Syscience

System Engineering Science

Concept of Operation

Needs capture and operational analysis

System: G04

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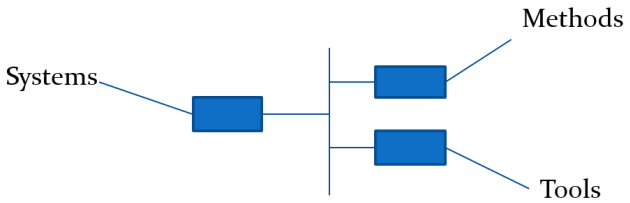

Reference: Syscience R001, V3

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1 Introduction

1.1 Object of the document

The purpose of this document is to establish the operational view of the system. It covers use-case identification, operational scenarios, needs capture and requirements definition.
This document was built using the Syscience Workshop. It was developed by Syscience to support engineers for the deployment of systems engineering.

1.2 References

- IEEE1220 (ISO1220): Standard for Application and Management of the Systems Engineering Process
- IEEE15288 (ISO15288): Systems Engineering - System Life Cycle Processes
- IEEE1471 (ISO1471): Recommended Practice for Architectural Description of Software-Intensive Systems
- EIA 632: Processes for engineering a system
- NASA SEH: NASA Systems Engineering Handbook
- Sys2016: P. Krapf, D. Loise, 2016, MÃ©thode dâ?identification des risques basÃ©e sur les modÃ¨les, 20e congrÃ¨s LambdaMu de maitrise des risques et de sÃ»retÃ© de fonctionnement, Saint-Malo, Octobre 2016.
- Sys2018: P. Krapf, S. Rakotosolofo, S. Berthier, 2018, Use of a system engineering workshop to identify the risks of a connected vehicle, 21e congrÃ¨s LambdaMu de maitrise des risques et de sÃ»retÃ© de fonctionnement, Reims, Octobre 2018.
- Sys2020: S. Berthier, P. Krapf, 2020, Understanding the risks caused by global warming using the System Engineering tool "Lâ?Atelier Syscience", 22e congrÃ¨s LambdaMu de maitrise des risques et de sÃ»retÃ© de fonctionnement, France, Octobre 2020.

1.3 Terminology

1.3.1 Terms

- Diagram: Graphical representation of a view of a system.
- Durability: capacity of the system to keed its desired properties during time.
- The functional needs: what is awaited from the SOI, for which users, and how it should be used.

- Non-functional needs: technical constraints that the SOI must respect (security criteria, number of users, computing power, etc.).
- Lifecycle: Succession of phases characterizing the system evolution, from the elaboration of its concept until its end of life.
- Lifecycle phase: A phase of the lifecycle of a system.
- Regulation: laws, rules or standards, defined by authorities, whose application is mandatory.
- Requirement: Formalized description of some characteristics of a system.
- Scenario: description of what happens to a system in a defined timespan.
- Sequence diagram: diagram representing actors and the succession of actions, events, messages and state changes. Sequence diagrams are used to represent scenarios.
- Stakeholder: Tangible or intangible entity, including persons, organizations, and company departments, likely to express needs, expectations or constraints about the system of interest [IEEE1220] 6.1.1, 6.1.2, 6.1.3.

1.3.2 Acronyms definitions

- COTS: Commercial Off The Shelf
- HMI: Human Machine Interface
- MBSE: Model Based System Engineering
- ppm: part per million
- RBSE: Requirement Based System Engineering
- SaaS: Software as a Service
- SOI: System Of Interest
- SOP: Start of Production
- TGA: Tooling Go Ahead

1.4 Document overview

This document gives an external view of the system of interest as a whole, without details about its internal design, using graphical model views. It defines the requirements that the system of interest shall satisfy.

1.5 Key measures of effectiveness

Key measures of effectiveness reflect the overall satisfaction level of stakeholder expectations [IEEE1220] Â§6.1.5.
The project identifies the technical performance measures (TPMs), which are key indicators of system performance. Selection of TPMs are usually limited to critical characteristics that, if not met, put the project at cost, schedule, or performance risk. Specific TPM activities are integrated into the project report to periodically determine achievement to date and to measure progress against a planned value profile [IEEE1220] Â§6.1.13.
List of KPI to monitor:

- Percentage of lifecycle phases without identified stakeholder expectation
- Number of expectations without link to system requirements
- Number of system requirements without link to stakeholder expectation

2 Lifecycle

2.1 Overall lifecycle

Utilization phase is an important phase of the project, but other phases should not be underestimated. A system that is too difficult to produce or too expensive is a waste of time and money. A system that cannot be maintained will not satisfy users for a long period of time. It is thus worth to define the whole lifecycle and to go through all phases to identify stakeholders. The system lifecycle is adapted from the standard [IEEE15288].

