Systems Engineering Management Plan
PMM-01

Case II Beumer

Group H
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Title	**PMM-01 Systems Engineering Management Plan**
Current Stage	Draft
Revision Number	0.5
Document Owner	Simon Alexander Alsing

Revision history

Revision	Major changes	Reporter	Date
0.5	Initial setup, scope, planning and risk	Simon Alexander Alsing	19/02/2019

Table 1: Revision list for the SEMP document.

Contents

1 Scope of project

The scope of this project is to supply an additional extension to a Crisbag baggage handling system, which is currently being delivered to a client. The purpose of the extension is to provide an additional screening level to the baggage handling, allowing for further automatic screening, and manual screening should it be necessary.

An initial layout of the extension can be seen on figure 1. The green circle indicates the automatic screening zone, where the required machinery is not part of this scope, however, appropriate interfaces must be provided. The blue circle shows manual inspection zone.

The extension is to be treated as a separate system with the original deliverance being out of scope. The only connection between the system of interest and the system which it extends is a given interface, where the extension is connected to the main part (see yellow circle). Thus, the project will be carried out as being independent, however, with some natural constraints given by the original system.

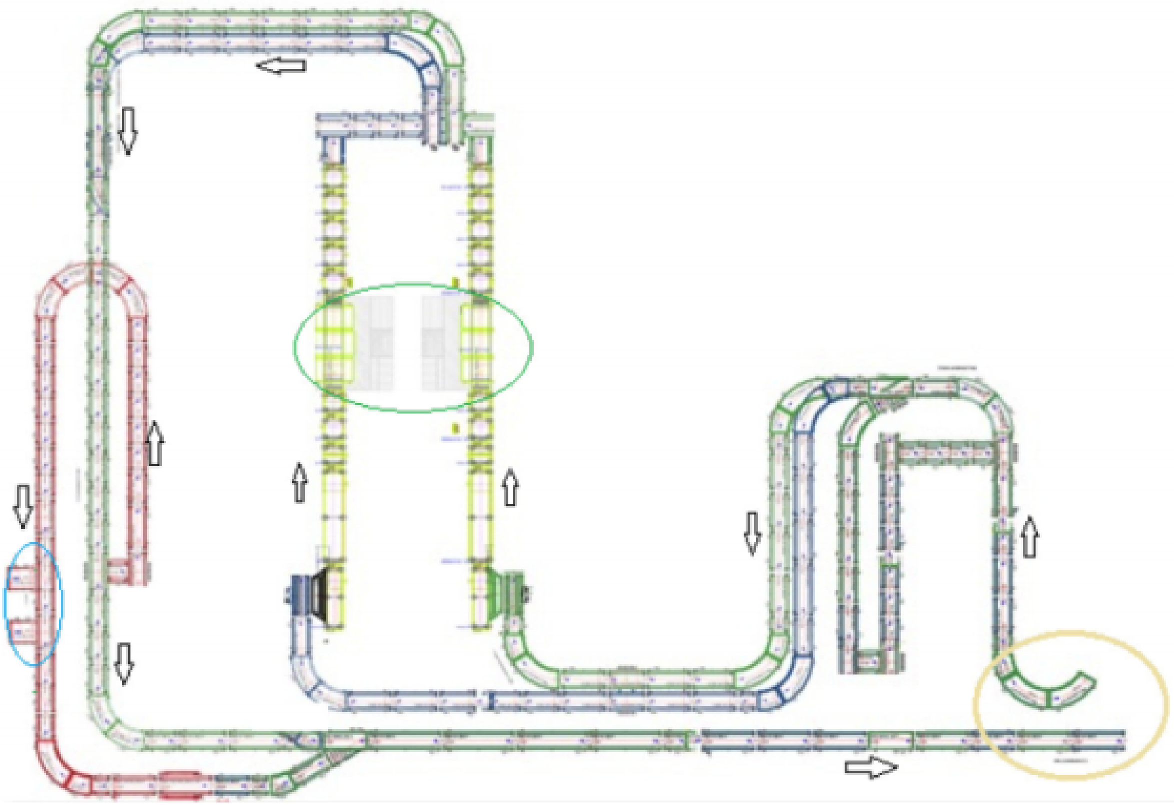

Figure 1: Layout extension sketch

2 Functional Analysis

The baggage handling system consists of a stream of baggage coming from an already existing system. An extended security screening of the baggage is performed. Based on the screening, some baggage will be redirected to manual inspection. If the baggage is cleared by manual inspection, it should be sent back into the existing system. Otherwise it will be not be sent back. The system has been described on figure 2

The security screening will not be delivered by this project, therefore the baggage system will have to interface with the security screening system.

