and was not always available immediately. Parallel execution of these analyses kept the speed of the project high. The diagnosis phase, in particular data gathering, was started before the conceptualisation phase was finished. Construction and analysis of the results of the model was an iterative process. Analysis of the results showed how the model should be adapted and adaptation of the model presented new results, which changed the analysis of the current flows. The preparation, execution and processing of the results of workshop 1 were performed parallel to the desk research on possible concepts, and both provided valuable input for the selection and detailing of the concepts afterwards. In workshop 2 these concepts were presented and evaluated. For the actual evaluation the input from the stakeholders and a lot of other information from the project was used. The planning for the project worked out well, though more time between the first and second workshop would have been better. The concepts would have been worked out in more detail and the workshop could have been better prepared.

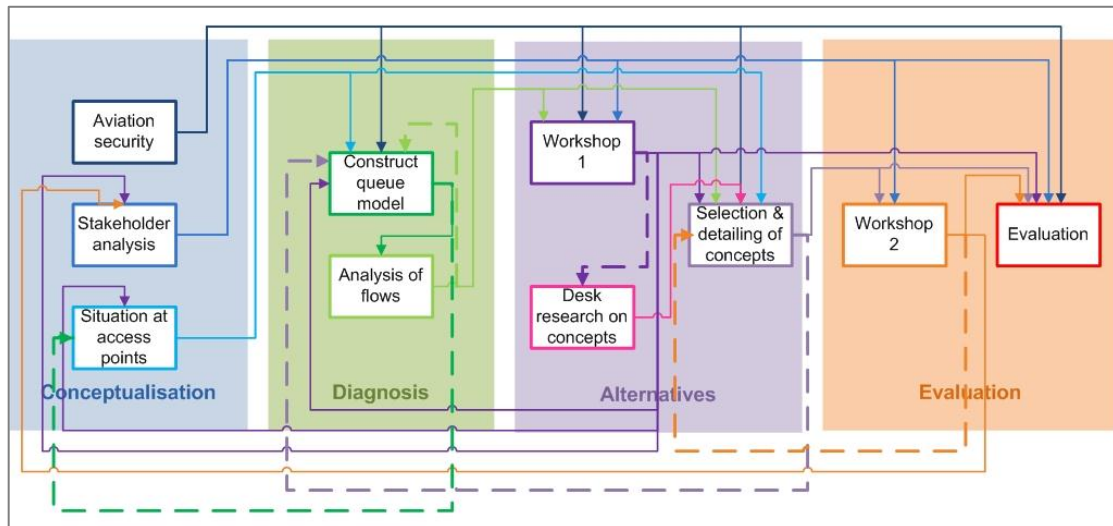


Figure 11-1 Adapted project plan

The main difference between the executed project overview presented in Figure 11-1 and the project plan presented in Figure 1-2 are the feedback loops. Some feedback loops were present in the project plan, such as from the workshops to the stakeholder analysis. But more were added while working on this project. They are presented in Figure 11-1 as dotted lines. Due to the data gathering for and construction of the queue model, more insight was provided into the current situation at the access points, which led to adjustments in the conceptualisation part. During the detailing of the concepts adjustments to the queue model were necessary to test the effects of the concepts on the queue length. And the evaluation and discussion in workshop 2 led to more extensive detailing of the different concepts. The use of feedback loops in this project resulted in higher quality analyses and better models of the actual situation.

## 11.2 Project Conclusions

The first research question was formulated as follows: “What is the context in which the project is set, taking into account the characteristics of the security system, aviation security developments, regulations and stakeholders?” The analysis in chapter 2 has resulted in insight in the current status and history of security, risk management and security concepts, such as ALARP, security-in-depth and barrier systems. Security systems of Schiphol have been analysed and the relevant regulations have been discussed. An overview of stakeholders and their interests and relations is presented in chapter 3.

Answers to the second question can be found in the Conceptualisation and Diagnosis part of this chapter. The question was: “What is the current situation at the access points for airport and in-flight supplies at Amsterdam Airport Schiphol and how will the new regulation affect this?” An extensive overview of the current situation at the access points is presented in chapter 4, including maps, procedures, users and their processes. The diagnosis with the queue model showed what the disastrous consequences are if supply screening is increased to 100% without changing anything apart from adding resources. The results from the analysis in chapter 6 showed that design of new concepts is necessary.

Question 4 was “What can be learnt from previous studies for Amsterdam Airport Schiphol, a benchmark study at other airports and similar system, such as baggage screening?” With this desk research, the set of solutions from the first workshop could be expanded and enriched. Aéroports de Paris had sent a questionnaire to airports in Europe on the reaction of these airports to the changing regulation on supply screening. Unfortunately, other airports did not show further progressions on the issue than Schiphol, and mentioned similar issues. Previous studies performed by graduates, related to security, provided insight into a terminal distribution centre and an innovative vehicle screening concept, as described in chapter 7. The construction consolidation centre at Heathrow airport showed that a distribution centre can also work for the outside supplies. The participants of the first workshop thought a consolidation centre would only be a feasible option for terminal supplies, such as retail and food. Performing a small research of similar systems with large flows of diverse entities, in this case toll gate systems, city centres and baggage processing systems, it could be learned how the performance of these systems is increased. Division of flows is one of the options stemming from this research, as well as automation of the system.

The research questions on the design objective are answered in the Alternatives and Evaluation parts of this thesis. Question 6, “Which concepts can be developed, taking into account stakeholder input and the desk research?”, is extensively discussed in chapter 8. In chapter 7 it is described how these concepts were collected and selected. The seventh research question is also partially answered in this chapter, and partially in chapter 10. The question was “What are the effects of concepts in different scenarios on the stakeholder requirements, security level, operational performance indicators and cost indicators?” The evaluation method is explained in chapter 9, and an overview of the evaluation is presented in chapter 10. The final choice of a concept is dependent on the scenario of known suppliership, the budget and division of costs, the weight of criteria and desired level of security.

### **11.3 Evaluation of Collaborative Business Engineering for this project**

Research question number 3 was “Which approach can be used to develop and evaluate screening concepts, considering the characteristics of the project and its context?” Collaborative Business Engineering was used in this project for several reasons explained in chapter 1. Technology, organisations and people are the main components of the security system. Security related organisations are linked, technical innovations are introduced constantly and people form a very important component in the security system. The environment of Schiphol and aviation security is very dynamic; regulations, culture and the market have changed constructively the past years. These characteristics require a systems approach, considering all components and the dynamic complex environment. A hard systems approach is necessary to analyse how the logistics affect the access points, and a soft systems approach is necessary to take into account the politics and qualitative factors. A thorough analysis of the current situation is necessary to grasp all the components of the security system. The large influence of the planned change in the security system on the operation of the airport and operations of stakeholders required involvement of many process owners. All these elements are reflected in the Collaborative Business Engineering approach. The CBE approach combines simulation modelling with high levels of involvement



of stakeholders, often using Group Support Systems to guide the meetings. Stakeholders are involved in gathering data, building conceptual models, analysing the current situation, developing concepts for the future and evaluating these based on simulation models.

The CBE approach was adapted for this project. The main difference is the two levels of involvement for stakeholders. A group of problem owners was involved at a high level during the project and has co-developed conceptual and empirical models. A larger group of stakeholders has participated in the gathering of conceptual data, provided input on ideas, criteria and the evaluation of concepts. Many of these participants were interviewed and most of them were present at the two organised workshops. Another difference with the most common process is that a final choice for a concept is not part of this project. The gathered participants were not all at the appropriate management level to make the final decision, and more information on the feasibility of known suppliership is necessary before a founded estimation of scenario can be made.

The use of Collective Business Engineering had a large influence on the process and the outcome of this project. In the following paragraphs the first part of the fifth research question will be answered: “How did the chosen approach affect the process and results of the project? How can this approach be used again for similar projects, in general and at AAS?” The second part will be discussed in the Recommendations section.

Using a Group Support System was very useful for the brainstorm workshop. A long list of ideas and comments to which every participant contributed, was the result of this workshop. The number of participants was large (20 people), so a traditional brainstorm would have been a challenge and more time consuming.

Using a simulation model to show the arrival behaviour at access points was very useful; most of the stakeholders had never seen an overview of the flows divided over time. Showing the effects of different concepts on the queue length and the suppliers’ process really contributed to the understanding of the concepts and their evaluation.

Security is an issue at the airport that is often considered a hassle; it costs a lot of money and time, and direct benefits are hard to define. This is true for the 100% supply screening project, as well. A solution needs to be found that causes the least negative effects on stakeholders, costs and other processes at the airport. By involving stakeholders at an early stage and providing as much insight into the issue as possible, stakeholders will be more understanding in later stages. They can prepare themselves and their relations for the future changes. By asking them for help or asking them to contribute to the project, stakeholders become co-owners of the problem. They will start looking for solutions to solve the issue. This is exactly what happened during the first round of interviews and the first workshop.

By involving stakeholders in the collection of solution directions and evaluation of concepts, their knowledge of the processes, users and issues is taken into account.

By involving stakeholders at an early stage, the need to change can be turned into an opportunity. For instance, a distribution centre is an idea that has existed at Schiphol for several years, but a clear motive for the construction was lacking. Building a distribution centre with supply screening facilities is one of the promising concepts in this project. A business case will have to provide more insight in the benefits of a distribution centre.

Using a collaborative approach often results in a longer project duration. Informing all stakeholders, providing opportunities for input such as workshops and keeping the stakeholders involved requires time. In this case, a high level of involvement from people with knowledge about the processes, procedures and all other aspects of the project was required anyway, since the analyst did not have any background knowledge on the context of the project. The workshops took a lot of preparation and processing time, but they also functioned as strict deadlines in the project, increasing the speed of working.

Using stakeholders for a brainstorm on new concepts for supply screening resulted in a long list of ideas, but only a few ideas were really innovative or radical. Incremental changes to the current system or small issues that annoyed these users were often entered. For the actual users of the access points it is difficult to think out of the box.

## 11.4 Limitations

Some limitations have influenced the results of this project, and they will be discussed in this section. Due to the fact that no budget and limited time was available, much of the input is based on assumptions or small samples of data. This influences the quality and meaning of the queue model in particular. This model can be upgraded by collecting more specific data on process times and more analysis of the staff filters in the terminal.

The selection of participants is of great influence on the final outcome of the project. Due to the lack of background knowledge, interviews started based on advice from some of the problem owners at Security Policy and desk research. From these interviews new stakeholders were selected and the group of participants grew. The participation of stakeholders was also largely dependent on the willingness to participate and availability at the time of the workshops.

The concept 'known supplier' was not discussed in detail during the workshops. During the evaluation of the other concepts negative effects for the main stakeholders were mentioned for all concepts. The idea of "outsourcing" a part of the supply chain of the suppliers, or adding an extra link did not sound appealing. The effect of not discussing the negative sides of known suppliership resulted in a positive attitude towards this solution.

The analyst in this project is not a specialist in the CBE field. The application and evaluation of the CBE approach is performed based on desk research of previous work on CBE and related fields, and the execution and results of this project. The analyst has no previous experience with CBE projects.

## 11.5 Recommendations for Schiphol Group

A follow-up project was started while this thesis was written. Some recommendations for the new project team are discussed in the following paragraphs. After that, more general recommendations will follow.

The first recommendation for the project team is to keep the participants of the workshops involved and informed about the further project. They have invested in this project and deserve to be included. Further research should be done to analyse the flows that pass the access points. The nature of this should be quantitative as well as qualitative. It is very important to know what supplies are brought in and with what frequency. This will help to build a more valuable model and be able to test the concepts more rigidly. The process with the legislator NCTb should commence as soon as possible. Some of the concepts need approval before they could be implemented and it is best to know this before more time is invested in detailing the concepts. The feasibility of known suppliership is also largely dependent on the outcome of discussions with NCTb. The law text is lacking detail and clarifications by NCTb are necessary. It is recommended to start discussing the budget of the project, responsibilities of stakeholders and eventually the (weighing of) decision criteria. For all feasible concepts, a business case should be built, dealing with the costs and benefits of these concepts. For the project team it is important to watch the development of other projects concerning security and the arrangement of areas at Schiphol, because this influences the size of the flows of supplies.

A final recommendation is to focus on future proof and flexible solutions. The trend in aviation security law is towards stricter regulations, so choosing a short term cheap concept to just meet the legal requirements is not wise. It is therefore not recommended to choose the known supplier option. This solution is not future proof and will change in the future. It will be difficult to convince suppliers to increase their own security system and costs will be incurred on Schiphol, directly or indirectly. It is much more sensible to keep the responsibility and investments for security in own hands. This results in manageable costs and the preferred quality of security.

More general recommendations now follow for the Security Policy department of Schiphol Group. It is important to inform potential stakeholders as soon as possible when new regulations are communicated to Schiphol. As an effect, stakeholders will be more involved, informed and cooperative, which will result in more and supported solutions which are based on more inside information. Projects with stakeholder involvement does require more time than projects with no stakeholder involvement, so project teams should be formed at the moment it is clear that there will be a change to the security system that influences stakeholders.

The second part of the fifth research question, “How can this approach be used again for similar projects, in general and at AAS?”, will be discussed in the following. For similar projects to the 100% screening system project, a similar process can be followed. An action plan has been created that shows the recommended process steps and recommendations to apply the process steps successfully. This action plan is depicted in Figure 11-2. This project approach can be used for projects at Security Policy but can also be applied at other

departments and even other organisations. The first step is very important, because this project approach will only work for particular projects. The described project approach can be used for (re)engineering projects of organisational systems if the changes influence the operational processes of many stakeholders. These stakeholders have different interests and goals, and their processes that are influenced deviate from each other. The relations between the problem owner or decision maker and these stakeholders should be non-hierarchical but bi-directional; their success and survival depends on each other. The last steps have not been executed in this project, but form an important part of the whole project. The actual implementation of the solution should be seen as a separate project.

Process steps	Success criteria & recommendations
Determine if CBE fits the project	<ul style="list-style-type: none"> <li>Examine whether the project results in a substantial change in the security system, that will influence on operations of many stakeholders</li> </ul>
Select participants for involvement	<ul style="list-style-type: none"> <li>Make a clear overview of stakeholders of project with insiders</li> <li>Do not hesitate to involve more stakeholders during the project, if this seems necessary</li> <li>Make sure all process owners are involved</li> <li>Offer participation to all and be clear on goals and results of participation</li> </ul>
Perform a conceptual analysis	<ul style="list-style-type: none"> <li>Analyse the cause for the project (regulations, expansion etc) and its implications</li> <li>Make sure that an overview of the current situation is available (maps, processes etc)</li> <li>Provide all participants with the same overview of the current situation</li> </ul>
Perform an empirical diagnosis of current situation and future implications	<ul style="list-style-type: none"> <li>Develop models of current situation and future changes with well-informed people</li> <li>Make sure that models of different alternatives can be constructed and evaluated</li> <li>Verify and validate the models with the stakeholders</li> </ul>
Develop and detail alternative solutions	<ul style="list-style-type: none"> <li>Organise a brainstorm with participants to collect alternatives</li> <li>Perform desk research to gather different solutions. Look at previous studies, benchmarks and similar systems</li> <li>Analyse the security level of all alternatives, and detail feasible concepts considering costs, benefits and impact before further evaluation</li> </ul>
Evaluate the alternative solutions	<ul style="list-style-type: none"> <li>Present the detailed feasible concepts to the stakeholders</li> <li>Make sure all participants understand the concepts before evaluating</li> <li>Gather criteria for solutions from stakeholders</li> <li>Have all participants evaluate the presented concepts individually</li> <li>Make an overview of all concepts with characteristics from detailing and evaluation</li> </ul>
Select the alternative to be implemented	<ul style="list-style-type: none"> <li>If necessary, perform more analyses on the alternatives</li> <li>Weights of selection criteria should be determined</li> <li>Final selection should be done based on all input</li> <li>Selection procedure and outcomes should be communicated to all participants</li> </ul>
Prepare for implementation	<ul style="list-style-type: none"> <li>Involve the stakeholders that will be affected by the solution</li> <li>Develop the process of implementation in cooperation</li> </ul>

Figure 11-2 Action plan for similar projects at Security Policy in the future

Overall, it is recommended that the responsibility for the level of security is internalised, and should not be left to the responsibility of organisations that do not have security as their core business. Currently security companies are hired to perform the security checks, and controlling the quality of their services is a challenge itself. It is the core business of these companies to perform security checks, and transferring the responsibility for the level of security to suppliers or other third parties with other core businesses will not result in a high quality security system. Extra procedures and modes of control need to be implemented to guarantee a certain level of security, if such a course is taken.

The goal of the Security Policy department is start shifting from reactive to pro-active security policy [46], staying more ahead of changes in regulations and being better informed on technological innovations. The focus should be moving from being compliant with regulations to a high quality security system. Analysing the existing risks and starting a large project to increase overall security of Amsterdam Airport Schiphol should be the focus of Security Policy in the future. Smaller projects can be determined in the larger programme, and priority projects should be handled first. All in all, this will result in a more focused future-proof way of working instead of solving day-to-day issues and reacting on changes hastily.

It should always be kept in mind that Schiphol can never be 100% secure and still be operationally successful. The ALARP principle, keeping risks As Low As Reasonably Practicable, is a good guideline for the level of security measures. The security departments at Schiphol should also start looking for synergies. When a security issue or new regulation is defined, a project team should start looking for departments and issues that can be connected. This way, existing issues can be solved in a security project. It is also important that the security department is involved in projects that are initiated at other departments but affect the security system. Security is a value that should be more integrated in the total organisation.

## **11.6 Recommendations for further research**

One of the recommendations for further research is to evaluate the application of the adapted Collaborative Business Engineering approach to this project. When the project is finished and one or more solutions have been implemented an evaluation of the process with all participant and the analyst can indicate the success of the approach.

