Introduction to:

ASD/AIA
S3000L
Logistic Support Analysis

Main goals of the introduction

- Understand the **LSA process** as a crucial element of the development process of complex technical products
- Position and importance of the LSA process within the environment of **Integrated Logistic Support (ILS)**
- Understand the **relations** of the technical and logistic disciplines among themselves
- Knowledge of the **ASD/AIA Specification Suite** and the related specifications

- Overview of LSA specification **ASD/AIA S3000L**
- Introduction to the specification **chapters**
- Overview of **supporting specifications** and of the S3000L **data model**

Introduction to ASD/AIA S3000L

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- Introduction to Logistic Support Analysis
- The ASD/AIA Specification Suite

- S3000L - Content overview
- S3000L - Chapter overview (selected chapters)
- S3000L - Data model and data exchange (DEXs)
- S1003X - Data exchange to Technical Publication (S1000D)

Challenge of supportability

Cost optimized maintenance concept for long-living and complex technical products

- **Repairs**
- **Maintenance**
- **Overhaul and services**
- **Upgrades**
- **Operation**

Each long-living and technical complex product requires an **optimized support system** to guarantee operation and corrective/preventive maintenance **within adequate costs**.

Importance of logistic support (1)

Excerpt from NATO Acquisition Logistics Workshop 1993

„Because of the dramatic increase of support costs we have to consider the **logistic requirements** for reliability, maintainability and in service costs in the same way and **on the same level** as the **operational, technical and economical** requirements“.

Importance of logistic support (2)

Definition of Integrated Logistic Support (ILS) [1)]

ILS is „basically a **management function** that provides the initial planning, funding and the controls which help to assure that the ultimate user will receive a system **that will not only meet performance requirements,** but one that can expeditiously and economically supported throughout its programmed life cycle“.

„An aircraft only has to be bought
once,
but it has to be maintained
every day“

[1)] Benjamin S. Blanchard „Logistics Engineering and Management“

The basic questions concerning a maintenance task

A simple approach to a complex problem

What has to be analyzed (in a nutshell)?

- **Who**
  repairs, maintains, inspects, …?
- **What**
  equipments, components, systems, … are concerned?
- **Why**
  what is the justifying event for the maintenance task?
- **Which**
  ressources are required?
- **Where**
  do you perform the maintenance task (maintenance level and location)?
- **How**
  do you perform the maintenance task?

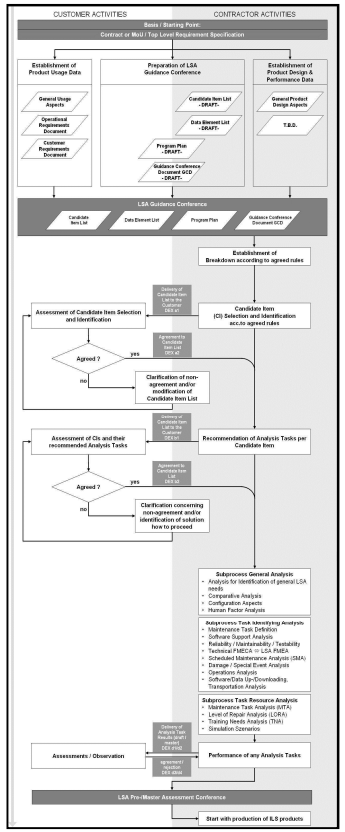
Definitions (1)

LSA - Logistic Support Analysis

Logistic Support Analysis (LSA) is an extended **process** to analyze carefully all elements of a complex technical system **to guarantee optimal logistic support** during the in service phase.

Three main working aims can be identified:

- **Influence on design** to optimize the technical system
- **Optimization** of the logistic resources
- Establishment of the **basic information** for the subordinated logistic disciplines



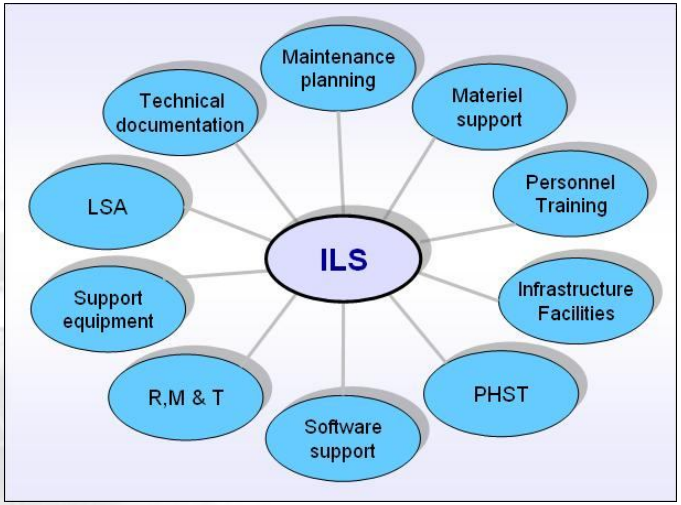
LSA is **not** to be considered an own logistic discipline
(e.g. like technical documentation, materiel support or training)

Definitions (2)

ILS - Integrated Logistic Support

Integrated Logistic Support (ILS) is a **management method** to integrate all elements of logistic support **during all phases** of product life cycle. The results of technical logistic analysis activities must be the basis for the implementation of an **optimized logistic support environment**. The following disciplines have to co-operate closely:

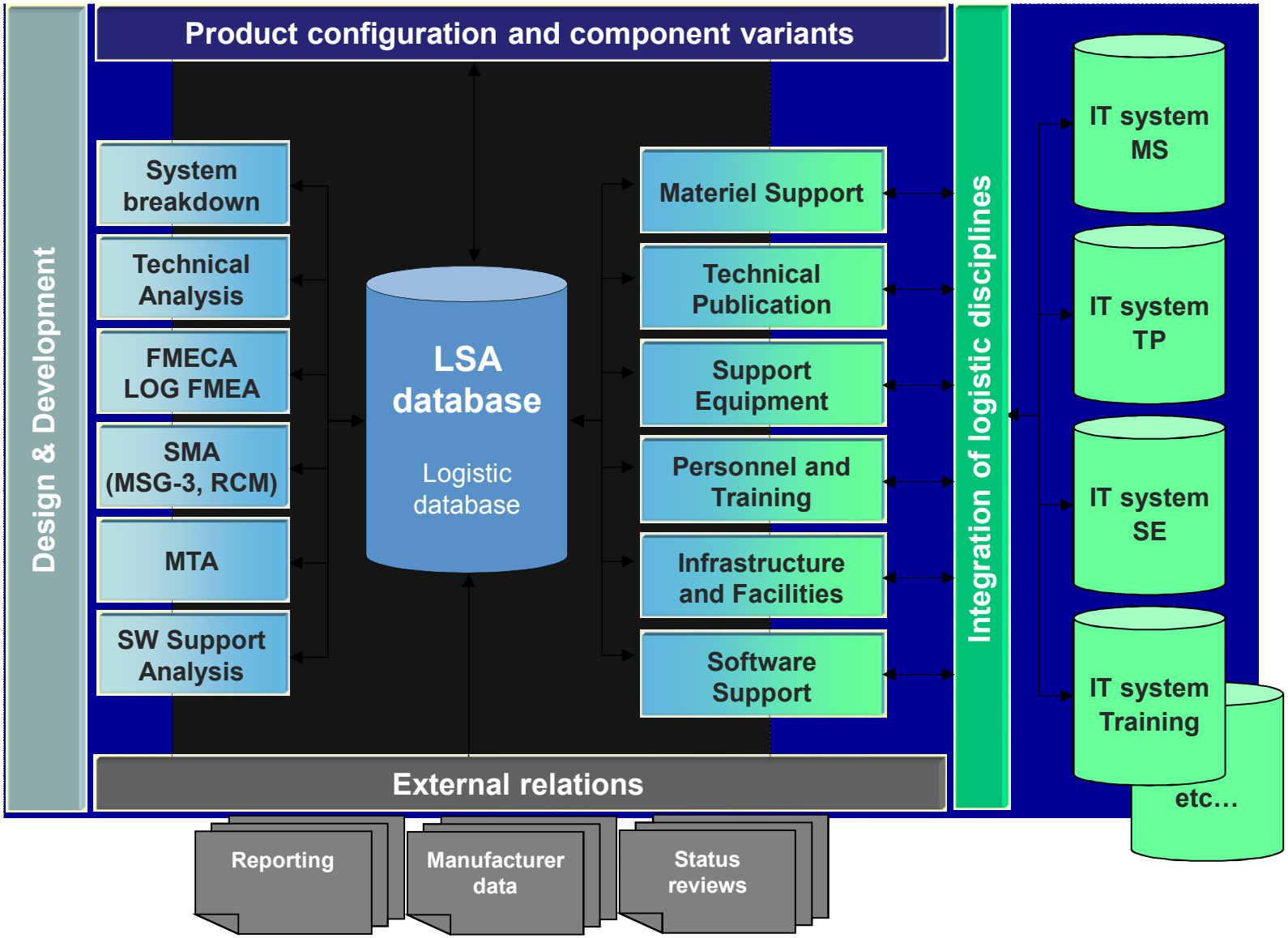
- Support engineering
  (RMT - Reliability, Maintainability, Testability)
- Materiel support
- Technical documentation
- Support and test equipment
- Personnel and training requirements
- Infrastructur and facilites
- Software support



The **LSA process**
is the central
management tool
to meet the target of **ILS**

Integrated Logistic Support

Schematic overview of impacted elements



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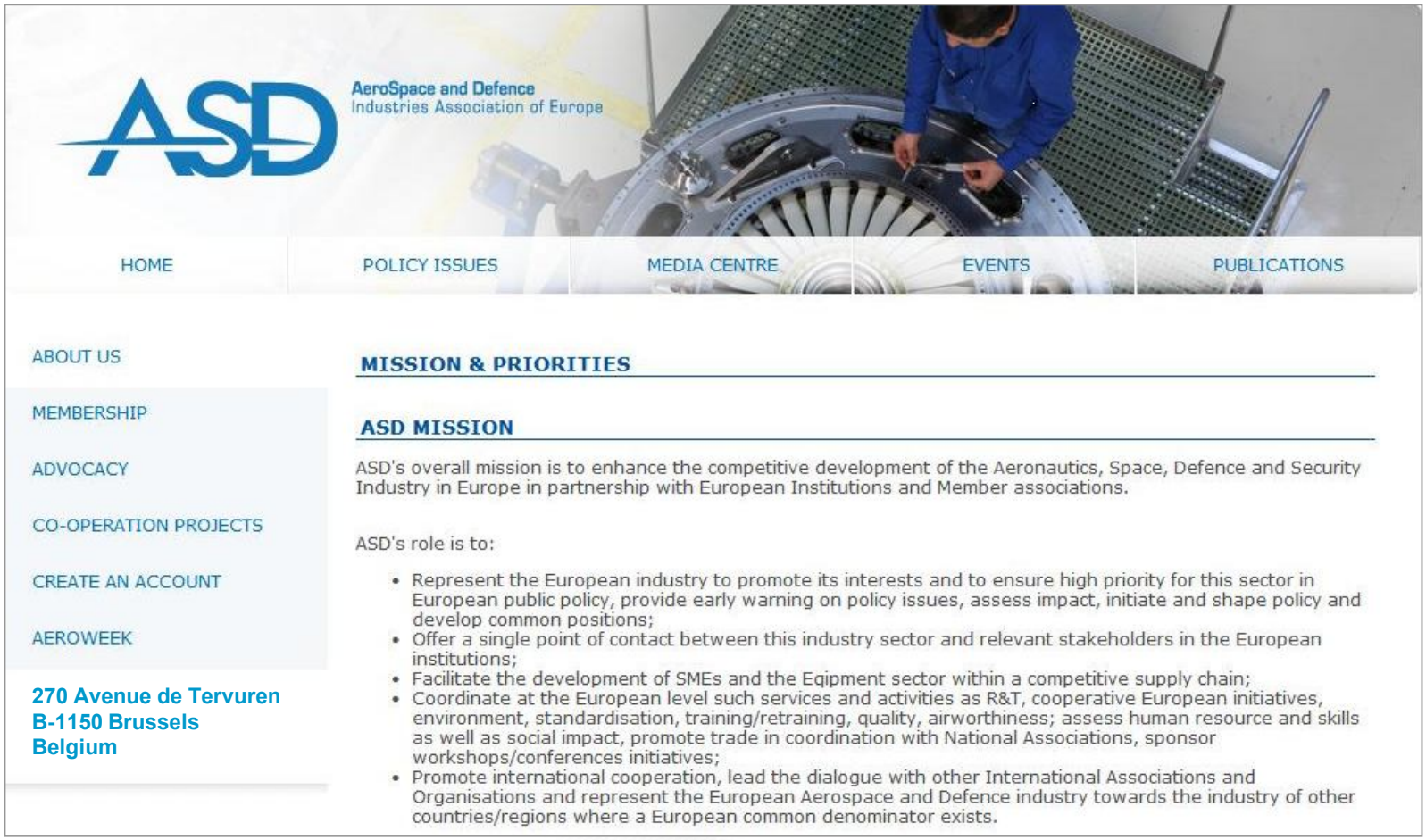
Organizations (1)

ASD - AeroSpace and Defence Industries Association of Europe

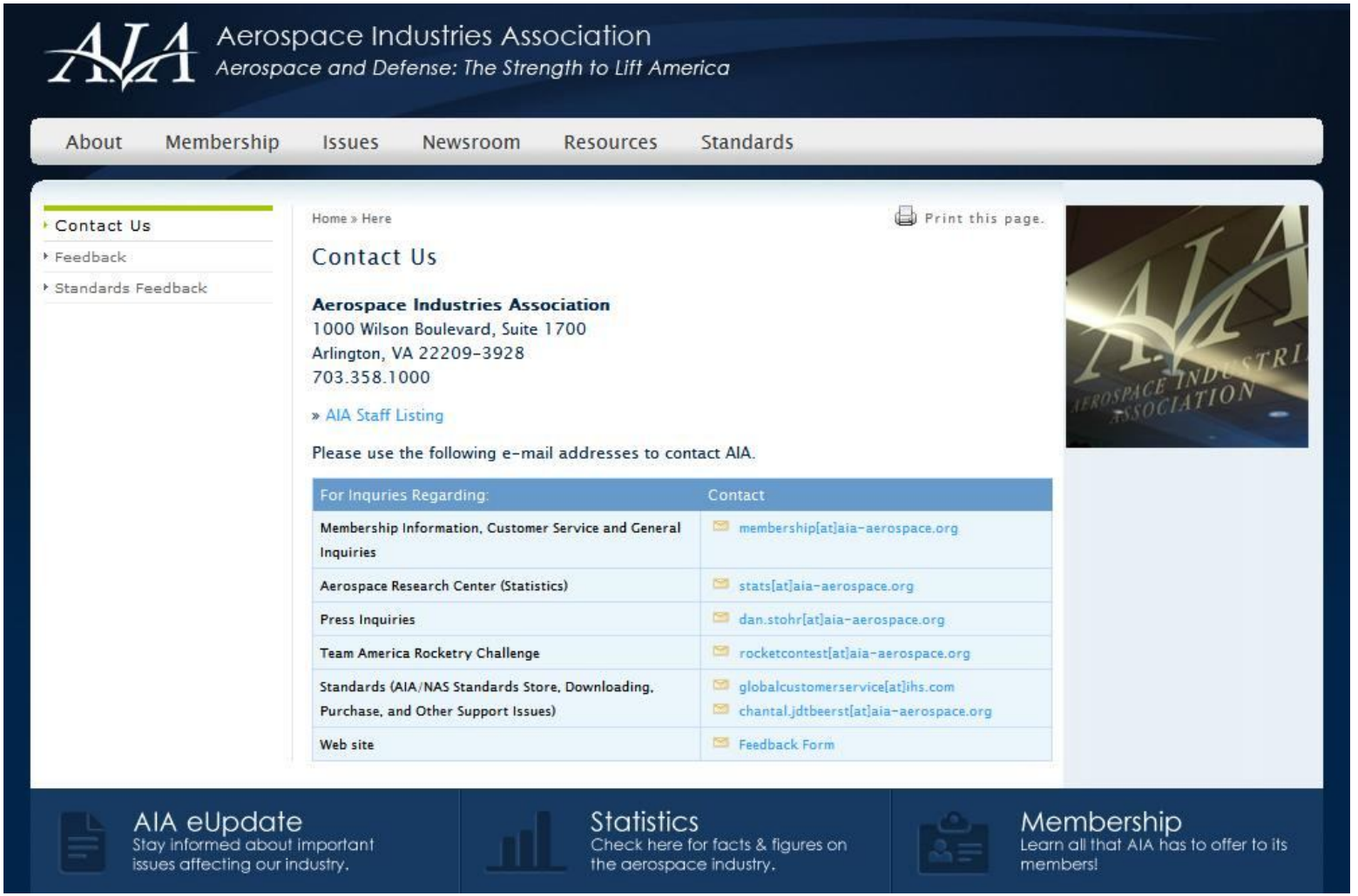
http://www.asd-europe.org



Organizations (2)

AIA - Aerospace Industries Association

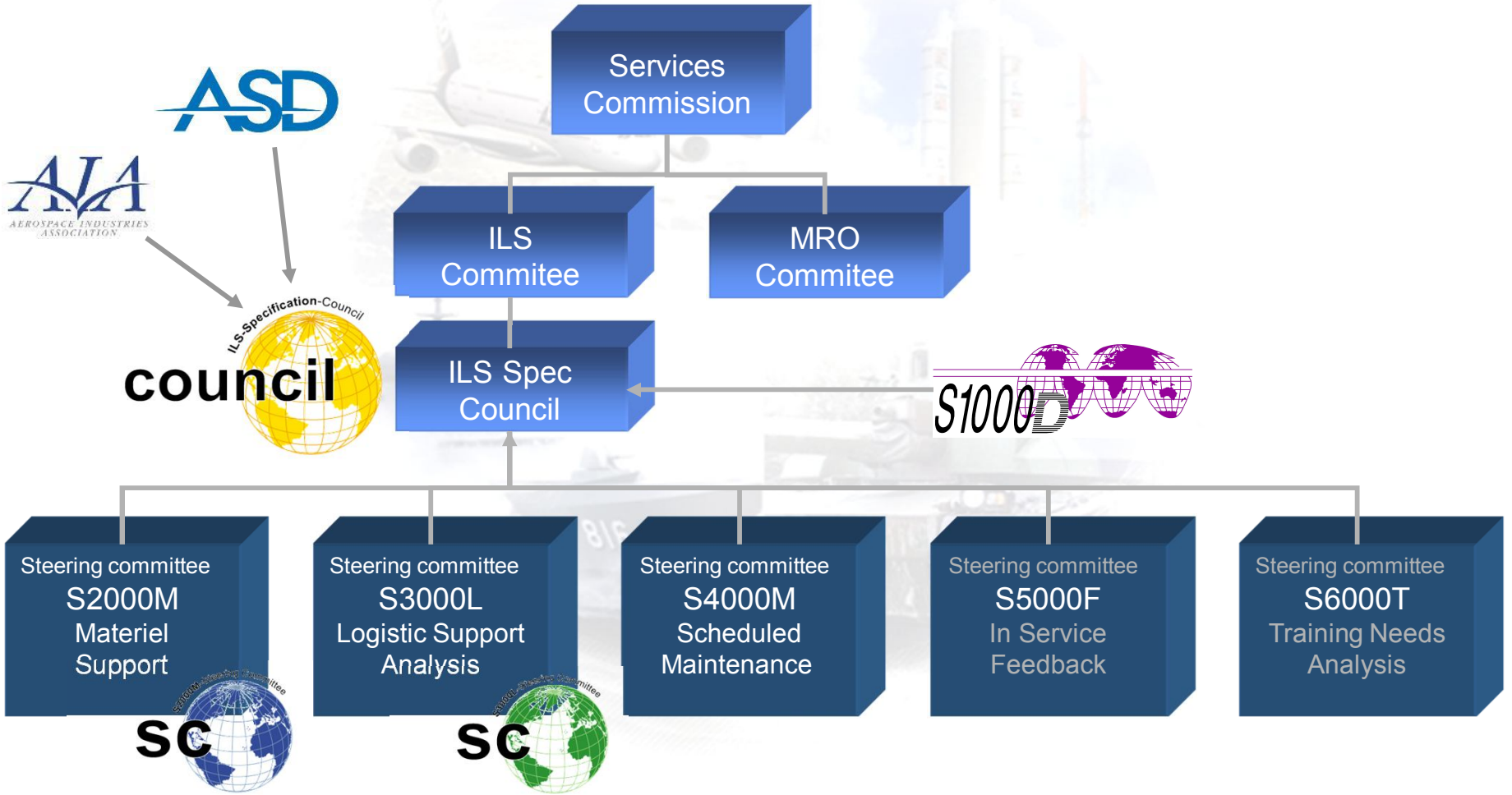
http://www.aia-aerospace.org/



Organizations (3)

ILS Specification Council and Specification Steering Committees

Structure of the **Aftermarket Commission**



ASD Specification Suite

Specifications of the first and second generation

1.Generation

International specification for technical publications utilizing a common source database

International specification for material management

STE100
Simplified Technical English

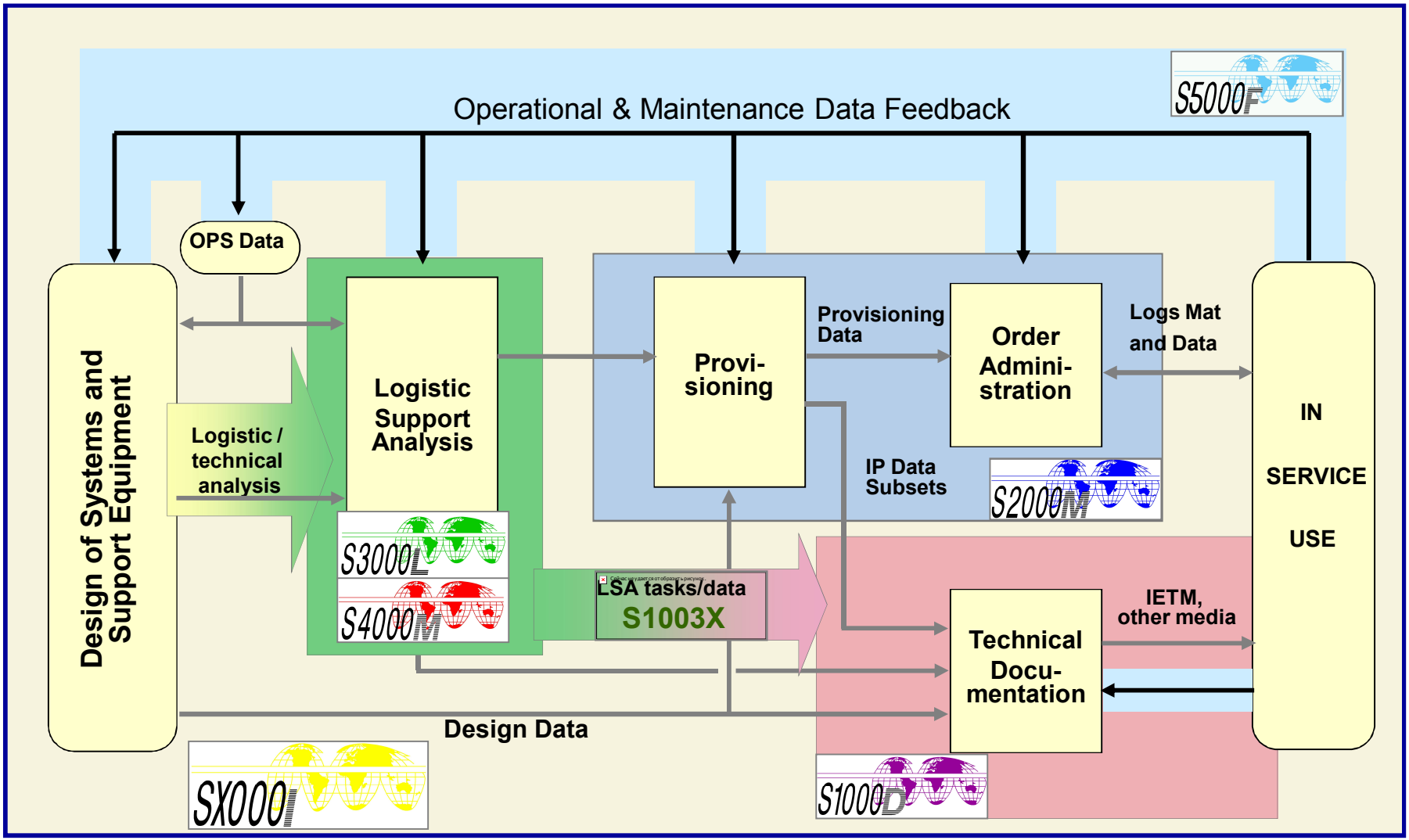
2.Generation

International procedure specification for Logistics Support Analysis

International procedure handbook for the development of scheduled maintenance programs

ASD Specification Suite

NATO Acquisition Logistics Workshop, Brussels 1993 - a source for S3000L



AS/AIA S3000L - why a new LSA Specification?