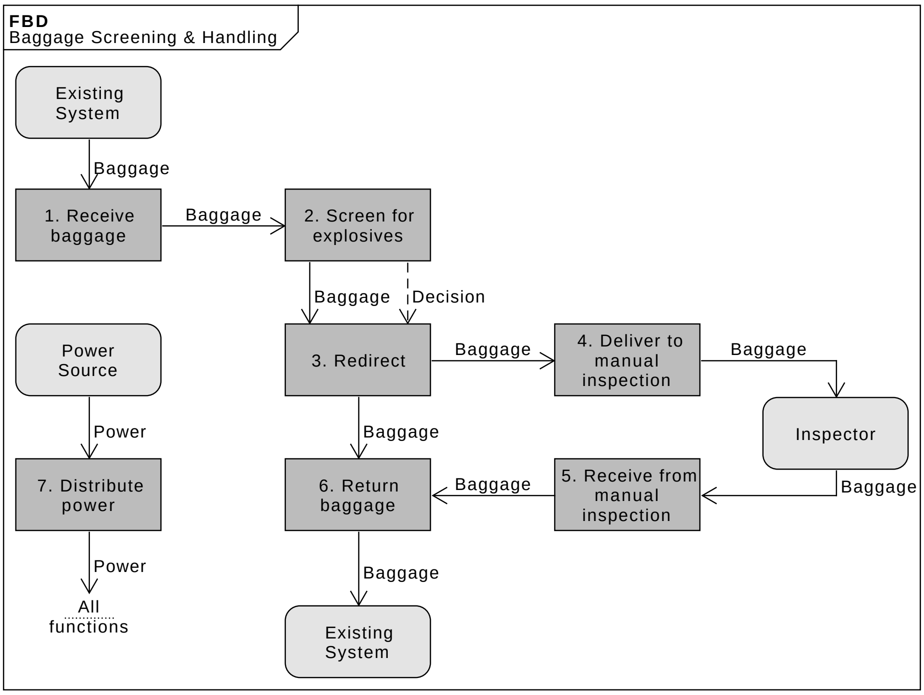

Figure 2: Functional Block Diagram (FBD) for baggage screening and handling system.

3 Systems Engineering Process

3.1 Systems Engineering Planning

The overall project life cycle is shown on figure 3. The figure shows key phases of the life cycle with notable deliverables in regards to system engineering related to each phase. The model is based off of the presented project life cycle in Beumer Case along with the overall requirement from the lecture assignment.

Transitions between each phase are gated, meaning some form of review or approval is required in order to continue onto the succeeding phase. It is worth noting that gate 4 is placed during the *Production & Internal Testing* phase, the gate does not trigger a transition to a new phase, but is still an important milestone during the phase.

