European Commission

Business Innovation Observatory

Space Enabled Applications

Satellite enabled positioning applications

Case study 57

Internal Market, Industry, Entrepreneurship and SMEs

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Space Enabled Applications

Satellite enabled positioning applications

Business Innovation Observatory
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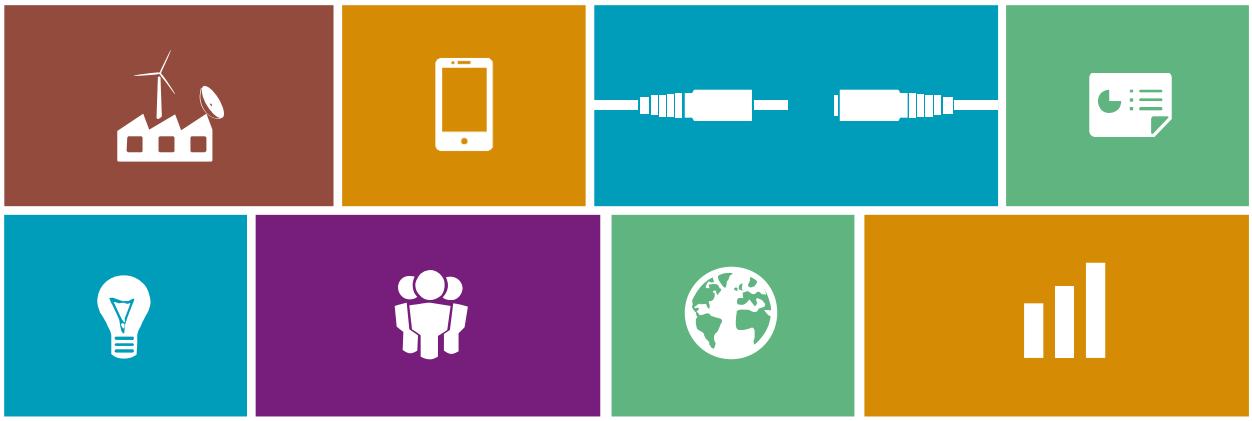


1. Executive summary

The advances in positioning data availability have been made possible by the launch, installation, and service activation of new satellite systems at in international level. In addition the development of multi-constellation global navigation satellite systems (GNSS) and receiving devices has also enabled the exploitation of highly accurate positioning data.

The new generation of satellite enabled applications is open to a wide range of commercial opportunities, coming from the new levels of accuracy in positioning data, as well as the economic (e.g. cross-industry cost effectiveness) and social (e.g. sensorial navigation for the disabled) benefits they generate.

The increased consumers' demand for positioning data is enabling incremental innovation in the cross-industry applications of accurate and precise navigation both outdoors and indoors. The development of these applications requires raising the awareness from end users in order to align the technical needs of application development and current consumer preferences and expectancies.

Satellite enabled applications are characterised by their cross industry nature and capacity to provide economic benefits in terms of cost effectiveness in many situations. They also become increasingly useful in decision making processes.

The diffusion and adoption of satellite enabled applications across large global market has been made possible by the rapid adoption of connected devices during the last few years (e.g. smartphones, tablets, etc.). Economic growth with significant impact on the development and positioning products and services has generated from the rapid diffusion of satellite enabled technologies.

The main driver supporting the rise of satellite enabled applications is related to the Europe's R&D capacity. This R&D intensive industry benefits today from wide public support for research activities, but its commercial focus is still limited.

Further development and commercialisation of satellite enabled applications face difficulties for both developers and end users. On the demand side, business models associated to diffusion platforms have blurred the end user's capacity to understand the actual utility and price of the technology creating disincentives for developers to develop better applications. On the supply side, knowledge and experience associated to the commercialisation phase of the technology is still problematic. Entrepreneurs within the industry very often come from a scientific field and need support to expand their business and risk management oriented skills, which impacts the pace at which the these high technology companies are able to grow.

From a policy perspective, support for the development of the space enabled applications industry can be provided. Support for commercialisation and business oriented sills development is certainly a crucial area for policymaking. As accurate positioning data becomes an angular intermediary input across several industries, policy initiatives on homogenous legislation can help ensure coordination and sustainability of the technological diffusion across different sectors of EU economies. Moreover, support for internationalisation and networking is vital for companies from this sector, where operating on a global scale is key to the success.