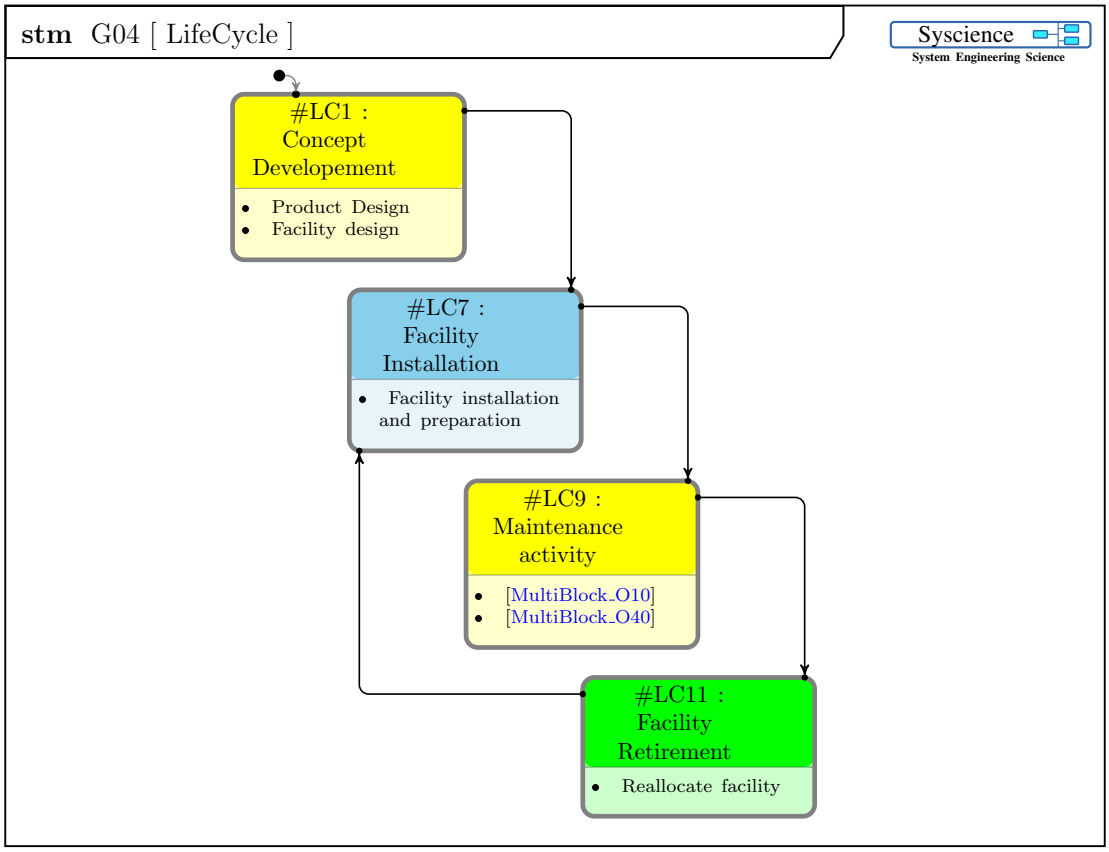

Figure 1: **State_LifeCycle**

3 Stakeholder needs

3.1 Stakeholders

External elements interact with the system of interest and exchange data, energy or matter with it.

Stakeholders express needs and expectations for one or even several lifecycle phases. They can be individuals or organisations (enterprise departments, associations, etc.). The following diagram gives a synthetic view of the system stakeholders and corresponding needs exression. Hyperlinks give connections to the detailed needs.