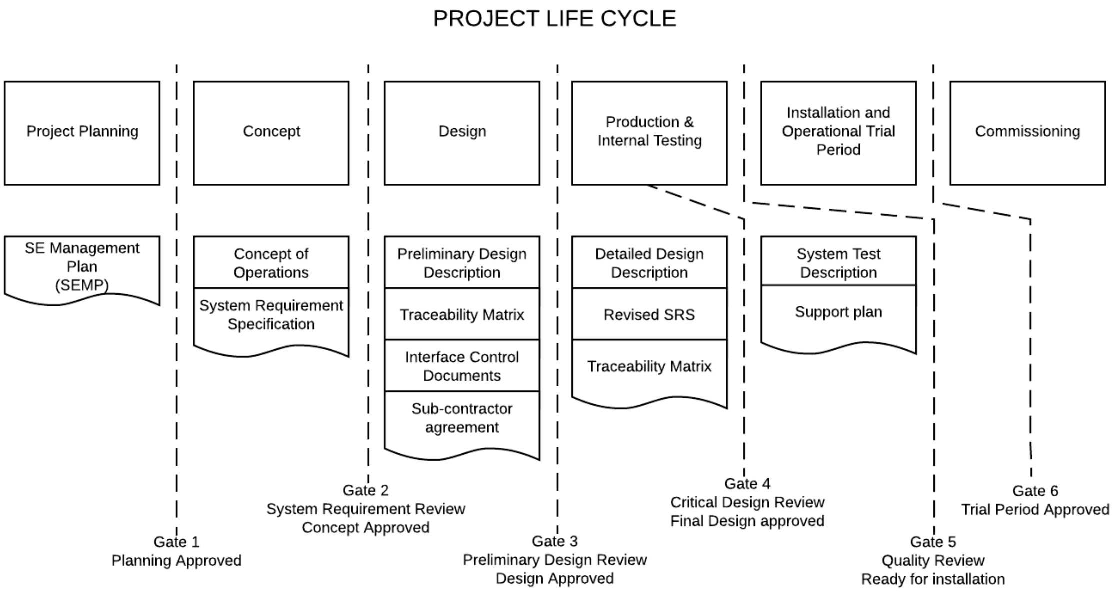

Figure 3: Life cycle model of project

Work Breakdown Structure (WBS)

The work breakdown structure on figure 4, gives an overview of key tasks in the project. Deliverables with regards to system engineering are shown here, along with parts of the system known at present planning state.

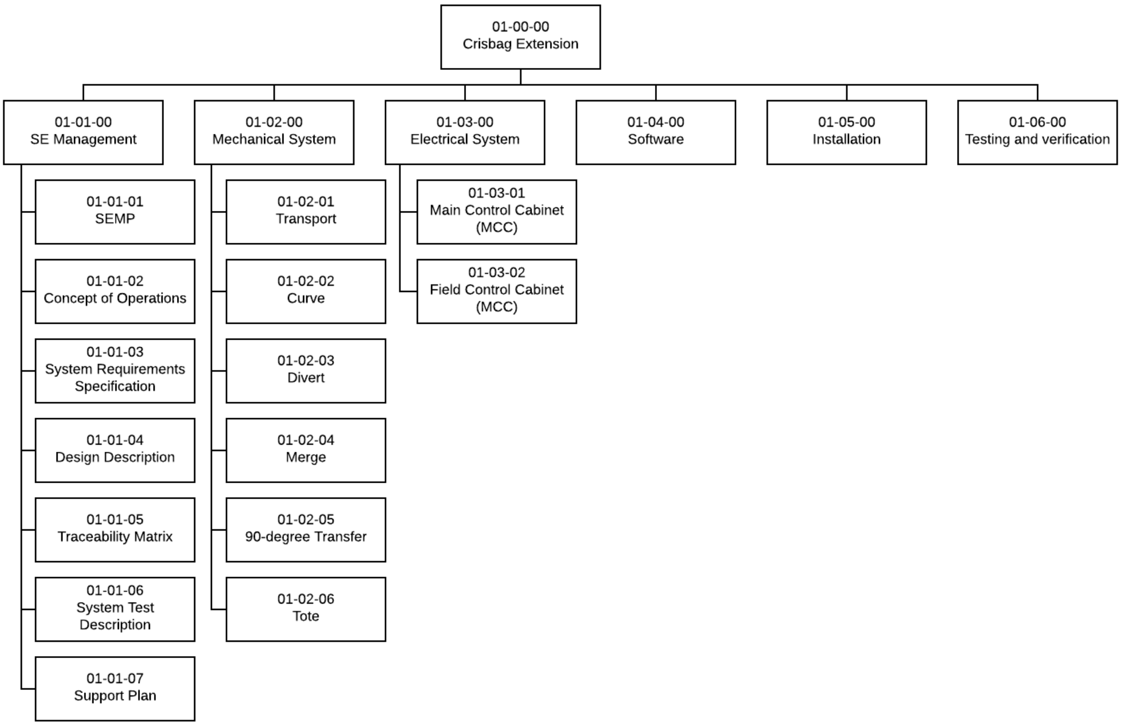

Figure 4: Work Breakdown Structure

Organizational Relationships

The organizational relationship is shown on figure 5. It shows that all formal communication must go through the systems engineering department, and only informal communication is allowed between other departments and the external entities such as the customer and sub-contractors.