2. Satellite Enabled Positioning Applications

2.1. Trend presentation

This case study is part of a series on space enabled applications. It focuses on technological innovations and applications enabled by the next generation of global navigation satellite systems. Global navigation satellite systems are constellations of earth orbiting satellites whose principal function is to broadcast their location in the space and time dimensions.[1] These constellations of satellites are complementary to a network of ground control stations which enable calculation of position and triangulation, allowing receiving devices to determine their position, velocity and time.

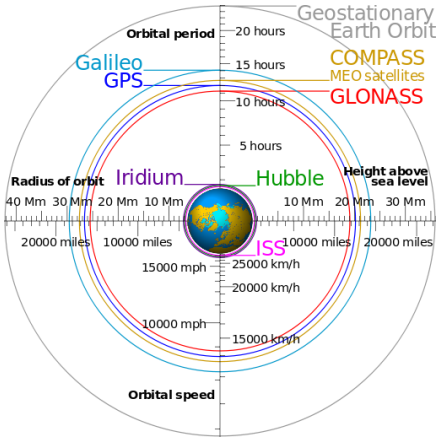
Today, there are two principal fully operational constellations: GPS (United States) and GLONASS (Russia). A new system, the European GALILEO, has gone under its initial development phase and is expected to be operational by 2017. Other important constellations are the Japanese MSAS, the Chinese BEIDOU, and the Indian IRNSS. At the moment, there are more than 70 satellites operating, and a total of nearly 120 will be available once the GALILEO and BEIDOU systems become fully operational.

Throughout history, determining one's exact position has been important for informed decision making. Advances in science and technology have helped drive forward the field of navigation and positioning during the second half of the 20th century, and today, our society relies on many location based services that depend on our capacity to accurately determine our position in space and time.

In March 1996, a US policy directive declared the GPS system a dual system (military and civilian), interpreting it as a national asset towards the "acceptance and integration of GPS into peaceful civil, commercial and scientific applications worldwide". Following this shift in the US GPS policy, the military satellite positioning systems became available for private use worldwide. This situation led an increasing range of industrial applications and services that have been developed and adopted during the past two decades.

The global positioning systems operate on the basis of the trilateration principle[1] from any point on the surface of the earth to the satellites in view.[2] Trilateration is performed by measuring the time it takes for a signal to reach receiving device, which determines the distance between them. This process requires highly precise clocks since the signals travel at the speed of light. Three satellites must be available to determine a 3D position narrowed down to two points on earth. An additional satellite is required to perform time and location correction by eliminating time differences from the atomic and quartz clocks. A fifth satellite is required to perform quality controls.

Figure 1: Comparison satellite navigation orbits



Source: Cmglee, Geo Swan

The rise of the systems based on the satellite transmissions using positioning information provided by GNSS systems have led to a change in the landscape of location based services and applications relying on capability to determine an exact position.

As an illustration, in the field of transport, intelligent positioning systems (through satellite based navigation) have improved safety, traffic management, fuel efficiency and travel time, consequently reducing emissions.

In the field of civil engineering, satellite positioning machine guidance can be used for large construction works and satellite navigation can be used to control vehicles transporting heavy loads, increasing the efficiency of construction sites.

Furthermore, the combination of GNSS systems and geographic information systems has led to major cost reductions in the discovery of natural resources (oil and gas), and the management of utilities such as water, electricity, sewerage, etc. It can also be used to increase effectiveness and precision in the agriculture through improved monitoring of soil and control of fertilizing and pesticide procedures.

[1] The process of determining absolute or relative locations of points by measurement of distances, using the geometry of circles, spheres or triangles.

GNSS systems are therefore vital to the European industry and public services. They increased the innovativeness of several sectors, such as transportation, tourism, telecommunications, agriculture or computer networks.

New applications stemming from development in Precise Point Positioning[3] will further improve precision and accuracy from GNSS data (e.g. satellite imagery for spotting natural resources such as oil and gas).

