

RYMD FÖR INNOVATION OCH TILLVÄXT

Space Innovation Forum 6

8-9 May 2018

Johanna Bergström-Roos, Project Manager

www.ritspace.se



Inauguration for ACS North Node

AEROSPACE CLUSTER SWEDEN



Göran Berlemo CEO ACS



Leif Johansson Project Manager SVIFFT



Olle Persson Cluster Coordinator North





Trends in aeronautics and aerospace

Anders Blom, Innovair



Space Innovation Forum 6 and ACScluster installation

Anders Blom Program Director

Kiruna, 2018-05-08/09

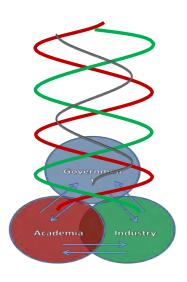
www.innovair.org

NRIA Flyg 2016 1 2018-05-08

NATIONAL RESEARCH& INNOVATION AGENDA



Written by Industry,
Universities, Research
Institutes, Armed Forces
and
Government Authorities
with Innovair as
Coordinating Forum



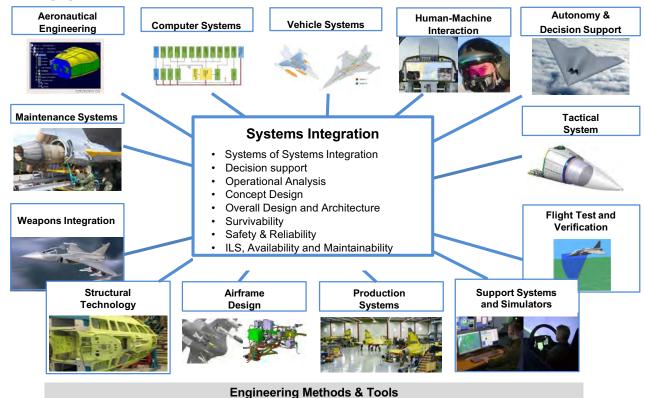
www.innovair.org

Swedish Baseline in Aeronautics

- The National Research Agenda <u>www.nriaflyg.se</u>



WHAT DOES AERONAUTICS CONTAIN?



What has happened since last time?

- Globalization / internationalization threats and opportunities
- Completion of the innovation system extending from regional to multinational level
- SME development

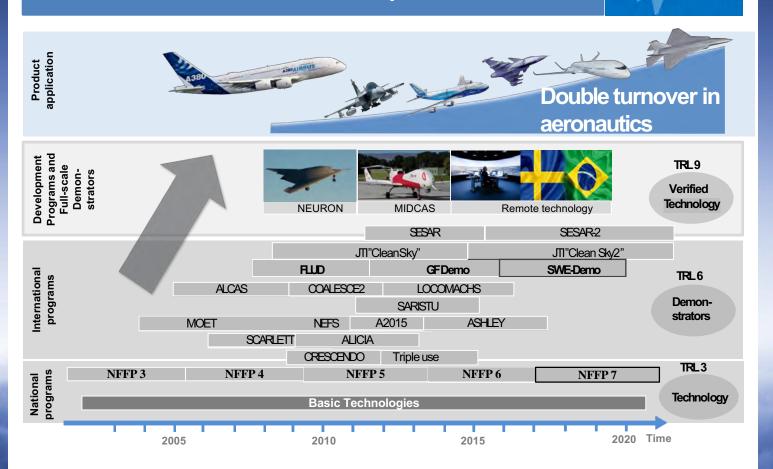


Long term changes – civil aeronautics

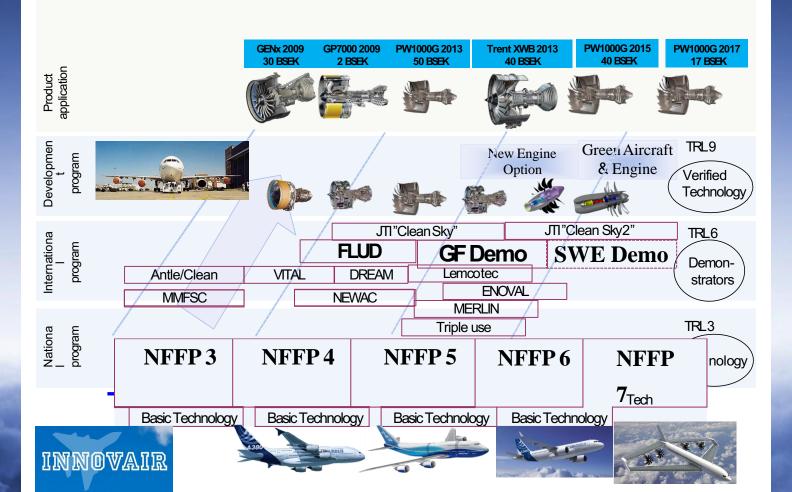
- Impressive growth!
 - Approx 5 %per year -> over 30 000 new aircraft during 20 years
 - Total value of these are 45 000 billion S■K
 - New actors
 - Challenges for Sweden: solutions for safety, reliability, life
 cycle cost, environment



NRIA Flyg 2016



GKN roadmap



Solution: Efficient innovation

- Competitive edge via technology
- Shorten time from new ideas to products on the market
 - Cooperation
 - Continuity
 - Common objectives

-Three challenges

NRIA Flyg 2016 2018-05-08

Cooperation

- Strategic international partnerships
 - Sweden <-> Brazil
 - Sweden <-> UK
 - Sweden <--> Germany
 - Sweden <-> EU
- National cooperation with other Strategic Innovation Programs
- Cooperation with Aviation System and Astronautics Sector
- New opportunities for SME's in R&T and demonstrators to strengthen their supplier role



Aeronautics as Pilot Case

- R&D intensive
- National coherence and common objectives across sector
- Innovation system within aeronautics can be copied to other sectors



Recommendations

- R&T programs, national and bilateral, co-funded by Government and Industry
- Low-TRL research program
- Demonstrator activities
- Increased cooperation between ministries
- SMECluster and involvement in R&T
- Swedish Aeronautics Research Centre







Trends in aeronautics and aerospace

Stefan Gustafsson, SSC

A Global Game Change Through Space



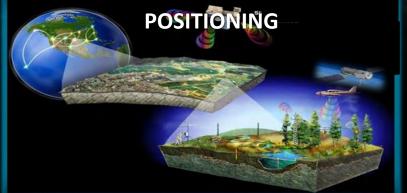
Satellite constellations and "Supersats" provide Global Transparency, Connectivity and Positioning

An enabling force for a sustainable planet



EARTH OBSERVATION

Multisensor constellations provide close to real time information of the planet, including land, oceans and the atmosphere.



COMMUNICATION

Communication constellations provide global access to internet, enabling the prospect of a sustainable development of the big world on our small planet.