Another very important recommendation for further research is to apply this adapted Collaborative Business Engineering approach to more projects. These case studies will deepen the evaluation of the adapted approach. It will also help to extend the set of preconditions for projects to which the approach can be applied and to which kind of projects the approach should not be applied. Executing more case studies will also validate and improve the action plan for future projects.

## Glossary

AAS	Amsterdam Airport Schiphol
ACPS	Access Control & Public Security
ALARP	‘As Low As Reasonably Practicable’ or ‘As Low As Regulations Permit’
BAA	Business Area Aviation
CBE	Collaborative Business Engineering
GSS	Group Support System
KMar	Royal Military Police (Koninklijke Marechaussee)
MIS	Management Information System
NCTb	National Coordinator for Counterterrorism
SRA-CP	Security Restricted Area – Critical Part
SSE	Safety, Security & Environment
SP	Security Policy
VAP	Vehicle Access Point
In-flight supplies	all items intended to be taken on board an aircraft for use, consumption or purchase by passengers or crew during a flight other than: <ul style="list-style-type: none"><li>(a) Cabin baggage;</li><li>(b) Items carried by persons other than passengers; and</li><li>(c) Air carrier mail and air carrier materials;</li></ul>
Airport supplies	all items intended to be sold, used or made available in security restricted areas of airports
Known supplier	a supplier whose procedures meet common security rules and standards sufficient to allow delivery of airport supplies to security restricted areas

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## A. Analysis of Security at AAS – CONFIDENTIAL

*Security-in-depth analysis*

CONFIDENTIAL

*Barrier system nature and function*

CONFIDENTIAL



## B. Stakeholder Analysis

### *Stakeholder problem perception*

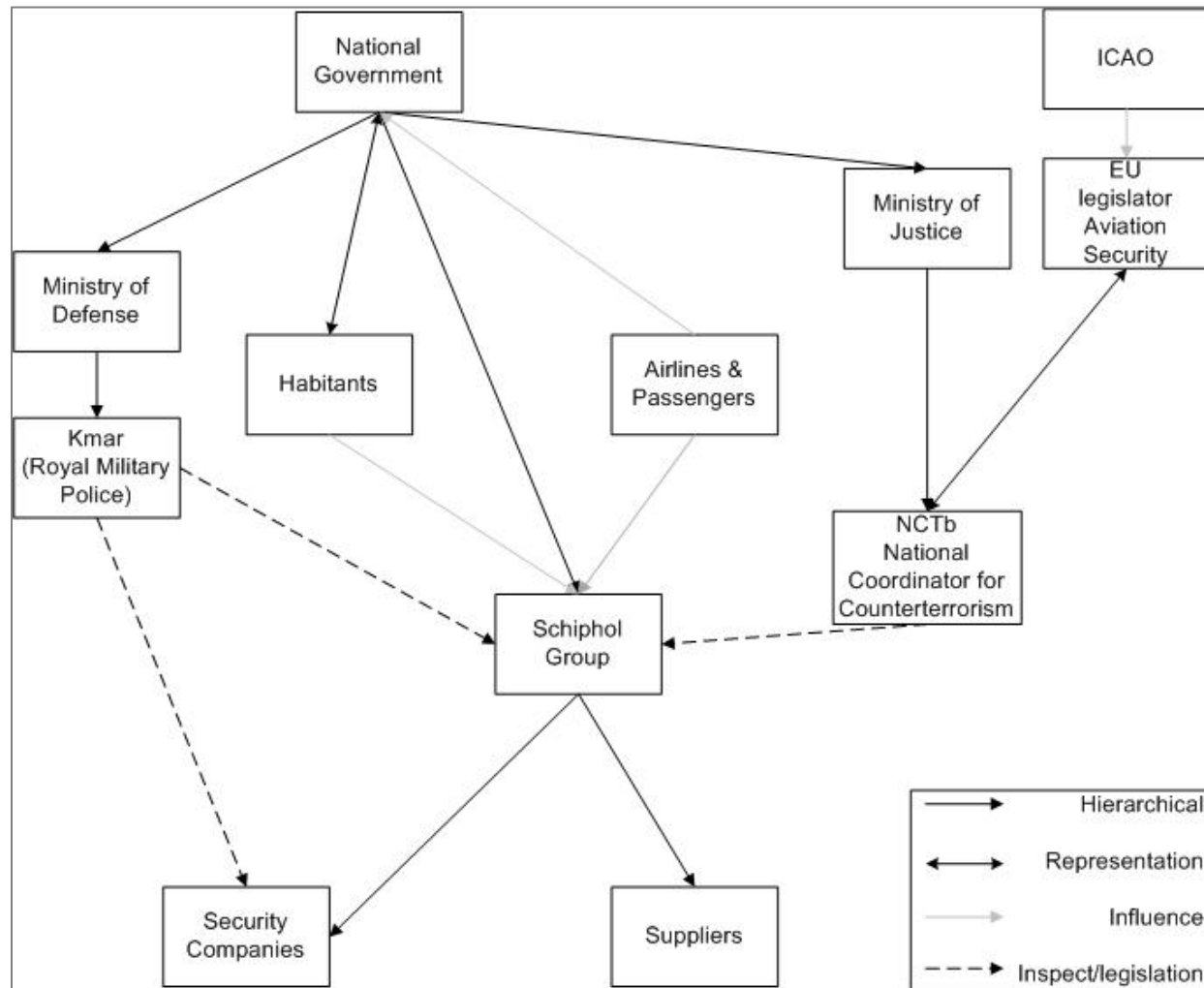
Actor	Value	Goal	Expected (problem) situation	Solution Directions
<b>Schiphol Group Aviation/SSE/SP</b>	Development of security policy that meets legal requirements, airline and passenger demands, taking into account costs and logistical processes	Find a solution that meets all legal requirements and the requirements of stakeholders	Known suppliership seems the best option, but suppliers' negative reactions could mean other options need to be taken into account. Steps need to be taken as soon as possible, before the EU/NCTb introduces a stricter regulation in the meantime	Known suppliership Distribution centre Separate screening lanes
<b>Schiphol Group A/SSE/Q&amp;C</b>	Keep security at the appropriate level and make sure all legal requirements are met	Make sure that supply screening meets all legal requirements	Afraid of intermediate raise of screening percentage or not meeting legal requirements Process of known suppliership needs to be approved by government.	Perform benchmark and find out how other EU airports are reacting
<b>Schiphol Group A/SSE/Control</b>	Keep costs of security at Schiphol at a reasonable level	Present a feasible business case	Large amount of money needed, suppliers will not easily cooperate	Look at many different options, also include funding known suppliership
<b>Schiphol Group Consumers</b>	Continuity and high profitability from horeca and retail	Keep the process as easy as possible for retailers and horeca, and do not present any extra costs for these businesses	Costs for suppliers and recipients will go up, which will be visible in prices and thus in profitability of the business area	Distribution centre Separate screening, not at filters Known suppliership

Stakeholder	Value	Goal	Expected (problem) situation	Solution Directions
<b>NCTb</b>	Prevent terrorist attacks by keeping security regulations at a high level in the Netherlands	Make sure that the security policy meets the legal requirements	Difficulty to meet the legal requirements, low scores on tests	Known suppliership and 100% screening for others
<b>KMar</b>	Prevent terrorist attacks by supervising security operations, arresting and detecting	Make sure that the security operations meet the required level	Difficulty to meet the legal requirements, low scores on tests	Use KMar arrangements, such as 'known shipper' for cargo
<b>Users: suppliers</b>	Continuity and profitability of operations	No longer waiting lines, no extra costs, continuity of supply, flexibility of delivery	Long waiting lines if 100%, extra costs and risks if known, discontinuity of supply	Distribution centre Security screening away from filter Known suppliership
<b>Users: recipients of supplies</b>	Continuity and profitability of operations	Continuity of supply, no extra costs	Damaged supplies (due to exposure or waiting time), discontinuity of supply (delays in chain), rising prices due to investments	Known suppliership
<b>Security companies</b>	Perform the job in accordance with the contracts, with the highest profitability and continuity possible	No big changes that require training or major process changes. Cooperative and informed suppliers	100% screening is physically not possible in current situation, suppliers will not be cooperative anymore	Use security equipment and innovative solutions
<b>Airlines &amp; Passengers</b>	Safe and secure airport and aircrafts, with least costs and interruption of processes	Security of a level as high as possible, lowest security charge as possible, no interruption	Higher security charge due to investments, interruption of primary process of Schiphol	Priority lanes Exclusion of airlines
<b>Habitants of airport surroundings</b>	Safe and secure airport and aircrafts flying over	Security of a level as high as possible	-	-

*Stakeholder criticality*

<b>Actor</b>	<b>Resources</b>	<b>Replaceability</b>	<b>Importance of resources</b>	<b>Critical Actor?</b>
<b>Schiphol Group A/SSE/Q&amp;C</b>	Tests security Contact with KMar and NCTb	Low	High	Yes
<b>Schiphol Group A/SSE/Control</b>	Budget	Low	High	Yes
<b>Schiphol Group Consumers</b>	Communicate and organise concessionaires	Low	High	Yes
<b>NCTb</b>	Can lobby at EU Fills in the gaps of EU law Can reject level of security and sanction the airport	Can be represented by Q&C, not replaced	High	Yes
<b>KMar</b>	Screens security, can reject the way of working / level of security	Can be represented by Q&C, not replaced	High	Yes
<b>Users: suppliers</b>	Can decide no longer to supply to Schiphol, have to go through the changes	Medium, depends on the type of supplies	High	Yes
<b>Users: recipients of supplies</b>	Schiphol receives money from concessionaires and needs these companies for construction, cleaning and maintenance among others	Medium, new parties could fill in the spots, but this is not a preferred situation	High	Yes
<b>Security companies</b>	Working capacity Working style	Medium, there are more companies, contracts can be renewed	High	Yes
<b>Airlines &amp; Passengers</b>	Power not to fly and buy at Schiphol	Medium, also represented by account management	High	Yes
<b>Habitants of surroundings</b>	Protest actions, not to be expected	Low	0	No

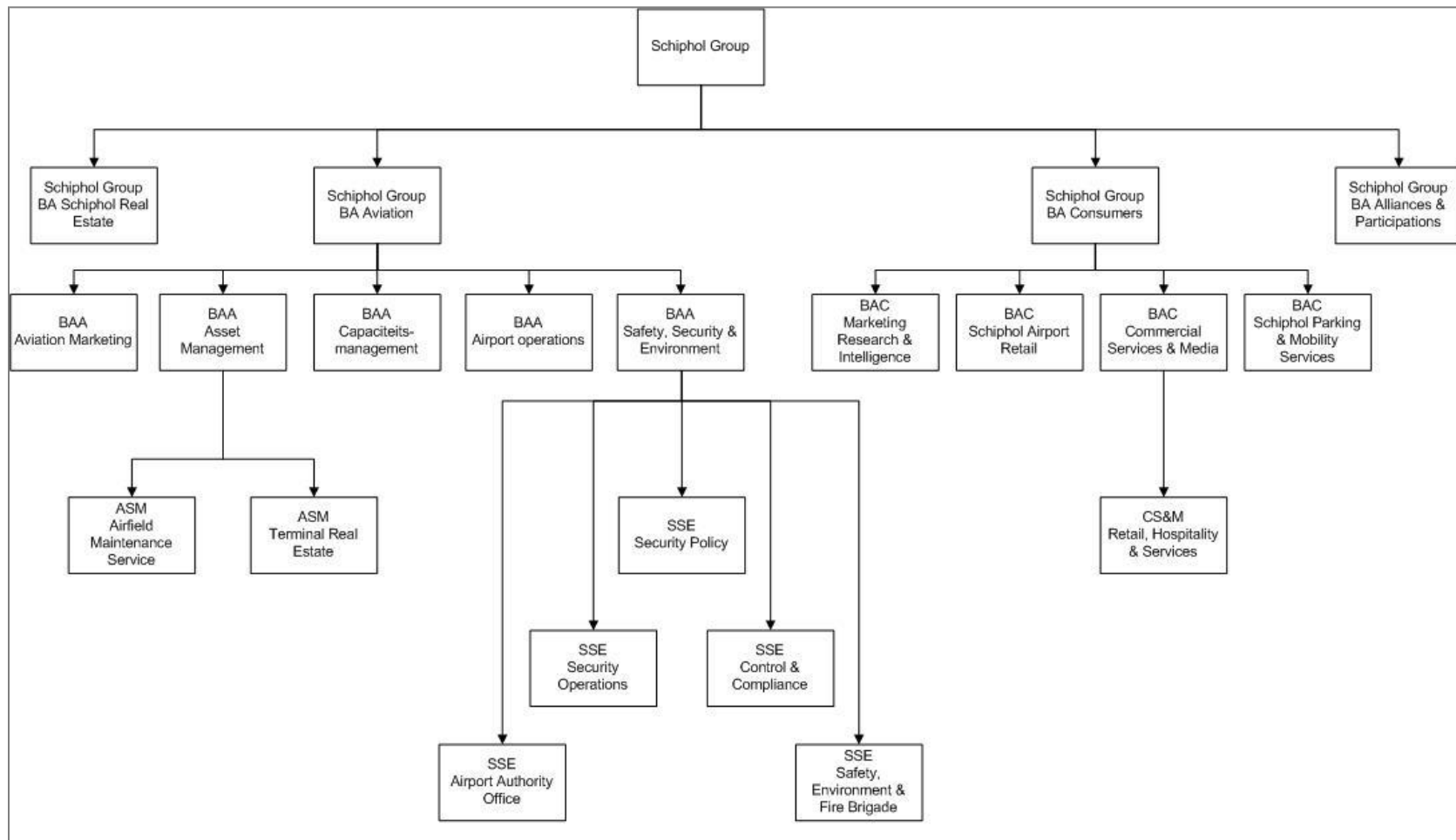
## C. Formal Mapping



In this figure the formal mapping is depicted. The formal relations between the main stakeholders can be read from this. All departments of Schiphol are grouped in Schiphol Group. The organisation chart of Schiphol Group can be found in appendix D. Some overarching institutions, such as ministries and governments, are also depicted to understand the relations between some of the stakeholders.

## D. Organisation Chart Schiphol Group

This organisation chart of Schiphol Group is not complete. All Business Areas are depicted, but below departments are missing due to low relevance. A full organisation chart would not fit on one page. A full organisation chart can be found as a tool on the Schiphol website.



## E. List of involved stakeholders

Department / Organisation	Interview	Workshop 1	Workshop 2 Outside	Workshop 2 Terminal
SSE-Control	05-10-2010	-	-	-
SSE-SP-ACPS coordinator	continuous	Yes	Yes	Yes
SSE-SP-PS	continuous	Yes	Yes	Yes
SSE-SP-AC outside	continuous	-	Yes	-
		-	Yes	-
SSE-SP-AC terminal	continuous	Yes	-	Yes
SSE-SP-AC cargo	continuous	Yes	Yes	Yes
SSE-ESM	06-10-2010	-	-	-
		Yes	Yes	Yes
		Yes	Yes	Yes
SSE-Quality & Compliance	15-09-2010	-	-	-
ACM KLM	07-10-2010	Yes	Yes	Yes
Terminal Real Estate	04-10-2010	Yes	-	Yes
	19-10-2010	-	-	Yes
Consumers	06-10-2010	Yes	-	Yes
Consumer Retail	07-10-2010	Yes	-	-
Construction & Maintenance Control	07-10-2010	Yes	Yes	-
		Yes	Yes	-
PLUS (projects)	13-10-2010	Yes	Yes	-
PLUS project manager	Project Board	-	Yes	Yes
Corporate Procurement	14-10-2010	-	-	-
Schiphol Airport Retail	15-11-2010	Yes	-	Yes
	08-11-2010	-	-	-
Trigion		Yes	Yes	Yes
KLM	25-11-2010	-	Yes	Yes
		-	Yes	Yes
Menzies		-	Yes	-
DHV NACO	Project Board	-	Yes	Yes
	Project Board	-	Yes	Yes
HMS Host	06-10-2010	Yes	-	-
		-	-	Yes
		-	-	Yes
Kappé		Yes	-	Yes
		Yes	-	-
CDVI		-	Yes	-
Heijmans		-	Yes	-
		-	Yes	-
Gerzon		-	-	Yes
KWS Infra		-	Yes	-
Spie		-	Yes	-
Dura Vermeer		-	Yes	-
TOTALS		17	24	21

## **F. Process depiction at access points - CONFIDENTIAL**

### *Vehicle Access Points*

CONFIDENTIAL



## *Terminal Access Points*

CONFIDENTIAL

## G. Overview of users of access points

### Users of vehicle access points

At least 800 different companies pass vehicle access points on a regular basis. Some of the most frequent users of the vehicle access points are shown in the following table. The overview is based on the Management Information System. The supplies are retrieved from a global research at vehicle access point 60 and 90.

