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IMPACT ASSESSMENT

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COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Action Plan on Global Navigation Satellite System (GNSS) Applications*)*

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IMPACT ASSESSMENT ON ENHANCING THE DEVELOPMENT AND ADOPTION OF APPLICATIONS OF EGNOS AND GALILEO

GLOSSARY

Acronym	Meaning	Acronym	Meaning
ADAS	Advanced Driver Assistance System	IACA	International Air Carrier Association
ANSP	Air Navigation Service Provider	IALA	International Association of Lighthouse Authorities
APV	Approach with Vertical Guidance	IATA	International Air Transport Authority
CBA	Cost Benefit Analysis	ICAO	International Civil Aviation Organisation
DG	Directorate General	ICD	Interface Control Document
DSRC	Dedicated Short-Range Communications	IEC	International Electro-technical Commission
EASA	European Aviation Safety Authority	IGS	International GNSS Service
EC	European Commission	IMO	International Maritime Organisation
EDAS	EGNOS Data Access System/Service	IOV	In Orbit Validation
EETS	European Electronic Toll Service	IPR	Intellectual Property Rights
EGNOS	European Geostationary Navigation Overlay Service	ISA	Independent Speed Adaptation
ERNP	European Union Radio Navigation Plan	ITU	International Telecommunications Union
ESA	European Space Agency	LBS	Location Based Services
ESP	EGNOS Service Provider	LRIT	Long Range Identification and Tracking of Vessels
EUROCONTROL	European Organisation for the Safety of Air Navigation	NSA	National Supervisory Authority
FAA	Federal Aviation Administration	OBU	On Board Unit
FP	Framework Programme	PPP	Public Private Partnership
FTE	Full Time Equivalent	PRS	GALILEO Public Regulated Service
GAGAN	GPS And GEO Augmented Navigation	PVT	Position Velocity and Timing
GJU	GALILEO Joint Undertaking	RFID	Radio Frequency Identification Devices
GLONASS	Global Orbiting Navigation Satellite System	RTCM	Radio Technical Commission for Maritime Services
GMES	Global Monitoring System for Environment and Security	SAR	Search and Rescue
GNSS	Global Navigation Satellite System	SBAS	Satellite-Based Augmentation System
GPS	Global Positioning System	SOLAS	Safety of Life at Sea
GSA	GNSS Supervisory Authority	WAAS	Wide Area Augmentation System
HMI	Human Machine Interface	WP	Work Package

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

This Impact Assessment has been carried out with the involvement of a broad range of relevant stakeholders from the European Commission services, the private sector, and the Member States

Lead Directorate General: Transport and Energy

Agenda planning or WP reference: 2007/TREN/020

Organization: Several Directorate Generals, including ENTR, ENV, INFSO, AGRI, MARE, SANCO, JRC, did participate in the Inter-Service Group on GNSS Applications constituting the Impact Assessment Steering Group (IASG).

Consultation and expertise: external expertise

Strategic input and know-how:

Management discussions with the EGNOS Service Provider and European Air Navigation Service Providers

Information provided by the results of R&D projects in FP5 (GNSS calls) and FP6 (1st, 2nd and 3rd calls)[1].

Analysis of trends and priorities in research and industry obtained through the evaluation of R&D proposals submitted to calls in FP5, FP6 and FP7.

Market studies sponsored by EU Institutions:

Post-FOC Exploitation Study (Roland Berger and others, 2009), GNSS Strategy (LEK, 2008) EGNOS Supercontract (Helios, 2008), EGNOS study (FDC, Esys, Telespazio, 2008), Proddage (2005), GALILEO consortium bids (2004-5) UK CBA (2009 – draft, June 20, 2009)

Other market studies:

UK Department of Transport GNSS Downstream Benefits Assessment ("Macroeconomic impacts of GALILEO", 2005; “GNSS and Transport Applications”, 2009), French Ministry of Transport ("Case for APV in Aviation", 2004; “GNSS Transport Applications”, 2007), FDC for CNES ("Etat des lieux des usages des systèmes GNSS et panorama des marchés associés de produits et de services", 2008), US FAA (2008), Japanese Ministry of Economy, Trade and Industry (METI, 2008), Thales Research (2002)

Workshops:

EC/GSA: "GALILEO FP7 Information Day" (2007), "GALILEO FP7 Information Day" (2008)

[1] A list of projects of particular interest in this context is available in Annex A

Comité économique et social européen; Comité des Régions: "Le futur système européen de radionavigation par satellite: les nouvelles opportunités pour les entreprises et la société civile" (June 2008)

Eurisy (www.eurisy.org): "Innovation at the service of cities and regions implementing sustainable energy strategies" (June 2009), "Regional Policy: the Benefits of Satellite Information and Services" (Sept 2008), "Innovation at the Service of Regional Growth - The Competitive Advantages of Satellite Information and Services" (May 2008), "Local and Regional Risk Management Integrated Use of Satellite Information and Services" (March 2008)

Eurocontrol: "Navigation Avionics Requirements Forum" (Dec 2008)

Consultation and expertise: consultation of external stakeholders

In December 2006, the Commission launched a large stakeholder consultation with a Green Paper on the applications of EGNOS or GALILEO[2]. This Green Paper aimed primarily at seeking input from the end-user community on specific EC-driven actions that could be pursued in order to: (i) foster the market penetration of GNSS-based applications and services, notably those that could build upon EGNOS and GALILEO; (ii) enhance the competitive position of European suppliers and service operators in the global marketplace.

This broad consultation was followed by several market research studies refining the previous input on key application segments, notably in terms of the identification of the key drivers and barriers that shape the trends in each distinct market. The results of this broad survey were discussed with the different departments of the European Commission which could act as users or sponsors of future GALILEO or EGNOS applications and services.

This preliminary ground work, was subsequently revised and augmented by consultations carried out in 2007 and 2008 through meetings with representatives of potential user communities in Transport, a domain already identified as a major user segment. They were aimed at eliciting to the extent possible the entire value chain across the most important EGNOS or GALILEO Transport-related applications.

During the Spring of 2009 a final round of consultations took place through targeted workshops with additional non-transport industry players end-user communities: high-accuracy in engineering, land-surveying markets, and user authentication and timing services.

In parallel, the general public had also been consulted via a Eurobarometer survey in the autumn of 2007. Citizens expressed a strong interest in the possible use of GALILEO for security-relevant applications.

Member States provided extensive contributions to the Green Paper consultation. Then they remained involved through their representatives in the GNSS Committee, and were also pivotal in contributing to this consultation process by means of specific debates during their regular meetings as well as in dedicated bilateral meetings with the Commission (see “Other market studies” above).

[2] The list of Green Paper respondents in the consultation, highlights of quotes excerpt from the contributions, and a synthesis of the responses are included in Annex B

Consultation and expertise: consultation of services of the Commission

A series of meetings have taken place in 2007 with about 30 units within the European Commission services, representing as many specific potential user communities. They commented upon the Green Paper consultation, and contributed with their own requirements as regards to their possible use of EGNOS or GALILEO.

A working group composed of representatives of the Commission's Directorates General with a direct interest on potential EGNOS and GALILEO-based applications and services was established in 2008, to build upon the stakeholder consultation and to assist in the definition of an Action Plan of the European Union and in the impact assessment of such a plan. Directorates General TREN, ENTR, ENV, INFSO, AGRI, MARE, SANCO, RTD, JLS, and the JRC (See annex C for further details) participated. For questions of facilitating in-house management this group was split into two sub-groups: one internal to DG TREN to address transport and energy–related questions, and one inter-service group involving the other Directorates General. Both sub-groups met several times, and contributed directly to this Impact Assessment in particular during their respective meetings of 21st April and of 7th May 2009.

Integration of comments of the Impact Assessment Board (IAB) on the previous version of this report:

When commenting on the report, the IAB requested (a) further assessing the potential of market dynamics in delivering the growth potential of the downstream industry; (b) better explaining how the blocks of actions under option 4b contribute to fulfilling the objectives; (c) further improve the summary comparison of options.

In order to take the Board's recommendation (a) into account, the "Baseline scenario" section under the "Problem definition" header has been completed with references to independent studies and opinions that back some of the quotes[3] from contributions from stakeholders collected during, and with paragraphs evidencing that market forces alone would not suffice to deliver the growth potential of the sector.

The Board recommendation (b) has been implemented through the inclusion of one figure indicating which block of actions supports which particular objective in the section 3.5 describing option 4b (whilst the 2 figures relating individual actions and objectives have been moved to Annex F), as well as through the addition of a reference justifying the target market share of at least 33% of the global GNSS market in section 2: "Objectives".

As for Board recommendation (c), indications have been added as to how many of our objectives would be tackled under each scenario in section 5.1 (where scenarios are compared.).

Finally, as requested by the board: the text has been shortened (down to 32 pages, excluding tables, diagrams and annexes); figures have been moved; and mentions of studies are better referenced, with hyperlinks when they are publicly available.

[3] In addition, a representative cross-section of quotes excerpted from the contributions to the Green paper consultation process, and an extensive synthesis of the responses of stakeholders have be included in Annex B.

2. PROBLEM DEFINITION

2.1. Background

The availability of GPS has generated the creation of a new economic sector world-wide

In the year 2000 a new technology was made available to the world, after having been restricted for many years to US military usage: satellite-based positioning and timing for civilian use, through the provision by the US to access their GPS signal, free of charge but with no guarantee of service. From 2001 on, a world-wide market of GNSS enabled product and services, called downstream GNSS applications, has been growing double digit. It was worth €124[4] bn in 2008, and it is expected to reach an annual value of over €230 bn by 2025[5] (with some predicting over €400 bn.)

According to the same source, confirmed by Japanese and US studies (see annex D):

– 75% of this market is provided by products and services linked to mobile telecommunications and personal handsets: services available on a mobile phone, social services provided over a specific mobile handset, help to elderly, sick or disable people.

– 20% of the market is linked to intelligent transport systems for road: navigation onboard devices, road charging schemes, emergency call systems with caller location, tracking and tracing of specific goods, traffic management, driver real-time information, etc.

– the remaining 5% of the market include all the other domains of application, many of which are expected to generate significant indirect benefits (e.g. increased safety in air, rail, or maritime transports; civil protection efficiency; search and rescue capabilities, security.)

The market is building upon primarily, basic positioning and timing signals, but it is expected to benefit from the planned introduction of authentication and encryption of signals.

Europe decided to establish its own independent GNSS

The GPS offering no guarantee of performance or reliability, the Member States of the EU and ESA decided in 2001 to launch the EU GNSS project[6]. Two systems are being established: EGNOS and GALILEO to provide signals guaranteed for civilian use[7]. EGNOS will provide three services over Europe (Open Service, Safety of Life Service, Commercial Service) and GALILEO five services world-wide (Open Service, Public Regulated Service, Safety of Life Service, Commercial Service, Search and Rescue.) EGNOS is building upon GPS, and will build on GALILEO in the future. EGNOS has already been partly available for a few years. It was initially envisaged that GALILEO, a fully autonomous system, would operate in 2008, but is now planned that the infrastructure is operational in 2013.

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4 Figure for the 'enabled market' (=GNSS devices +services); whereas 'core market' (GNSS chipsets + services) is €13 bn. LEK GNSS Strategy study (2008)

5 LEK and others (2008)

6 Council Resolution 2001/C 157/01 of 5 April 2001

7 See Regulation 683/2008

Other countries are developing their own GNSS and applications

The strategic value of GNSS has been recognised by a number of other regional powers.

Russia, China, India and Japan declared their intention to deploy GNSS capabilities for civilian use. The performance of these systems remain unclear, but the announced greater performance of GALILEO over GPS and the competitive advantage that it would entail may fade away in view of the developments announced by Russia, China, India and Japan, as well as with respect to the next generation GPS.

The Russian and Chinese initiatives are developing in their respective military context, whereas the Indian and Japanese systems are being established in their civilian sphere. All promote the development by their industry of applications based on their own system. Some (Russia and China in particular) are planning to make the use of such applications mandatory in certain civilian domains.