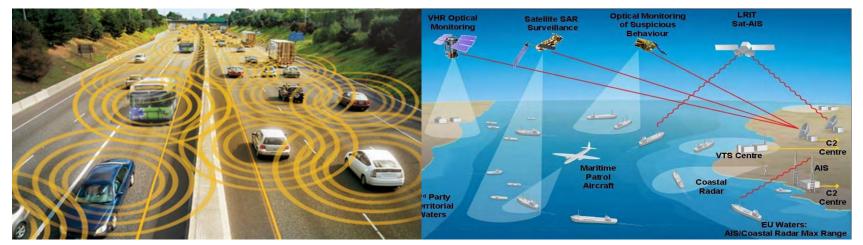
GLOBAL SHIFT-ENORMOUS OPPORTUNITIES



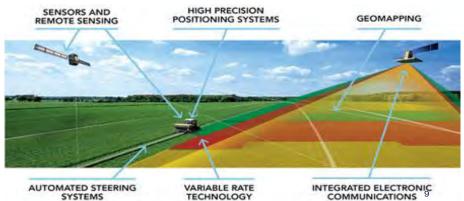
NEW APPLICATIONS & NEW USERS



SYSTEM OF SYSTEMS







SPACE ECONOMICS - DRIVING FORCES FOR THE COMING DECADE



- 1. Rapid Tech Development Digitalization, Miniaturization
- 2. Return of Investments & Competition Societal, Corporate, Market
- 3. Information is the product driving the Value Chain
- 4. Global Distribution of Wealth Sustainable Global Growth
- 5. Functions on Earth, Sustainable Planet and Societal Competiveness is the main political driving forces
- 6. Investments: Institutional & Private Coherent Value Chain

PRIVATE INVESTMENTS IN "NEW SPACE"



VENTURE FUNDS













ENTREPRENEURS



E. Musk SpaceX



R. Branson Virgin Galactic



Jeff Bezos Blue Origin



B. Gates Kymeta



E. Schmidt Planetary Resources. Planet



P. Allen Stratolaunch

TECHNOLOGY COMPANIES













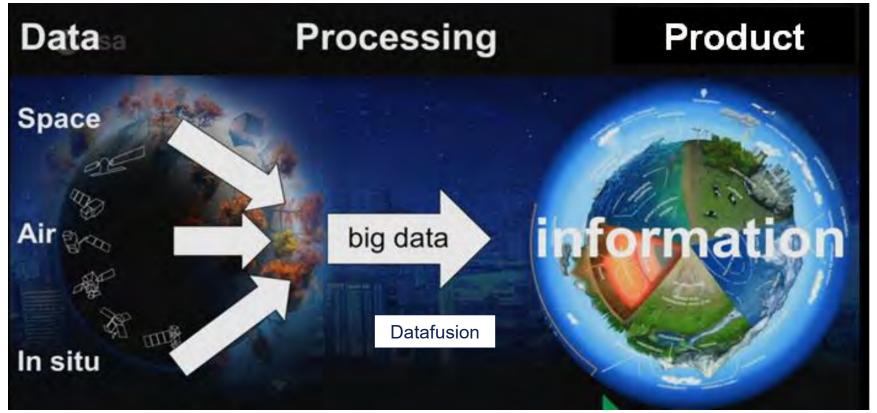


SAMSUNG



SPACE SERVICES FOR VITAL SOCIETAL FUNCTIONS





INDUSTRY SHIFT THE VIRTOUS CIRCLE



INNOVATION



MINIATEURIZATION STANDARDIZATION

INDUSTRIALIZATION

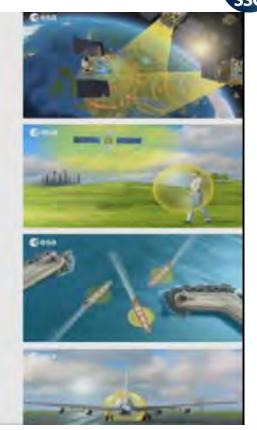


GLOBALIZATION

DATA, INFORMATION, APPLICATIONS, ACCESSABILITY......

Space = a tool for policy

- Agriculture
- Maritime and Fisheries
- Environment
- Transport
- Energy
- Health
- Regional Development
- Research and Technology and Industry
- Foreign Policy
- Security and Defence
- Global Sustainability

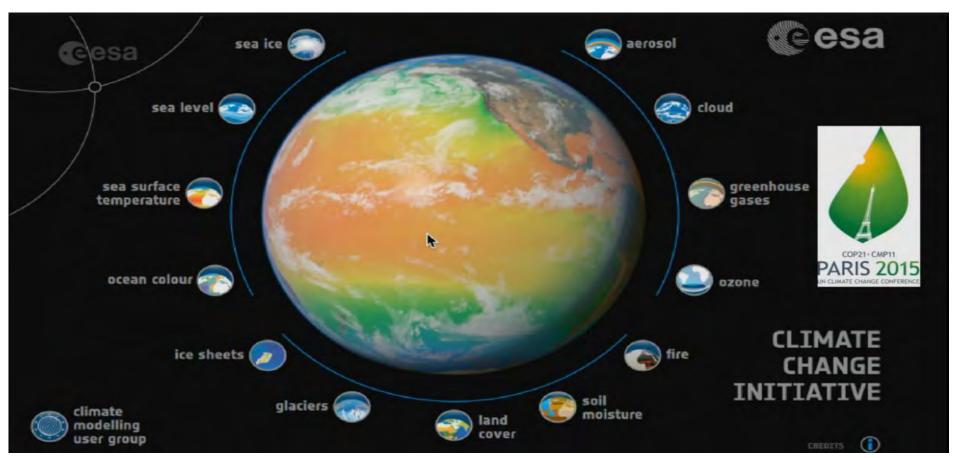


Source & Image: ESA

UN GLOBAL SUSTAINABILITY GOALS



SPACE CRUCIAL FOR ALL 17 GOALS

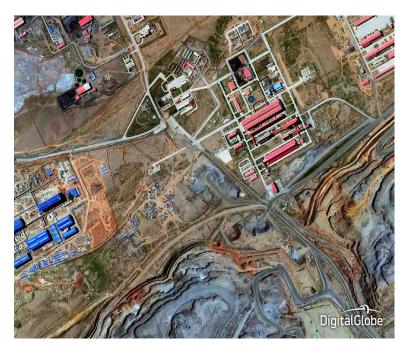


EXAMPLE, MINING





Satellite imagery of operational mines, such as The Diavikk Diamond Mine in Canada, (pictured) allows for environmental impact assessment



The progress of mining can be monitored over time.

Above, Bayan Obo Mining District, western Inner Mongolia,
China

EXAMPLE: CRISIS MANAGEMENT





More than half a million Rohingya Muslims fled from the Rakhine province of Myanmar for neighboring Bangladesh after government forces burned hundreds of their villages in what is being deemed a genocide. This image, taken by DigitalGlobe's WorldView-2 satellite on November 5, shows the Nayapara refugee camp in Bangladesh



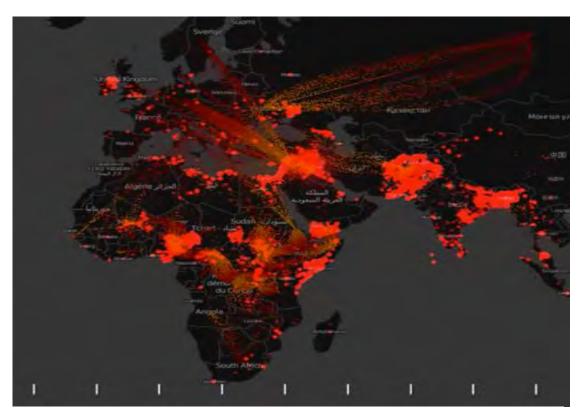
Shilluk minority homes in South Sudan, December 2016



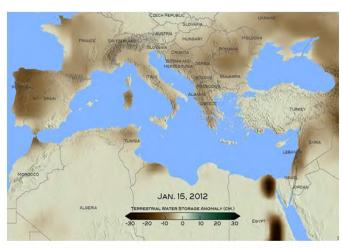
Shilluk minority homes in South Sudan after they were burnt, shelled and systematically looted by the government, March 2017

EXAMPLE GLOBAL WATCH: CONFLICTS, DROUGHTS AND MIGRATION





A screen shot from the Carnegie-Mellon University visualisation of warm (armed) and cold (tensions) conflicts and terrorist attacks (in red) and refugee flows (dotted lines). This screen shot is taken around 2015 at the height of the refugee flux from Syria.



