GSAW 2010

Ground Space Technology Innovation within Agencies, Universities and Industry - Same purposes and results?

N Peccia – ESA/ESOC

3rd March 2010

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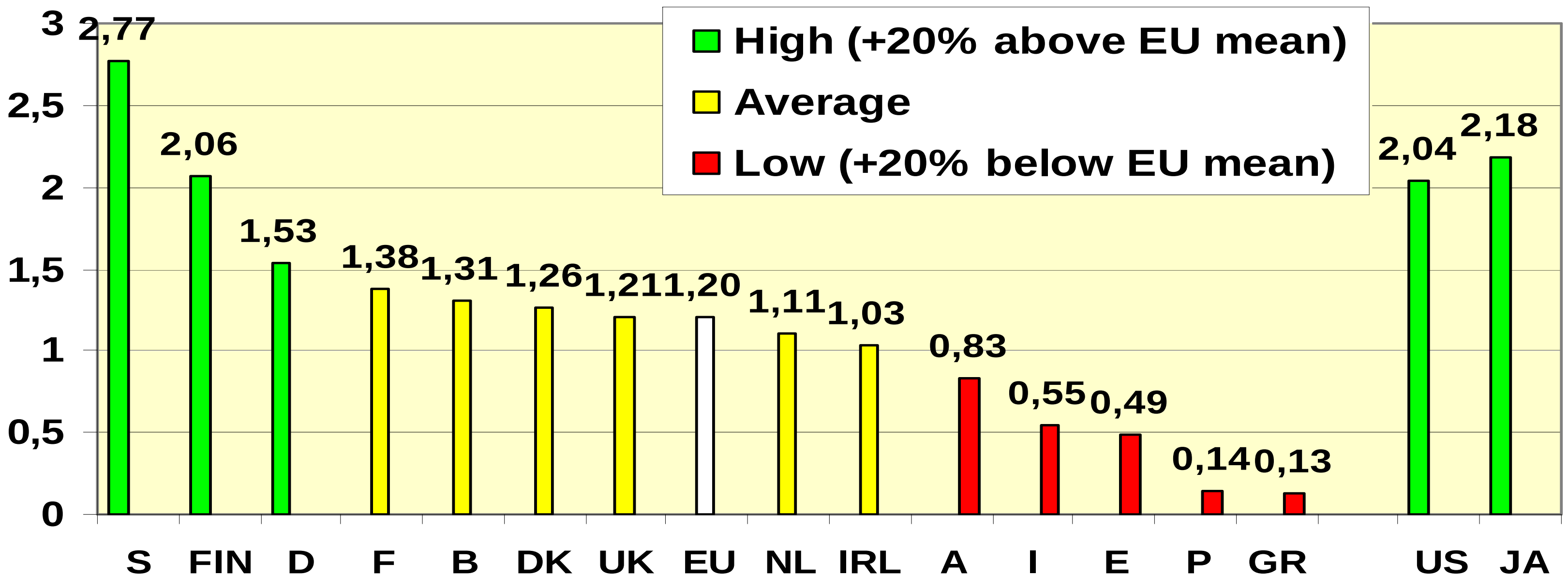
Outline

- The EU Lisbon Summit
- The EU Innovation Policy
- ESA's Innovation Objectives and roadmap
- ESA's study on Fast Innovation Transfer from Academia to Industry
- ESA Innovation Triangle Initiative
- The Ground CSOS experience

THE EUROPEAN FRAMEWORK

European Union - The 2000 Lisbon Summit

- A new strategic goal for the EU for this decade :
  - "to become the most competitive and dynamic knowledge-based economy in the world"
  - This can be achieved only by making Europe more entrepreneurial and innovative



