Detailed Design Document - Company B

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1 Scope

1.1 Identification

The system-of-interest is identified as the extension to the CrisBag system. The purpose of this extension is described in section 1.2. The system consists of every component used in building the system, and the software controlling those components.

1.2 System overview

The purpose of the system is to add an extra security measure to the CrisBag system. This is achieved through adding an extension to the CrisBag system. All baggage that is deemed insecure in the CrisBag system is routed through this extension for an additional screening and security check, and if the baggage passes the check, it is routed back into the original system, otherwise the extension contains a destruction area from where insecure baggage is destroyed.

1.3 Document overview

In this document the Preliminary Design [1] is expanded upon, and the document will contain all relevant information needed for developers to start developing the system, including system-wide decisions, and more specific decisions regarding interfaces and components.

2 Referenced documents

[1] Preliminary Design

3 System-wide design decisions

This section explains decisions made on the overall system design, this includes how inputs and outputs are defined, how the system is split into subsystems, how the system responds to different inputs and lastly how the user is presented with data files. Furthermore this section will elaborate on construction decisions regarding which components that can be used, and how privacy matters are handled.

3.1 Inputs and outputs

The overall system is split into smaller subsystems, and then the interfaces between each subsystem is defined using inputs and outputs. The names of the subsystems can be found in the Preliminary Design document in the PBS diagram [1]. This system consists of three subsystems: the CrisBag solution for transporting totes between the areas (the green and blue lines on figure 1). The inputs and outputs are defined relative to this subsystem, because this subsystem serves as the driver for the whole system. Then besides the CrisBag solution, there are two other, smaller subsystems. Firstly there is the Additional Screening Area (yellow lines), which depicts the SecureScreen subsystem. This subsystem functions as a black box, because it is already installed, and the extension will merely interface with it. Lastly, there is the Ultimate Control Area (red lines) which is the third subsystem consisting of the manual handling area.

As previously mentioned all inputs and outputs are defined relative to the main subsystem. For instance O2 is an output from the main subsystem, and input into the SecureScreen subsystem, but is notated as an output, because it is relative to the main subsystem.

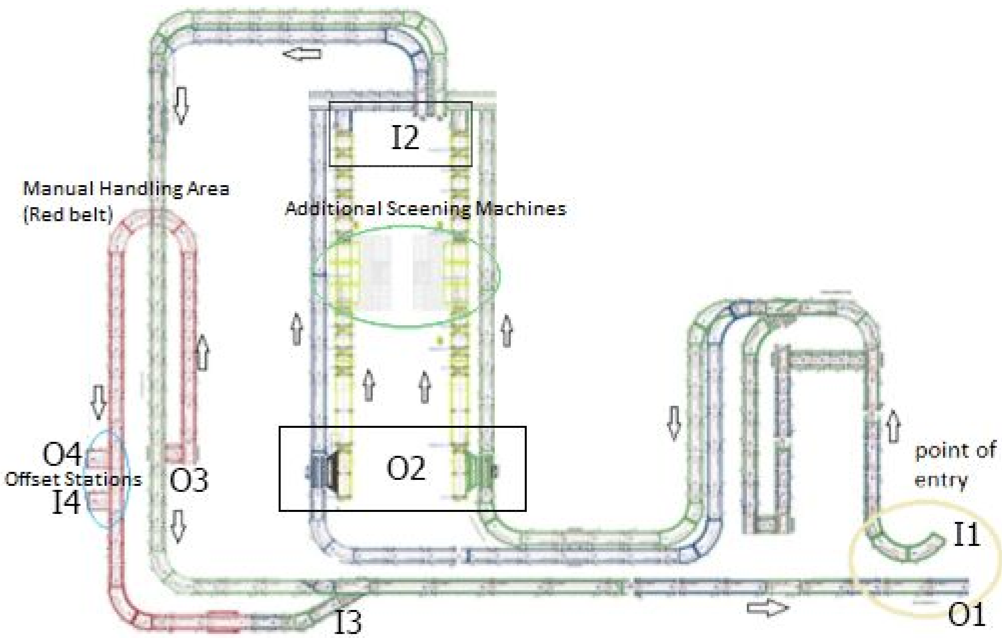

Figure 1: Layout of extension with input and outputs

The following table (table 1) describes all inputs and outputs in more detail. Besides the description there is also noted, what kind of baggage the input or output takes. There are three kinds of baggage. Insecure baggage is baggage that has yet to be approved by security personnel. Secure baggage has been approved and is ready to be reintroduced to the CrisBag system. Scanned baggage can be either insecure or secure.