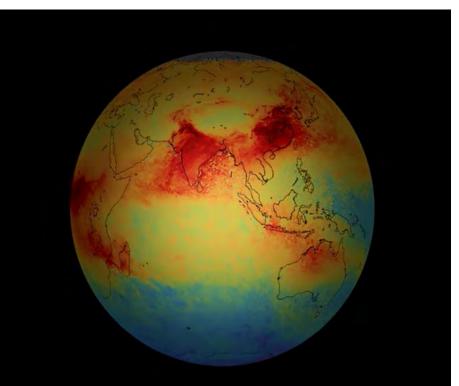
For January 2012, brown shades show the decrease in water storage from the 2002-2015 average in the Mediterranean region. Units in centimeters. The data is from the Gravity Recovery and Climate Experiment, or GRACE, satellites, a joint mission of NASA and the German space agency. Credit: NASA/ Goddard Scientific Visualization Studio.

EXAMPLE CO2





The Henan Coal Mine and power plant in China. Satellite shots can indicate the plant's emission and fuel

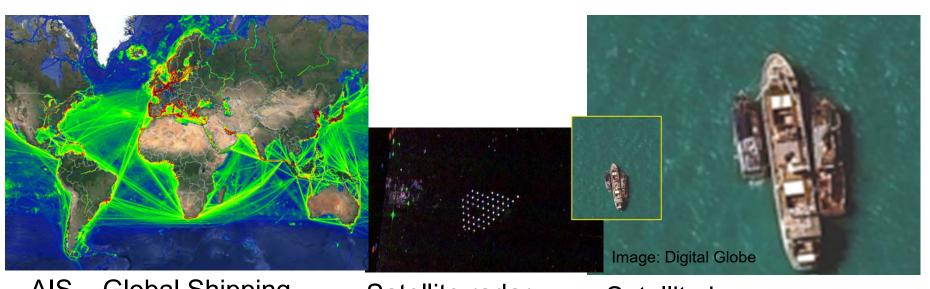


Carbodioxide streams followed and measured from space

EXAMPLE MARTITIME SURVEILLANCE



SYSTEM OF SYSTEM COLLABORATIVE APPROACH



AIS - Global Shipping

Satellite radar

Satellite images

SPACE TRENDS & DRIVING FORCES



DRIVING FORCES

- Technical Development Enormous Opportunities
 - a) Miniaturization, Digitalization,
 - b) Low Cost Production
 - c) Competition Competiveness
- 2. Commercialization & Private equity
- 3. Availability New Actors / Nations
- 4. Planet Sustainability
- 5. Sustainable Global Growth
- Exploration opportunities for Societal Development

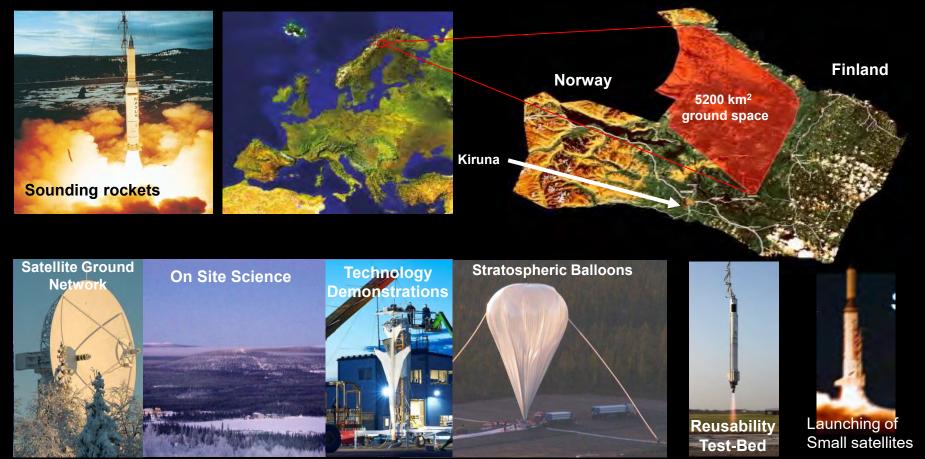
SOME KEY TRENDS

- 1. Small Satellites: Constellations
- 2. More Advanced large Satellites
- Micro Launchers & Test Beds Globa Lack of Capacity
- Space Traffic management & Space Debris
- Applications & Services Societal development
- 6. Sensor tech & onboard processing
- 7. Start Ups New tech
- 8. Data com (Optical, Ka-band etc)

CONVERGENCE OF IT, TELECOM AND SPACE

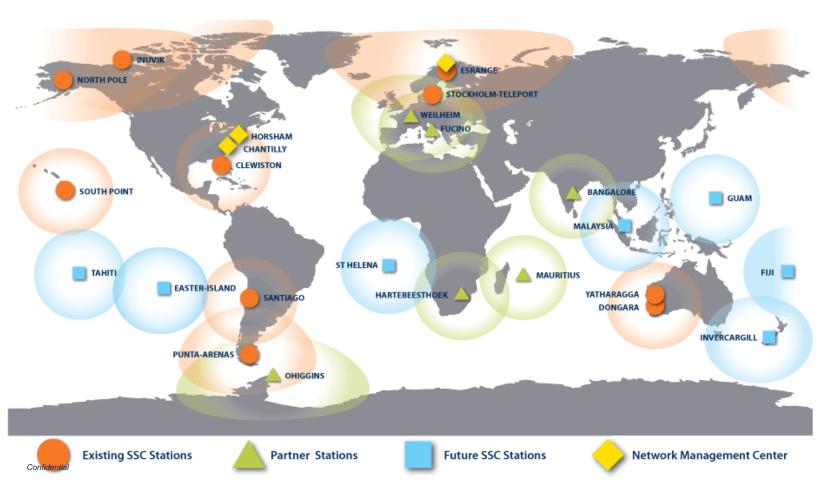
ESRANGE - BECOMING THE MOST VERSATILE SPACE CENTER IN THE WORLD

Twice the size of Luxembourg or Rhode Island



A WORLD OF COVERAGE









Aerospace industry from a regional perspective

David Sundström, Region Norrbotten, Stefan Sydberg, Kiruna kommun

Space Innovation Forum 6 8-9 May 2018



Aerospace industry from a regional perspective

David Sundström, Region Norrbotten

Space Innovation Forum 6 8-9 May 2018



Aerospace industry from a regional perspective

Stefan Sydberg, Kiruna kommun

Stefan Sydberg
2. vice chairman municipality board
Chairman space council



Aerospace industry from a regional perspective

Norrbotten, Space county

Meeting place and arena for innovation, entrepreneurship, research and development