- Business expenditure on R&D as a percentage of GDP

EU Innovation Policy: The Five objectives

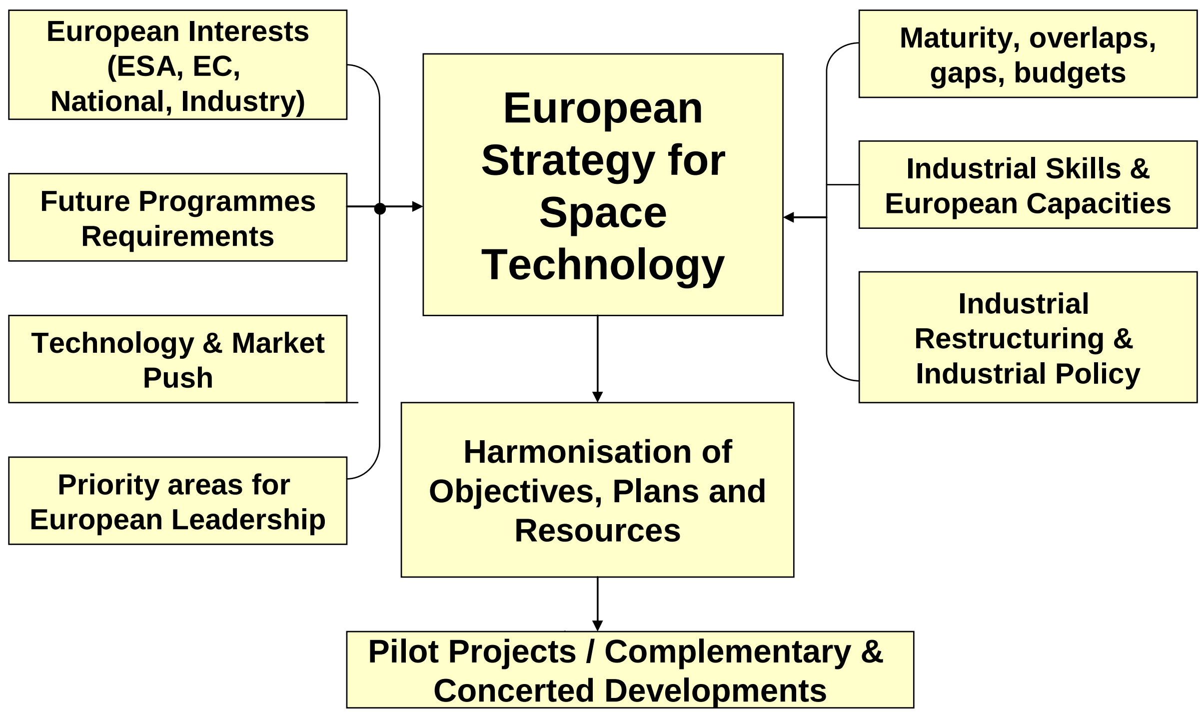
- Coherence of innovation policies
  - Bring policy up to level of the best, exchange of ‘best practice’, monitoring, evaluation.
- A regulatory framework conducive to innovation
  - Ensure innovators are not hampered by excessive red-tape (e.g. norms, IPR, accounting standards), particularly at local level
- Encourage creation and growth of innovative enterprises
  - Improve climate for innovative start-ups, access to new technologies, venture capital, seed funds, support structures; particularly at local and regional level
- Improve key interfaces in the innovation system
  - Help innovation to permeate the entire economic and social fabric: regional dimension, lifelong learning, role of universities and of public research facilities
- A society open to innovation
  - A well-informed European society, stakeholder debates, innovation at the workplace, in public administrations

ESA Innovation's Objectives

- Contribute to, encourage & advance an overall innovation process of the European space sector
- Support European autonomy and maintain technical excellence in core activities
- Prepare & enable more capable and more cost effective space Programmes
- Develop new competencies & support competitiveness of industry in the global commercial markets
- Innovation and Competitiveness Aspects
  - Improved cost/benefit to user
  - New applications & markets
  - Reduced response time to market
  - Patents
  - "Indicators" / "best practices" / "bench marking"
  - New funding sources
  - More cooperation between universities and industry
  - PhD's sponsorship research focussed

ESA Innovation's Thrust

- co-ordinated strategies and targeted priority objectives
- visionary "think tanks" with multidisciplinary teams
- call for ideas
- innovative technologies and processes ➔ patents
- innovative and competitive product and services ➔ profits



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An Innovation Roadmap

- Identify strategic and priority objectives for European space programmes and European leadership

- Higher investments for long term (10 years) objectives:
  - high risk/high payoff concepts
  - highly improved mission performance (x10)