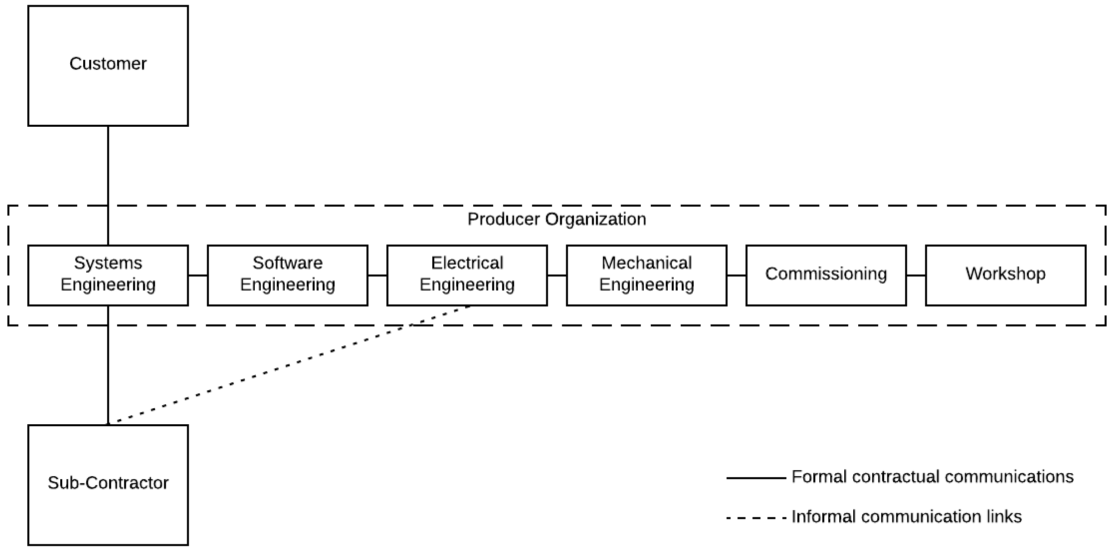

Figure 5: Organizational Relationship

Resource allocation

Allocation of required resources is based on preliminary assumptions primarily drawn from the Beumer Case Presentation.

Facilities and Infrastructure

It is presumed that the required facilities, including office space, will be available as needed throughout the project. In addition the *workshop* is assumed available when needed for internal testing purposes.

As all mechanical parts of the system are in stock, and logistics are considered out of the project scope, it is assumed that all parts can be made available at the workshop with two weeks notice, which is the time the warehouse needs prior notice for timely delivery when items are in stock.

Staff allocation

Table 2 shows available personnel, their respective period of availability as well as their time commitment throughout this interval. Note that neither the department for mechanical- or electrical engineering will be available throughout the project in a dedicated manor. Due to the mechanical part of the system being made up from standard components, which are assumed in stock, no active mechanical engineering involvement is required. However, components for the electrical part of the system are required, which creates an acquisition need as these parts will have to be obtained from a sub contractor.

Department	Role	Start	End	Time
Software	SW Project Manager	01-02-2019	31-12-2019	100%
Software	SW Architect	01-02-2019	31-12-2019	100%
Software	Developer	01-02-2019	31-12-2019	100%
Software	Developer	01-05-2019	31-12-2019	100%
Software	Developer	01-08-2019	31-12-2019	75%
Workshop	Electrical Specialist	As needed	As needed	50%
Workshop	Mechanical Specialist	As needed	As needed	50%
Commissioning	Commissioner	01-06-2019	31-12-2019	100%
Commissioning	Commissioner	01-08-2019	31-12-2019	100%
Commissioning	Commissioner	01-08-2019	31-12-2019	100%

Table 2: Staff availability across departments. Source: Beumer

Time plan

Based off of the project life cycle an initial timeline is outline. Figure 6 shows the time plan.

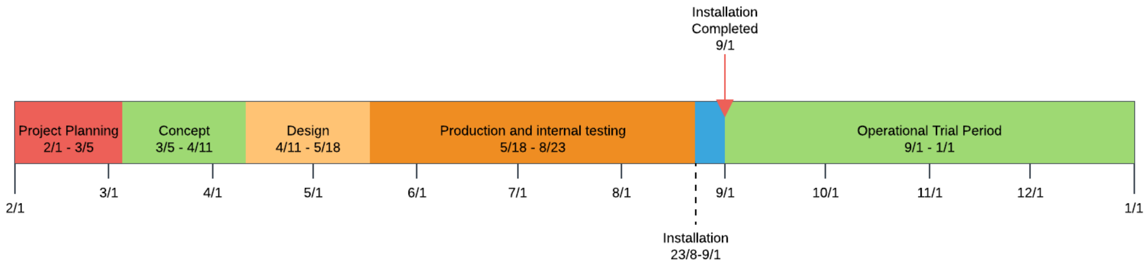

Figure 6: Project initial time plan

Budget

The overall budget can be found in the project budget spreadsheet[1], see appendix A.

