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“Forskningspusslet”

– en utmaning för en väldigt bred verksamhet!

Per-Olof Marklund, CTO, Aeronautics



Innovation track record 1937-

- | | | |
|---|--------|-------------------|
| • 1st Ejection Seat | J21 | (prod.1944-47) |
| • 1st A/C modified from propeller to jet engine | J21 | |
| • 1st Swept Wing Jet in Europe | Tunnan | (1st flight 1948) |
| • 1st production A/C with afterburner | Tunnan | |
| • 2 world speed records | Tunnan | |
| • 1st Saab Supersonic A/C | Lansen | (1st flight 1952) |
| • 1st Saab System A/C ex Radar | Lansen | |
| • 1st Double Delta Wing | Draken | (1st flight 1955) |
| • 1st Canard configuration in production | Viggen | (1st flight 1967) |
| • 1st A/C w Central Computer | Viggen | |
| • 1st Tactical Data Link bw A/C | Viggen | |
| • 1st Digital FCS | Viggen | |
| • 1st Auto Gun Aiming | Viggen | |
| • 1st HUD in production | Viggen | |
| • 1st virtual target training aid | Viggen | |
| • 1st metal bonded wing panels in Mach 2 A/C | Viggen | |
| • Unprecedented capability- size ratio | Gripen | |
| • First Nato fighter of 4th generation | Gripen | |
| • First fully autonomous flight in Europe | Sharc | |
| • First fighter to fire Meteor | Gripen | |
| • | Gripen | |
| 2. | Gripen | |



What matters

Pace of change

PERFORMANCE

INFORMATION
TECHNOLOGY

VEHICLE
TECHNOLOGY

TIME

Major topics to be addressed in 10-20 years

- Autonomy
- Information Technology & Cyber security
- Communication
- Quantum technologies
- Green technologies
- Human-performance enhancement
- Materials and manufacturing
- ...etc

... in a closed system

So traditional aeronautical disciplines will always be needed!



TAKTISK ÖVERLÄGSENHET

Operationell förmåga i luftarenen
- Flygvapnets tillvägagångssätt

FLYGVAPNETS METOD:

- Hög och dynamisk beredskap
- Spridning
- Omgruppering över tiden inom och mellan flygbaser, där flygbaser ibland är operativa endast under timmar
- Skenmål
- Kraftsamling i tid och rum
- Flygsystem och materiel anpassade för snabb klargöring och enkla förhållanden
- Ledningskedja funktionsoberoende av central ledning
- Kvalificerad personal – anställda såväl som värnpliktiga

TEKNIK

KVANTITET

I luften
(TTP:er, telekrig,
datalänksuppträdande
etc.)

TAKTIK

På marken
(företagsgenerering,
ledning, logistik)

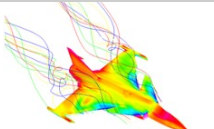
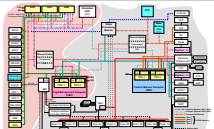
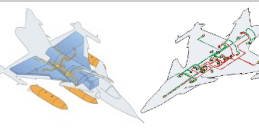



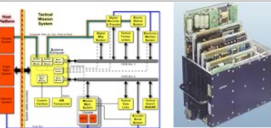
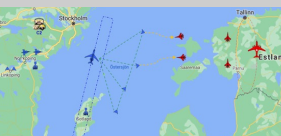







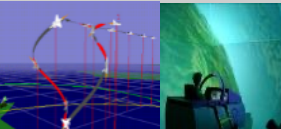
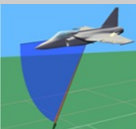
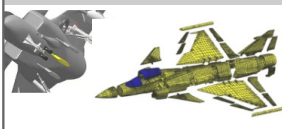