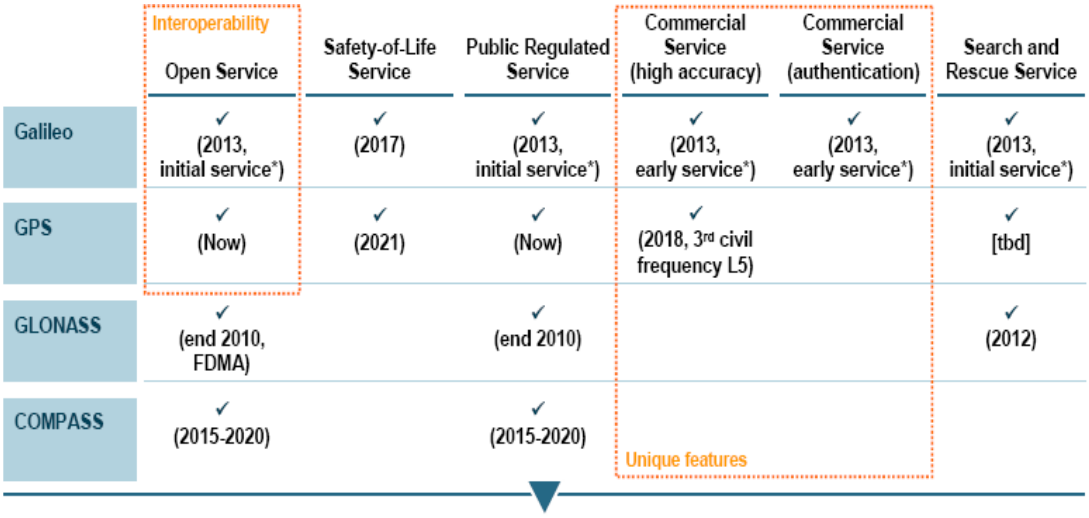

Fig 1: Future GNSS services (Estimate 2009)

Europe has not taken an appropriate share of the GNSS application sector

As of today, the US industry captures nearly 50% of the market of GNSS applications, Europe and Asia slightly less than 25% each, and Canada a few per cent. In spite of Europe's investments in its GNSS infrastructure, in spite of the availability of EGNOS, the share of the European industry in the market of GNSS applications is low compared with the share that Europe is capable to achieve in other sectors of high-technology.

2.2. Nature and extent of the problem

Europe is visibly facing a limited and slow development and adoption of GNSS downstream applications based on EGNOS or on GALILEO, which constitutes a problem in several ways:

The low participation of Europe in the market of GNSS applications means that it misses a big opportunity in the context of the EU Lisbon strategy

Applications based on GALILEO and EGNOS give an opportunity to pursue the Lisbon strategy by contributing to the generation of growth rooted on high-technology and services, by providing leverage to superior technology developments, by contributing decisively to the

development of a knowledge-base society, and by creating high-value jobs within the European Union. The most recent and conservative assessments of the overall benefits of EU GNSS programs[8] to EU industry, citizens and Member States estimate their amount between €55 and €63 bn cumulated over the next 20 years, with most important benefits arising from the revenues of the downstream industry (between €37 bn and €45 bn)

Europe is therefore missing a huge opportunity if it does not take the appropriate share of the expected economic benefit resulting from GNSS applications, which is especially regrettable in these days of economic difficulties.

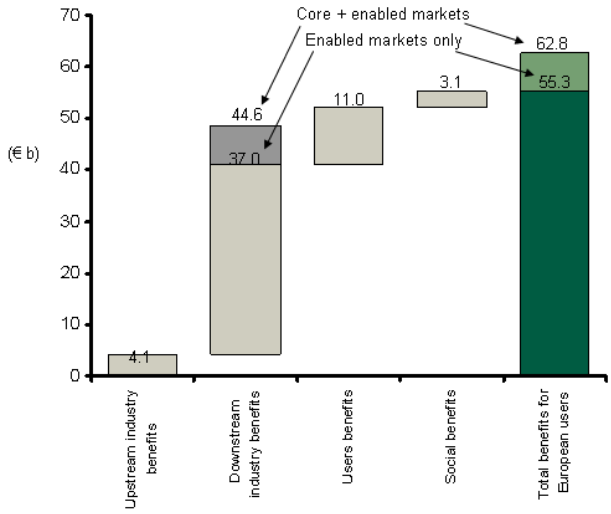

Fig 2: Total cumulated benefits for the European firms, users and society (2008-2030)

The limited usage of applications based on EGNOS and GALILEO leads to critical dependencies

GNSS are keys to critical infrastructures: they provide position, navigation, and timing information upon which depends Europe's security and social and economic development. They contribute directly and critically, and will increasingly do so, even if not always in a visible way[9], to the operation of transport, energy, communication and banking networks, as well as of safety and emergency-related public services. GNSS and their applications are very pervasive. They are becoming key elements in the daily life of the European citizens and in economic sectors[10] representing a substantial part[11] of the EU27 GDP.

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8 E.g "GNSS Strategy", LEK, 2008

9 GNSS provide an enabling technology that often requires to be combined with telecommunication and information technologies, software, and embedded into systems, products and service.

10 The wide variety of domains for potential applications include: localisation for all modes of transportation, navigation, logistics, fishing and precision agriculture, surveillance, civil protection, mapping and Earth science, cadastre, management of natural resources, meteorology, environment and disasters management, and timing for the synchronization of networks (telecommunications, electrical power grids).

11 The size of economical activities that rely on GNSS is conservatively estimated as 6-7% of the whole GDP of the European Union (ca €800 bn), which highlights the intrinsic value of GNSS for the economy and, therefore, the importance of securing its supply.

By relying only on GPS-based applications, the EU would be exposed to the effects of the un-availability of the GPS signal, which it cannot control since its primary objective is to support the military operations of a third-country.

By developing applications based on EGNOS and GALILEO, which are endowing the EU with own GNSS facilities, the EU would ensure greater independence and secure the supply of a key element of its infrastructure. On the contrary, the limited or slow development of downstream EGNOS or GALILEO-based applications may become in turn a problem that could contribute to marginalize GALILEO.

2.3. Identification of key players and affected populations

The value chains operators, both private and public organizations, in transport and non transport sectors are the key players affected by slow and limited development of downstream applications of EGNOS or GALILEO. Value chains differ across the various sectors (e.g. aviation, rail, maritime, road, agriculture, cadastre, surveying, telecommunication, energy, asset tracking, or banking) but concur with the following general model:

– Manufacturers of hardware and software components of GNSS receivers and similar equipment (e.g. uBlox, Qualcomm, Broadcom, CSR-SiRF)

– Manufacturers of GNSS standalone receivers (e.g. Spirent, Trimble, Septentrio, Garmin, TomTom, Magneti Marelli, Rockwell-Collins, Magellan, Universal, Honeywell, Thales Avionics)

– Integrators of equipment supporting GNSS applications (e.g. Telespazio, Thales Alenia, GMV, Claas, Leica)

– Developers of new applications based on GNSS (e.g. Thales, Huntaskill, NSL)

– Services providers (e.g. air navigation service providers, D-GPS (differential GPS) service providers for coastal, channel, or inland navigation, Toll Collect, Fugro, John Deere, Veripos)

– Clients of these industries (e.g. commercial and general aviation, railways, commercial and leisure marine, motorways operators, farmers, law enforcement agencies using positioning and navigation capabilities; mobile phone service providers, energy, communication or banking companies using timing capabilities for synchronization of networks; individual consumers: citizens, patients, in Europe and potentially worldwide).

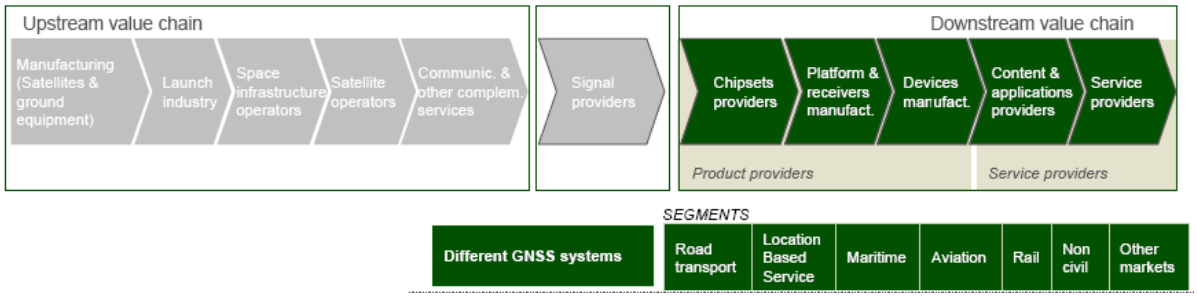

Fig 3: GNSS market value chains – Upstream and Downstream

All players in the value-chain are affected, as well as existing and potential new entrants. Some producers of hardware and software components of GNSS applications and systems, and most developers of new applications are SMEs, in many cases they are spin-offs of bigger corporations.

Other players include public authorities at national, regional, or local level, and regulatory and institutional bodies (from the European Aviation and Maritime Safety Agencies (EASA, EMSA) to the Aviation National Supervisory Authorities and Ministry of Transport or of Infrastructures in each Member State, including international organisations such as ICAO, IMO, etc. that set the standards for major application domains.) The European Commission services are also key users since they can influence and open doors for GNSS applications to develop in their respective domains of responsibilities (e.g. the measurement of fields in agriculture for Common Agriculture Policy subsidies calculation).

At a more macroscopic level the European innovation system may be handicapped by the slow adoption of EGNOS and GALILEO: According to the economic theory and practice[12], innovation in technologically complex domains as GNSS is not a linear process, but rather builds upon the introduction of "milestone" technologies. If GALILEO does not become the underlying GNSS standard in Europe, many application domains may remain locked in a technological paradigm[13] which is inferior and which will rule out addressing the new performances that can be made possible by the European GNSS.

Eventually, the citizens, primarily in Europe but also worldwide, are being affected by the slow development of applications based on EGNOS or GALILEO, since they are not benefitting from the added-value of for instance: location-based services, search and rescue facilities, or advanced navigation and safety features, in many aspects of their life.

2.4. Drivers and underlying causes of slow development of EGNOS or GALILEO downstream applications

Uncertainty around the European GNSS has been weakening confidence in potential downstream business.

Many stakeholders have commented along this line during the Green Paper consultation process. The European GNSS were indeed initially intended to be managed under a public-private partnership, which failed before delivering. The responsibility for establishing EGNOS and GALILEO was transferred to the public sector further to the conclusion of a long decision process. Such fundamental changes in the programme delivery finally resulted in significant cost and time overheads – notably a shift of the planned date of establishment from 2008 to 2013 – and a certain undermining of the credibility of Europe to assert itself as a major reference player in the GNSS markets.

Meanwhile decisions remained pending on a number of issues the clarity of which is deemed necessary for investing in application development:

– the legal and regulatory framework – in terms of liability, intellectual property rights, or pricing policies – under which EGNOS and GALILEO services would be provided was not

[12] Nelson & Winter, 1977

[13] Dosi, 1988

made explicit, which makes it difficult to estimate possible financial returns on investments in application developments;

– the technical characteristics, and the timing for the availability of EGNOS and GALILEO services could not be published, which makes it difficult both to grasp their functional advantages over GPS, and to schedule investments in application developments;

– the way EGNOS will evolve when GALILEO materializes was not decided, which casted doubts on the willingness of Europe to maintain both in the lung run;

– in the absence of an empowered system owner and a service provider, no coordinated strategy was implemented to communicate with potential users and market players through a single reliable voice, and no one-stop-shop was available to disseminate relevant technical and program information;

– the certification process of EGNOS or GALILEO services remained still, which was highly detrimental in key sectors, in transport in particular[14].

Growing "competition" has changed the context for the development of GNSS applications to the detriment of European players.

Because the Russian and Chinese systems could be in a position to broadcast signals and to enter into operations at about the same time as GALILEO, application developers are considering alternatives to base their work on, in particular the combination of signals from several GNSS.