Situation of LSA Standards in USA

MIL-STD 1388-1A	Description of the aquisition process of military equipment
MIL-STD 1388-2A	(data definitions based on punch card technology)
MIL-STD 1388-2B	(data definitions based on table structures)

Cancelled Cancelled

MIL-HDBK 502	Aquisition Logistics (replacement of MIL-STD 1388-1A)
MIL-PRF 49506	Logistics Management Information (data definitions of MIL-HDBK 502)

GEIA 0007 — **Logistics Product Data**

Data definitions based on table structures similar to MIL-STD 1388-2B, data exchange based on XML technology,

replacement of MIL-STD 1388-2B

GEIA

Government Electronics Information Technology Association

AS/AIA S3000L - why a new LSA Specification?

Situation of LSA Standards in Europe

DEF-STAN 00-60
www.dstan.mod.uk

UK ILS Standard (integrates LSA according to MIL-STD 1388, ASD S1000D and ASD S2000M)

Part 0: Application of ILS
Part 1: Logistic Support Analysis
Part 10: Electronic Technical Documentation
Part 20: Supply Support

Superseded Superseded

ASD/AIA Specification Suite *

ASD S1000D		Technical Documentation
ASD S2000M		Materiel Support
ASD S3000L		Logistic Support Analysis, published 06/2009
ASD S4000M		Scheduled Maintenance Analysis, published 06/2009
ASD S5000F		In Service Feedback (end of 2011)

*(extended by STE100, ASD SX000I, ASD S6000T, ASD S9000D, ASD S1003X, ..)

Summary

ASD/AIA Specification Suite

The ASD/AIA Specification Suite offers a **powerful toolset** to establish a proper ILS process within the acquisition process of complex technical products.

Most of the core specifications are developed and maintained by international experts **under the umbrella of international organizations** (ASD, AIA, ATA).

S3000L and **S4000M** are an appropriate extension of the existing **S1000D** and **S2000M**

Future developments will **extend the capabilities** of ASD/AIA specifications in the area of Integrated Logistic Support and will **harmonize the existing specifications** continuously

- Introduction to Logistic Support Analysis
- The ASD/AIA Specification Suite

- **S3000L - Content overview**
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Purpose of ASD/AIA S3000L

from chapter 1

The **Logistic Support Analysis (LSA)** is one of the most important **processes** in the scope of product supportability.

It is the principal tool:

- to design products relevant to **maintainability**, **reliability**, **testability requirements** and to optimize life cycle costs
- to **define all required resources** to support the product in its intended use during in-service operation

S3000L defines the **processes**, **general requirements** and related **information exchange** governing the performance of the LSA during the life cycle of aerospace and defence products. This specification may also be used for complex technical products from other industrial domains.

Scope of ASD/AIA S3000L

from chapter 1

S3000L is designed to cover all processes and requirements governing the performance of the LSA process:

- It provides rules for the **establishment of the product breakdown** and for the **selection of LSA candidate items**.
- It describes type and methodology of **performance of the specified analyses**.
- It gives guidelines on **how to process the results of the analysis tasks**
- Interface between **industry (contractor)** and **customer**
- It covers the interface between LSA and the **support engineering areas**
- It covers the interface between LSA and the **ILS functional areas**

ASD/AIA S3000L

The main chapters (1)

Nr	Chapter	Responsible
01	Introduction	EADS MAS
02	General Requirements	BOEING
03	LSA Business Process	EADS MAS
04	Configuration Management	EADS CASA
05	Influence on Design / RMT Interface	SAAB
06	Human Factors Analysis	BOEING / EADS MAS
07	LSA FMEA	EUROCOPTER
08	Damage and Event Analysis	DASSAULT
09	Logistics Related Operations Analysis	EADS MAS
10	Scheduled Maintenance Analysis	EADS MAS
11	Level of Repair Analysis	LOGSA
12	Maintenance Task Analysis	EADS MAS

ASD/AIA S3000L

The main chapters (2)

Nr	Chapter	Responsible
13	Software Support Analysis	EADS MAS
14	Life Cycle Costs Considerations	EADS CASA
15	Obsolescence Analysis	OCCAR
16	In Service Feedback	BOEING
17	Disposal	DASSAULT
18	Interrelation to other ASD Standards	EADS-MAS / MTDTT
19	Data Model	SAAB
20	Data Exchange	SAAB
21	Terms, definitions and abbreviations	AGUSTA WESTLAND
22	Data element dictionary	AGUSTA WESTLAND

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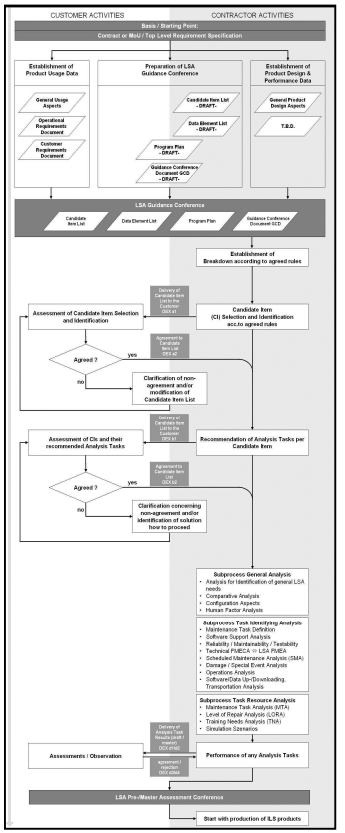
Chapter 3 - LSA Business process

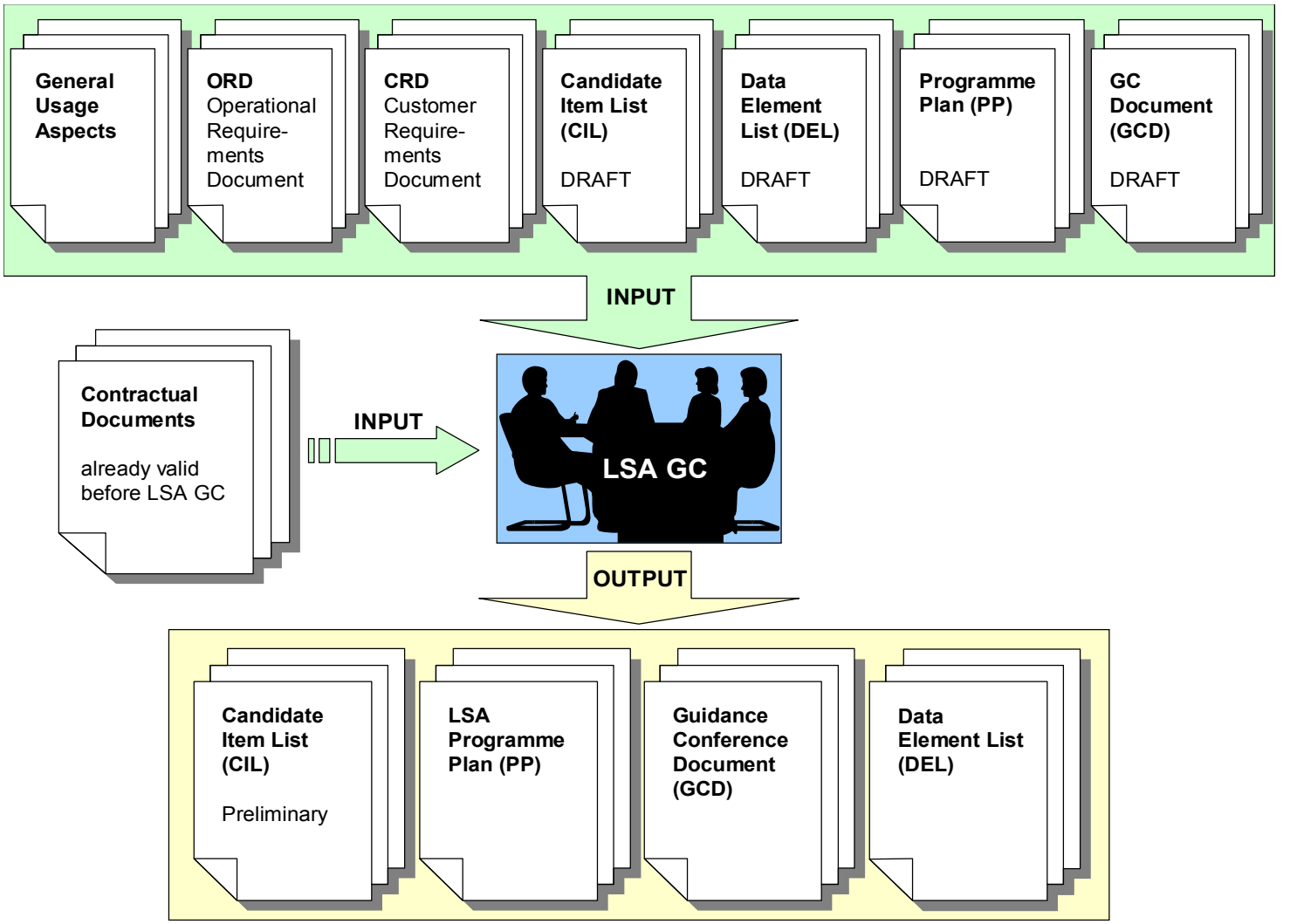
Subchapters

- Introduction
- Establishment of **Product Usage Data**
- Establishment of **Product Design & Performance Data**
- **LSA Guidance Conference**
- Establishment of **Breakdown** according to agreed rules
- **Candidate Item** Selection and Identification
- **Analysis Tasks** for Candidate Items
- **Customer Involvement**
- **LSA Review** / Assessment Conference
- Starting Point / **Interface to creation of ILS Products**
- Checklists



Chapter 3 - LSA Business process

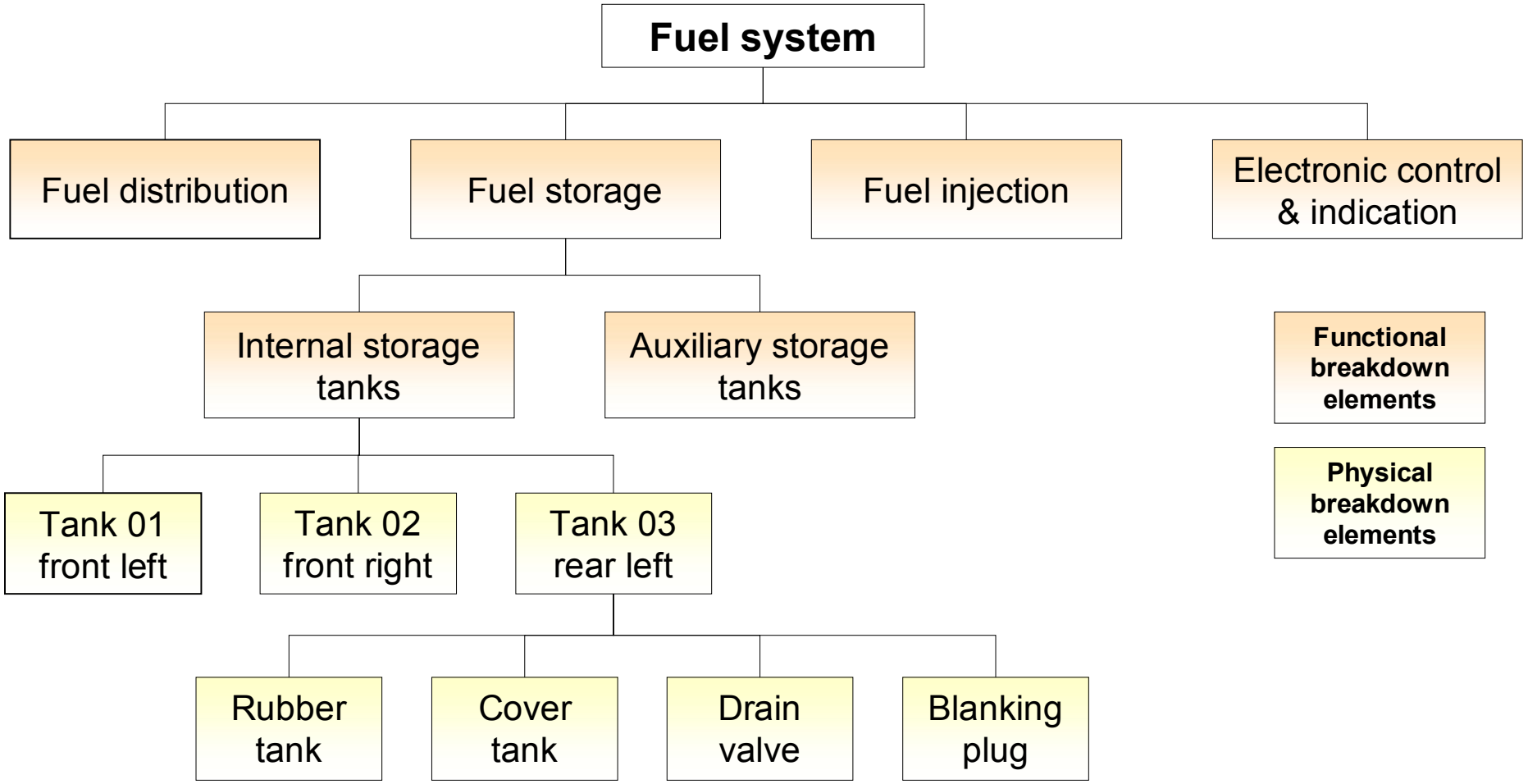
LSA Guidance Conference

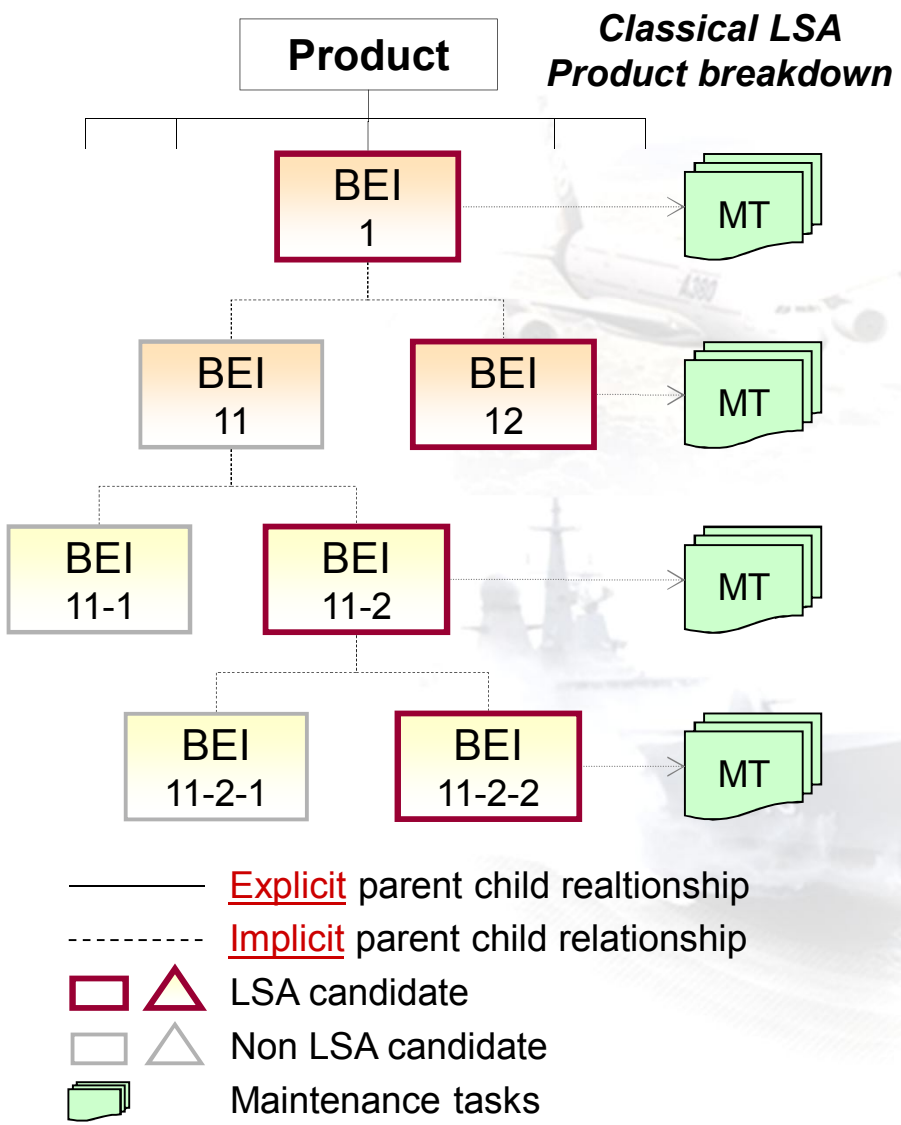


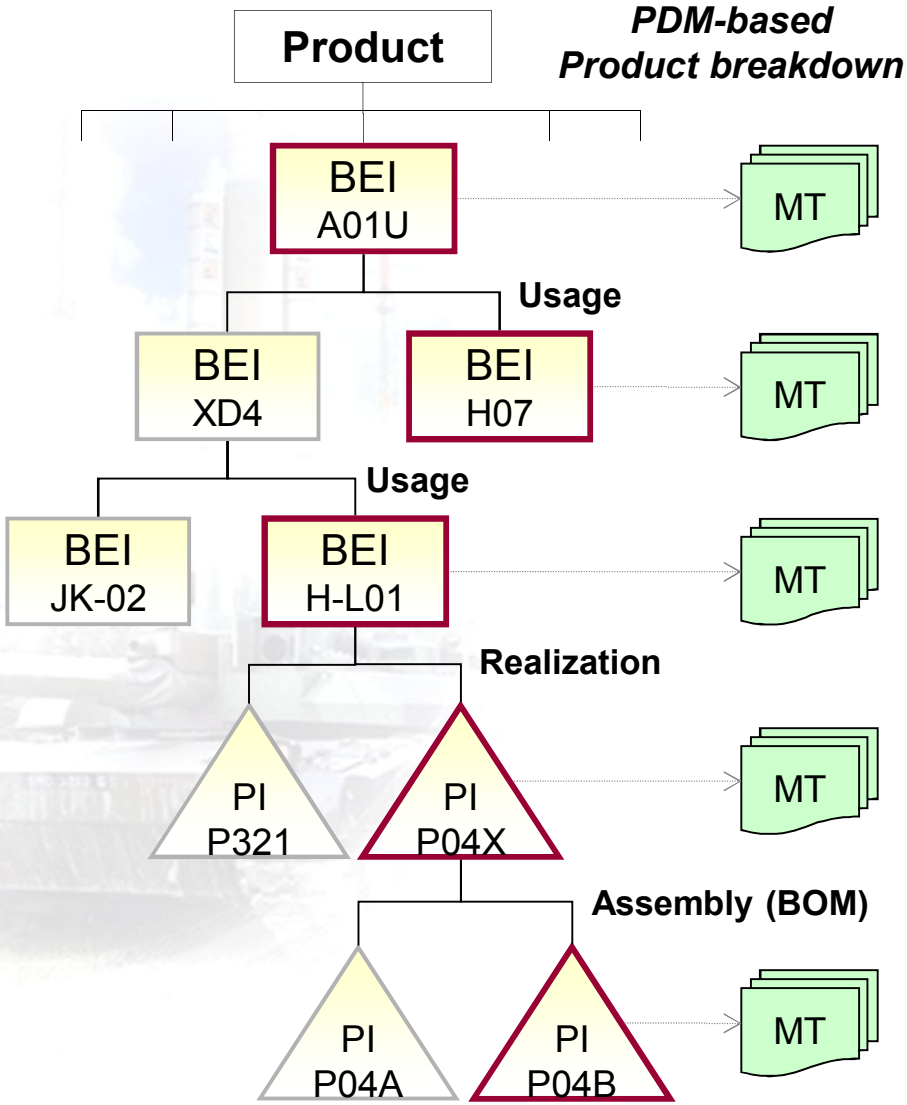
A systematical breakdown of the product, which is subject to an LSA process, is **essential** with respect to the following aspects:

- To provide a clear understanding of **how the product is structured** (physically and functionally) concerning its systems, subsystems, functions, hardware and software components, …
- To provide a **clear relation** of the **Item under Analysis (IuA) and its hardware components** included any contained software as far as applicable
- To enable the allocation of **key addresses for IT purposes**
- To enable the establishing of a **variant and configuration management**

Product breakdown - Mixture of physical and functional breakdown

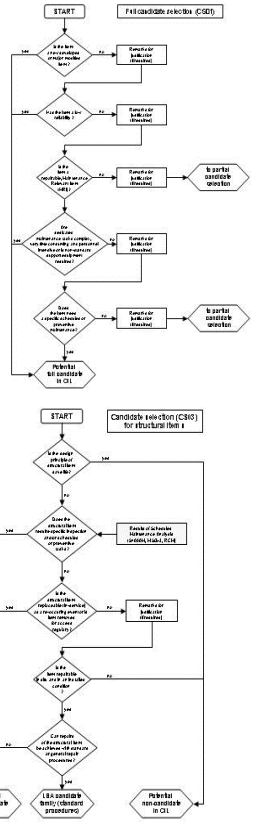



Product
Classical LSA
Product breakdown
BEI
1
MT
BEI
11
BEI
12
MT
BEI
11-1
BEI
11-2
MT
BEI
11-2-1
BEI
11-2-2
MT
Explicit parent child realtionship
Implicit parent child relationship
LSA candidate
Non LSA candidate
Maintenance tasks


Product
PDM-based
Product breakdown
BEI
A01U
MT
Usage
BEI
XD4
BEI
H07
MT
Usage
BEI
JK-02
BEI
H-L01
MT
Realization
PI
P321
PI
P04X
MT
Assembly (BOM)
PI
P04A
PI
P04B
MT

The LSA candidate is the driver of all LSA activities.

A potential LSA candidate in general can be **any item** on system, subsystem, equipment, module or sub module level, which is **repairable**, which **requires maintenance or operational support** in any **scheduled** or **unscheduled** way.



Categories of LSA candidates:

- **Full** LSA candidate
- **Partial** LSA candidate
- LSA candidate **families**
- LSA candidates for **standard procedures**

- Analysis for identification of general LSA needs
- Comparative Analysis
- Human Factors Analysis
- Logistic Product breakdown and Product configuration
- RAMTS (Reliability, Availability, Maintainability, Testability and Safety Analysis)

- LSA FMEA (Logistic FMEA)
- Damage Analysis
- Special Event Analysis
- Scheduled Maintenance Analysis (S4000M, MSG-3, RCM)
- Operations Analysis (PHST)

tasks triggered by events or by operational needs

- Software Support Analysis (SSA)
- Level of Repair Analysis (LORA)
- Maintenance Task Analysis (MTA) ⇨ Task requirements

- Simulation of operational scenarios
- Training Needs Analysis (TNA)

The **starting point** for the creation of the logistic products is dependent on several factors, including technical documentation and an illustrated spare part catalogue availability. In this context, ILS products to be considered, include:

- **Technical documentation**
- **Materiel support (illustrated spare part catalogue)**
- **General and special support equipment**
- **Training**

Timely creation of the ILS products must be supported by LSA status information. Triggering of the logistic disciplines should be carried out by the support engineering department to ensure a proper starting.

It must be avoided to create unnecessary effort in any logistic discipline, like:

- Creation of technical documentation for maintenance tasks, which are never carried out at customer operational site.
- Documentation of spare parts or consumables, which are never required at customer operational site.
- Starting of development or procurement of special tools, which are never required at customer operational site.
- Planning of training for maintenance tasks, which are never carried out at customer operational site.

- Description of the **relationship** between human factors and the logistic support analysis process.
- Human factors analysis provides source data which must be used within the LSA activities to determine **maintenance crew** and **support equipment requirements**
- Limitations because of human factors influence the establishment of the **support environment** as well as the **design of the product** itself

Human ability is influenced by **physical constraints** and **limitations**.

- **Anthropometric** aspects
- **Ergonomic** aspects
- Other **physiological** aspects

LSA has to take into account these human aspects **to evaluate proper support solutions** or **to influence design** accordingly.