Table 1: Description of inputs and output in the extension

I/O	Baggage	Comment
I1	Insecure	The overall input to the extension. All baggage deemed insecure in the Level-1 X-Ray will enter at this point.
O1	Secure	The overall output of the extension. All baggage not destroyed in the manual handling area will be the output of the system.
I2	Scanned	All baggage that has been scanned by the SecureScreen RX 5001 will be put onto a tote by a top-loader.
O2	Insecure	Baggage that needs to be scanned by the SecureScreen RX 5001 will be discharged from the CrisBag system onto the conveyor belt.
I3	Secure	Baggage that has been deemed secure in the manual handling area enters the main flow of the extension.
O3	Insecure	The Baggage that the SecureScreen RX 5001 deemed insecure will be diverted into the manual handling area
I4	Secure	Baggage that the manual handling area has deemed secure enters the CrisBag system
O4	Insecure	All baggage that was deemed insecure in the SecureScreen RX 5001

		will be manually checked in the manual handling area. If baggage is deemed insecure after manually checking, it will be destroyed. Additionally, bags which failed to be scanned by the top-loader at I2 will be marked as unknown and also manually checked.

3.2 System responses

The system responds to inputs from I1 by ensuring it will take a bag at least 70 seconds before it reaches O2. This is done by controlling the speed of the lines, and furthermore queue up totes, if there are too many on the line. The purpose of this requirement is to ensure a constant flow of bags through the SecureScreen subsystem.

At O2 the system will respond by separating the bag from the tote. The tote will continue through the CrisBag subsystem, and get the same bag assigned at I2. This happens, because the SecureScreen subsystem does not accept totes as an input.

Another time requirement that must be implemented is the 30 second delay between I2 and O3. It must take a bag 30 seconds between entering at I2 and arriving at O3. Again, this is achieved through controlling the speed of the lines. It is important since the personnel in the manual handling should be able to manually inspect the images from SecureScreen.

Lastly, there is a strict requirement that must be enforced. Under no circumstances a tote loaded with a bag can pass through the line between O4 and I4. If the system registers a tote loaded with a bag, there will be a mechanical error that stops the tote from going further. This stopping mechanism will work under all circumstances, even if other parts of the system are in error. The purpose of this stopping mechanism is to ensure all bags that enter the manual handling area are manually inspected by security personnel.

3.3 System data

The users of the SecureScreeen RX 5001 will mark baggage going through as either secure or insecure. When the baggage is marked, the data will be stored in a database which knows what baggage is on which tote. This is used further on in the system when the system needs to make a decision whether the baggage should go through O3 or follow the main flow.

Furthermore each x-ray scan will be saved for later training of new personnel and evaluation. There will be a possibility to use this data in regards to machine learning and thereby make the system more automatic, or enable the personnel to make better decisions.

Beumer Group also has an interface to the system. This part is hosted at Beumer and the customer doesn’t have any access to this. This system contains logs of the system, to be able to provide an overview of what has happened in the case of a system breakdown. Beumer is trying to predict system failures with machine learning and contact the customer before they even know there is a problem. To do this logs are shipped from the airport to Beumer. Before the logs are shipped they are filtered to make sure nothing confidential is shipped to Beumer. When the logs enter Beumer the files are first forwarded into Kafka, which stores the raw logs. Kafka is efficient in regards to a high throughput. Kafka processes some of the data before data is sent into Logstash which formats the logs to a format that Elasticsearch is able to search through at high speed. This makes it possible for Beumer to search through and visualize logs fast with a UI like Kibana.

3.4 Construction decisions

Excluding the Additional Screening Area provided by the airport the extension is built using already existing components from the CrisBag system. All the used components in the extension are depicted on figure 2. The extension will therefore use the same materials as used in the CrisBag system.

Figure 2: CrisBag components

The different components are described in further detail in table 2.