Even if the timing of the establishment of systems is unpredictable, even if EGNOS is already there to support the development of applications to be used in Europe, and even if European independence from signal suppliers can only be granted by GALILEO, some European companies have signalled to be ready to use the Russian or Chinese systems if they become operational earlier than GALILEO: Further to constituting alternate solutions to GPS, the advent of a second constellation of satellites will provide back-up and redundancy at reasonable cost if combined with GPS[15]. Such advantages may still exist in integrating services provided by a third or a fourth constellation in applications, but will be offset by extra equipment costs.

Meanwhile, the potential availability of more systems, combined with difficulties in the establishment of GALILEO, is postponing decisions of investments in application developments. Such delays may not only hinder the possible growth of the sector of GNSS applications in Europe, but also lead to grasping a lower share of the world market, especially in view of accelerated development of GNSS applications in the countries that establish competing GNSS.

The provision of GNSS services does not follow traditional market models.

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[14] For example, IATA opposes the use of EGNOS whereas it supports that of WAAS, a satellite-base augmentation system (SBAS) very similar to EGNOS, in the US.

[15] Technical studies and simulations indicate that the combination of signals provided by two different GNSS will be the most cost-effective solution for enhancement performance of applications.

The supply of GNSS position, navigation and timing services enabling the development of value-added applications and services does not follow nowadays a traditional market model as GPS and other operating infrastructures are firmly placed under military control. Defence requirements fully determine the capability, evolution, procurement and operation of these systems that are fully met by public funds, in terms of both investment and recurrent expenditure. Those requirements evolve mainly from geopolitical and national security implications bearing no links to commercial considerations, a fact that will continue to play a decisive role in keeping GNSS under governmental control. The emergence of more GNSS facilities based on the same philosophy reinforces such conclusion.

This defence-orientation of most of the GNSS programmes brings clear advantages to home-grown industries that can directly benefit from the military-funded programs to develop technological capacities with financial support much beyond those justified by strict market economy considerations. Moreover, such a competition-protected defence arena enables home-grown industry and service providers to bring, through testing and field operation, applications and services to a sufficient level of maturity and stability prior to bringing them into the civilian markets. Such use of the defence markets to acquire competitive advantages has placed the US industry as the clear leader of the GNSS applications and services market. In this context, a parallel can be drawn with the Airbus versus Boeing experience, where Europe was required to mobilise large amounts of public funds to assist Airbus in the development of commercial aircrafts to offset the flow of indirect financial assistance from defence contracts used by Boeing to enhance its in-house design and engineering capability also used for the civilian market.

The case of GPS demonstrates that complex and always risky GNSS programmes cannot adhere to straight direct cost versus benefit considerations. The development of EGNOS and GALILEO applications cannot benefit from indirect military funding, but compensation for the absence of such resources is necessary to grasp, in Europe, the same overall indirect benefits as those brought by GPS in the US.

Shortage of funds allocated to research and innovation for applications based on EGNOS or GALILEO is delaying technological advances and growth of industrial capacities in Europe.

Further to the collapse of the GALILEO public-private partnership industry slowed its research investment in the sector. The market operators did not dare to take risks, given the innovative nature of both the service model and the technologies under development.

At the same time, when the programmes were re-profiled, priority was given to delivering the EGNOS and GALILEO infrastructures, the detriment of EU's staffing and funding for research on applications[16]. The lack of funding is a deterrent to innovation and testing of new applications, and to the establishment and training of the work force of future application developers. Stakeholder associations and clusters of SMEs have pointed at this issue, including by addressing directly the European Commissioners and Council.

As experience shows it has been the case for any new pervasive technology (as exemplified by Internet and its many similarities with GNSS: military-born oligopoly, extreme pervasiveness, just to name two) GNSS is impacted by 'network effects': the more users the

[16] €350 millions were taken from the FP7 budget planned for GNSS applications and reallocated to the funding of the infrastructure.

more valuable the technology is for new adopters; the more use one system, the harder it is to compete against it. The shortage of funds for research and innovation for applications based on EGNOS or GALILEO prevents from catching up against the first-mover: GPS-based applications, which continue to benefit annually from over €500 million of US public funds instilled through support to military applications.

Whereas the US GPS program and many of its applications were funded and accompanied since start by the US Department of Defence (DoD), Europe offers more limited access to capital funding to nurture spin-offs of its GNSS programs, or to reap benefits from their technology spill-over and the development of downstream applications[17].

[17] No system of innovation in Europe I seven close to match the US space-related innovation programmes sponsored by the DoD or NASA

KEY PROBLEM	DRIVERS	
Limited or slow development and adoption of downstream applications based on EGNOS or GALILEO	Unclear regulatory and legal framework and unclear governance for the provision of the EGNOS and GALILEO services (including pricing of services, liability, IPR regime).	Regulatory issues
	Certification for use in life-critical applications in transport (aviation, maritime, rail and road) not completed.	
	Unclear commitment of the EC to maintain both EGNOS and GALILEO in the long term.	
	Lack of perception by the end-user communities of the added benefits of EGNOS and GALILEO over other GNSS – notably GPS.	Market issues
	Wait-and-see approach by the GNSS and application industry, in the event that other technologies become available before GALILEO.	
	Doubts within the GNSS industry in the EC commitment and capability to deliver EGNOS and GALILEO on time and according to specifications.	
	Very limited EC financial resources for R&D, and absence of financial instruments for supporting parties involved in the development of EGNOS and GALILEO applications and services.	Financial issues
	Uncertainty in the direct financial returns of the value-added EGNOS and GALILEO applications and services.	
	Limited availability of risk capital in Europe to fund innovations in GNSS applications.	

Fig 4: Key problem and drivers –Summary table

2.5. Baseline scenario, including, where necessary, sensitivity analysis and risk assessment

The baseline scenario consists in the mere continuation of the current limited level of activities undertaken towards the adoption of downstream applications based on EGNOS or GALILEO:

– Raising awareness among the aviation community towards adopting EGNOS and GALILEO for safety of life applications (primarily for en-route navigation and landing procedures)

– Conducting market studies and providing information to actors in other segments potentially interested in using the open signal or the commercial service of EGNOS and GALILEO (e.g. agriculture for precision farming, road charging, asset tracking, scientific applications, oil and gas, surveying, mapping), or the future search and rescue service of GALILEO (primarily for fisheries and maritime transport)

– Granting the €38 million left for the funding of research and development in GNSS applications, and monitoring the about €50 million worth of ongoing projects in the area.

The baseline scenario is highly risky, since there is no chance it impacts effectively the drivers and underlining causes of our key problem:

– If the level of activities is not increased in the aviation segment, the adoption of EGNOS may be at risk since opposition can still be heard within this community[18]. In the US, where the WAAS system[19] has been developed, the Federal Aviation Authority (FAA) invested hundreds of millions and established a team of over one hundred just to support, since 2003, the roll-out of enablers required for applications in general and commercial aviation[20]. It requires at least for the EC to mobilize the additional resources necessary to support the certification of the system by the civil aviation authorities and the definition of EGNOS-based landing procedures across Europe.

"Aviation is a small but significant segment of the GNSS market. […] Unless GALILEO becomes available within the next few years, the market for GALILEO related applications is reduced."[21]The situation with WAAS in the US shows that market forces alone fail accelerating the adoption of such technologies, which have a cost for airlines and aircraft manufacturers, and the benefits of which lie primarily in the public sphere: increased safety, improved traffic management, reduced emissions resulting from route or approach optimisation.

– Because it is acknowledged that the primary user of EGNOS, further delays in the adoption of EGNOS by the aviation segment nurture the current lack on confidence expressed by stockholders in other sectors. They may also lock several applications on technologies that are inferior in terms of safety or efficiency (e.g. road charging could remain locked on solutions that are less precise.)

> *"Wherever there is a contribution of positioning applications to the overall security, health and wealth (dangerous goods, livestock, buses and coaches, E112…), the EU should take measures to accelerate the introduction of such services and technologies[22]"*

– Not raising the quality and intensity of information and support provision to application developers and users cannot compensate the unclear perception of EGNOS and GALILEO by the public.

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18 See footnote 11

19 As said, WAAS is the US equivalent of EGNOS

20 FAA presentation at "SBAS Implementation Forum", Eurocontrol, Jan 2009

21 Quotes excerpted from stakeholders' response to the Green paper consultation

22 The recent UK GNSS Downstream Study (2009) also points specifically at the application for E112

"We propose the establishment of national centres of excellence that provide complimentary skills, capabilities and facilities to others around Europe"

– The baseline scenario does not provide incentives for applications developers, manufacturers of GNSS hardware, software, and receivers to use EGNOS or GALILEO standards, to test and demonstrate its capabilities to compare with GPS or the new competitors.

"There is no sufficient visibility on the public sector recognition and planned use of GALILEO which would undoubtedly promote the system. Accompanying actions to foster downstream application developments should be continued.[23]*"*

– No provision is made within the baseline scenario to compensate or mitigate the negative economic impact of delays in the roll-out of GALILEO. However, it has been calculated that any additional year of delay will miss total cumulated economic benefits linked to downstream applications development worth €3 to €4 bn. The downstream players would lose market opportunities, users postpone their benefits, while the externalities would not materialise.

"Unless GALILEO becomes available within the next few years, the market for GALILEO related applications is reduced.[24]*"*

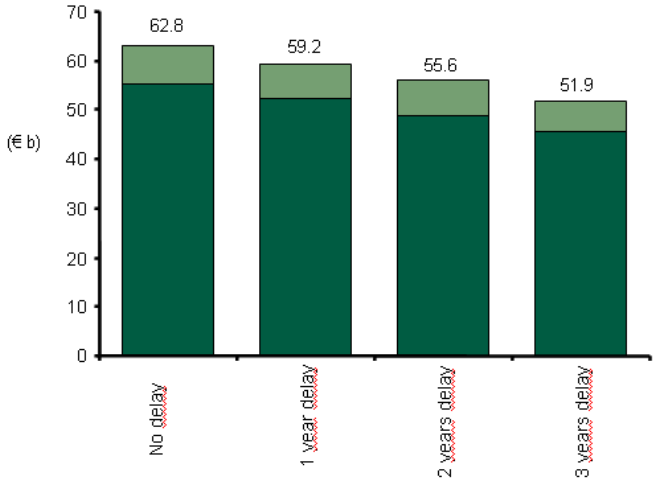

Fig 5: Impact of further delays in the roll-out of GALILEO on cumulated benefits (2008-2030) for Europe

– Only a very limited amount (no more than €38 million) of funding for research and development in GNSS applications remains available. This is regarding as highly insufficient in view of amounts of such funding which is normally required for the uptake of new pervasive technologies[25]. The situation is particularly damaging since researchers and innovative entrepreneurs are expected to be the primary designers of applications, as it has been the case when introducing the Internet and mobile telecommunication platforms.

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23 Consistent with the outcome of the Helios, Supercontract study (2008)

24 Consistent with the outcome of the LEK GNSS Strategy study (2008)

25 The US federal budget allocated to that effect amounts to an estimated €500 million annually. Although figures are not available, it is well-known that Russia and China are also providing research funding through military applications. China is mobilizing an additional €135 million in support to research for civilian GNSS applications

"[Even €100 million would be] insufficient for an annual basis for research effort, compared to what is made in other parts of the world. The EU R&D effort should balance the technology support that the US provides to their industry."

The European downstream industry is currently not investing substantial own financial resources into research and development. The downstream industry in the US only started to do so when military contracts generated sizable activities and triggered the establishment of research teams in the private sectors.

– Unlike with GPS, or the Russian and Chinese systems, the development of EGNOS and GALILEO applications cannot benefit from the indirect powerful effects resulting from their funding, development and broad deployment in the highly regulated military context. The baseline scenario does not compensate for the absence of such effects, which would be mandatory for Europe to grasp the same overall indirect benefits as those brought by GPS in the US.

  "Member States should become clients of GALILEO and EGNOS"

  "The Directive on European Universal Services should constitute an interesting starting point to feed the ideas on new legal tools to foster the business on downstream GNSS markets"

  "An effective regulatory framework is essential to ensure compatible and interoperable solutions are rolled out across Europe."