Human physical ability - some examples

- **Lines of sight** (vertical and horizontal visual fields)
- **Muscle strength** of arms, hands and thumb
  - Required muscle strength for **vertical pull extension**
  - Required muscle strength for **horizontal push and pull** movements
- **Maximum weight** of units to be lifted
- Arm and hand **access dimensions**

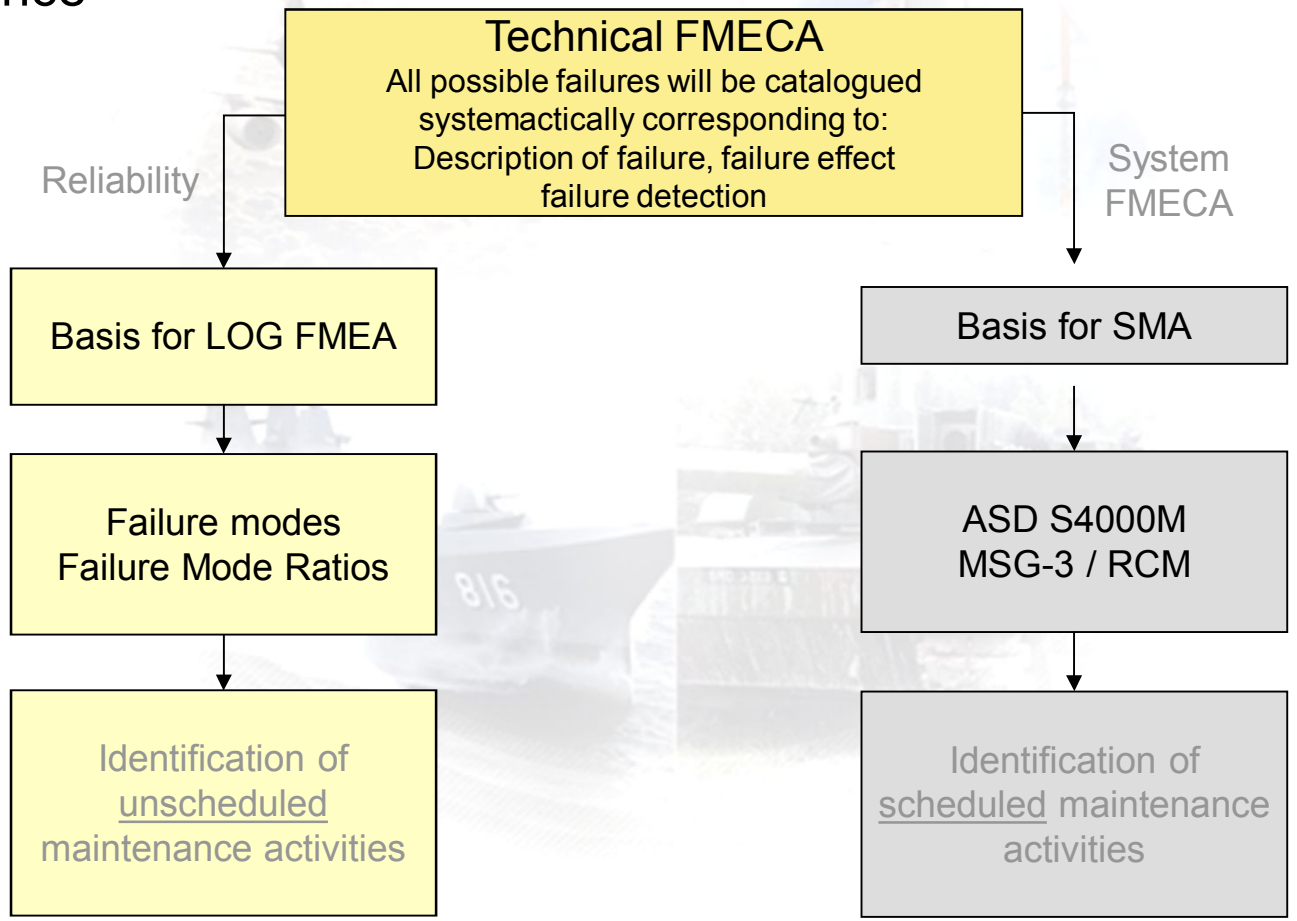
Working under **unpleasant** conditions or the handling of **dangerous** material or material which is **hazardous to health** must follow strict regulations to ensure physical integrity.

- Very **cold, hot or humid** environment
- Working **underground** or **underwater**
- Critical environment because of eg **dust**, exposure to **fumes**, **noise**
- Handling of **hazardous chemicals** or **radioactive** material

In general, maintenance activities are driven by **maintenance relevant events**. These events can be the following:

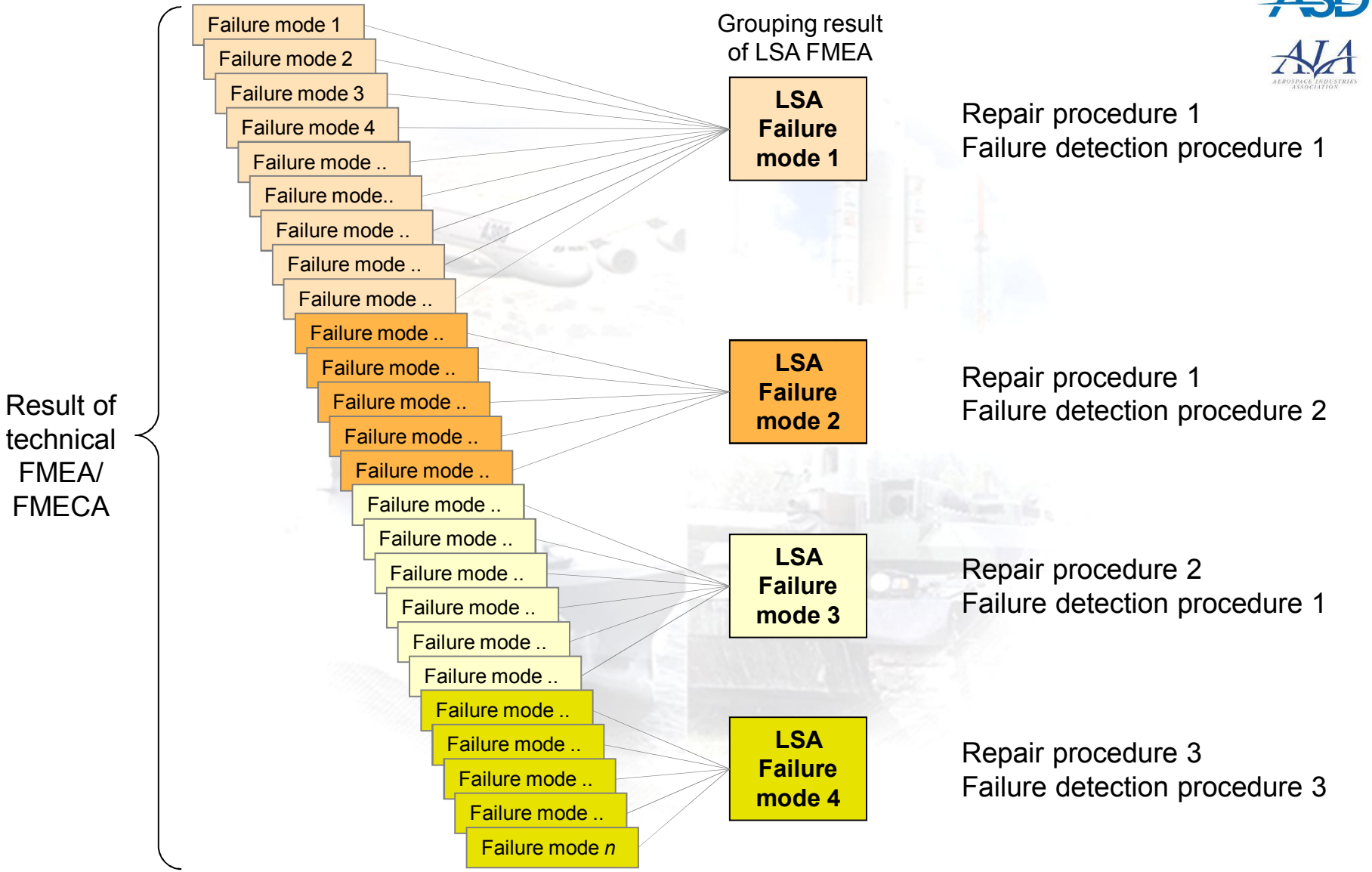
- a **failure (or defect)**
- a **damage** (covered by chapter 8)
- a **special event** (covered by chapter 8)
- a **threshold, e.g. time limitation** (covered by chapter 10)

A **technical FMECA** (eg MIL-STD 1629) is the central input for the identification of both, scheduled and unscheduled maintenance



Chapter 7 - LSA FMEA

From technical FMECA to LSA FMEA



Damages are often candidates for **family concepts** for event analysis and also for **standardized repair concepts** for the rectifying maintenance activities.

Examples:

- Standard repair concept for structural items
- Standard repair concept for electrical connections

In the case of damages, a **prediction of the frequency of occurance** is difficult in the majority of cases. Sometimes statistical data exist which can be used for estimations.

Definition: Special event

A special event is something that may occur during system life and can not be considered as a normal way of operation. It can be due either to **external causes** (e.g. meteorological phenomenon, bird strike) or to **internal causes** (e.g overheating, hard landing)

External cause

A cause is designated external when something independent to product usage happens.

Internal cause

A cause is designated internal when it comes from product usage by itself.

Consequences of special events

After a special event it is required to perform a **certain sequence of inspection activities** by proper qualified personnel. It cannot be predicted which kind of corrective maintenance in which depth has to be performed. This is **dependent** on the **inspection results**.

Frequency of special events

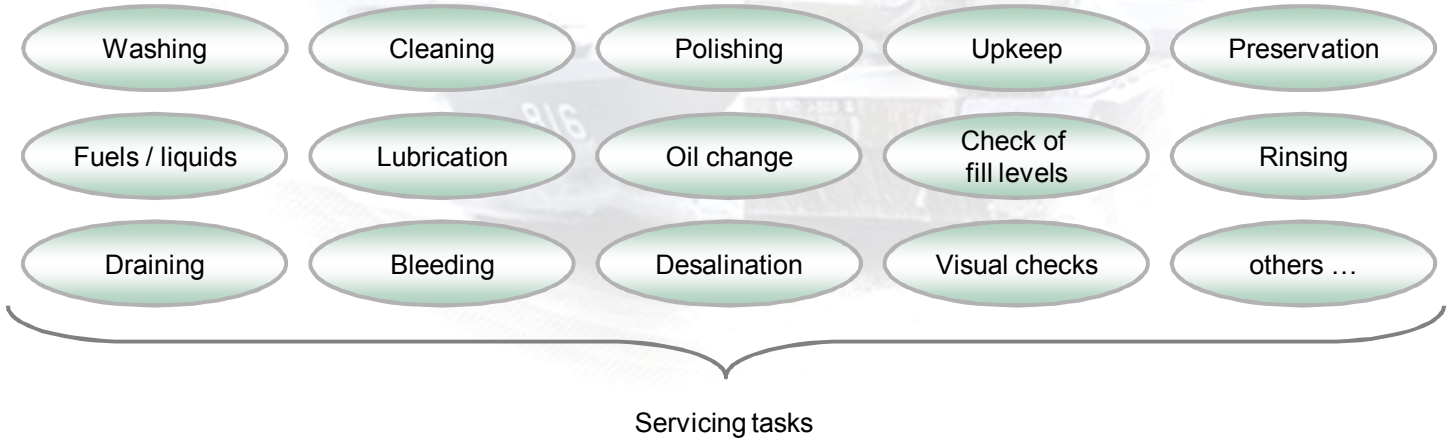
Similar to the damages (which are basically also a certain kind of special event) it is **difficult to predict the occurrence of a special event**. Sometimes statistical data exist which can be used for estimations.

Example:
US-Airforce collected for a long time data concerning bird strikes in different areas. These statistical data are very helpful to predict the need for spare engines at different locations.

Purpose:

Beside the activities concerning maintenance and repair of a product, there are **additional aspects concerning the operation and the handling** to be considered.

Logistic relevant operations are tasks, which can neither be assigned to the area of direct usage of a product (documented in **operating instructions**) nor to the area of maintenance (documented in **maintenance manuals**).



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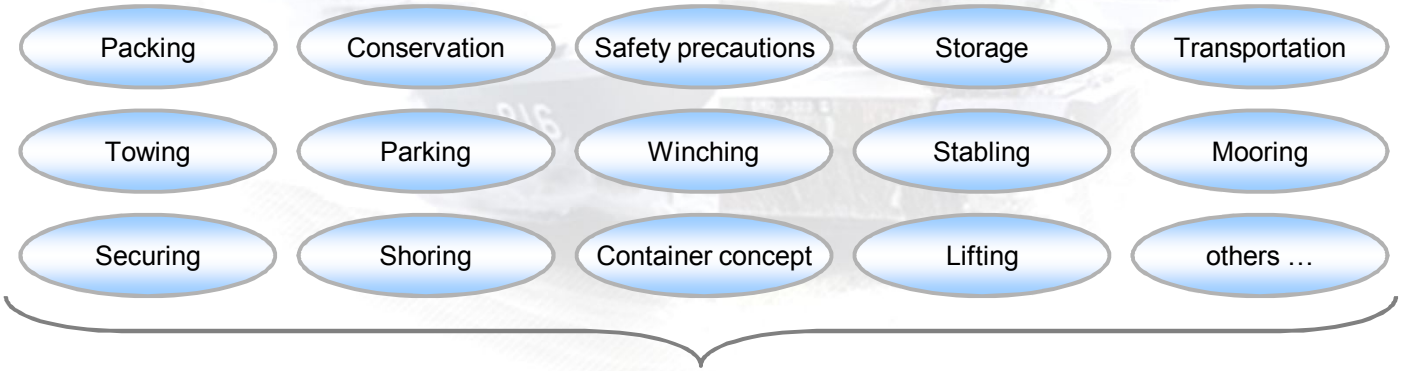


PHST aspects (packing, handling, storage, transportation)

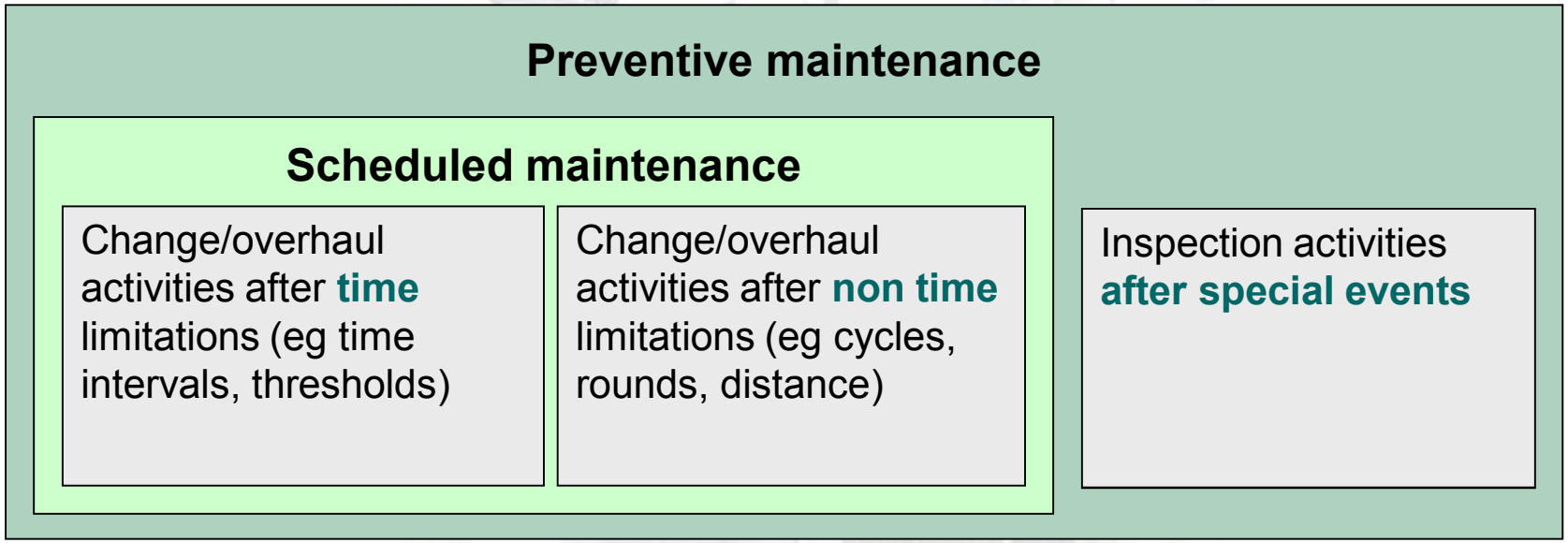
The identification of required **scheduled maintenance** is of vital importance for the operation of a complex product. **Safety, economic, environmental and ecological** aspects must be considered very carefully.

Scheduled Maintenance Analysis (SMA) is documented in international specifications:

- **ASD S4000M**
- **MSG-3** (civil specification)
- **RCM** (Reliability Centered Maintenance, military specification)

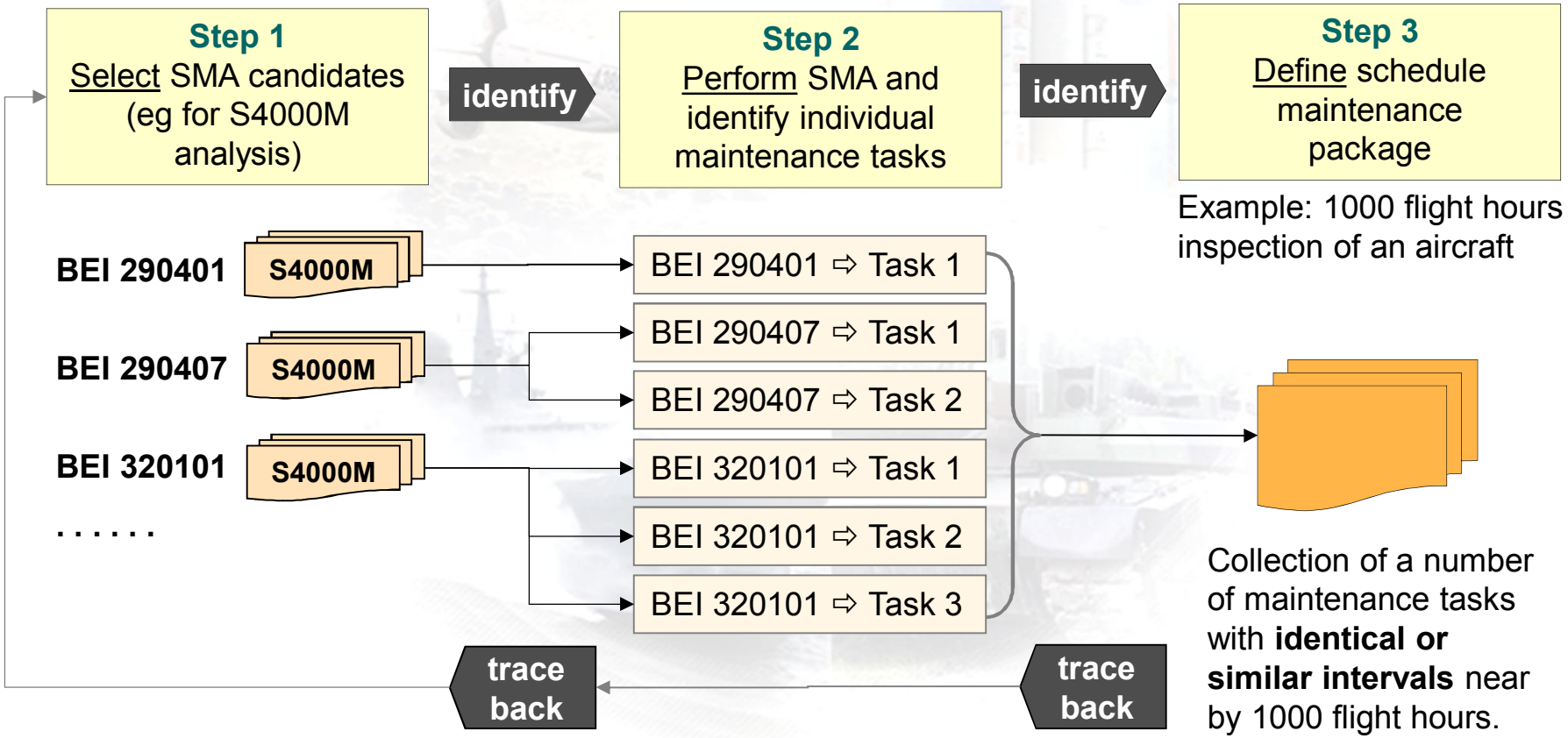
Scheduled maintenance can be regarded as a subset of **preventive** maintenance.

The main characteristic of a **scheduled maintenance task** is the existence of a **specific interval or threshold**.



LSA and SMA are related very closely. The common view on unscheduled maintenance **and** scheduled / preventive maintenance respectively gives a complete impression of maintenance activities.

SMA is **not finalized** by identification of single maintenance activities plus identification of specific intervals and/or thresholds



Supporting Task

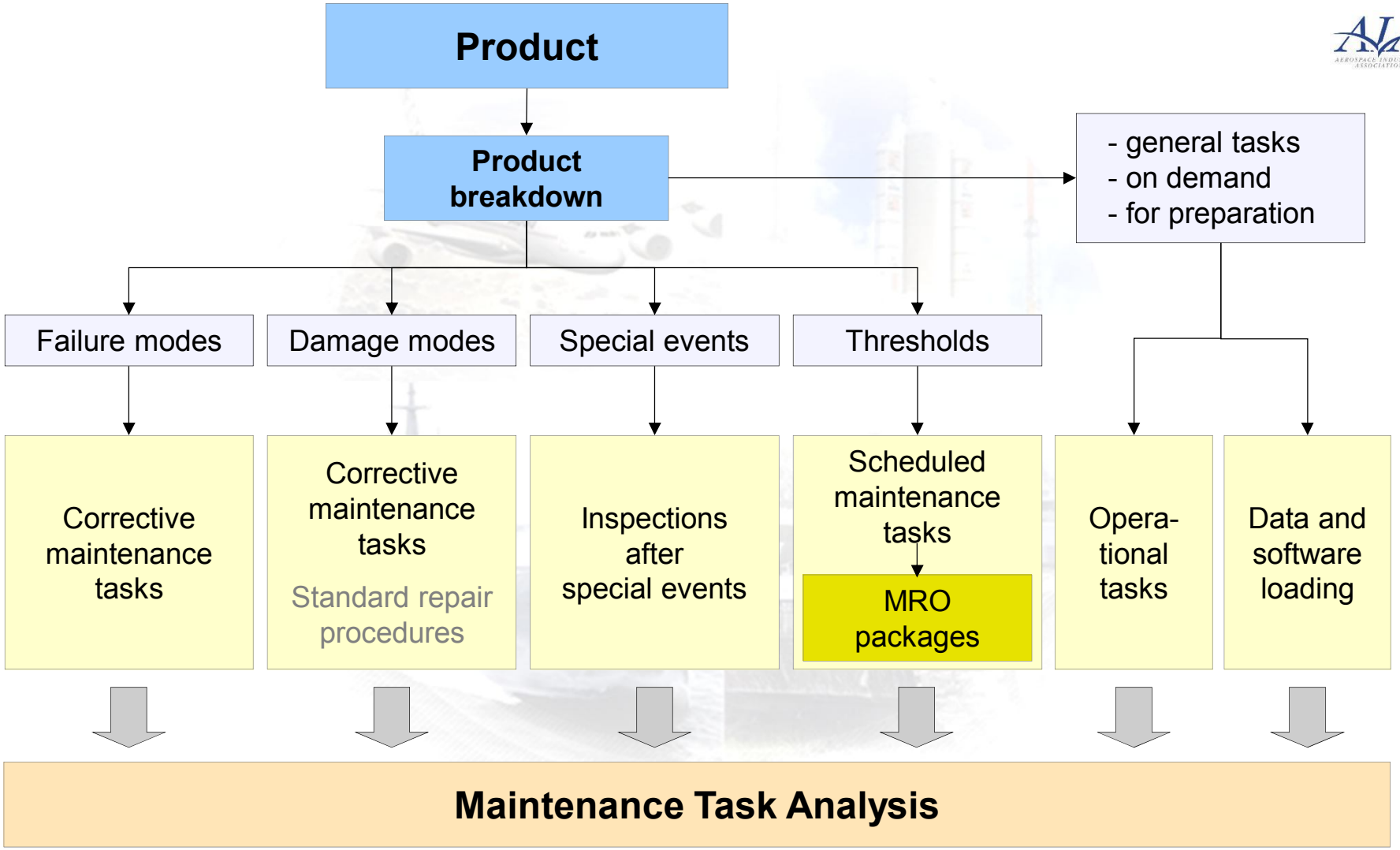
A supporting task is a part of a complete maintenance activity, which cannot hold to rectify any event like failure, damage or any special event. However, a supporting task can contain **several or even a lot of working steps**.