[1] `https://docs.google.com/spreadsheets/d/1kIm3F1vqOm9m9VcNl8U-YcHNigD-PMMIggeUkkp_iZI/edit?usp=sharing`

4 Risk Management

4.1 Risk Planning

Process

The risk managing process will consist of four steps:

1. Risk Identification - Description of the risk, responsible individual, potential cause.
2. Risk Analysis and Mitigation - Estimation of likelihood and impact. Plan for reducing risk
3. Risk Handling - Handle the consequence of a risk impact.
4. Risk Monitoring - Evaluate the effectiveness of chosen risk handling.

Categories

The identified risks are categorized in the following categories:

- Personnel
- Outsourcing
- Client

Inputs and Outputs

- Inputs - Candidate risks
- Outputs - Risk Report, risk record

Stakeholders

- Project team
- Client
- Sub contractors

4.2 Risk Identification

table 3 shows the identified risks.

#	Risk Category	Risk	Risk Description	Potential Cause	Responsible
1	Personnel	Loss of personnel	If the project loses personnel then the projects timeline may be extended.	A member of the staff resign/gets sick/dies.	Project Manager.
2	Outsourcing	Sub contractor missing deadline	If a sub contractor does not deliver on time then the project timeline may be extended.	Lack of communication.	Subcontractor contact.
3	Client	Client change request	If a client pushes for a change then it could change the requirements to the system.	Lack of communication	Client contact

Table 3: Risks

4.3 Risk Analysis and Mitigation

The previous identified risks are evaluated in terms of likelihood and impact. These are presented in table 4 which futhermore includes a strategy for reducing the risk.

#	Risk	Likelihood	Impact	Mitigation
1	Loss of personnel	M	L	Daily contact with personnel. Have backup personnel.
2	Sub contractor missing deadline	L	H	Regular updates from sub contractor.
3	Client change request	H	L	Plan for incorporating changes.

Table 4: Risk analysis and mitigation

4.4 Risk Handling and Monitoring

At this point no plans for handling the consequences of a risk impact has been decided or implemented. In addition no risk records exists as no evaluation has taken place yet.

5 Decision Management

A formal decision-making processes allows for decision to be reached, with a sufficient explanation of the design space without succumbing to analysis paralysis.

The decision process in this project distinguishes between three different kinds of decisions: trivial decisions, minor decisions and major decisions. Trivial decision is a decision that has an obvious solution. A minor decision is a decision where minor impact to the system or process is minimal and where multiple seemingly equal solutions can be found. A major decision is a decision where major impact on the project or system.

Process for trivial decision No formal process for this is needed, all group members are empowered to make these decisions.

Process for minor decision These decisions should be made at group meetings on the basis of a written description containing problem that the decision addresses and possible solutions.

Process for major decision These decisions should be made at group meetings on the basis on a trade study. As described in TISYE_L2_Concept_-Stage.pdf Page 68

6 Configuration management

Configuration management is to know which artifacts exists in the project, and which versions are the most current or relevant for a earlier delivery/baseline. Therefore the goal of configuration management can be outlined as

1. Identification / register of artifacts.
2. Identify different versions of released artifacts.
3. Retrieving old versions of artifacts.
4. Identifying when/how the artifacts can be changed.
5. Maintaining the integrity of baselines
6. Providing accurate status and current configuration data to developers and customers.

6.1 Artifacts

Artifacts is any material that is relevant for the systems or operations of the group, except for *minutes of meetings.*

How do we register artifacts

Artifacts are registered in the artifact register spreadsheet[2] by the creator.

The registrations consists of:

- The documents ID consists of 3-4 letters followed by at least two numbers, letters indicate the kind of document se table 5 and the numbers are used to create unique IDs.
- Title of the document, this does not need to be unique.
- Revision number, consists of a major and a minor number written as major.minor where the major number is determined by the last release, minor identifies the draft version.
- Revision date, the date where current version was updated.
- The document owner, the person currently responsible for the document.