- Synergy with high tech terrestrial developments and in concertion with other institutions

- Highly focused technology domains, compatible with tbd M€ related to:
  - platform and payload equipment, system engineering, mission architectures, software
  - design, development, production and exploitation phases

Example of Long Term Objectives

- Within 10 years, decrease power requirements and cost of telecom satellite by a factor 10 and increase bit rate and bandwith by a factor 10.
- Within 10 years, achieve 1 cm resolution of remote sensing from GEO.
- Within 5 years, demonstrate in orbit assembly and shape control of 1000 m2 structure.
- Within 5 years, reduce ground operation cost by a factor 10 by use of intelligent systems.
- Within 10 years, demonstrate a factor 10 improvement on angular resolution of astrophysic observations (down to 1 microarcsecond).
- Within 10 years, develop an energy source capable of operating continuously at 100 KW level on the surface of Mars.

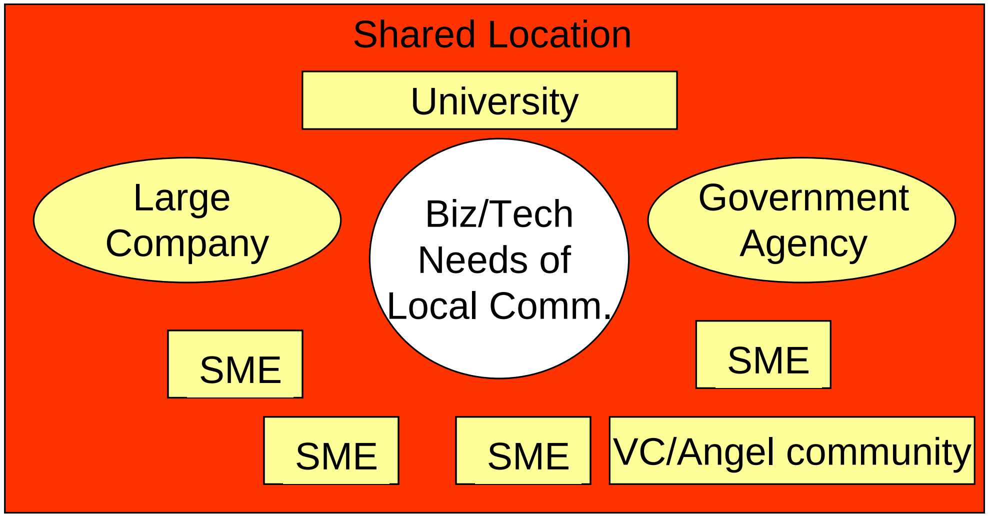
HOW TO TRANSFER INNOVATION FROM ACADEMIA

Fast Innovation Transfer from Academia to Industry

- Academia consists of
  - science parks,
  - interdisciplinary research centres,
  - spin-out companies,
  - strategic research alliances and
  - virtual universities,
  - and assess their effectiveness in commercializing innovative technologies developed within the science base
- ESA has tried via several studies
  - to identify examples of good practice and lessons learned from existing mechanisms and, where possible, to identify differences in performance between the space and non-space sectors
  - To identify areas where the space industry could utilize these mechanisms, and to determine whether any new mechanisms are required to assist with the commercialization of new technologies
  - To identify a role for ESA in supporting space industry use of/participation in these mechanisms, and to identify a role (if any) for ESA in establishing new mechanisms

Science Parks

- Science parks are more than just economic development schemes and shared facilities
- Routine passing of know-how / info
  - Formal training programmes
  - Business / technical support from larger entities
- For space inter-park communications necessary as space participants are scattered (no ‘Space Science Park’ identified)
- Speed is not an issue
- Time-to-market is not in mission / goals consequently is not tracked



Interdisciplinary Research Centre (IRC)

- 5 Levels of IRCs
  - One IR department at a university (level 0)
  - between university departments (level 1)
  - between university - industry (levels 2 - 5)
  - “local clusters
    - ⇨ University department
    - ⇨ IRCs
    - ⇨ non-university departments / uni-institutes
    - ⇨ Industry