Rectifying Task

A rectifying task is any maintenance activity, which **resolves** an event like failure, damage or any special event. A rectifying task can be assembled using **descriptive tasks as references and/or definite working steps**. Also any kind of preventive and scheduled maintenance coming from an SMA holds as a rectifying task.

Chapter 12 - Maintenance Task Analysis (MTA)

Event / task correlation

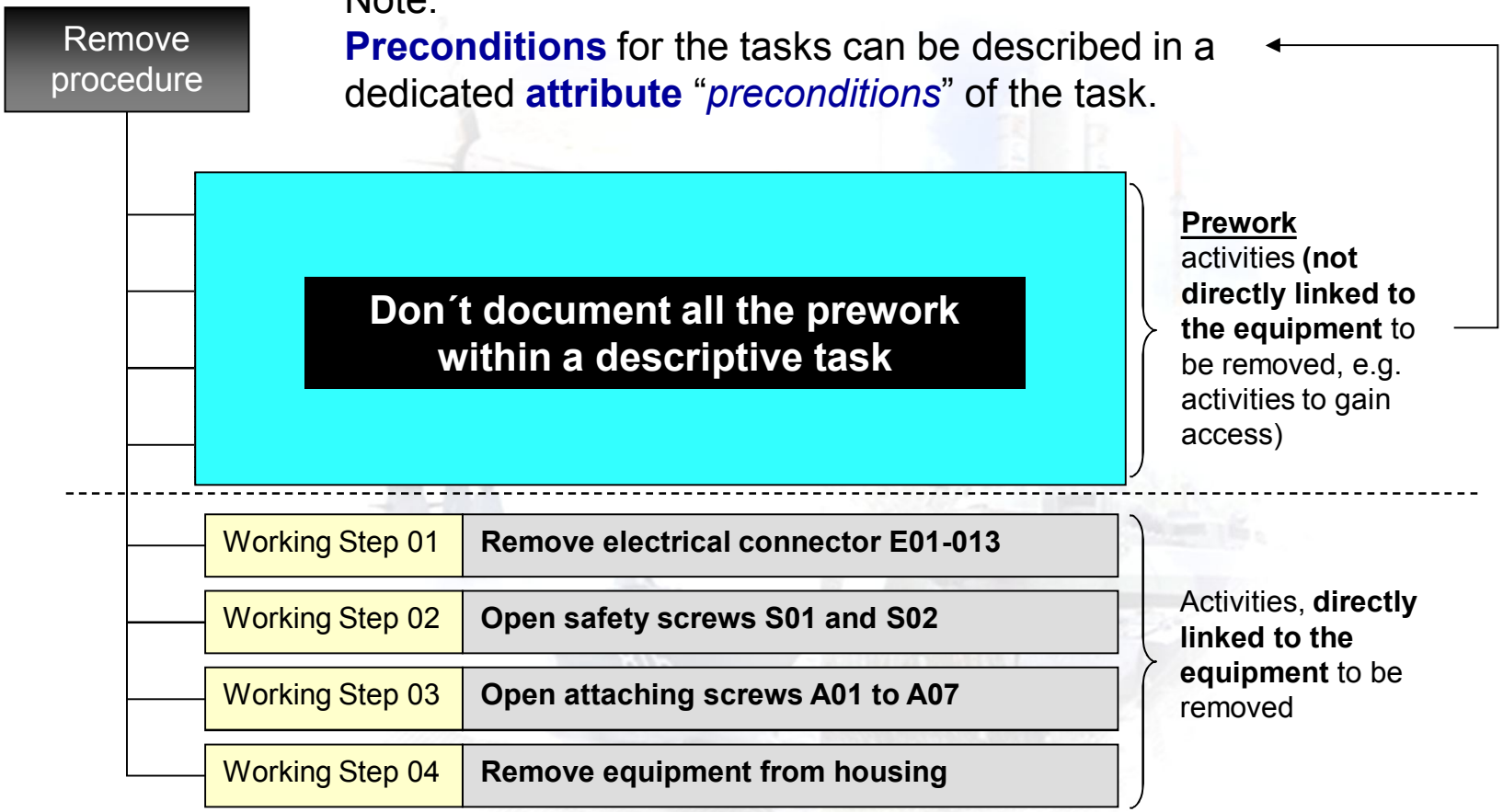


The following aspects concerning the **structure** of a maintenance task are covered within ASD S3000L:

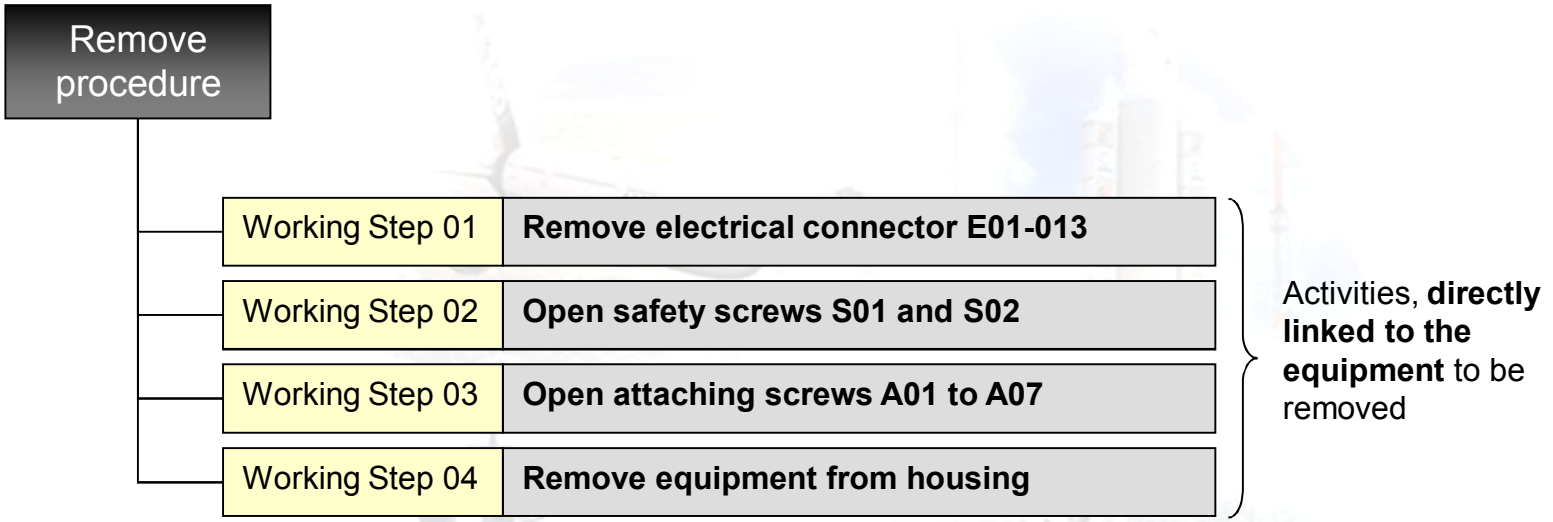
- Documentation of **supporting tasks** with the help of **subtasks/working steps**
- Documentation of **rectifying tasks** with the help of **referenced supporting tasks** and **additional subtasks and working steps** respectively
- Integration of **preconditions, pre-work and post-work**
- **Narrative description**

Chapter 12 - Maintenance Task Analysis (MTA)

The lowest level, the structure of a supporting task (1)



The lowest level, the structure of a supporting task (2)



Rule:

To avoid any confusion and nested references, a supporting task can only contain work steps, no references to other supporting tasks

The structure of a rectifying task

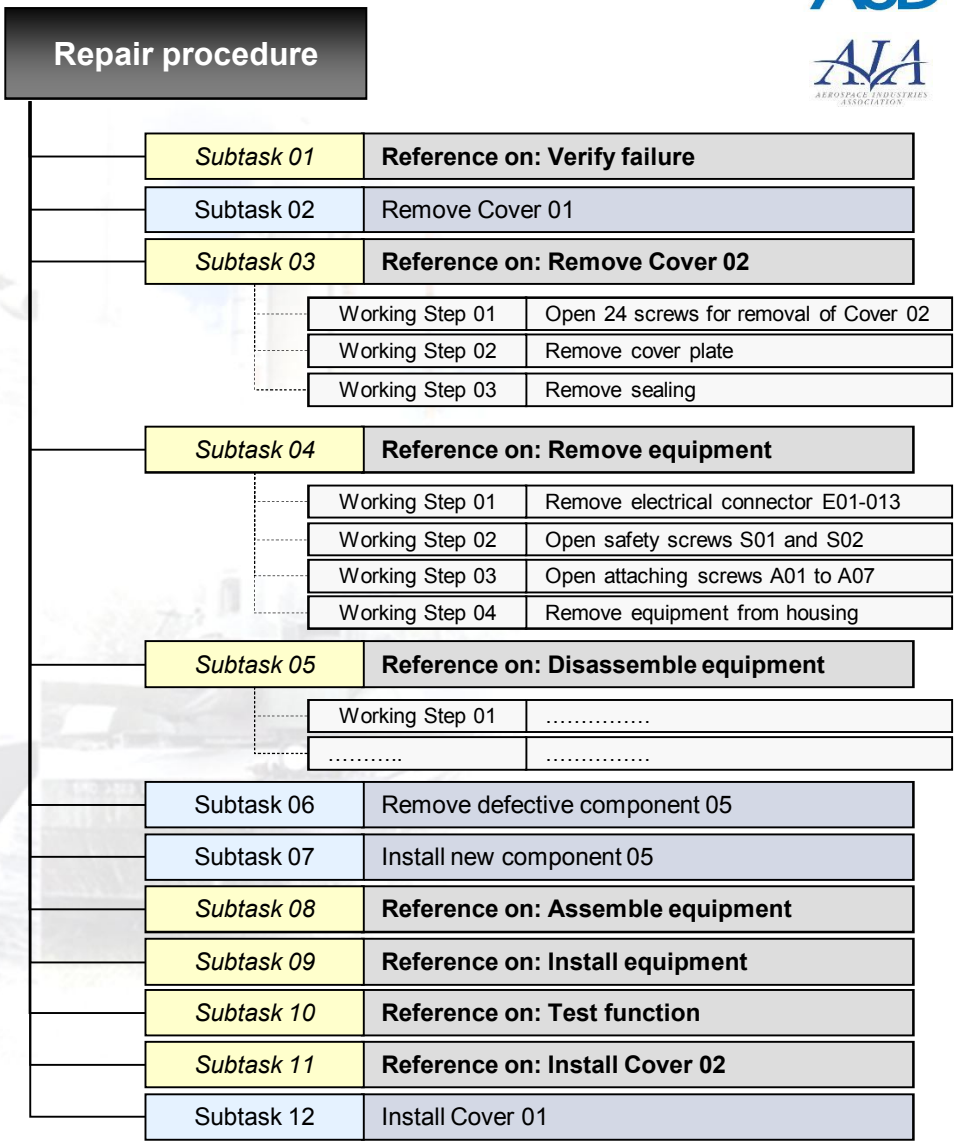
References:

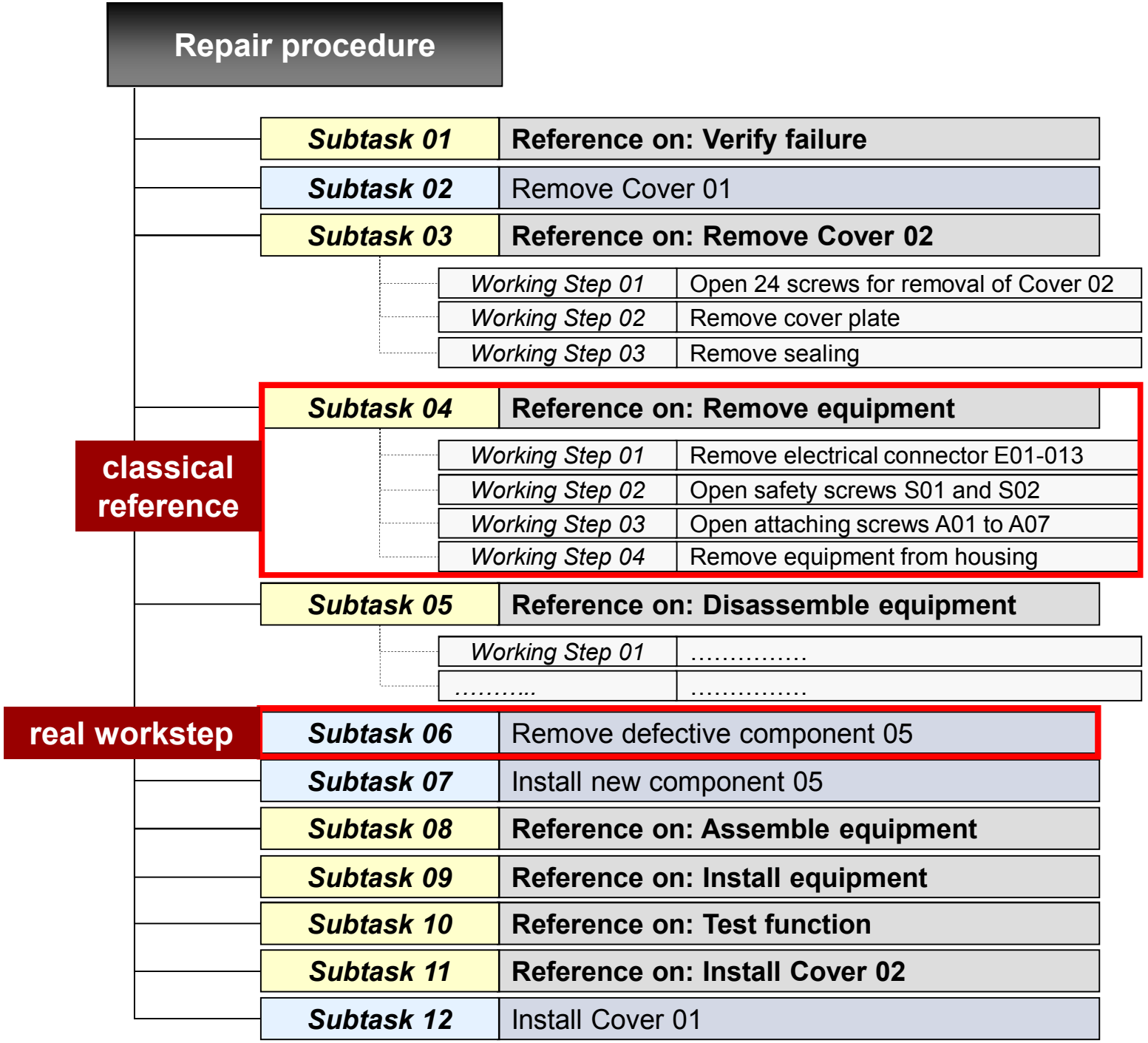
The usage of references **is recommended** for all activities, **which are always the same**.

Examples:

Disassemble or **assemble** tasks are normally always the same, when the items are removed from the product.

Installation and **removal** tasks on the other side can be different if an item is installed several times on the system, depending on the place of installation.




Repair procedure
Subtask 01
Reference on: Verify failure
Subtask 02
Remove Cover 01
Subtask 03
Reference on: Remove Cover 02
Working Step 01
Open 24 screws for removal of Cover 02
Working Step 02
Remove cover plate
Working Step 03
Remove sealing
Subtask 04
Reference on: Remove equipment
Working Step 01
Remove electrical connector E01-013
Working Step 02
Open safety screws S01 and S02
Working Step 03
Open attaching screws A01 to A07
Working Step 04
Remove equipment from housing
Subtask 05
Reference on: Disassemble equipment
Working Step 01
……
……..
……
classical reference
real workstep
Subtask 06
Remove defective component 05
Subtask 07
Install new component 05
Subtask 08
Reference on: Assemble equipment
Subtask 09
Reference on: Install equipment
Subtask 10
Reference on: Test function
Subtask 11
Reference on: Install Cover 02
Subtask 12
Install Cover 01

The required resources to perform a maintenance task should be defined **at a common level** within the task itself.

Generally, it should be possible to identify **when** any resource should be available **within the sequence** of the task. The resources can be (but not limited to):

- Personnel and required training for the task
- Materiel (spare parts and consumables)
- Support and test equipment
- Facilites and infrastructure
- Technical documentation
- IT support

The following aspects concerning the performance of any maintenance task are **additionally** covered by S3000L:

- **Resources** out of supporting task references
- **Harmonization** of support equipment and spare parts
- Task **location** aspects
- Product and system **availability** during maintenance performance
- Support solutions (**task variants**)
- Task **duration** and **task frequency**
- **Parallel activities** within maintenance tasks

Comparison of „flying“ software in fighter aircraft programs:

F4

nearly none (at first introduction)

Tornado

27 KLOC* (at first introduction)

* KLOC = KiloLines of Code
  Measurement base for amount of software

Eurofighter

1600 KLOC

82 programmable computers interconnected via 8 network buses

- In modern products, software aspects are of increasing importance. More and more functionalities are supported or realized by **complex software packages**.
- Similar to the logistic analysis activities for hardware, software must be analyzed concerning its **operational** and **maintenance requirements**.
- For software itself, a clear distinction between **operational and maintenance** aspects and **real software modification** should be established.

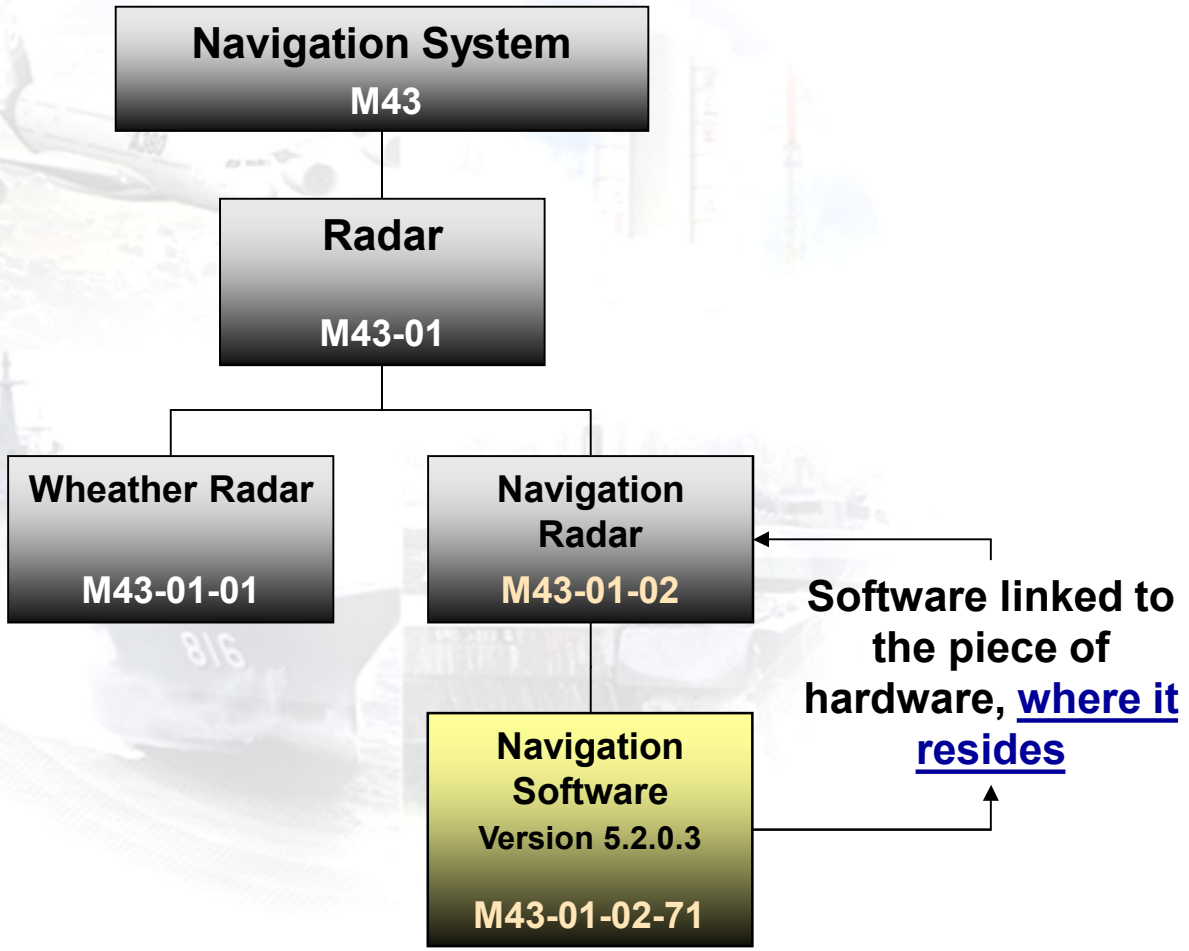
Analysis of scheduled and unscheduled activities, eg installation, deinstallation, loading, unloading, administration or modification of software.

- **Software modification ⇨ it is a design activity!**
  - **corrective**
    e.g. bug-fixing
  - **adaptive**
    e.g. modification because of changes of environmental requirements
  - **perfective**
    e.g. modification for increase of functionality

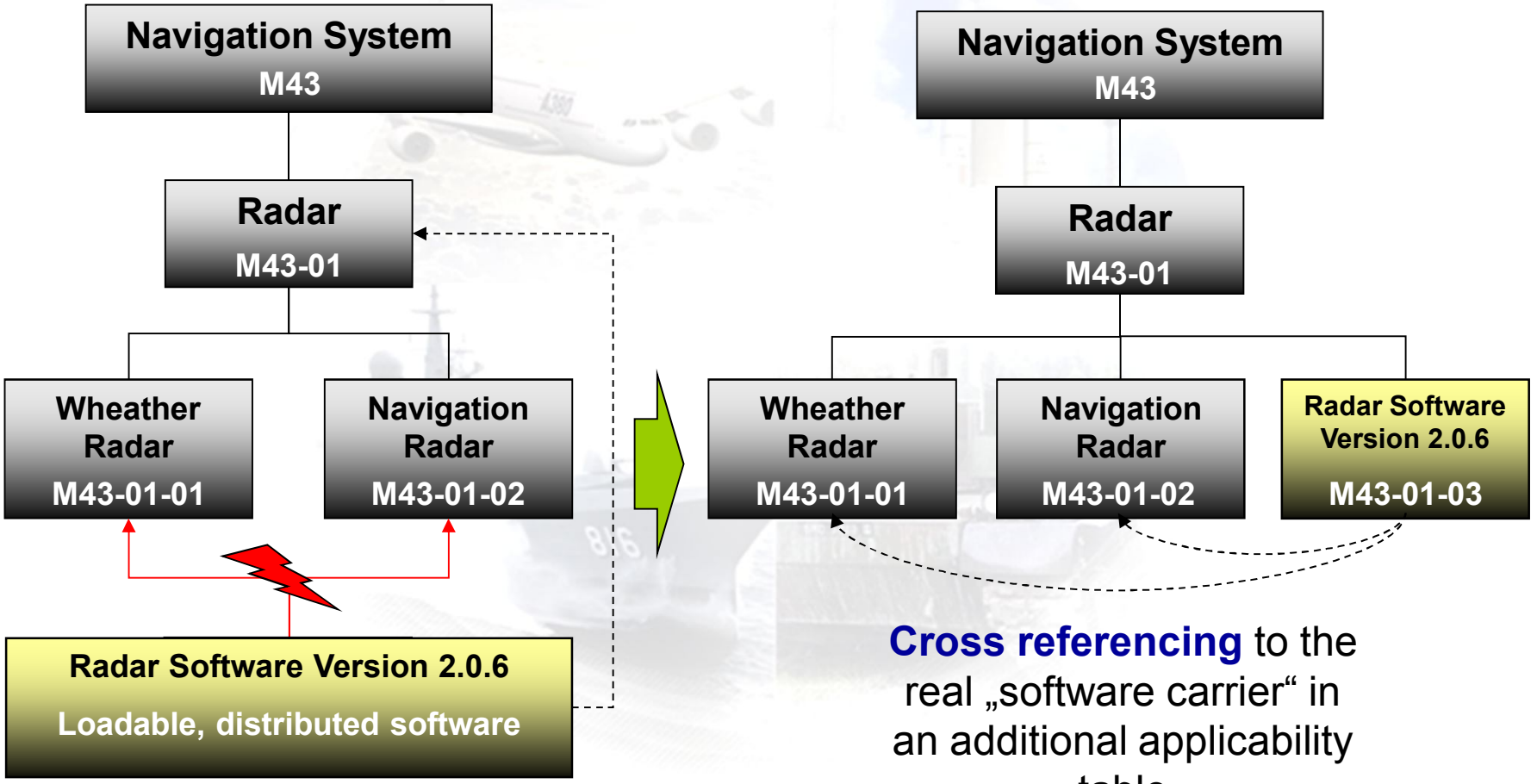
- **Maintenance related activities concerning software**
  - **Preparation** of loadable data
  - **Loading** and unloading of software packaging to hardware
  - Software **configuration** after loading
  - etc…

Software - a normal breakdown element comparable to hardware?

