Aarhus University
Systems Engineering
Company H

02-00-JJ_RC_MB_MJE-v02_1-20210204

# System Requirements Specification

BEUMER Group

*Group members:*
Martin Jespersen (201706221)
Tristan Møller (201706862)
Rikke Christensen (201704464)
Jesper Jakobsen (201708777)
Mikkel Jensen (201708684)
Jens Bendtsen (201708413)
Mads Dahl (201705285)
Marie Bærentzen (201608667)

*Superviser:*
Stefan Hallerstede, Lektor

April 7, 2021

# 1 Version History

| Ver. | Date | Initials | Description |
|---|---|---|---|
| 1.0 | 03-03-2021 | TM | Document created |
| 1.1 | 03-03-2021 | RC, MJ, JJ, MB | Requirements pt. 1 to 14 created and added |
| 1.2 | 03-03-2021 | MJ, JJ | Scope identification and overview + introduction added |
| 1.3 | 03-03-2021 | RC | Requirements pt. 15-16 created and added. Scope identification and overview + introduction edited |
| 1.4 | 03-03-2021 | MB | Requirements R23 + R24 added |
| 1.5 | 03-03-2021 | RC, MJ, JJ, MB | Requirement R24 removed. Scope + Requirements corrected |
| 1.6 | 16-03-2021 | RC | Edited multiple requirements and added a few/divided some requirements into multiple requirements. Changed the sub version number of this document. |
| 1.7 | 24-03-2021 | RC | Edited requirements with identification |
| 2.0 | 02-04-2021 | RC | Added Customer need section and change request requirements |
| 2.1 | 07-04-2021 | RC, TM | added requirement |

# Contents

# 2 Introduction

The purpose of the System requirement specification (SRS) is to document the functional as well as the non-functional requirements derived from the Requirement Analysis phase. The SRS document identifies the requirements and contains important details about them.

To create this document the *SE Case Book* [1] have been used. The book can be found on blackboard in the course material.

# 3 Scope

## 3.1 Identification

This System Requirements Specification is for the CrisBag® baggage transport and sortation system. This system is the best-in-class tote-based system for transport and sortation of luggage. The system allows for easy control of individual luggage bags, all the way from check-in to the storage area. The system allows the airport to have complete tracking and traceability throughout every stage of the handling process. The system offers a wide variety of different building blocks that allows the user to customize their specific baggage and sortation system to their specific needs.

## 3.2 System overview

The purpose of this new system is to add additional security to an already existing airport baggage handling system. The system will add two level 3 x-ray scanners and a station/ area for manual handling of insecure baggage. Since the system is an upgrade to an already existing system, the original system will have to work with the current system and it has to be able to run without issues even if the new system gets added.

## 3.3 Document overview

This document will include a brief explanation of the system and its purpose and all the requirements of the system. These requirements will be put into different categories to make it easier for the reader to understand the different requirement and to minimise confusion.

The majority of the requirements have been identified in the BeumerGroup Baggage Handling Upgrade case description which can be found in appendix.

Beumer Group_Case Description Revision 02 [2]

A full list of the document references used in this specification can be found in the end of this document.

# 4 Requirements

This section holds the system requirements organised into a number of subsections describing both the functional and non-functional requirements.

The identification of the requirements is listed numerically before they are divided into subsections. All requirements start with 'T' for technical requirement followed by the identification number starting with T1.

## 4.1 Required states and modes

```
States:
    Operational
    Maintenance

Operational modes:
    Fully
    Low
Maintenance modes:
    Maintenance on Track 1
    Maintenance on Track 2
    Fully Off
```

**Definitions of states**
*Operational:* This state will be active when the system is fully functional, there are several modes that the system can run in when ever it is in operational mode. These will be described in a separate section. This state will define the system to be fully functional to a full or semi full extent and should be running as defined.