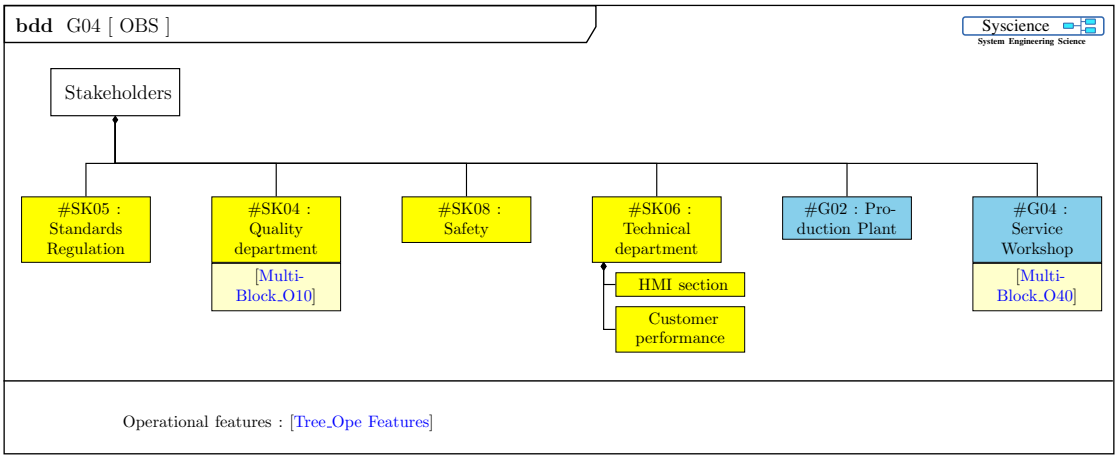

Figure 2: **Tree_OBS**

3.2 Method

Some needs and expectations concerning the SOI are written in specifications or in standards. These documents have to be analyzed in order to identify these needs and to define how the SOI will answer them. Sometimes needs and expectations are not formalized, and thus, it is necessary to capture them by interviewing stakeholders. This activity can be broken down into the following steps:

- Identify the stakeholders that are likely to write formalized documents and the ones that have unformal expectations
- Organize and carry out interviews with each stakeholder
- Collect the documents
- Identify the expectations concerning the SOI
- Review requirements with stakeholders in order to validate them.

3.3 User requirements

User requirements are written from the user point of view. They describe the problem the user is facing and are independant form the solution the system will deploy.
Visual diagrams have been used to capture and represent needs about the system of interest. This approach is referred to as model based system engineering. Requirements based system engineering refers to an approach in which requirements about the system of interest are managed as textual requirements. These both aprroaches complement each other: while MBSE is useful to check completeness of needs capture, RBSE allows to state

clearly the engagement of the system owner. System requirements define unambiguously what has to be tested, while visual diagrams do not always distinguish the system engagement and informative description of the environment.
Each requirement shall be:

- Specific: the requirement is a usefull description of a system feature. Something would be missing if the requirement is not satisfied.
- Measurable: a measurement action (a test or a process check) can be defined to decide wheather a given system satisfies the requirement or not.
- Attainable: the defined target shall not be unreachable. The target is defined to be attained.
- Realistic: requirements are coherent with the state of the art.
- Traceable: it is possible to identify why this requirement has been defined, and which needs it satisfies.

3.3.1 Customer performance

Customer performance requirement define the user expectations about the system. Corresponding system requirements are listed in this paragraph.

Figure 3:

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3.3.2 Durability

Durability requirement define the system mission profile and the ability of the system to maintain its characteristics during the lifecycle depending on mission profile. Corresponding system requirements are listed in this paragraph.