– The baseline scenario does not provide with the instruments necessary to plan how the future radio-navigation systems will develop, in relation with each other, and according to the requirements of their main user domains.

  "Europe needs a Radio Navigation Plan especially in the area of transport"

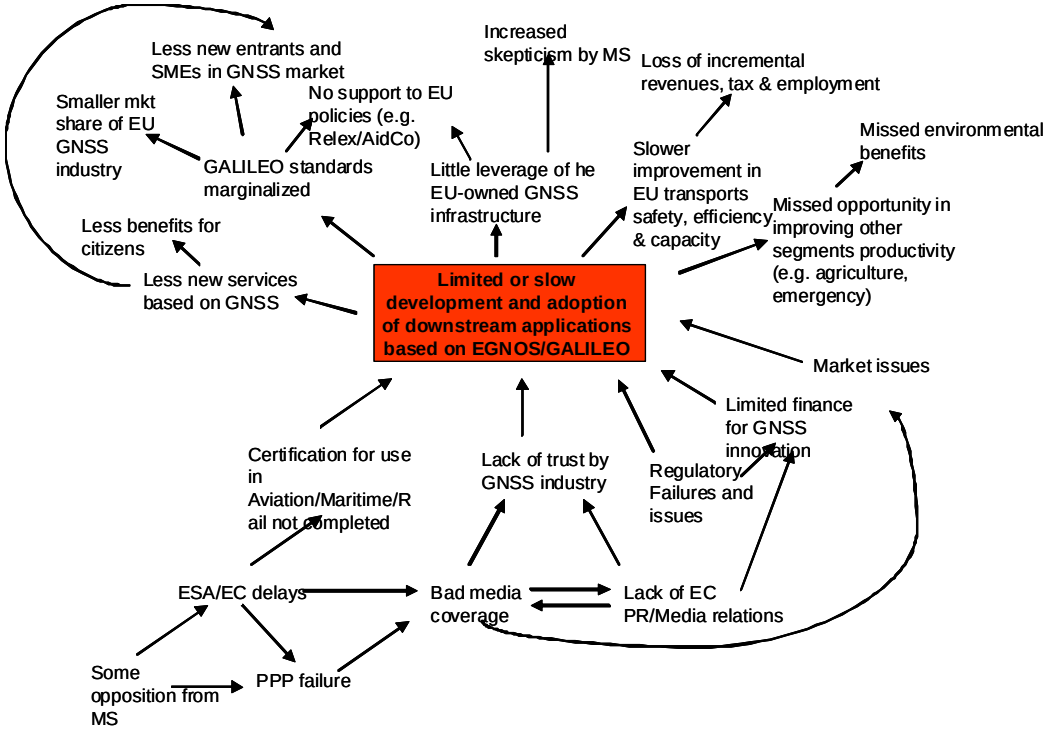

Fig 6: Chain of causes and consequences linked to the key problem at stake

Continuing with the baseline scenario would not tackle the causes underlying our problem, and would not mitigate the risks that have been identified so far. The chart above illustrates the complexity of the questions at hands, and sketches out the chain of underlying causes to the problem, and its consequences.

2.6. EU right to act: necessity and value added

The EU right to act is based on the Treaty on the functioning of the European Union, particularly on Article 172, and on the subsequent regulation on GALILEO and EGNOS[26]. The use of EU satellite navigation systems can have wide and deep economic, social and environmental impact, and the promotion of EU GNSS directly supports EU strategic priorities such as the Lisbon Agenda, is transnational in nature, and does cut across several policy fields coordinated at EU level.

The adoption of EU GNSS signals in several application domains requires compliance with international norms (e.g. ICAO) or certification at European level (e.g. the certification of EGNOS for use in aviation). Action at EU level would then avoid duplication and waste of efforts at Member State level.

The lack of EU's action, or the undertaking of fragmented or uncoordinated action by Member States alone (e.g. the fragmented adoption of GNSS-based road charging systems) would limit the marketability of the identified applications and create barriers to the free circulation of goods and services, or inequality of treatment of the European citizens.

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[26] Regulation (EC) No 683/2008 of the European Parliament and of the Council of 9 July 2008 on the further implementation of the European satellite navigation programmes (EGNOS and GALILEO), O.J. L196 of 24.07.2008, p. l.

The European Commission is programme manager of EGNOS and GALILEO. The fact that the EC manages GALILEO and EGNOS on behalf of the EU only adds one more reason to continue such investments.

The Commission is also, in its more usual role and with the EU Member States, in a privileged position to leverage and propagate best practices and standardisation, to promote cross-border cooperation as well as competition of project ideas, and to facilitate the establishment of a wide market for new applications, in a much more effective way than any Member State could on its own.

It is also the role of the European Commission to efficiently mobilize R&D funds to the benefit of the EU research policy, in particular through the management of the EC Framework Programmes. Whilst the European Commission was mandated to allocate € 400 million to GNSS R&D at the inception of the 7th Framework Programme, a large part of these funds were reoriented in urgency to support the establishment of the GNSS infrastructure. The rational behind the initial allocation of funds for R&D, however, has not been questioned, and has even been reinforced. The European Commission is therefore entitled to seek for the replenishment of the GNSS R&D budget, up to at least the amount initially planned to that purpose.

Meanwhile it is also the responsibility of the European Commission to promote the exploitation of results of EU R&D. This applies in particular to the results of the nearly 100 projects focused on EGNOS and GALILEO financed using funds of the 6th[27] and 7th Framework Programmes for Research and Technological Development.

[27] The need for the EU to better follow-up on its R&D funding dedicated to EGNOS and GALILEO, and to increase the dissemination of their results was pinpointed by the European Court of Auditors (ECA) in its recent report: "The management of the GALILEO programme's development and validation phase" on the activity of the GALILEO Joint Undertaking. .

3. OBJECTIVES

The objectives are to remove the barriers and obstacles preventing the maximisation of the benefits generated by EGNOS and GALILEO for the citizens and the industry of the Member States of the European Union.

OBJECTIVES		
General (G)	**Specific (S)**	**Operational (O)**
I) Ensure that EGNOS and GALILEO technologies are applied and adopted early in transport and non transport domains where they can bring benefits	1) Promote and enable EGNOS adoption in Aviation	1) Promote development and use of EGNOS landing procedures in commercial and general aviation across Europe and Africa
		2) Promote installation of EGNOS-enabled avionics
	2) Ensure that EGNOS releases fulfil requirements from non-aviation users	3) Promote trial of EGNOS in non-aviation segments
		4) Interact periodically with user communities for input and feedback
	3) Ensure GALILEO fulfils requirements for adoption across transport and non-transport domains	5) Promote trial of GALILEO across relevant domains
		6) Interact periodically with user communities to get inputs
	4) Establish EGNOS and GALILEO into key GNSS markets (i.e. for size, growth)	7) Negotiate the inclusion of GALILEO features in key GNSS components (i.e. chipset antenna)
	5) Improve the attitude of the GNSS industry towards EGNOS and GALILEO	8) Inform clearly on technology (e.g. publish ICD) and program management
	6) Remove any legal/regulatory/technical uncertainty	9) Disseminate all relevant technical information
		10) Clarify IPR, liability, pricing regimes in consumer and professional markets
	7) Gather support from Member States	11) Monitor GNSS market and technology trends within Member States and provide feedback
		12) Ensure coordination among and within Member States, leverage best practices
II) Ensure that the European industry (particularly SMEs) captures an increasing market share of	1) Support R&D for GNSS applications innovation to pop up	1) Launch an FP7 call every year (financial resources permitting)
		2) Enable a steady flow of innovative ideas from existing SMEs, new start ups and new entrants
		3) Launch joint initiative with private VC industry

the GNSS downstream application markets (33% at least[28])	2) Ensure European industry leverages appropriately EU GNSS programs	4) Ensure standards & interoperability of services across EU market to drive production costs down and efficiency up
	3) Ensure EU Institutions leverage appropriately EU GNSS programs	5) Ensure coordination among and within Member States, leverage best practices
		6) Use EU policies that could boost usage of EGNOS and GALILEO
		7) Coordinate with the European Investment Bank towards financing innovation and deployment of applications

Pursuing these objectives will tackle the underlying drivers of the key problem and avoid the negative consequences that have been highlighted before.

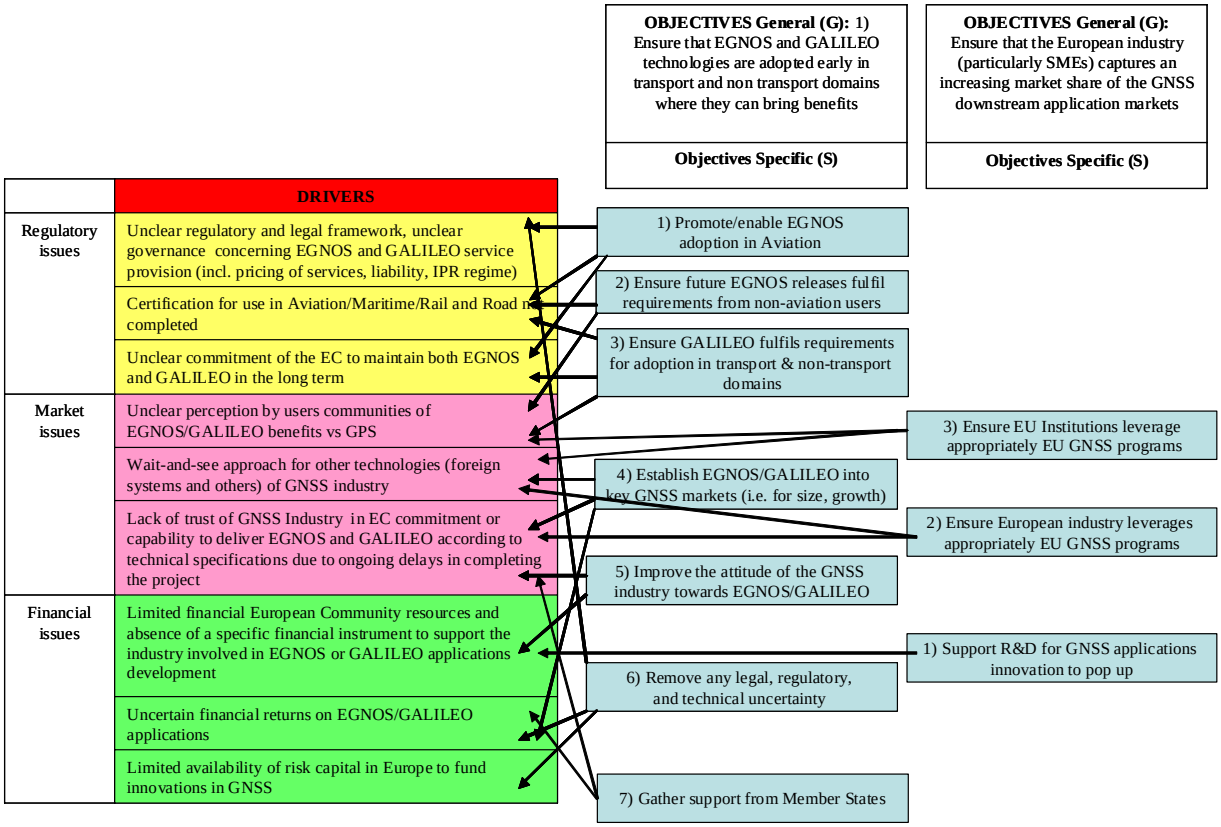

Fig 7: Which objective is addressing which driver behind our key problem

3.1. Who is affected and in what way

Wider, deeper and faster[29] development and adoption of GNSS technology based on EGNOS or GALILEO across transport and non-transport domains will impact:

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28 The share that Europe is capable to achieve in other sectors of high-technology is in the order of one third of the global market. In telecommunication for instance, it reaches 38% (Source: ISTAG Report to the EC: "Shaping Europe's Future through ICT", 2006). Such a target is indeed coherent with the Lisbon objective for the EU to become the most competitive and dynamic knowledge-based economy in the world.