FLYGVAPNET

Technical Disciplines Aeronautics

Engineering Methods & Tools

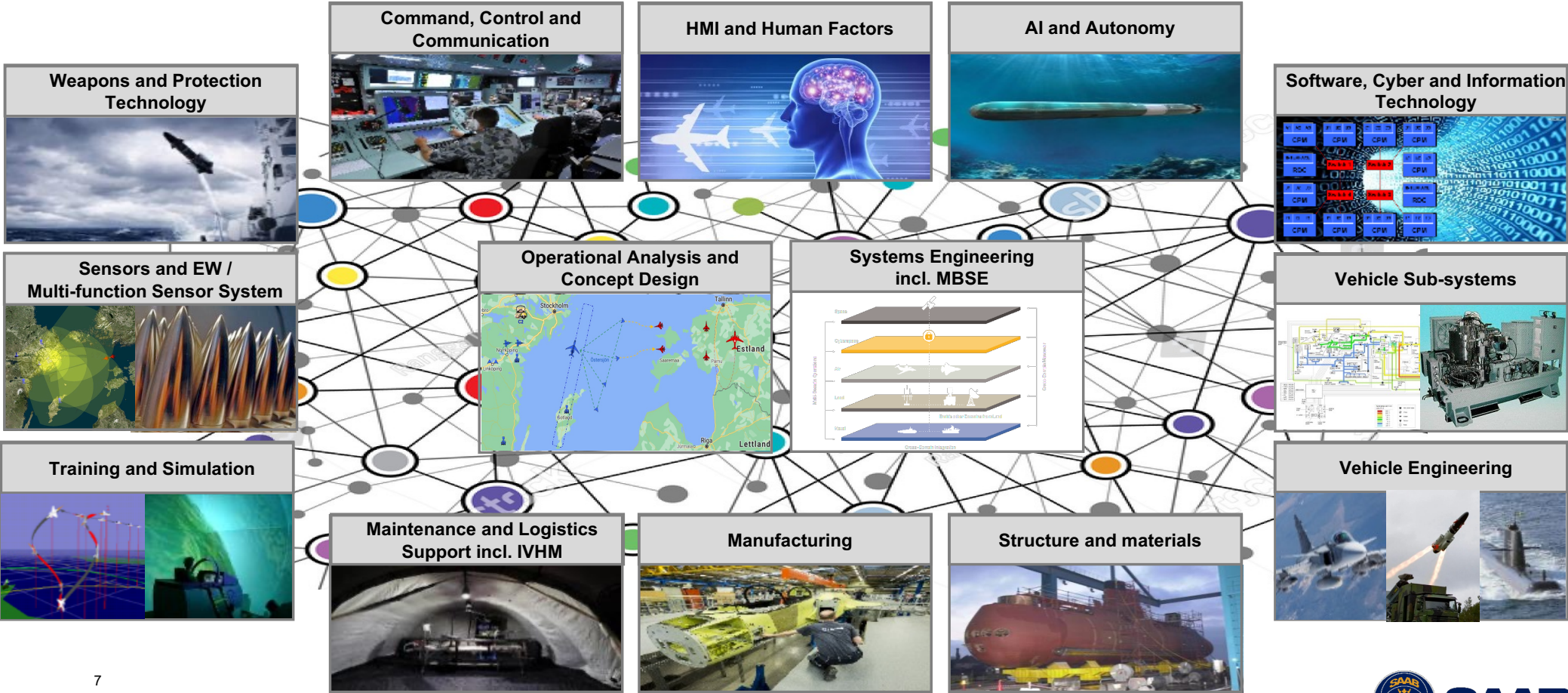
European Airworthiness Requirement (EMAR)

<p>Aeronautical Engineering</p> 	<p>Avionic Systems</p> 	<p>Airframe & Vehicle Systems</p> 	<p>Propulsion Systems</p> 	<p>Crew Station & Interaction</p> 	<p>Simulators</p> 
<p>Airborne Computer Systems</p> 	<p>OACD & Systems-of-Systems</p> 			<p>Overall Air Vehicle</p> 	<p>Tactical Systems</p> 
<p>Core Autonomy</p> 	<p>Tactical Autonomy</p> 			<p>Air Mission Planning & Analysis Systems</p> 	<p>Weapons</p> 
<p>Maintenance Systems</p> 	<p>Training & Training Systems</p> 	<p>Flight Test & Verification</p> 	<p>Airframe</p> 	<p>Production Systems</p> 	<p>Emerging Technologies</p> 