Table 2: CrisBag components details

Element	Qty	Cost [€]	Time to install [minutes]	Standard sizes [meters]
Tote	20	2.50	0	1.150 x 0.9
Transport (straight)	120	2.000	120	Slave element - 1.0, 1.4 Standard elements - 2.7, **3.0**, 4.0 All width are 1.0

Curve (45 degree)	25	2.500	120	Slave - 1.309 x 1.0 Standard - 1.963 x 1.0
Divert	8	6.000	240	2.6 x 1.0
Merge	8	5.000	240	2.6 x 1.0
90-degree Transfer	6	7.000	360	2.4 x 1.0, 1.5 x 1.7
Top Loader incl. Scanner	2	12.600	600	3.292 x 1.0
Discharge	2	8.500	420	2.35 x 1.0

3.5 Privacy concerns

All data that is logged and shipped to Beumer will be anonymous, and therefore not be identifiable with a bag or person. Furthermore only airport personnel with appropriate clearance will be able to access data. The clearance level varies from airport to airport and country to country, but guidelines addressed by the authorities will be followed. Likewise at Beumer only cleared staff will be able to access logs and data.

4 System architectural design

This section describes the system architectural design.

4.1 System components

This section describes the different components in the system.

Table 3: System components

Component	Project identifier	Purpose	System requirements and system-wide design.	Static relationship(s)	Development status/type (if known)	Characteristics for identified resources
Tote	Tote	Store bags	No requirements		Developed	Length: 1150 mm (45 in) › Width: 900 mm (35 in) › Height: 200 mm (8 in) › Weight: 14 kg (31 lbs) ›
Transport (straight)	Transport	Transport tote	Control Speed (Requirement 2, 3)		Developed	
Curve (45 degree)	Curve	Transport tote	Control Speed (Requirement 2, 3)		Developed	
Divert	Divert	Sort tote	No requirements		Developed	
Merge	Merge	Merge tracks	No requirements		Developed	
90-degree Transfer	Transfer		No requirements		Developed	
Top Loader incl. Scanner	Top Loader	Load bags in totes and scan the bags and tote	Can load tote from conveyor belt (Requirement 19)		Developed	
Discharge	Discharge	Discharge bag from tote	Can discharge to conveyor belt (Requirement 18)		Developed	
SercureScreen RX 5001	SecureScreen	Scan bags	No requirements		Developed	

Conveyor belt	Conveyor	Transport bags	No requirements		Developed	
Manual scanner for O4	Manual scanner	Scan bags(tote)	No requirements		Developed	
Full Tote Stopper		Stop full tote	Stop full tote		Unknown	

4.2 Concept of execution

This section describes how the dynamic relationship of the different components interact during system operation.