- Relevance to Space Industry
  - High relevance to the space industry – focus on ‘real-life’ problems
  - IRCs work best when an industry-oriented body (e.g. ESA) actively defines and promotes real problems to be solved
  - Electronic communication tools/practices that are standard in the US need more development in Europe
  - Professional and social networking needs to be encouraged across discipline

Spin-Out Companies

- New company created through
  - the licensing of university-developed intellectual property
  - acquisition of knowledge/skills from a university
  - Nomination of university personnel as key staff
  - Early involvement of relevant industry players
  - Visibility is maintained within the academic networks
  - Intellectual property rights are handled separately from the operational part of the spin-out
- Relevance to the Space Industry
  - Limited impact of spin-out companies in the space industry (few exceptions e.g. SSTL, SpaceHab)
  - Significant impact in assisting the spin-off of space technologies into non-space markets (e.g. Anson Medical, QSS in the UK)
  - Comparatively limited market opportunities in the space sector

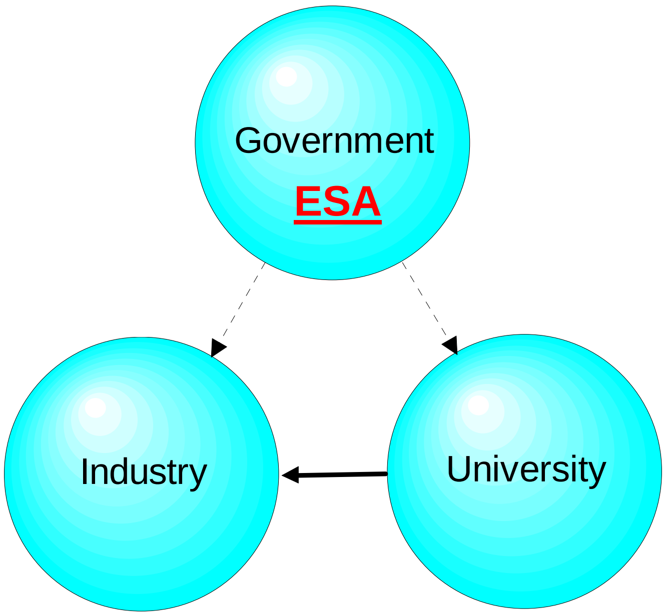
Strategic Research Alliances (SRAs)

- Reasonably long term (3+ years)
- Joint understanding of overall direction
- Relationships between partners are typically fairly loose and flexible
- Significant investments in time and infrastructure required by both parties
- SRAs often keep a low profile for competitive reasons
- Relevance to the Space Industry
  - SRAs are considered to be of limited relevance to the space industry
  - Possible SRAs could be formed to address research areas of long-term strategic interest to the space sector (next generation launch vehicles etc), however commercial/financial risk would be significant
  - Few space companies would have sufficient resources to commit to such a venture