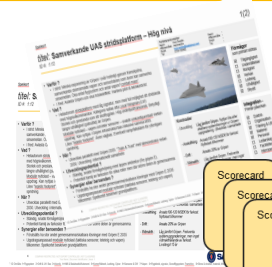
SAAB

Saab R&T Clusters



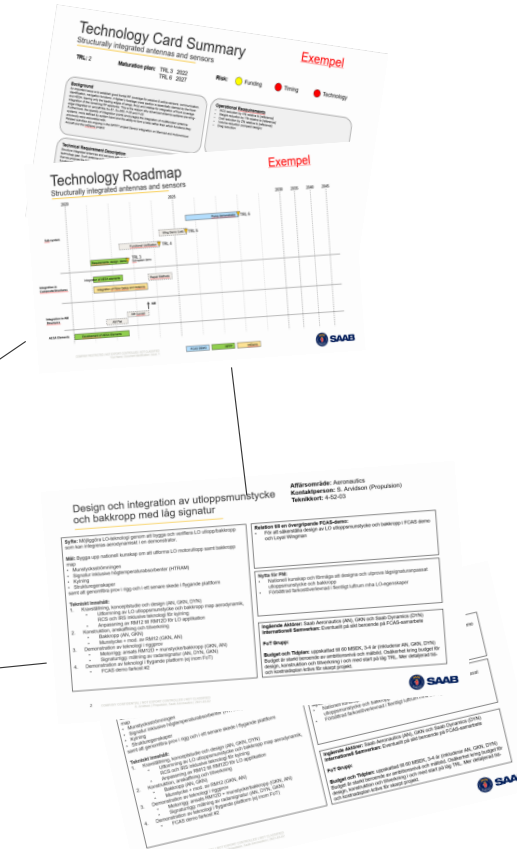
R&T (Cluster) Way of working

Technology Cards and Roadmaps



- Operational Analysis
- Score cards / IoT

Portfolio & Product Plans



Technology GAPS

- Future needs in product plans generate gaps relative existing technology base
- New technologies / forecasts creates opportunities for new capabilities and solutions