2.2. Overview of the companies

Table 1: Overview of the company cases referred to in this case study

Company	Location	Business innovation	Signals of success
Geko Navsat	Spain	Geko Navsat has developed sensorial navigation applications utilising satellite positioning information to provide solutions of mobility to individuals and businesses.	- Participated in research projects under the FP7 and H2020.. - Has won several SME and technology competitions at national and European levels.
Geosat	Germany	Geosat uses patented technology to make use of satellite data to identify oil and gas wells. The space enabled technology improves cost effectiveness in the energy industry by reducing the costs of exploration.	- Disruptive patented technology. - Supported by the European Space Agency Business Incubator Centre.
Abbia GNNS Technologies	France	This company provides accurate positioning data to third parties. An emphasis is made on the utilisation of new satellite technologies to produce and treat large sets of data reducing the error margins of estimates within increased confidence intervals. This emphasis improves the precision in the estimation of positioning data sold to third parties.	- Participated in research projects under the FP7. - Publications in Inside GNSS Magazine
Deimos Engenharia	Portugal	Deimos Engenharia integrates innovative products and services covering all aspects of an aerospace mission, from the launch systems to derived commercial applications such as 3rd party imagery and access to satellite data for imagery services.	- Successfully launched its satellite in 2015. - Media coverage - Participates in ARTES programme funded by the European Space Agency

Problem 1 – Trial and error exploration methods for the detection of hydrocarbon traps (sources of oil or gas) require important investment and return on investment is not always guaranteed.

Innovative solution 1 – Geosat was developed to face the challenge of increasing cost effectiveness in the identification of oil, gas, minerals, and water sources. The company uses patented technology based on the utilisation of satellite data and imagery, and geographic information to identify sources of oil and gas with higher precision and at lower costs. This very disruptive technology lies between two different fields: aerospace and energy, and it provides a cost effective alternative to existing seismic methods.

Visual representation of satellite exploration of hydrocarbon traps

Source: GEOSAT

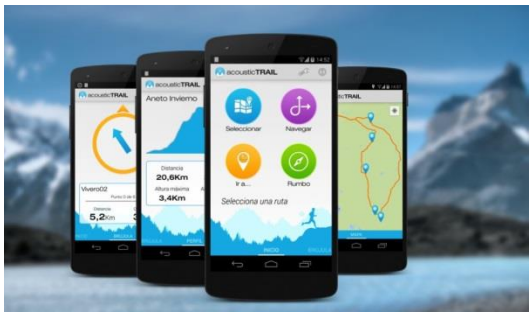
Problem 2 – Physical mobility may be affected not only by the environment and surroundings but most importantly, the individual's capacity to move.

Innovative solution 2 – Sensorial navigation utilises satellite positioning information to provide a solution to individuals with reduced mobility or moving in complex environments. Initially, the vocational approach of Geko Navsat's staff helped define a technology utilisation focused on the disabled, and also helped identify potential clients. This vocational approach turned into a commercial and client oriented vision which was necessary for business development and growth.. The innovative solution involved developing sensorial navigation for handicapped people (blind or with limited vision) with the idea of identifying derived applications from an analysis of cooperative objects in movement.

*"We all move, except some of us are able to move more easily"– **Geko Navsat***

This innovation led to two principal applications: the improvement of people's ability to move, and the improvement of security for employees who need mobility in hostile environments.

Visual representation of Acoustic Trail applications



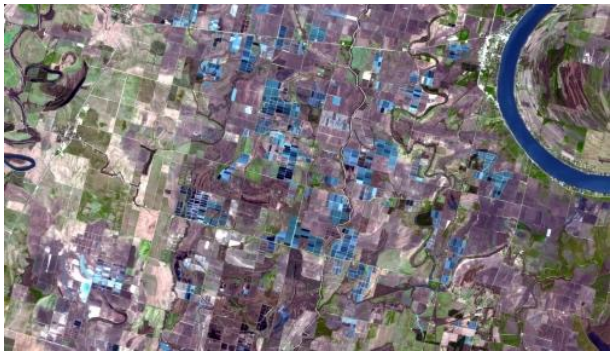
Source: GEKO NAVSAT – Acoustic Trail Project

Problem 3 – Creating value across the whole satellite industry value chain: from launching satellites to developing commercial applications.

Innovative solution 3 – The products and services provided by Deimos Engenharia cover all aspects of an aerospace mission. The group had the capacity to launch systems and to exploit satellite data (in particular from the GPS and GALILEO constellations). It also provides access to imagery data, and develops additional commercial applications derived from the acquired data to 3rd parties.

In 2009, the group launched its first satellite (DEIMOS-1), with the aim of securing its position across the whole value chain of earth observation applications, from data acquisition and processing (developing receivers and signal processing techniques), to the development and services provision through navigation algorithms. The group has also given particular attention to environment and natural resources monitoring.

