



# INTRODUCING SUPPORT SYSTEMS FOR SAAB ELECTRONIC WARFARE SYSTEMS AND PRODUCTS

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# AGENDA

- ▶ Introduction of myself and SAAB
- ▶ Business challenges ahead for SAAB
- ▶ Systems Engineering is the way forward for SAAB
- ▶ Improvement Project of In Service Support at EW Systems
  - ▶ What?
  - ▶ How?
  - ▶ Observations & Conclusions
- ▶ Discussion from a CM perspective

# MY (OWN) MISSION AT SAAB

- ▶ Combine Business with Systems Engineering = Business Engineering!
- ▶ Risk Management
- ▶ Configuration and Delivery Management
- ▶ Training
- ▶ Modelling and simulation
  
- ▶ At SAAB 2007 - now
  - ▶ Employee at EW Systems/Surveillance 2013 - now
  - ▶ Consultant at Combitech 2007 – 2013
  
- ▶ Various assignments within SAAB:
  - ▶ Surveillance, Systems Engineering in internal and customer projects  
(2013 – now)
  
  - ▶ Aeronautics, Development of Training for Model Based Flight Simulation &  
Linköping Support to Product Management for Simulator Products  
(2012 – 2013)
  
  - ▶ Surveillance, Configuration Management & Systems Engineering  
Järfälla (2009 – 2012)
  
  - ▶ Dynamics, Configuration Management &  
Linköping Product Management Support  
(2007 – 2009)
  
- ▶ Contact me at: [mikael.g.larsson@saabgroup.com](mailto:mikael.g.larsson@saabgroup.com)

# SAAB IN A (VERY) FEW BULLETS

- ▶ SAAB = Svenska Aeroplan Aktiebolaget (Swedish Aeroplane Corporate). The roots are in airplane business since 75+ years.
- ▶ Today a diversified supplier of defence products for Air, Land and Sea
- ▶ Several Business Areas with different products, history, locations and culture. Please see [saabgroup.com](http://saabgroup.com) for more details.

# IMPORTANT SAAB PLATFORMS



Gripen fighter  
*Developed and produced by  
Aeronautics*



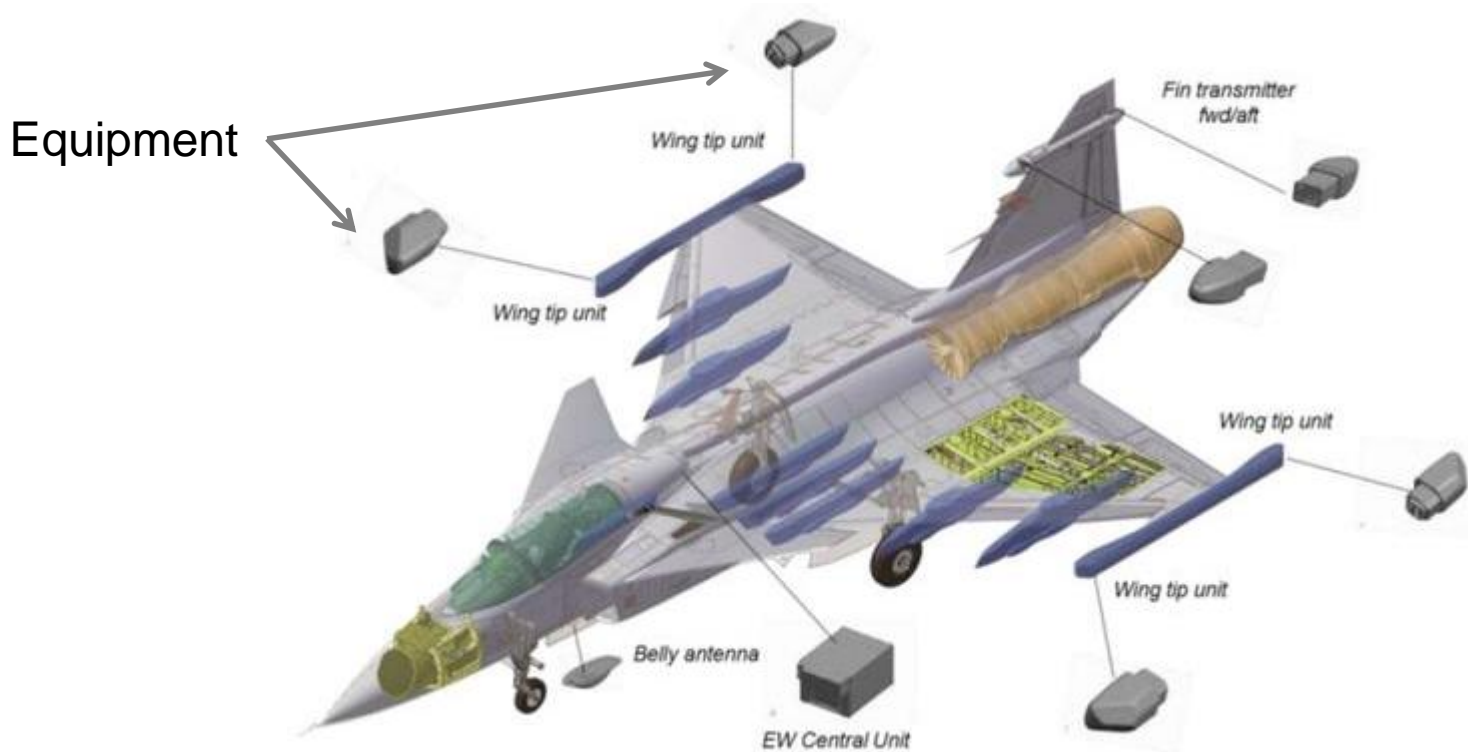
Submarines (Gotland & A26)  
*Developed and produced by  
SAAB Kockums*



Visby Corvettes  
*Developed and produced by  
SAAB Kockums*

# ELECTRONIC WARFARE (EW) FOR GRIPEN

- Sensor system (to detect threats from other weapon systems)
- Electromagnetic Countermeasures (depending on threat)
- One of the most complex system in the aircraft
- Consists of Equipment and Application Software + Ground Mission Support Systems