	User	Supplies
1	Trigion BV Nederland Aviation Security	-
2	Customs	-
3	TCR Nederland BV	Tools and parts for repair of equipment on airside
4	Royal military police	-
5	KLM	Tools, parts for maintenance
6	Lavos aircraft cleaning	Cleaning equipment and supplies
7	Gate Gourmet	Meals
8	Schiphol Group	Unknown
9	Randstad	-
10	Dura Vermeer	Tools, construction materials

Overview of main users of VAP 43, 60 and 90, 2010

### Users of staff entrances

	Concessionaire	Products
1	AKO	Books, magazines
2	Aviflora	Flowers, plants, bulbs and souvenirs
3	Capi-Lux	Electronics
4	Gassan	Jewellery
5	Gerzon	Clothes
6	HMS Host	Restaurants, cafés, Grab & Fly
7	Kappé	Perfumes and cosmetics
9	Schiphol Airport Retail	Tobacco, chocolate and spirits
10	World of Delights	Delicacies, gifts and souvenirs

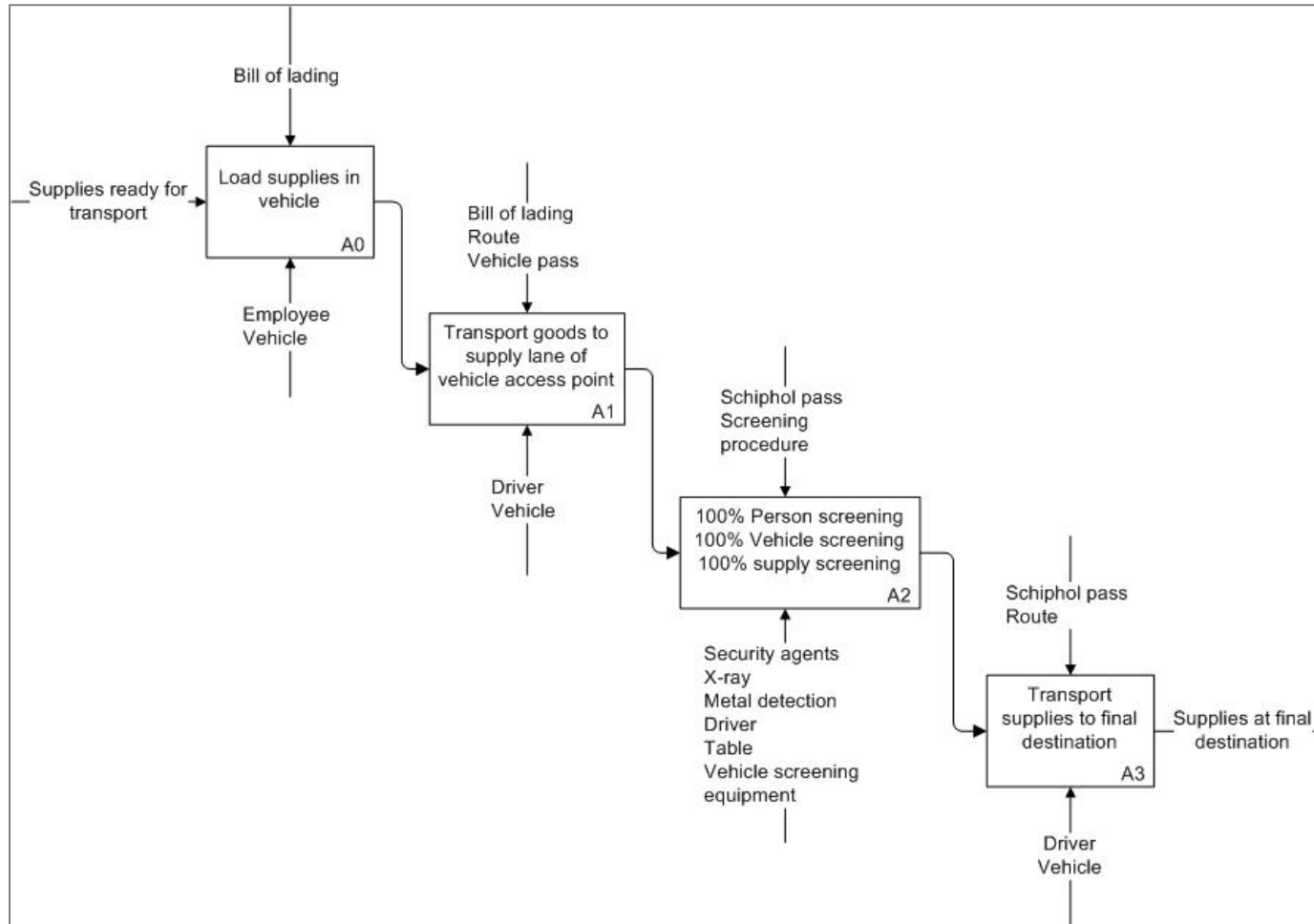
Overview of main concessionaires in terminal 2010 [3]

	Company	Focus
1	Asito	Cleaning, glass and façade
2	CSU	Cleaning
3	EW	Cleaning
4	GSA	Maintenance of seating areas and counters
5	GSH	General maintenance
6	Hago	Sanitary maintenance
7	Kone	Elevator maintenance
8	Raggers	Cleaning of secured entrances
9	Rentokil	Pest and vermin control
10	Siemens	Maintenance of moving walkways
11	Westplant	Maintenance of all plants
12	Workspheer-Heijmans	General maintenance

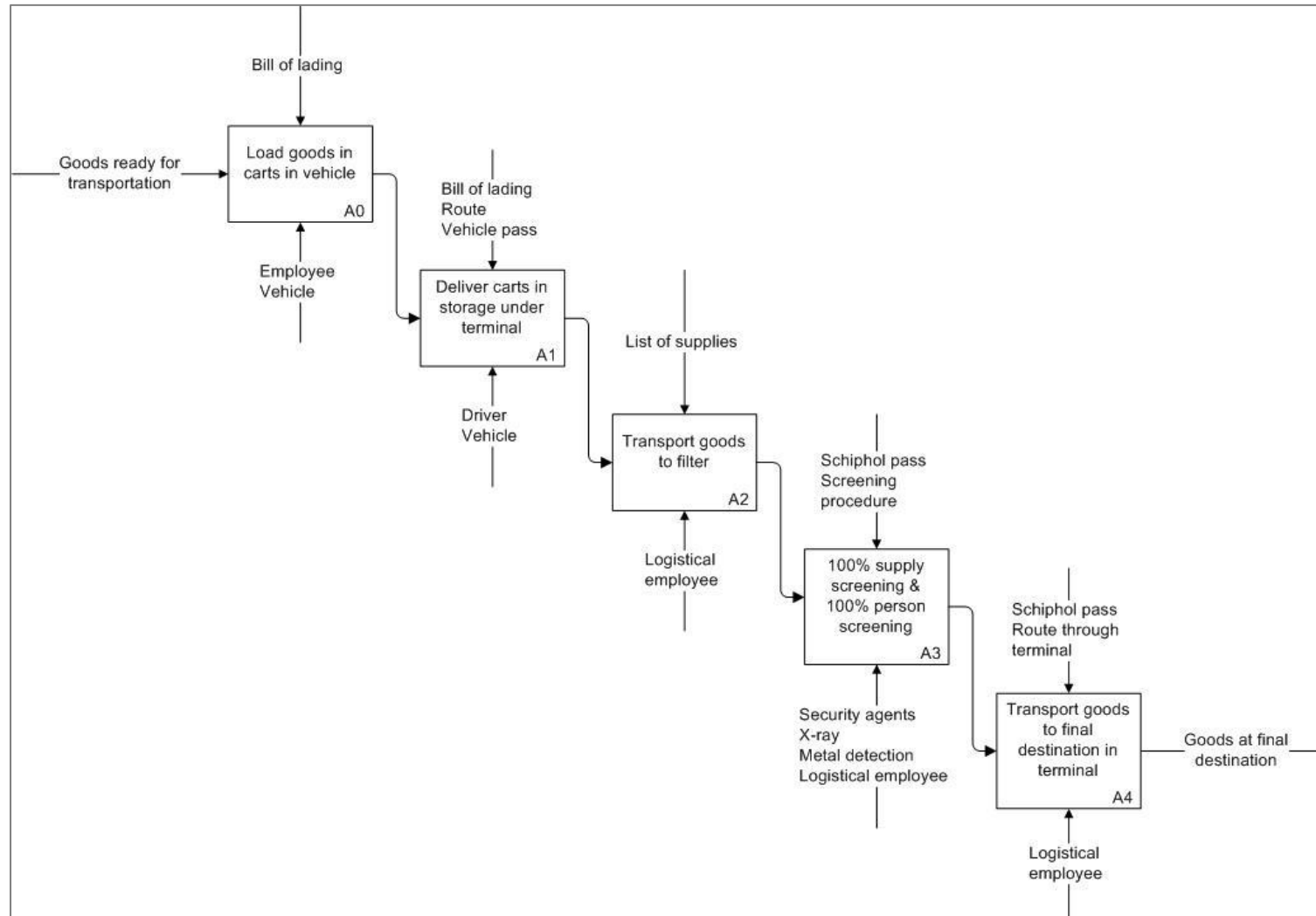
Overview of Maintenance and Cleaning companies in the terminal 2010 [3]

## H. Current supplier processes

### *Process of a typical supplier passing through Vehicle Access Points*

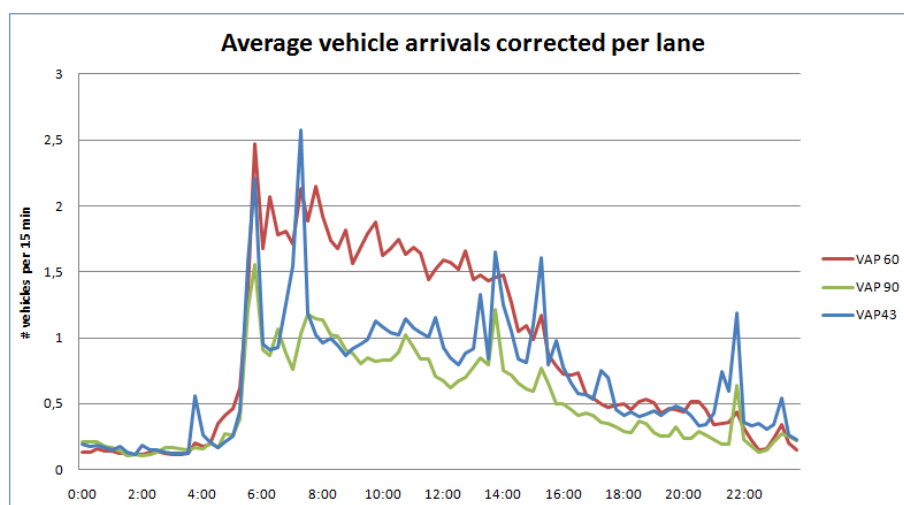
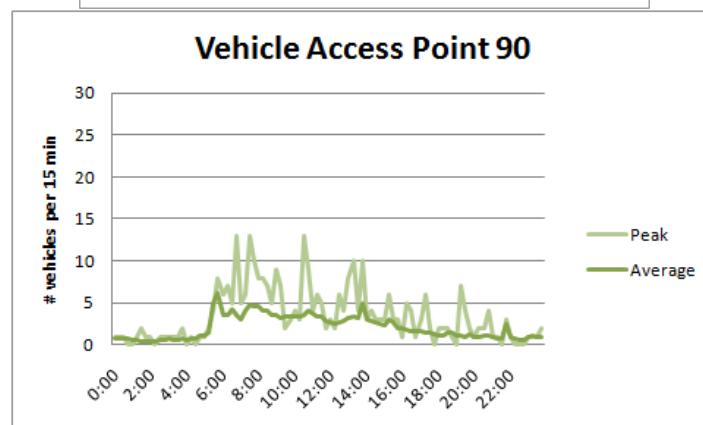
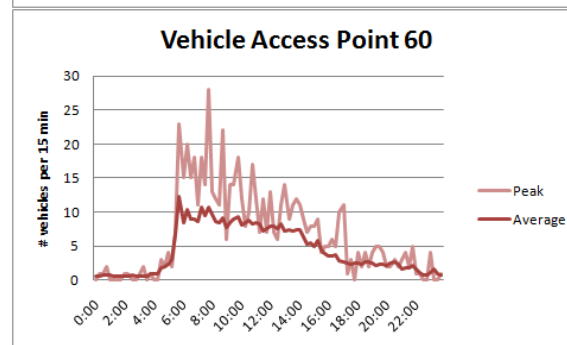
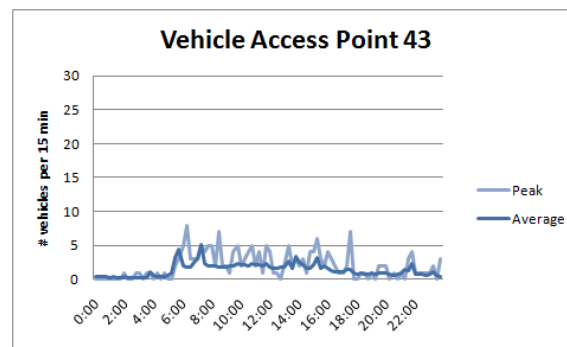


*Process of a typical supplier to the terminal building*

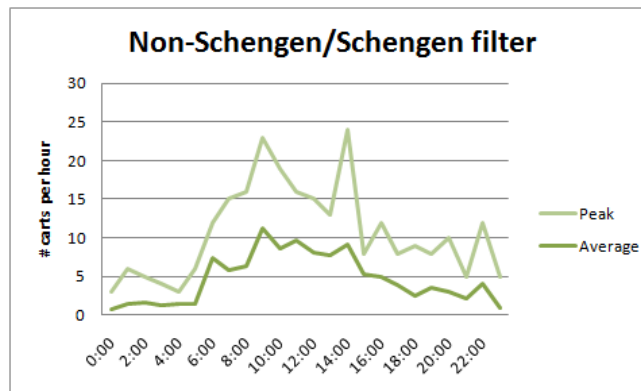
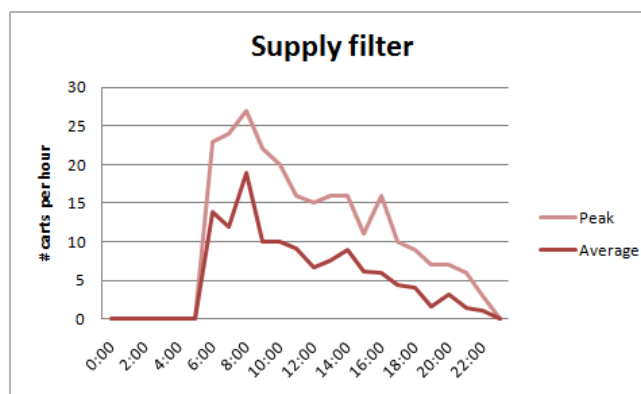
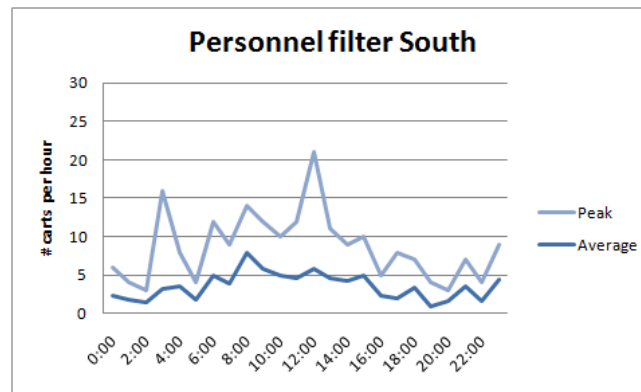


## I. Graphs of current flows

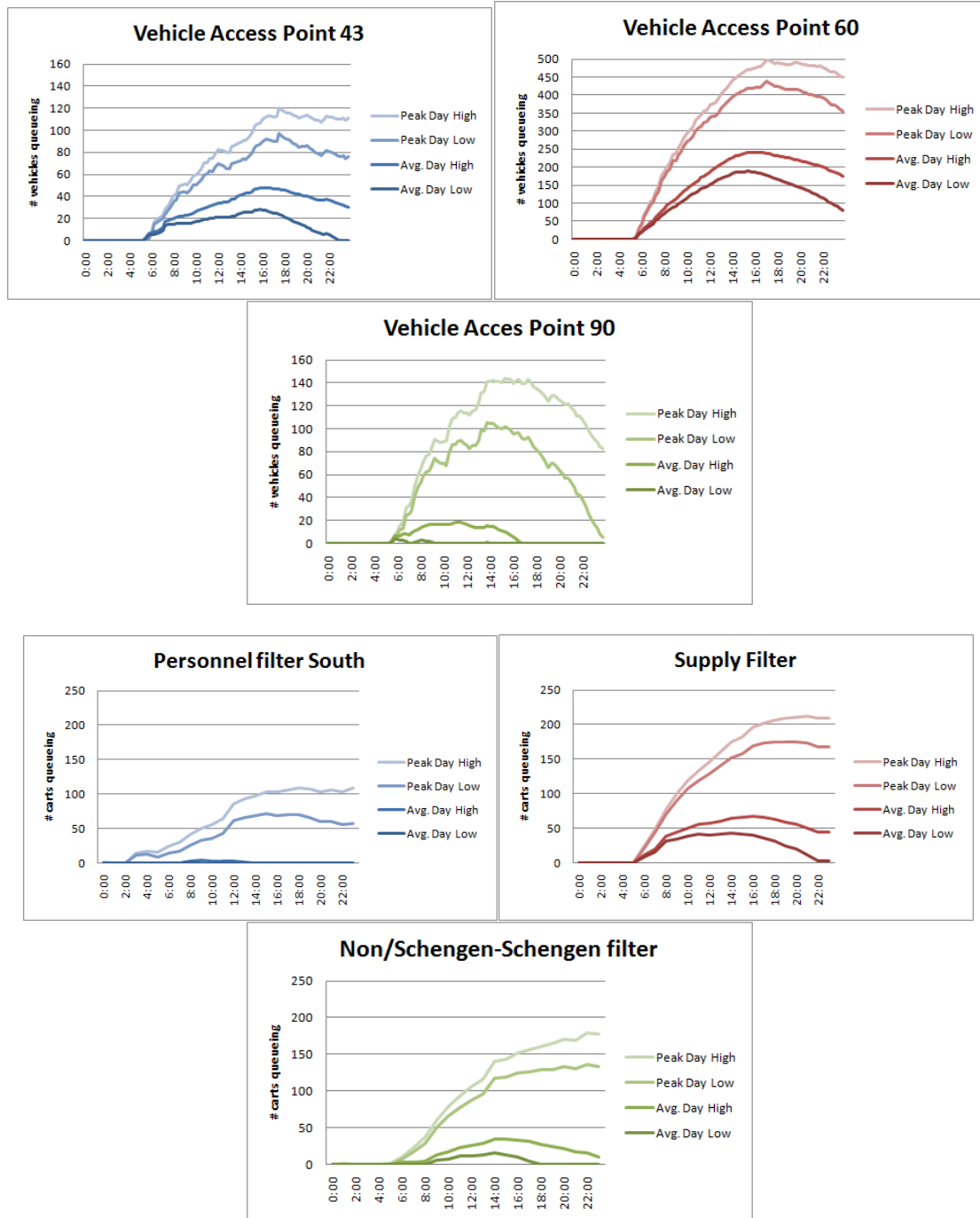
### Current vehicle flows at vehicle access points



**Current cart flows at staff access points in the terminal**



## J. Queues at access points with 100% screening





## K. Results from workshop 1

The main ideas are presented in the following table. Many more ideas were collected, but many were similar or could not really be classified as concepts, more as small adaptations of the current situation. 80 ideas were entered for the terminal and 50 ideas were collected for the outside area.