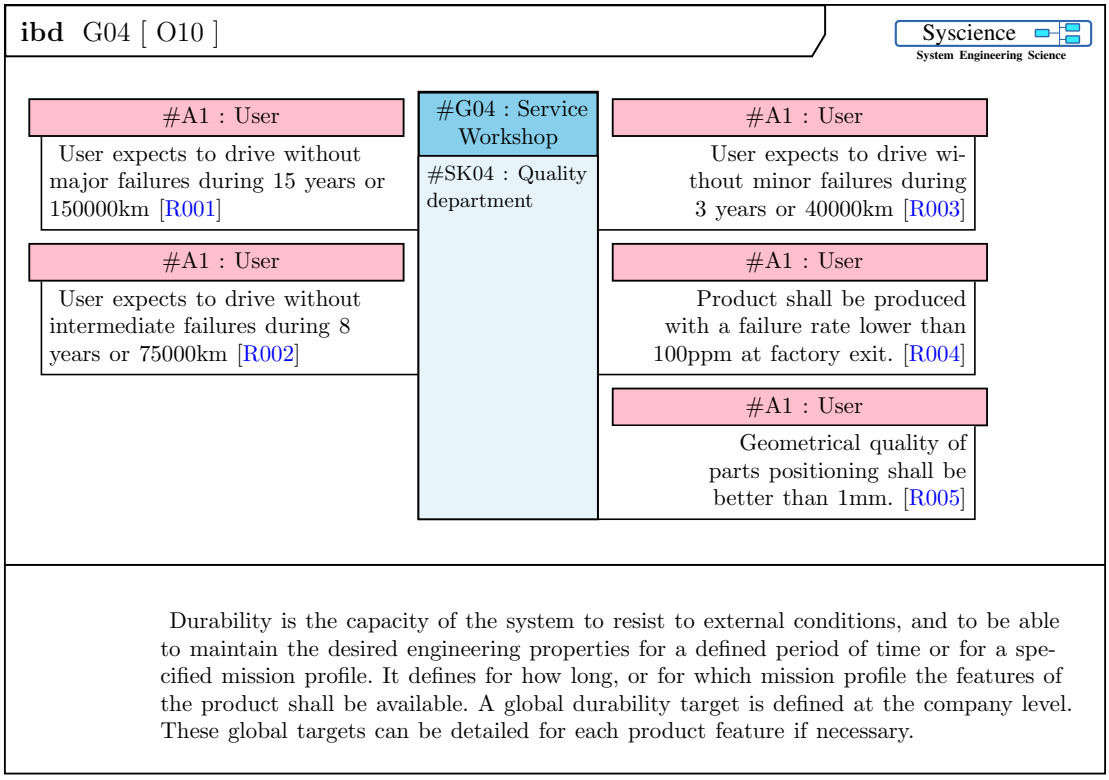

Figure 4: **MultiBlock_O10**

This figure was cited in State_LifeCycle, Tree_OBS.

Requirement identifier	MultiBlock_O10 R001
Requirement Text	User expects to drive without major failures during 15 years or 150000km
Diagram	MultiBlock_O10
Id	R001
Link	[G01:MultiBlock_O10 R001]
Type	Stakeholder Need

Table 1: **MultiBlock_O10 R001**, cited in the figure MultiBlock_O10

Requirement identifier	MultiBlock_O10 R002
Requirement Text	User expects to drive without intermediate failures during 8 years or 75000km
Diagram	MultiBlock_O10
Id	R002
Link	[G01:MultiBlock_O10 R002]
Type	Stakeholder Need

Table 2: **MultiBlock_O10 R002**, cited in the figure MultiBlock_O10

Requirement identifier	MultiBlock_O10 R003
Requirement Text	User expects to drive without minor failures during 3 years or 40000km
Diagram	MultiBlock_O10
Id	R003
Link	[G01:MultiBlock_O10 R003]
Type	Stakeholder Need

Table 3: **MultiBlock_O10 R003**, cited in the figure MultiBlock_O10

Requirement identifier	MultiBlock_O10 R004
Requirement Text	Product shall be produced with a failure rate lower than 100ppm at factory exit.
Diagram	MultiBlock_O10
Id	R004
Link	[G01:MultiBlock_O10 R004]
Type	Stakeholder Need

Table 4: **MultiBlock_O10 R004**, cited in the figure MultiBlock_O10

Requirement identifier	MultiBlock_O10 R005
Requirement Text	Geometrical quality of parts positioning shall be better than 1mm.
Diagram	MultiBlock_O10
Id	R005
Link	[G01:MultiBlock_O10 R005]
Type	Stakeholder Need

Table 5: **MultiBlock_O10 R005**, cited in the figure MultiBlock_O10

3.3.3 Assembling constraints

Assembling contraints requirements describe the system engagement concerning assembling needs and expectations. Corresponding system requirements are listed in this paragraph.

Figure 5:

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3.3.4 Regulation requirements

Regulation requirements describe system engagement concerning the compliance with regulations and standards. Corresponding system requirements are listed in this paragraph.

Figure 6:

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3.3.5 Maintenance constraints

Maintenance contraints requirements describe the system engagement concerning maintenance and repairing needs and expectations. Corresponding system requirements are listed in this paragraph.