- Publicity & branding
 Sweden & Norrbotten
- A cause for travel
- Inspiration
- Innovation
- International cooperation
- Educations and research
- New companies
- New jobs



The chans to create benefits between above earth and under ground



-





That's it

Space Innovation Forum 6 8-9 May 2018



Aerospace Industry from a national perspective and Inauguration Aerospace Cluster Sweden

Carl Rosén, Näringsdepartementet

Space Innovation Forum 6 8-9 May 2018



Fika + PhD Exhibition



Aerospace Cluster Sweden

Göran Berlemo, ACS

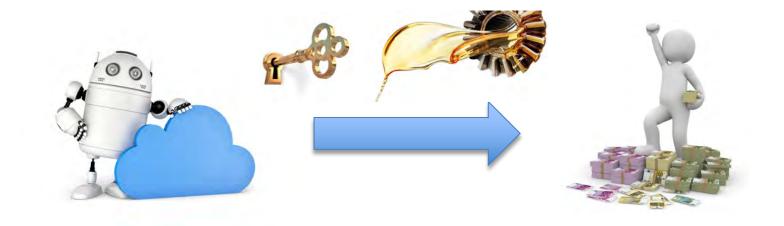




Aerospace Cluster Sweden

Kiruna 2018-05-08--09 Göran Berlemo

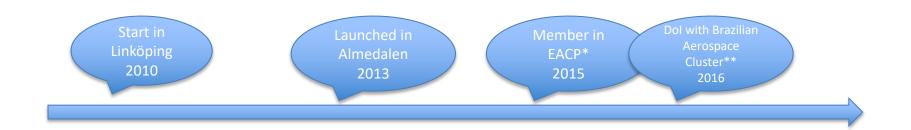
What is ACS?







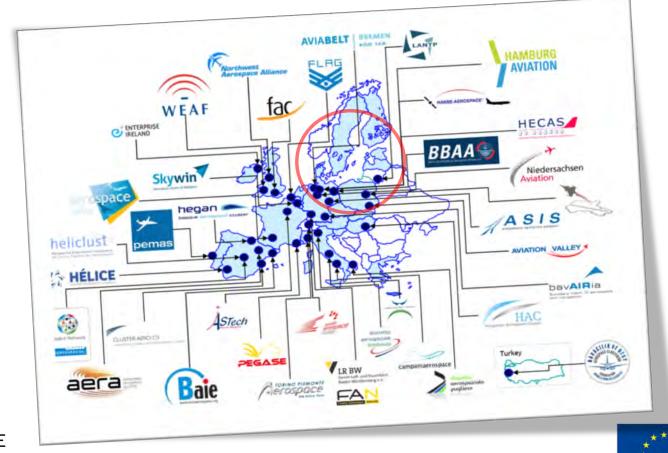
Milestones for ACS



- * EACP = European Aerospace Cluster Partnership
- ** Declaration of Intent med Sao José dos Campos Technology Park, Brazilian Aerospace Cluster







AEROSPACE CLUSTER SWEDEN EUROPEISKA UNIONEN Europeiska regionala utvecklingsfonden

ACS Mission

Support Swedish Aviation and Space companies to become a national area of excellence

- Focus on increased business for Small and Medium-sized Enterprises
 - Collaboration between Industry, Academia and Government
 - Collaboration between SME and Large companies
 - Support R&D to Business in an efficient way
 - Support national and international business
- Member Value!





ACS Areas of Business

- Networking Industry/Academia/Government, site visits, event...
- Exposure Homepage, exhibitions, matchmaking...
- Competence Share knowledge and competence, arrange courses and seminars...
- Internationalization EACP, visits, event, exhibitions, matchmaking...
- Policy & Regulations Drive important issues as an organization (SOFF, SAI, UAS Sweden)...
- Support Information by email and homepage, establish contacts...
- Very important with dedicated cluster members!







ACS

2016

- Clean Sky, Region Östergötland and Region Västra Götaland signed a MoU
- ACS became an economic Association and companies from the western part of Sweden started to become members





"SVIFFT"

 Pilot study "Aeronautic Area of strengths" spring 2016















SVIFFT a project within ACS

Evolving Sweden's Future Aerospace Industry through collaboration

SVIFFT Background

Current situation:

- A few large Swedish companies with a revenue of approx.
 24 BSEK (2016)
- Few Swedish suppliers (< 5%)

Potential:

- Aeronautics business grow with approx. 5% yearly during the next
 20 years
- Needs next 20 years: >30 000 new airplanes 45 000 BSEK
- Space = next upcoming business area
- Goal to grow the business for SMEs 5 times until 2050
 AEROSPACE 500 MSEK (2016); 1.5 BSEK (2035); 2.5 BSEK (2050)



SVIFFT Partners and funding - 12 MSEK during 2017- 2019

3,7%
AEROSPACE
CLUSTER
SWEDEN

swerea sicomp

8,8%

Companies:

Saab AB
GKN Applied Composites AB
Exova Materials technology AB
RUAG Space AB
Nordic Aircraft AB

25%

VÄSTRA

GÖTALANDSREGIONEN



12,5%







ACS and SVIFFT

ACS is an association for everyone in, or on its way into the Aerospace and Space business

SVIFFT, project run by ACS during 2017-2019:

- Short term
- Establish ACS
- Strengthen the link between R&D&I and Business
- Strengthen existing Production Arenas
- Long term
- ACS is a cluster financed by the members and with an viable model for business and collaboration
- Intensive business within the Production Arenas





Contacts



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Cluster Coordinator East
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Project Manager SVIFFT,
Cluster Coordinator West
leif@aerospaceclustersweden.com



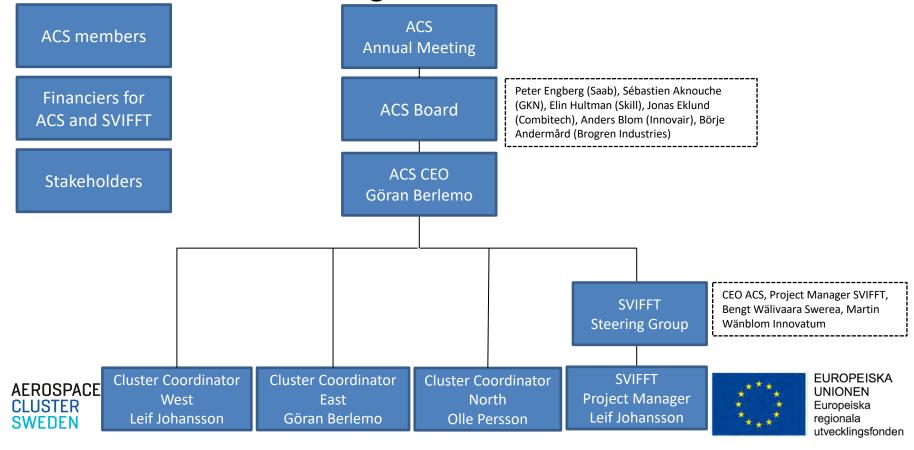
Olle Persson
Cluster Coordinator North
olle@aerospaceclustersweden.com

www.aerospaceclustersweden.com

AEROSPACE CLUSTER SWEDEN



ACS and SVIFFT organization







Thank you for your attention!