Airside	Terminal
Central transshipment points for supplies	Distribution Centre
Planning of arrival times	Collective screening location
X-ray installation for vehicles	X-ray installation for carts
Separate access points for supply screening	Separation of flows of supplies and personnel
Expansion of access point capacity	Expansion of filter capacity

After ideas were collected, the participants were asked to enter criteria for the concepts. In the following table the most important criteria are depicted. Others were similar or could not be classified as criteria. 113 items were entered in this phase of the workshop.

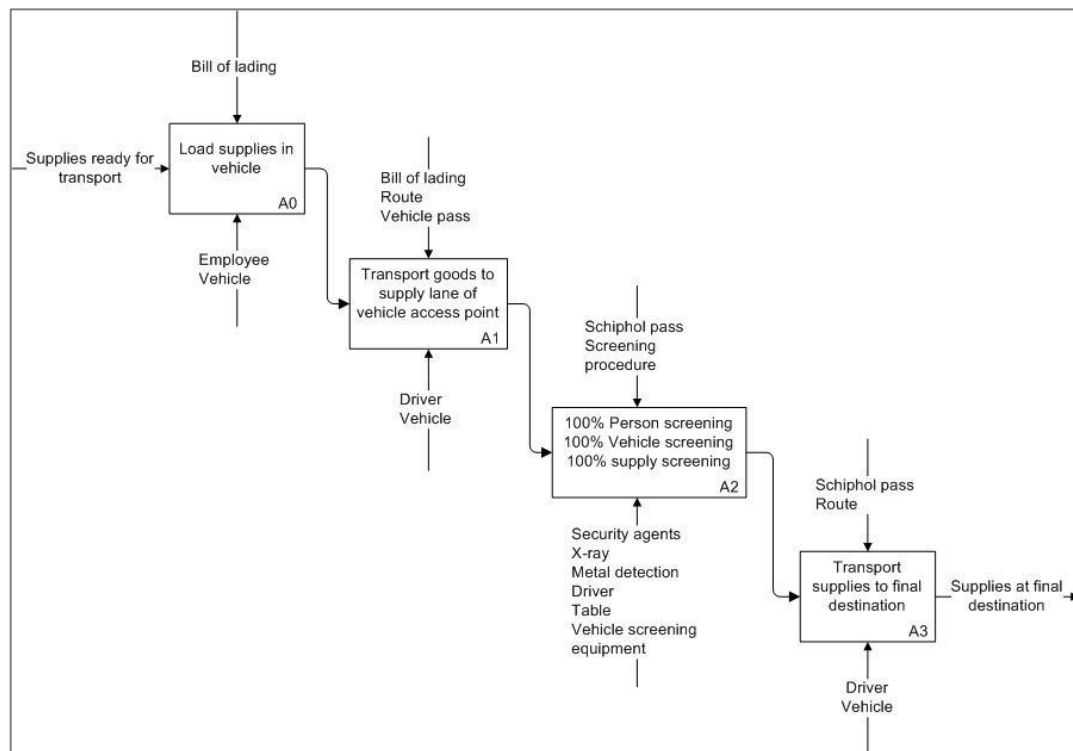
Cost-effectiveness	No increase in security charges
Few security agents	Better screening equipment
Unambiguous process at gate	Sustainability of solution
Flexibility for delivery	Applicable to all kinds of supplies
Lowest distance to delivery point	No queues
Less traffic under terminal building	Undisturbed passenger processes
Fast access	Supply screening cannot hinder transport without supplies
No hard physical work such as lifting	Ownership of process with supplier
Less traffic on airside	

After the criteria collection was finished the participant were asked to vote for their preferred solutions. The 5 highest scoring ideas per location are shown in the following table.

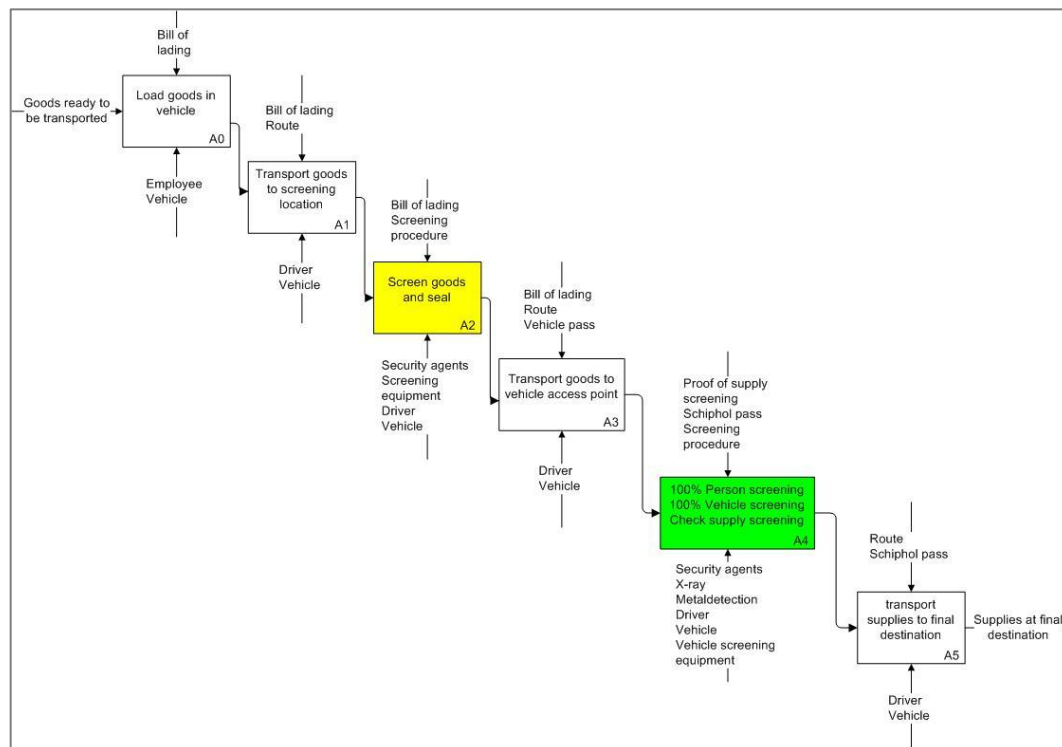
Terminal		Vehicle Access Points	
1	Distribution centre	1	Vehicle X-ray
2	Suppliers screen supplies	2	Organise arrival time slots
3	Central screening	3	Transshipment location to airside
4	Screening of full carts with X-ray	4	Screening separated from normal access
5	Separation of flows with and without supply screening	5	Increase capacity of access points as well as queuing area

## L. Process diagrams per concept

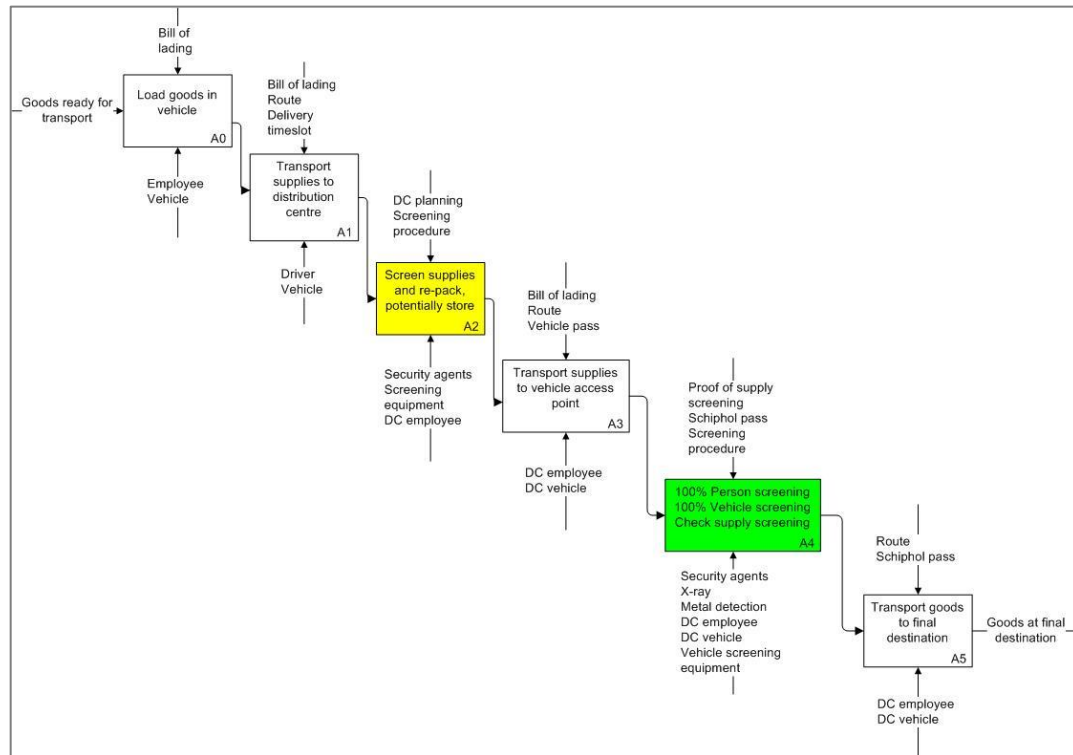
### 1.0 VAP Current process with 100% screening



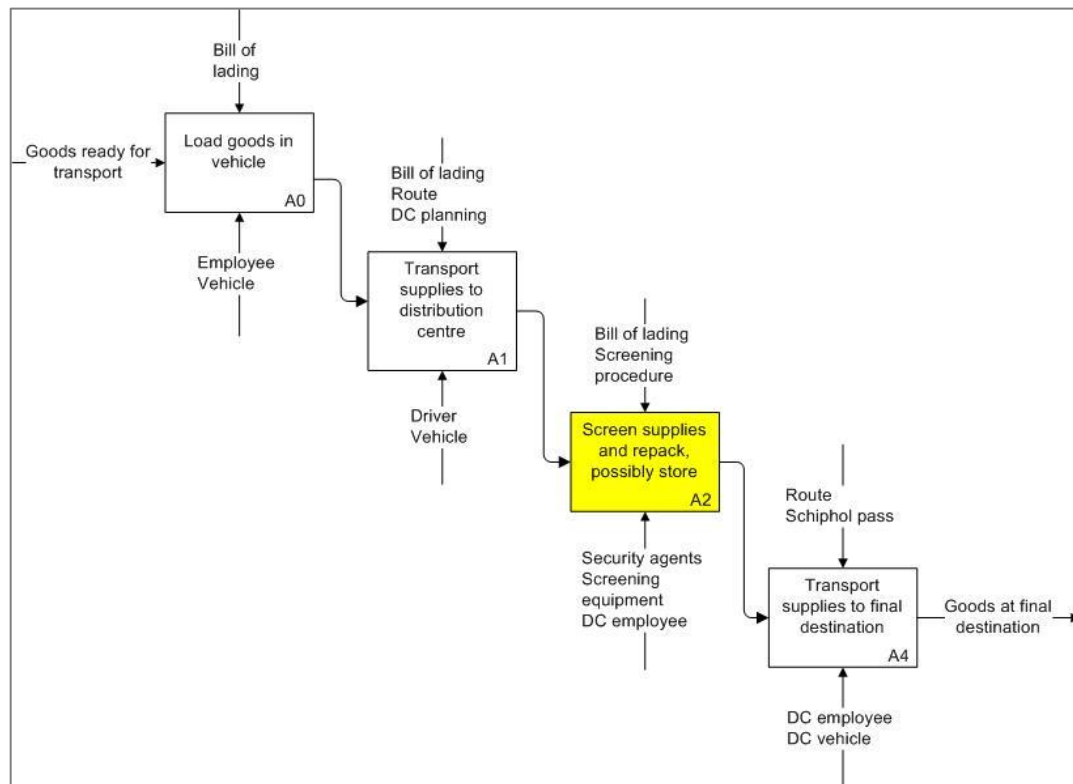
### 1.1 VAP Screening Location



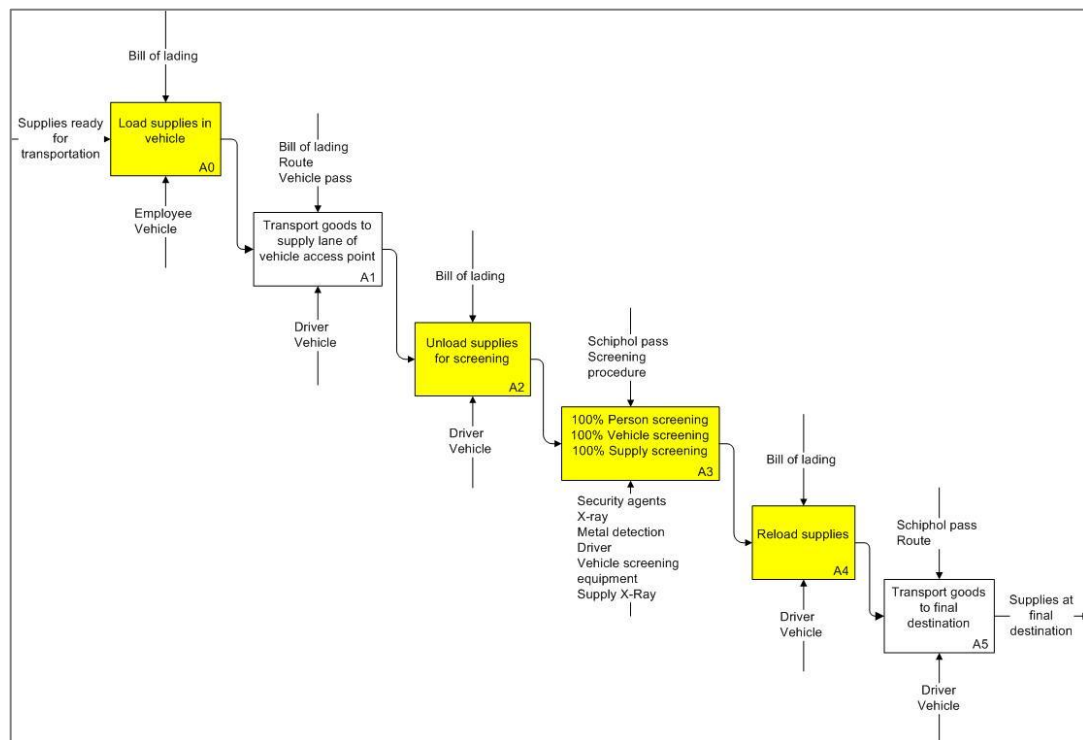
### 1.2a VAP DC between origin and border



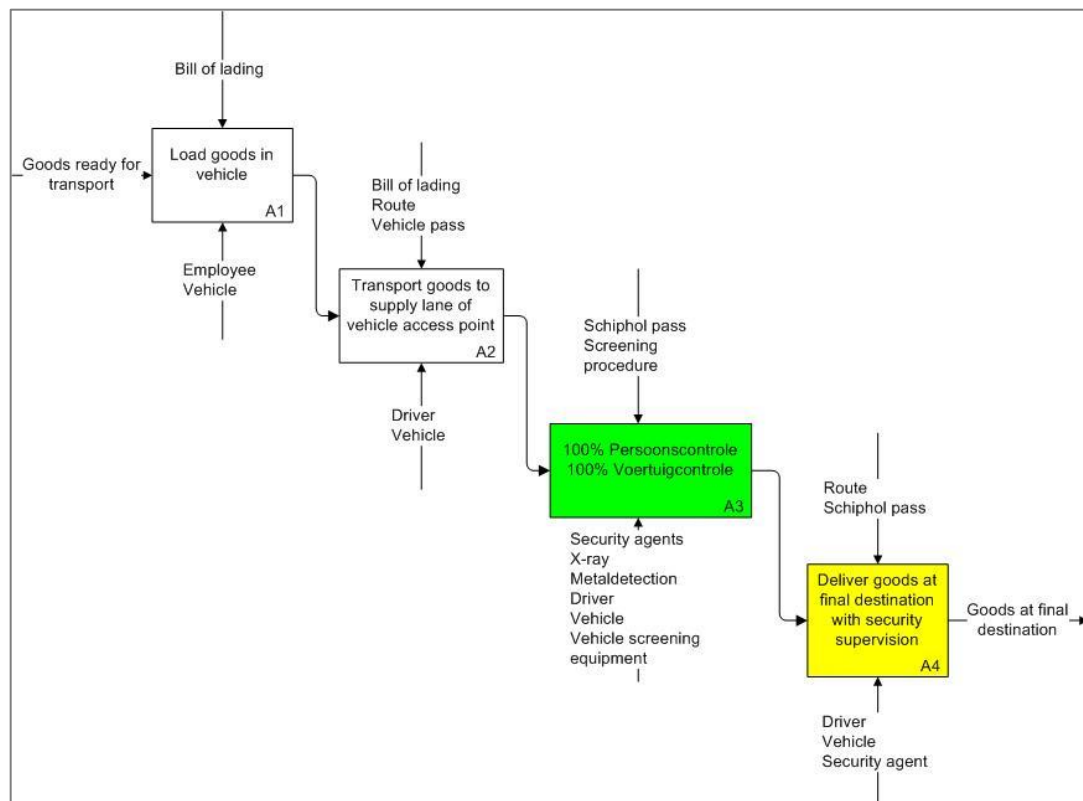
### 1.2b VAP DC on border to SRA-CP airside