Virtual university

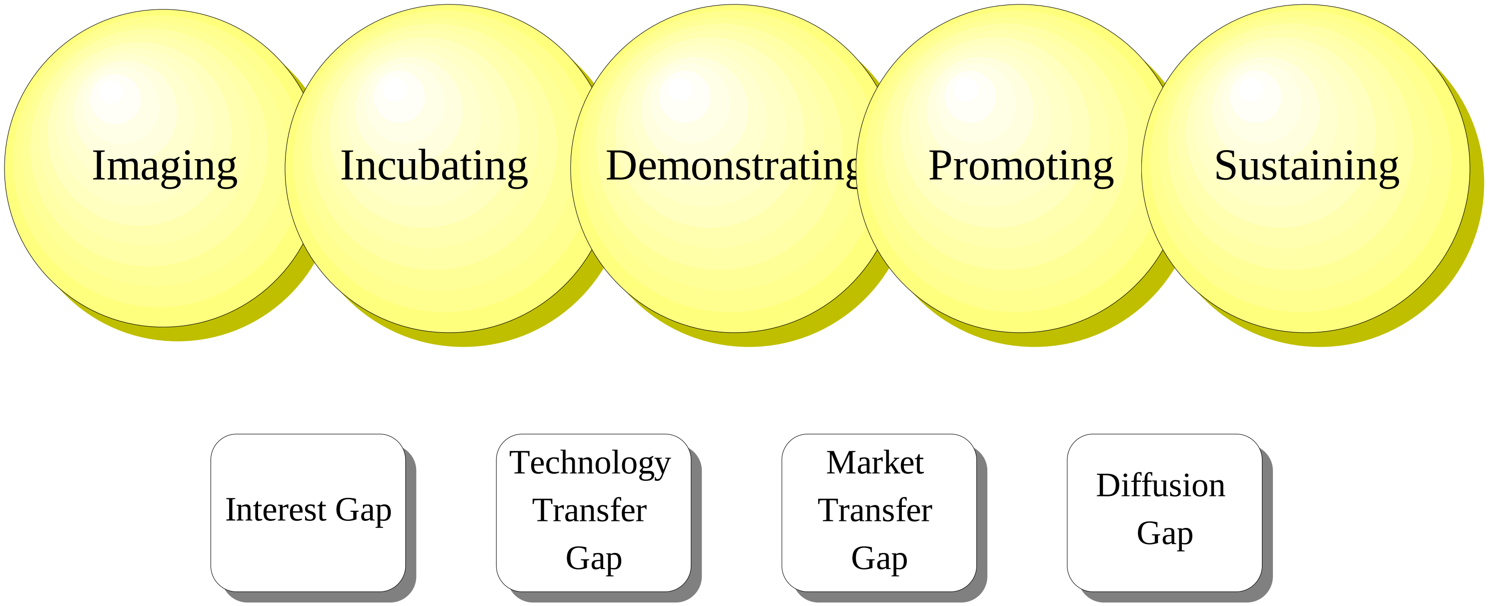
- Established by multi-national companies with large, distributed workforces
- Prime purpose is the delivery of training and educational content to workforce
- Virtual universities are being used as a knowledge management tool
- Numerous advantages in terms of numbers of users which can access resource, rapidity of update of content etc
- Disadvantage of such resources is some users prefer face-to-face training, also difficult to tailor content to needs of user base
- Relevance to Space Industry
  - Strong relevance to the space sector – it has large, distributed workforce with significant technical training requirements
  - Useful tool for knowledge capture & dissemination