Cluster and benefits for SMEs

Fredrik Olofsson, Brogren Industries





Fredrik Olofsson



"Sverige flyg AB"

- Kluster
- Stora möjligheter
- GKN, SAAB
- Övriga världen

Följ med på vår resa



AIDA 2009









2010 Varför!

- 3 frågor, vilka är vi? vad kan vi? vart ska vi?
- 3 svar, vet vilka vi är, vad vi kan och vart vi ska.
 - Etablerat företag inom industrin
 - Långsiktig satsning på kunder, teknik, organisation mm
 - Långsiktig positionering, vår framtida position inom flyg
 - Hållbart i framtiden
- Gav oss en ny fråga, Hur? (F-n ska vi komma dit)
 - Överst på listan



AS 9100



Resan mot AS 9100

Vi startade arbetet med att ta reda på

Vad är skillnad på ISO 9001 och AS 9100

Hur väl följer vi kraven i ISO 9001

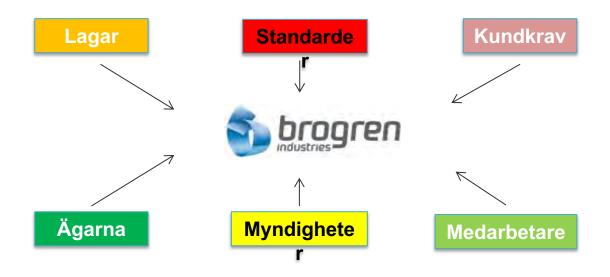


Resan mot AS 9100





Vilka krav har vi på oss?





Efter några månader så konstaterade vi att:

Vi behöver förändra hela vårt verksamhetsledningssystem



SAGE 3 2011-2012









3 April-2012

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Brogren Industries AB Hålstensvägen 24, 446 37 Älvängen Sweden

has been approved by Lloyd's Register Quality Assurance Limited, Coventry, UK, to the following Quality Management System Standards:

AS 9100C (technically equivalent to EN 9100:2009) ISO 9001:2008

This certification has been performed in accordance with the requirements of EN 9104-001:2013

The Quality Management System is applicable to:

Precision engineering production of machined parts for aerospace engines.

This certificate is valid only in association with the certificate schedule bearing the samenumber on which the locations applicable to this approval are listed.

Certificate No: GBG0001605/2

Original ISO 9001 Approval: 28 June 1999 Original ASCS Approval: 3 April 2012

Current Certificate: 3 April 2015 Certificate Expiry: 2 April 2018

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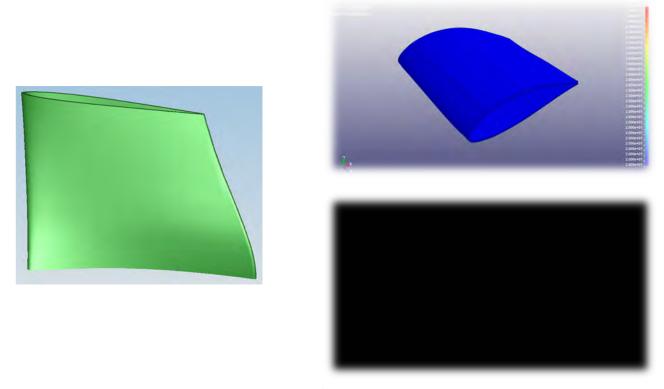


Clove's Register Quality Assurance Ltd., Hiremford, Middlemurch Office Village, Siskin Drive, Coventry, CV3 4FJ, United Kingdom

Layer's negative Quality Assistance List, Hamilton, Michaelland China Visagie, Solan Dilver, Corentin, Cvi ale, Lines Angocom-land and Assistance Control of the Control o



Lasersvetsning och simulering BIV 2013



Material-laserskärning-bearbetning-plåt formning-laserskärning-tillverkning- NDT

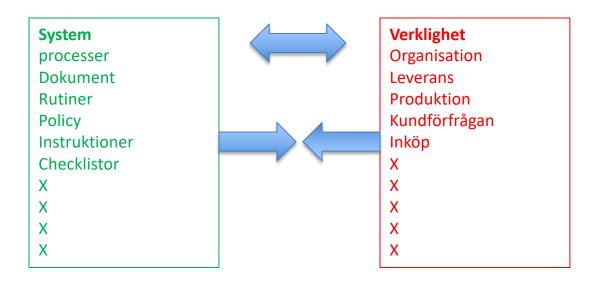


2013 Nytt kundsamarbete





Resan mot AS 9100





Open Rotor 2015-2016





Har resan varit en bra investering?

Tydliga och långsiktiga prognoser
Organisationens förståelse för att hantera kravbilder
Förståelse och kunskap om att kvalificera egna leverantörer
på Systemnivå, Metodnivå, Artikelnivå
Teknisk utveckling med lasersvetsning och simulering
skärande bearbetning med tuffa geometrier och utmaningar









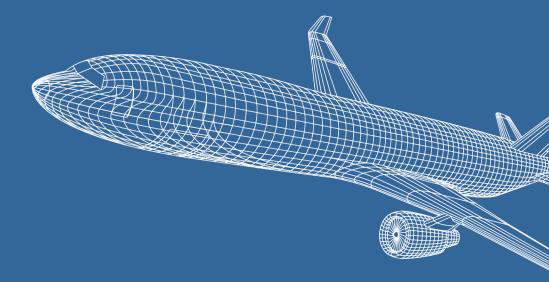






Cluster and benefits for large companies

Sébastien Aknouche, GKN Aerospace



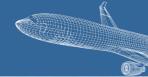
Cluster and benefits for large companies

Aerospace Cluster Sweden North

Sébastien Aknouche



GKN Aerospace at a glance



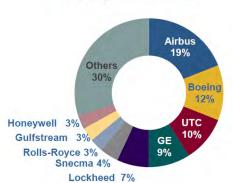
- > 17,950 employees
- 55 manufacturing locations
- > 14 countries
- > Sales: £3.42bn
- Trading Profit: £339mTrading Margin: 9.9%

> ROIC: 14.6%

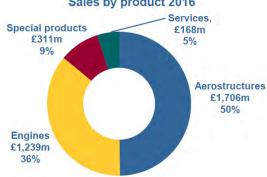
GKN Aerospace is a leading global tier one supplier of airframe and engine structures, landing gear, electrical interconnection systems, transparencies and aftermarket services. It supplies products and services to a wide range of commercial and military aircraft and engine prime contractors and other tier one suppliers.