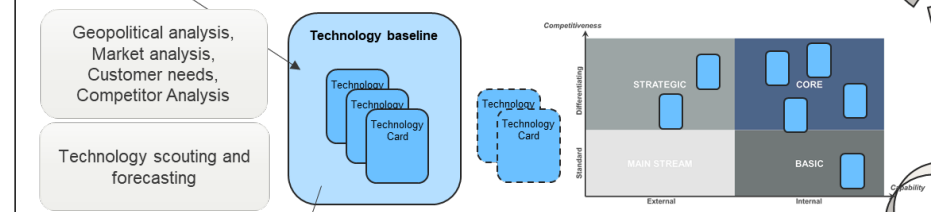
Funding & Collaborations

- R&T needs lead to need for funding and collaborations

Execution

- Manage R&T project and dissemination of results

Strategy / Roadmap – Technology and Industrial Capability



Funding Opportunities

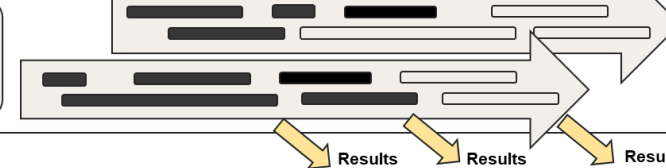
Project back log

Capture plan



R&T Activities AND Projects

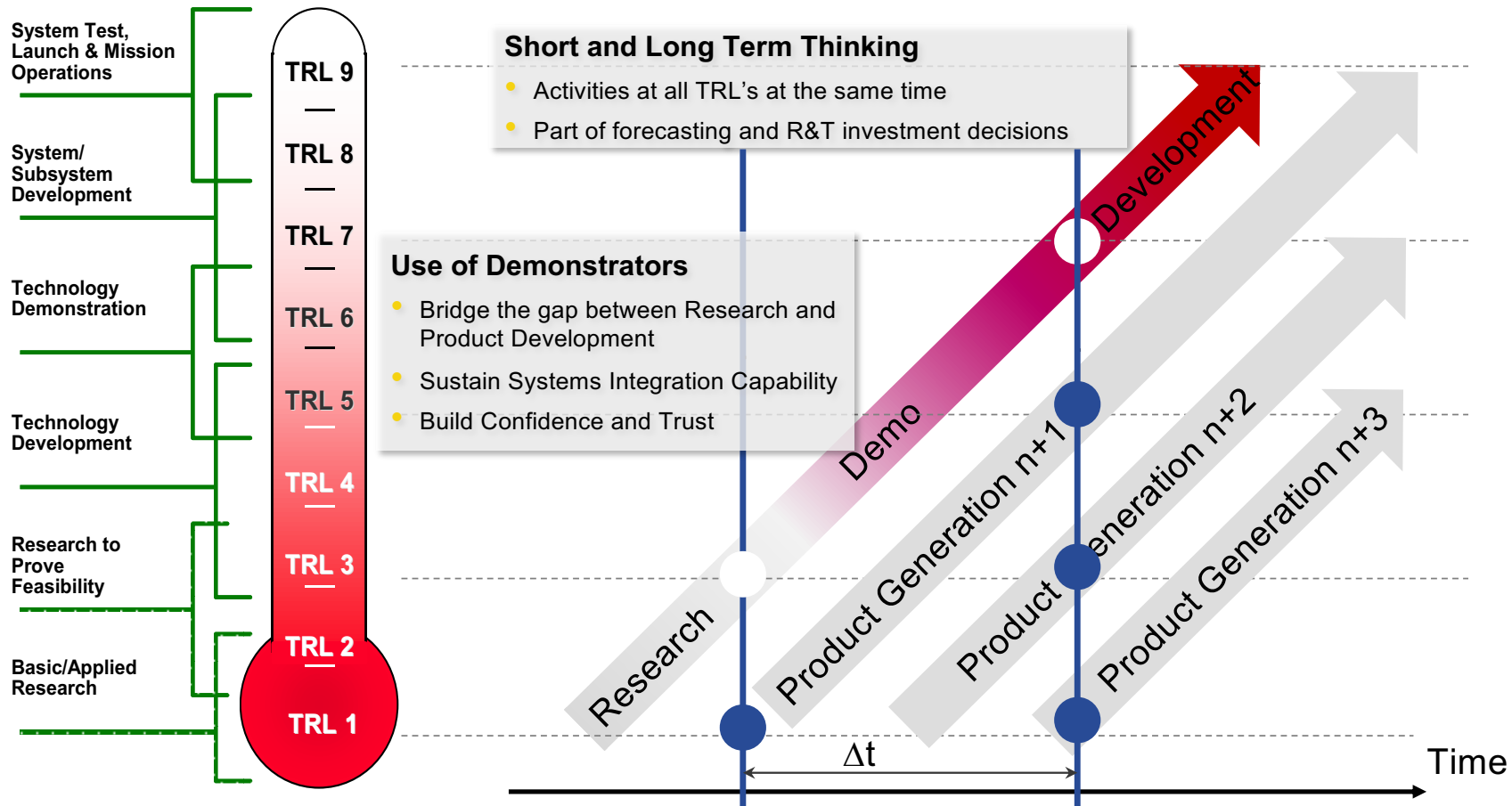
R&T Budget



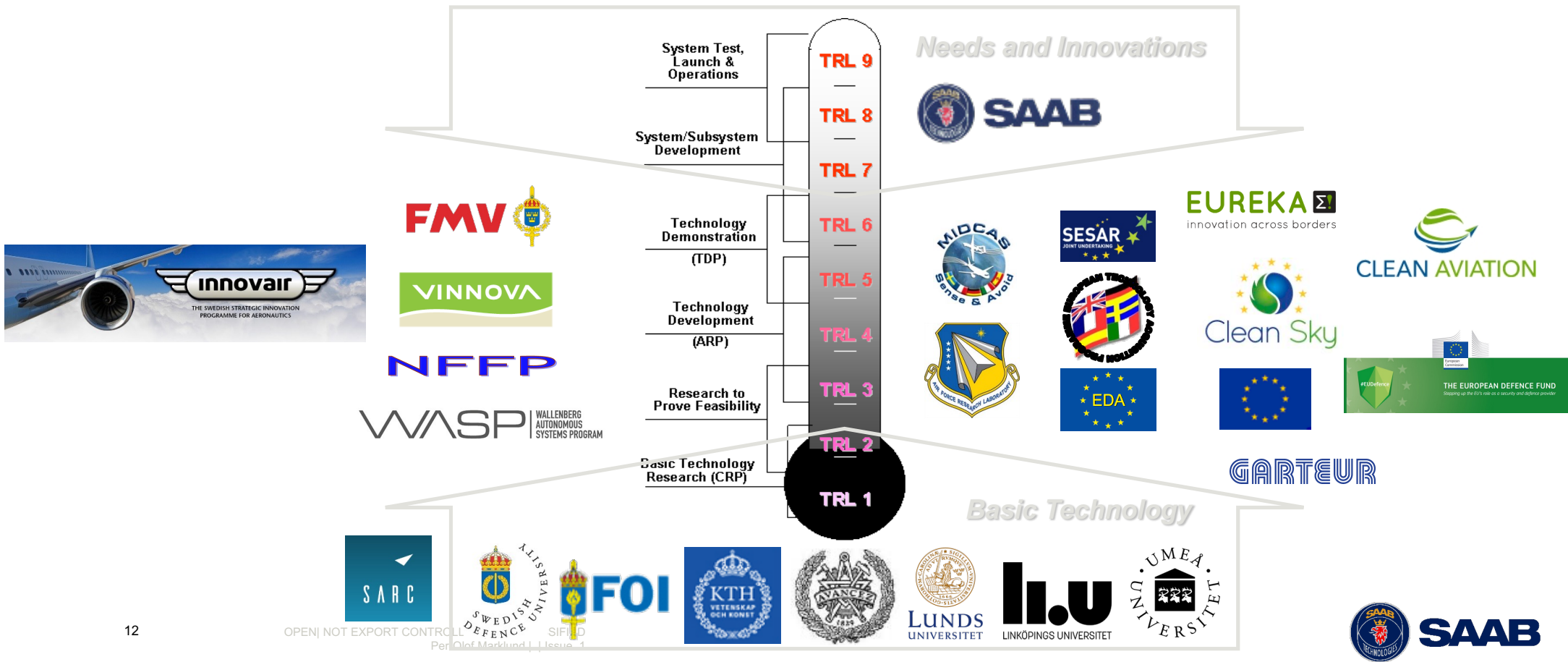