# BUSINESS UNIT ELECTRONIC WARFARE: SOME KEY FACTS

- ▶ *Hardware development and equipment production* has been the core business since 50 years
- ▶ Own Software development, still an add-on
- ▶ Always on a tight budget (compared to aircraft development at Aeronautics)
- ▶ Traditionally a sub-supplier of Electronic Warfare equipment to different platform (even for Gripen within SAAB)
- ▶ Partnership-level contracts with Aeronautics only in recent years
- ▶ Complex products, hard to understand for external parties, *Black Boxes*

# BUSINESS UNIT ELECTRONIC WARFARE: SOME KEY FACTS

- ▶ Has the ambition to become a leading supplier of Electronic Warfare systems
- ▶ After Sales as a function (and own department) is quite new, established 2010
- ▶ Systems Engineering thinking among a few individuals for about 10 years, an own department since 2013
- ▶ CM mostly about Document Management



# MAJOR CHALLENGES AHEAD

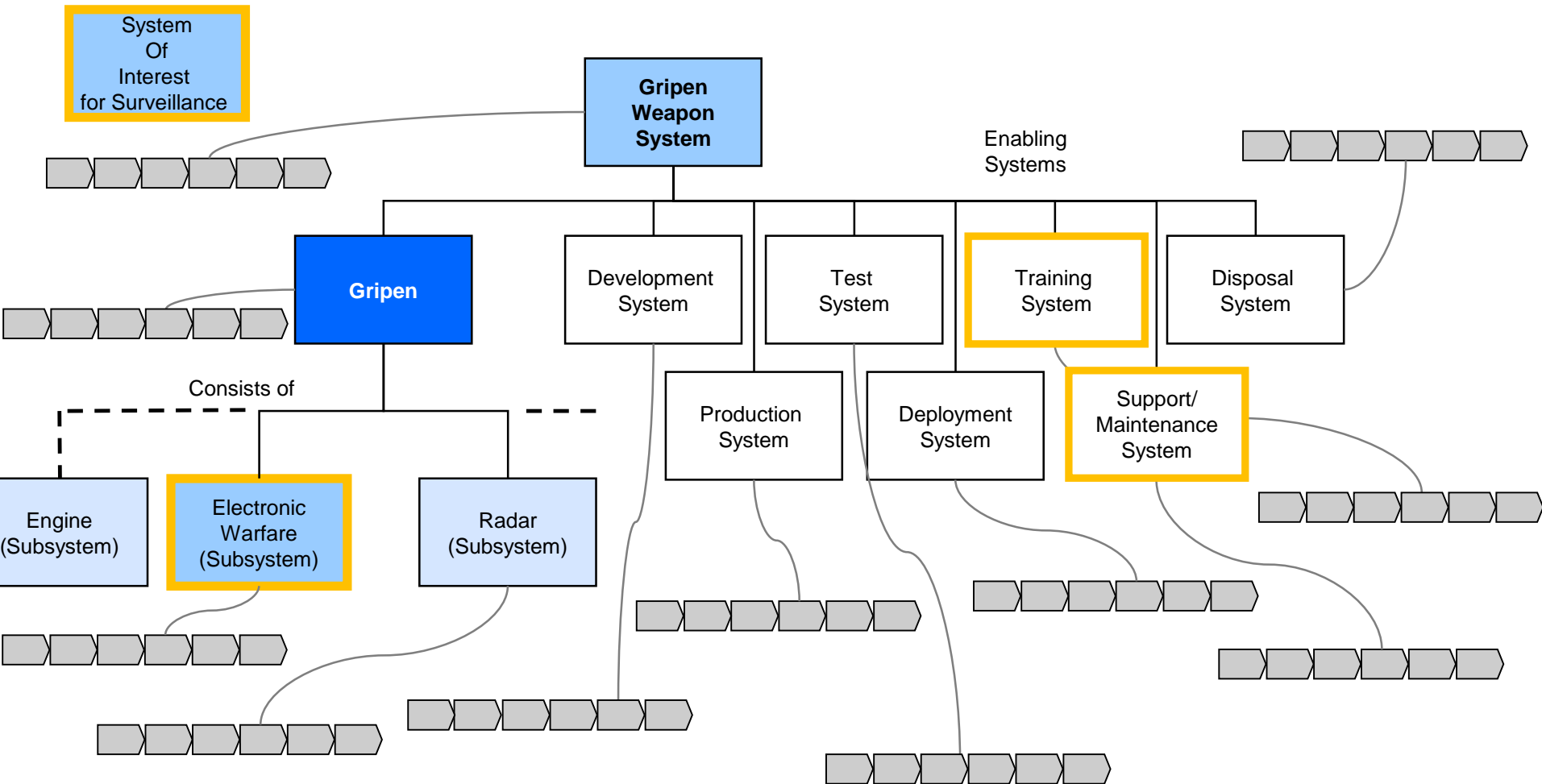
- ▶ Example: Gripen Next Generation for Brazil (Gripen NG)
- ▶ Electronic Warfare is an important sub-system
- ▶ Brazil is SAAB's own customer, puts pressure on SAAB
- ▶ Lots of technical transfer to Embraer in Brazil
- ▶ Common development of new Gripen (incl. two-seater)
- ▶ Common production of Gripen
- ▶ Support and Service contracts important
- ▶ Showtime for how to do things at SAAB!