Example 1: **Embedded software**



Example 2: **Distributed software**



Cross referencing to the real „software carrier“ in an additional applicability table

The **decline of products** in a market due to the introduction of better competitor products or rapid technology developments. (wikipedia)

Diminishing **manufacturing sources** and material **shortages** (DoD)

The loss, or impending **loss of the manufacturers or suppliers** of items, or **shortages of raw materials**. (web search)

- **Obsolescence** can be considered as **one of the major cost drivers** in the through life management of a product/system and is **one of the biggest technical risks** impacting operational availability and product supportability
- It is a serious subject area for **defence, telecommunications, medical, petrochemical, nuclear, power and railway**
- Rapid advances in technology **have shortened component life cycles** from between 10 and 20 years to between 3 and 5 years (in some cases even shorter, eg memory devices, micro-processors and other electronical components)

Obsolescence effects **all products and systems** and is not limited to hardware and components, but includes:

- Test and support equipment
- Software and development tools
- Manufacturing technology
- Processes
- Logistic end products
- Standards and specifications
- Expertise of personnel

Proactive

- **Proactive** implies that there are resources and planning in place for managing obsolescence issues.
- Active monitoring of the system creates time to review resolution options and justify decisions.

Reactive

- **Reactive** implies that there are no specific resources for managing obsolescence or for the resolution of the obsolescence issues
- Obsolescence is dealt with as it occurs. There is no link to the risk management activities.

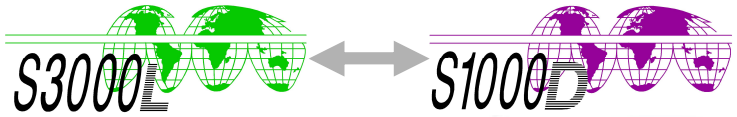
This chapter provides guidance for developing:

- a **disposable** product (design-to-dispose strategy)
- a **disposal procedure** applicable for:
  - the product at end of life
  - disposal of wastes, discarded parts, etc. during product service life (operation and maintenance)

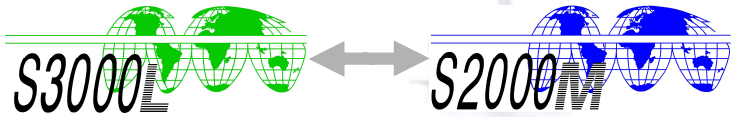
- **Destruction/neutralization of toxic substances** that harm humans or the environment

- **Sustainable development** by recycling materials or converting them into energy

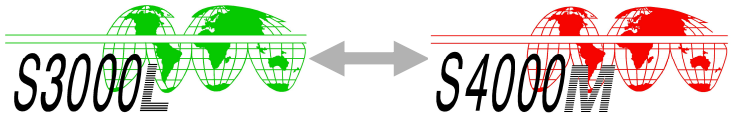
- **Demilitarization** of defense products (eg ammunition) to avoid weapons proliferation and use by terrorist groups



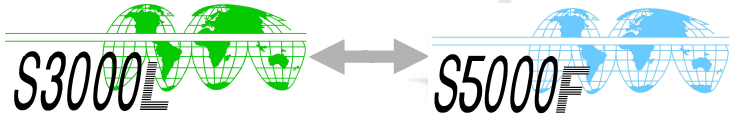
The maintenance task information developed during the LSA process is the **baseline for the maintenance procedures** to be produced in accordance with S1000D. The LSA data is also the input for the **maintenance planning information**.



During the S3000L LSA process, information will be generated that will determine the **range and depth** of the maintenance of the product, as well as the **required material resources** during in-service operation.



LSA and SMA are interconnected very closely. Only the common view on unscheduled maintenance **and scheduled or preventive maintenance** respectively gives a complete impression of maintenance activities.

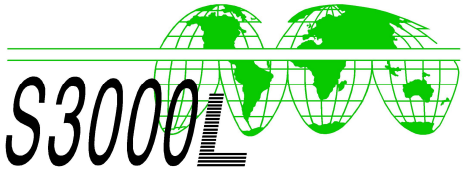


In-service reality and the maintenance concept/tasks and the logistic support requirements developed by an S3000L LSA process must be **continuously compared** to ensure the identification of required revaluation or adaptation.

Summery of chapter 1 to 18

Procedural part of ASD/AIA S3000L

- ✓ S3000L gives a guideline how to establish a **proper LSA process** for the entire life cycle of a product (from concept to disposal) with regard to the involvement of the customer/operator.
- ✓ S3000L provides a guideline how to create a **product breakdown** and how to select potential LSA candidates
- ✓ S3000L gives an overview of **potential technical/logistic analysis activities** and how the results can be documented within a logistic database (LSA database)
- ✓ S3000L gives a guideline how to document maintenance or operational **tasks** and the corresponding **resources**.
- ✓ S3000L covers **additional subjects** like e.g. handling of software, PHST, obsolescence and disposal aspects.



Questions ?

Table of content

Objective

Describe a coherent S3000L **data model** and **data element definitions** for exchange of LSA data with related business processes.

Scope

- Definition of the **LSA project** and the **products** that shall be supported
- Document the early phases of the LSA process in terms of selecting the **LSA candidate items** and selecting **LSA analysis activities** for each candidate item
- Document **LSA Failure Mode Effect Analysis (LSA FMEA)** and **event analysis results**
- Document the **Maintenance and Operational Task Analysis** activities.

The S3000L data model presented in chapter 19 is predicated on:

ISO 10303 AP239 - **P**roduct **L**ife **C**ycle **S**upport (**PLCS**) data model
http://en.wikipedia.org/wiki/ISO_10303

Chapter 19

- documents the data originated **from the S3000L chapters**
- contains the data required to create task related S1000D technical publication (**data modules)**
- is the basis for data exchange specifications **DEX1 A&D** and **DEX3 A&D**

A **joint industry and government initiative** to accelerate development of new standards for product support information

An international project to produce an **approved ISO standard** within 4 years, commenced in November 1999

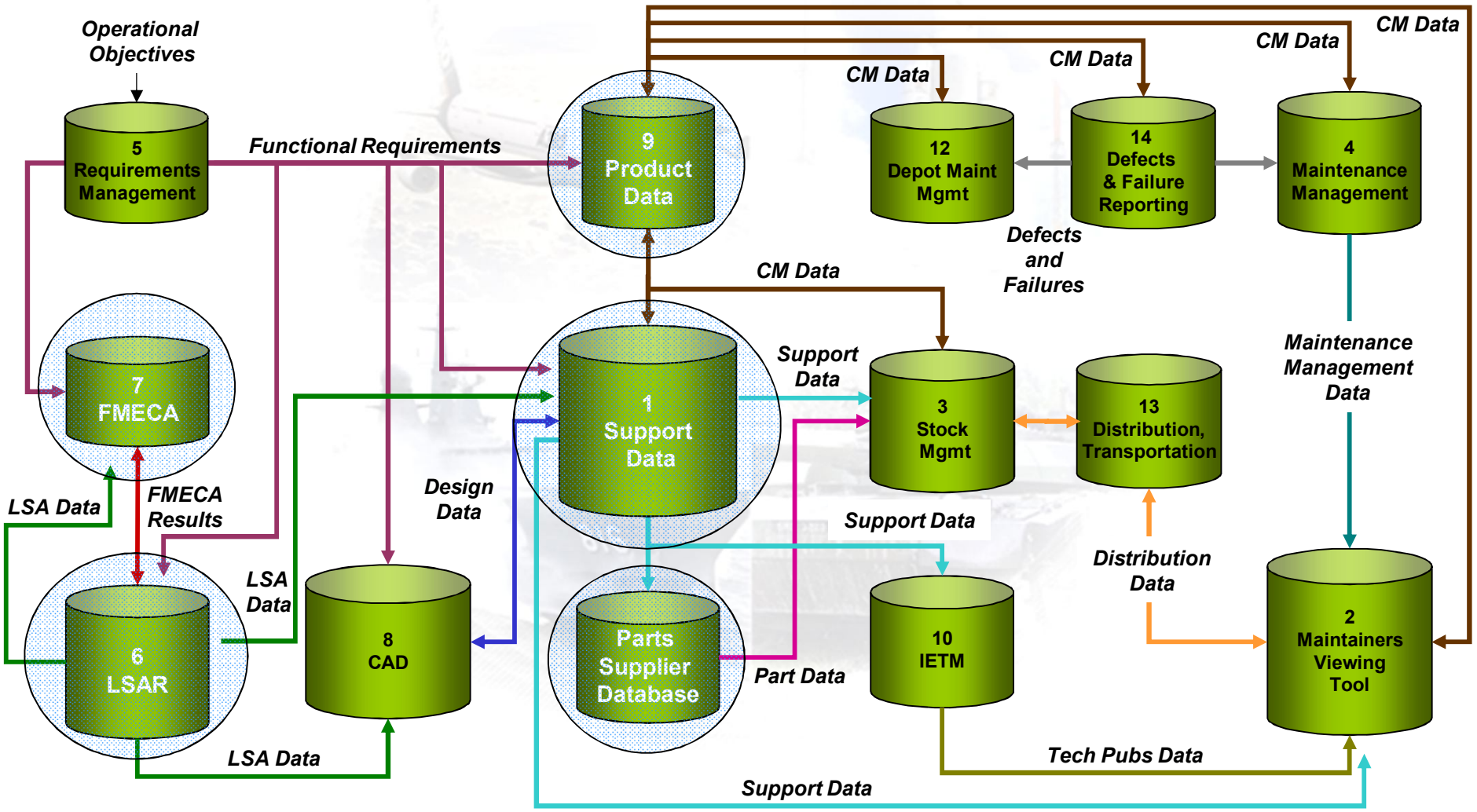
PLCS will ensure support information being aligned to the evolving product definition **over the entire life cycle**

PLCS extends ISO 10303 STEP* - the standard for exchange of product model data

* **ST**andard for **E**xchange of **P**roduct model data

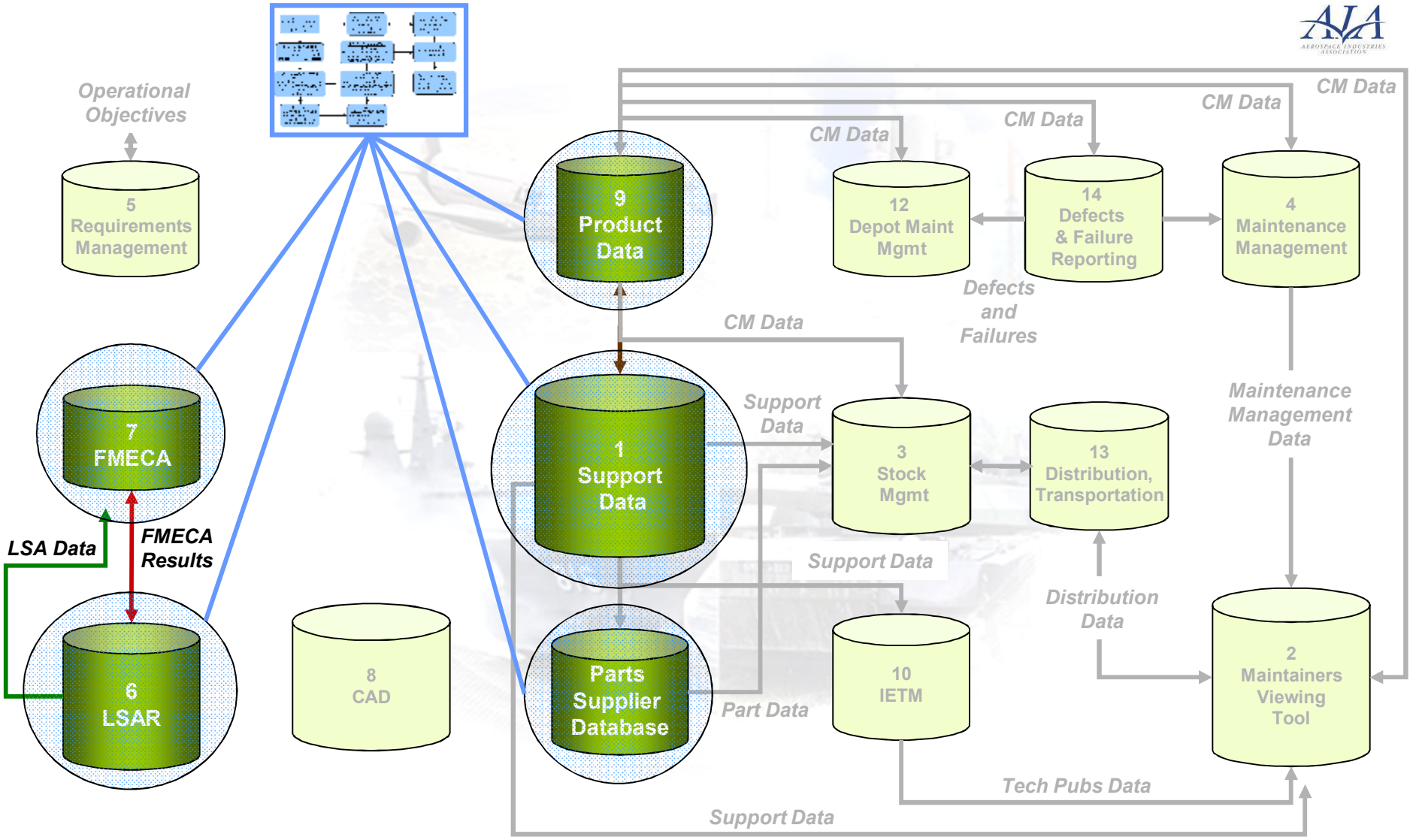
Chapter 19 - data elements and data model

PLCS - Product Life Cycle Support - a complex environment



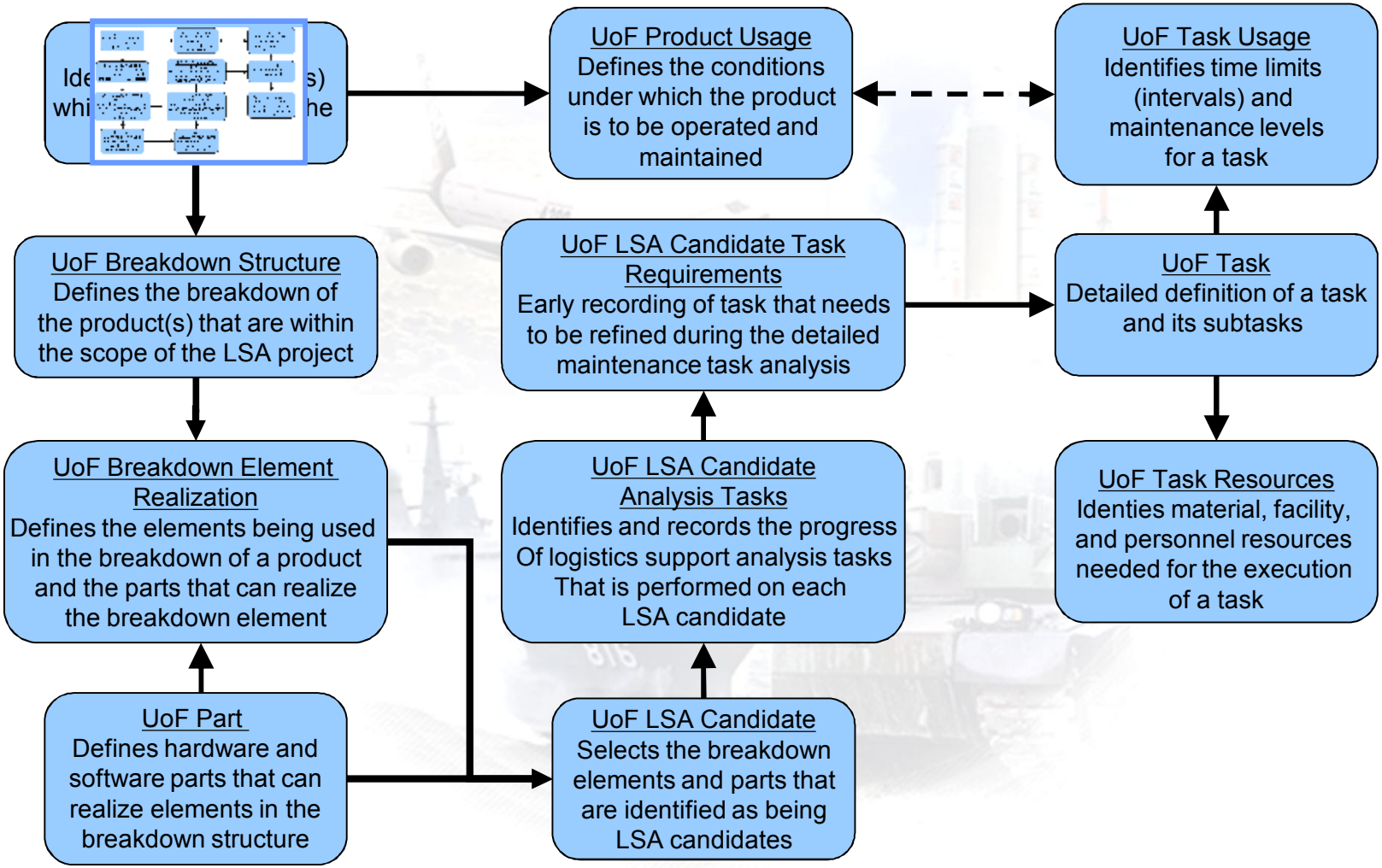
Chapter 19 - data elements and data model

S3000L data model - a subset of PLCS

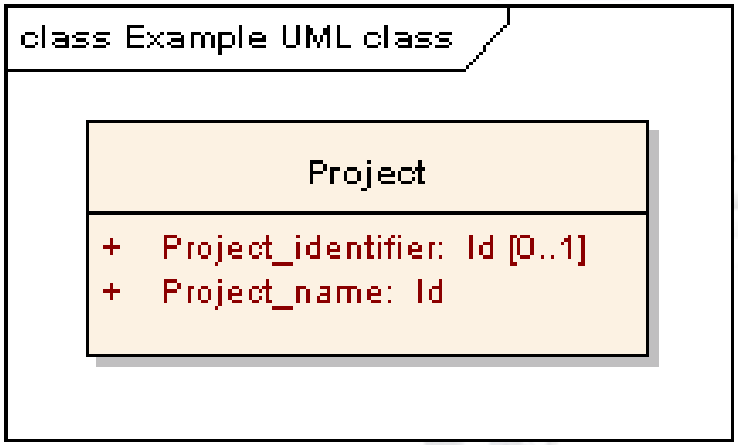


Chapter 19 - data elements and data model

S3000L data model - simplified overview of the most important entities



Class: UML basic element (**U**nified **M**odelling **L**anguage)



UML terminology:
The **class *Project*** can have 0, 1 or many **instances**.

What does that mean?

The **table *Project*** in the corresponding relational database can have 0, 1 or many **datasets**. Unified identifier of the record is the **Project_identifier** (= primary key)

Classes within a UML data model can be interpreted as **tables** within a relational database.

An **instance of a class** is equivalent to a **data record/dataset in a table**

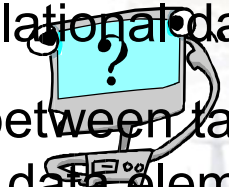
An **attribute of a class** is equivalent to a **column of a table**

Properties of **relational databases**:

Composed of **tables** following the rules of **data normalisation** (4 levels of data normalisation).

Concrete values of **attributes** are only documented in exact **one** table of a relational database.

Relations between tables are created by the means of neutral, internal key data elements.

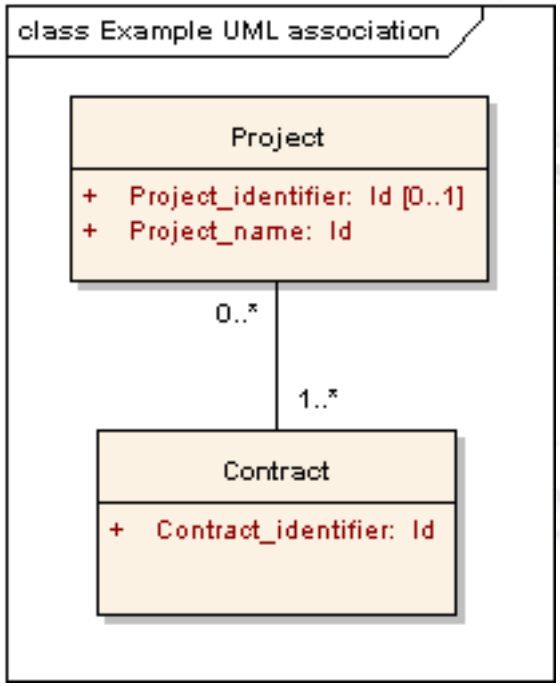


Relational database

What does that mean?

Relational databases follow the principle of **referential integrity** to guarrantee the deletion of son data records in the case of deleting the corresponding father data record (avoiding data garbage)

Association: UML basic element



An **association** within a UML data model can be interpreted as a **connecting table** within a relational database.

The **columns** of the connecting table are populated with the **key data elements** of the tables (classes) to be linked to each other.

The **datasets** of the connecting table are the **relations** between the linked tables (classes).

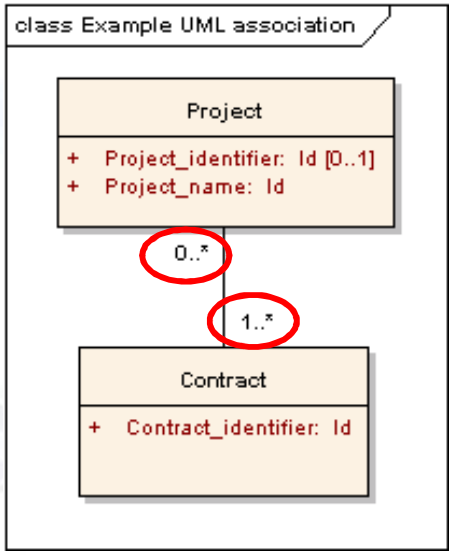
In this case the connecting table would contain 2 columns:

- **Project_identifier**
- **Contract_identifier**

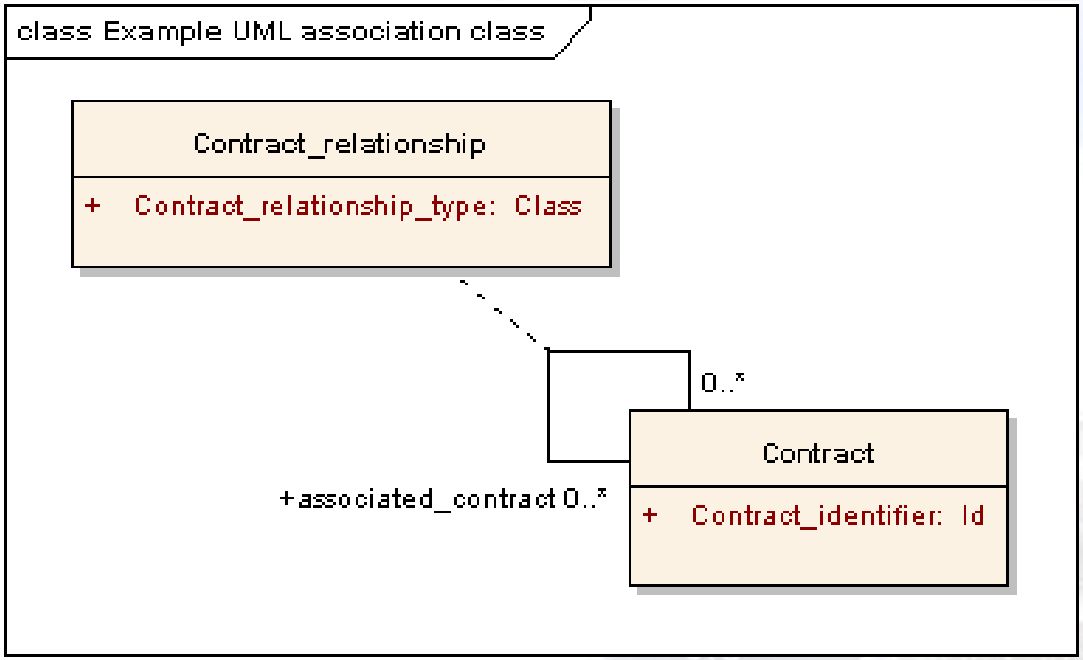
PROJECT_CONTRACT_RELATIONSHIP	
PROJECT_Identifier	CONTRACT_IDENTIFIER
NFA_03_2008	CCT-2008-011
NFA_03_2008	CCT-2008-034

Relations: Rules for the different kinds of relations

	**Description**
1	One (and only one) instance of the related class **must** be related to one or many instances of the relating class (mandatory relation).
0..*	0, 1 or many instances of the related class **can** be related to each instance of the relating class (optional relation, e.g. typical part of an m:n relation).
1..*	At least one or many instances of the related class **can** be related to each instance of the relating class (optional relation, e.g. typical part of an m:n relation with at least one relation).



