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http://artes-apps.esa.int

→ SOCIO-ECONOMIC IMPACT OF THE ARTES APPLICATIONS PROGRAMMES

With a Focus on Integrated Applications Promotion (IAP)

European Space Agency

→ INTRODUCTION: PARTNERSHIP FOR SUCCESS

ESA's Advanced Research in Telecommunications Systems (ARTES) programme transforms research and development activities into operational, profitable and self-sustaining products and services.

The success of ARTES is the result of partnerships that involve both public and private players and which engage not only the space industry but also developers, service providers, users and paying customers from many other market sectors. Within this context the ARTES applications programmes co-fund and promote the development of space-based applications, services and solutions to meet the needs of European citizens and society. In the process they demonstrate the usefulness of space infrastructure in stimulating economic growth and wider societal benefits, which is the core business of ESA.

The backbone of the ARTES applications programmes is the newly created Integrated Applications Promotion programme or IAP (ARTES 20), which enjoys funding from 19 ESA Member States. Opportunities focused on satellite communications are addressed by SATCOM Apps (ARTES 3-4 Applications). The applications programmes also include the initiation of user-driven missions, e.g. SAT-AIS (ARTES 21) in partnership with EMSA; and applications for industry-led missions, e.g. Alphasat and HYLAS (with Inmarsat and Avanti respectively). Other partnerships include one with the European Defence Agency for civilian use of remotely piloted aircraft systems (RPAS); "Space for Med" with the European Investment Bank; and eHealth in Sub-Saharan Africa.

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As the ARTES Applications programmes become more established, a growing number of their projects are generating operational services. Although often still at an early stage, many of these new ventures are now generating revenues and results that enable both their individual socio-economic impact and that of the overall programmes to be assessed.

The applications programmes share a philosophy of responding to real user needs rather than pushing particular technologies or solutions. This requires strong user engagement. Most of the programme activities require 50% match funding from industry and this also means substantial industry and user commitment, especially at the demonstration stage. The objective is always the delivery of an operational service supported by a sustainable business model. As this approach has only been fully implemented since 2009 and most projects take 3-5 years before operational services can begin, the results can only now start to be assessed.

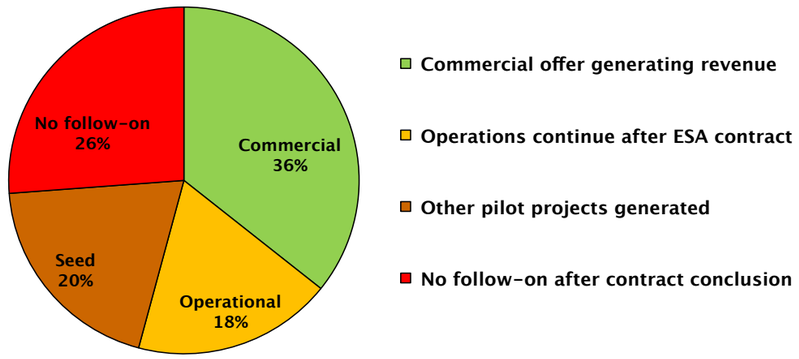
Methodology for assessing socio-economic benefits

The methodology adopted for assessing socio-economic impact takes account of approaches and lessons learned by OECD, national governments, consultants and ESA itself. General principles are that the methodology should:

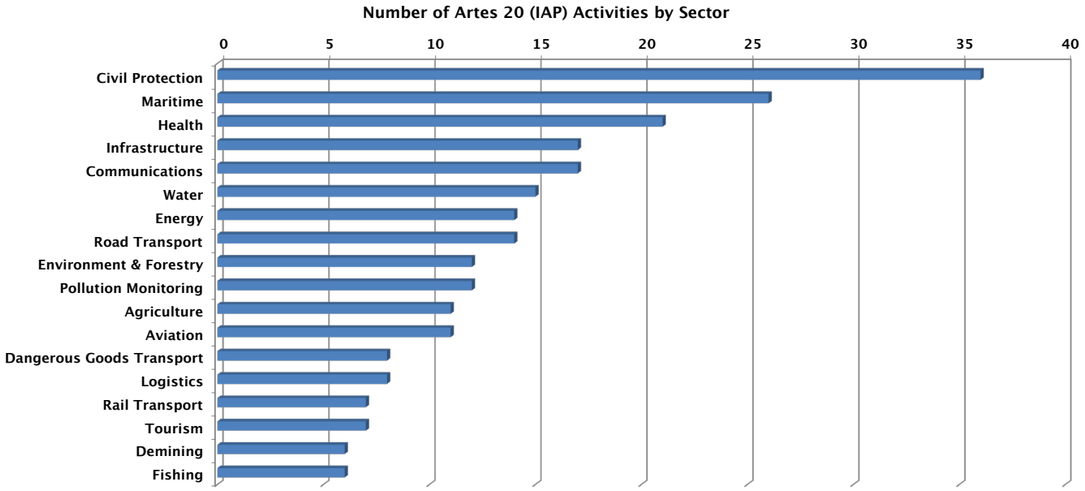
- be robust, repeatable, understandable and consistent with widely accepted methods;
- avoid top-down, macro-economic multipliers, as these have a poor reputation among many economists and national governments, with different studies giving wildly differing results;
- be specific to the downstream sector, rather than addressing the space sector as a whole;
- focus on what can be measured accurately; and
- focus on bottom-up assessment of individual projects, only aggregating where there is sufficient, compatible, hard data.

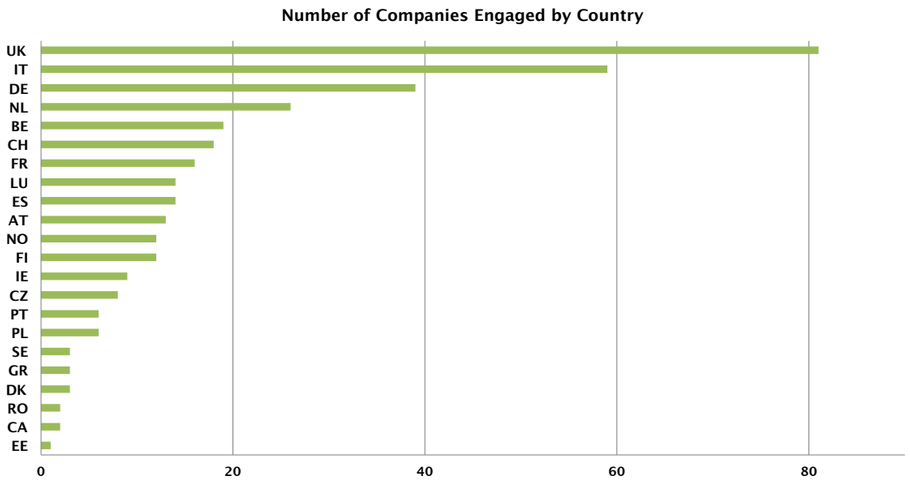
The initial assessment has been done to identify **market success rates** based on 168 completed projects results from ARTES applications programmes. Based on this assessment 54% of projects have led to operational services with 36% already generating revenue.

Snapshot of Projects' Status
(based on 168 projects assessed up to September 2014)



Further analysis on 46 generated services has been carried out using a set of five binary **Key Performance Indicators (KPI)**, each measured at different stages of the project implementation. The correlation between these KPIs and the successful outcomes of the projects has been used to identify which KPIs are the most influential for the degree of commercial success. They mostly relate to user acceptance, technical quality, motivation of stakeholders and ability to generate revenues during the demonstration phase. These KPIs are being used to guide and assist on-going projects and as they reflect core values within the ARTES applications programmes, there is good reason to anticipate success rates at least as good as those previously observed.

