



---

# A SWEDISH NATIONAL COMPETENCE CLUSTER IN AERONAUTICAL ENGINEERING

Roger Larsson

FT2016 12/10-2016, Stockholm

Roger Larsson, [roger.gunnar.larsson@saabgroup.com](mailto:roger.gunnar.larsson@saabgroup.com)



# SAAB AERONAUTICAL TRACK



**Saab B17**  
322 delivered 1941-1944



**Saab B 18**  
243 delivered 1944-1948



**Saab J 21**  
298 delivered 1944-1947



**Saab 91 Safir**  
323 delivered 1946-1966



**Saab 90 Scandia**  
18 delivered 1950-1955



**Saab J 21R**  
60 delivered 1947-1950



**Saab J 29/S 29**  
661 delivered 1951-1960



**Saab 32 Lanser**  
447 delivered 1955-1960



**Saab 35 Draken**  
604 delivered 1960-1975



**Saab 105/SK 60**  
190 delivered 1965-1972



**Saab 37 Viggen**  
329 delivered 1971-1990



**Saab Safari/Supporter**  
More than 200 delivered  
1972-1987



**Saab 340**  
459 delivered 1984-1999

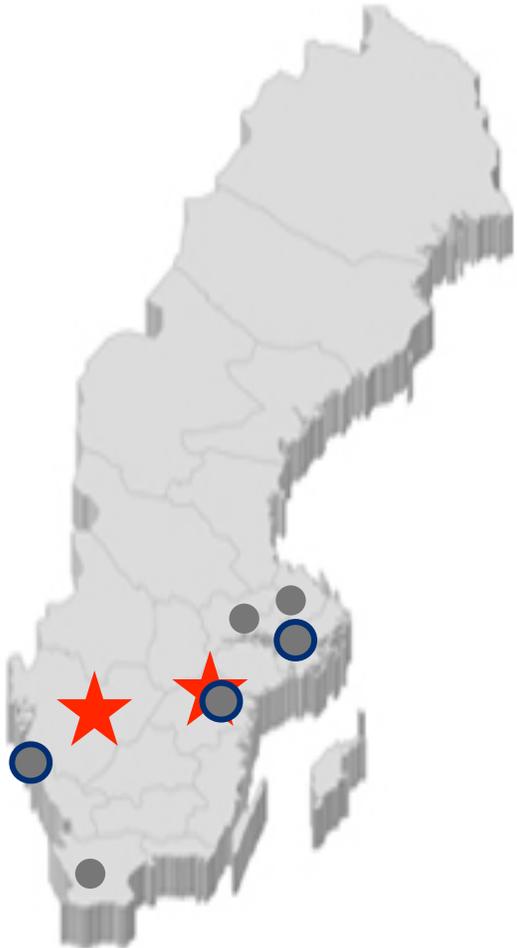


**Saab 2000**  
63 delivered 1994-1999



**Saab 39 Gripen**  
116 delivered by January 2002  
1994-

# COMPETENCE CLUSTER LEADERS



- Create a network/structure based on the collaborations of today.
- To work with the aeronautical problem formulations. Identify possible collaborations with other areas.
- Manage the brief of projects and collaborations that exist.
- Identify other financial sources.

DIPLOM



**Roger Larsson**

har under perioden september 2014 till november 2015 deltagit i Innovairs program för

**Klusterledare**

Programmet för Klusterledare är ett skräddarsytt utvecklingsprogram för ledare av kompetenskluster inom Innovair, Sveriges nationella strategiska innovationsprogram för flyg. Programmets syfte är att stärka och inspirera ledarskapet inom kompetenskluster och forskningsnätverk. Programmet består av sex delar à 2 dagar med följande innehåll:

- Vad är kluster och vilken är den grundläggande idén som skall förverkligas.
- Att leda och organisera kluster och forskningsnätverk.
- Kommunikation för att bygga nätverk och skapa förtroende utåt och inåt.
- Att hantera IPR och identifiera intellektuella tillgångar.
- Att leda förändring och förebygga konflikter.
- Önvärdsbevakning och trendanalys. Identifiera forskningsaktörer och finansierare.
- Strategi för fortsatt utveckling.