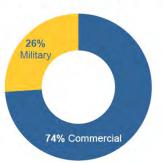




GKN Aerospace Sales by product 2016



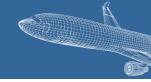
GKN Aerospace Sales by market 2016



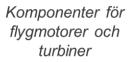


ev.1

GKN in Sweden– GKN Aerospace Engine Systems









Militära flygmotorer



Delsystem till raketmotorer

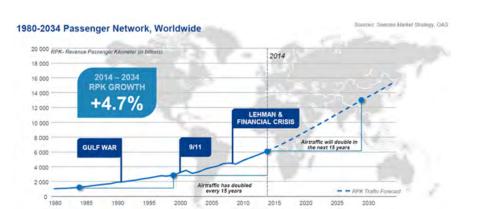


Motorservice

- Global leading supplier for engine original parts. 90% of all new modern large commercial aircraft are equipped with components from Trollhättan
- "European Center of Excellence" for Turbines and Nozzles till Europe's launcher Ariane
- OEM for Gripen fighter RM12 engine
- Sales 7,3 Billon SEK (2017), around 90% export
- 2000 employees in Sweden, largest private employer in Trollhättan
- Trollhättan is the headquarter and design and development center for GKN Engine Systems



Trender flygtrafik och flygindustri - Möjligheter och utmaningar



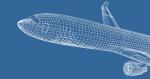


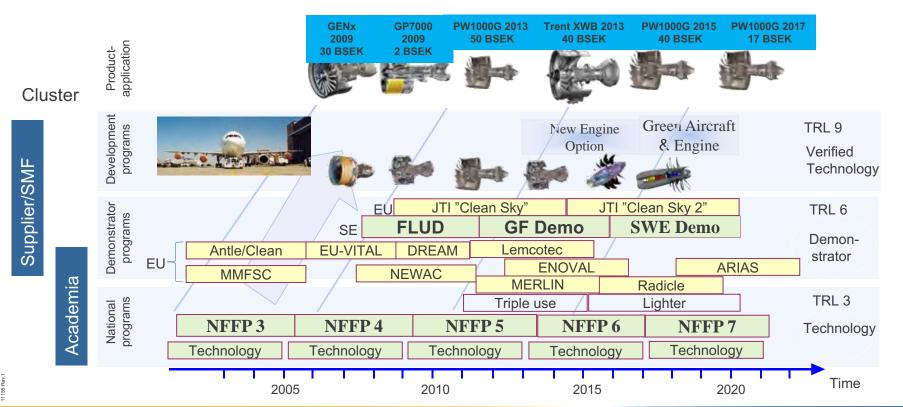




- 4.5% combined CAGR in all three segments to 2020
- Current backlog for commercial aircraft will ensure strong demands for the next 5+ years
- Strong future development in global air traffic, especially in Asia, provides long term growth
- Military spending is increasing globally
- Increased privatization and spending in the space industry opens up more available content for GKN

TRL maturation at GKN Aerospace Engine Systems



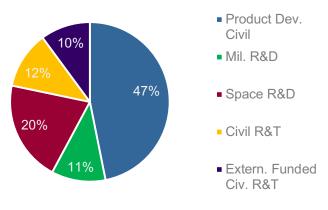


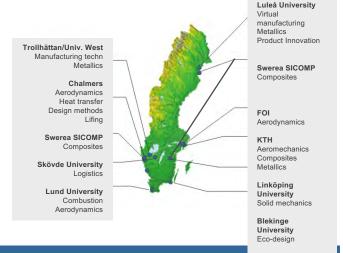


GKN R&D in Sweden 2017



- GKN SE Manages ~ 800 MSEK in R&D Projects in Sweden Across Space,
 Military & Commercial Applications
- · Core GKN Aerospace Technology Center in Trollhättan
- Strong National Research Network



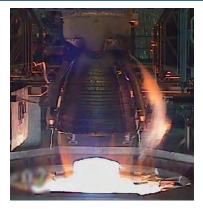


More than 60 PhD Projects in Current Portfolio
9 EU projects Commercial applications – Clean Sky 2 (CS2) project includes 6 demonstrators
2 ESA Projects Space applications – ETID and Prometheus



Why demonstrators?

- > Validation to TRL6 is difficult and very expensive
- > Can only be made in collaboration with an OEM
- > Positioning for future business
- Relevant, high TRL topics for SMEs and Research Centres
- > INNOVATION





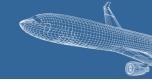








GKN demonstrators in Clean Sky 1



Important cooperation with Innovatum/PTC and SME

GKN Compressor structure to Rolls-Royce's demonstrator – tested 2012



Brogren (bearbetning) och PTC (lasersvetsning)



GKNs turbine structure – engine test at MTU in Germany 2015 (HDL – hydroformning)



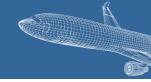
GKNs rotating structure to Open Rotor Engine. Engine test 2017 (*Tooltec, Brogren, PTC*)







GKN Demonstrator in Space Propulsion



SWEA- Nozzle demonstrator verifying GKN Sandwich

platform



Extensive local SME participation Trestad Laser, Tooötec, A-terknik Welding and machining of tooling and manifold

Etid- Upper stage Nozzle demonstrator



Tooltec partner on critical milling of cooling channel

Turbine demonstration programs

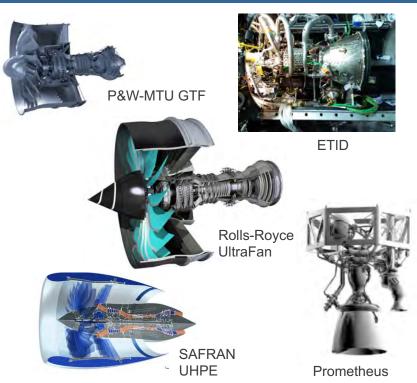


SME participation by A-Teknik & Rydverken

TT155 KeV.1

Demonstrators projects ongoing

- > Fan static module with Pratt & Whitney (USA)
 - GKN responsible for fan case, fan frame, fan OGVs, IMC
- Compressor module with MTU (DE)
 - GKN responsible for LPC and IC-duct
- > Exhaust module with MTU (DE)
 - GKN responsible for TEC and exhaust
- Compressor structure with Rolls-Royce (UK)
 - GKN responsible for ICC
- > Turbine structure with SAFRAN (FR)
- Compressor structure with SAFRAN (FR)
- Prometheus Ultra Low Cost Space engine with Arianegroup (FR-DE)
- > ETID upper-stage Space engine with Arianegroup and DLR (DE)







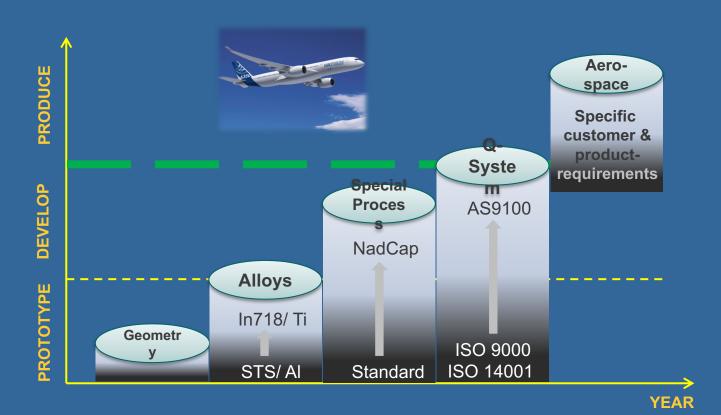
- Distance
- Language Culture
- Time
- Security of SupplyExport Control







NEW SUPPLIER DEVELOPMENT







Presentation of National Space Strategy

Helene Hellmark Knutsson, Utbildningsdepartementet

Space Innovation Forum 6 8-9 May 2018



Cluster and benefits for collaboration between industry and academy

Marta-Lena Antti, Luleå tekniska universitet

Cluster and benefits for collaboration between industry and academy

Marta-Lena Antti
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Coord. Graduate School of Space
Technology