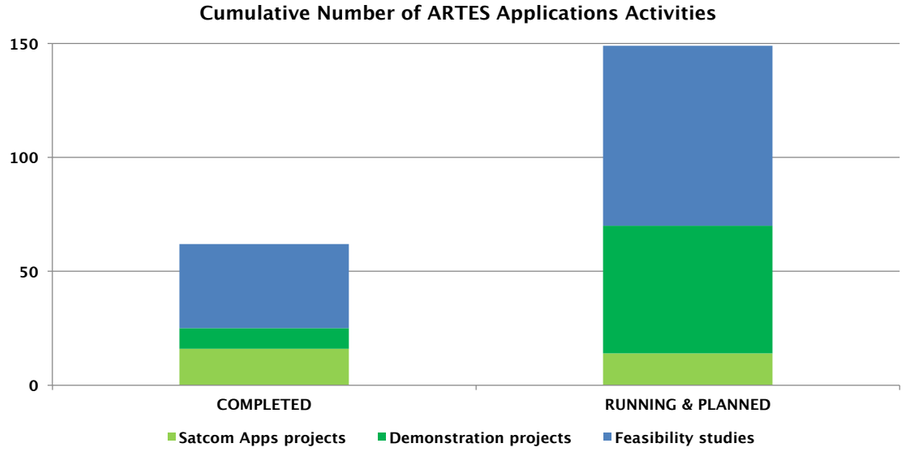




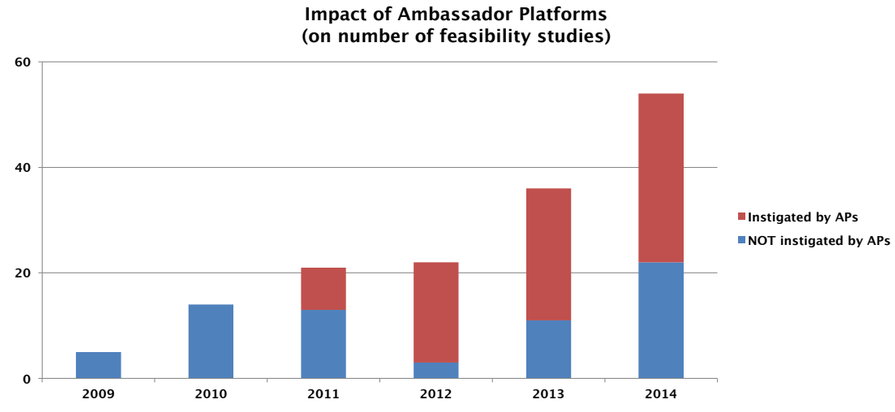
Generic analysis of the ARTES Applications programmes shows not only the great diversity of markets addressed but also the large number of companies engaged (366), of which 59% are SMEs. (Most of the other 41% are from academia or large system integrators.) The diversity of thematic areas addressed by ARTES applications is in itself an indication of the usefulness of space in daily life.

Partnerships underpin the success of the programmes, with 79% of activities involving more than one entity and 62% involving three or more. Almost half of all projects involve international partnerships and this proportion is well above 50% if users are included. IAP thus brings the benefits of international reach, which is often critical in penetrating markets that are large enough to achieve financial viability for new services and ventures.

For IAP in particular, the rapid increase in the number of promising activities means that in 2015/16 up to five times as many projects are likely to generate new operational services as the total number experienced to date. As of October 2014 there are 34 running IAP demonstration projects plus 9 ARTES 3-4



projects. Many more are in preparation and moreover there is a strong flow of new ideas and activities entering the pipeline as feasibility studies. This will ensure longer term growth in the number of new services coming to market.



A key tool for stimulating new activities is the Ambassador Platform (AP). Dedicated to promoting ESA's applications programmes, the APs raise awareness of the benefits of space-based services among users and act as "honest brokers" between ESA, industry, academia and user communities. The network of Ambassador Platforms has a clear impact on the IAP programme's growth, not least because the APs encourage local users and industry to network and partner on a European level, thereby obtaining the critical mass needed to sustain new services.

Individual projects from both IAP and SATCOM Applications have been assessed in detail to identify their impact. Projects are selected on the basis of their maturity (i.e. that they have led to operational services and have had enough time to generate results that can be analysed).