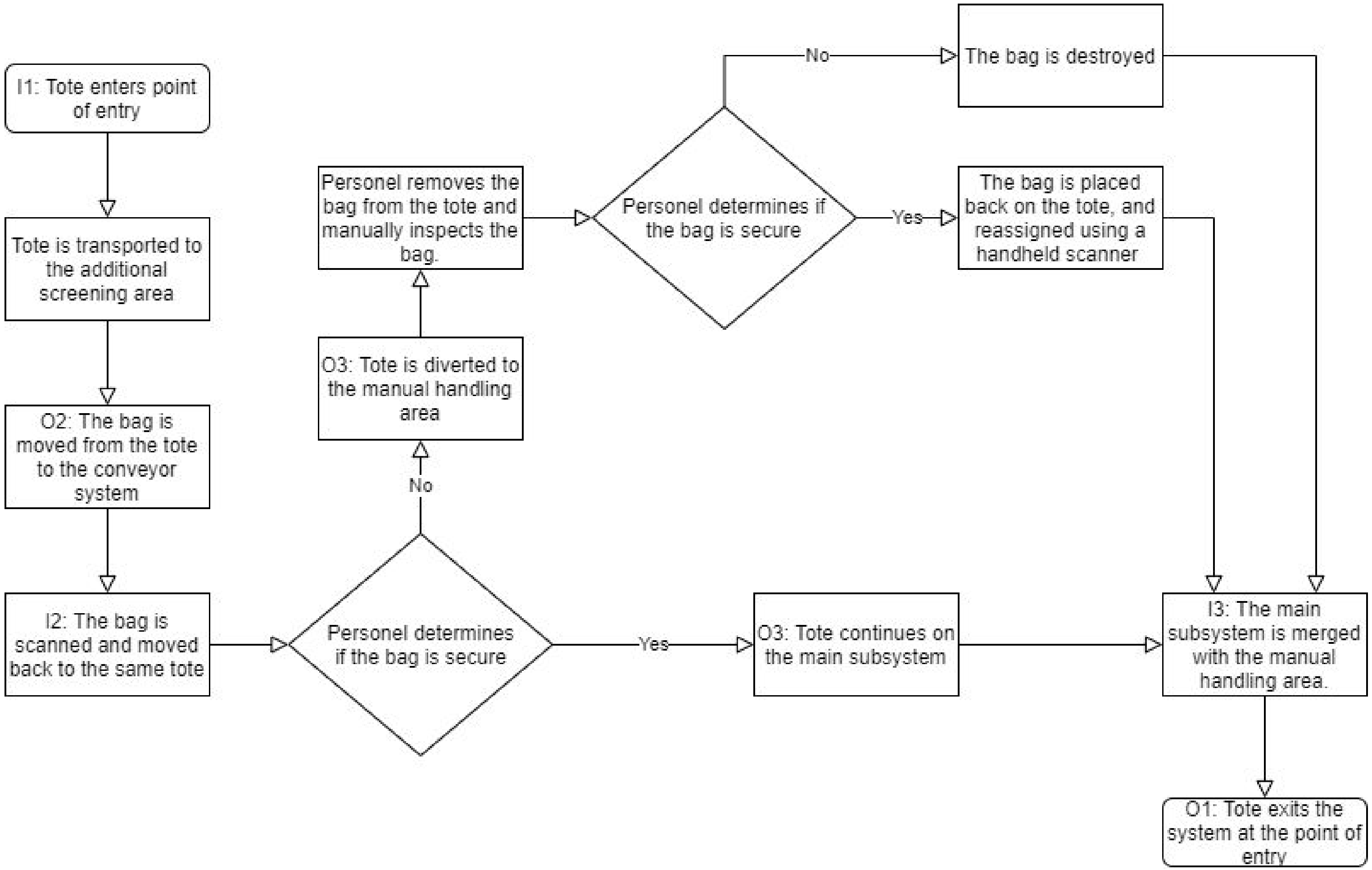

Figure 3:

4.3 Interface Design

This paragraph shall be divided into subparagraphs to describe the interface characteristics of the system components. It shall include both internal and external interfaces. If part or all of this information is contained in Interface Control Descriptions (ICDs) or elsewhere, these sources may be referenced.

Table 4:

Internal Interface	Project-unique identifier	Type of interface (such as real-time data transfer, storage-and-retrieval of data, etc.)	Characteristics of data elements that the interfacing entity(ies) will provide.	Characteristics of data element assemblies (records, messages, files, arrays, displays, reports, etc.) that the interfacing entity(ies) will provide, store, send, access, receive, etc.	Characteristics of communication methods that the interfacing entity(ies) will use for the interface.	Characteristics of protocols the interfacing entity(ies) will use for the interface.	Other characteristics, such as physical compatibility of the interfacing entity(ies) e.g., dimensions, tolerances, loads, voltages, plug compatibility, etc.

External	Project-uniq	Type of interface	Characteristic	Characteristics of	Characteristics	Characteristic	Other

Interface	ue identifier	(such as real-time data transfer, storage-and-retrieval of data, etc.)	s of data elements that the interfacing entity(ies) will provide.	data element assemblies (records, messages, files, arrays, displays, reports, etc.) that the interfacing entity(ies) will provide, store, send, access, receive, etc.	of communication methods that the interfacing entity(ies) will use for the interface.	s of protocols the interfacing entity(ies) will use for the interface.	characteristics, such as physical compatibility of the interfacing entity(ies) e.g., dimensions, tolerances, loads, voltages, plug compatibility, etc.

5 Requirements traceability

See apendix Traceability Matrix Revised - Document id: A01