Remote Sensing, image from Deimos-1 Satellite



Source: Deimos-Space

Problem 4 – The use of the GPS system as sole mechanism to obtain positioning data limits accuracy.

Innovative solution 4 – The utilisation of new satellite technologies has enabled ABBIA GNSS to provide access to accurate positioning data to third parties by exploiting information from several GNSS systems. Their solutions reduce the margins of confidence intervals and improve the accuracy in the estimation of positioning data required by business customers.

The added value of ABBIA's products resides in the accuracy of the treated data. It materialises in the design of applications which GNSS positioning data and process the information through mathematical and statistical procedures. In particular, it is applied in the field of logistics and fleet management providing solutions for real time accurate mobility, traceability geo-localisation, and cost effective operations.

3. Impact of the trend

Identifying all the possible commercial applications and their development is a long process. Added value created from access and exploitation of observational data will continue to grow and new applications will be developed. It has taken years since the military applications based on GPS data were exploited for positioning based civil applications for the general public.

In terms of barriers for further development current technical issues affecting accuracy in positioning services are related to the geometric position of the satellites, clock

errors, atmospheric conditions, inaccuracies of receivers, and deterioration of civil data by the military. These issues often lead to a failure or inaccurate determination of a position in outdoor or indoor environments.[4]

Since GNSS systems were originally designed for outdoor clear-sky operations (military genesis of satellite navigation), inaccurate positioning is an important challenge for companies developing positioning based services.

New satellite constellations (e.g. GALILEO) provide a clear advantage in terms of increasing precision (beneath the meter scale) and reliability of the signals and information. Their function is not only to increase the technical capacity of satellite constellations scaling up the volume of exchanged data, but also to increase accuracy. New applications will emerge from these advantages in precision and reliability, increasing the potential economic benefits from future satellite enabled applications.

3.1. The market potential of the trend

The market potential of satellite-enabled applications is closely related to the wide range of industries they might impact. Applications in several markets such as road, aviation, rail, maritime transportation, agriculture mapping and surveying, and other position-based services are especially promising.

The market for satellite enabled applications relies on the products and services required, namely hardware and the software applications. According to the estimations of the European Global Satellite Agency (GSA)[5], nearly 3.6 billion devices were globally in use in 2014, and the projections indicate that by 2020, this number will grow by 100% to an average of 1 GNSS device per living individual.

Positioning services enabled by the availability of satellite information has created a market of nearly 3 billion mobile applications that are currently in use. This market is expected to continue its growth over the next years along with the growth of the smartphone market which has enabled a diffusion for positioning based applications across individuals. Today the largest share of positioning based applications is represented by navigation services, social networking, entertainment, and healthcare and fitness services that exploit the location information received by the devices. On average 70 applications are currently downloaded per device. In addition to smartphones, tablets, laptops, sports and wearable devices, or personal tracking devices use this technology. Their increased availability and market growth will also have an impact on scale and scope of positioning based services.

Since 2011, the integration of multiple GNSS constellations in chipsets enabled the receiving devices to exploit positioning information from different satellite constellations, in particular GPS and GLONASS. Ever since, multi-constellation devices exploiting several other GNSS constellations such as GALILEO and BEIDOU have entered the market. Today the market comprises in 60% of devices supporting at least two constellations and improving accuracy and reliability of location information.

Applications in specific industries indicate that market penetration of GNSS location information services will be driven by the introduction of incremental innovations focused on commercial advantages. As an illustration, GNSS applications in the road transportation industry improve productivity, safety, monitoring and derived added value services. The market penetration of these applications has reached nearly 100% equipping vehicles with multi-service GNSS receivers. The rapid adoption of portable navigation devices and satellite positioning applications diffused through smartphones has created business opportunities for future innovations and derived added value services (e.g. telematics for insurance and even autonomous driving).

Market penetration of GNSS devices and applications has also reached 100% of the rail industry, helping to increase safety, time optimisation, fleet management, or passenger information among others. The use of GNSS devices and applications on this market opened new business opportunities: for example manufacturers use multi-constellation information for railway signalling to enhance positioning performance.[6]

The GALILEO Signal Priority project under the FP7 demonstrated the improvement in accuracy. New approaches to transit signal priority and on-board intelligence will further optimise railway operations by improving reliability of the signalling systems and reduce delays for mass transit vehicles, significantly reducing costs for operators.