*Maintenance:* This state will be active if maintenance is required on a baggage screening machine or a transportation module. There are three different modes that can be chosen in the maintenance state. These modes can be used to stop either of the baggage screening machines, which makes it possible for the maintenance to take place while the system is running on a lower capacity.

**Definition of modes**
*Fully:* The system is running to its full extent, with both of the transportation modules running. There should be no parts of the system that isn't running in this mode.

*Low:* The system will run on low where only one of the transportation modules are running, this should be used whenever there aren't need for the throughput of both transportation modules at given time.

*Maintenance on Track 1:* This mode is chosen if track 1 is to be maintained while the mode of track 2 is unchanged.

*Maintenance on Track 2:* This mode is chosen if track 2 is to be maintained while the mode of track 1 is unchanged.

*Fully off:* The system will be completely shut off with no transportation module running. This should only be used whenever the maintenance cannot be fulfilled unless both modules are stopped.

## 4.2 Customer needs

In this section the customer needs are listed. The customer needs are from Beumer Group. Need R1 to R11 can be found the case description[2]. The additional need R12 is derived from a change request from Beumer Group[3].

R1: Regardless of mechanical errors, operational faults etc. no baggage must be able to go through the area without having been security approved.

R2: From the point of entry (Yellow circle on the drawing), to the point of additional screening (Green circle), there must pass at least 70 seconds (to allow for manual inspection of a previous taken x-ray image)

R3: From passing additional screening (Green circle) until reaching entry point of manual inspection (The red lines), at least 30 seconds must pass.

R4: The unsecure bags in the CrisBag totes are conveyed through two additional screening machines. The machines are foreseen to be of type SecureScreen RX 5001. (The machines are not included in this supply), but a software interface must be made.

R5: Bags can manually be removed from the system through one offset workstation (First in the blue circle). They can then be manually transported to the search room and destruction area to complete the security process.

R6: Space constraints
Specified areas are as per below:
-Search office: 15m$^2$ (6m x 2.5m)
-Destruction area: 10m$^2$ (5m x 2m, with free high 3m)

R7: Items rejected at first screening (prior to the extension), or with no result supplied, must be routed to Additional Screening Area

R8: Items rejected in the additional screening machine, must wait for the final result from the operator, after which rejected items are sorted to the manual handling area for inspection. Cleared items are sorted to planned destination.

R9: It shall be possible to load cleared items back to the system at the manual handling areas.

R10: It must not be possible to send full totes through the manual handling area. Even if other elements are in error

R11: Secure bags are then re-introduced to the system through one dedicated workstation. Bags are loaded to an empty tote and associated by a hand-held scanner/or keyboard.

R12: [T]he sorting system [must] be able to discharge all baggage to traditional conveyor lines, on which they can then pass through the SecureScreen RX 5001 machine. Upon completed screening, the baggage must then be reloaded into the tote system, and continue as originally designed.

## 4.3 System capability requirements

T11: Items rejected in the additional screening machine, must wait for the final result from the operator

T12: Items rejected from the operator are sorted to the manual handling area for inspection.

T13: Items cleared from the operator are sorted to their planned destination.

## 4.4 System external interface requirements

T18: The system upgrade must be able to interface with the external baggage handling system, which already is in place.

T28: There must be dedicated workstations/offsets where baggage can be manually removed.

T36: Scan, location and state of all totes are monitored in by the system and accessible by on-site operators

## 4.5 System internal interface requirements

T6: The screening machines must have a software interface (included in this supply).

## 4.6 System internal data requirements

T19: Every stored personal information about luggage should be kept in according to GDPR regulations.

T20: The data stored in the system should be backed up to an off-site location each 24 hours.

## 4.7 Adaptation requirements

T2: From the point of entry, to the point of additional screening, there must pass at least 70 seconds (to allow for manual inspection of a previous taken x-ray image)

T3: From passing additional screening until reaching entry point of manual inspection, at least 30 seconds must pass.

T32: The system must discharge all baggage from a tote to a traditional conveyor line before reaching the screening machine.