– The EU citizens at large, as passengers of safer and more efficient and effective transport systems, consumers of navigation-based services (e.g. disabled and elderly people, fishermen, sailors, hikers and all categories of people in danger with the Search and Rescue service capability)

– The public sector in Member States, that will have the opportunity to upgrade some of their services (e.g. transport and non-transport infrastructure operators/owners and regulators, law enforcement agencies, medical assistance) as well as enjoy direct and indirect benefits of economic and social nature (e.g. incremental employment, tax revenues)

– The EU industry players along the several GNSS value chains, who will be able to benefit from expanded business opportunities, both in Europe and worldwide

– The EU SMEs in GNSS and GNSS-related industries, who can start new, or expand existing business

– Those players in non-EU States who will join common projects and initiatives (e.g. FP7 R&D programs, or dedicated MEDA projects)

– The EU Member States and the EU Institutions involved in external relations with countries, through the generation of an increased interest in EU technology and applications

The expected benefits for the EU Member States are to be mainly indirect benefits resulting from the creation of additional jobs in the whole EU[30], and the improved environment provided by the introduction of GNSS in different sectors highlighted in the Lisbon Strategy, including e-Europe. The workforce involved in the GNSS downstream applications provision is highly qualified (scientists, engineers, IT-specialists, etc), which will contribute to the development of a pool of new opportunities comparable to what resulted from the expansion of Internet.

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29 Or alternatively the opposite, limited, superficial and slow development and adoption as this would happen if no or ineffective policy is pursued (see below in policy impact section)

30 It is estimated that GALILEO will add in Europe, cumulated during the period 2008-2030, about 1400 employees in the upstream industry and between 17300 and 20900 in the downstream industry (LEK, 2008, cit)

4. MAIN POLICY OPTIONS

To achieve the above objectives, we have assessed diverse policy options for the Commission to adopt:

(1) No policy change (i.e. the baseline scenario)

(2) No EU action, discontinuing existing actions

(3) Regulate across all relevant domains (with aim to force adoption)

(4) Improve the framework conditions for the market to work through an Action Plan

- Comprehensive
- Targeted

(5) Consultative approach

4.1. Option 1: No policy change (also see the baseline scenario section)

The EC could decide not to make any additional action and let the market forces play. Under current arrangements, only €38 million budget remains available until 2013.

No further activities will be performed by the Commission beyond what it is already in its work-plan and no additional budget or resources will be required (neither at Commission nor at the other EU entities involved in the GNSS programs). The current activities include:

- FP7 calls applications-focused projects management
- EGNOS Commercial Service (EDAS) beta testing (through the GALILEO Supervisory Authority)
- Interaction and coordination with stakeholders
- Policy planning, and market monitoring

These activities shall be carried out by existing staff that is approximately, by all accounts, at least five to ten times smaller than staff allocated to comparable GPS activities in the US[31].

The focus will then be limited to one transport domain: aviation, and possibly to one non-transport domain (e.g. high precision agriculture). Tackling the above-described drivers generating lack of confidence among the EU GNSS industry will only be pursued to a very limited extent.

[31] FAA, USAF GPS wing

4.2. Option 2: No EU action, discontinuing existing actions

The EC could decide to discontinue any activity aimed at promoting the development of downstream applications and, for example, focus all its resources and management on delivering the EGNOS and GALILEO systems.

This policy entails the progressive closure of the existing GNSS-focused FP7 contracts with no possibility to promote their output.

Similarly all other initiated activities in the baseline scenario intended to promote downstream applications of both EGNOS and GALILEO shall be phased out. In this respect the message sent to the GNSS industry will clearly be that the sole role of the Commission with respect to GNSS is limited to the establishment of the GALILEO and EGNOS infrastructure.

Other bodies involved in ensuring that European GNSS systems can be used downstream (e.g. Eurocontrol, National Supervisory Authorities, EASA in aviation) will be left to interact among themselves with no EU coordination.

4.3. Option 3: Mandatory use of GNSS applications

The EC could propose to the Council and the Parliament regulations with the aim to make mandatory the use of GNSS in many if not most of the key domains of applications.

Many of these domains could potentially be strongly influenced by regulation and legislation both at EU and national level.

World Trade Organization rules[32] on the provision of services would make it extremely difficult, if not impossible for the EC to make mandatory the use of GALILEO or EGNOS in a systematic way, whilst they could permit enforcing the use of GNSS technologies in general.

In certain domains with global reach such as Aviation (the first beneficiary of EGNOS) or Maritime it is impossible to impose GNSS technology, let alone EGNOS or GALILEO without compliance to the guidelines of international well-established and acknowledged bodies (ICAO and IMO). These guidelines however tend to leave final choice among technologies to the end-users, who are left free to decide according to specific functional and cost-benefit considerations. Any EU regulation here will have therefore to comply with worldwide standards.

Some Member States and stakeholders already expressed their reluctance towards extensive regulations which would make the use of GNSS technologies mandatory (without however excluding targeted actions in specific, well-justified areas). Member States usually prefer to adopt technical neutrality. Regulations which would make mandatory the use of GNSS are not welcome in several domains, and most stakeholders express their preference for a market lead approach, with the public authorities doing their best to convince users about the benefits of EGNOS and GALILEO, and regulating only in duly justified cases.

In addition to becoming a difficult political issue the mandatory use of EGNOS or GALILEO would also raise legal concerns with respect to liability or to privacy.

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[32] Doha WTO Ministerial 2001, Ministerial Declaration WT/MIN(01)/DEC/1, 20 Nov 2001

4.4. Option 4a: Comprehensive Action Plan

Under this title appears a list of over 70 actions[33] that address all the issues highlighted by the stakeholders interviewed during the consultation process undertaken by the European Commission across a dozen of transport and non transport domains. These issues correspond to the full range of causes to the problem, and the matching actions shall provide adequate remedy to most of them. All application segments relevant to the GNSS were considered and an extensive set of actions were designed in each case, from rail to fisheries, without prioritization based on any specific criteria.

Adopting this policy, the European Commission will work on the vertical issues of each domain identified, with the external support from other Institutional actors, and will ensure coordination with the actions performed at a more general, horizontal level. Some of the actions will be market-led or promoted with the help of private sector operators, other initiatives foresee the use of EU-wide regulation.

Concerns have been raised, regarding the amount of resources required, in particular human resources within the European Commission, and capabilities for the Commission to deliver against such an extensive action plan.

4.5. Option 4b: Targeted Action Plan

Given the resource dilemma that the Commission would face adopting option 4a, but considering the wide breadth of application domains and the large variety of actions that could be useful, option 4b consists in selecting a subset of the actions envisaged in option 4a.

The first step leading to option 4b was to limit domain-specific actions within a small number of the most promising domains, whilst providing sufficient ground favourable to innovation across domains and to the "bottom-up" uptake of GNSS services. The domains identified in option 4a have been looked at with the view to selecting priority domains according to the following criteria:

– contribution to the Lisbon objectives (growth, jobs, knowledge society);

– maximization of indirect economical (including energy consumption) and social benefits;

– positive influence on emissions and other types of pollution;

– positive influence on the operation of the single market and trans-border exchanges;

– positive influence on the interoperability of applications;

– interest expressed through consultations and calls for ideas and business cases;

– influence of European Commission and Member States authorities;

– timing constraints and opportunities (with EGNOS available now, GALILEO IOV soon, GALILEO only later);

[33] See full detailed list split by area/domain in annex E

– specific added-value brought by competitive advantages of EGNOS and GALILEO services: authentication, integrity, very high accuracy for positioning, navigation and timing.

The table below shows the result of this assessment, domain by domain, in the light of information and feedback provided through the consultation process undergone since 2006.

	Aviation	Maritime transport	Road transport	Urban transport	Rail	Logistics	Fishing	Precision agriculture and environment	Meteorology and desaster prevention	Synchronization of networks	Mapping and land management	Energy	Civil protection and surveillance	Handsets and mobile phones
Lisbon objectives	++	++	++	+	+	++	++	+++	+	+	++	+	+	+++
Maximization of indirect economical and social benefits	ssr	sss	sssr	sr	srr	rrs	ssr	rrhh	sss	rs	rr	ssr	sss	rrr
Impact on emissions and pollutions	++	++	+++	++	=	+	+	+++	+	=	=	+	+	=
Impact on the single market and trans-border exchanges	+	+	+++	+	++	++	+	=	=	+++	+	++	++	+
Impact on interoperability of applications	++	++	+++	+	++	+	=	=	++	+++	+	++	+++	+++
Manifestation of interest	++	++	+++	++	+	+	++	+++	+	++	+	+	++	++
Influence of public authorities	+++	+++	+++	+++	+++	+	++	++	+++	++	+++	++	+++	++
Timing priority (urgent: +++, timely: ++, with Galileo: +, not urgent: -)	+++	++	+++	+	++	++	+	+++	+	-	++	++	+	+++
Specific value added by EGNOS or Galileo	+++	+++	+++	++	+	++	+++	++	+	+++	++	+	++	++

safety or security	s
revenues	r
health	h
education	e

Fig 8: Prioritization scheme for GNSS segments

This process has lead into focusing the action plan on the domains that appear under the darker shades: road transport; applications for individual handsets combining with mobile phones; aviation; maritime transport; precision agriculture and environment; and civil protection and surveillance. The European Commission will however continue monitoring the market, and assessing the impact of actions with a view to adapting priority domains accordingly.

The second step in the refinement process applied to the extensive action plan described in option 4a consisted in giving priority, within each “preselected” domain, to those actions that are seen as most cost effective in terms of European Commission human resources, and for which the principle of subsidiarity indicates that the European Commission is best equipped to act.

This policy option envisages 24 actions across 6 specific domains (“vertical” actions) or trans-domain in nature (“horizontal” actions enhancing all potential application segments and intended to ease the conditions for the market forces to exert), which address market failures and issues that typically arise when a new technological infrastructure becomes available, as highlighted in section 1. It is a much more limited, targeted set of actions compared with option 4a.

The proposed actions can be grouped into four main blocks of activities:

B1: measures related to certification, to standardization, or to coordination;

B2: information dissemination, information exchange, and awareness-raising campaigns;

B3: fund-raising for GALILEO or EGNOS-based innovation (Note that a targeted ex-ante evaluation will be performed for each action labelled B3e if required by the Financial Regulation to provide the rationale for additional budget allocation.)

B4: regulatory measures (Note that each regulatory measure in B4 will be the subject of a specific Impact Assessment Report, to be prepared in due time during the Regulation drafting process, which will assess the feasibility, proportionality and effectiveness of the measure.)

The actions in block B1 and B2 will start immediately, and will focus on EGNOS, which is now available and constitutes an excellent precursor to GALILEO and a basis for applications that can be used in Europe first, and globally once adapted to GALILEO when it becomes available world-wide.

Block B3 (and B3e) of actions will aim at forming basis for decisions at the time of the revision of the current financial perspective, and when preparing for the next.

Actions in block B4 will be initiated in a timely manner, taking into account, where appropriate, developments of the ITS Action Plan or the revision of existing regulations.