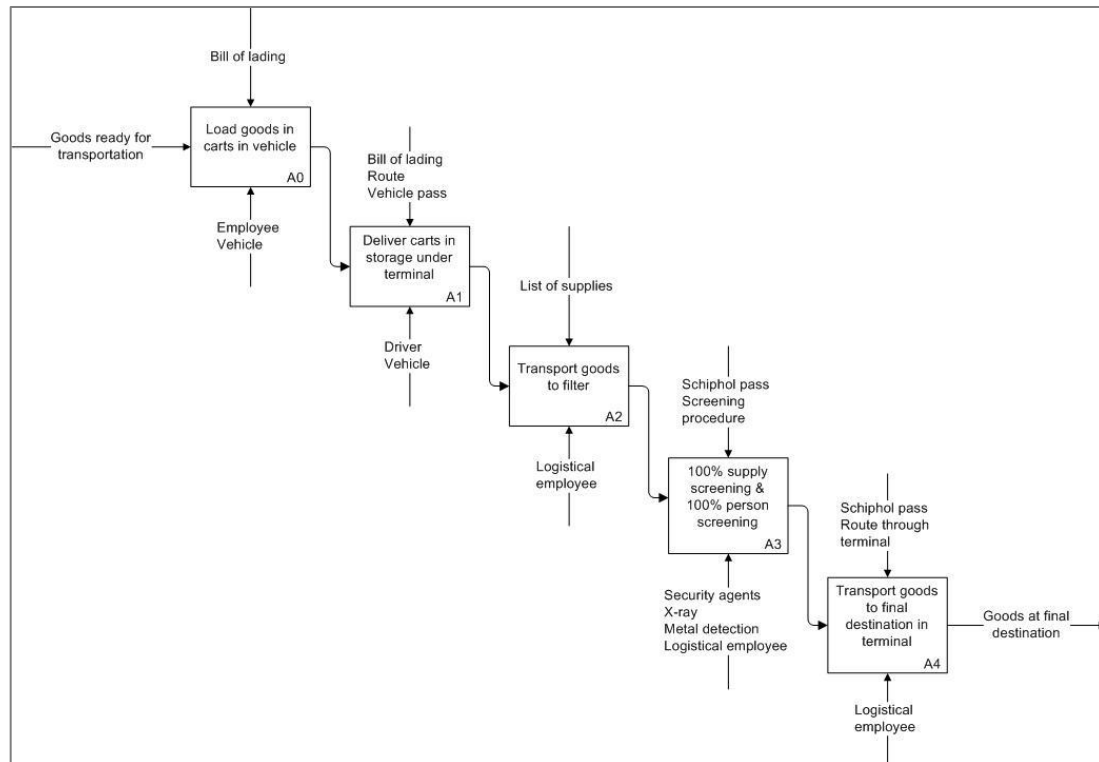
### 1.4b VAP Supply X-ray installation



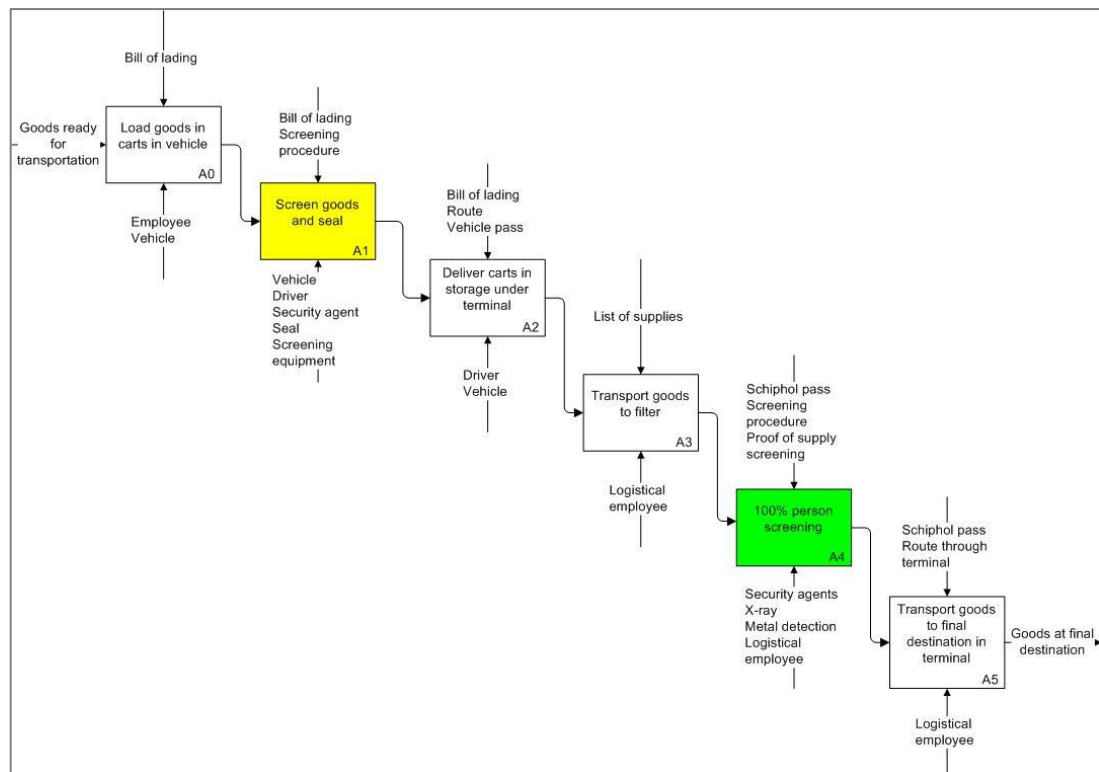
### 1.5 VAP Accompanied delivery



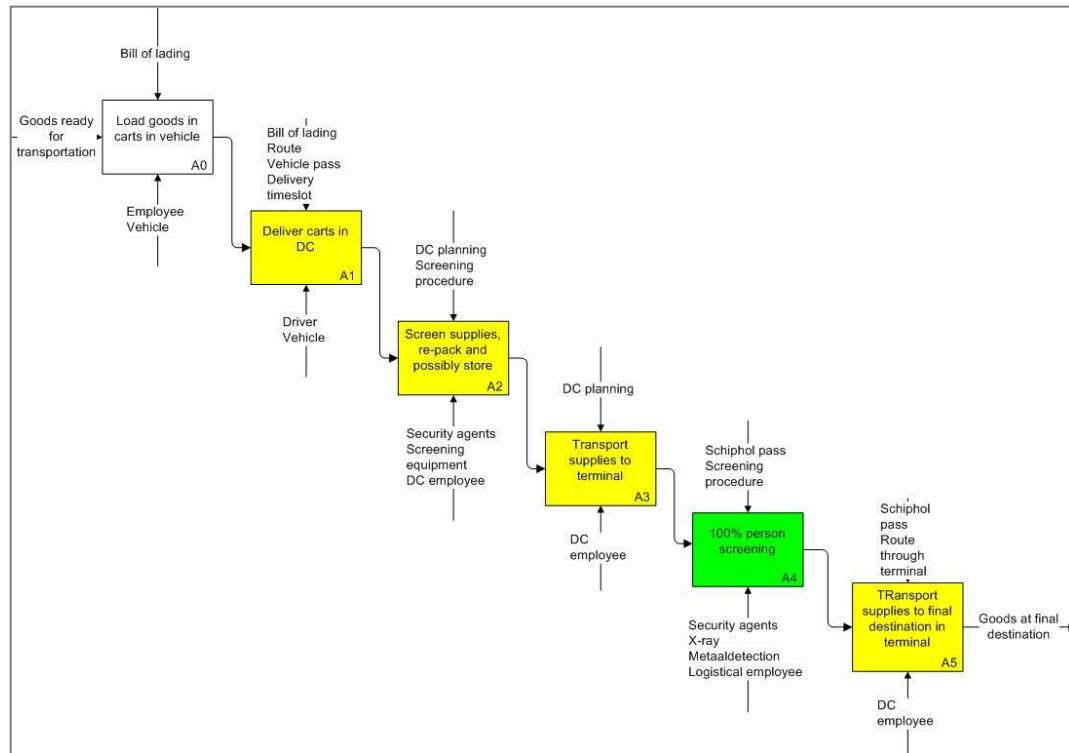
## 2.0 Terminal supplier process with 100% screening



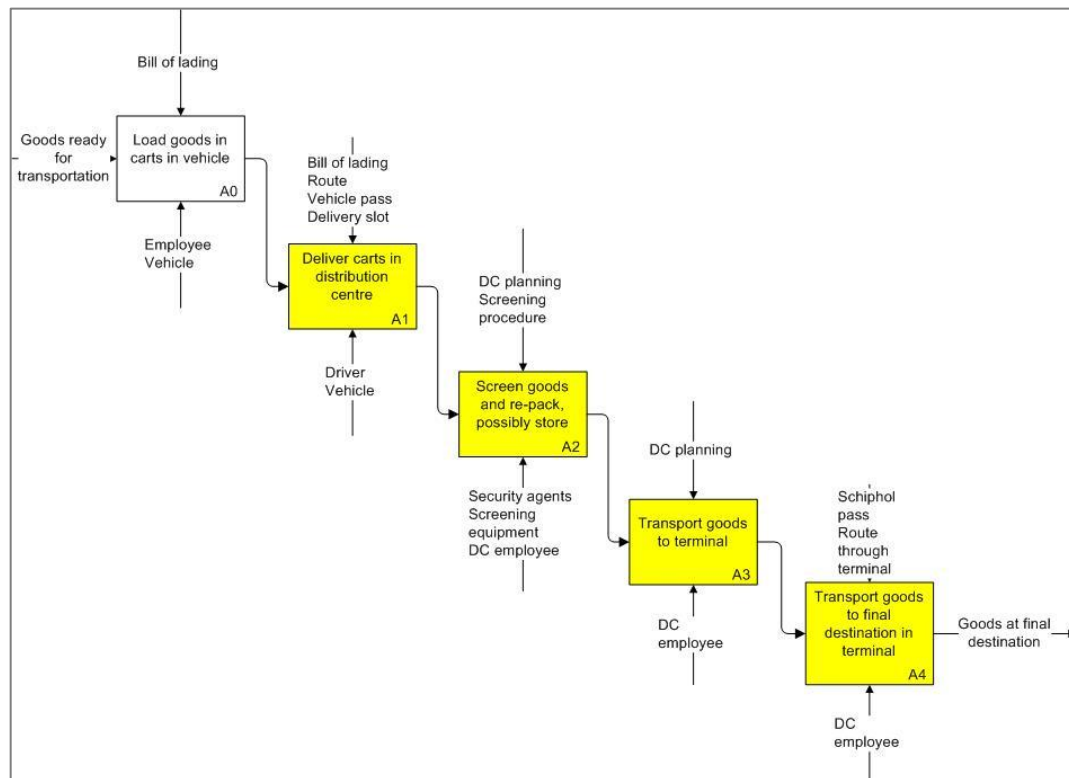
## 2.1 Terminal supplies screening location



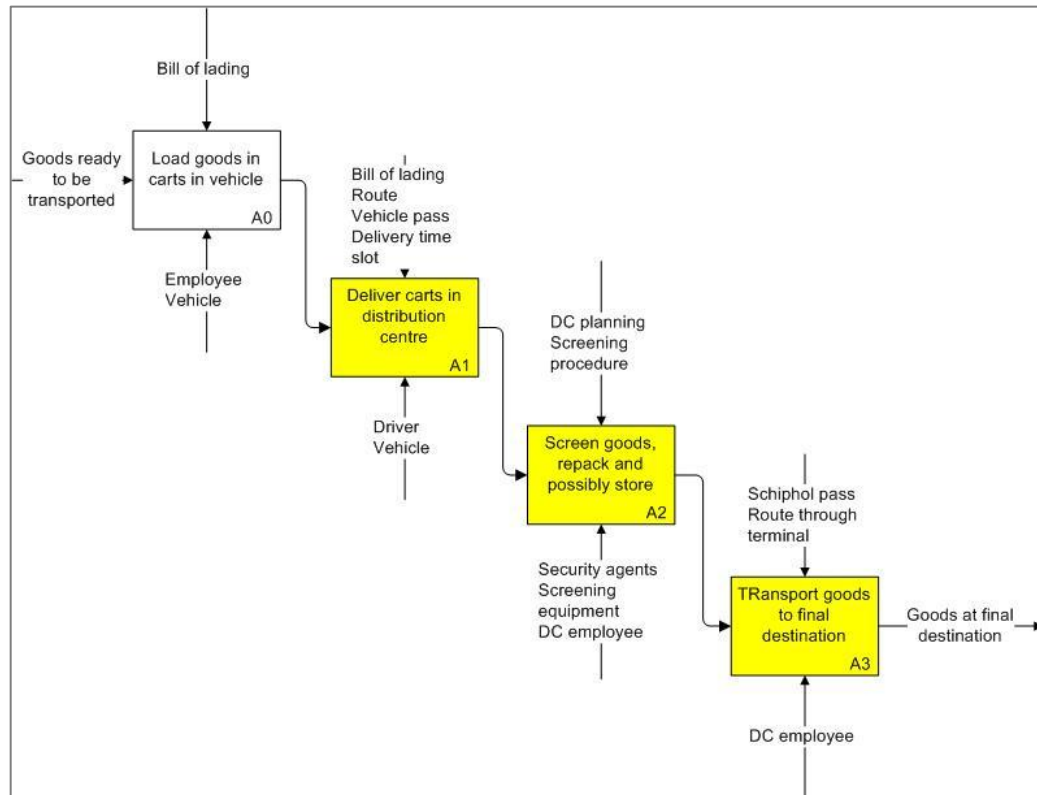
## 2.2a Terminal supplies DC between origin and border



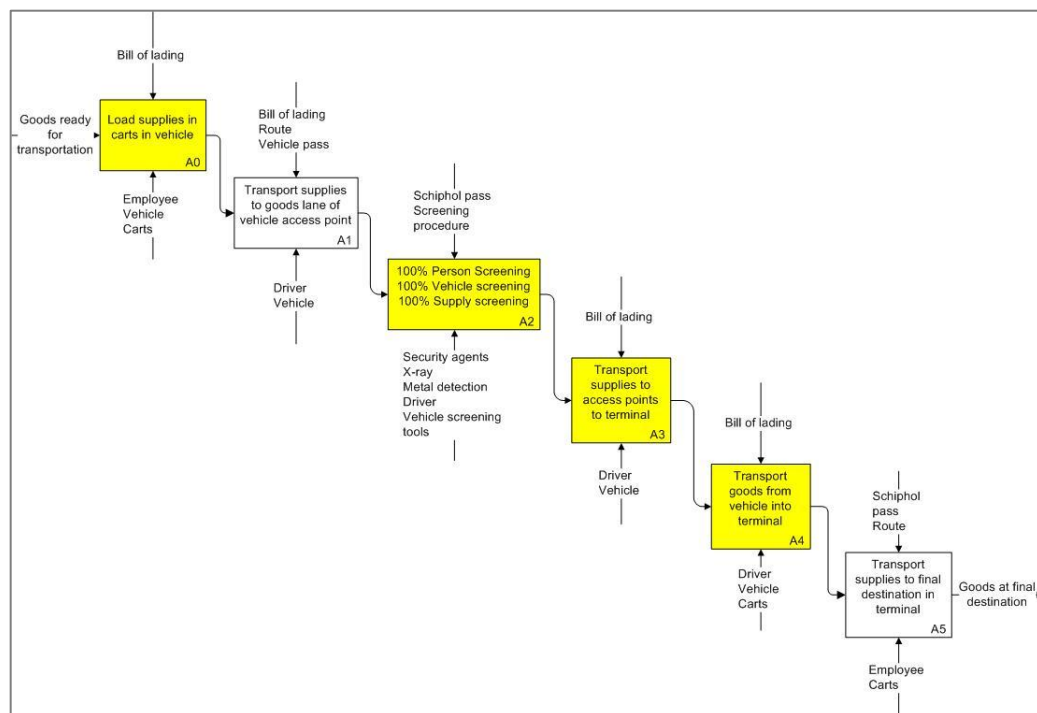
## 2.2b Terminal supplies DC on border to SRA-CP airside