O Globo News Magazine

# KEY TO THE FUTURE: WE SELL SYSTEMS TO OUR CUSTOMERS

Life cycle steps

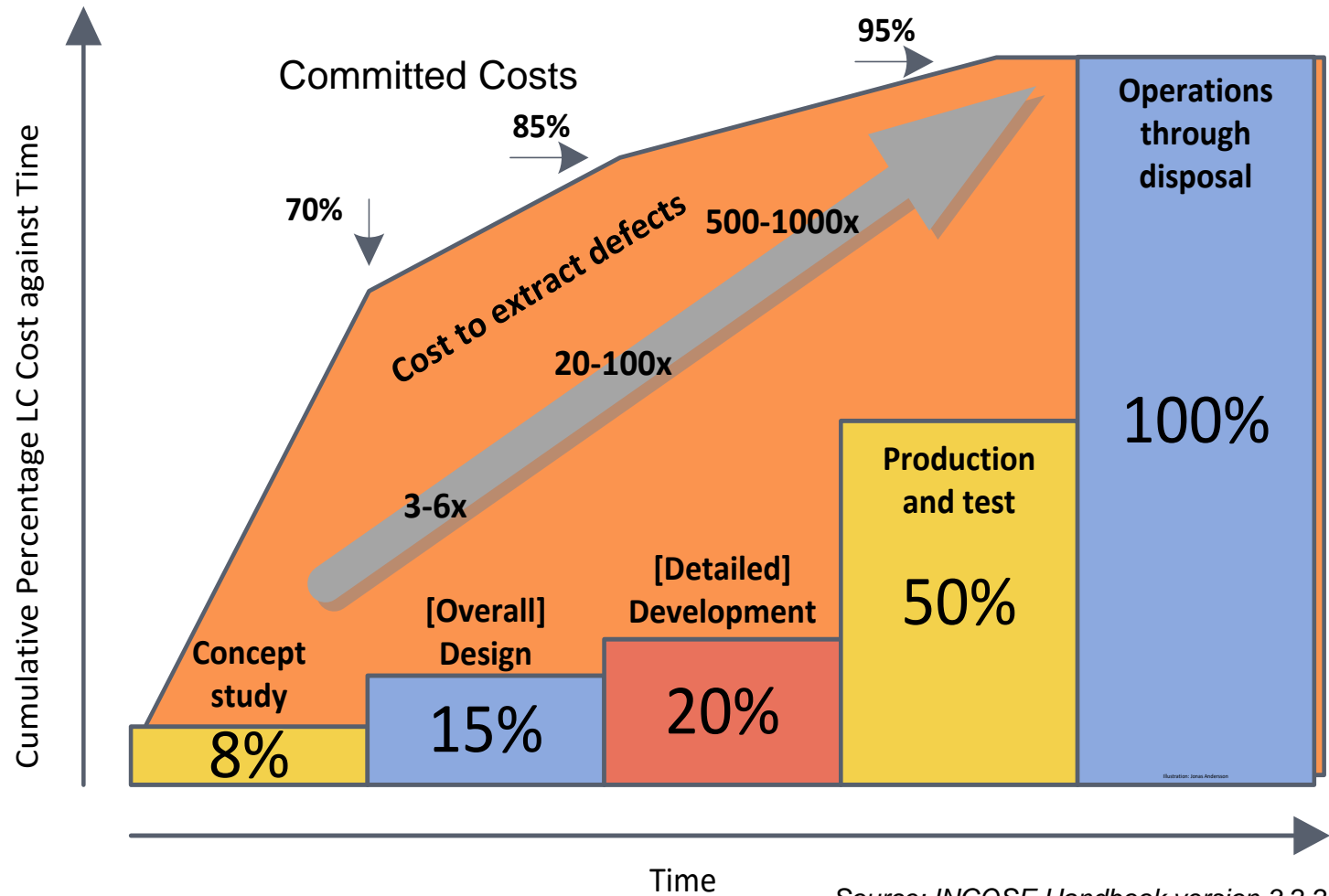


# SYSTEMS ENGINEERING IS THE KEY

- ▶ SAAB as a supplier today has to think in *systems* and *life cycles* much more than previously when the customer did it for us
- ▶ ISO/IEC 15288 is a foundation for this (see life cycle below)
- ▶ This includes the perspective of supporting customers in the Utilization and Support phase for many years (20 – 50 years are not uncommon for military products)



# GOOD SYSTEMS ENGINEERING IS GOOD BUSINESS: LIFE CYCLE COST



Source: INCOSE Handbook version 3.2.2

# CASE STUDY

## IMPROVING IN SERVICE SUPPORT AT EW SYSTEMS

# THE CHALLENGE

- ▶ A very open-ended challenge in 2014 from the After Sales department manager
- ▶ Four years of struggle, mainly repair of EW Systems for Gripen C/D
- ▶ A fact, but no general commitment in the organization
- ▶ Initially hard to define the problem of why and how to execute In Service Support in a development organization



# IDENTIFICATION OF STAKEHOLDERS

- ▶ The key to success was to apply Systems Engineering and identify the major stakeholders at EW Systems:
  - ▶ After Sales Project Office
    - ▶ Responsible for business development
    - ▶ Process responsible
  - ▶ After Sales repair and overhaul organization
    - ▶ Responsible for doing the workshop job on faulty Equipment
  - ▶ Product Portfolio Management for EW Systems
    - ▶ Responsible for defining common products or sub-products at EW Systems
    - ▶ Interested in definition of potential *Services* around the products, e.g. Training