[2]`https://docs.google.com/spreadsheets/d/1LLH8KdmbeW6QeE9vqF2NjwudcYvo2Xrk8yodB9oCvxc/edit?usp=sharing`

This information should be kept up-to-date by the document owner.

Letter Code	Definition
PMM	Process Management Material
HSSD	Main System Specific Document
AOSD	Outsourcing documents for work related to group A
GOSD	Outsourcing documents for work related to group G

Table 5: Document id definitions.

How do we label artifacts

Documents are labeled on the front page with: Document title (ID + Title), Last time it was updated, Status of the Document(Initial drafts, draft or Released), Document Owner and Revision Number See table 6.

Title	**PMM-01 Systems Engineering Plan**
Stages	Draft
Revision Number	0.5
Document Owner	Simon Alexander Alsing

Table 6: Front page information example.

In the front of the artifacts is a version table containing version, date of update and description of change All subsequent pages are marked with document ID, Last time it was changed and page x of y.

6.2 Artifact States

In this project, three states will be used to distinguish between if an artifact is published. The requirements for changing a artifact state differ according to the state of the artifact.

Initial drafts

Changes to artifact in initial draft are permitted with coordination with the document owner, any proposed changes should be reviewed by another group member, preferably the document owner. When the document is ready, agreement must be obtained from the group or change committee to change the status to released.

Draft

Changes to artifact in draft are permitted if it's inside the scope of the approved changes and it's coordinated with the document owner, changes should be reviewed by another group member preferably the document owner. When the document is ready for release it must be reviewed by the change committee.

Released

Changes to artifacts in released state are not permitted. Instead a change proposal should be submitted to group meeting, The group appoints a change committee To approve the final changes, Unless there is a pre-appointed change committee for the artifact. When a change is approved, the version And state of the document should be updated both in the document and in the artifact register.

6.3 Change committee

One or more group member which are empowered to approve or reject change to specific artifacts. This means they are allowed to approved change requests, by changing the state of document to draft, define the scope of changes based on the change request and they also promote drafts to releases when the artifact is deemed ready for release.

6.4 Baselines

Baseline should provide a detailed descriptions of which artifacts versions in the current point in time should be included in the baseline. Only release documents should be included in a baseline. A baseline is practically a copy artifact register, where the artifact versions to be included is described, when a baseline has been created it should not be altered.

7 Quality Management

In order to ensure a system of high quality, a strategy for quality management is necessary.

7.1 Defining Quality Attributes

The quality attributes can be used to measure the performance of the system. For the quality attributes for the system, it has been based on the quality characteristics from ISO 25010.

- Reliability - The system has to be operational 24/7, hence the fault tolerance of the system as a whole is highly prioritized and the availability is 24/7. Not all parts of the system has to be operational 24/7, but the transportation aspect has.
- Functional Suitability - This is also highly prioritized, since the requirements of the systems is the security link for baggage, incorrect functionality can result in unauthorized baggage getting past security.
- Portability - The system has to be transported to the customer, and have the different parts installed to a complete system.

7.2 Measuring Quality Attributes

The identified quality attributes can then be measured in the following ways:

- Reliability - To measure the reliability the system has to undergo endurance testing, where the system is being used for very long periods of time without errors.
- Functional Suitability - To measure the functional suitability of the system, the system has to undergo thorough testing, where the system is being exposed to intentional errors, but is still functional. The system is acting according to specifications, corresponding to the error occuring.
- Portability - To measure the portability physical measurement of the different parts for the system can be used.

7.3 Strategy

A strategy for ensuring the quality of the system is developed, which is an iterative process, keep being repeated until a satisfactory result has been reached.

The process is:

1. Develop/improve the system.
2. Measure quality attributes as described.
3. Analyse the measurements.
4. Repeat process, using the results of the analysis.

8 Information Management

For a project to succeed, necessary and relevant information should be available to the engineers for them to be able to make the correct decisions. An effort is therefore needed in Information Management (IM). An Information Management effort tries to answer questions such as:

- What information will have to be collected and stored?
- How will the information be stored and accessed?
- Who will be able to access the information?
- Are there any legal requirements for how long information can be stored?