  
Anna Aspögren  
Aspögren Ledarresurs AB

  
Anders Blom  
Innovair / Svenskt Flyg

# AERONAUTICAL ENGINEERING

$$\sum \mathbf{F} = m \cdot \left. \frac{d\mathbf{V}}{dt} \right|_B + \boldsymbol{\omega} \times m\mathbf{V}$$

$$\sum \mathbf{M} = \mathbf{I} \cdot \left. \frac{d\boldsymbol{\omega}}{dt} \right|_B + \boldsymbol{\omega} \times \mathbf{I}\boldsymbol{\omega}$$



Performance & Flight mechanics

# AERONAUTICAL ENGINEERING

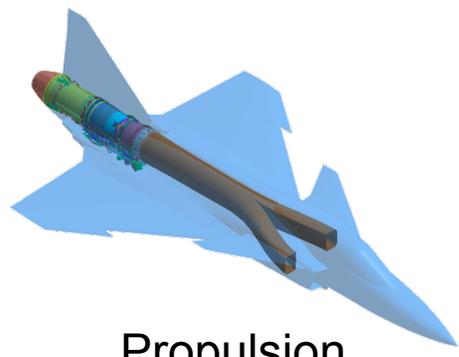
$$\sum \mathbf{F} = m \cdot \left. \frac{d\mathbf{V}}{dt} \right|_B + \boldsymbol{\omega} \times m\mathbf{V}$$

$$\sum \mathbf{M} = \mathbf{I} \cdot \left. \frac{d\boldsymbol{\omega}}{dt} \right|_B + \boldsymbol{\omega} \times \mathbf{I}\boldsymbol{\omega}$$



Performance & Flight mechanics

# AERONAUTICAL ENGINEERING



Propulsion

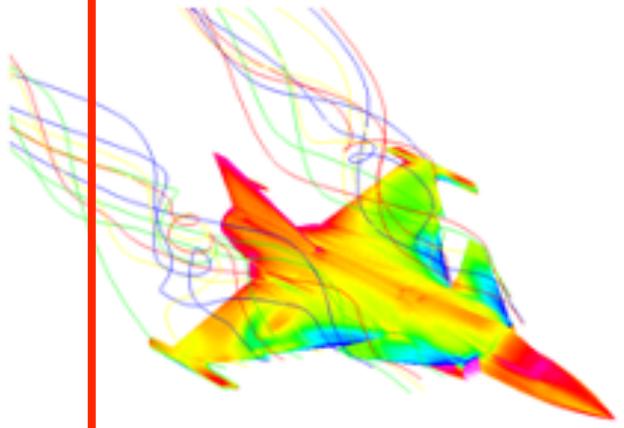
$$\sum \mathbf{F} = m \cdot \left. \frac{d\mathbf{V}}{dt} \right|_B + \boldsymbol{\omega} \times m\mathbf{V}$$
$$\sum \mathbf{M} = \mathbf{I} \cdot \left. \frac{d\boldsymbol{\omega}}{dt} \right|_B + \boldsymbol{\omega} \times \mathbf{I}\boldsymbol{\omega}$$



Performance & Flight mechanics



Flight Control System



Aerodynamics



Flutter & Loads

# AERONAUTICAL ENGINEERING

**Propulsion**

**Performance & Flight mechanics**

**Aerodynamics**

**Flight Control System**

**Flutter & Loads**

**Equations:**

$$\sum F = m \cdot \frac{dV}{dt} = m \times a$$
$$\sum M = I \cdot \frac{d\omega}{dt} = I \times \alpha$$

**Logos and Institutions:** CREO, CN, Linköping University, CHALMERS, KTH, UAS, KTH, Linköping University, LUNDS UNIVERSITET, intuitive aerial, SIEMENS, MÅLARDALENS HÖGSKOLA ESKILSTUNA VÄSTERÅS, FOI, UPPSALA UNIVERSITET, Linköping University, FOI, KTH, Linköping University, CREO, KTH, Linköping University.



# AERONAUTICAL ENGINEERING

The diagram illustrates the interdisciplinary nature of Aeronautical Engineering, centered around four key areas:

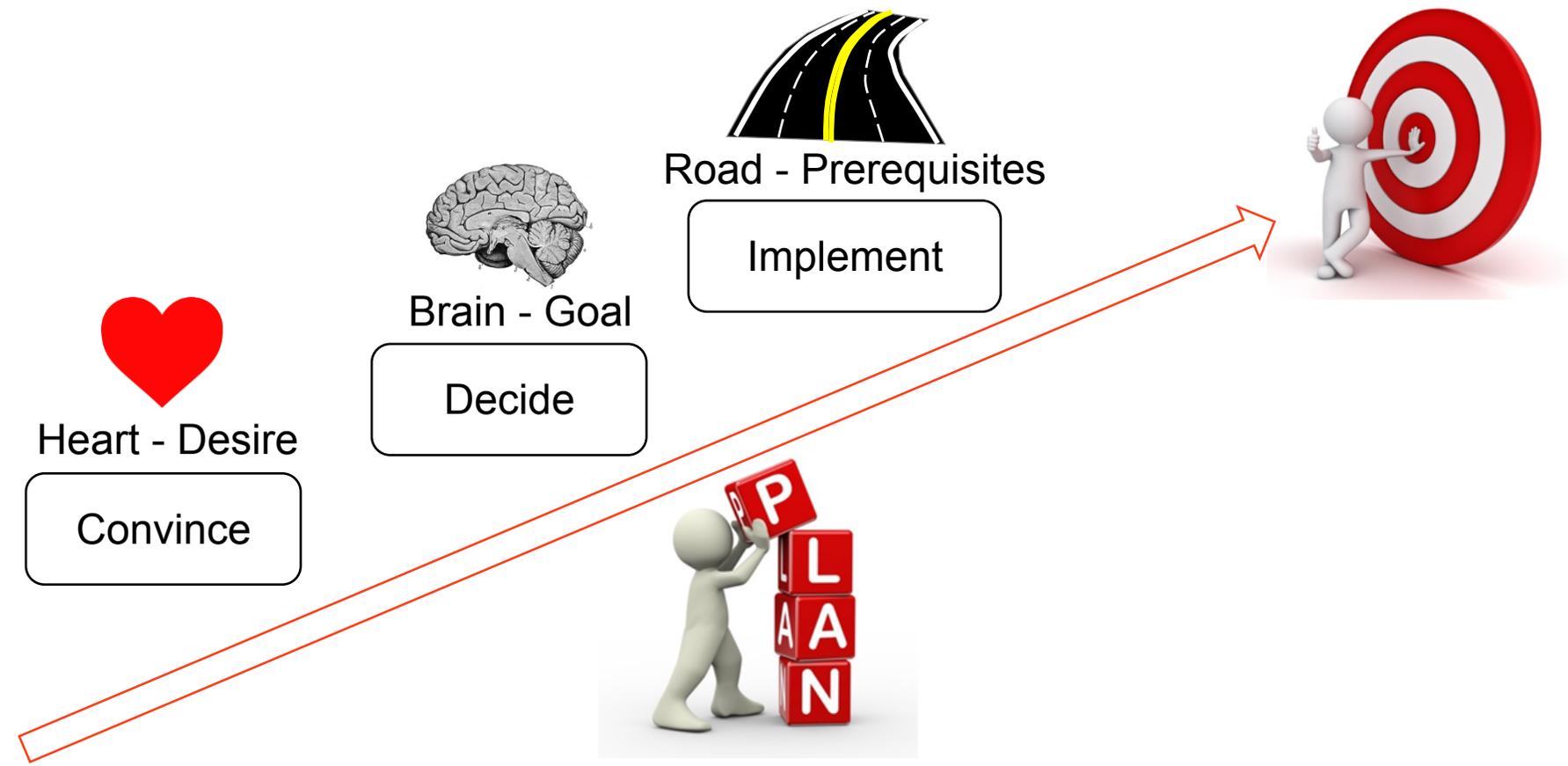
- Propulsion:** Includes a jet engine diagram and the equation  $\sum F = m \frac{dV}{dt} = \dot{m} V$ .
- Aerodynamics:** Shows a colorful flow field around a fighter jet.
- Flight Control System:** Features a fighter jet in flight.
- Flutter & Loads:** Shows a fighter jet.

The central box is surrounded by logos of various institutions and companies, including CREO, SIEMENS, FOI, KTH, Linköping University, CHALMERS, UAS, LUNDS UNIVERSITY, intuitive aerial, and UPPSALA UNIVERSITET. The Swedish flag is also present.

# AERONAUTICAL ENGINEERING

The diagram is a central hub for aeronautical engineering, enclosed in a blue border. It is surrounded by a green border containing flags of the European Union (top-left, top-right, bottom-left, bottom-right) and Brazil (top-center, bottom-center, left-center, right-center). The central area contains several logos: CREO, KTH, FOI, UAS, Linköping University, CHALMERS, SIEMENS, MELANISKO HAKKOLA EKOLSTINA RÄSTENÄS, LUNDS UNIVERSITY, intuitive aerial, and UPPSALA UNIVERSITET. A red-bordered box in the center highlights four key areas: Propulsion (with a jet engine diagram), Aerodynamics (with a colorful flow field diagram), Flight Control System (with a fighter jet diagram), and Flutter & Loads (with a fighter jet diagram). In the center of this red box, there are two mathematical equations:  $\sum F = m \frac{dV}{dt} = \dot{m} V$  and  $\sum M = I \frac{d\omega}{dt} = \dot{m} r V$ . Below these equations is a small image of a fighter jet in flight, labeled 'Performance & Flight mechanics'.