Indicators of socio-economic impact

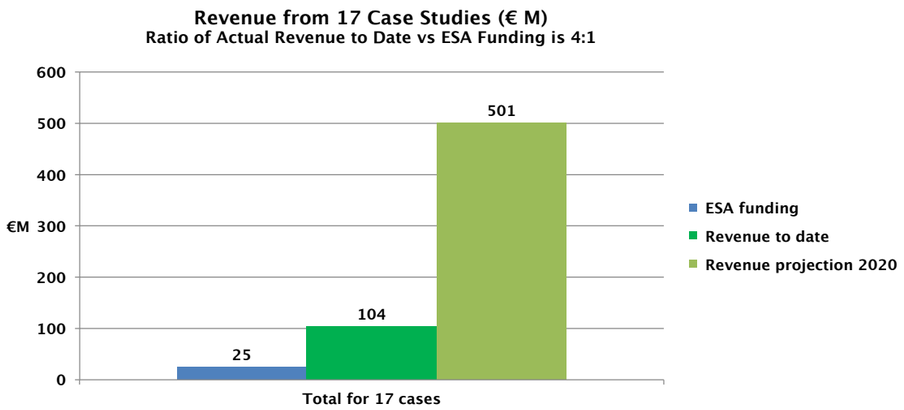
Ten indicators are assessed for each project. These include traditional, mature-stage indicators such as revenue and jobs as well as good indicators of the potential for future growth, such as 3rd party

investment and uplift in R&D spend. The data is aggregated where possible, whilst multiple individual results are also highlighted. The indicators are:

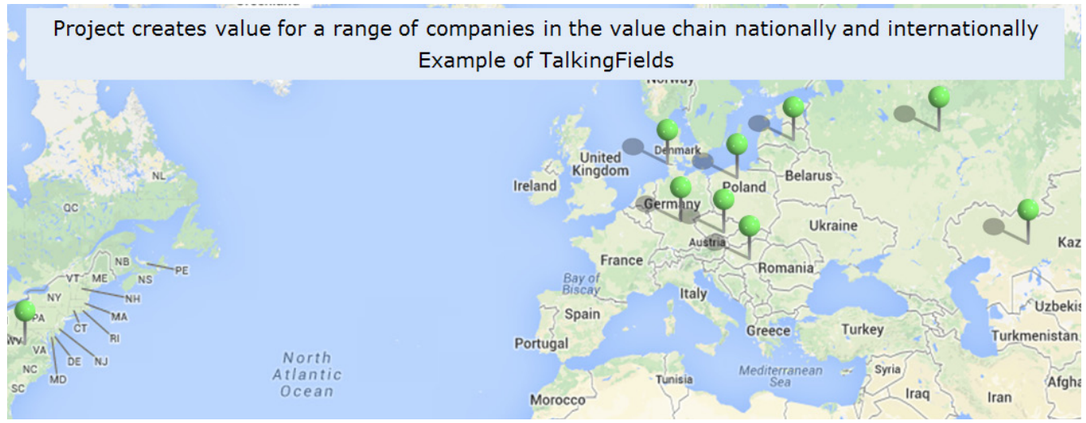
1. Revenue (absolute and compared to the ESA co-funding).
2. Exports (proportion of revenue outside the home country and outside the EU).
3. Jobs (created or sustained as a result of the project).
4. Investment leverage (total 3rd party investment in terms of equity, debt, grant, public funds or M&A following on from the ARTES project, as compared to the ESA co-funding).
5. Extent of the value chain (number of business relationships including consortium partners, suppliers, distributors etc.).
6. Addressable market size (in terms of potential financial value).
7. Increase in the ratio of R&D spend to revenue (a positive indicator is that both the ratio and revenue increase).
8. Value creation (for the users).
9. Societal benefits (quantifiable but non-financial).
10. Innovation impacts (e.g. market disruption and patents).

Summary of socio-economic benefits

Results from the first 17 projects that were selected as case studies are summarised below.
(As the IAP programme started in 2009, most of these examples have only entered operational service within the last two years.)



- To date there is a ratio of 4:1 between revenue and ESA co-funding, with conservative projections of 20:1 by 2020.
- Most of the businesses are strongly export led, with exports accounting for over 80% of revenue in at least half of the cases. Exports outside the EU vary more widely but are also substantial in the same percentage of cases.
- Overall, 188 Full Time Equivalent jobs have been created or sustained to date from the cases analysed, representing an average of 11 jobs per new venture. It shall be noted that these newly created jobs are sustainable and not limited to the period of the projects.
- More than half of the 17 cases have obtained 3rd party and private investment for the market rollout and or a new venture that resulted from their ARTES co-funded project. In most cases the amount is between €1M and €3M. This is in addition to the original 50% match funding typically provided by consortium members.
- Value chain development is typically multi-national, with very few cases involving only domestic partners. In a Euroconsult survey of companies engaged in IAP, most identified this development of international partnerships as a key benefit of the programme.