Motivation Behind Academic-Industry Interfaces - ESA

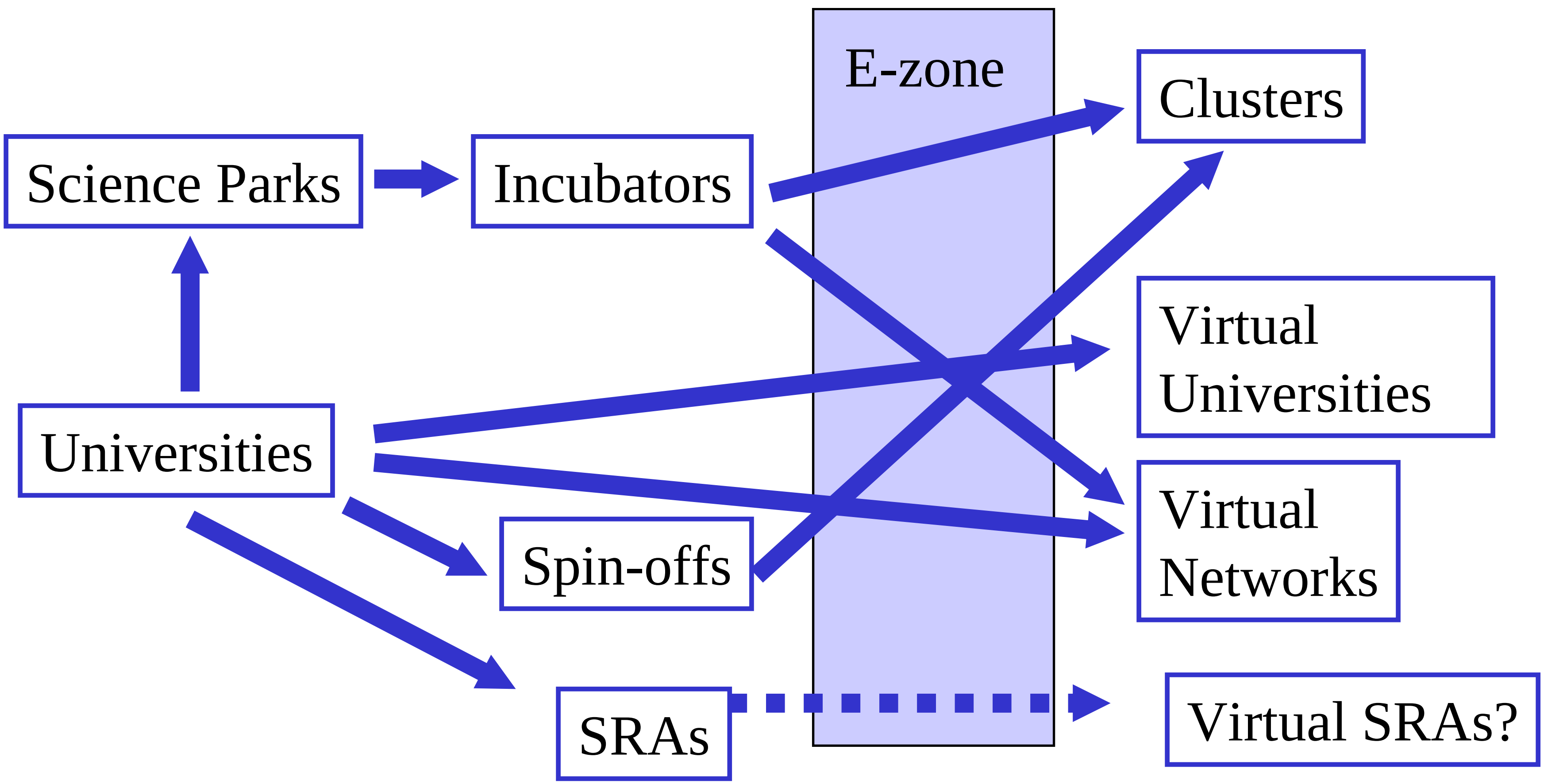


- Government induced (pseudo) cooperation
- Industry induced (pull) cooperation initiatives
- University induced (push) services

Windows and Gaps in Commercializing a Technology



Evolution of Distributed Innovation Systems



Remarks on ESA study

- Time-to-market is not tracked in any mechanism
- Erosion / evolution of mechanisms
- Increasing efforts by academia and industry to seek more effective means of co-operation
- Large-scale intervention by ESA is not considered to be necessary; ESA is well placed to take advantage of these mechanisms as they are established by other organizations
- ESA should consider smaller-scale, more focussed initiatives such as the proposed incubator, networks, help professionalize soft-issues
- There is a transfer gap from “confidentiality-stage” to “European-recognition-stage”
- Time-to-market (=speed) are not recognised in “Business-plans”
- Speed is an issue in innovation and there is new knowledge available on good-practices in academic-industry co-operation

Remarks on ESA Study

- Science parks:
  - Recommended that ESA investigate measures to target non-space companies on science parks with an interest in participating in space RTD
  - Recommended that ESA establish informal links with science park associations
- IRCs:
  - Recommended that ESA create a database of IRCs engaged in RTD of relevance to the space sector
  - Recommended that these IRCs then be provided with data on the industry's future technology requirements
- Spin-out companies:
  - Recommended that ESA investigate a dedicated support scheme for space-related spin-outs (e.g. mentoring, preferential access to ESTEC incubator)
  - Recommended that ESA broker linkages between spin-outs and relevant IRCs
- Virtual universities:
  - Recommended that ESA investigate the establishment of a virtual university to serve the space industry in Europe/Canada – in partnership with space companies and national agencies, also content providers such as ISU, INSEAD etc