# CHALLENGE



# FOCUS TODAY

---

Today's airplanes are way more advanced than the Flyer I and have to meet very strict regulations, demands on availability, environmental and economical issues.

The competence cluster aeronautical engineering focus:

## Design

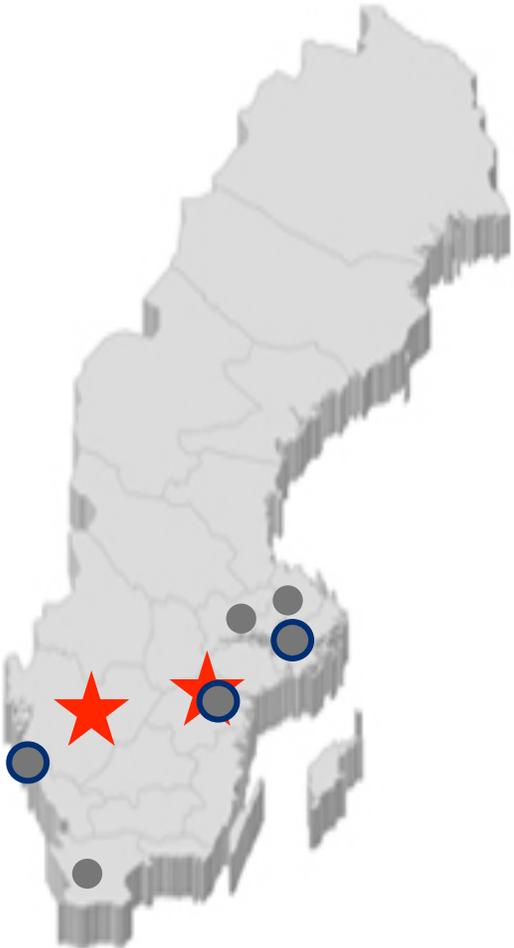
- Passive/Active laminar flow for increased efficiency and environmental friendly flight
- Control law design for safer flight

## Modeling

- Turbulence modeling for more accurate numerical computations
- Aerodynamic modeling for increased quality and more reliable analyses and simulations
- Aeroelastic modeling for a better understanding of coupling effects between aero- and structural dynamics

## Simulation

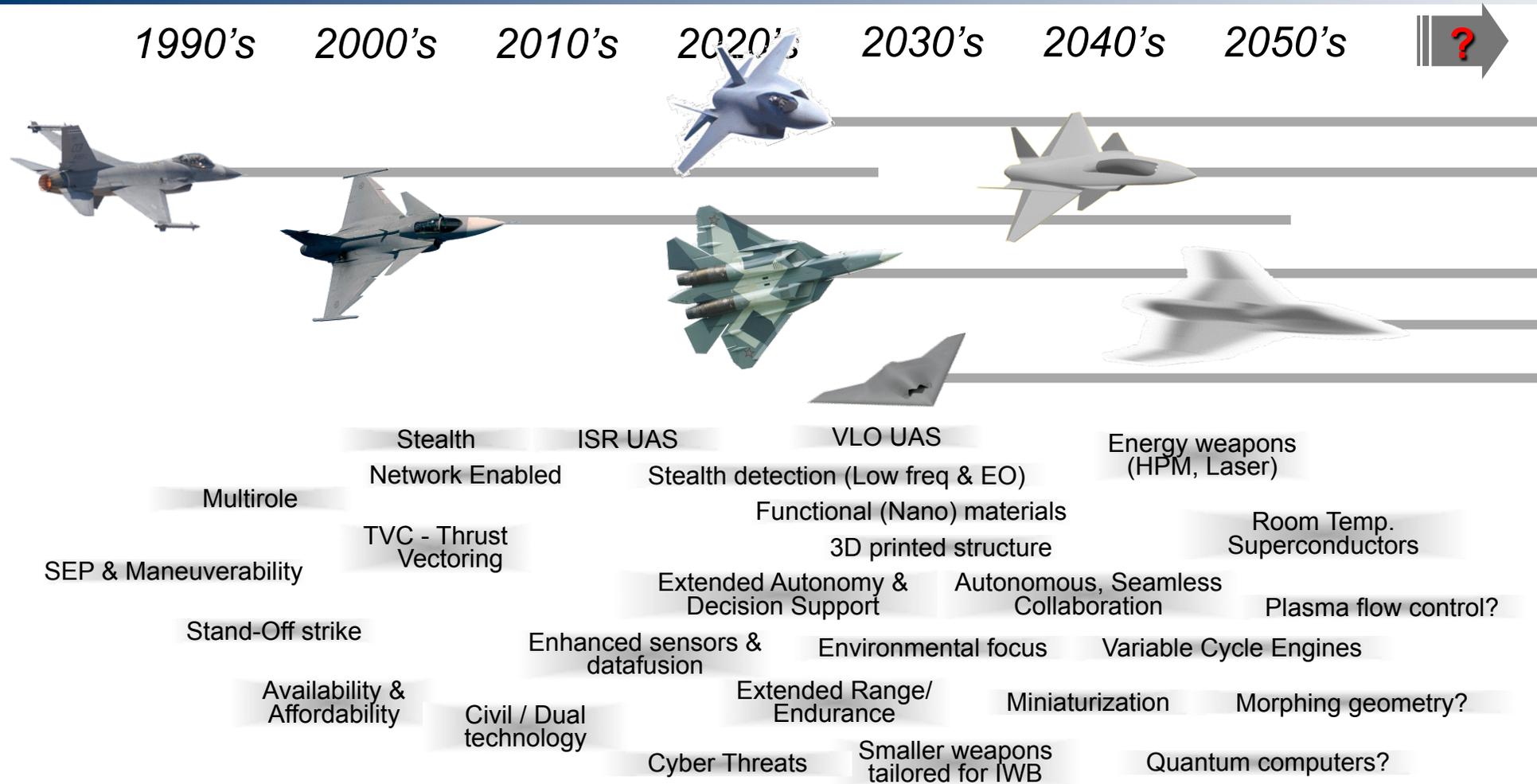
- Extensive use of simulation for better understanding of flying qualities and thereby produce support for more reliable design in many disciplines