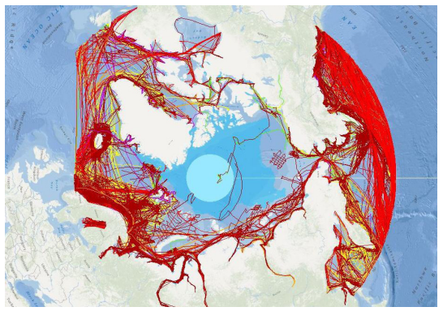
- Addressable markets range in size from niche (e.g. €2M) to global (up to €4Bn), with half in the range from €10M to €500M. These market opportunities are mostly driven by the innovation impacts of the ventures concerned, which either enlarge existing markets or create new ones.
- R&D spend is quantifiable in two thirds of cases, with the ratio of R&D spend/revenue often increasing as a result of ESA co-funding even as revenues grow.
- In addition to revenue, most of the projects show quantified value creation, societal benefits and/or innovation impacts. These do not lend themselves to aggregation but they are described in the individual case studies that are summarised below.

Strategic partnerships

The development of partnerships can go beyond value chain development and enter a more strategic realm that includes the definition of new space missions. By entering into a partnership with the European Maritime Safety Agency, IAP was able to interact more effectively with users in the maritime community and to identify needs that led to definition of the SAT-AIS programme This in turn has led to the development of operational services and their supporting space infrastructure, as well as to partnerships between players from different parts of the space industry, including an operator. In Europe alone there are now about 170 users of the SAT-AIS pre-operational services.

A further example is provided by ESA partnership with the European Investment Bank. This has led to the programme “Space for Med”, focused on the potential of space-based services to provide economic development in the countries of the southern and eastern Mediterranean region. Following the “Space for Med” initiative, an acceleration programme is being designed with the European Investment Bank. This initiative is strongly supported by the King Abdullah II Fund for Development. The “Space for Med” initiative offers an opportunity for European space applications industry to expand their export potential.

Access to emerging markets of a different kind is being facilitated by ESA’s partnership with the European Defence Agency, for the application of space-based services to Remotely Piloted Aircraft Systems (RPAS). The DeSIRE projects co-funded by ESA and EDA and with the support of EUROCONTROL and the European Aviation Safety Agency (EASA), have in particular demonstrated for the first time the feasibility of operating RPAS in unsegregated airspace, a vital milestone on the journey towards the large scale implementation of RPAS across multiple market sectors.



→ ARTES APPLICATIONS CASE STUDIES

Each of the case studies is summarised below.
Due to commercial confidentiality, the information included here is limited but sufficient to give a good indication of the purpose and achievements of the projects and partners involved. The project name is given in the title, whilst the main partners are identified in the summary text. For more details on each project see the ARTES applications web portal: http://artes-apps.esa.int/projects

More wood from fewer trees: SATMODO and SATFORM3D

Irish SME TreeMetrics has developed services to manage forest resources in a more sustainable and profitable way. This is disrupting a global market for forest mapping and harvesting that is estimated at over €15Bn. By combining Satnav, EO and Satcom, TreeMetrics enables forest owners to improve yields of higher value timber, which creates customer savings of more than €20M. With more accurate cutting instructions forest value loss can be reduced by 20%. The easy-to-use systems are also giving private forest owners better knowledge of their assets, resulting in more sustainable management practices in 20 countries.

More Crop per Drop: Fruitlook and Grapelook

Dutch company eLeaf have combined three space assets to develop twin services that improve water use efficiency for vineyards and deciduous fruit trees. Starting in South Africa, this gives farmers and agricultural authorities a tool to optimise their water use and there is the potential to extend this to 30 further countries in which eLeaf is active. Big cost savings and extra revenues have been quantified, plus improved identification of disease affected areas, enabling more targeted application of pesticides.

Medical Care Anywhere: AMAZON and Tempus

The UK SME Remote Diagnostic Technologies integrate Satcom and Satnav in a dual system of vital signs monitoring and telemedicine, for managing medical incidents in remote locations. To address a global market worth €4Bn, they have partners including International SOS and are operating in more than 20 countries. They have already generated tens of millions of Euros in revenues, 90% of which are from exports.