Cluster

" a group of several discrete items that are close to each other"

Wikipedia



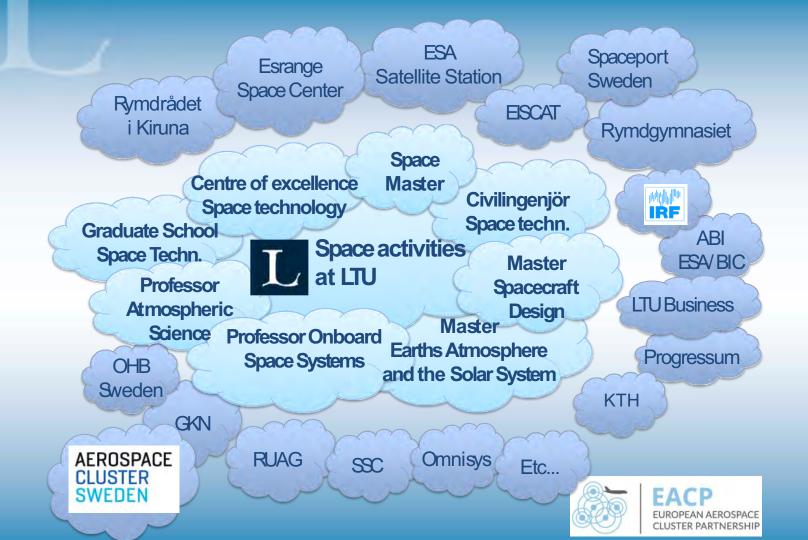
Together we are stronger!



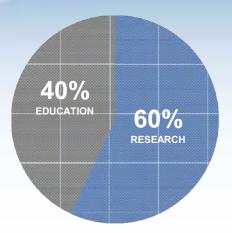








Luleå University of Technology



- Founded 1971
- 15 000 students
- 1 637 employees
- 779 teachers, researchers, professors
- 352 PhD-students

Turnover: 1.6 billion SEK:

- Research share:911 MSEK
- 60% externally financed whereof 19% company financed
- 70 research subjects



Space Education

- Civilingenjör Space Technology, 5 year
- Master programs, 2 year:

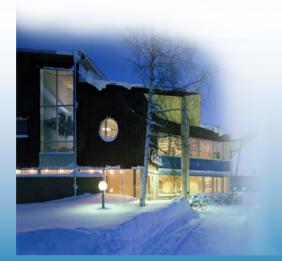
Space Master

Spacecraft design

Earths Atmosphere and the Solar System



>150 students / year focusing on space technology / science





Education in collaboration with industry

Example:

Master thesis work: 5 months full time. A good entrance to academia!

Project courses: 7.5 - 30 hp (= one semester full time)

• Why collaborate?:

- Good for the student, contact with companies.
- Good for the company, problem solved, can employ good students.
- Good for supervisors, more interesting projects.
- •Knowledge accumulation about company's research questions through several different projects together.
- •Same student can do both projects and master thesis work. Longterm goals important in all research!
- •Cost efficient collaboration. Access to supervision, labor and research instruments at no or low cost.
- Industry needs can influence our courses.

Master thesis projects and one-semester projects



Lisa Markusson, now employee at GKN

Claire Karlsson, now employee at GKN

Graduate School of Space Technology



Atmospheric Science
Onboard Space
Systems
Engineering Materials
Applied Physics
Machine Elements
Product innovation

- Started 2002
- 3rd round, 6 subjects, 18 PhD-students
- 39 PhD-exams
- > 200 publications
- Collaboration with IRF, RUAG,
 GKN, SSC, OHB, Nanospace, SNSA...
- Courses, workshops, meetings



Ange 1Ca lin dwall, Product Innovation angeta ind-MI @ttu.se Supervisors: Anti OhNnl AonnbKii:(Pn:d.,ct l VIM hrich (IlWMltionand Entrepren Åsa M:kbffg Nwon (Industriil Desig1)

THE INFLUENCE OF ADDITIVE MANUFACTURING ON THE **DESIGN PROCESS**

The space industry is charaderised by high-risk projects in low production volumes. While the new initiotive throl ligh ESA1OJ, directs the industry towards chelliper Produt s opportunitie> such as short er lead times bring lodil1es in using Additive Manufacturi ng IAM}. However, de,signers tod ay do not have e nough knowledge of AM and how to apply it in the design proces s.



Two mojo r issue s of implementing AM into the design process is (1) the designers' a bility to abs or b a ll the pos.s ibi/ities t hat AM o ffe r5 a nd (2) for the d es igner to have know le dge of t he num e ro us !imitations in des ig n t hat th e s.e ma nufact un ng proc esse s brings. The a im of the project is to increase know ledge in design for a dd it ive mill nuRl ct u nr12 in o rde r fo r >pace companies to success fully utilise t he: met ho d in their d es ign.s. In the initial stud iss, four a reas have bee n id ent ifi ed as import ant fact ors for t ti e eng inee r to a dop t AM in the irdesign wo r k a nd a re p resente d in t t,e figure below.

















kanika Garg, Onboard Space Systems Knilc.a.garg@hu.se Su p e rviso r: M. Reza Emami

High-altitude scient ific balloons provide a p/a tform for environm ental research as wel/ as for testing /uture space instruments. Howevefioperating such balloons is a chal/e nging task. This project aims to provide a solution to the chal/enges faced by the

bal/oon flight community by studying and providi,ig a methodo/ogy and te chno/o gy to make balfoon navigat ion more accurate.

Balloons loat in the direct ion of the winds and need manual steering for operations like ballast ing a nd ve nti ng of the gas _This ma kes the balloo n flight comp lex in tenns of mane uvers and a koint roduces, the risk of losini? an experiment as winds cannot be determined to a great exte nt in the strato:sphericregion. Therefore:, having a system that

c.an facil interpre flight and real tilme flight path planning could be useful lasiwillred uce t he cost and risk associa ted with the ballo on flight.

An autono mous navig ation system and a s.emi- auto no mous plloting system wil lhe des ign ed for us,e en-board the ball oon, that will be capable of trajectory estimation by ta king into consideration the environment and system constraints in real time. This will facil it ate a decision m aking syste m on-board for various steering parameters (ball asting and vatving,) thus red ucin g the complexity of balloon flight operations.



















Concurrent agile verification and validation of onboard space embedded systems using a hardware-in-the-loop simulation platform

Cristå bal Nieto Perov Onboard Space Systems ctvis.nie to @ttu.se Superviso r M. Reza Emami

Onboord computer s (OBC) for space applications have to be flexible enough to meet the requiremen t s of vorious c:ontroctor.s. Curren tly, the spaceworthiness af an OBC is validated through the verification of very di!tailed low-levd efe c.tronics and the erificat;on of every operational scenario, which is still not an automatized task.

he present project investigates title means to accelerate the validation procedure of RUAG's pacecraft M1 magem ent Unit (SMU) in terms of methodo logyond filicilities. The aim I!i allio to be able to genera ize this set of practices and took to other subsystems. In order to a uto matize the

l/alidation proced ure an agile method ology is implemented. Specificalty, Se haylor Drive n. Deve b. pme.nt. (60D) assu mes that any product can be validated if the outco mes of such product \n al Ishations can be verified.