Aggregation: UML basic element

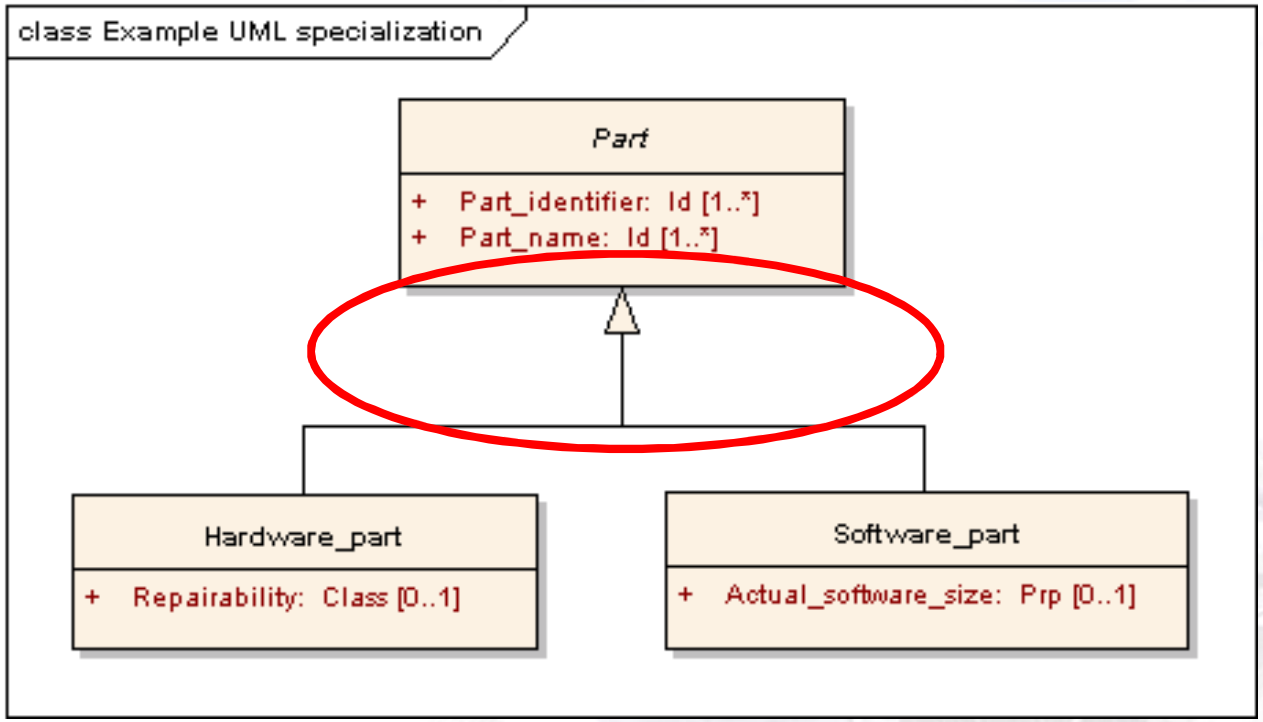


CONTRACT_CONTRACT_RELATIONSHIP		
CONTRACT_ID_1	CONTRACT_ID_2	REL_TYPE
CCT-2008-011	CCT-2008-034	Subcontract

Instances of a class can be related with other instances ***of the same class***.

For that purpose an internal relation must be established with the help of an additional ***connecting table***.

Specialisation: UML basic element



Repairability is only given for the class ***Part*** for hardware elements (from the class ***Hardware_part***).

Actual_software_size is only given for the class ***Part*** for Software (from the class ***Software_part***).

Basic terms - specialisation (2)

Specialisations can be merged in the higher class (table) **or** by own tables with repeated primary keys of the higher class.

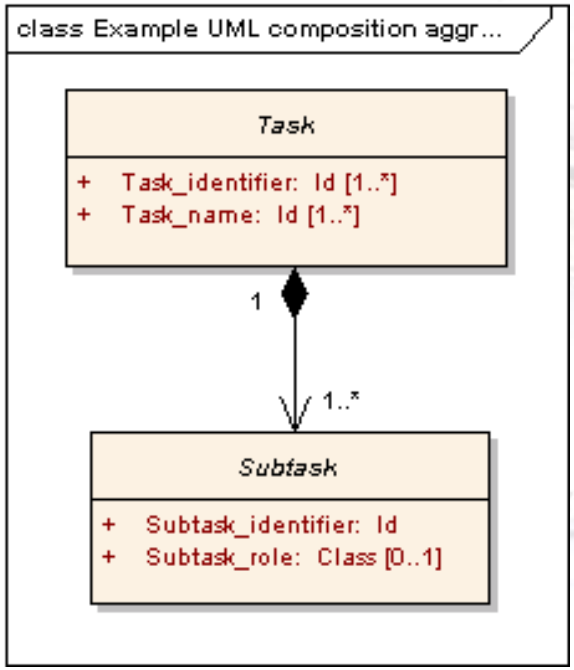
PART			
	REPAIRABILITY	ACTUAL_SW_SIZE_VALUE	ACTUAL_SW_SIZE_UOM
	Repairable		
		200	Megabyte

or

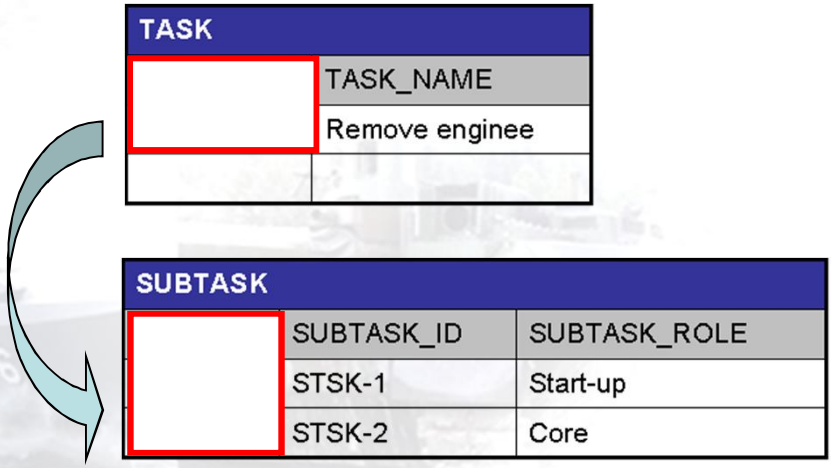
HARDWARE_PART	
	REPAIRABILITY
	Repairable

SOFTWARE_PART		
	ACTUAL_SW_SIZE_VALUE	ACTUAL_SW_SIZE_UOM
	200	Megabyte

Aggregation: UML basic element



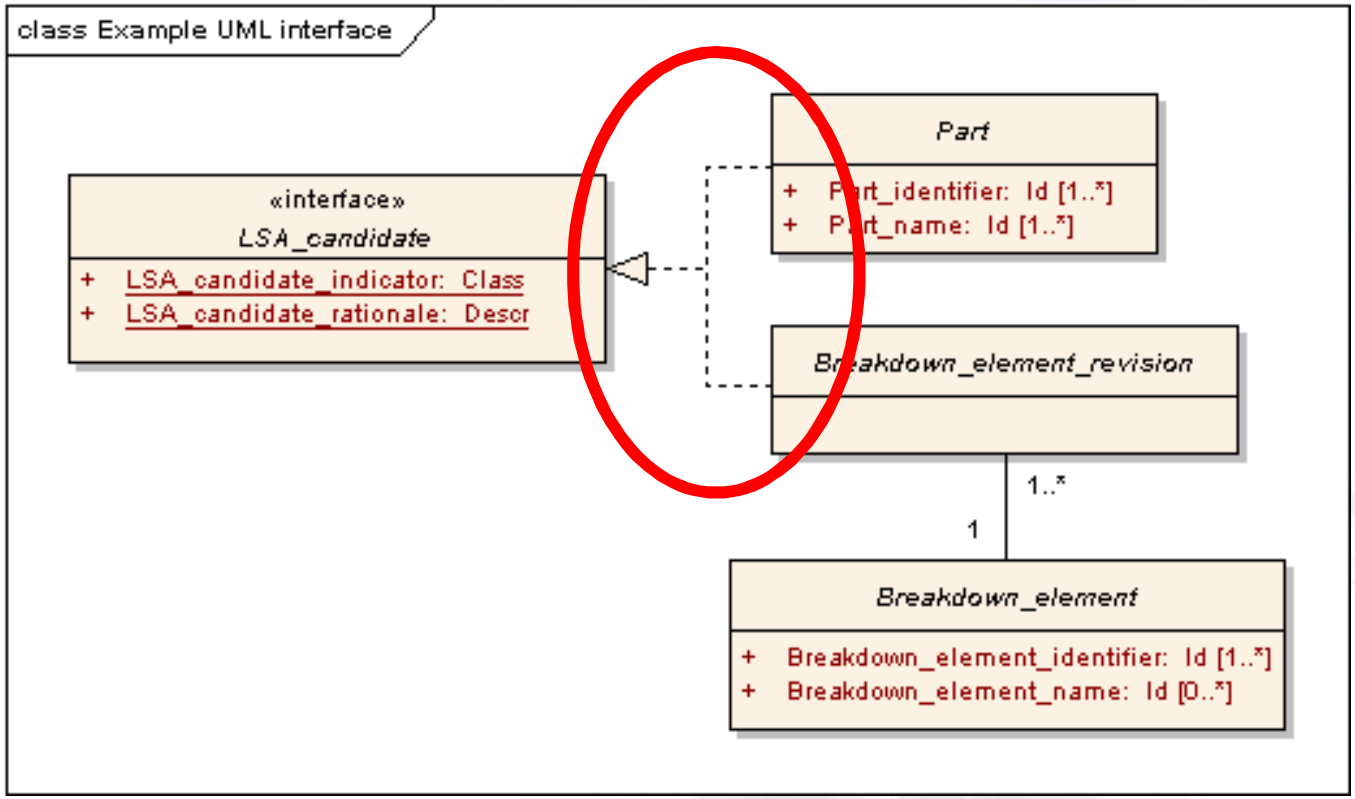
Composition aggregation as s UML data model element can be interpreted as two **tables** within a relational database. The related table contains the primary key of the relating table as the connecting element.



Composition aggregation is the typical relation to realize a **1:n** relation (one instance of a class contains many sub-instances of another class (e.g. a task contains many subtasks).

Basic terms - interface / realization (1)

Interface / relalization: UML basic element



Attributes from **interface classes** can be added to existing classes as **additional columns** in the tables.

Interface / relalization: UML basic element

BREAKDOWN_ELEMENT_REVISION			
BE_ID	BE_NAME		
190-23-143244	Left engine		

PART			
PART_ID	PART_NAME		
240-45-656654	Engine		

Columns from other tables are added to existing database tables:

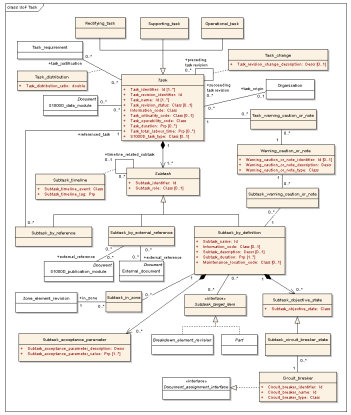
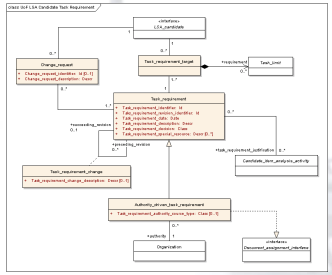
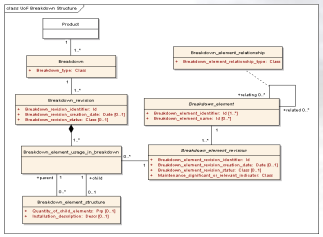
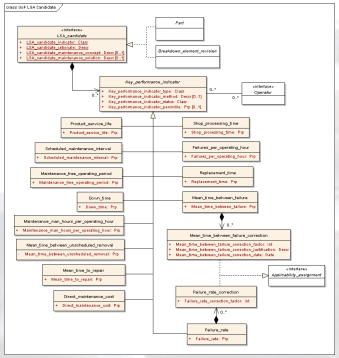
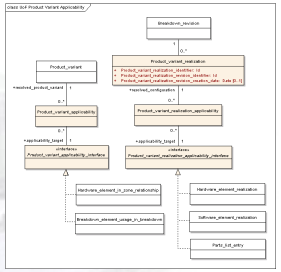
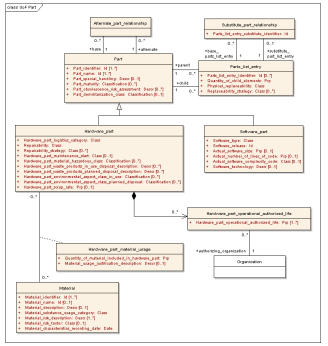
Realization in the example:

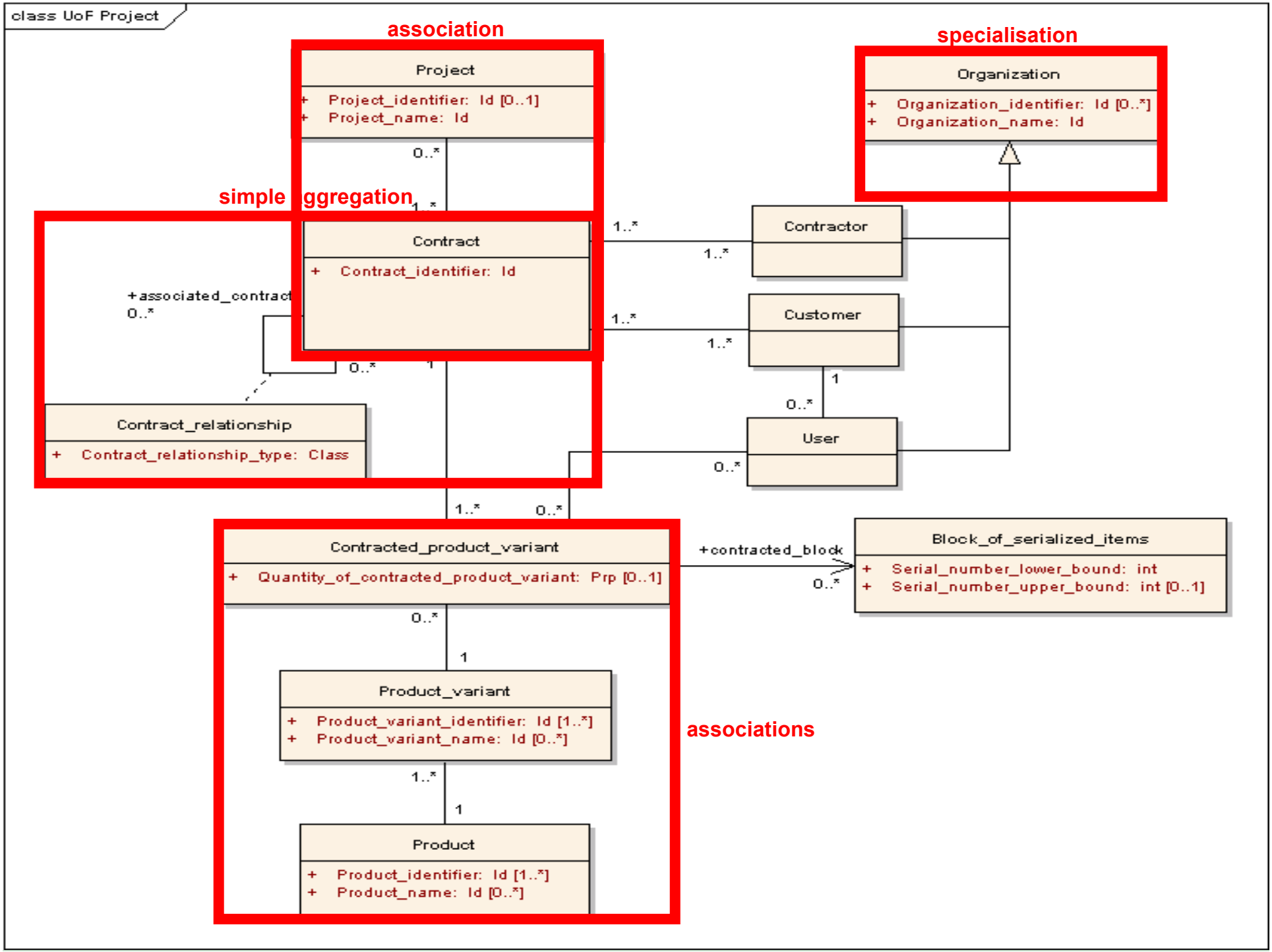
The interface data elements from the class ***LSA_candidate*** are added to the tables ***BREAKDOWN_ELEMENT_REVISION*** and ***PART*** to select these instances of these tables as an LSA candidate.

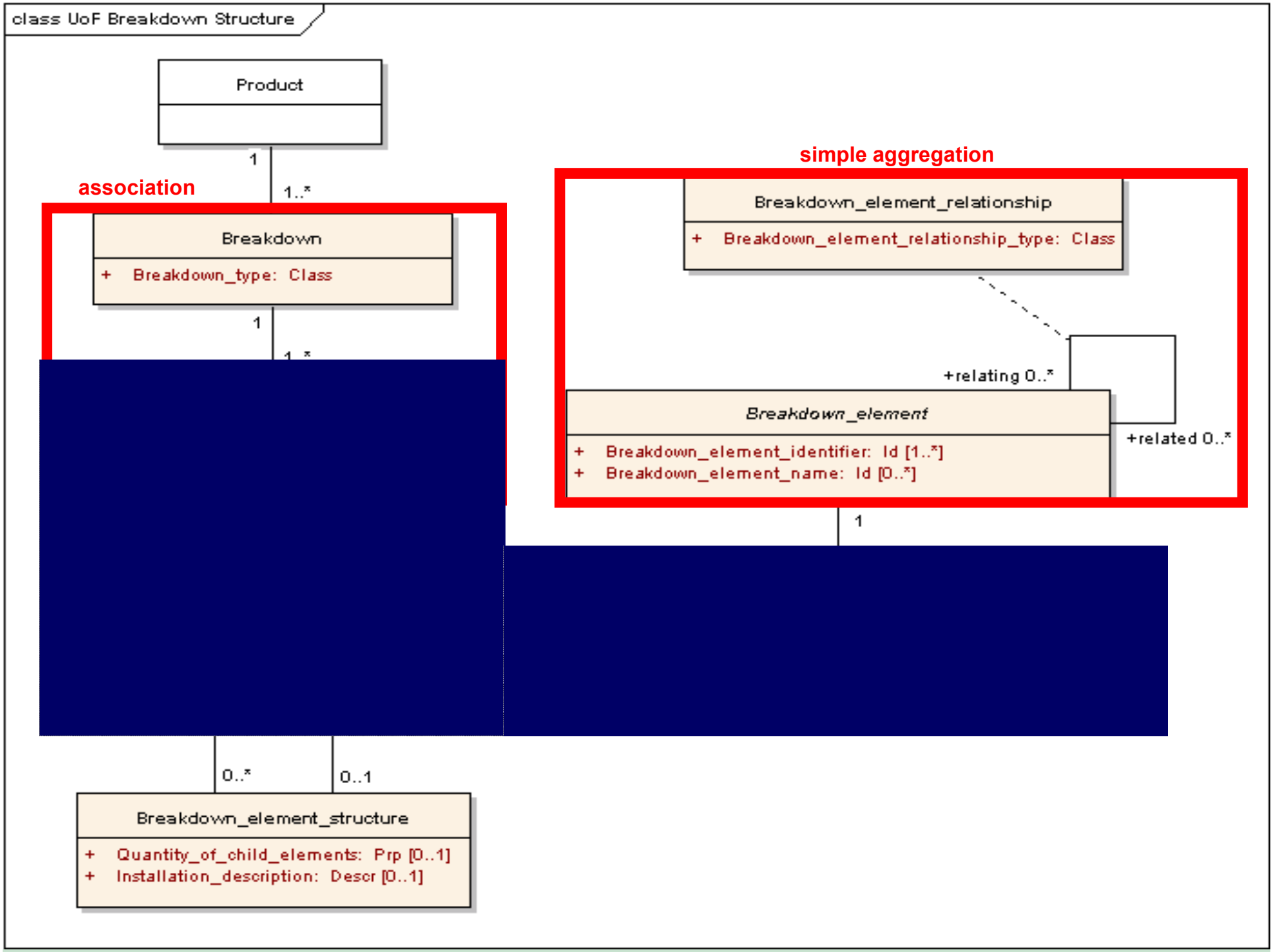
The **S3000L data model** is composed of a set of **Units of Functionality (UoF)**

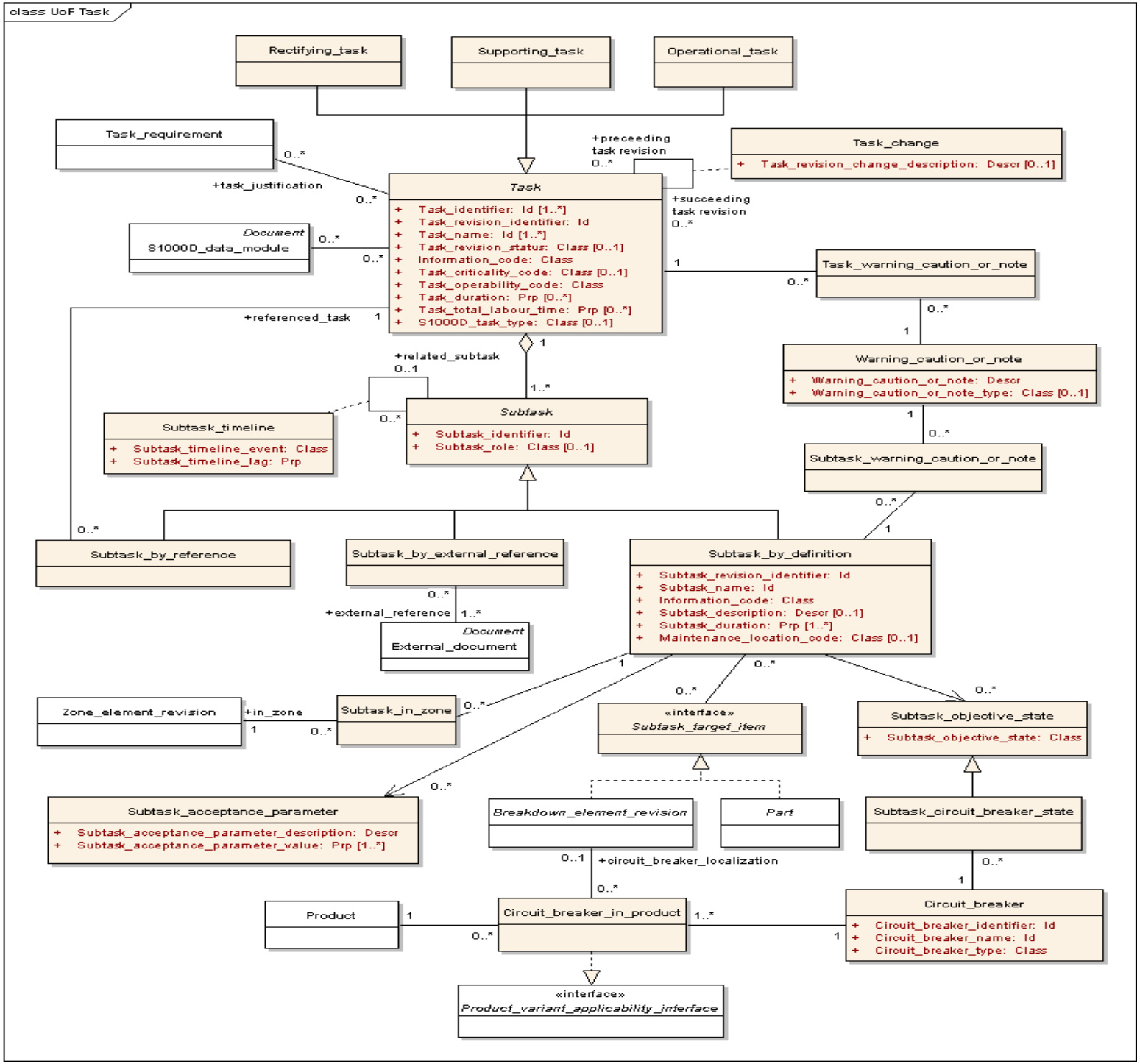
The **UoFs** divide the entire data model in **smaller and consistent units** to simplify the understanding of the relations within the data model.