# SAAB AERONAUTICS ROADMAP

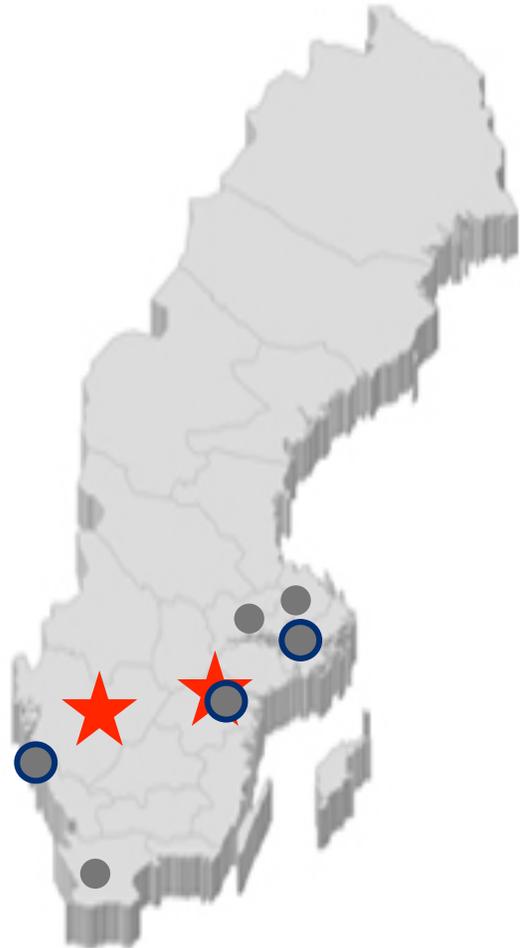


# FOCUS TOMORROW



# FOCUS TOMORROW

---



There are more unrest in the world today than it has been in many, many years. Saab is building the next generation of Gripen and also looking into the Future Combat Air System (FCAS).

The civil aviation market will need to meet the environmental and economical demands of the future which is said to be possible only with a revolution in technology.

The competence cluster Aeronautical Engineering focus:

## **Design**

- Finding innovative and revolutionary new technologies to stay ahead of our competitor

## **Modeling**

- Finding effective modeling methods from first design to operation to support analysis and development

## **Simulation**

- Finding smart simulation and analysis solutions to get cost effective ways to understand what are going to be developed