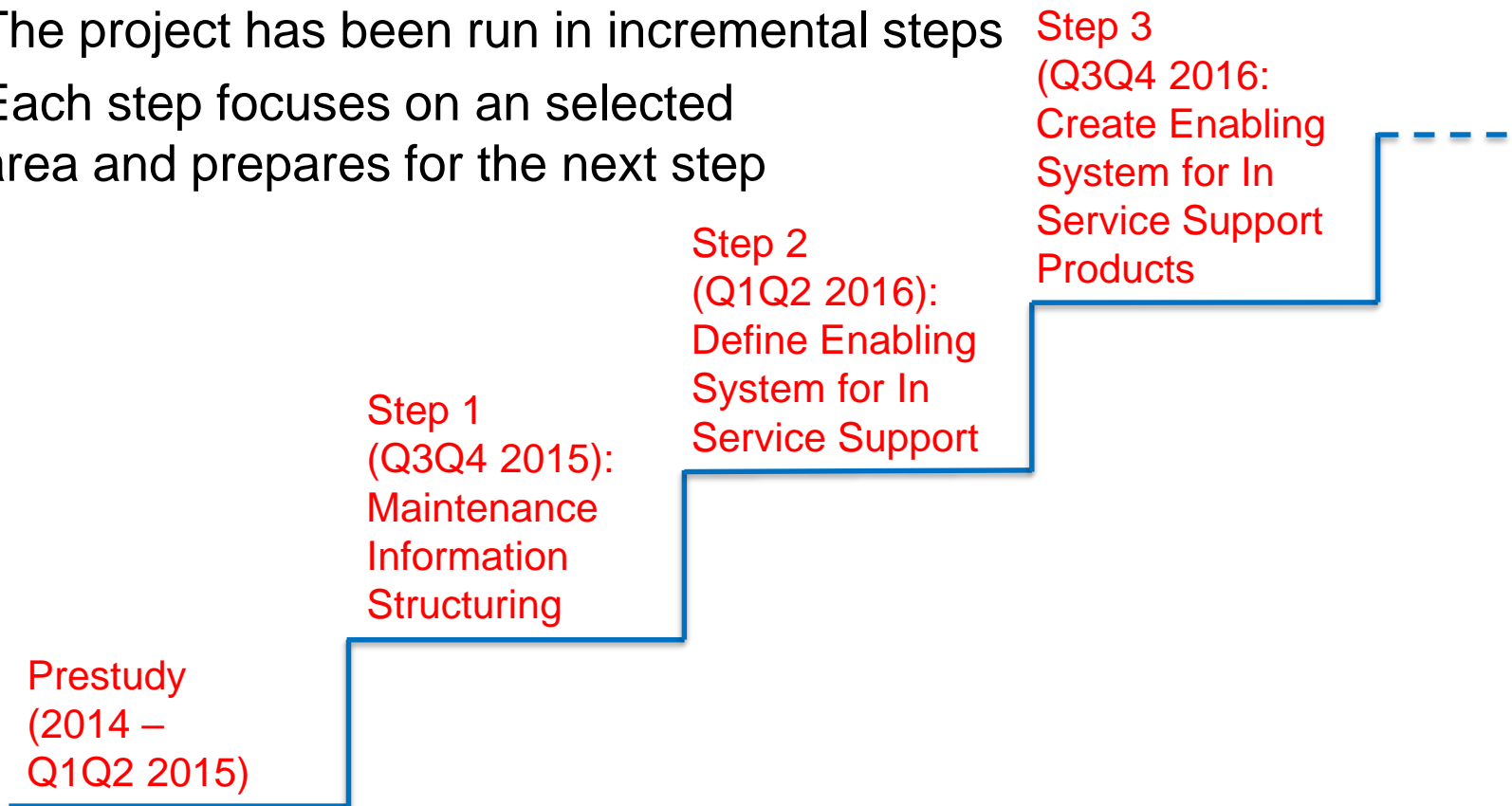
# DEFINITION OF THE PROBLEM AREA(S)

- ▶ Problems with Configuration Management for tracking delivered equipment in use, e.g.
  - ▶ Hard to trace changes on individuals done *after manufacturing*, e.g. replacement of components or modifications
  - ▶ Unclear process around Change Management and Configuration Management at EW Systems
  - ▶ Different processes for the same area, e.g. Configuration Management, at EW Systems and at Aeronautics (platform level)
- ▶ How to find relevant information about how to repair faulty equipment in an efficient way?
  - ▶ Questions from the workshop struggling with repair and overhaul
- ▶ How to create services around the products?
  - ▶ Question from portfolio with no obvious connection to the above (*An example of a service is Training*)

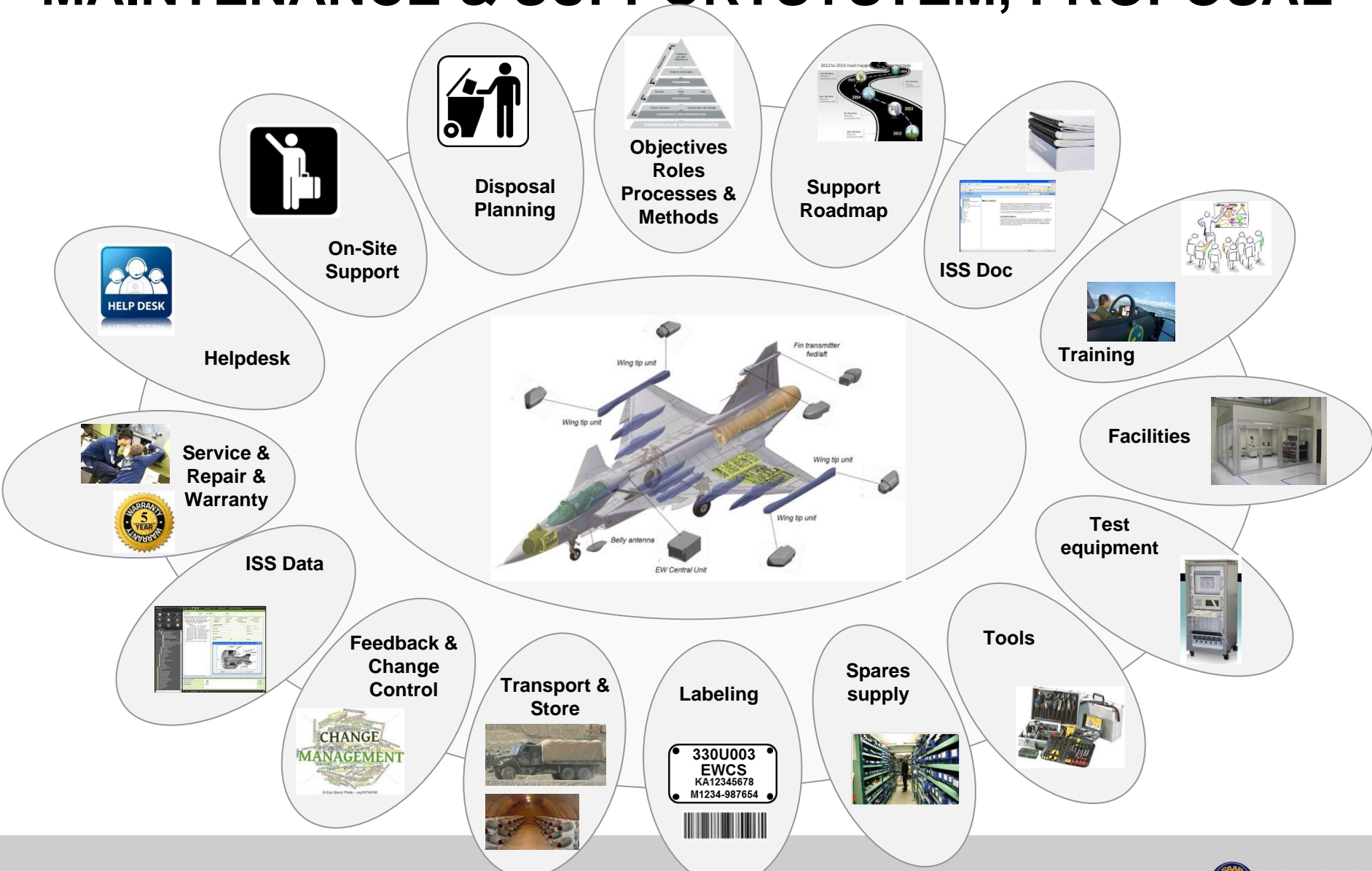


# IN SERVICE SUPPORT CAPABILITY PROJECT FOR EW SYSTEMS (CIP)

- ▶ A prestudy project was set-up in Q4 2014 to start build knowledge
- ▶ The project has been run in incremental steps
- ▶ Each step focuses on an selected area and prepares for the next step