Domain	**Description**	**Block**
Horizontal	Action 1: The European Commission will establish and maintain a virtual information centre (200k euro/year) and a proactive Communication/PR/Media relations ongoing campaign	**B2**
	Action 2: The European Commission will increase awareness among SMEs through the SME networks run by the European Agency for Competitiveness and Innovation (500k euro/year)	**B2**
	Action 3: The European Commission will seek synergy between investment programs run by the European Investment Bank on behalf of the European Union and other programs (e.g. by ESA.)	**B3**
	Action 4: The European Commission will call for research proposals with the largest possible scope in 2011, and seek for additional budget through the mid-term revision of FP7 towards the launching of such calls on an annual basis (targeting 40 M euro/year until 2020)	**B3**
	Action 5: The European Commission will increase synergy between GALILEO, GMES, and communication programmes towards improved combined services (200k euro/year)	**B2**
	Action 6: The European Commission will design and adopt the European Radio-Navigation Plan for transport (200k euro/year, 2010-2020)	**B1**
	Action 7: The European Commission will coordinate with interested Member States and third-countries towards the provision of tools for establishing cadastre. Ideally, such an effort could be continued towards the provision of a "universal" cartography service	**B1**
	Action 8: The European Commission will establish an International EGNOS and GALILEO Application Forum where users, developers, infrastructure and systems providers can exchange views to feedback into the GNSS evolution project of the European Commission and ESA	**B2**
Services linked to mobile	Action 1: Industrial policy (coordinated action) towards reducing the cost of receivers	**B1**

communications (social, informative, or leisure)	and towards the inclusion of GALILEO and EGNOS-enabled chips handsets Action 2: Support to the "GALILEO Masters" competition involving more regions, focusing on the GALILEO and EGNOS added-value, and promoting in particular services to ageing or handicapped people (2 M euro/year, 2010-2020)	 **B3**
Road Transport for persons and goods	Action 1: The European Commission proposes a Directive on GNSS-based monitoring of transport of dangerous goods, another on GNSS-based monitoring of long-range coaches, and one on GNSS-based multimodal logistics (200k euro/year) Action 2: The European Commission proposes a Directive to equip vehicles with a GNSS and RFID-enabled on-board unit/functionality providing both the exact authenticated position, and the electronic identification of the vehicle Action 3: The European Commission proposes to modify the Directive bearing on digital tachygraphs by adding information about localisation to speed and time. It will reinforce the Directive on tolling with work promoting standards for GNSS-based solutions (1M euro + 200k euro/year) Action 4: Certification of GALILEO will be explored for future advanced driving assistance systems Action 5: The European Commission will undertake an awareness campaign including: a series of tests of EGNOS; a marketing campaign (possibly delegated to the GSA) (200k euro/year)	**B4** **B4** **B4** **B1** **B2**
Air transport	Action 1: Certification of EGNOS will be sought for civil aviation (through EASA and according to ICAO standards), which involves certifying the system and its operator Action 2: The European Commission will engage in an awareness and market development campaign including towards aircraft manufacturers and small airports (1 M euro/year) Action 3: The European Commission will explore providing Africa, the Middle East, Eastern and Nordic Europe, with SBAS coverage at par with EGNOS level of performance in the EU (targeting €100 million for Africa, 2010-2016)	**B1** **B2** **B3e**
Maritime and waterways transport	Action 1: Adoption of EGNOS, then GALILEO, will be sought for maritime transport (in line with IMO requirements and within the SOLAS convention, together with EMSA.) The European Commission will then consider adapting safety regulations and LRIT specifications accordingly, whilst exploring in full the use of SAR capabilities offered by the GALILEO payload Action 2: The European Commission engage in an awareness campaign including leisure boating and fisheries (200k euro/year) Action 3: Acceptance of GALILEO SAR capabilities Cospas-Sarsat organisation	**B1** **B2** **B1**
Agriculture and environment	Action 1: The European Commission will undertake an awareness campaign targeting high-precision agriculture and other natural resource management activities (200k euro/year) Action 2: The European Commission will seek to introduce the use of EGNOS and GALILEO in the management and control systems of EU programmes (e.g. the CAP.)	**B2** **B4**

Government applications (justice, security, civil protection, etc.)	Action 1: The European Commission will seek to raise awareness and coordinate Member State activities related to civil protection. Complementarities will be sought among EGNOS, GALILEO, GEOSS[34] and GMES (200k euro/year)	**B1**

Fig 9: Groups and blocks of actions in option 4b

The chart below summarizes the primary and secondary impact of the four blocks of actions envisaged in policy option 4b, on the two general objectives tackling the key issue and problem at hand: A block of actions is having a "primary impact" when its positive effects are substantial and can materialize in the short term. A block of actions with "secondary impact" will have positive effects, but in the longer term.

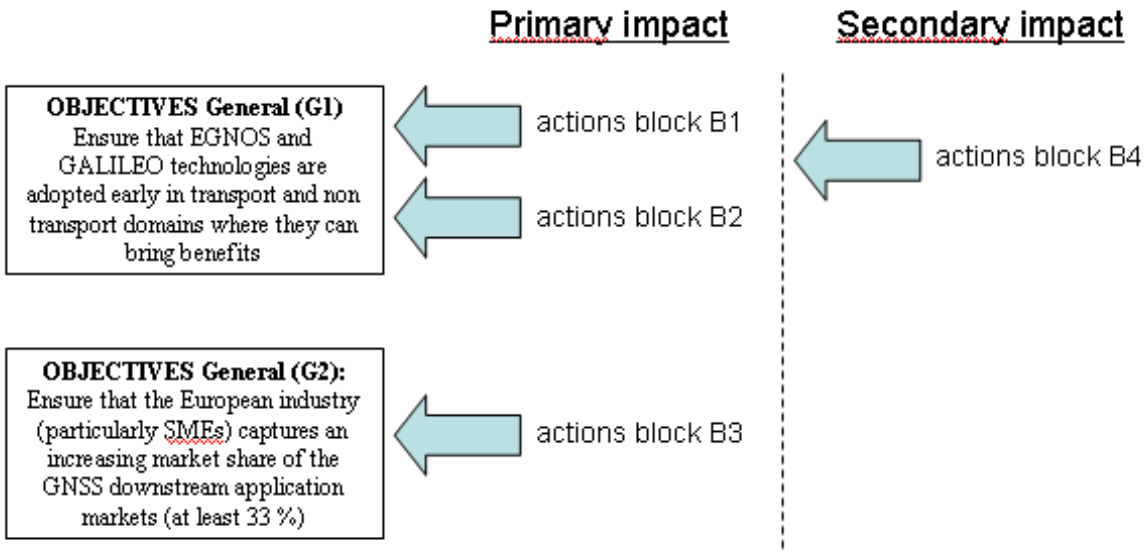

Fig 10: Policy Option 4b: main lines of interaction between blocks of actions and the general objectives[35]

4.6. Option 5: Consultative approach

The Commission could involve all the relevant public and private stakeholders in an *ad hoc* permanent consultative body that should follow closely the roll out of EGNOS and GALILEO to foster downstream applications based on their standards, work on the underlying causes of the key problem to remove any roadblock and ease the functioning of the market forces.

This approach would minimize the range of proactive action possible at EU level (including R&D funding) and focus on building consensus among players as well as on rallying their efforts and commitment in removing obstacles. Supranational bodies and specific authorities (e.g. ANSP, Aviation Navigation Service Providers, Maritime & Rail National Authorities) should also be involved.

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34 GEOSS : Global Earth Observation System of Systems

35 See Annex F for tables detailing the lines of interactions between individual Actions of option 4b and specific objectives.

For each domain a separate "vertical" consultative body could be set up where all relevant stakeholders are represented; this body should function as forum for the industry to obtain development and adoption of the GNSS applications significant in that domain. Such consultative bodies would have neither formal power, nor budget to spend. A similar initiative was the 'Toll Forum' that DG TREN created in connection with the Directive 2004/52 on interoperability of electronic road toll systems. A 'horizontal' forum cutting across all domains and facing common issues could also be envisaged. This approach would require setting up an agenda of regular meetings (quarterly or every 6 months) and continuous consultations with relevant stakeholders along the different value chains, covering all EU 27 countries and relevant supranational bodies to ensure that work is carried out in a coordinated manner[36]. Participation of stakeholders would happen on a voluntarily basis and with no EU funding, each party paying for own expenses.

Such an option would allow addressing some of the causes of our problem in an economic manner, but its intrinsic nature would not allow tackling urgent matters.

4.7. Proportionality

Policy options will cost between €3 and €50 million per year from 2010 onwards, including the targeted R&D budget (see the "Comparison of the options" section for details.) No further preparatory work is required to perform this impact assessment. The yearly evaluation and monitoring of the situation will cost €500 k plus staff cost.

The overall budget required to deliver each option only constitutes in any case a very small proportion of the financial benefits (tens of billions) expected to result from options that entail efforts to be made: As it was explained above, several recent studies[37] identified the main economical benefits of GNSS programs for Europe in the development of downstream applications (€44 bn) and generation of indirect public benefits (€14 bn). Such figures are deemed conservative and probably underestimated, as it is often the case in this sector (the actual revenues measured in the GPS downstream industries in 2007 in the US was about three times bigger than estimated a few years earlier, at the start of the GPS programme[38]) or, more generally, in new sectors developing as the result of the introduction of pervasive technologies (e.g. the Internet in the past 20 years.)

5. ANALYSIS OF THE IMPACTS OF THE OPTIONS

5.1. General Issues

Identify (direct and indirect) economic, social and environmental impacts and how they occur (causality)

The Commission intends to enhance the delivering of wider, deeper and faster downstream applications based on GALILEO and EGNOS technology and to ease their adoption across the world as well as to ensure that the European industry (particularly SMEs) captures an increasing market share of the GNSS downstream application markets. Pursuing these objectives will obtain

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36 For example, in the aviation domain, by the ESP, national ANSPs and NSAs, Eurocontrol, ICAO, airlines, aircraft manufacturers, avionics manufacturers, EASA

37 LEK 2008, Esys 2008, Helios 2009

38 Len Jacobson, "GNSS Markets and Applications", 2007

significant Economic, Social and Environmental impacts across EU-27 and beyond. EU GNSS can also become a reliable tool to enforce internal and external policies.

As proven by several trials, tests and R&D projects, EGNOS or GALILEO applications can generate increase in the efficiency and safety of aviation, rail and maritime transports, allowing enforcement of road and transport infrastructure pricing schemes fully in line with other EU policies including CO2 emission reduction plans, the Eurovignette directive and Single Sky. Satellite navigation downstream applications are knowledge-intensive businesses that enable creation of high value added job occupations all along the value chain (i.e. from hardware and software manufacturing to the service provision). Expected rate of growth of GNSS downstream application is estimated to be 22% over the next 11 years[39].

Some applications are infrastructure-enhancing and generate several economic spill-over[40]. Increasing capacity of existing infrastructure and making a more efficient use of them will also contribute to the reduction of congestion, pollution and other environmental damages[41]. Development of downstream applications in the EU society will have of course to comply with privacy protection that is part of EU Fundamental Rights. Indeed, many applications will not take off until consumers and citizens are reassured that they do not invade their privacy[42].

The above mentioned general, specific and operational objectives that EC wants to pursue are coherent with existing EU policies and strategies, such as the Lisbon and Sustainable Development Strategies, respect for Fundamental Rights as well as the Commission's main priorities and proposals.

Methodology for assessing the impacts against the baseline in qualitative, quantitative and monetary terms

This document presents a qualitative and quantitative assessment of the direct and indirect benefits of the development of GNSS downstream applications, as targeted within each option to consider. The approach is based on numerous, extensive, and often very detailed studies and cost-benefit analysis performed over the past 4 years, including those mentioned in Annex D.

Figures and measures that are used in this Impact Assessment are very recent, and extracted from the "Market analysis for the GALILEO post-FOC Exploitation Study" (Roland Berger, 2009), the cost-benefit analysis of "GNSS for Transport" (UK Department of Transport, 2009), the "GNSS Strategy Study" (LEK, 2008), the "EGNOS Supercontract" (Helios, 2008), and the "EGNOS Market Study" (FDC, Esys, Telespazio, 2008), or result from interaction with experts of GNSS industry. Global figures have also been extracted from American or Japanese literature, including the US FAA study dated 2008, or the analysis made by the Japanese Ministry of Economy, Trade and Industry also in 2008.

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39 Len Jacobson (2007), based on several sources

40 For example, it is calculated that the increased use of capacity in smaller airports, achievable thanks to EGNOS, generate €70/day spent on average in the local economy by each passenger.

41 Some examples: Navteq 2009 research proved that car navigators increase fuel efficiency by 12%; EGNOS-enabled landings reduces fuel burning and noises over inhabited areas, rail track network can be optimised.

42 Positioning, navigation and timing signals by themselves are not invading privacy. They are one-way signals, from satellite to devices, which do not inform others about the position of a device unless combined with other technologies.