R&T Project Definition / SoW

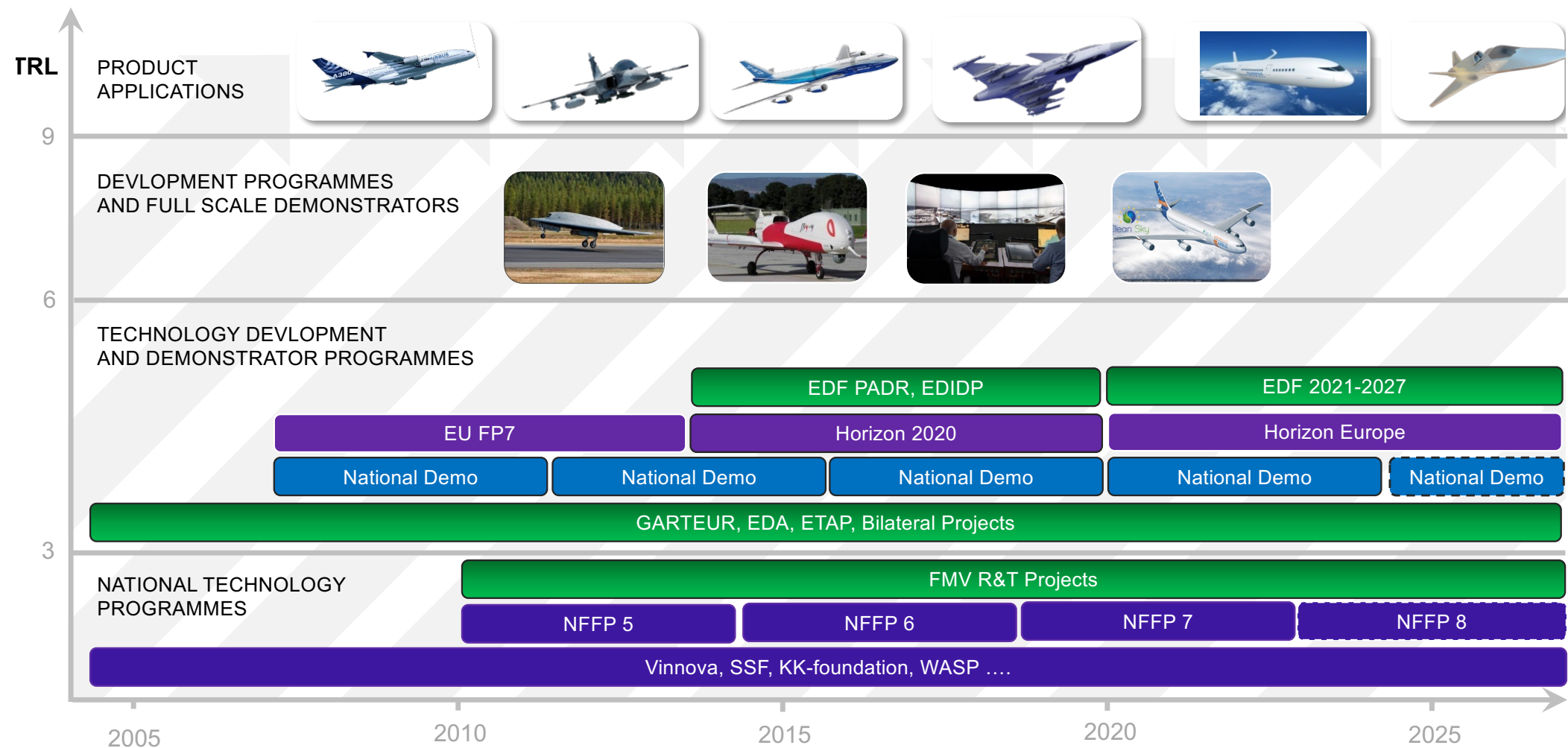


TRL – Technology Readiness Level



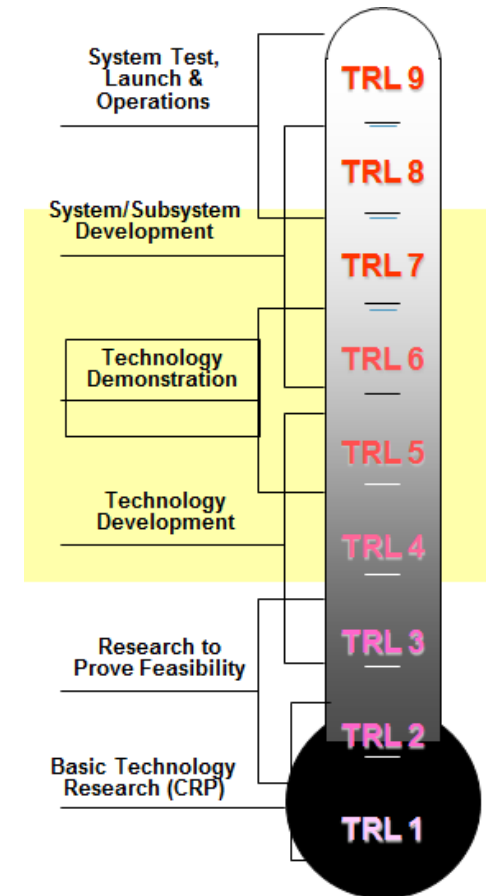
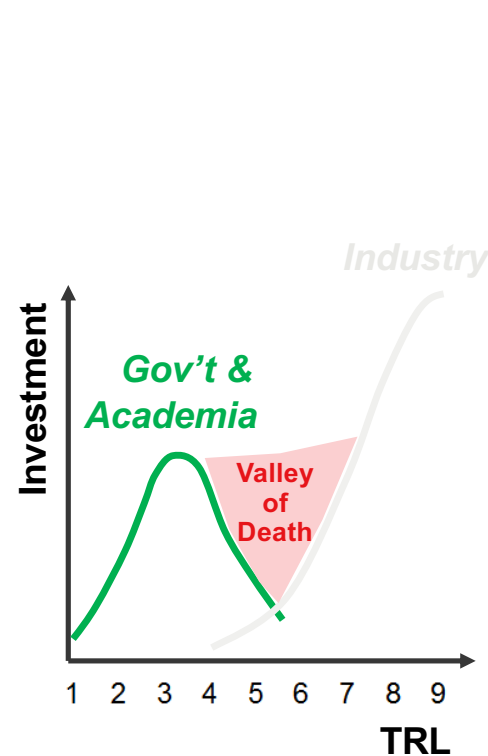
R&T Stakeholders