# MAINTENANCE & SUPPORT SYSTEM, PROPOSAL



# PROPOSAL OF MAINTENANCE AND SUPPORT AS A SYSTEM

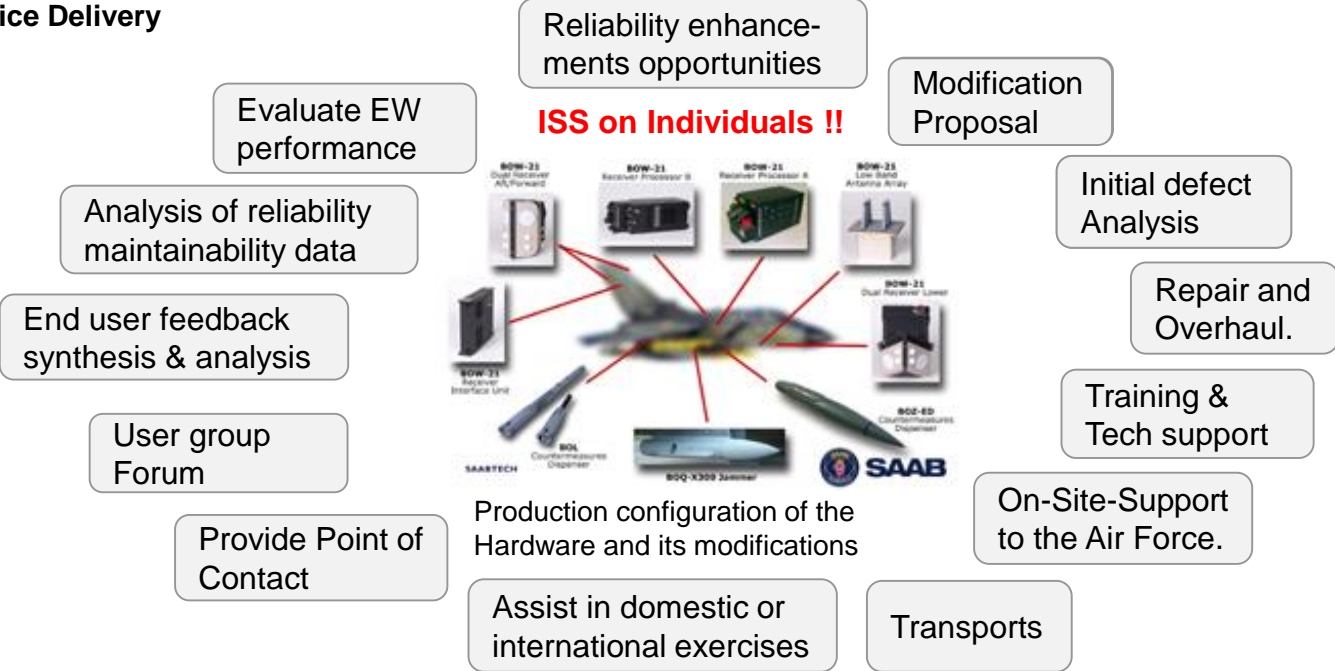
- ▶ This system is an enabling systems to the operational system of interest and includes services as an integral part
- ▶ Today EW Systems have to follow the definitions given by the customer for the content of the In Service Support contract
- ▶ There is long-term work ongoing within all of SAAB to standardize these elements as *business objects*