Building Satellite ICT capabilities in Africa: SWAY4EDU

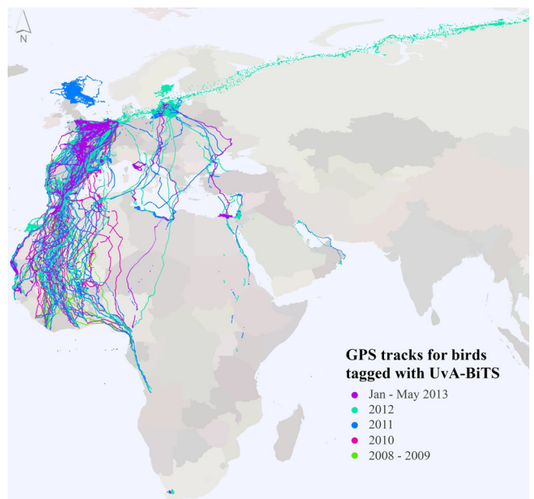
Italian company OPENET, working with SES Broadband Services from Luxembourg and Newtec from Belgium, have developed a Satcom solution to address three different markets. The rural radio service trains journalists, whose programmes have made local farmers 50% more likely to adopt improved agricultural practices. The electoral service has been demonstrated with Electoral Management Bodies in five Central African states. The Space4Education service supports education in rural schools and provides local communities with communications capabilities including cyber cafes and teacher training. Revenues of over €2m have already been generated for the service providers and large scale growth opportunities are perceived in all three markets.

Instant Airborne Intelligence for Rapid Response: SASISA

A consortium of British, Swiss, Austrian, German and Luxembourgish companies is developing a European-wide airborne sensing service, to supply near real-time surveillance information that enables rapid and affordable response to disasters and security threats. Operation from regional bases and partnership with local aircraft operators will ensure response in 6-8 hours throughout Europe, with the potential to expand service to other continents.

Reducing deadly bird-plane collisions: FlySafe

Experts, developers and service providers from The Netherlands, Belgium, Germany, Switzerland and France have developed a bird warning system to inform pilots about bird densities, enabling them to adjust their operations to avoid collisions with birds. (> 219 people were killed & > 200 aircraft destroyed in accidents attributed to bird strikes since 1988.) The project led to a start-up company, Robin Radar (25 employees and several millions euros of revenue in 2013). The bird tracking system has been used in 42 projects worldwide, involving more than 40 research institutes and companies; and the associated bird migration model is now part of a new international network.

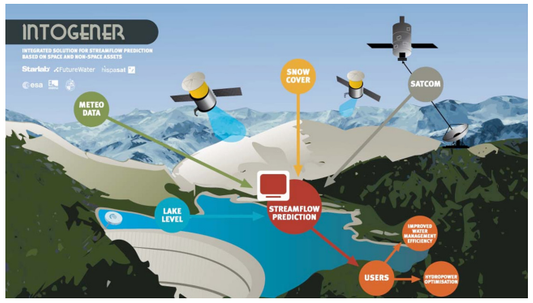


Peat Spotter: Example of a Promising Feasibility Study

In addition to the 17 cases summarised here, this IAP Feasibility Study illustrates how the ARTES applications programme cross-fertilises with ESA BICs and private investors. Rezatec, incubated at the Harwell BIC, has undertaken an IAP study with Efeca to develop a mapping, measuring and monitoring service to support the sustainable development of peatlands. Vast markets in both tropical and temperate climes can be addressed by integrating EO with local surveys using Satnav and Satcom. Support from the BIC has facilitated the development of a related data service. Rezatec has investment from Business Angels in addition to its co-funding support from ESA, which has enabled a doubling of its R&D investment. The company also expects to double its headcount in 2015 in response to contract awards.

Microfinance in African villages: SatFinAfrica

Sea & Space Exploration leads a Belgian-Luxembourgish consortium that focuses on serving the financial institutions market in remote or unconnected parts of Africa (i.e. money transfers and Automatic Teller Machines). It uses Satcom to provide reliable, secured and affordable services which are aligned with World Bank recommendations to improve the market for remittances in Africa and to decrease the cost of sending money. The project triggered the creation of SatADSL in 2012, to provide professional IP access in Africa. Profitable services are now available in 39 Sub-Saharan countries and provide employment for around 20 specialized support staff.