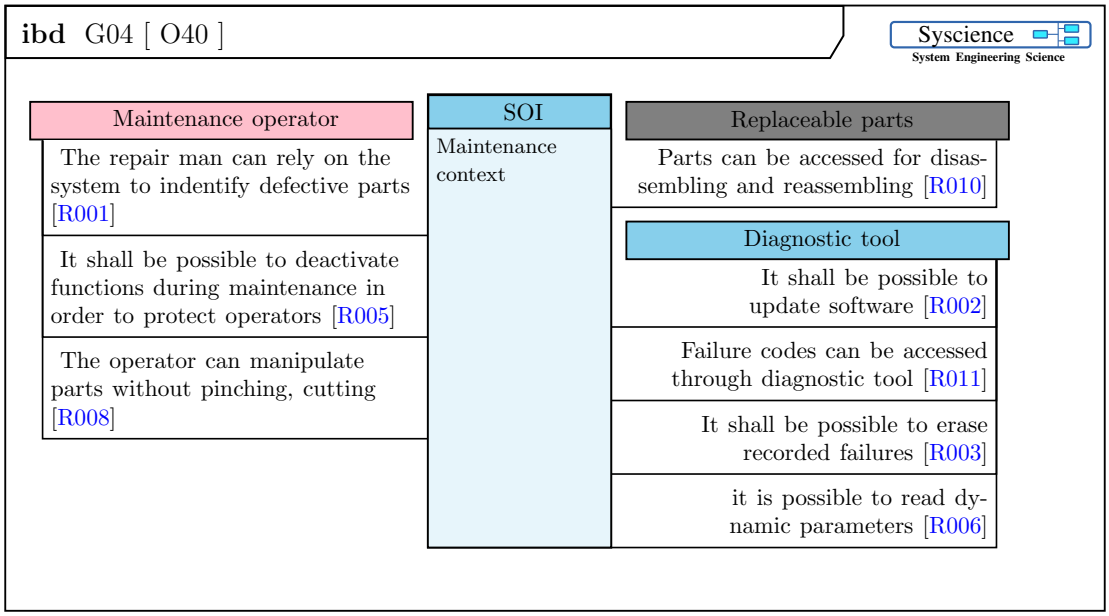

Figure 7: **MultiBlock_O40**

This figure was cited in State_LifeCycle, Tree_OBS.

Requirement identifier	MultiBlock_O40 R001
Requirement Text	The repair man can rely on the system to indentify defective parts.
Diagram	MultiBlock_O40
Id	R001
Link	Design rules
Type	Stakeholder Need

Table 6: **MultiBlock_O40 R001**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R005
Requirement Text	It shall be possible to deactivate functions during maintenance in order to protect operators.
Diagram	MultiBlock_O40
Id	R005
Link	Design rules
Type	Stakeholder Need

Table 7: **MultiBlock_O40 R005**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R008
Requirement Text	The operator can manipulate parts without pinching, cutting .
Diagram	MultiBlock_O40
Id	R008
Link	Design rules
Type	Stakeholder Need

Table 8: **MultiBlock_O40 R008**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R010
Requirement Text	Parts can be accessed for disassembling and reassembling.
Diagram	MultiBlock_O40
Id	R010
Link	Design rules
Type	Stakeholder Need

Table 9: **MultiBlock_O40 R010**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R002
Requirement Text	It shall be possible to update software.
Diagram	MultiBlock_O40
Id	R002
Link	Design rules
Type	Stakeholder Need

Table 10: **MultiBlock_O40 R002**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R011
Requirement Text	Failure codes can be accessed through diagnostic tool.
Diagram	MultiBlock_O40
Id	R011
Link	Design rules
Type	Stakeholder Need

Table 11: **MultiBlock_O40 R011**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R003
Requirement Text	It shall be possible to erase recorded failures.
Diagram	MultiBlock_O40
Id	R003
Link	Design rules
Type	Stakeholder Need

Table 12: **MultiBlock_O40 R003**, cited in the figure MultiBlock_O40

Requirement identifier	MultiBlock_O40 R006
Requirement Text	it is possible to read dynamic parameters.
Diagram	MultiBlock_O40
Id	R006
Link	Design rules
Type	Stakeholder Need

Table 13: **MultiBlock_O40 R006**, cited in the figure MultiBlock_O40

3.3.6 Safety constraints

Safety contraints requirements describe the system engagement concerning technical characteristics that impact user safety, external peaople safety or environmental safety. Corresponding system requirements are listed in this paragraph.

Figure 8:

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3.3.7 Recycling constraints

Recycling contraints requirements describe the system engagement concerning the end of life of the system, and needs and expectations concerning recycling and reuse. Corresponding system requirements are listed in this paragraph.

Figure 9:

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3.3.8 HMI requirements

HMI requirements define the characteristics of the system HMI. Corresponding system requirements are listed in this paragraph.

Figure 10:

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