# EXAMPLE OF A REAL LIFE IN SERVICE SUPPORT CONTRACT

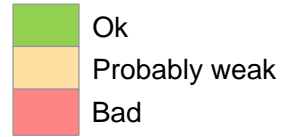
## ISS Management



## ISS Service Delivery



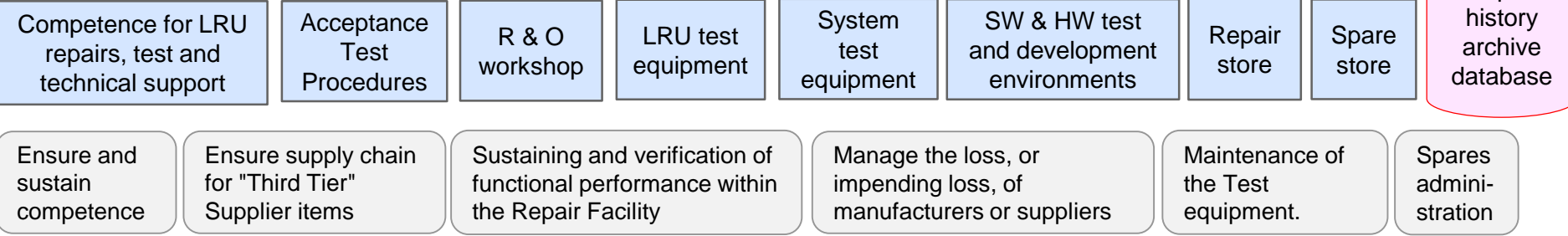
## ISS Capability Status



## Capability Elements

G	Governance
O	Organization
P	Process
M	Method
I&C	Info & Concept
IT	IT-Support

## EW Systems ISS Factory



# BASIC ENABLERS FOR IN SERVICE SUPPORT (ISS) AT EW SYSTEMS

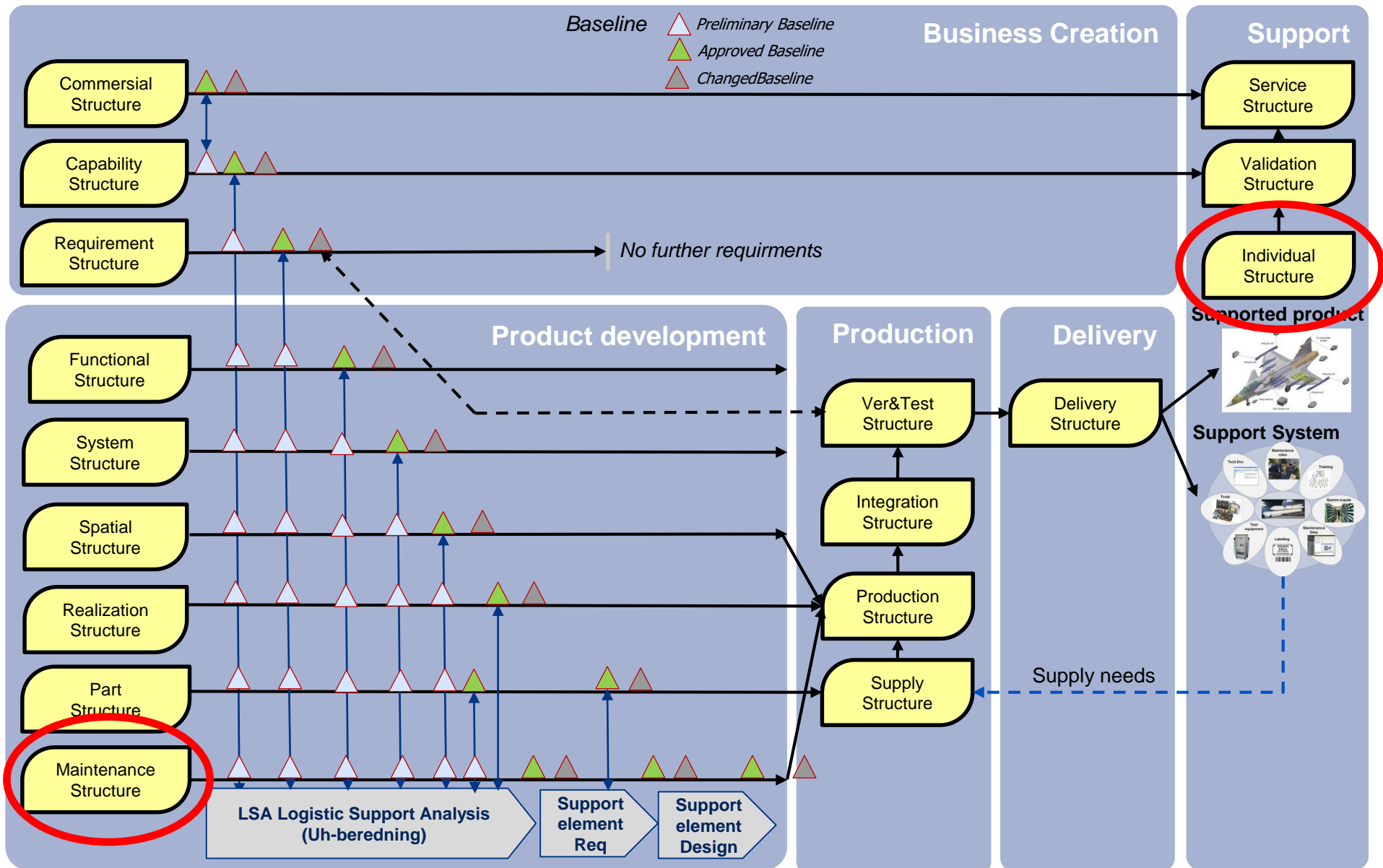
- ▶ How to structure life cycle data from sales via design to the workshop?
- ▶ How to do Change Management for delivered equipment individuals?
- ▶ How to enable and make use of feedback from the end user back into EW Systems?
- ▶ How to enable a supply chain for spares?
- ▶ How to improve test capability for In Service Support?

# How to structure Life Cycle data from sales via design to the workshop?

# STRUCTURING OF LIFE CYCLE INFORMATION

- ▶ All kinds of information that is perceived to be relevant together (e.g. for design) can be collected in a structure
- ▶ This is not only for Maintenance, but is generally true
- ▶ This need starts already with business information (customers, customer needs, sale information etc.)
- ▶ By grouping information useful along the complete life cycle, the use of the information (the information flow) can be detected and analyzed

# STRUCTURING OF INFORMATION THROUGH THE LIFE CYCLE





# CONFIGURATION MANAGEMENT

- ▶ CM is about *Information Management for all life cycle phases*, not just Document Management!
- ▶ It must be possible to move and maintain information along the life cycle phases
- ▶ Today there is a lock-in effect where different tools are used by different disciplines
- ▶ It must be possible to find the correct design for an old equipment individual in for service
- ▶ Tools for product life cycle management must therefore support *Baseline Management*

# LOGISTICS SUPPORT ANALYSIS

- ▶ Planning for In Service Support need to start early
- ▶ Logistics Support Analysis (LSA) is a central activity for developing products to be used for a long time
- ▶ During early phases predictions are made (Initial LSA)
- ▶ LSA data must be kept up-to-date during Utilization and Support (Continuous LSA)  
*(Failure Reporting, Analysis and Corrective Action System, FRACAS)*
- ▶ The supply chain (spares) is improved with help of LSA