The use of such sources allowed for describing the qualitative and quantitative impact of the actions proposed within each option. In addition a model is being developed[43], which will allow for the continuous monitoring of the direct and indirect benefits, in monetary terms, of the impact of actions intended to achieve a wider, deeper and faster adoption of GNSS applications, including: the measure of the GNSS markets size, of the incremental revenues for EU downstream applications providers, and usage and adoption by the general public, and of related social benefits.

5.2. Impact of no policy change (i.e. continuing with the baseline scenario)

If no new actions are undertaken, a few services would become a reality on the market anyway. One good example is the new development of navigation terminals in vehicles: the concept is not new, but this type of application has become indispensable to the modern driver. No-one had foreseen such sudden developments, which led the retail price dropping from above 1000 euro in 2002, to a range of 100-300 euro in less than 5 years. The same could happen exactly in the same way with different other market-led applications.

But contrary to the US that promotes indirectly industrial innovation through its defence contracts and fosters entrepreneurship through a well established and effective venture capital industry[44], Europe has instead a much less favourable environment to nurture spin-offs of the EU GNSS programs and benefits from their technology spill-over (e.g. development of downstream applications). Under the baseline scenario it has to be noted that EU R&D funds are expected to stop in 2011, according to the current EU GNSS program budget decisions, a situation highly criticized by the innovative developers of new applications. This means that the overall amount devoted by the EU to research on GNSS applications during the FP7 period (2007 – 2013) will not be more than €90 million[45]. In comparison, the US budget on GPS military applications (which most of the time have a derived civil use) amounts, from inception until 2006, to approximately $26 bn and the current expenses on the same area are estimated to be in the region of $200 M per year.[46]

Unfortunately, most applications would be based on the American GPS and not on GALILEO, as GPS is the sole GNSS already in operation. One must also consider the efforts made by the other nations to support their own GNSS. The cumulated amount of money spent by the US in 20 years for the research and development of GNSS civilian applications is about $2.5 bn[47]. Russia has already started to mobilize its industry on the applications of GLONASS[48]. Products developed in China based on a COMPASS interface might be proposed on the European market and successfully compete against the European products. Europe shall not stay passive.

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43 See Annex G for a detailed description of the model, a preliminary and partial version of which has already been used successfully for EGNOS applications to air transport in Africa.

44 Most of the recent innovative business success stories started up with venture capital funding: Google, Yahoo, eBay

45 FP7 Space funding for GMES (1.2 billion EUR) sees roughly 60% of funds given to infrastructure development. Services derived from GMES data and the development of science and technologies use the remaining 40%. A further €200 million of FP7 Space funding is foreseen for Strengthening Space Foundations through R&D on space technologies.

46 Len Jacobson, "GNSS Markets and Applications", 2007

47 Information gathered at Munich GNSS Conference, 2008

48 Contacts have been started with industrials in the world of mobile telecommunication (e.g. NOKIA)

Therefore, the industry would develop on its own, using already existing sub assemblies, primarily based on GPS. It would of course go much slower, and the final shares of the European industry in the world market would be smaller. As rough indicator, any year of delay/slower growth will create a €136 million of missed economic opportunity and therefore over the time span considered (2008 – 2030) a negative gap of more than €3 bn.

5.3. Impact of Option 2: discontinue EU action

Doing nothing would not allow enjoying benefit from the assets of EGNOS or GALILEO. Industrial developers would keep their current approach to GNSS, i.e. base their technological innovation and development activity on GPS. SMEs would not risk developing new ideas based on EGNOS or GALILEO would not have enough support. Without the 'signalling effect' provided by R&D funds and other support from the Commission, many investors would not consider the GNSS applications domains as profitable and interesting and the industry (especially SMEs and new entrepreneurs) might lack the funds needed.

Many applications of GALILEO would just not exist in specific segments like environment or civil protection. Development and export of European technologies, know-how and services would therefore be weaker. Furthermore, national actions by Member States with no European coordination would lead to duplication likely to result in waste of resources, new barriers, weakening markets. Action at EU level could instead strengthen the industry by increasing the market size and therefore by reducing production costs. Considering that the EC is the promoter, the developer and the manager of GALILEO and EGNOS, discontinuing EU action would be similar as investing in a new technological infrastructure and take no action to encourage customers to use it.

GALILEO is a technology operating in a competitive environment (though an oligopolistic one) and needs to be promoted according to a marketing strategy which aims to be in line with the users' requirements. Option 2 would result in integrators and developers staying with GPS and wait for GPS 3, leaving to GALILEO only a marginal place. The application industry on other continents, supported by the local industrial policy (e.g. military spending supporting civilian applications) will likely enjoy the advantage of relying on their own infrastructure to become leaders on the downstream markets, including in Europe, and to reap the benefits from European investments. Compared to option 1, it will materialize the delays in the development of downstream applications, and it will also very likely disrupt the initiatives undertaken so far with public money and from the EU budget. The very negative signal sent by the disengagement of the European Commission from the development of downstream applications based on EGNOS or GALILEO may be interpreted by the GNSS market operators that there are little benefits to be pursued.

Furthermore, consultations of the general public and of stakeholders in application domains have proven a total lack of knowledge about EGNOS. No action to raise the awareness of EGNOS would limit its extension to aviation and to a very small number of users in domains like maritime transport or agriculture.

5.4. Impact of Option 3: regulations across all relevant domains

Coming back to the split of the market between the different domains of applications, it appears that regulations impact can be expected as follows:

– very limited in LBS or mobile telecommunications (75 % of the market)

– a limited number of regulations is possible in the road domain (20 % of the market), especially to make mandatory the tracking of transported dangerous goods or of passengers. Accident data recorders or tolling systems are other examples

– some very limited regulations are envisaged in a few other domains (civil protection, security enforcement…), but with limited effect, due to the sizes of these market segments

Furthermore, the experience shows that from inception to actual implementation European regulations may take over 5 to 10 years to become effective, which in many sectors is not in line with the needs. Extensive regulation would be disproportionate.

In respect of the rules of the Single Market, regulations and recommendations by the European Commission and by Member States could however have some positive impact to ensure interoperability of location-based services, at technical, and at business level to avoid the deployment of closed systems, notably at national level. Interoperability is required to allow equipment provided in one country to communicate with others provided in other countries, and to enable a service operator established in one country to accept the equivalent equipments provided by other service operators. Most services envisioned under this action plan would simply have no sense if limited geographically. Regulation could thus be used where its impact is most significant, as in the field of road transport, options 4a and 4b.

It must be noted that US implemented mandatory use of GNSS technology for emergency call from mobile phones, after 11 September 2001. This sparked general adoption of GPS-enabled antenna in all mobile phones and creates a good base for future development and adoption of consumer-oriented LBS services: In the case of certain immature markets regulation may be instrumental in defining the framework within which market forces may work.

5.5. Impact of Option 4a: Comprehensive Action Plan

The actions proposed: a mix of few regulatory intervention and market-driven initiatives, shall achieve improvement of the framework conditions for the private sector to function. The comprehensive list of actions is trying to tackle all specific vertical issues identified across several user segments and therefore shall fulfil at least some of the objectives.

There is however no prioritization and segments across both transport and non-transport domains are pursued at the same time. The positive impact of this is that GNSS is truly approached as a general, critical utility and infrastructure that has applications across an extended variety of domains. This may rally political and stakeholders' consensus in the first place and help reaffirm scope, importance and width of GNSS technology. The downsides of this option are however significant

First of all the risks of becoming ineffective, being distracted on the management of too long a list[49] of initiatives is high. Efforts will be spread too thin and attempts may be made by different stakeholders to win priority on the Commission agenda. The Commission limited resources may simply prevent to fulfil this policy.

Resulting slow actions and dispersion of effort would do not solve the problems highlighted above, but may even raise uncertainty in some domains and increase lack of confidence among stakeholders.

[49] Available in Annex E

5.6. Impact of Option 4b: Targeted Action Plan

This policy prioritizes the actions deemed necessary to achieve the objectives, focusing Commission's effort on fewer segments and on horizontal actions.

In a few priority segments, the impact of the proposed horizontal actions is to be combined with that of regulatory measures and of segment-specific market-oriented measures, in view to the early adoption of EGNOS or GALILEO-based innovative solutions, and where necessary, to increased market shares.

The overall set of horizontal actions will, independently from the sectors in which adoption may occur, enhance the possibilities for novel applications to be designed, researched upon, and brought to market.

Actions in blocks B1 and B2 of Option 4b are direct attempts to ensure an early adoption of EGNOS and GALILEO.

Actions in block B3 are aimed at generating the quantum leap in innovation which is necessary for maintaining, and hopefully increasing market shares in a market where European actors are not the first movers, and do not benefit from the same investments into military applications as their competitors.

Actions in block B4 should result in an increased market share for European application developers, and also in the earlier adoption of EGNOS and GALILEO in domains where Europe is experiencing market failure (e.g. in the deployment of intelligent transport systems)

5.7. Impact of Option 5: Consultative approach

Given the number of parties involved across all the different value chains, the organizational effort required would be quite significant. Effectiveness is not guaranteed at all as voluntary consultative processes may lead to stalemate or lack of commitment by some of the key players. This could even increase uncertainty and distrust from market players, if there will be no early results. Many decisions taken, and effort spent by some may impact others in often unpredictable ways, and intentions of some stakeholders may easily become suspect to others. Uncooperative behaviour may easily arise from any of the many involved parties[50] and result in a general suboptimal situation for Europe.

For this reason, the efficiency of this option is strongly questionable. Very little may be achieved even after years of consultation.

As a matter of fact EGNOS went through a similar experience as regards to its use in the Aviation domain in the year 2006-2008, when the three main system stakeholders[51] and the EGNOS Operator Investment Group (EOIG) have been following a comparable consultative approach during the final stage of the EGNOS system deployment, and the planning of its evolution (through the EGNOS Change Control Board). The experience was negative and delays accumulated because all parties had continuously to agree on details; indeed the process incited some of the actors to slow the process down to gain much weight and

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50 A prisoner's dilemma kind of situation can be easily envisaged

51 EGNOS was initially set up and funded by Eurocontrol, EC and ESA. Aviation community was heavily involved

influence. The way out was to stop the iterative process and to decide that EC would fund, own the assets of, and manage the system[52].

This happened in spite of the fact that the Aviation domain is tightly coordinated and structured at international level. One can only easily anticipate that such an approach to other less-structured or fragmented environments (e.g. LBS, road transport) would be even less conclusive.

5.8. Identification and assessment of administrative burden and simplification benefits within the options

The main service in charge of implementing the Action Plan should be the European Commission with the support of the GSA, established as an Agency for the management of security and market development issues of both EGNOS and GALILEO. European Commission and Member States authorities may also be addressed for some actions of a regulatory type.

At this stage it is difficult to foresee a detailed assessment of incremental administrative burden both at EU and Member States level. As far as the private sector is concerned, the different policy options have indeed very diverse impact on them, from the heaviest in option 3 to the lightest in option 2. Ideally, the policy to be chosen shall focus on providing framework conditions most favourable for market force to operate, serving public interest, and to create minimal administrative burden or costs. Considering all together the opposition of several players to extensive regulation and the administrative burden that it may entail, option 3 would be the worse, option 2 and option 5 the best, with options 1, 4b and 4a constituting acceptable solutions.

Of course, the burden that is generated must be balanced off against the expected benefits that each policy is deemed to produce, as analysed in the previous section. Burdens are, in all cases, very marginal compared to such benefits and all mainly at EC level.

5.9. Risks and uncertainties in the policy options, including obstacles to transposition/compliance

The policy options rely on the use of different instruments. Uncertainty prevails as regards to availability of FP7 funds planned to be dedicated to applications-related GNSS research activities initially amounted €400 million. They have been reduced down to less than €90 million consequently to the financial agreement reached by the budgetary authority at the end of 2007. If the FP7 budget was not revised to reinstate the €400 million that were used for building the infrastructure of the systems many actions would need to be cancelled, or delayed until funds are available (which, as explained, would very negatively impact their effectiveness.)