## 2.2c Terminal supplies DC in terminal basement



## 2.5 Terminal supplies through vehicle access points



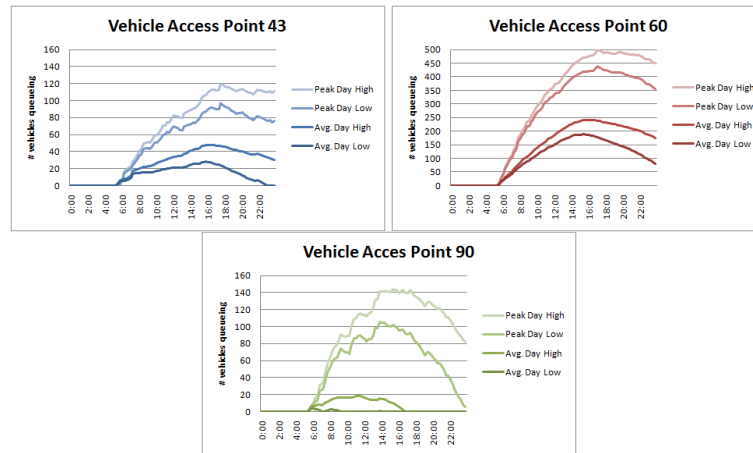


## M. Evaluation of logistical impact on access points per concept

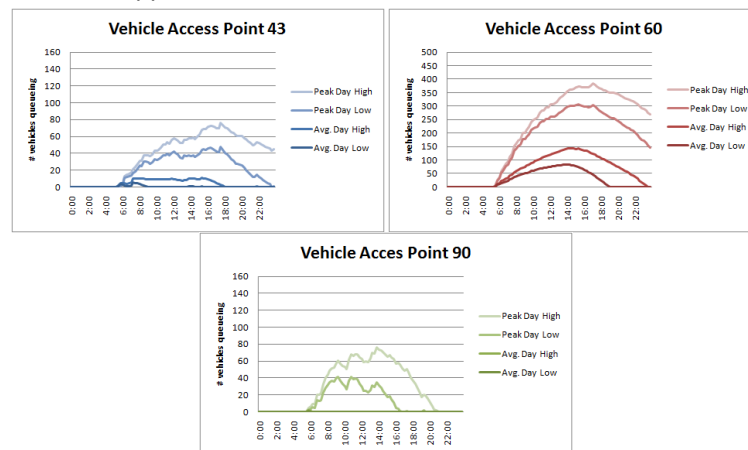
### Vehicle Access Points

#### 1.0 100% screening situation in different scenarios

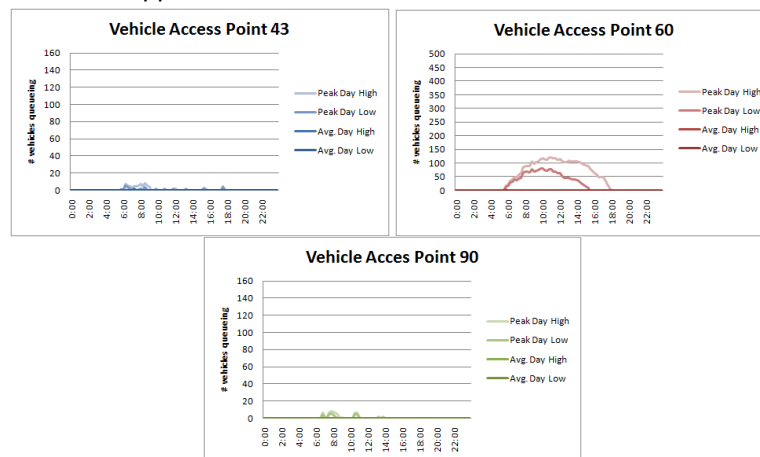
##### Scenario 1: 0% known suppliers



##### Scenario 2: 40% known suppliers

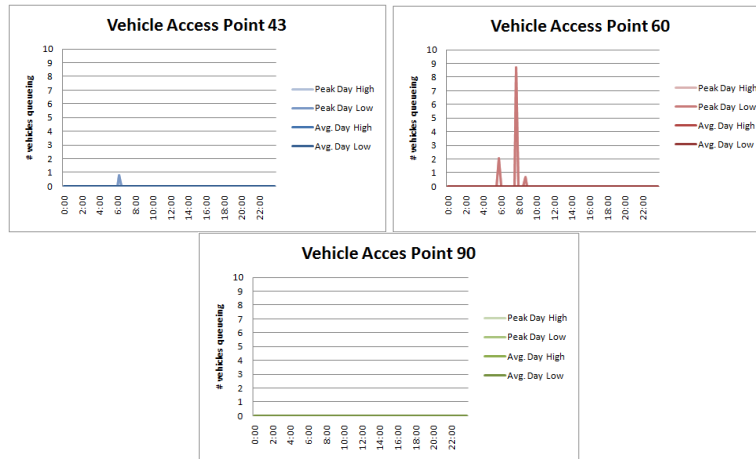


##### Scenario 3: 80% known suppliers



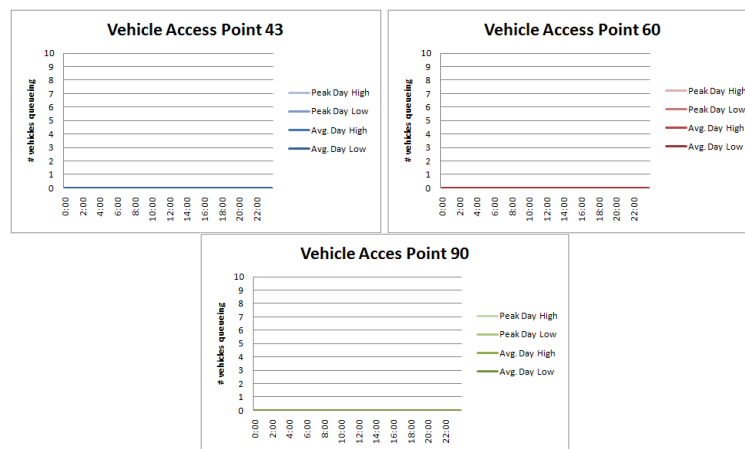
## Concept 1.1 Screening Location

*All Scenarios*



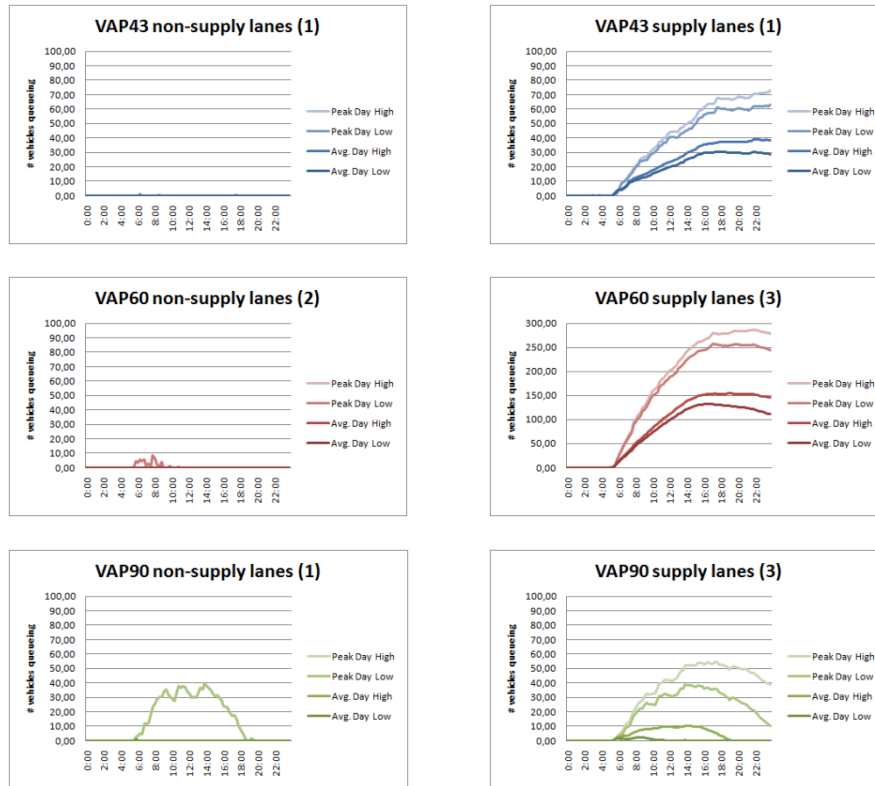
## Concept 1.2 Distribution Centres

*All Scenarios*

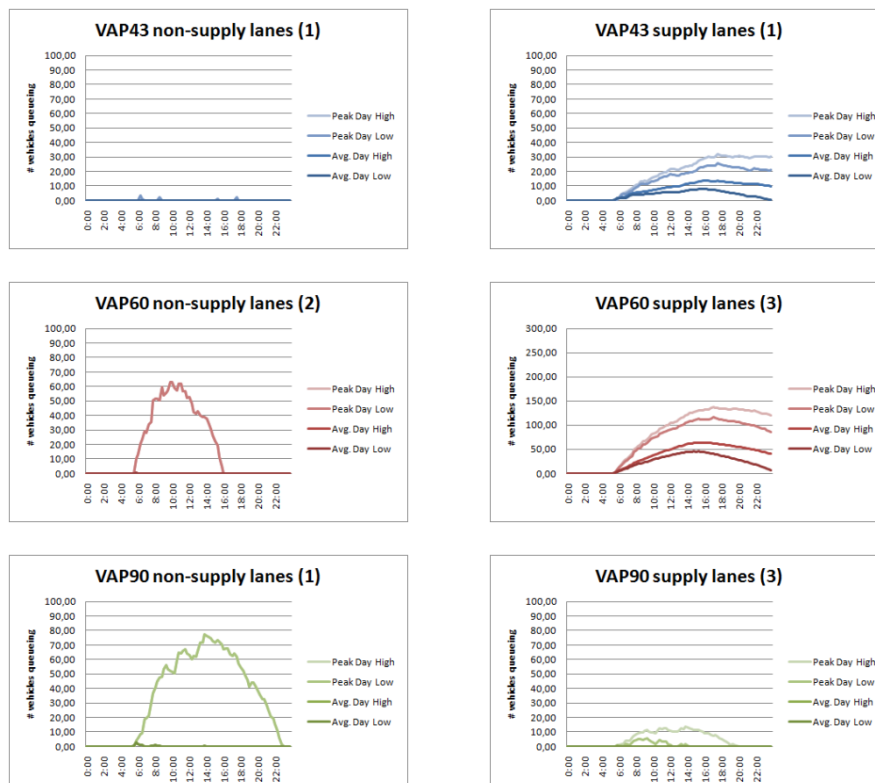


### Concept 1.3a Separating the flows per lane

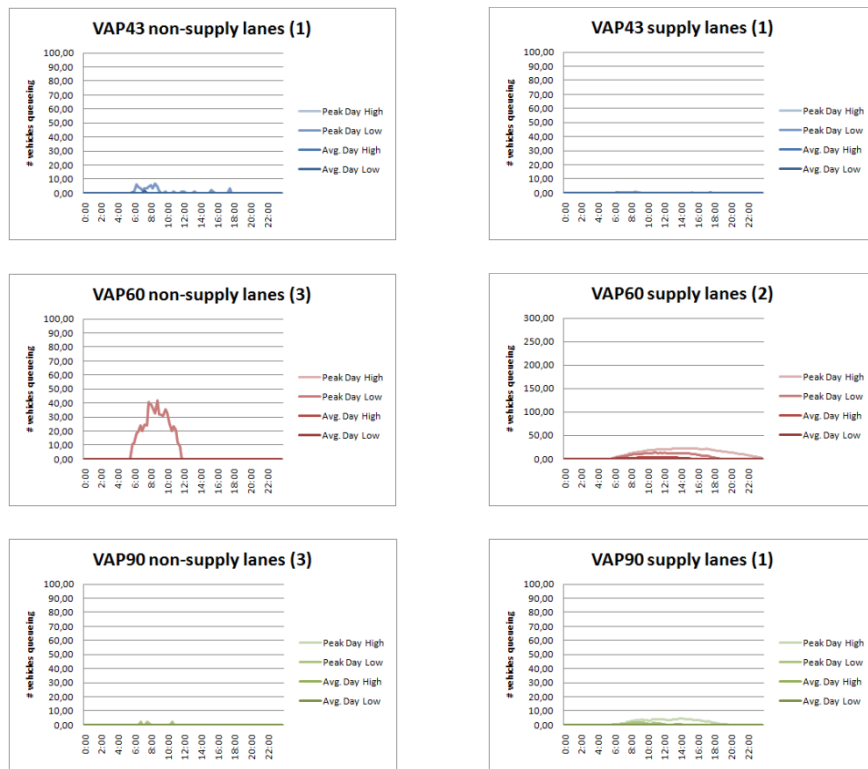
*Scenario 1: 0% known suppliers (graphs shown is in the best possibility of lane differentiation)*



*Scenario 2: 40% known suppliers*

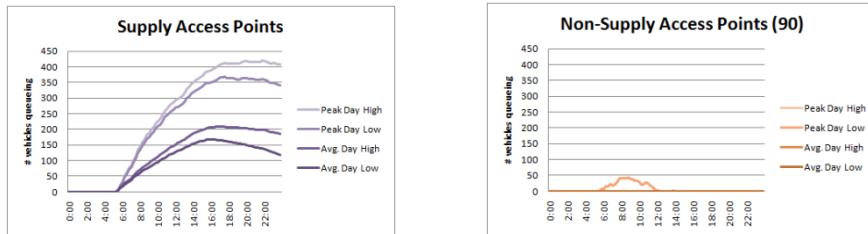


### Scenario 3: 80% known suppliers

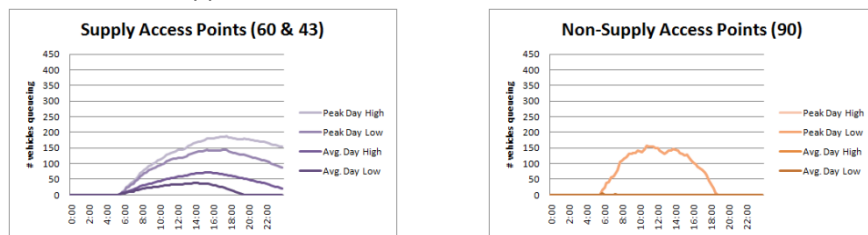


### Concept 1.3b Separating the flows per access points

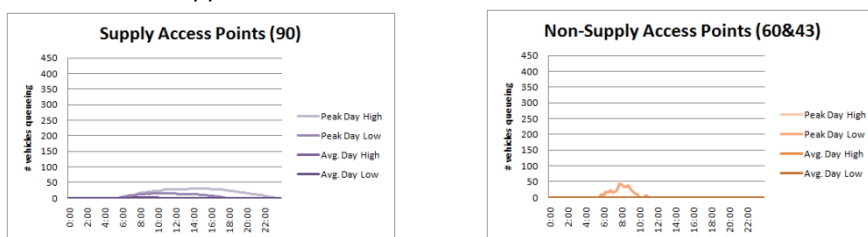
#### Scenario 1: 0% known suppliers



#### Scenario 2: 40% known suppliers

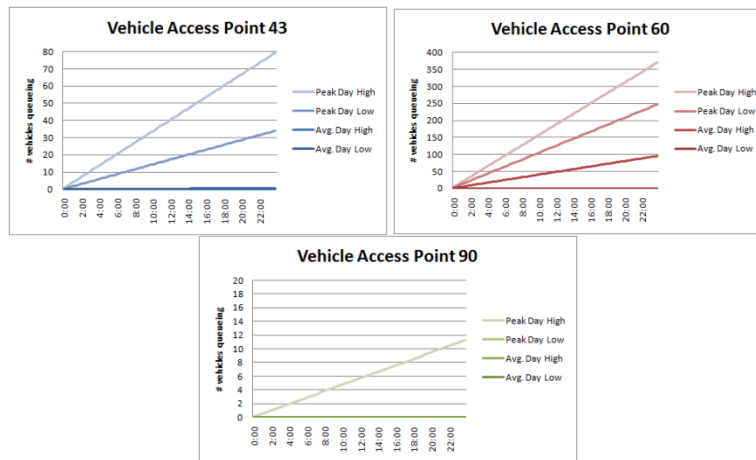


#### Scenario 3: 80% known suppliers

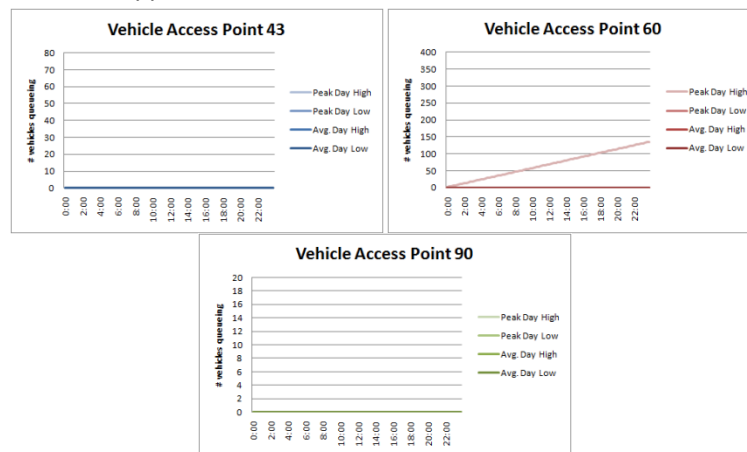


## Concept 1.3c Spreading the flows in 24 hours

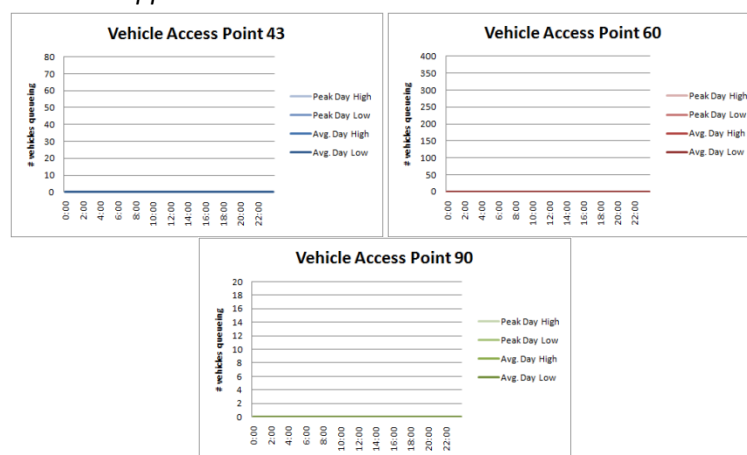
### Scenario 1: 0% known suppliers



### Scenario 2: 40% known suppliers



### Scenario 3: 80% known suppliers



#### **Concept 1.4 X-ray installation for carts**

The current estimation is that more security agents are needed for this option, and process duration is not reduced. This concept should be implemented in concept 3b, where there are separate lanes for vehicles with supplies to be checked. There is no logistically desirable scenario. Process time for supply screening should be reduced to make this concept feasible.