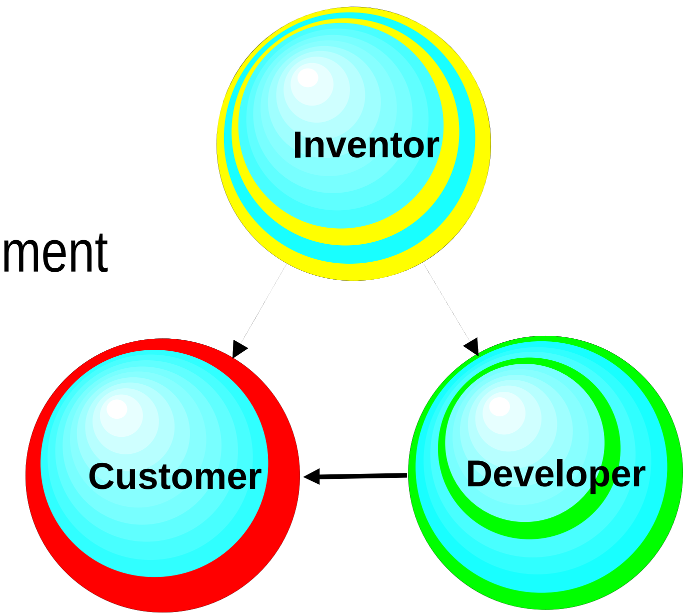
A WAY TO IMPROVE INNOVATION AT ESA

ESA Innovation Triangle Initiative (ITI)

- Based on previous studies the ESA ITI was launched
- It aims at supporting the fast introduction of breakthrough innovations in the European Space Industry by combining the creativity, know-how and experience of
  - The Research Community
  - Space Customers
  - Industry
- It aims at providing early financial support, networking and technical support with the objective of creating a dynamic environment where innovative ideas can be easily validated, developed and used by Space Industry
  - To increase the European Industry Competitiveness

ESA InnovationTriangle Initiative (ITI)

- ITI is based on the “Innovation Triangle” concept
  - A rapid and successful introduction of breakthrough innovations in Industry requires the collaboration of 3 different entities due to improved information exchange between 3 key players
- Business units
  - the “customer”
- An independent R&T organization
  - the technology “developer”
- A University or external Research Centre
  - The innovation source or “inventor”
- ITI supports identification, validation and development of breakthrough innovation based on new ideas or concepts including innovation coming originally from non-space industrial or research sectors



ESA Innovation Triangle Initiative (ITI)

- ITI provides
  - Technical support
  - Networking
  - Seed money
- Three types of activities are foreseen within the ITI
  - Proof of concept (for **Inventors**)
    - ⇨ Fast validation of new ideas and demonstration of its advantages
  - Demonstration of feasibility and use (for **Developers**)
    - ⇨ Component and / or breadboard development up to validation in a laboratory
  - Internal Critical Process review (for **Customers**)
    - ⇨ Internal review to identify products, processes or services candidates for innovation
- Examples in the Ground
  - XASTRO (a potential solution to current data exchange problems)
    - ⇨ Predecessor of the Ground Product EGOS UMF (Unified Modelling Framework)
  - Advanced SW metrics for CSOS (Complex System of Systems)
    - ⇨ Currently used in ESA / ESOC Data Systems
  - Maintenance at runtime (e.g. Erlang for concurrency)
  - RIA applications for Visualization
  - Data Systems designed for Multi-Core (i.e multiple OBSW emulators)

Innovation

and

The reality of CSOS supporting current missions

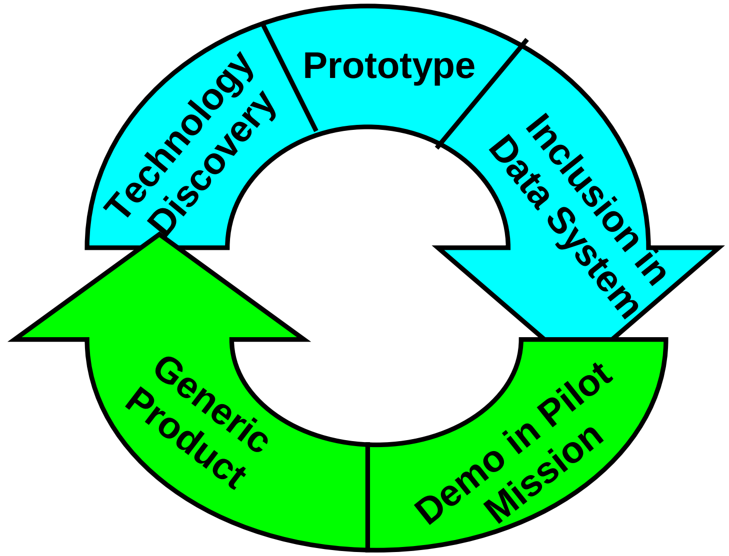
The Bottom-Up Approach

- The SW engineer (without "managerial" dreams (yet)) working as a "civil servant" in ESA or a National Agency thinks wrt Technology in a 180 degrees apart direction when compared to his managers