The future of the industry of satellite enabled applications, in particular for accurate and confident positioning, is likely to be shaped by the development of businesses and exploitation of opportunities in the field of machine-to-machine technologies. Currently, the operability of these technologies is often limited by the dependence on telecom companies channelling the information from one machine to another once the positioning data is acquired and processed by any given machine. And high prices charged on data transmission are an obvious challenge for the industry. Further analysis and regulatory action are desirable to further develop the European market for machine-to-machine communication.

"Data transmission fees amount inaverage up to 6 EUR per sim card per machine".– ***ABBIA GNSS Technologies***

3.2. The social & economic impact of the trend

Firms within the industry are always looking for the best engineers to develop products and services based on excellence. For this purpose companies usually rely on privately initiated agreements with universities (e.g. supporting research topics for conducting a master's thesis within the company) based on the scientific content that can be developed and applied. These agreements are seen as an investment in skills of future graduates. However, there is currently little, though slowly increasing support for this type of initiatives.

Indeed, while companies within the industry are able to establish direct agreements with higher education institutions, a gap between the required skills they need and the initial skills of students is observed. Given that the mass of 'best engineers' is finite; companies have to spend efforts and resources to provide the appropriate skills. They interpret therefore this training as an investment in skills and open a question on who is to bear the production of a skilled labour force to the labour market. As a consequence, further support and responsibility by policy makers and higher education institutions towards the production of a skilled workforce is welcome by firms in the industry.

According to the GSA, increasing volumes of satellite data that will be available for exploitation by innovative positioning applications will also help to create new jobs within the industry. Today, the GNSS market represents more than 50,000 jobs in the European downstream market (trade of applications based on information pulled from satellite systems), and 3,000 in the upstream market (collection and generation of information from satellites). 6% of the European GDP already depends on GNSS, and the market is expected to grow by 8.3% per year until 2019.[7] The number of jobs in the downstream and upstream industries is expected to grow accordingly. According to Arianespace, the GALILEO project itself will support the creation of between 15,000 and 20,000 jobs in the European Union.[8]

Similar trend is observed in other economies. For example, in the US, 3.3 million jobs that rely on GNSS technology have been created, including 130,000 jobs in GNSS manufacturing industries, as well as 3.2 million in the downstream commercial industries.[9]

4. Drivers and obstacles

4.1. Understanding technology at an early stage of adoption

Today, the scope of application of satellite positioning applications is cross-sectoral, being widened by developments of GNSS systems and multi-constellation devices. As these applications can be utilised in different industries (ranging from agriculture, transportation, logistics, energy, health, to food) one of the first decisions start-ups in the industry have to make is the identification of their segment.

Raising awareness of potential clients about the wide range of technology applications is the biggest challenge for market take-up. Users do not really understand those technologies as an investment but rather see them as a free curiosity or add-on. This challenge is tackled by the numerous national and European programmes which take users on board. That helps to raise their awareness and therefore accelerate the absorption, limiting the risks at the late stage of product development.

"Today, we are only up to one third of the technology adoption curve" –
Deimos Engenharia

Since we are at the beginning of the technology adoption curve, the remaining steps to full adoption require mutual understanding of the actual needs of the end user by the industry in the one hand, and the ways in which the technology can address consumer needs by end uses on the other. As an example, observational data applications have penetrated the agricultural and farming industry, but this incursion has only been possible because of a clear understanding of the aerospace technology by end users (agronomists and framers).

To close the gap between the technology and the end user, close communication and collaboration between stakeholder networks is necessary.[10] These kind of networks include developers of observations data applications (businesses), end users (*e.g.* farming industries), higher educational institutions (*e.g.* which provide added value algorithms), and public institutions (which may sponsors and testing adopters new technology at early stages in the case of investment intensive technologies). This solution allows testing new methods to develop user-friendly applications, and reduce costs and time of development.

4.2. Satellite enabled applications: A research intensive industry

Initiatives supporting basic and applied R&D are important for companies in the industry even if they are considered to be too bureaucratic and far away from the actual client. EU's

"We are all part of an ecosystem; companies need to be actively involved not only in the process of creating linkages between the academia and the industry, but also in the process of defining the educational curriculum today for educational programmes, in order to meet the industry's needs of tomorrow".— ***ABBIA GNSS Technologies***

Large European research programmes provide enough support for businesses during the intensive R&D phases these technologies require. The Seventh Framework Programme for Research (FP7) was vital for the research phases and today Horizon 2020 is still important for the same reasons.