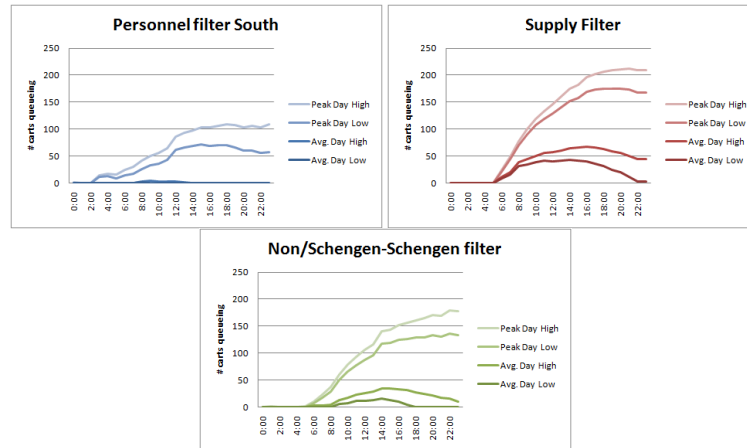
#### **Concept 1.5 Delivery under security company**

This concept treats the suppliers as non-suppliers in the system, if there is a security agent available to escort the vehicle. This solution is developed for bulk and very large goods only, of which the exact percentage is unknown. The impact on the access points can therefore not be calculated.

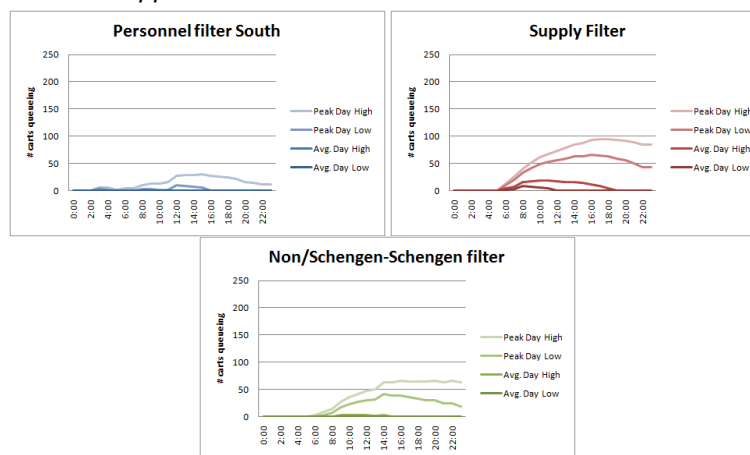
## Terminal access points

### 2.0 100% screening in different scenarios

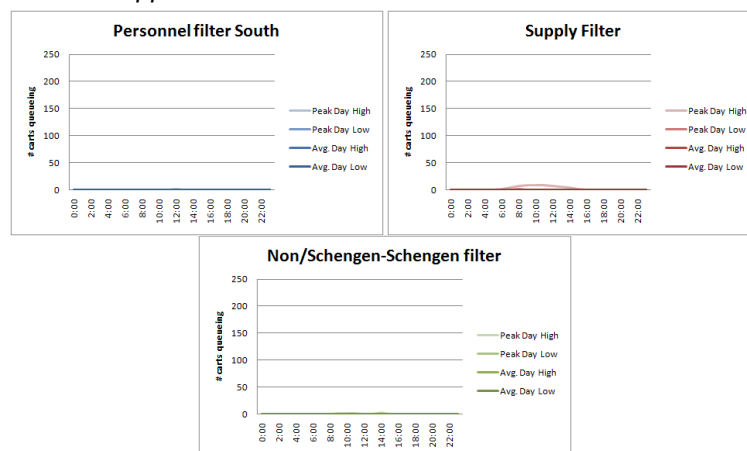
#### Scenario 1: 0% known suppliers



#### Scenario 2: 50% known suppliers

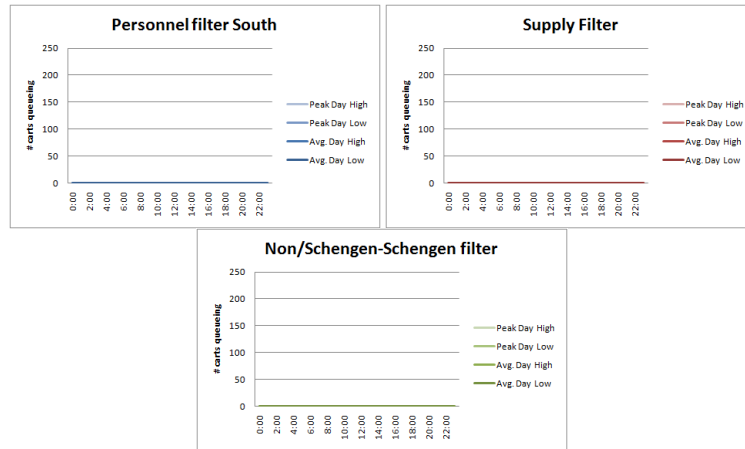


#### Scenario 3: 95% known suppliers



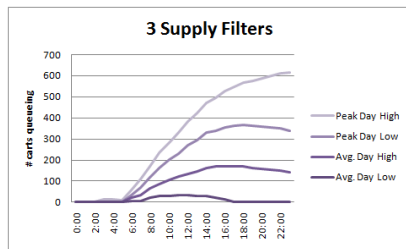
## Concept 2.1 Screening location and Concept 2.2 Distribution Centre

All scenarios

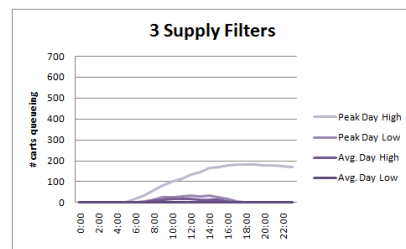


## Concept 2.3a Separating the flows

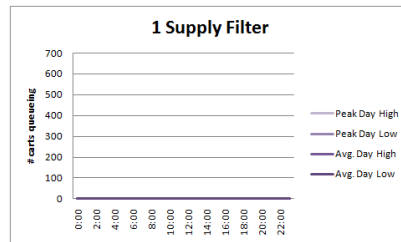
Scenario 1: 0% known suppliers



Scenario 2: 50% known suppliers



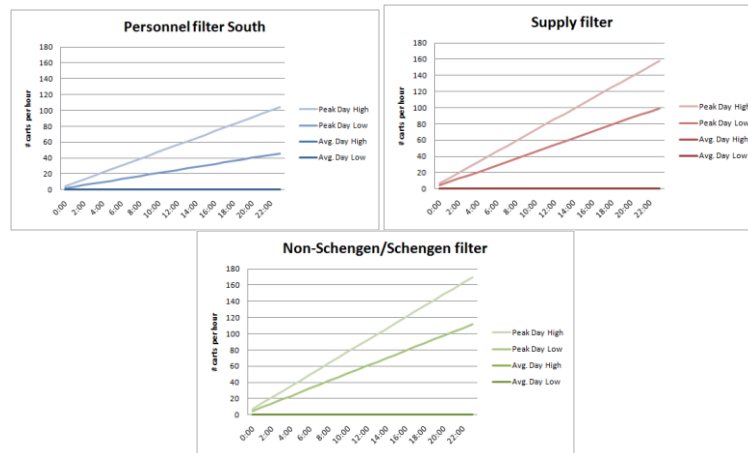
Scenario 3: 95% known suppliers



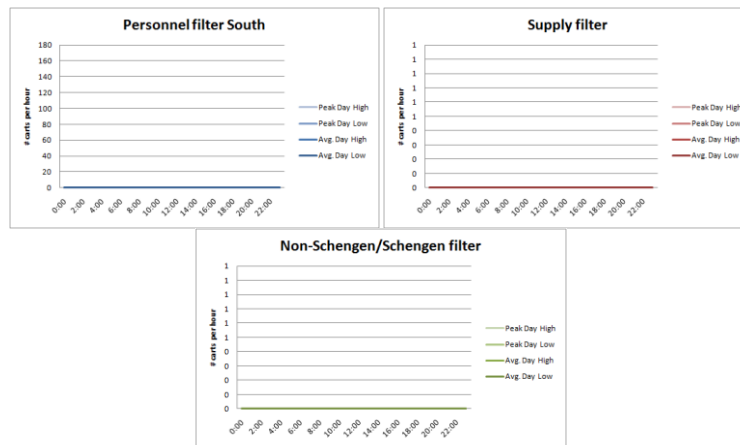


## Concept 3b Spreading the flows in time

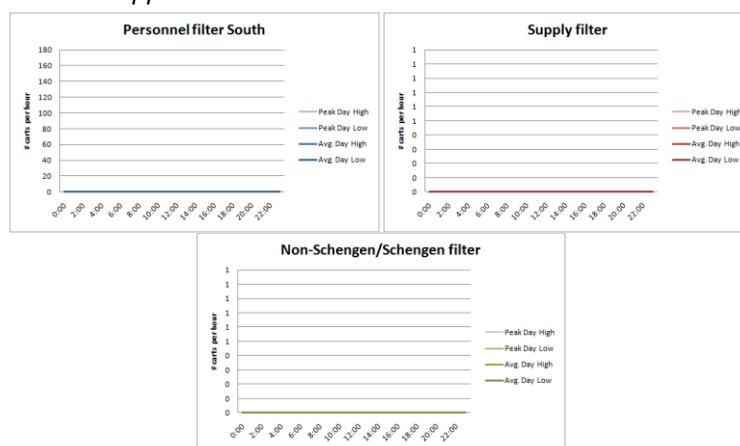
### Scenario 1: 0% Known suppliers



### Scenario 2: 50% known suppliers



### Scenario 3: 95% known suppliers



## N. Workshop 2

### *Question form after presentation of all concepts*

#### **Concept ...**

1. Do you think this is a suitable solution? Why (not)?

2. What are your negative responses to this concept?

3. What are positive sides of this concept?

4. For which target group of suppliers or which type of supplies do you expect problems if this concept was introduced? Please explain.

5. What would you change about this concept?

6. What needs to be considered if this concept is detailed in the future?

*Results from evaluation*

Vehicle access points	1. Suitable?	2. Positive	3. Negative	4. Expected problems	5. Changes	6. Future considerations
1. Screening location	Yes: 13 No: 6 Blank: 1	<ul style="list-style-type: none"> <li>- No change of procedure/situation at vap</li> <li>- No extra pressure on vap's</li> <li>- No delay at vap's</li> <li>- At cheap location</li> <li>- No changes at airport</li> </ul>	<ul style="list-style-type: none"> <li>- Delay for incidental suppliers</li> <li>- Return for suppliers that did not know</li> <li>- Extra step in procedure for supplier, detour</li> <li>- Sealing is extra step, necessary due to distance</li> <li>- Weak link between screening and border</li> </ul>	<ul style="list-style-type: none"> <li>- Supplies that cannot be sealed</li> <li>- Urgent deliveries</li> <li>- Bulk</li> <li>- Vans for maintenance</li> <li>- Companies close to Schiphol</li> <li>- Planning</li> </ul>	<ul style="list-style-type: none"> <li>- More than 1 screening location</li> <li>- Combi with other concepts</li> <li>- Keep possibility to screen at airport</li> </ul>	<ul style="list-style-type: none"> <li>- Level of security at location</li> <li>- Location and size of screening location</li> </ul>
2. a DC between origin and border	Yes: 9 Partly: 2 No: 5 Blank: 4	<ul style="list-style-type: none"> <li>- Less traffic on airside</li> <li>- Unambiguous solution</li> <li>- Efficient</li> <li>- Sustainable</li> <li>- More time for supply screening</li> <li>- No extra pressure on vap's</li> <li>- No queues</li> <li>- Separation supplies and vehicle</li> <li>- All "known" suppliers at vap's</li> </ul>	<ul style="list-style-type: none"> <li>- Large investment</li> <li>- Another (DC) party is introduced</li> <li>- Not flexible</li> <li>- Time loss</li> <li>- Less influence on own planning</li> <li>- Extra process steps</li> </ul>	<ul style="list-style-type: none"> <li>- Bulk</li> <li>- Incidental suppliers</li> <li>- Perishables</li> <li>- Cool products</li> <li>- Maintenance</li> <li>- Companies close to Schiphol</li> </ul>	<ul style="list-style-type: none"> <li>- More than 1 DC</li> <li>- Combine with terminal supplies</li> <li>- Combine with concept 5</li> <li>- Video monitoring in DC</li> </ul>	<ul style="list-style-type: none"> <li>- Size of DC</li> <li>- Location</li> <li>- Expansion possible</li> <li>- Responsibilities of DC</li> <li>- Security level of screening</li> <li>- Clear agreements</li> </ul>

2. b DC at border	Yes: 9 No: 3 Blank: 8	<ul style="list-style-type: none"> <li>- Direct access to airside</li> <li>- No detour</li> <li>- Unambiguous solution</li> <li>- More control for AAS</li> <li>- Efficient</li> <li>- Sustainable</li> <li>- Automation an process optimisation possible</li> <li>- No extra traffic airside</li> <li>- No extra pressure on vap's</li> <li>- Supplier delivers and leaves, no waiting</li> <li>- Centralised</li> <li>- No possibility for manipulation after screening</li> </ul>	<ul style="list-style-type: none"> <li>- More traffic near central delivery point</li> <li>- Longer transport routes on airside</li> <li>- Not flexible, dependency on planning</li> <li>- Process changes</li> <li>- Space on airside</li> <li>- Transhipment</li> </ul>	<ul style="list-style-type: none"> <li>- Bulk</li> <li>- Incidental deliveries</li> <li>- Perishables</li> <li>- Companies close to Schiphol</li> </ul>	<ul style="list-style-type: none"> <li>- Storage for tools</li> <li>- Split up</li> <li>- More than 1 DC</li> <li>- Combine with other concepts, such as 5</li> </ul>	<ul style="list-style-type: none"> <li>- Infrastructure on landside</li> <li>- Growth</li> <li>- Size</li> <li>- Location</li> <li>- Communication</li> <li>- Level of security at DC</li> </ul>
3. a Separate lanes	Yes: 9 No: 7 Blank: 4	<ul style="list-style-type: none"> <li>- Use current concept, comparable to current situation</li> <li>- Flexibility</li> <li>- No extra location</li> <li>- No planning</li> <li>- Separation of supply screening</li> </ul>	<ul style="list-style-type: none"> <li>- Long process times</li> <li>- Screening on border</li> <li>- Unaware people</li> <li>- High occupation rate of lanes</li> <li>- Busy at border</li> </ul>	<ul style="list-style-type: none"> <li>- Incidental</li> <li>- Urgent deliveries</li> <li>- Heavy freight</li> </ul>	<ul style="list-style-type: none"> <li>- Extra lanes?</li> <li>- Extra access for large transport</li> <li>- Combine with other concept, such as 5</li> <li>- Change equipment</li> <li>- Increase capacity</li> </ul>	<ul style="list-style-type: none"> <li>- Communication</li> <li>- Waiting space</li> </ul>
3. b Separate vehicle access points	Yes: 6 No: 4 Blank: 10	<ul style="list-style-type: none"> <li>- Division of flows</li> <li>- Known suppliers and non-suppliers have quick access</li> <li>- Efficient</li> <li>- Clear</li> </ul>	<ul style="list-style-type: none"> <li>- Unclear</li> <li>- Detours</li> <li>- Long screening duration</li> <li>- Big pressure on vap's</li> <li>- CO2</li> <li>- Chance to end up at wrong vap</li> <li>- More traffic on airside</li> </ul>	<ul style="list-style-type: none"> <li>- Incidental suppliers</li> <li>- Perishables</li> <li>- Bulk</li> <li>- Daily delivery</li> </ul>	<ul style="list-style-type: none"> <li>- More access points</li> <li>- Shorter process times</li> <li>- New equipment</li> </ul>	<ul style="list-style-type: none"> <li>- Communication</li> <li>- Space</li> </ul>