# How to do Change Management for delivered equipment individuals?

# CHANGE MANAGEMENT

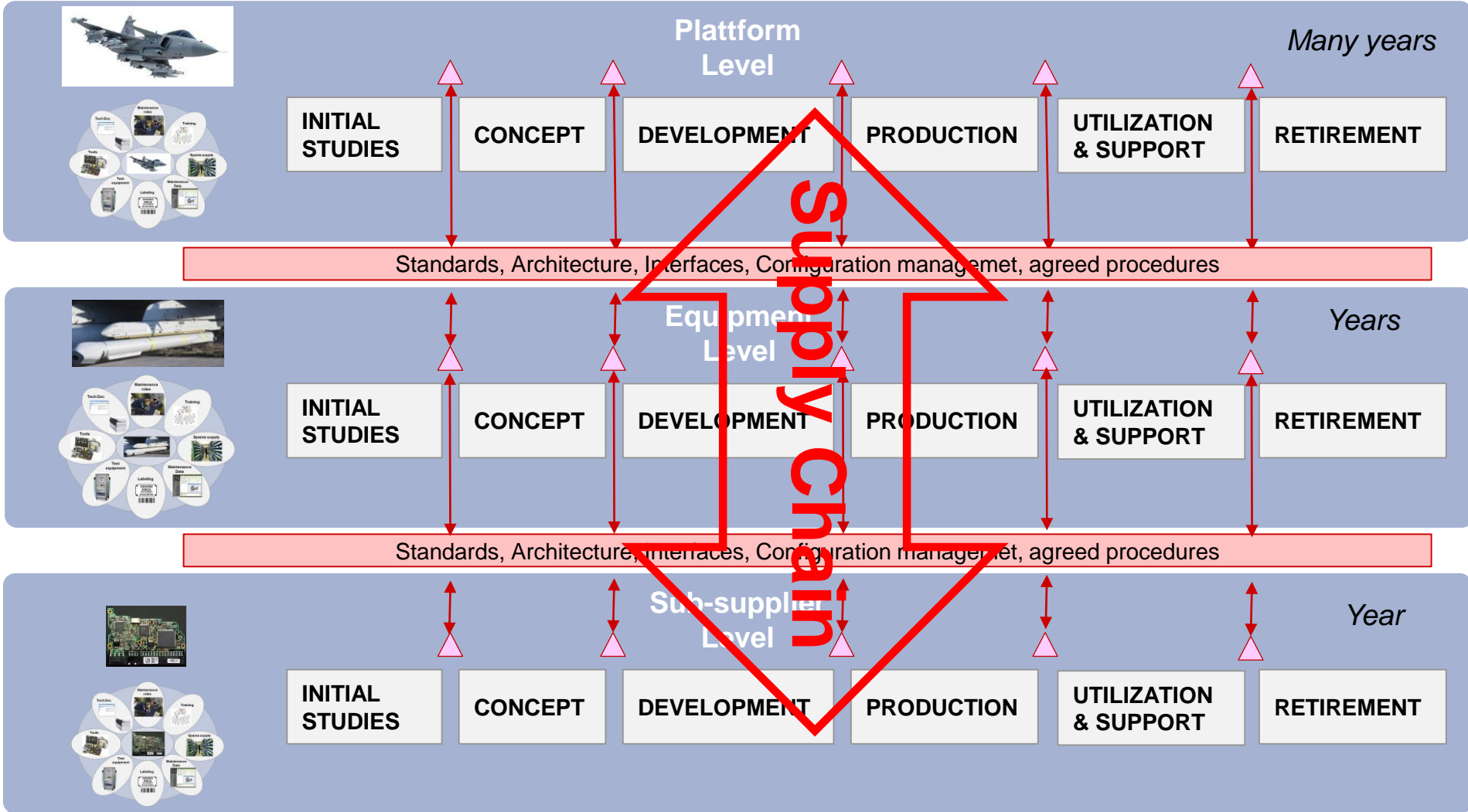
- ▶ After delivery the product belongs to the customer!
- ▶ The customers are often responsible for air worthiness and need to declare all changes of an individual (*Part Number + Serial Number*)
- ▶ Customers have different Modus Operandi:
  1. The customer needs to be informed regarding changes
  2. The customer needs to approve changes
  3. The supplier is required to be able to account for changes made to particular individuals
- ▶ The ISS contracts are written without any communication with e.g. CM

# CHANGE MANAGEMENT, CONT'D

- ▶ No support in Management System how to tailorize work methods to different Modus Operandi
- ▶ CM as a role is not involved in the early contractual phases
- ▶ CM is often seen as support to other more active roles
- ▶ The CM roles needs to be developed to become a specialized System Engineering role!

# How to enable a Supply Chain for spares?

# SUPPLY CHAIN IN THE LIFE CYCLE



# SPARES AND SUPPLY CHAIN

- ▶ All products in operational use needs spares
- ▶ A spare is used to *restore functionality* for a product
- ▶ Functionality is related to a certain design and thus the requirements for that design
- ▶ To secure availability of spares, the supply chain need to be open for a very long time



# CONSISTENCY OF SUPPLY CHAIN

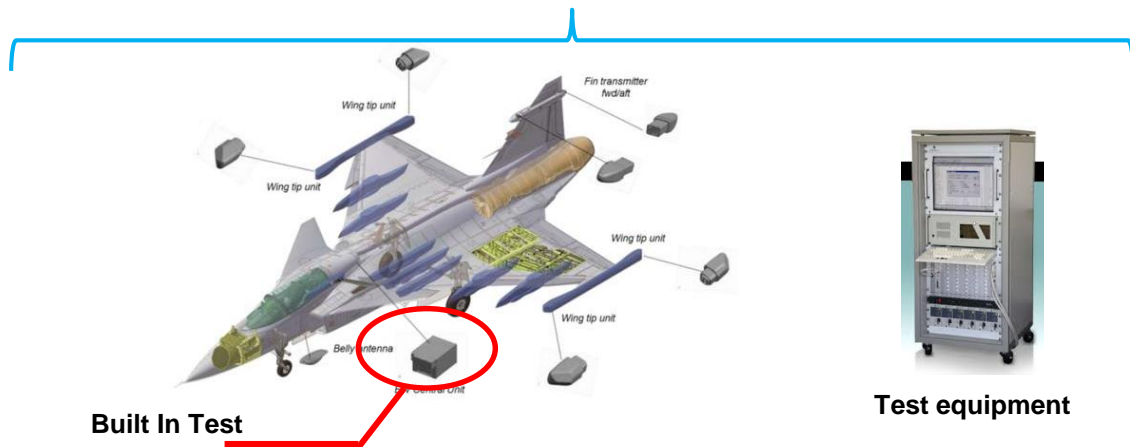
- ▶ What spares that are needed will change over time:
  - ▶ The maintenance concept of the customer will change
  - ▶ The design will change
- ▶ A good and self-standing CM capability is crucial for keeping the long-term consistency of the Supply Chain