Thien, we pui: the actual SMU in a hardwa re mthe-loop sim li a uon tHILSJ which is rum rl g t ne see narios gene rat ed by BDD. In Fuch s imula ion the SMU is con necte d to a fet of virtual d evice s thro ugh t tle se rver as it Is done in a rea l pacecraft. The SMU a n atso interface real d evices to com ple ment the virtual ones.

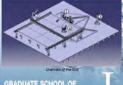


The Onboard Space Systems group has developed an Integrated Design and Simulation J Environment (IDSE). Soch envi ronment, which performs HILS simula ons, can emulate the s pace dynam ics of a p ayload up to a 6Ucu besat.

The IDSEdyna mic emulation is achieved by:

- Fixed-base 6 d.o.f. Rob ot Mampulator Free-ba s.e 6 d.o.f. Robot Ma nipulato r
- 3 Statk 3 d.o.f. Air Searing Stand 4. floating-base 5 d.o.f. Air Bearing Stand.

In collaboration with. RUA

















Cross-disciplinary research example: Machine Elements and Atmospheric Science

- Oil lubrication on Mars rovers evaporates
- Solid lubricants have low service life
- Low vapor pressure fluids can freeze and need preheating (takes energy from battery)
- Hybrid-lubrication developed, that is self-healing if damaged
- Wants collaboration with a company!





Supervisors























- → Onboard Space Systems
- → Engineering Materials
- \rightarrow Applied Physics
- → Machine Elements
- → Product Innovation
- → Fluid Mechanics
- → Chemical Technology
- \rightarrow Signal Processing
- → Entrepreneurship and Innovation
- → Control Engineering







Course in Product Innovation, 7.5 hp Anna Öhrwall Rönnbäck and Reza Emami

- What is the difference between **Invention** and **Innovation**?
- What is the "**product**" in your research project? (instrument, hardware, software, method, model, etc).
- Who are the **users**? Who are the **customers**?



Project management with space applications, 7.5 hp *Peter Berlin*

How can we (the cluster) increase collaboration between industry and academy?

- •Industry offer more master thesis projects.
- •The ones building instruments and the ones using them should collaborate more, e.g. workshops and conferences.
- •Send newsletters to each other.
- •Academy invite more industry representatives to dissertation and lic-thesis presentations.
- •Send theses to industry.
- •Invest time to discuss common interests, arrange meetings.
- Adjunct professor / lecturer from industry, and vice versa.

Knowledge is needed to make money, money is needed to increase knowledge - that is one reason for collaboration!

I. Sandahl, IRF and H. Runnemalm, GKN. Workshop at IRF, 2010.

Thanks! We are open for collaboration!

Together we are stronger!





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Summary and next step for ACS North

Olle Persson, RIT-projektet Göran Berlemo, ACS

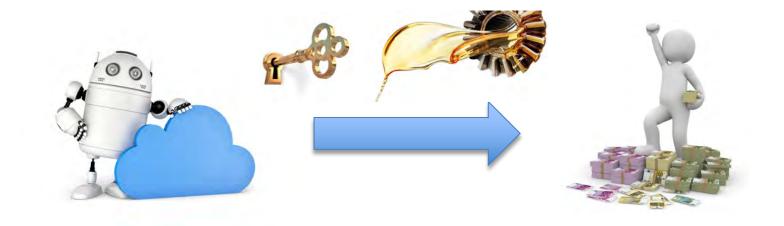




WS ACS North

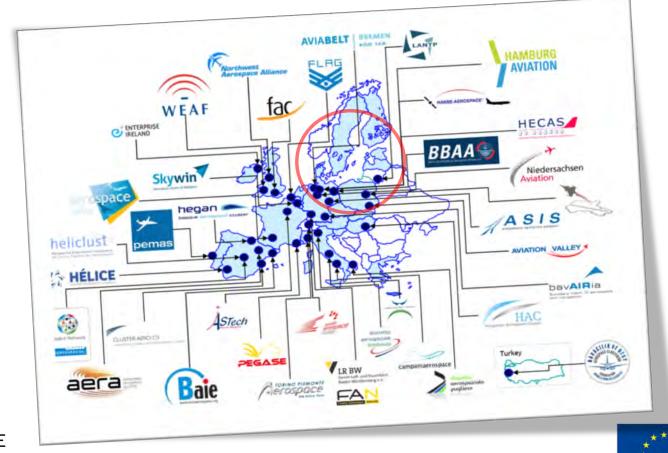
Kiruna 2018-05-08--09 Göran Berlemo

What is ACS?









AEROSPACE CLUSTER SWEDEN EUROPEISKA UNIONEN Europeiska regionala utvecklingsfonden

ACS Mission

Support Swedish Aviation and Space companies to become a national area of excellence

- Focus on increased business for Small and Medium-sized
 Enterprises. Increase the number of companies and their revenue
 - Collaboration between Industry, Academia and Government
 - Collaboration between SME and Large companies
 - Support R&D to Business in an efficient way
 - Support national and international business
- Member Value!





ACS Areas of Business

- Networking Industry/Academia/Government, site visits, event...
- Exposure Homepage, exhibitions, matchmaking...
- Competence Share knowledge and competence, arrange courses and seminars...
- Internationalization EACP, visits, event, exhibitions, matchmaking...
- Policy & Regulations Drive important issues as an organization (SOFF, SAI, UAS Sweden)...
- Support Information by email and homepage, establish contacts...
- Very important with dedicated cluster members!







Contacts



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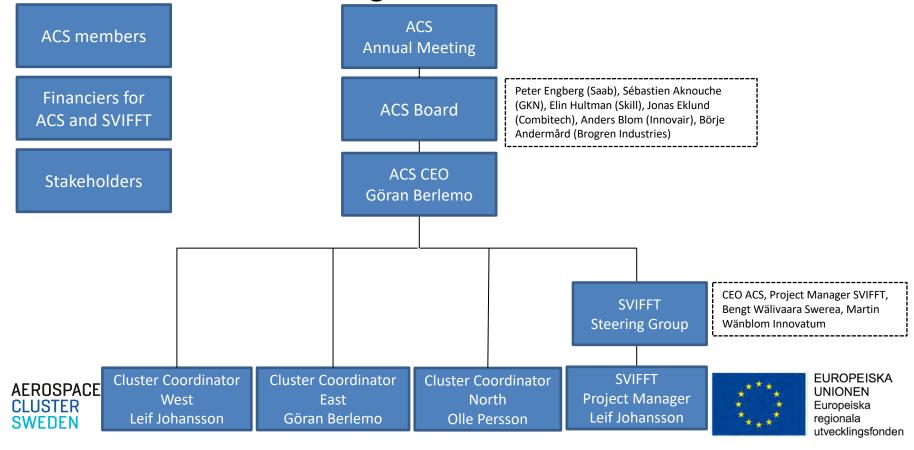
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AEROSPACE CLUSTER SWEDEN



ACS and SVIFFT organization







Thank you for your attention!



Thank you!

- 13.00 Workshop about what to do in ACS North
 - what is the customer benefit in our region?
 - Anna Öhrwall Rönnbäck, Prof. Product Innovation at LTU
 - Göran Berlemo, Managing Director ACS
 - Olle Persson, Head of ACS North Node
- 15.00 End