# SWEAER, SWEDISH AERONAUTICAL ENGINEERING RESEARCH INVITATION TO A FULL DAY WORKSHOP, 2/12-2015

• **53 Participants:** Engineers, Prof. PhD, MSc

• **4 UoH:** KTH, LIU, Chalmers, MDH



• **3 Companies:** Saab, Creo dynamics, Cybaero



• **1 Institute:** FOI



• **1 Cluster:** Aerospace Cluster Sweden

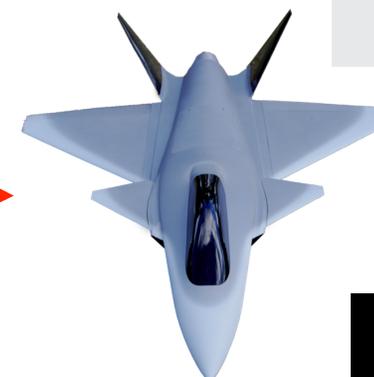
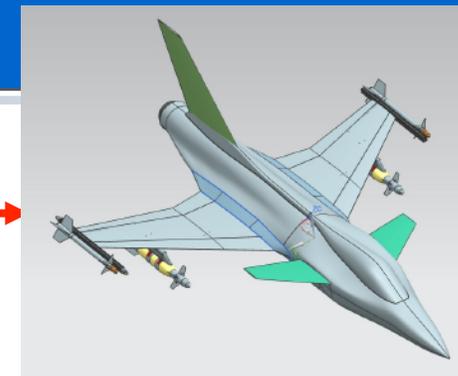


**Also invited:**



# AERONAUTICS AND DESIGN

Nr	Ämne	Program	Klockan	Från	Tid
		<b>Registrering</b>	<b>09:00</b>		00:30
1	Intro	Välkomna	09:30	Saab	00:05
2		Roger Larsson	09:35	Saab	00:15
3		Christopher Jouannet	09:50	Saab	00:15
4		Roger Larsson	10:05	Saab-INNOVAIR	00:15
		<b>FIKA</b>	<b>10:20</b>		00:20
5	UoH	Ulf Ringertz	10:40	<b>KTH</b>	00:20
6		Petter Krus	11:00	<b>LIU</b>	00:15
7		Lars Davidson	11:15	Chalmers	00:15
8		Konstantinos Kyprianidis	11:30	<b>MDH</b>	00:15
9	Inst	Peter Eliasson	11:45	FOI	00:15
		<b>LUNCH</b>	<b>12:00</b>		01:00
10	SMF	Torbjörn Larsson	13:00	Creo	00:15
11	Cluster	Anna Rehncrona	13:15	Aerospace Cluster Sweden	00:15
12	NFFP	Daniel Simon	13:30	<b>Saab-LIU</b>	00:15
13		Sebastian Arvidson	13:45	SAAB-Chalmers	00:15
		<b>FIKA</b>	<b>14:00</b>		00:20
14		Ricardo Vinuesa Motiva	14:20	KTH	00:15
15		Ingo Staack	14:35	LIU	00:15
16		Alejandro Sobrón Rueda	14:50	LIU	00:15
17		Erik Holmberg	15:05	Saab	00:15
18	SUM	Summering FIKA	15:20	Alla	01:00
			<b>16:20</b>		<b>07:20</b>