Improving water flow forecasts: Intogener

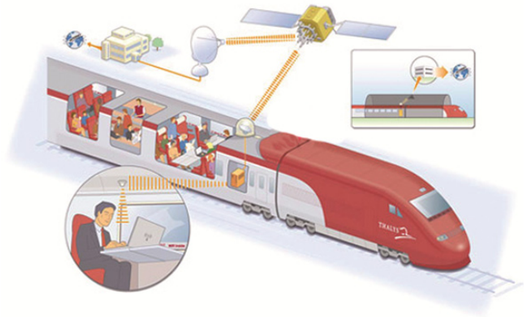
Spanish companies Starlab and Hispasat teamed with Dutch company Futurewater to deliver improved streamflow forecasts for the hydroelectricity industry. Using EO, Satnav and Satcom to target points of interests in large and generally remote mountainous basins, the results are improved energy forecasts and increased value of hydropower electricity, e.g. by better alignment with peak power prices. Local operators and authorities can either decrease the price to consumers by up to 5% or save government subsidies, as well as attracting more investors because new hydropower plants' (particularly small ones) can become more profitable.

Collaborative meteo exchange for pilots and flight operations: Planet

The French company Atmosphere Systemes et Services and its German subsidiary worked with Triagnosys and DLR to create this system. Providing pilots with in-flight updates on weather conditions, it also contributes to atmospheric observation with in-situ measurements from aircraft, including data from locations where large commercial aircraft are not flying. Turbulence-related incidents cost airlines on average US$150k, civil aviation pays €380M a year in Europe for meteo services and European weather agencies spend €2M yearly to collect data from commercial aircraft. A new company, WxFUSION, has been spun off from DLR to be the data provider for real time thunderstorm information and TriaGnoSys has received orders for its certified avionics unit, to serve the wireless multimedia passenger entertainment market.

Broadband on Trains: EOMST

UK based and Belgian operated company 21Net have introduced the world's first bi-directional satellite communications system capable of delivering broadband internet on high-speed trains. This system is helping enable the infotainment market on trains which is expected to exceed €140M by 2021. 21Net already equip trains that serve North West Europe, Italy and India and further international expansion is imminent.



Secure, Fast and Accurate Medical Image Transmission: Mercury

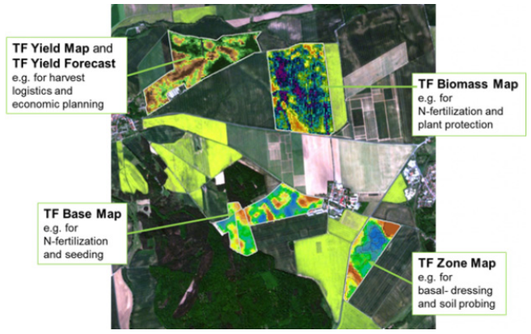
UK based RedFoot Technologies use Satcom and Satnav to directly transmit medical images from mobile Breast Screening Units to central hospital image reading desks. This service helps to save lives by enabling quicker diagnosis and reduced diagnosis errors. It allows increases in screening throughput of between 4% and 23%, extends the service to remote locations and reduces costs to the National Health Service through earlier diagnosis, efficiency gains and higher utilisation of equipment.

Integrated Maritime Communications: SASS@Sea

German based company MediaMobil provides an integrated maritime communications service enabling greater integration of ship and shore information systems at a competitive cost. This provides shipping companies with access to vessel condition information and reduces the response times between crew and company. After having completed the pilot phase in 2013 the service is already revenue generating, with numerous large customers in a global market estimated to be worth over €500M in 2015.