3. c Spreading in time	Yes: 8 No: 5 Blank: 7	<ul style="list-style-type: none"> <li>- More efficient use of vap</li> <li>- Pressure on vaps and roads less</li> <li>- Less waiting times</li> <li>- Innovative</li> <li>- Comparable to current situation</li> </ul>	<ul style="list-style-type: none"> <li>- Low attainability</li> <li>- Lots of planning necessary</li> <li>- Not practical / realistic</li> </ul>	<ul style="list-style-type: none"> <li>- Incidental suppliers</li> <li>- Perishables</li> <li>- Bulk</li> <li>- Urgent deliveries</li> </ul>	<ul style="list-style-type: none"> <li>- Fee for spreading</li> <li>- Partial implementation in other concepts</li> <li>- Storage airside</li> </ul>	<ul style="list-style-type: none"> <li>- Planning</li> <li>- Incentives</li> </ul>
4. Small X-ray	Yes: 2 No: 9 Blank: 9	<ul style="list-style-type: none"> <li>- No opening of supplies</li> <li>- Use of technology</li> </ul>	<ul style="list-style-type: none"> <li>- Unloading and reloading is time consuming</li> <li>- Not a high level of security</li> <li>- Expensive equipment</li> <li>- Not for all supplies</li> </ul>	<ul style="list-style-type: none"> <li>- Incidental suppliers</li> <li>- Perishables</li> <li>- Bulk</li> <li>- Urgent deliveries</li> </ul>	<ul style="list-style-type: none"> <li>- Combine with other concepts</li> <li>- In DC</li> <li>- Larger X-rays</li> </ul>	<ul style="list-style-type: none"> <li>- Space availability</li> </ul>
5. Delivery with security agent	Yes: 10 No: 1 Blank: 9	<ul style="list-style-type: none"> <li>- For bulk and construction material</li> <li>- Flexible</li> <li>- No transshipment</li> <li>- No longer process at vap</li> </ul>	<ul style="list-style-type: none"> <li>- Extra agents</li> <li>- Training</li> <li>- Low quality of security checks</li> <li>- Not a complete solution</li> </ul>		<ul style="list-style-type: none"> <li>- Depots for bulk on airside</li> <li>- Security agent present at construction location</li> </ul>	<ul style="list-style-type: none"> <li>- Planning</li> </ul>

Terminal	1. Suitable?	2. Positive	3. Negative	4. Expected problems	5. Changes	6. Future considerations
1. Screening location	Yes: 7 No: 3 Partly: 1 Blank: 5	<ul style="list-style-type: none"> <li>- Less pressure on filters</li> <li>- Central security</li> <li>- Little delay in process</li> <li>- Unambiguous process at filter</li> <li>- No extra space in terminal needed</li> <li>- Comparable to current procedure</li> </ul>	<ul style="list-style-type: none"> <li>- Extra step in process</li> <li>- No control between screening and destination</li> <li>- Unloading of supplies twice</li> <li>- No uniformity in terminal</li> </ul>	<ul style="list-style-type: none"> <li>- Urgent and fresh deliveries</li> <li>- Installers</li> <li>- Maintenance &amp; cleaning</li> <li>- Perishables</li> </ul>	<ul style="list-style-type: none"> <li>- Integrate screening with other function</li> <li>- Priority lane</li> <li>- Combine with DC</li> </ul>	<ul style="list-style-type: none"> <li>- Location</li> <li>- Changes in lay out of terminal</li> <li>- Customs requirements</li> </ul>
2. a DC between origin and border	Yes: 5 No: 5 Blank: 6	<ul style="list-style-type: none"> <li>- More efficient</li> <li>- Co2 reduction</li> <li>- Central point of delivery</li> <li>- Unambiguous process at filter</li> <li>- 1 responsible for distribution</li> <li>- Comparable to current situation</li> <li>- Screening time not in critical path</li> </ul>	<ul style="list-style-type: none"> <li>- No direct delivery</li> <li>- No control over full process</li> <li>- Stick to planning</li> <li>- 3<sup>rd</sup> party responsible for goods</li> </ul>	<ul style="list-style-type: none"> <li>- Urgent deliveries</li> <li>- Perishables</li> <li>- Suppliers for SRA and non-SRA</li> </ul>	<ul style="list-style-type: none"> <li>- Priority lane</li> </ul>	<ul style="list-style-type: none"> <li>- Storage in DC</li> <li>- Shift of responsibility</li> <li>- Forecasting &amp; planning</li> <li>- Contracts</li> </ul>
2. b DC on outside border to airside	Yes: 5 No: 3 Blank: 8	<ul style="list-style-type: none"> <li>- Combination with supplies outside</li> <li>- Co2 reduction</li> <li>- Centralisation of deliveries</li> </ul>	<ul style="list-style-type: none"> <li>- More traffic on airside</li> <li>- High costs</li> </ul>	<ul style="list-style-type: none"> <li>- Urgent deliveries</li> <li>- Perishables</li> <li>- Supplies for non-SRA in terminal</li> </ul>	<ul style="list-style-type: none"> <li>- "people mover"</li> <li>- Priority lane</li> </ul>	<ul style="list-style-type: none"> <li>- Location</li> <li>- Storage</li> </ul>

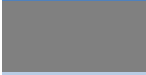





2. c DC under terminal	Yes: 1 No: 4 Blank: 11	<ul style="list-style-type: none"> <li>- More efficient use of storages</li> <li>- Fits in current conduct of business</li> <li>- Least process changes of 2</li> <li>- No extra kilometres</li> </ul>	<ul style="list-style-type: none"> <li>- No space available</li> <li>- Environmental issues (fumes)</li> <li>- ARBO regulations (working in day light!)</li> <li>- No combi with supplies airside</li> <li>- Big impact on current building</li> </ul>	<ul style="list-style-type: none"> <li>- Concessionaires non-SRA</li> <li>- Perishables</li> </ul>	<ul style="list-style-type: none"> <li>- Delivery per terminal</li> </ul>	<ul style="list-style-type: none"> <li>- Positioning of docking stations</li> <li>- Distribution of supplies</li> <li>- Delivery routes</li> </ul>
3. a Separation of supply flow	Yes: 4 No: 3 Blank: 9	<ul style="list-style-type: none"> <li>- Priority for known suppliers (no queues)</li> <li>- Comparable to current situation</li> </ul>	<ul style="list-style-type: none"> <li>- Space availability in terminal</li> <li>- Queues</li> </ul>	<ul style="list-style-type: none"> <li>- Unknown suppliers</li> </ul>	<ul style="list-style-type: none"> <li>- Decrease process time</li> </ul>	
3. b Spreading in time	Yes: 1 No: 3 Blank: 12	<ul style="list-style-type: none"> <li>- Filters open 24 hrs</li> <li>- Supplies no longer same peak as passengers</li> </ul>	<ul style="list-style-type: none"> <li>- Compulsory delivery slots</li> <li>- More storage room necessary</li> <li>- Cooperation of suppliers difficult</li> <li>- No control over process</li> <li>- Planning</li> </ul>		<ul style="list-style-type: none"> <li>- Centralised logistical service</li> <li>- Adjust to opening times</li> <li>- Compensation / incentives for delivery in non-popular hours</li> </ul>	<ul style="list-style-type: none"> <li>- Agreements with concessionaires</li> </ul>
4. X-ray for carts	Yes: 4 No: 4 Blank: 8	<ul style="list-style-type: none"> <li>- Ideal for pallets</li> <li>- Large volume screening</li> <li>- Comparable to current situation</li> <li>- Efficient</li> </ul>	<ul style="list-style-type: none"> <li>- Reading of images time consuming</li> <li>- Space use</li> <li>- Acquisition of different carts</li> <li>- More carts necessary</li> <li>- Energy consumption high</li> <li>- Lifting of supplies</li> </ul>	<ul style="list-style-type: none"> <li>- Hanging supplies, such as clothing</li> <li>- Heavy objects</li> </ul>	<ul style="list-style-type: none"> <li>- More automatic</li> <li>- Combine with other concept</li> <li>- Size of machine should increase</li> <li>-</li> </ul>	

5. Delivery via vehicle access points	Yes: 1 No:3 Blank: 12	<ul style="list-style-type: none"> <li>- Bundling with supplies for airside</li> <li>- No use of space in terminal</li> </ul>	<ul style="list-style-type: none"> <li>- More vehicle screening</li> <li>- Busier vehicle access points</li> <li>- Busier airside roads</li> <li>- Construction of injection points in terminal</li> <li>- Storage on airside</li> </ul>	<ul style="list-style-type: none"> <li>- Suppliers for SRA and non-SRA</li> </ul>	-	-
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## O. Evaluation scorecards

### *Legend for evaluation score cards*

Colour	Meaning
	Excluded from further analysis
	No difference compared to current situation
	Small positive impact
	Large positive impact
	Small negative impact
	Large negative impact

Vehicles	0 100% screening in current situation	1 Screening location	2a DC between origin and border	2b DC on border airside	3a Separation of flows per lane	3b Separation of flows per access point	3c spreading of flows	4a Vehicle X-ray installation	4b Supply X-ray installation	5 Accompanied delivery
<b>Scenario 1 0% known suppliership</b>										
Queues										
Security level	1	2	2	3	2	2	2	1	2	1/2
Go/no go	No go				No go	No go	No go	No go	No go	For bulk
Investment										-
Exploitation cost										
Flexibility of suppliers' planning		Opening hours	DC planning	DC planning						Planning based on company
Change of current procedures supplier		Extra process step	Different process & location	Different process						Hardly
Supplier process control		-	Taken over by DC	Taken over by DC						-
Distance to drop-off for suppliers		Detour	Delivery earlier in process	Delivery earlier in process						-
Investment suppliers		-	-	-						-
AAS process control		Potentially controlled	Controlled delivery	Controlled delivery						Controlled by planning
Urgent delivery possible		First screening	Difficult	Difficult						Difficult
Traffic on airside roads		Equal	Less	Less						Equal
Uniform process at access points		All screened	All by DC and screened	Only no supplies						Only for bulk, so different processes
Lifting of supplies		-	-	-						-
Works for all supplies		Difficult for bulk	-	-						bulk

<b>Vehicles</b>	<b>0</b> 100% screening in current situation	<b>1</b> Screening location	<b>2a</b> DC between origin and border	<b>2b</b> DC on border airside	<b>3a</b> Separation of flows per lane	<b>3b</b> Separation of flows per access point	<b>3c</b> spreading of flows	<b>4a</b> Vehicle X-ray installation	<b>4b</b> Supply X-ray installation	<b>5</b> Accompanied delivery
<b>Scenario 2</b> <b>40% known</b> <b>suppliership</b>										
Queues										
Security level	1	2	2	3	2	2	2	1	2	1/2
Go/no go	No go				No go	No go	No go	No go	No go	For bulk
Investment										-
Exploitation cost										
Flexibility of suppliers' planning		Opening hours	DC planning	DC planning						Planning based on company
Change of current procedures supplier		Extra process step	Different process & location	Different process						Hardly
Supplier process control		-	Taken over by DC	Taken over by DC						-
Distance to drop-off for suppliers		Detour	Delivery earlier in process	Delivery earlier in process						-
Investment suppliers		-	-	-						-
AAS process control		Potentially controlled	Controlled delivery	Controlled delivery						Controlled by planning
Urgent delivery possible		First screening, unless known	Difficult, unless known	Difficult, unless known						Difficult, unless known
Traffic on airside roads		Equal	Less, still known	Less, still known						Equal
Uniform process at access points		All like known	All known or DC	Known and no supplies						Only for bulk, so different processes
Lifting of supplies		-	-	-						-
Works for all supplies		Difficult for bulk	-	-						bulk

<b>Vehicles</b>	0 100% screening in current situation	1 Screening location	2a DC between origin and border	2b DC on border airside	3a Separation of flows per lane	3b Separation of flows per access point	3c spreading of flows	4a Vehicle X-ray installation	4b Supply X-ray installation	5 Accompanied delivery
<b>Scenario 3 80% known suppliership</b>										
Queues									?	
Security level	1	2	2	3	2	2	2	1	2	1/2
Go/no go	No go		No go	No go	No go	No go		No go		For bulk
Investment							-		Machines	-
Exploitation cost							planning		Maintenance, training, agents	
Flexibility of suppliers' planning							Strict planning		-	Planning based on company
Change of current procedures supplier		Extra process step					Different planning		Unload all supplies, scan and reload	Hardly
Supplier process control		-					-		Supplies relocated	-
Distance to drop-off for suppliers		Detour					-		-	-
Investment suppliers		-					-		Special packing	-
AAS process control		Control by hours & location					Controlled by planning		-	Controlled by planning
Urgent delivery possible		First screening, unless known					Difficult, planning		-	Difficult, unless known
Traffic on airside roads		Equal					Equal		Equal	Equal
Uniform process at access points		All like known or no supply					All mixed		mixed	Only for bulk, so different processes
Lifting of supplies		-					-		Unload and reload	-
Works for all supplies		Difficult for bulk					-		Only small packed	bulk

Terminal	0 100% screening in current situation	1 Screening location	2a DC between origin and border	2b DC on border on airside	2c DC under terminal	3a Separation of flows	3b spreading of flows	4 X-ray installation	5 Supply through vehicle access points
<b>Scenario 1 0% known suppliership</b>									
Queues									
Security level	1	2	2	3	3	2	2	2	2
Go/no go	No go					No go	No go		
Investment									
Exploitation cost									
Flexibility of suppliers' planning		Depends on screening	Arrival planning	Arrival planning	Arrival planning			-	Arrival planning or waiting
Change of current procedures supplier		Extra process step	Different delivery, based on planning	Different delivery, based on planning	Different delivery, based on planning			Move carts in installation	Other entrance
Supplier process control		-	Strict planning	Strict planning	Strict planning			-	planning
Distance to drop-off for suppliers		Detour	Delivery earlier in process	Delivery earlier in process	Still at terminal, but no handling			-	Detour
Investment suppliers		-	-	-	-			Special carts	-
AAS process control		Can be more organised	Controlled processes	Controlled processes	Controlled processes			-	Same entrance for all supplies
Urgent delivery possible		Pass screening	Difficult due to planning	Difficult	Difficult			-	-
Traffic on airside roads		-	-	DC trucks	-			-	All suppliers
Uniform process at access points		All passed screening	Only DC trucks	Only personnel, no supply	Only personnel, no supply			Mixed supply and personnel	No supplies
Heavy lifting		-	-	-	-			maybe	-
Efficient use of terminal basement		-	No supply screening	Less storage, no supply screening	Organised storage, re- construction			Space needed for installation	No supply screening
Air quality under terminal		-	Better, but still suppliers for public areas	Better, but still suppliers for public areas	No vehicles			-	Better, but still suppliers for public areas
Passenger experience		-	Organised cart logistics possible	Organised cart logistics possible	Organised cart logistics possible			-	-
Works for all supplies		-	-	-	-			-	-
Influences processes of suppliers for SRA-CP and public areas		Extra stop for SRA- supplies	Two points of delivery	Two points of delivery	Different entrances to terminal?			-	Two points of delivery

Terminal Scenario 2 50% known suppliership	0 100% screening in current situation	1 Screening location	2a DC between origin and border	2b DC on border on airside	2c DC under terminal	3a Separation of flows	3b Spreading of flows	4 X-ray installation	5 Supply through vehicle access points
Queues									
Security level	1	2	2	3	3	2	2	2	2
Go/no go	No go					No go	No go		
Investment									
Exploitation									
Flexibility of suppliers' planning		Depends on screening	Arrival planning	Arrival planning	Arrival planning			-	Arrival planning or waiting
Change of current procedures supplier		Extra process step	Different delivery, based on planning	Different delivery, based on planning	Different delivery, based on planning			Move carts in installation	Other entrance
Supplier process control		-	Strict planning	Strict planning	Strict planning			-	planning
Distance to drop-off for suppliers		Detour	Delivery earlier in process	Delivery earlier in process	Still at terminal, but no handling			-	Detour
Investment suppliers		-	-	-	-			Special carts	Screening time
AAS process control		Can be organised	Controlled processes	Controlled processes	Controlled processes			-	Same entrance for all supplies
Urgent delivery possible		Pass screening	Difficult due to planning	Difficult	Difficult			-	-
Traffic on airside road		-	-	DC trucks	-			-	All suppliers
Uniform process at access points		All like known suppliers	All like known suppliers	Only known suppliers	Only known suppliers			Known unknown mixed	No or known supplies
Heavy lifting		-	-	-	-			-	-
Efficient use of terminal basement		-	No supply screening	Less storage, no supply screening	Organised storage, re- construction			Space needed for installation	No supply screening
Air quality under terminal		-	Still known suppliers and for public areas	Still known suppliers and for public areas	No vehicles due to reconstructio n			-	Still known suppliers and for public areas
Passenger experience		-	Organised cart logistics possible	Organised cart logistics possible	Organised cart logistics possible			-	-
Works for all supplies		-	-	-	-			-	-
Influences processes of suppliers for SRA-CP and public areas		Extra stop SRA supplies, unless known	Two drop off points, unless known	Two drop off points, unless known	Different entrances to terminal?			-	Two drop off points, unless known

Terminal	0 100% screening in current situation	1 Screening location	2a DC between origin and border	2b DC on border on airside	2c DC under terminal	3a Separation of flows	3b Spreading of flows	4 X-ray installation	5 Supply through vehicle access points
<b>Scenario 3 95% known suppliership</b>									
Queues									
Security level	1	2	2	3	3	2	2	2	2
Go/no go	No go		No go	No go	No go				
Investment						-	-		
Exploitation cost						-	planning		
Flexibility of suppliers' planning		Depends on screening				-	Planned	-	Arrival planning or waiting
Change of current procedures supplier		Extra process step				Different entrance	Different timing	Move carts in installation	Other entrance
Supplier process control		-				-	-	-	planning
Distance to drop-off for suppliers		Detour				Detour in terminal	-	-	Detour
Investment suppliers						-	-	Special carts	-
AAS process control		Known suppliers, no control				Known suppliers, no control	Known suppliers, no control	Known suppliers, no control	Known suppliers, no control
Urgent delivery possible		First pass screening				-	Planning	-	-
Traffic on airside road		-				-	-	-	Unknown suppliers
Uniform process at access points		All like known suppliers				Separate flows	-	Known unknown mixed	No or known supplies
Heavy lifting		-				Lifting necessary	Lifting necessary	-	-
Efficient use of terminal basement		-				More traffic	No peak arrival	Space needed for installation	No supply screening
Air quality under terminal		-				-	-	-	Still known suppliers & public areas
Passenger experience		-				-	-	-	-
Works for all supplies		-				-	-	-	-
Influences processes of suppliers for SRA-CP and public areas		Extra stop for SRA supplies, unless known				-	-	-	Two drop off points, unless known