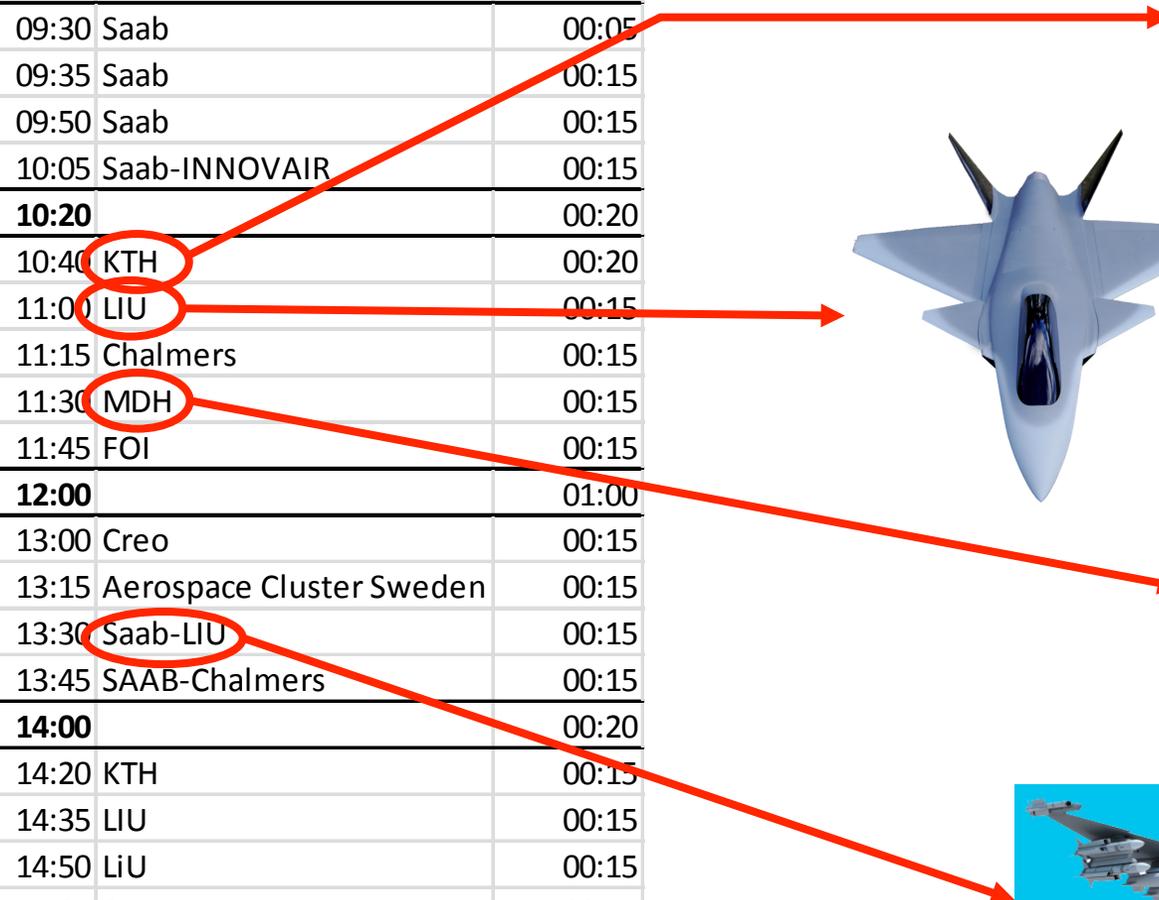


KTH

LIU

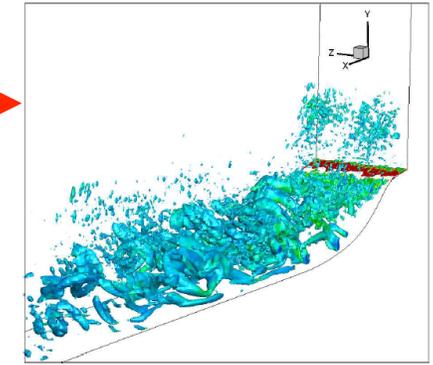
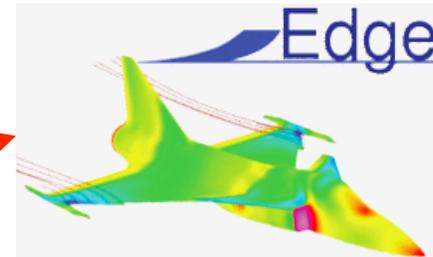
MDH

Saab-LIU



# COMPUTATIONAL FLUID DYNAMICS (CFD)

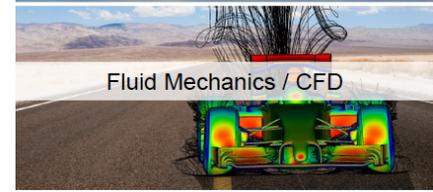
Nr	Ämne	Program	Klockan	Från	Tid
		<b>Registrering</b>	<b>09:00</b>		00:30
1	Intro	Välkomna	09:30	Saab	00:05
2		Roger Larsson	09:35	Saab	00:15
3		Christopher Jouannet	09:50	Saab	00:15
4		Roger Larsson	10:05	Saab-INNOVAIR	00:15
		<b>FIKA</b>	<b>10:20</b>		00:20
5	UoH	Ulf Ringertz	10:40	KTH	00:20
6		Petter Krus	11:00	LIU	00:15
7		Lars Davidson	11:15	Chalmers	00:15
8		Konstantinos Kypriandis	11:30	MDH	00:15
9	Inst	Peter Eliasson	11:45	FOI	00:15
		<b>LUNCH</b>	<b>12:00</b>		01:00
10	SMF	Torbjörn Larsson	13:00	Creo	00:15
11	Cluster	Anna Rehncrona	13:15	Aerospace Cluster Sweden	00:15
12	NFFP	Daniel Simon	13:30	Saab-LIU	00:15
13		Sebastian Arvidson	13:45	SAAB-Chalmers	00:15
		<b>FIKA</b>	<b>14:00</b>		00:20
14		Ricardo Vinuesa Motiva	14:20	KTH	00:15
15		Ingo Staack	14:35	LIU	00:15
16		Alejandro Sobrón Rueda	14:50	LiU	00:15
17		Erik Holmberg	15:05	Saab	00:15
18	SUM	Summering FIKA	15:20	Alla	01:00
			<b>16:20</b>		<b>07:20</b>