Questions regarding IM for this project will be answered here

Information storage Shared information will be stored in a GitLab server hosted by Aarhus University. Git is a distributed versioning system, therefore, in the unlikely scenario that the central server shuts down, no information will be lost.

Information Configuration Control GitLab has an inbuilt document review system, making it easy for the group to ensure information is correct and in tact with group consensus. If possible, documents can be assigned at owner who will have authority to accept or reject editions to documents, further increasing Information Configuration Control.

File formats Minutes of the meeting documents will be stored as plain text file, using the `.txt` file format. Documents meant for distributing to subcontractors or hand ins will be written in LaTeX and will be compiled to `.pdf` files.

Information Distributing Information will internally be available at all times for all group members, as the group is as small as it is, with no strong hierarchy system in place. Information shared with other companies (groups) will be formally delivered at agreed upon a times.

9 Assessment and Control

9.1 Project assessment and control strategy

The project is divided such that there is an responsible person for every major part such as contact with the subcontractor and contact person for the prime contractor. The current plan of who is responsible for what can be seen in table 7.

Area of responsibility	Responsible person	Date
Contact person for the group	Søren Herskind Nielsen	13/02/2019
Contact person to subcontractor group G	Mathias Wenzel Fogh	20/02/2019
Contact person to primecontractor group A	Rasmus Hjorth	20/02/2019

Table 7: Overview of responsible people and their areas of responsibility.

Every meetings internally or externally is logged with at least: date of the meeting, who is present, what was agreed upon. After each meeting the parties involved must agree upon what have been logged of the meeting. Every document must be created within a git repository, stored at the project repository such that is can be back-traced who have done what, when. The repositories are created such that merge requests with at least one reviewer is required, this ensures consent of the documents created across the group.

Review of the delivered work with subcontractors will be done in accordance to the of NASA Guidance on Technical Peer Reviews/Inspections[1, Appendix N].

9.2 Project performance measures needs

In the following section the objectives current state are evaluated in table 8, since the objectives are not clearly defined yet, this is currently just a template.

Objective	Current state	Notes	Date

Table 8: Project performance measures needs

A Appendix A

Beumer Crisbag Extension Budget Estimate

Staff						
Role	**Start**	**End**	**Time commitment**	**Salary (hr)**	**Hrs**	**Total cost**
SW Project Manager	01/02/2018	31/12/2018	100%	€ 75,00	1784	€ 133.794,64
Software Architect	01/02/2018	31/12/2018	100%	€ 75,00	1784	€ 133.794,64
Developer	01/02/2018	31/12/2018	100%	€ 75,00	1784	€ 133.794,64
Developer	01/05/2018	31/12/2018	100%	€ 75,00	1307	€ 98.035,71
Developer	01/08/2018	31/12/2018	75%	€ 75,00	611	€ 45.803,57
Electrical Specialist	As needed	As needed	50%	€ 75,00	100	€ 7.500,00
Mechanical Specialist	As needed	As needed	50%	€ 75,00	100	€ 7.500,00
Commissioner	01/06/2018	31/12/2018	100%	€ 75,00	1141	€ 85.580,36
Commissioner	01/08/2018	31/12/2018	100%	€ 75,00	814	€ 61.071,43
Commissioner	01/08/2018	31/12/2018	100%	€ 75,00	814	€ 61.071,43
Total						€ 767.946,43

Mechanical System			
Element	**Cost (Unit)**	**Qty**	**Total cost**
Tote	€ 250,00	20	€ 5.000,00
Transport	€ 2.000,00	120	€ 240.000,00
Curve	€ 2.500,00	25	€ 62.500,00
Divert	€ 6.000,00	8	€ 48.000,00
Merge	€ 5.000,00	8	€ 40.000,00
90-degree Transfer	€ 7.000,00	6	€ 42.000,00
Total			€ 437.500,00

Electrical System (Sub-contractor)			
Element	**Cost (Unit)**	**Qty**	**Total cost**
Main Control Cabinet	€ 500,00	1	€ 500,00
Field Control Cabinet (FCC)	€ 250,00	4	€ 1.000,00
Total			€ 1.500,00

Total Estimate	€ 1.206.946,43

Figure 7: Budget

Bibliography

Books

[1] NASA. **NASA systems engineering handbook**. 2007. URL: https://www.nasa.gov/sites/default/files/atoms/files/nasa_systems_engineering_handbook.pdf (visited on 02/19/2019).