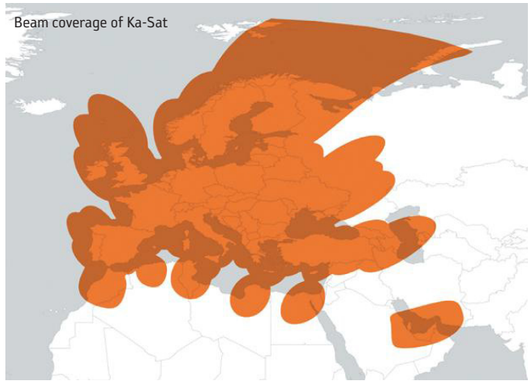
Precision Pest Management: VECMAP

Belgian based Avia-GIS leads a European consortium in using space assets to pioneer a cost and time efficient system of predicting vector-related health risks, to help prevent the spread of vector-borne diseases like malaria. Trading in multiple countries, the system has been adopted as the standard for vector surveillance by a leading European network and is extending the use of prediction techniques within public health authorities, research centres and pest control companies internationally.



Efficient utilization of natural and anthropogenic resources for farms: Talking Fields

After a successful implementation in their home country of Germany, VISTA Remote Sensing GmbH and PC–Agrar Information and Consulting Services are seeing their common trademark "TalkingFields" gain market traction across Eastern Europe. More than 60 customers farming winter wheat, maize and sugar beet now benefit from this cost-effective and site specific field management service. The monetary benefit of tens of euros per hectare helps to sustain each farm's economy and the environment also benefits as use of chemicals and fertilizers is reduced.

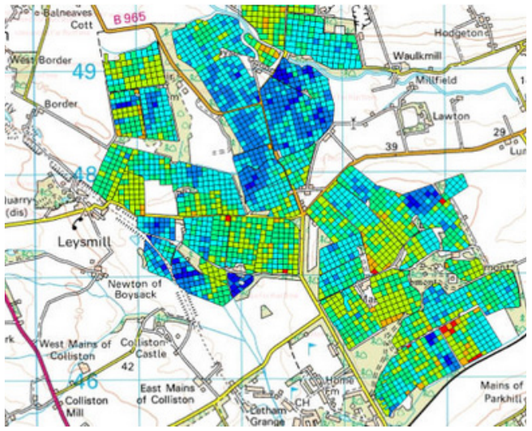


Internet Distribution (Deep Packet Inspection Solution): Lift Off

Italian companies OpenSky and NITEL have developed an innovative offering for internet connectivity via satellite in both the B2B and B2C markets. This is helping to make satellite more sustainable as a vehicle for addressing the digital divide and OpenSky now have 75% of the internet-by-satellite customers in Italy. Recently launched European telecommunication satellites with powerful Ka-band spot beams can deliver affordable broadband connectivity. Deep packet inspection gives a breakdown of individual usage patterns, enabling Lift Off to manage bandwidth with tailored service offerings.

Monitoring and Alerting Service for Precision Agriculture: KORE

Magellium, a French inward investor to the UK's Harwell space cluster, is working with G2Way, incubated at the ESA BIC, in the development of change detection maps to improve precision farming for crops such as potatoes, wheat and grass. This project is enabling yield increases as well as reductions in the use of pesticides and fertilizers, through more precise agricultural methods.



Digital Entertainment Distribution: ISIDE

An Italian based consortium has enabled Microcinema and OpenSky to become leading players in the provision of digital entertainment distribution via satellite to cinemas throughout Italy and Europe respectively. This service provides the flexibility and innovative formats of satellite distribution to cinemas at an accessible cost. In addition to traditional films, 3D formats and high definition live events covering sport, music, opera and ballet are now accessible to cinema audiences in 25% of digital cinemas across Europe (which now account for the vast majority of cinemas).

→ CONCLUSION

This assessment of socio-economic impact represents a beginning, just as the 17 case studies summarised here represent just the first of the ARTES applications projects to enter the market. To put this in perspective, there are nearly 200 additional ARTES applications activities now in progress and over the coming years more and more of these will generate new services. It follows that the social and economic benefits already identified in this paper will be reinforced over time. ESA will continue to monitor these impacts and where necessary to refine its methodology.

Yet even if the results are based on a necessarily limited number of cases, they are quite clear. IAP and the other ARTES applications programmes have created significant, measurable benefits across every one of the ten key indicators of socio-economic impact. Moreover, most of the cases have created benefits across most of the indicators. Since most of them are still at an early stage, there is every reason to anticipate that their impact will continue to grow.