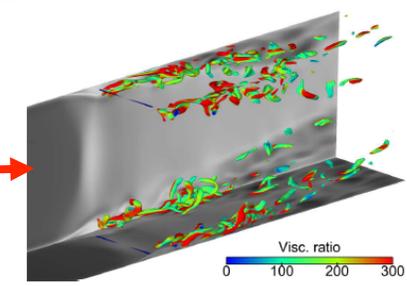
LES for flow over a hump



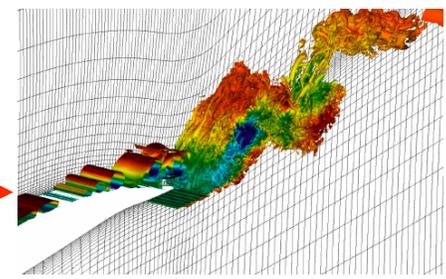
Acoustics



Fluid Mechanics / CFD

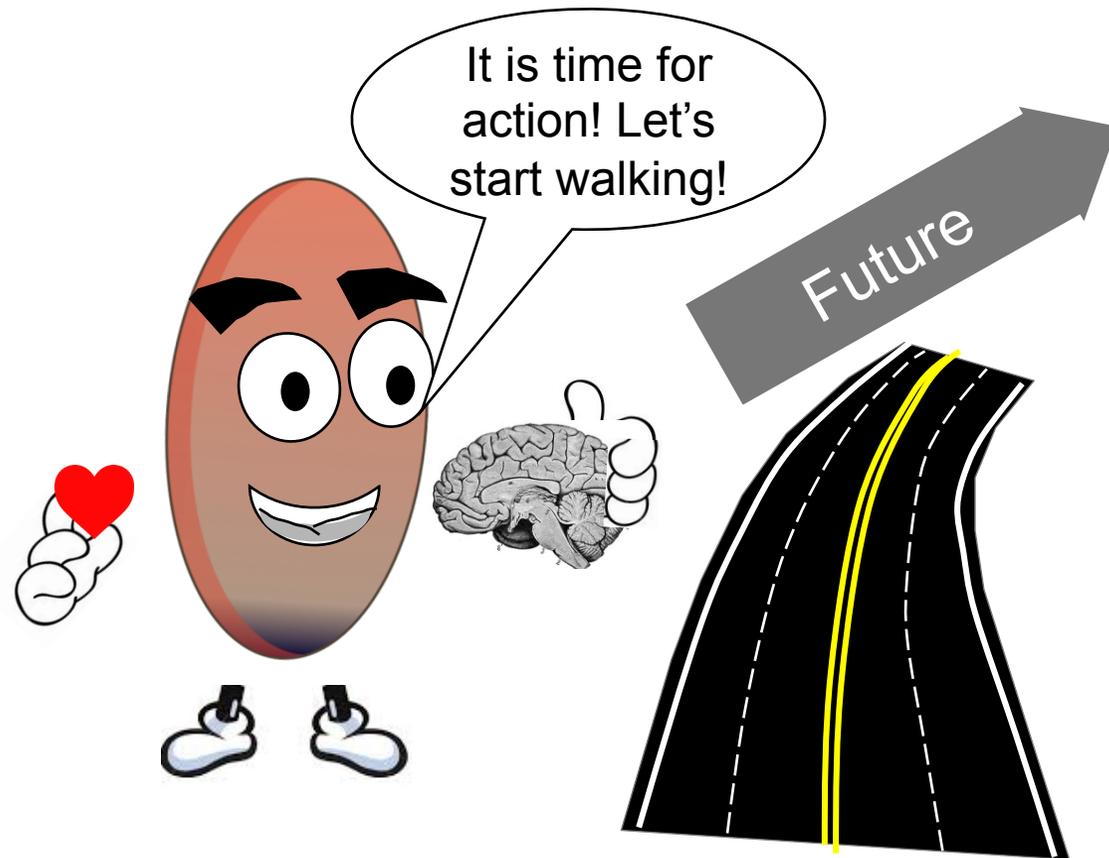


(a) Resolved turbulent structures.



# NEED FOR THE FUTURE

---



We need:

- Aeronautical engineers
- Top class researchers
- Prerequisites for action
- To come together to take Swedish Aeronautical Research into the future



Roger Larsson, [roger.gunnar.larsson@saabgroup.com](mailto:roger.gunnar.larsson@saabgroup.com)