Collaboration with universities is also important for the development of the industry – it enables the identification of talented human resources and close cooperation with research laboratories. The main challenge is related to the commercialisation of economically viable products or services coming from the research.

4.3. Satellite enabled applications: Different support models

While support mechanisms and funding for basic research and development give companies in this industry the opportunity to benefit from good financial conditions during the development phase, wide access to subsidies and other forms of financial help, though necessary, may be dangerous. Companies too much depending on public finance might not to be able to reach the market on their own. Financial support for R&D is important to go thru the initial stages of the technology development, but must be justified, and monitored with clear focus on market orientation.

Public procurement for technology, as it is designed today, poses a problem for SMEs trying to access public markets. Procedures are often too long and not adapted to the nature of incremental innovation technologies. In addition, they often favour big groups. Therefore there is a clear need to improve technology sponsoring mechanisms which in the views of the industry, even in the case of evolving public procurement, are either insufficient or too slow for the pace at which technology advances.

Raising the awareness of end-users and ensuring the technology is well understood requires educational initiatives. Innovative businesses in high technology industries are by located definition either on a different technological paradigm or close to its frontier; any products or services offered by these companies are therefore often misunderstood by the base of customers. Initiatives aiming at raising the awareness of the customer base are welcomed.

4.4. A research intensive industry aiming at a client-centric vision

Support in training courses and activities for young businesses at local level (training developed by local authorities such as commerce chambers) has the capacity to complement the technical skills of entrepreneurs with a business vision. These initiatives must have the objective of instructing entrepreneurs to be ready to face time-consuming activities that may create a distraction from the technical development of the products and services offered by the SME.

During the development phase entrepreneurs should also have support in terms of the administrative and financial aspects required by appropriate business plans. Support regarding the assessment and management of risks, awareness of technical capabilities and limitations, and exploration of informal solutions to specific problems is essential to the development of these companies, which otherwise would be consumed by the technical aspects of the technology rather than the viability and operability of the business.

The remaining question is how to go from successful R&D phases to actual products and services sold? How can research and development be sustainable?

"Cooperation with other SMEs rather than outsourcing is the way to have a true European vision"— ***Geko Navsat***

Even if several contests and prizes provide visibility to company in the industry, and even if access to tools such as incubators cover the "last step of the ladder", these do not provide the "know how" to properly have a client oriented vision or mind-set and be able to develop a good business plan. Networking and contact with companies and entrepreneurs who have experienced similar problems in the past is valuable in this context.

Support for commercialisation is limited but necessary for the market uptake. There are many cases of talented start-ups that have been unable to reach the market and entered the trap of needing public funding for further research in order to survive. These companies, although characterised by scientific and technological excellence are unable to manage risks and exploit commercialisation opportunities. Initiatives such as business coaching and trainings are useful, but only if provided by real experts.

Currently, in Europe there are many support initiatives for research and development, although sufficient initiatives on instructing start-ups and SMEs on how to reach the market are still scarce.

5. Policy recommendations

5.1. A global market of satellite data applications requires support for an international business vision

Global development is a process that takes time. Innovative companies in the field of satellite enabled applications need to secure a corporate profile and need help to obtain international visibility to ensure their long term operability. Internationalisation events are therefore a necessity to SMEs in the industry. However, the number of internationalisation events to showcase the technologies is still limited, and access to them is often difficult and expensive. At the same time, financial support for the participation is usually limited and difficult to obtain.

Support the development of new business oriented events

Attracting attention and gaining visibility is important to companies in developing and providing space enabled applications and services. The emergence of GALILEO and EGNOS has drawn public attention to the sector. Also a number of contests, prizes and networking events at national and EU levels that help to build the visibility (*e.g.,* The South Summit, the European Space Expo) though they are still not sufficient or enough commercially oriented.

Support for the development of business oriented events with a client vision is therefore recommended. The whole sector needs to be conscious about the interests of the client and the value that those technologies can provide.