New Technology →	On which Space Ops Domain? →	Maps any existing driver?
• Hybrid Technology for behavioural SIM	• RT Ops	• Innovation
• SOA / MDA / MDD	• Off-line Ops	• Cost reduction
• Virtualization / Cloud Computing	• Performance Assessment	• Competitiveness
• Thin Clients	• Diagnostics	• Quality of service
• Model based Sys Eng /Ops Val	• Optimisation	• Reduced time to Ops
• Statistical analysis	• Visualisation	• Reduced Requirements
• Data Warehousing + BI	• Reporting	• Low cost of data acquisition
• AI Planning + automation	• Mission planning	• Short time to access data
• Genetic Algs	• Training	• etc.
• 3D VR	• Automation	
• Web based applications	• Decision Making	
	• etc.	

The Technology Deployment saga

- A long process

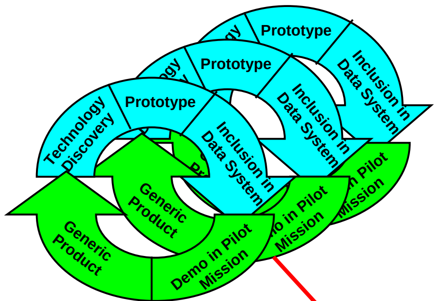


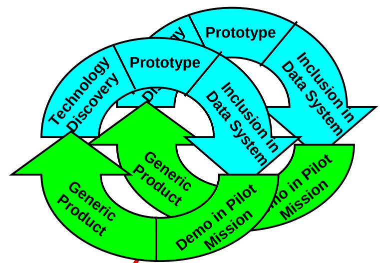
+ Conservative Users
Not willing to have their
Systems as the guinea pig
Pilot project

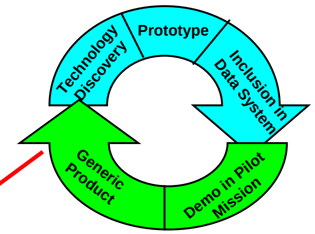
Technology Discovery (Innovation)	**T0**
Activity in Tech Programme	**T0 + 1 year**
Start + Prototype TRL 3	**TO + 3 years**
Enhanced Tech Development TRL 6	**TO + 4 years**
Inclusion in Data System Delivery	**T0 + 5 years**
Pilot Mission Usage	**T0 + 6 years**
Generic Product	**T0 + 7 years**

Collision of Approaches in the "Legacy Systems" arena

Simple technologies takes until 5 years to be deployed in the ESA/ESOC Data Systems, and 7 years to be operationally demonstrated



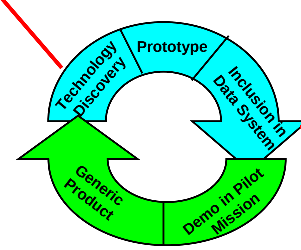




Top-Down

ID		Task Name	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1		Data System Release 1																
2		Data System Release 2																
3		Data System Release 3																
4		Data System Release 4																
5		Data Systems Release 5																
6		Data System Release 6																

And every release shall be mature 3 months prior to Mission SVT0 (normally 1.5 / 2 years before Launch



Other technologies (C++ , CORBA) are kept for 10 – 20 years

Bottom-UP

How to find the right balance

Vision, Strategy, Roadmap, Objectives, Plans

Industry & R&D Budget

Is it possible to speed up Tech Programmes ?

Secure Funding

Technology Discovery

!! Organizational High Entropy!!

What is important for a manager And / or a technology Engineer ?

Fast Prototyping

Learning, Formation

Business Model

Technology Deployment

How can we convince users To deploy technology in their systems?

Balance between Products and a "good prototype"

!! Gaps & Duplications !!

Long Term Maintainability

SUCCESS ORIENTED

How many technologies are failing to be deployed ?