Concept Demos

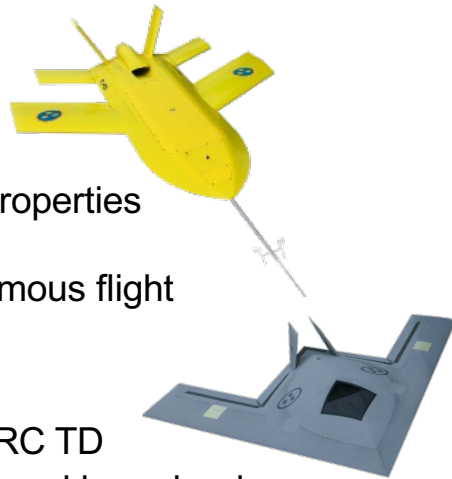
- Demonstrators are important for evaluation and maturing
 - New technologies
 - New features and capabilities
 - Industrial Collaborations
- Advance technology from research (TRL 1-3) to application (TRL 8-9) & Bridge the “Valley of Death”
- Demonstrators create market attention and customer confidence
- From validation in simulators and rigs to flight tests in representative, operational conditions.



EXAMPLE OF DEMONSTRATORS

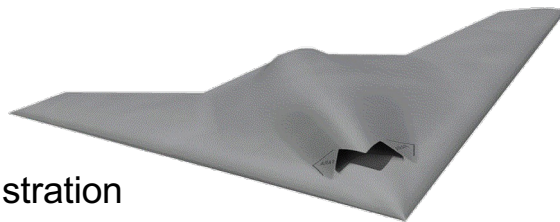
SHARC TD

- Fully autonomous flight
- Sensor data link
- Stealth geometry flight properties
- First flight 2002
- Europe's 1st fully Autonomous flight



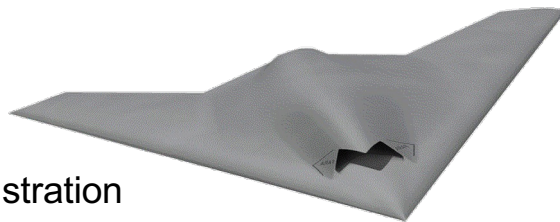
FILUR

- Core avionics from SHARC TD
- Stealth demo against ground based radar
- First flight 2005



NEURON

- Full scale Stealth demonstration
- Weapons release from internal bay
- First flight 2012
- Dassault lead, Saab 23%