Each UoF represents **a group of UML components** (and its data elements), which covers a specific "**subject**".


class UoF Project
association
specialisation
Project
+ Project_identifier: Id [0..1]
+ Project_name: Id
Organization
+ Organization_identifier: Id [0..*]
+ Organization_name: Id
simple aggregation
Contract
+ Contract_identifier: Id
Contractor
Customer
User
+associated_contract
0..*
Contract_relationship
+ Contract_relationship_type: Class
Contracted_product_variant
+ Quantity_of_contracted_product_variant: Prp [0..1]
+contracted_block
Block_of_serialized_items
+ Serial_number_lower_bound: int
+ Serial_number_upper_bound: int [0..1]
Product_variant
+ Product_variant_identifier: Id [1..*]
+ Product_variant_name: Id [0..*]
Product
+ Product_identifier: Id [1..*]
+ Product_name: Id [0..*]
associations


class UoF Breakdown Structure
Product
1
1..*
association
Breakdown
+ Breakdown_type: Class
1
1..*
simple aggregation
Breakdown_element_relationship
+ Breakdown_element_relationship_type: Class
+relating 0..*
Breakdown_element
+ Breakdown_element_identifier: Id [1..*]
+ Breakdown_element_name: Id [0..*]
+related 0..*
1
0..*
0..1
Breakdown_element_structure
+ Quantity_of_child_elements: Prp [0..1]
+ Installation_description: Descr [0..1]


class UoF Task
Rectifying_task
Supporting_task
Operational_task
Task_requirement
0..*
+task_justification
0..*
+preceeding
task revision
0..*
Task_change
+ Task_revision_change_description: Descr [0..1]
Task
+succeeding
task revision
0..*
+ Task_identifier: Id [1..*]
+ Task_revision_identifier: Id
+ Task_name: Id [1..*]
+ Task_revision_status: Class [0..1]
+ Information_code: Class
+ Task_criticality_code: Class [0..1]
+ Task_operability_code: Class
+ Task_duration: Prp [0..*]
+ Task_total_labour_time: Prp [0..*]
+ S1000D_task_type: Class [0..1]
Document
S1000D_data_module
0..*
0..*
1
0..*
Task_warning_caution_or_note
0..*
1
Warning_caution_or_note
+ Warning_caution_or_note: Descr
+ Warning_caution_or_note_type: Class [0..1]
1
0..*
Subtask_warning_caution_or_note
0..*
1
+referenced_task
1
+related_subtask
0..1
1
1..*
Subtask
+ Subtask_identifier: Id
+ Subtask_role: Class [0..1]
Subtask_timeline
+ Subtask_timeline_event: Class
+ Subtask_timeline_lag: Prp
0..*
0..*
Subtask_by_reference
Subtask_by_external_reference
Subtask_by_definition
+ Subtask_revision_identifier: Id
+ Subtask_name: Id
+ Information_code: Class
+ Subtask_description: Descr [0..1]
+ Subtask_duration: Prp [1..*]
+ Maintenance_location_code: Class [0..1]
0..*
+external_reference
1..*
Document
External_document
Zone_element_revision
+in_zone
1
0..*
Subtask_in_zone
0..*
1
0..*
0..*
«interface»
Subtask_target_item
0..*
Subtask_objective_state
+ Subtask_objective_state: Class
Subtask_acceptance_parameter
+ Subtask_acceptance_parameter_description: Descr
+ Subtask_acceptance_parameter_value: Prp [1..*]
Breakdown_element_revision
Part
Subtask_circuit_breaker_state
0..1
+circuit_breaker_localization
0..*
0..*
1
Product
1
0..*
Circuit_breaker_in_product
1..*
1
Circuit_breaker
+ Circuit_breaker_identifier: Id
+ Circuit_breaker_name: Id
+ Circuit_breaker_type: Class
«interface»
Product_variant_applicability_interface

Chapter 20 - data exchange

Data exchange specification (DEX)

Purpose

Definition of **data exchange specifications (DEX)** based on existing data exchange specifications of the PLCS data model.

ISO Standard:

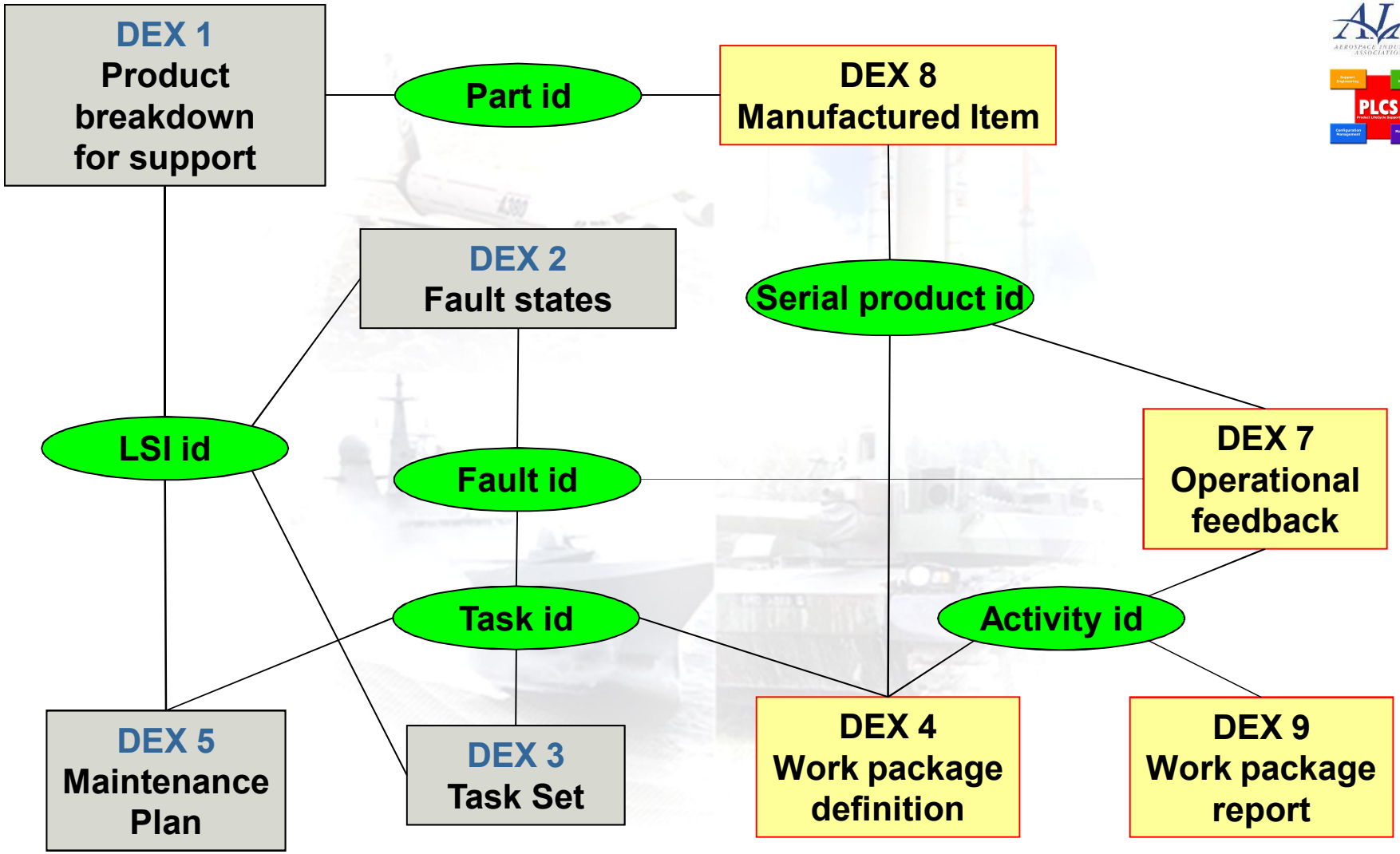
ISO 10303 **STEP AP**239 Product Life Cycle Support (PLCS) data model
(**ST**andard for **E**xchange of **P**roduct Data - **A**pplication **P**rotocol 239)

DEX1A&D — Aerospace and defense business DEX (product breakdown data)

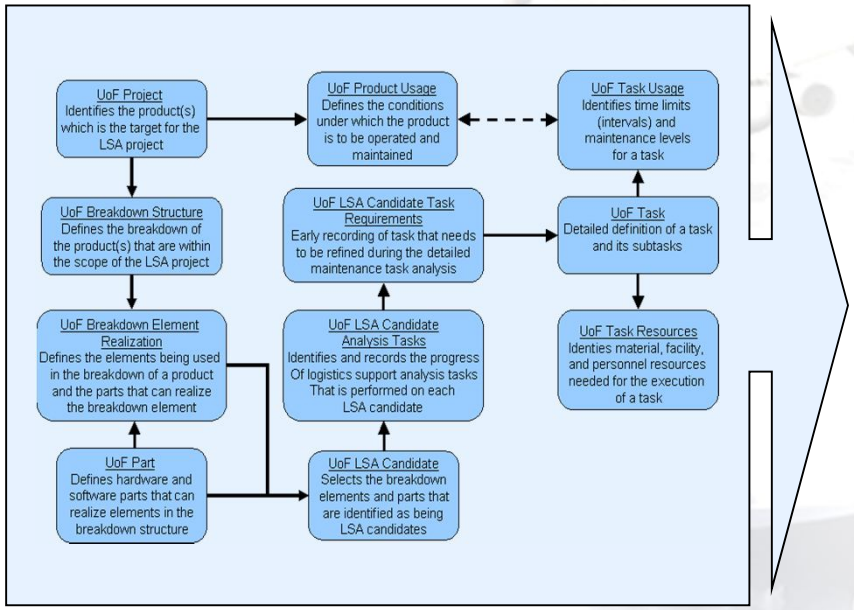
DEX3A&D — Aerospace and defense business DEX (maintenance tasks data)

S3000L **A&D DEXs** are a **specialization** of the existing PLCS DEXs

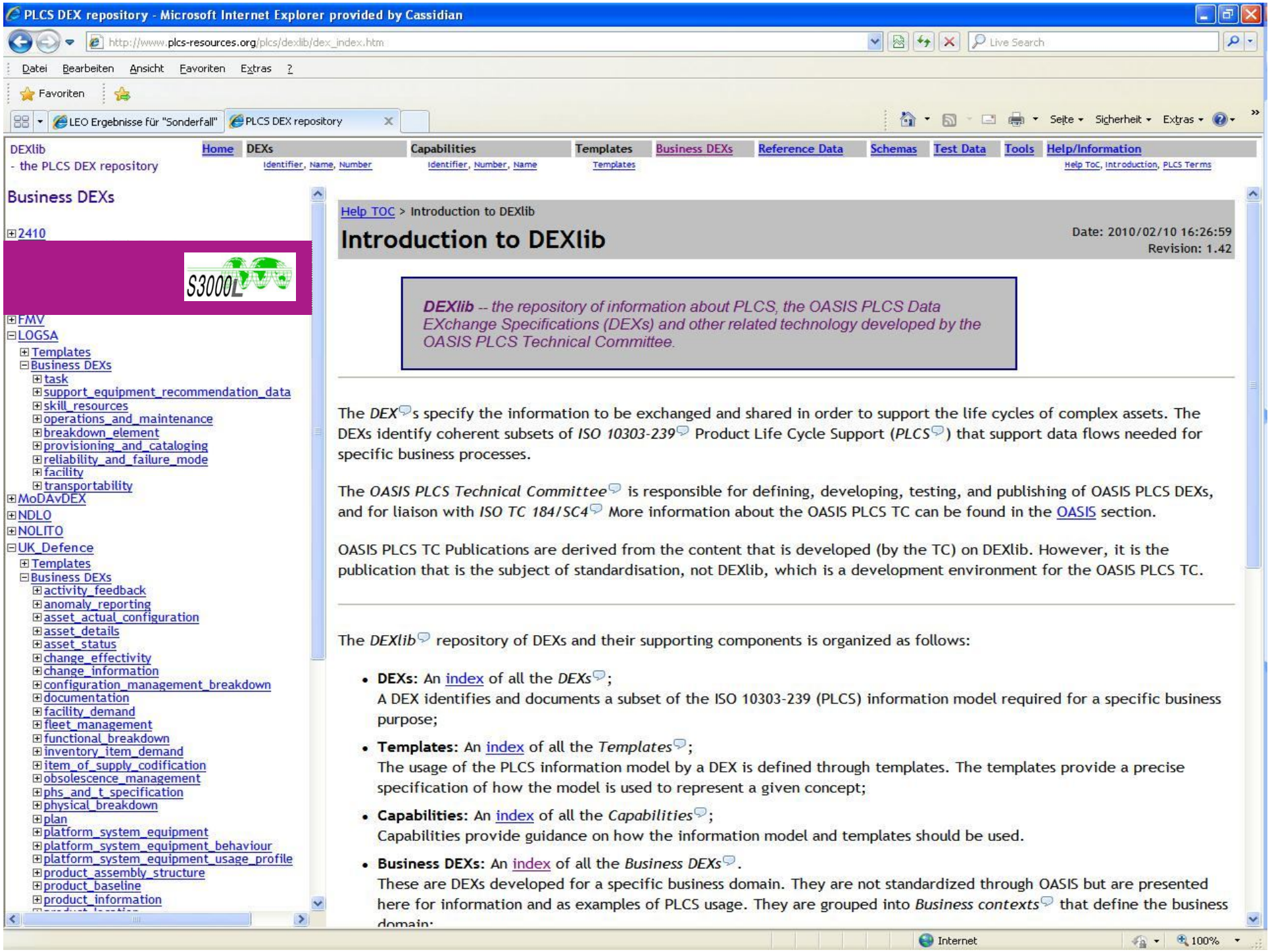
PLCS DEX architecture



S3000L DEXs are developed within the open development environment of **OASIS dexlib**



http://www.plcs-resources.org/plcs/dexlib/dex_index.htm


PLCS DEX repository - Microsoft Internet Explorer provided by Cassidian
http://www.plcs-resources.org/plcs/dexlib/dex_index.htm
Live Search
Datei Bearbeiten Ansicht Favoriten Extras ?
Favoriten
LEO Ergebnisse für "Sonderfall"
PLCS DEX repository
Seite Sicherheit Extras
DEXlib
- the PLCS DEX repository
Home
DEXs
Identifier, Name, Number
Capabilities
Identifier, Number, Name
Templates
Templates
Business DEXs
Reference Data
Schemas
Test Data
Tools
Help/Information
Help TOC, Introduction, PLCS Terms
Business DEXs
2410
S3000L
FMV
LOGSA
Templates
Business DEXs
task
support_equipment_recommendation_data
skill_resources
operations_and_maintenance
breakdown_element
provisioning_and_cataloging
reliability_and_failure_mode
facility
transportability
MoDAvDEX
NDLO
NOLITO
UK_Defence
Templates
Business DEXs
activity_feedback
anomaly_reporting
asset_actual_configuration
asset_details
asset_status
change_effectivity
change_information
configuration_management_breakdown
documentation
facility_demand
fleet_management
functional_breakdown
inventory_item_demand
item_of_supply_codification
obsolescence_management
phs_and_t_specification
physical_breakdown
plan
platform_system_equipment
platform_system_equipment_behaviour
platform_system_equipment_usage_profile
product_assembly_structure
product_baseline
product_information
Help TOC > Introduction to DEXlib
Introduction to DEXlib
Date: 2010/02/10 16:26:59
Revision: 1.42
DEXlib -- the repository of information about PLCS, the OASIS PLCS Data EXchange Specifications (DEXs) and other related technology developed by the OASIS PLCS Technical Committee.
The DEXs specify the information to be exchanged and shared in order to support the life cycles of complex assets. The DEXs identify coherent subsets of ISO 10303-239 Product Life Cycle Support (PLCS) that support data flows needed for specific business processes.
The OASIS PLCS Technical Committee is responsible for defining, developing, testing, and publishing of OASIS PLCS DEXs, and for liaison with ISO TC 184/SC4 More information about the OASIS PLCS TC can be found in the OASIS section.
OASIS PLCS TC Publications are derived from the content that is developed (by the TC) on DEXlib. However, it is the publication that is the subject of standardisation, not DEXlib, which is a development environment for the OASIS PLCS TC.
The DEXlib repository of DEXs and their supporting components is organized as follows:
DEXs: An index of all the DEXs;
A DEX identifies and documents a subset of the ISO 10303-239 (PLCS) information model required for a specific business purpose;
Templates: An index of all the Templates;
The usage of the PLCS information model by a DEX is defined through templates. The templates provide a precise specification of how the model is used to represent a given concept;
Capabilities: An index of all the Capabilities;
Capabilities provide guidance on how the information model and templates should be used.
Business DEXs: An index of all the Business DEXs.
These are DEXs developed for a specific business domain. They are not standardized through OASIS but are presented here for information and as examples of PLCS usage. They are grouped into Business contexts that define the business
Internet
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Business DEXs

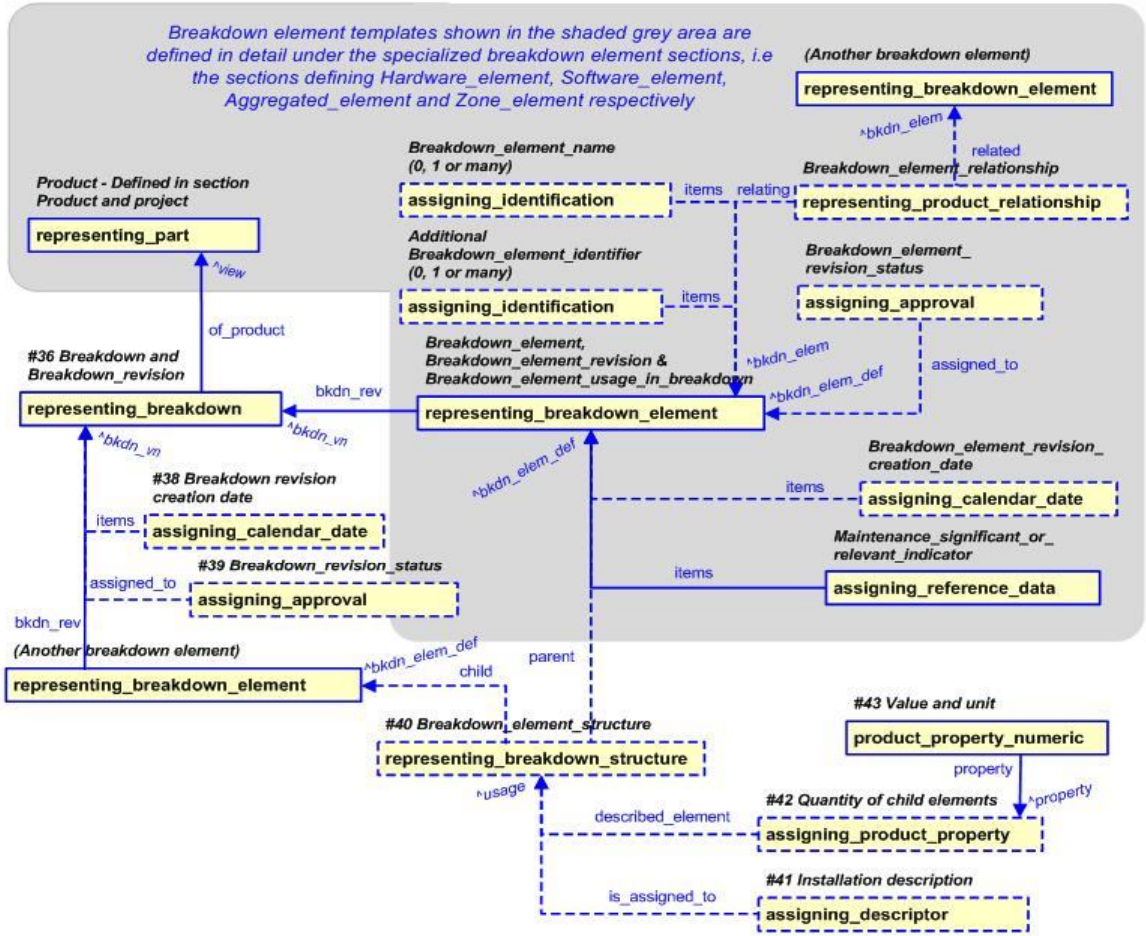


Figure 3 — UoF Breakdown structure

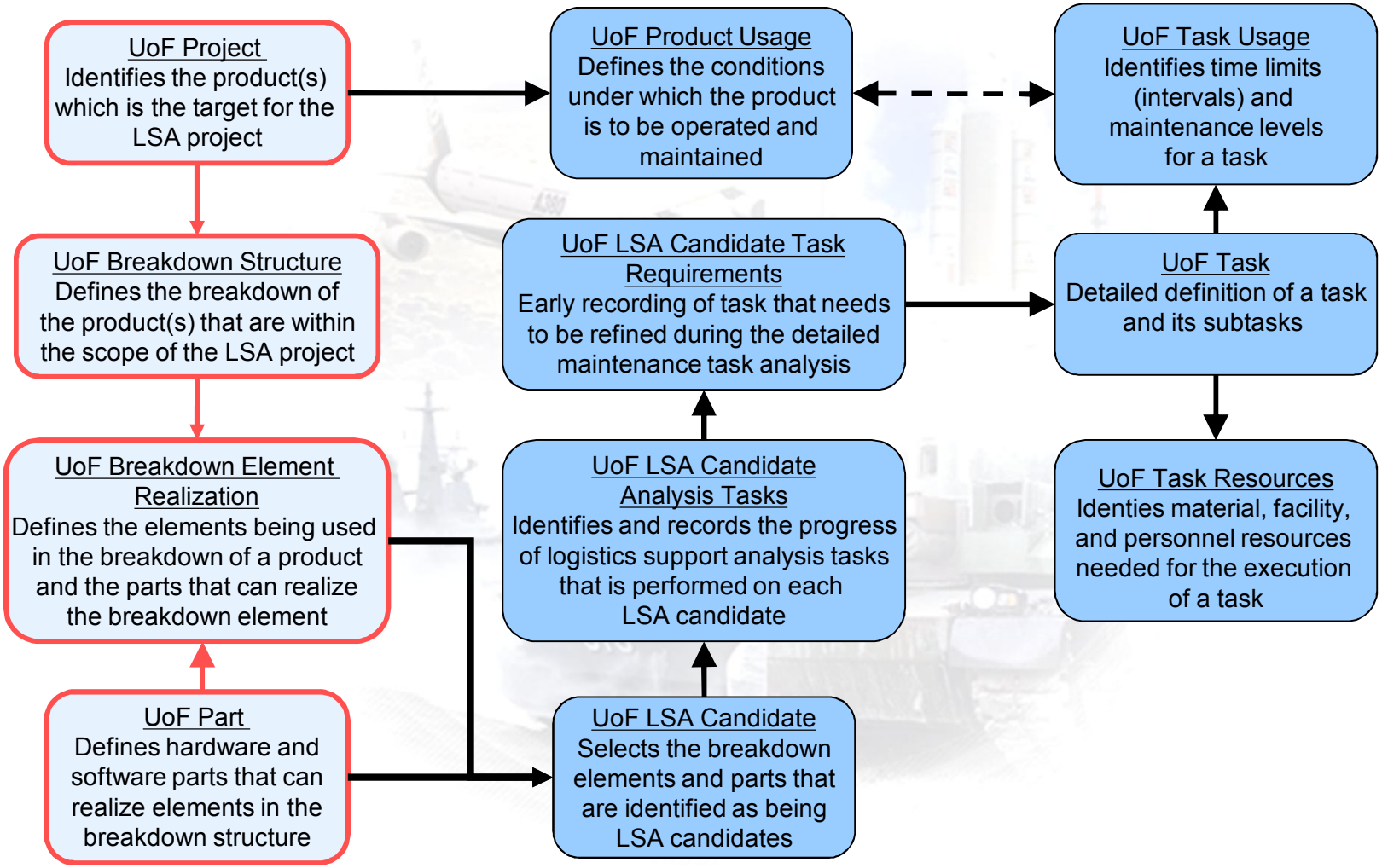
Representation of a Breakdown and its revision

Template instantiation for a breakdown and its revision must follow the rules defined in template table: Template #36(Figure 3) template table: Template #38(Figure 3), and template table: Template #39(Figure 3).