T33: The system must register the discharge of all baggage when discharged from a tote.

T34: Upon completed screening, the baggage must be reloaded into the tote system

T35: The conveyor line going through the screening machine must be traditional conveyor lines

## 4.8 Safety requirements

T7: Bags can manually be removed from the system through one offset workstation. They can then be manually transported to the search room and destruction area to complete the security process.

T21: If an unexpected blockage of the system occurs, the system should stop immediately to avoid any personal or property damage.

## 4.9 Security and privacy requirements

T1: No baggage must be able to go through the area without having been security approved.

T4: The screening machines in the CrisBag are foreseen to be of type SecureScreen RX 5001 (The machines are not included in this supply).

T31: The unsecure bags in the CrisBag totes are conveyed to the additional screening machines where they are leaving the tote system before going through the screening

machines.

T15: It must not be possible to send full totes through the manual handling area.

## 4.10 System environment requirements

T8: The search office has the limited space for a maximum $15m^2$ with the dimensions: 6m x 2.5m and height 3m

T9: The destruction area has limited space for a maximum $10m^2$ with the dimensions: 5m x 2m and height 3m

## 4.11 Computer resource requirements

T22: The system software must be able to be implemented on the already existing servers.

T23: The servers that holds the system software can be upgraded if this is deemed necessary.

## 4.12 System quality factors

T24: The system must be able to track 100% of all the baggage loaded onto the system.

T25: The system must include the ability to test each section of the new upgrade to identify any issues.

T26: The system must be able to be maintained without stopping the complete system if the maintenance area doesn't cover both tracks.

## 4.13 Design and construction constraints

T10: Items rejected at first screening (prior to the extension), or with no result supplied, must be routed to Additional Screening Area

T14: It shall be possible to load cleared items back to the system at the manual handling areas.

T16: Secure bags are re-introduced to the system through one dedicated workstation after being manually searched and cleared.

T17: After being manually searched and cleared, bags are loaded to an empty tote and associated by a hand-held scanner.

## 4.14 Personnel-related requirements

T27: The system must be able to be operated by individually trained personal.

## 4.15 Packaging requirements

T29: The system components must be marked with an unique ID upon delivery.

T30: Upon delivery, an overview of the system component with IDs and internal relationship between the components must be included

## 4.16 Quality Provisions

Each requirement should be testable and made sure agrees with the together agreed upon testing methods for each individual requirement. If the requirement is not testable, it should be verified by other agreed upon testing methods such as, analysis, demonstration, inspection or review of design.

## 4.17 Requirements Traceability

Requirements traceability will ensure that all requirements in this document can be traced back to user needs. All requirements in this document concerns the over all system but the traceability shall concern all requirements in subsystems as well.

Each requirement must be linked to one from a higher level in the system and must be traceable through design documents, architecture and interface structures down to acceptance test procedures.

To accomplish the traceability all requirements must be introduced in a traceability table performed with a tool chosen by the leading system engineer. The highest level of requirements must be the user need from which the system requirements are derived.

In case that a requirement is not linked to a user need, the requirement will be labeled as *nice to have* and should be prioritized accordingly or reevaluated as a requirement.

The traceability matrix can be found the appendix with the name: TraceabilityMatrix-00-JJ_RC_MB_MJ-v01_3-20211003.pdf

# References

[1] R. H. Jacobsen and S. Hallerstede, "Systems Engineering Cases and Instructions," [Online]. Available: https://blackboard.au.dk/bbcswebdav/pid-2945704-dt-content-rid-10601901_1/courses/BB-Cou-UUVA-94215/SECaseBook8.pdf.

[2] Beumer, "BAGGAGE HANDLING UPGRADE," vol. 2017, pp. 1–11, 2018.

[3] ——, *Beumer case: BAGGAGE HANDLING UPGRADE LEVEL 3 X-RAY SCREENING CHANGE REQUEST*, 2021.