# How to improve test capability for In Service Support?

# TEST CAPABILITY FOR ISS

- ▶ Testing is one method of verifying something
- ▶ The needs of the test capability are very different along the life cycle
- ▶ Test equipment can be built in to the system of interest or be an external test equipment, part of an enabling Maintenance and Support system

## Total test capability



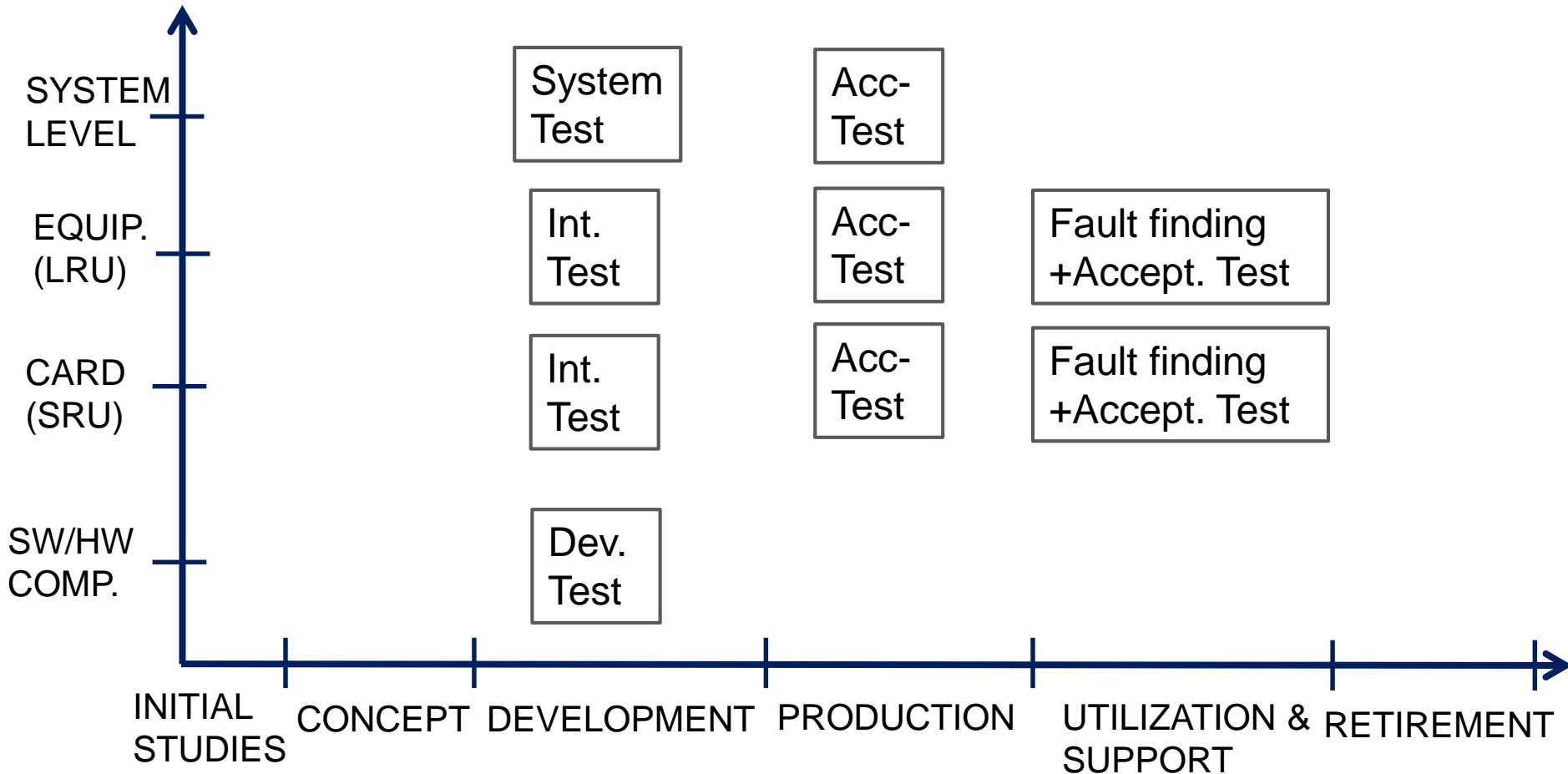
# TRADITIONAL VIEW OF TESTING

- ▶ Among development engineer's test equipment that is part of the product is interesting while external test equipment is boring
- ▶ The total test capability is not considered
- ▶ External test equipment is therefore often dictated by the needs in development and production
- ▶ There is often a considerable time span between design of built-in test and the design of the external test equipment

# ESTABLISHING A TEST CAPABILITY FOR THE ENTIRE LIFE CYCLE

- ▶ Establish the needs along the entire life cycle for all system levels
- ▶ Formulate a *test strategy* how to interpret and transform the needs into a requirement specification
- ▶ E.g. how to balance the test capability between the BIT and the external test equipment
- ▶ Just as for Supply Chain, the CM capability is crucial for keeping the long-term consistency of the Test Capability

# TEST NEEDS IN THE LIFE CYCLE



# CONCLUSIONS

- ▶ The In Service Support capability is the sum of all previous activities in the life cycle
- ▶ The life cycle commitment must be planned from the beginning
- ▶ Think big (SAAB)
- ▶ Start small (dig where you are)
- ▶ Prepare for a long journey

▶ ***Those with know-how  
(and know where they  
put it) will win***

END

Questions or comments?



# WAY OF WORKING IN CIP

- ▶ A small amount of people in the start (2-3 people)
- ▶ During the project a core team has formed itself
- ▶ Initially a lot of time was spent time to meet people within different disciplines at EW Systems
- ▶ Benchmarking within SAAB was done
- ▶ Workshops were held around a selected project or a disciplin or product area
- ▶ A few focus areas were selected for test implementation in methods and tools for demo to stakeholders  
*E.g. Proposal of potential services around a product*

# SYSTEMS ENGINEERING IS THE KEY, CONT'D

- ▶ Supporting the customer is an excellent opportunity to establish and maintain a good relationship with the customer & end user!
- ▶ This leads to a deeper understanding of their needs and deeper insight in how the delivered products are being used
- ▶ A good relationship is a great chance to get contracts on upgrades or on new systems
- ▶ But, it does not come for free...