Template #36 (Figure 3): representing_breakdown

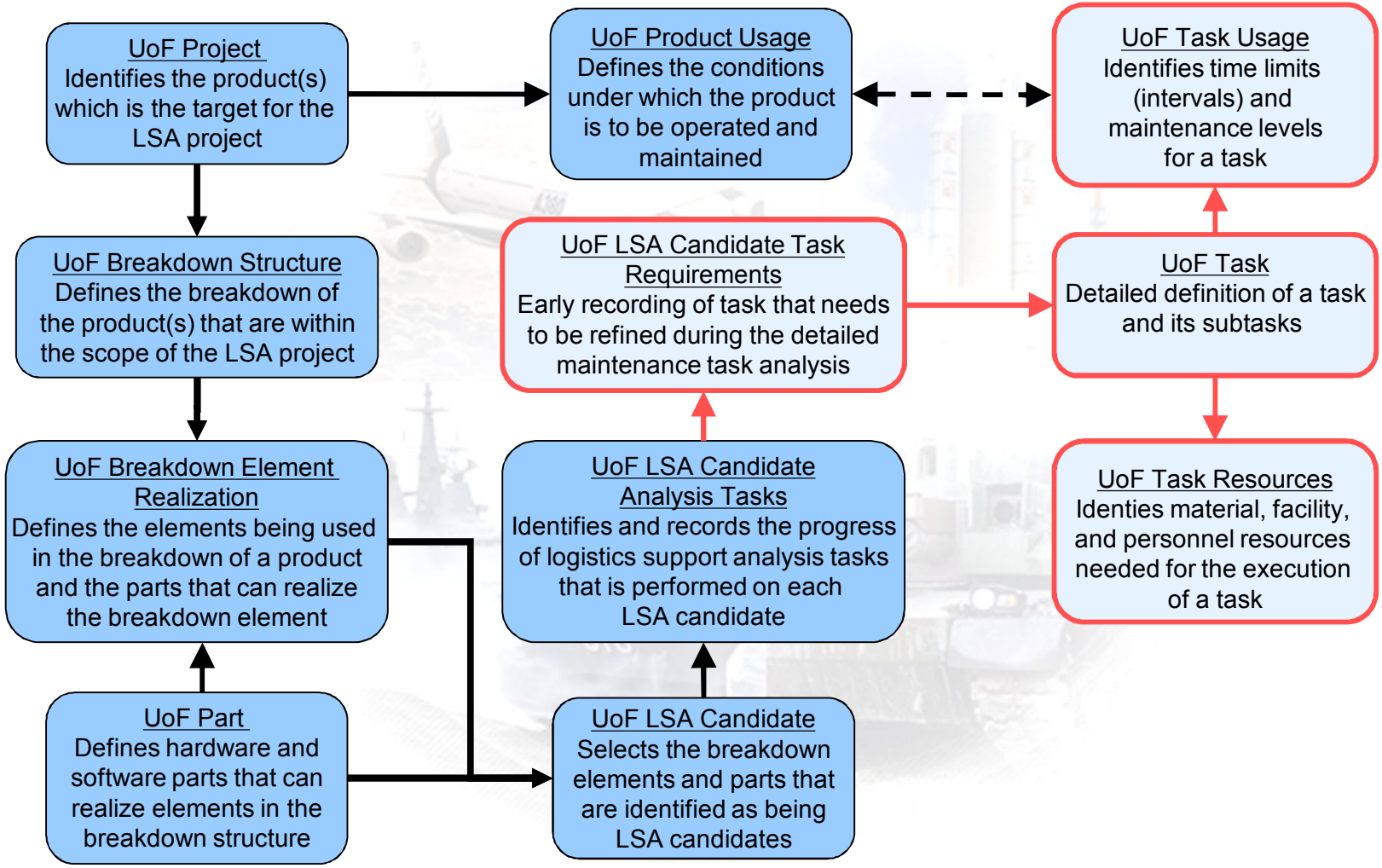
Hide template parameters | Hide all template parameters | Show all template parameters

DEX1 - Aerospace and Defence Product Breakdown for Support



Chapter 20 - data exchange

DEX3 - Aerospace and Defence Task Set



Chapter 19/20 - data model and data exchange

Summary

Predicated on **ISO 10303 AP239 Product Life Cycle Support (PLCS) data model**

Documents the data **from the S3000L chapters**

Contains the data required to “build” task related S1000D **data modules**

Basis for **DEX1A&D** and **DEX3A&D**

Each **A&D DEX** supports a **subset** of the S3000L Data Model

Working platform **OASIS dexlib (**using the same infrastructure as the OASIS PLCS DEXs)

Realized for S3000L, issue 1.0:

- **DEX1** Product Breakdown for Support
- **DEX3** Task Set

Table of content

- Introduction to Logistic Support Analysis
- The ASD/AIA Specification Suite

- S3000L - Content overview
- S3000L - Chapter overview (selected chapters)
- S3000L - Data model and data exchange (DEXs)
- S1003X - Data exchange to Technical Publication (S1000D)

ASD/ AIA S1003X - data exchange from S3000L to S1000D

Summary

Objective:

Specify data required from the product development and Logistic Support Analysis (LSA) activities, in order to produce **task related data modules** in S1000D.

Scope:

S1000D maintenance **procedure** schema

S1000D maintenance **planning** schema

S1000D **applicability** cross-reference table schema

S1000D **conditions** cross-reference table schema

ASD/ AIA S1003X - data exchange from S3000L to S1000D

Relevant data/information in both specifications

- **Task identifier**
  Unique identifier in S3000L for each task (Supporting, Rectifying & Operational)
- **Information Code** - S1000D identification of activity
- **Subtask identifier** - Task step
- **Data Module Code** - Key data element in S1000D
- **Scheduled Tasks**
  Limits (perform once, periodic & on condition), threshold, triggers, sampling, mixed limits (whichever comes first)
- **Task/Subtask Resources**
  Material and Facilities, Personnel by Role, Skill and Trade

ASD/ AIA S1003X - data exchange from S3000L to S1000D

Content and key areas

Content:

High level S1000D to S3000L **data relationships**

Detailed S1000D to S3000L **data element matrix** and business rules

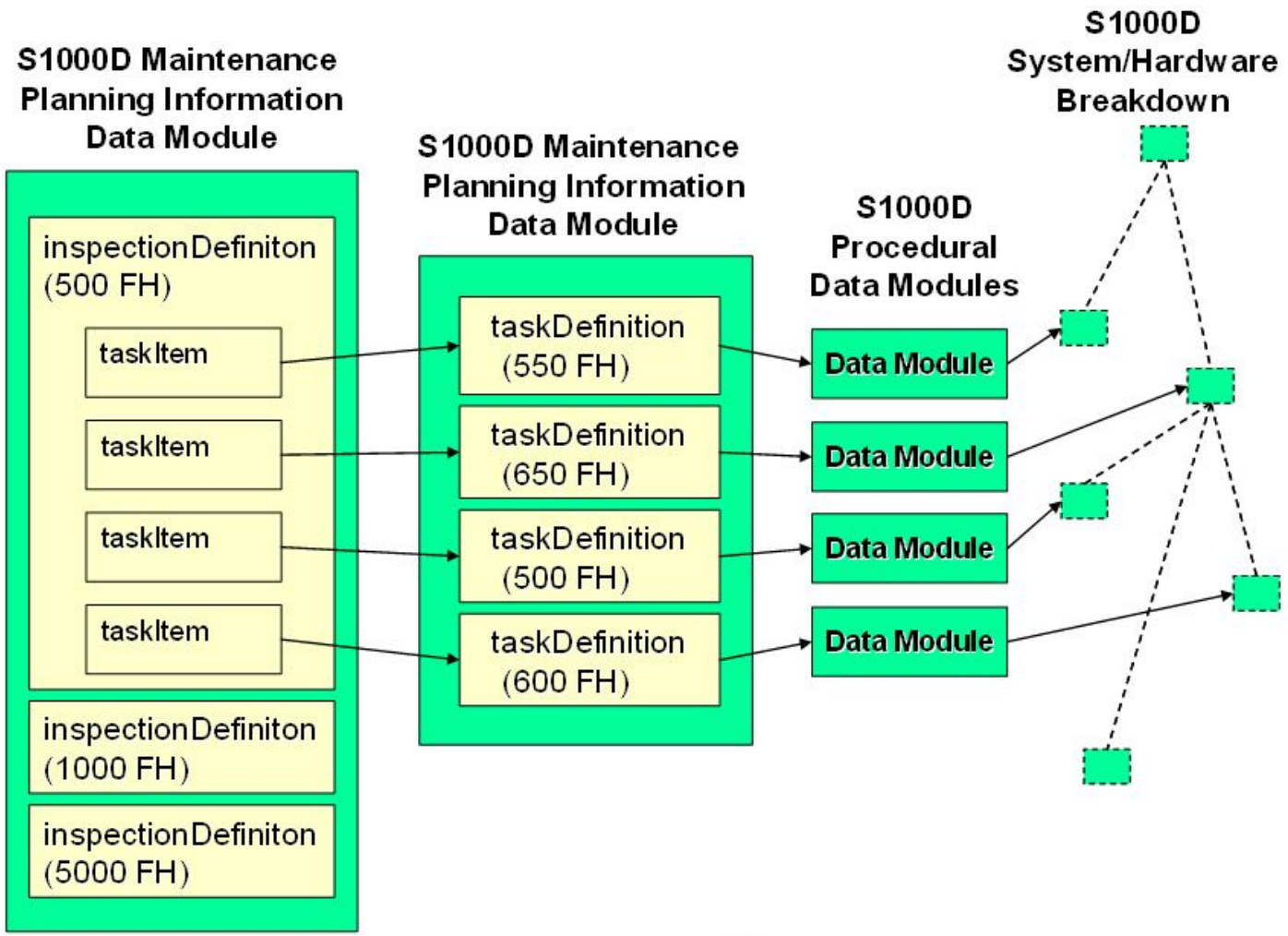
S3000L to S1000D **data element identification**

Key areas:

- Product breakdown
- Task and task structures
- Task limits
  Thresholds / limits / triggers
- Applicability statements

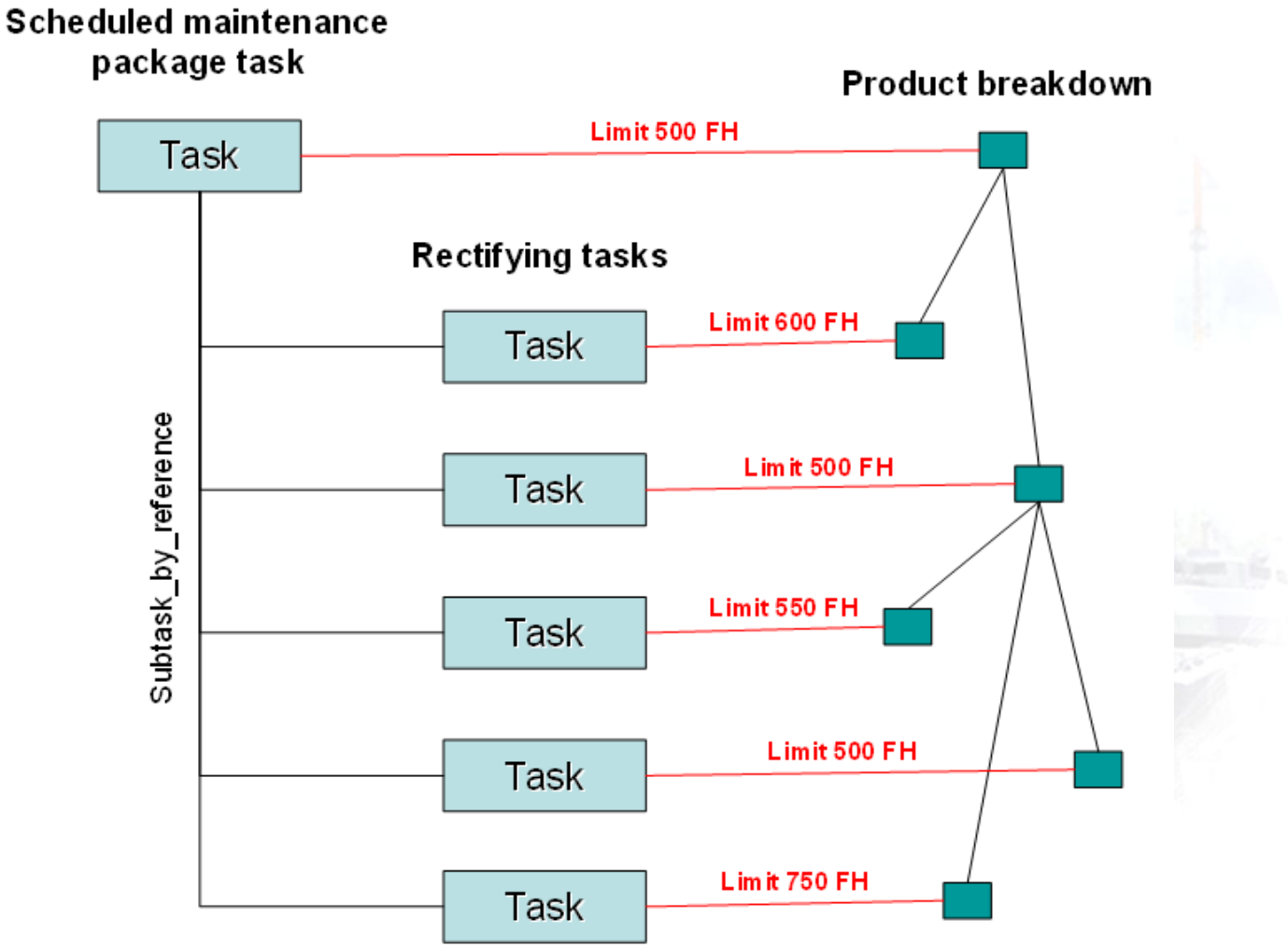
ASD/ AIA S1003X - data exchange from S3000L to S1000D

Example for task hierarchy in S1000D



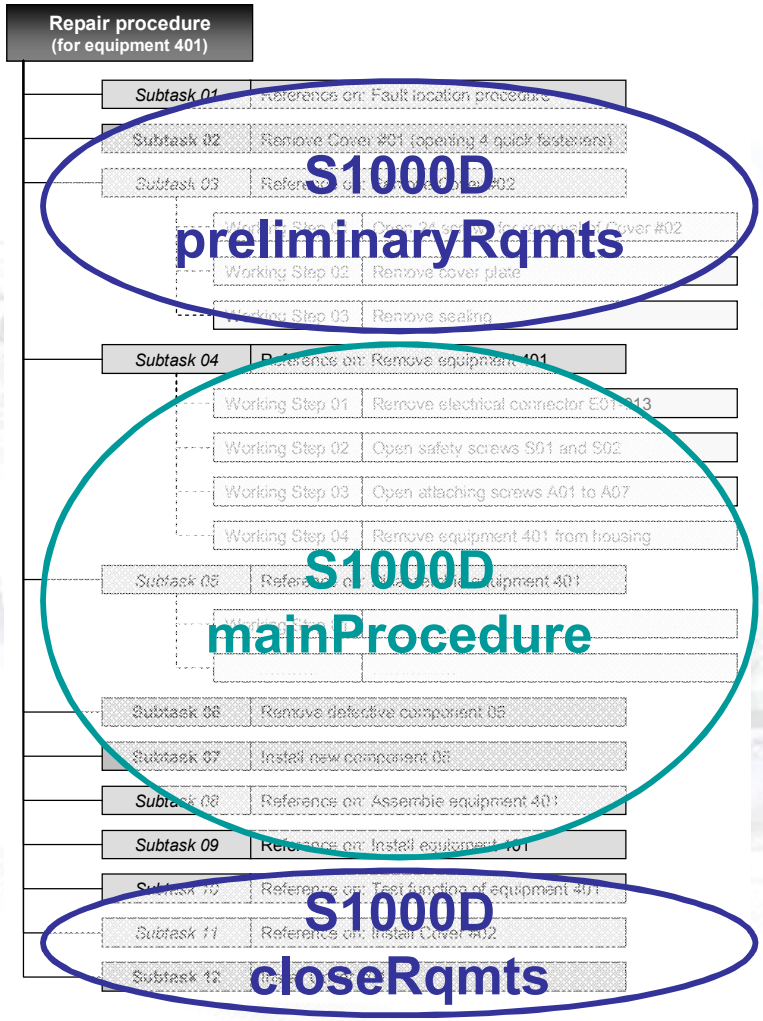
ASD/ AIA S1003X - data exchange from S3000L to S1000D

Example for task hierarchy in S3000L

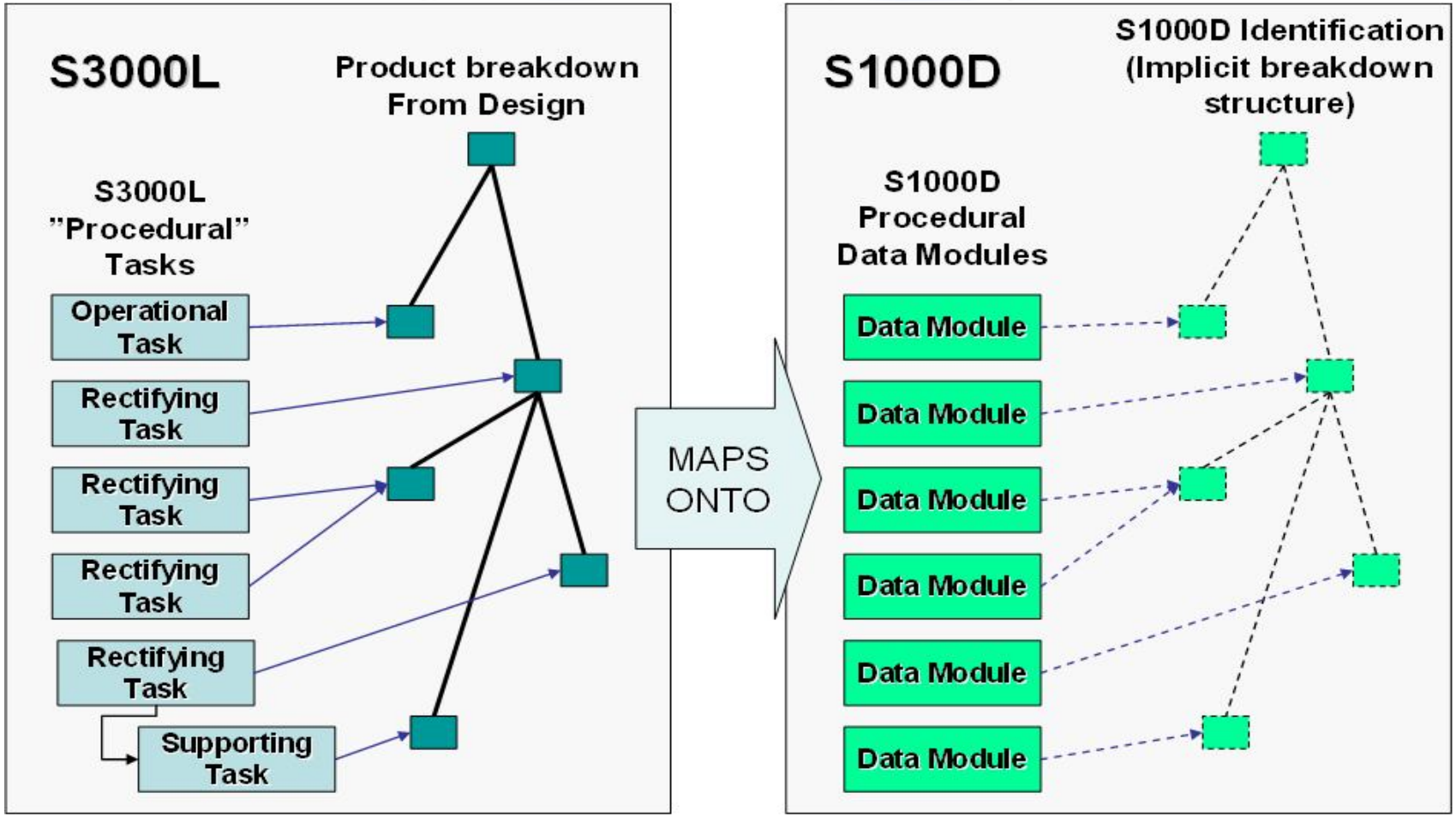


ASD/ AIA S1003X - data exchange from S3000L to S1000D

Task scope in S1000D

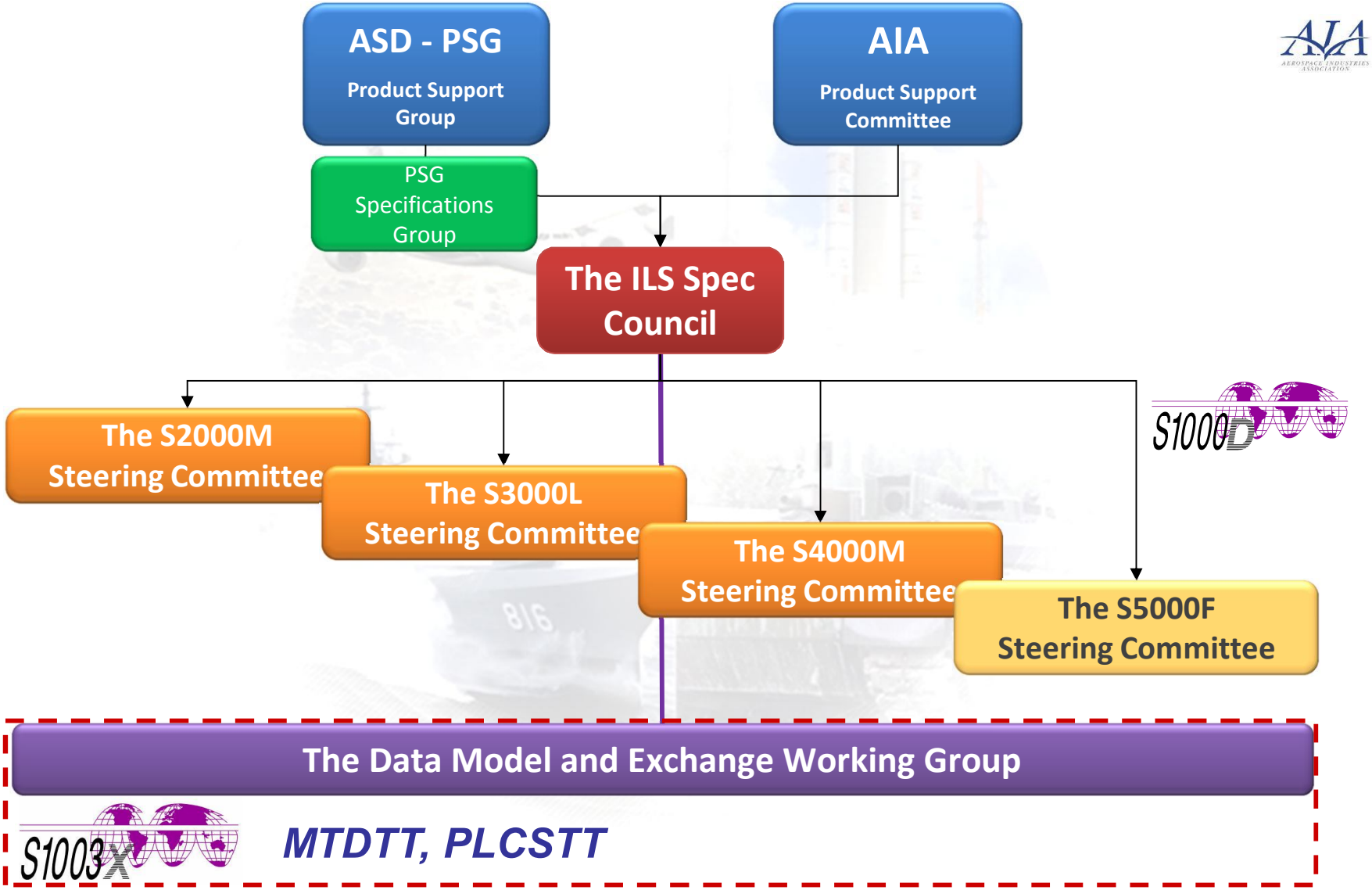


Idealization: A S3000L task maps S1000D data module

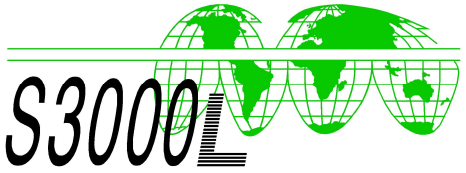


ASD/ AIA S1003X - data exchange from S3000L to S1000D

Responsible organization within ASD/AIA for data exchange specifications








Questions ?

Thank you for your staying power !