BIOFUEL

- 100% Biofuel
- First flight March 2017



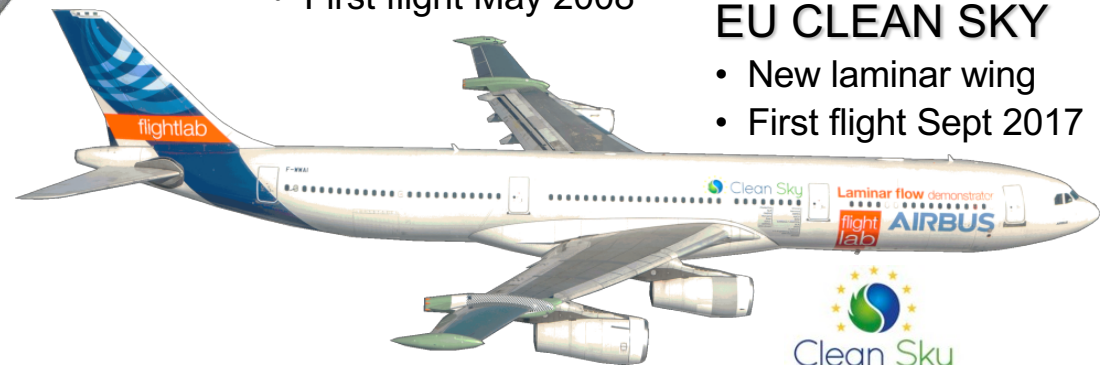
GRIPEN DEMO

- Demo of Gripen NG capabilities
- First flight May 2008



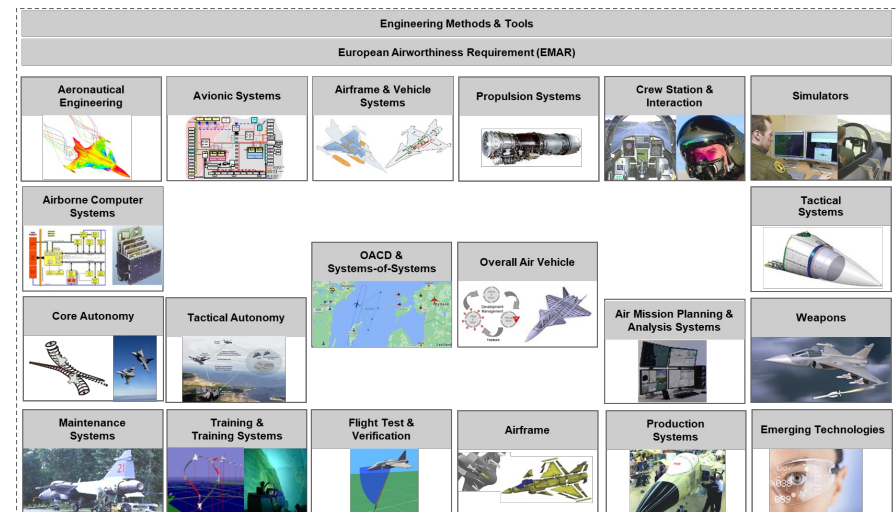
EU CLEAN SKY

- New laminar wing
- First flight Sept 2017



Technical fellow program

- Started about 30 years ago
- Alternative career path
- Means to stay at the forefront of technical development in areas of strategic importance
- Today ~40 Technical Fellows
- Requires an approved designated area of expertise that fulfils certain requirements
 - Area of strategic importance
 - Business coupling
 - Long term nature
 - Difficult to acquire from outside
 - Academic coupling



Technical fellow designated area of expertise

- Radar cross section technologies
- Electromagnetic effects
- Conceptual design of air vehicles
- Operational analysis
- Systems architecture of air vehicle and systems-of-systems
- Numerical and mathematical modelling
- Flight mechanics
- Propulsion aerodynamics
- Ice on air vehicles
- Sense & Avoid
- Flight performance
- Flight control design
- Electronics design in avionics
- Fault tolerant systems
- Real time systems in avionics
- Safety critical software
- Software verification
- Modelling of vehicle systems
- Applied HMI (Human Machine Interaction)
- Human capability
- Modelling and Simulation
- Geodata
- Multi sensor systems - integration
- Data links for air vehicles
- Information fusion
- Radar systems integration
- Aiming and weapons delivery
- Structural integrity
- Loads
- Structural analysis complete aircraft
- Multi disciplinary optimization
- Structural dynamics
- Aeroelasticity
- Material, Surface Treatment and Corrosion
- Manufacturing Simulation of Fiber Composites
- Production Engineering Metrology
- Systems Engineering
- Reliability engineering
- Diagnostics and prognostics
- Electrical power systems
- Aircraft life support and escape systems
- EO-systems and countermeasures
- Separation analysis
- Flight testing

University collaboration

- Collaboration agreements with KTH, LiU, CTH, SDU, Lund University
- 10 Adjunct professors and a number of affiliated faculty at Swedish universities
- ~40 industrial PhD students

li.u LINKÖPINGS
UNIVERSITET



LUND
UNIVERSITY



Adjunct career path