Financial support to access useful internationalisation events

Taking into account the important of the global scale, companies from the sector need to invest in attending international fairs and shows which are often expensive, especially for start-ups and SMEs. Currently, some public financial support is available for this purpose, although it is often seen to create a lot of administrative burden. To deal with that same companies hire consultants in order to be eligible and receive support. Financing and administrative support initiatives should be thoroughly reflected and validated by skilled individuals coming from the industry in order to take into account the actual needs of SMEs.

Limited technical and financial support to attend internationalisation events creates a situation of trade-off between the expenses and possible benefits. In consequence, internationalisation events become an investment that needs to be evaluated rather than a measure of support for the development of businesses.

5.2. Conquering a global market of satellite data applications needs commercial and business focus

As mentioned before existing European support instruments for the development of the technology have a vision focused on the research and innovation stages of start-ups rather than on their business orientation and commercialisation.

Support for commercialisation is limited but necessary for the market uptake. There are many cases of talented start-ups that have been unable to reach the market and entered the trap of needing public funding for further research in order to survive. These companies, although characterised by scientific and technological excellence are unable to manage risks and exploit commercialisation opportunities. Initiatives such as business coaching and trainings are useful, although it is regrettable that these kinds of initiatives are in many cases implemented or delivered by individuals who lack knowledge about the technology and its limitations, and/or lack the motivation to actually motivate. Currently, there are too many support initiatives for research and development while we lack initiatives on instructing start-ups and SMEs on how to reach and take-up the market.

Increase support for late stage development and commercialisation

Initiatives such as incubators have been successful at providing guidance and related services for start-ups during commercialisation stages. They have enabled them to access resources for prototyping, testing, and demonstration to guarantee that the late stage product development reaches commercialisation without or with limited difficulties.

Such initiatives, which intend to promote and provide match-making between the application development and the market are welcome and necessary. Increased support for businesses in late stages of pre-commercialisation and commercialisation is therefore needed; initiatives can take the form of incubator like services, market guidance, testing and demonstration project, etc. to ensure businesses reach end users that otherwise would have not been approached.

5.3. Cross-industry technologies need to be better understood

Space enabled applications involve cross cutting technologies across different industries. This characteristic requires higher integration and cross communication between developers in the industry and potential clients and end-users, creating the need to connect the client with the basic research. SMEs are determinant elements in the process of helping the client understand the utility of the technology, but they need support to fulfil this need. Today, certain business models and market practices have given clients the habit that technology is a commodity and hence its price is driven downwards. That puts the industry in a situation where there is important uncertainty about actual understanding and awareness clients have of the technology and their willingness to pay for it.

Better regulation of market practices and business models

Since certain business models such as the 'over the top' mobile applications models have led end users to believe that applications can be obtained and exploited at nearly no cost, it is important to provide clear legal and commercial frames leading to business models that actually take into account the nature of space enabled applications.

Better regulation of market practices regarding platforms for the commercialisation of space enabled applications and services through networks and devices is recommended to help both developers and service provides, and end users understand each other.

Educational campaigns

Within the context of the current digital paradigm, raising the awareness of the population regarding the use of technology is a necessity in order to promote the digital skills of users. Ultimately these digital skills will enable the population not only to consume but eventually produce these technologies. In consequence, Educational programmes that render adults sensible to the advantages of technology and its costs in one hand, and awaken children to understand technology better and develop the will to use it on the other hand is necessary. "In general, we are not engineers because of random reasons, it is usually because as children, we had a close relationship with technology, and we now know what it costs to develop technology".

As mentioned before, mentoring programmes for young companies, networking and informal coaching can also help them to obtain a more client oriented vision and to raise client willingness to pay for the product or service; it is not a question of who is responsible for bringing the digital skills of the population up to the requirements of the current digital paradigm but rather how can those skills be developed rapidly.

6. Appendix

6.1. Interviews

Company	Interviewee	Position
Geko Navsat	Rafael Olmedo	CTO and Co-founder
Geosat	Michael Mumelter	CEO and Co-founder
Deimos Engenharia	Nuno Avila	Director
ABBIA GNSS Technologies	Brtrand Ekambi	CEO and Co-founder

6.2. Websites

Company	Web address
Geko Navsat	http://gekonavsat.com/
Geosat	http://www.geosattechnology.eu/engl/intro.html
Deimos Engenharia	http://www.deimos.pt/en
ABBIA GNSS Technologies	http://www.abbia.fr/

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