If the take up of EGNOS applications is not increased before GLONASS or COMPASS become available, the mutation to GALILEO applications will be difficult: GPS, GLONASS or COMPASS would penetrate almost the whole of the professional and consumer markets, and the use of GALILEO may be confined to those applications using its PRS service.

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[52] Consultations among the three players went on in 2006 and 2007 and achieved little progress across all dimensions related to service provision (i.e. assets ownership, operations and maintenance, pricing, etc)

Both the sequence of deployment of GALILEO and of the other competing GNSS, and the speed at which applications can be developed using of EGNOS or GALILEO will impact the growth of the GNSS market as well as the EU share in it, as illustrated below[53]:

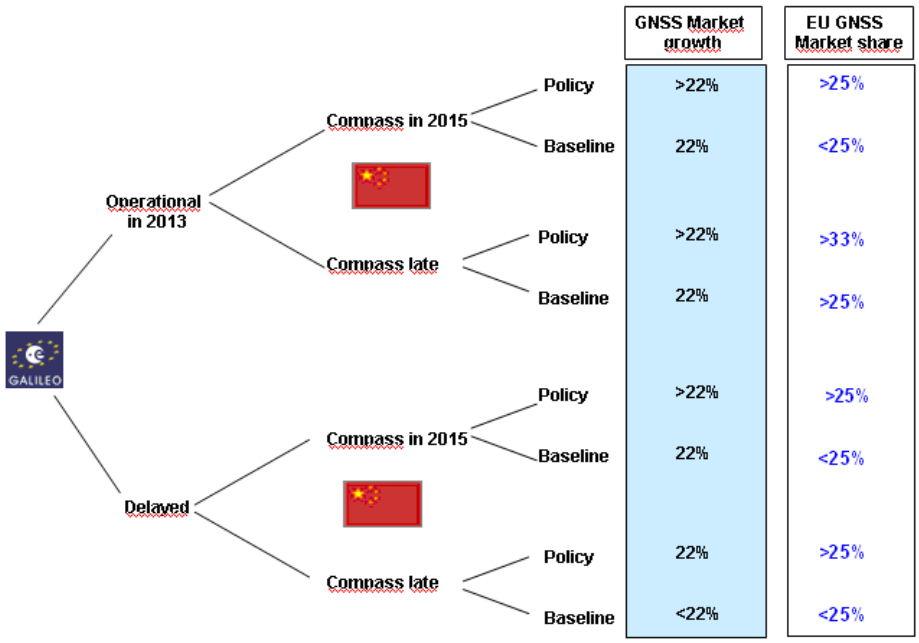


Fig11: Impact of option 4b depending on the timing of the deployment of COMPASS

If the development of the applications of EGNOS or GALILEO is left entirely to the market, only the most economically profitable applications would be pursued. Many of the social benefits, when they are not economically profitable, would not be reaped. The industry is not likely to invest in products where the short term financial profitability is not clear, as in the case of civil protection and crisis management, eHealth, or for applications to assist the disabled and the elderly.

The framework conditions that will influence the way some of the actions can develop (pricing policy, IPR policy, liability policy) are being established in particular through an "Exploitation Study" which is to provide recommendations by mid-2010, to be endorsed by European Council and Parliament in the same year. When available, such framework conditions will be analysed, and if necessary, some actions will be amended accordingly. All actions in option 4b are however doable in the current context, and may start soon.

53 Attempt, based on the recent market studies referred to in Annex D, to model the relative impact of an efficient policy (e.g. option 4b) depending on the availability of GALILEO and COMPASS, and compared with the baseline scenario.

6. COMPARISON OF THE OPTIONS

6.1. Weighing of the positive and negative impacts for each option on the basis of criteria linked to the EU objectives

Policy option 1 (Baseline) entails no change of what is currently being performed. Its main benefit lies in the fact of adding neither new tasks and activities nor new resources to the EC. Existing actions will be carried out (except R&D that will have no funds beyond 2011) but this will not be enough to tackle the problem of slow development of downstream applications. It will eventually leave the EU GNSS industry timid and in the current state of uncertainty. This would only achieve three out of our ten specific objectives, have vey little impact on GALILEO adoption, and on sectors beyond aviation.

Policy option 2 will have the only benefit of marginally cutting down on the very few resources currently devoted to GNSS downstream application development, but will entail even more than policy option 1, a very negative impact on the EU GNSS industry, EU Member States, and EU citizen. This would only achieve two out of the ten specific objectives.

Policy option 3 will provide for an immediate positive signal to the EU GNSS industry and may even rally enough attention to get applications kicked off in certain domains, but with strong opposition from some Member States and of some stakeholders to regulations that they consider invasive and inappropriate. Cost of regulating and enforcing from EC side will also be significant. It will achieve three of our objectives, and leverage EU-level legislation to impose GNSS in few sectors.

Policy option 4a outreaches extensively across many segments and constitutes a balanced mix of regulation and supportive actions for the downstream applications market. Nevertheless, the human resources required for its implementation may simply make it too expensive, with a benefit/cost ratio much lower in respect to the next option. This policy could reach from eight to all our ten specific objectives. It would however require a level of resources far beyond what can be granted to the European Commission.

Policy option 4b focuses the limited resources available on priority application segments, creating a positive momentum in the downstream industry involved in the most promising markets, thus potentially breeding further efforts beyond the scope of the action plan itself. Its cost will be largely compensated by the achievements expected from the action plan. This policy will require fewer resources that option 4a and concentrate them so as to achieve eight out of the ten specific objectives. It fits quite well with what was expressed during the consultations.

Policy option 5 may attract some stakeholders in the EU GNSS programs and therefore generate a positive attitude towards EGNOS and GALILEO. The actual results of this policy option are likely to be poor in the absence of further incentives, and given that the lengthy interactions needed to coordinate so many players would not allow addressing the urgency of the problem. It could however achieve results in the long term, providing improved user requirements for GNSS.

6.2. Comparison of costs

The overall budget required for each option to deliver is, in any case, a very small proportion of the expected benefits, which makes the criteria of cost secondary.

Options 1 and 2 are the less expensive options. Options 3, 4b and 5 are comparable in terms of cost. Option 4a is substantially more costly than 3, 4b and 5 in terms of staff.

Policy options are estimated to cost as follows:

Policy Options	**2010-2013**	**2014-2020**
1	5 FTE[54] + 20 Millions euro/year	5 FTE + 20 Millions euro/year
2	5 to 3 FTE (phasing out)	0
3	20 FTE + 20 committee mtgs/year	20 FTE + 10 committee mtgs/year
4a	30 FTE + 60 Millions euro/year	30 FTE + 40 Millions euro/year
4b	20 FTE + 50 Millions euro/year[55]	20 FTE + 30 Millions euro/year
5	20 FTE + 3 Millions euro /year	20 FTE + 1,5 Millions euro /year

6.3. Comparisons between options by categories of impacts or affected stakeholder

Referring to section 2, the parties to be mainly impacted by development and adoption of GNSS downstream applications based on EGNOS and GALILEO are:

– In the public domain:

- The EU citizens at large, as passengers of safer and more efficient and effective and cleaner transport systems, consumers of navigation-based services
- The public sector in Member States, that will have the opportunity to upgrade some of their transport services as well as enjoy direct and indirect benefits of economic and social nature (e.g. incremental employment, tax revenues)

– In the private sector:

- EU industry players along the several GNSS value chains, manufacturers and user industries, who will be able to benefit from expanded business opportunities and improved performance, both in Europe and worldwide
- EU SMEs in GNSS and GNSS-related industries, who can start new, or expand existing business

[54] Number of staff in the European Commission Directorate General for Transport and Energy and in the GALILEO Supervisory Agency

[55] Excluding EGNOS geographic extensions' capital expenditure (Africa, Arabic Peninsula, etc)

Policy options can be compared looking at their economic, environmental and social impact: Our assessment consisted in analysing the various options through the angle of the major categories of stakeholders, on the basis of information and findings resulting from consultations and specific market studies, a detailed list of which available in Annex D.

Market studies have been submitted to expert stakeholders on several occasions, meetings and workshops, including in the workshops mentioned in Section 0. These comments have in turn been taken into account when producing further versions of market studies, as in the case of the "GNSS Strategy" and "EGNOS CBA" by LEK and of the "post-FOC Exploitation Study" by Roland Berger. Our conclusions have been discussed in an iterative process spanning over the past year with experts within the EC and within stakeholder organisations.

References that specifically helped assessing the impacts displayed in cells the following tables are referenced by the following notes:

(1)	LEK GNSS strategy study (2008)*
(2)	Except for Aviation, that would develop and adopt applications anyway (but more slowly and in non harmonized way)
(3)	UK GNSS CBA for Transport (June 2009), LEK GNSS strategy study (2008)*, EGNOS study and "super-contract" (2008)*
(4)	FP6, FP7 projects outcome and European Commission, Green paper consultation (2007)
(5)	UK Department of Transport GNSS Downstream Benefits Assessment ("Macroeconomic impacts of GALILEO", 2005)*, Market Monitoring Forecasting Tool (2008)*

* Not publicly available.

Economic impact *of considered options: positive or negative/likelihood to happen/estimated timeline if to happen*

	Private sector: SMEs	**Private sector: EU GNSS Industry**	Private sector: Transport providers	Public sector
Option 1	Negative/Certain[N1]	Negative/Probable[N1]	Negative/Probable[N2]	Negative/Probable[N1]
Option 2	Negative/Certain[N1]	Negative/Certain[N1]	Negative/Probable[N1]	Negative/Certain[N1]
Option 3	Positive/Unlikely/ /in >5 years[N3]	Positive/Unlikely/ /in >5 years[N3]	Positive/Certain/ /in >10 years[N3]	Positive/Probable/ /in >10 years[N3]
Option 4a	Positive/Probable/ /in 3-4 years[N4]	Positive/Probable/ /in 3-4 years[N4]	Positive/Probable/ /in 3-4 years[N4]	Positive/Probable/ /in >5 years[N4]
Option 4b	Positive/Probable/	Positive/Certain/	Positive/Probable/	Positive/Probable/

	/in 2-3 years	/in 2-3 years[N4]	/in 2-3 years[N4]	/in >3 years
Option 5	Neutral/Certain	Positive/Unlikely/ /in > 5 years[N4]	Positive/Probable/ /in > 5 years[N5]	Positive/Unlikely/ /in > 5 years[N4]

Social and environmental impact *of considered options: positive or negative/likelihood to happen/estimated timeline if to happen*

	Citizen: safety and security	**Citizen: attitude towards EU**	**Citizen: passengers transport infrastructures**	**Congestion, CO2 emissions, Energy efficiency**
Option 1	Negative/Certain[N5]	Negative/Probable[N5]	Negative/Probable[N2]	Negative/Probable[N5]
Option 2	Negative/Certain[N5]	Negative/Certain [N5]	Negative/Probable[N5]	Negative/Certain [N5]
Option 3	Positive/Unlikely/ /in >5 years[N3]	Positive/Unlikely/ /in >5 years [N3]	Positive/Certain/ /in >10 years [N3]	Positive/Probable/ /in >10 years [N3]
Option 4a	Positive/Uncertain/ / in 2-3 years	Positive/Probable/ /in 2-3 years	Positive/Probable/ /in 3-4 years	Positive/Probable/ /in >5 years
Option 4b	Positive/Probable/ /in 2-3 years [N5]	Positive/Certain/ /in 1-2 years [N5]	Positive/Probable/ /in 2-3 years [N5]	Positive/Probable/ /in >3 years [N5]
Option 5	Neutral/Certain[N4]	Negative/Probable/ /in 2-3 years [N4]	Positive/Unlikely/ /in > 5 years [N4]	Positive/Unlikely/ /in > 5 years [N4]

6.4. Conclusion

The preferred option is 4b, delivering a targeted Action Plan, that maximises the impact on prioritized segments by a mix of horizontal, vertical actions and some regulatory measures.

Summary overview of policy options

	Effectiveness in reaching the 10 specific objectives	**Efficiency in using resources**	**Consistency with EU objectives, strategies and priorities**
Option 1	Achieves 3 objectives May achieve 1-2 additional ones	Only uses limited resources	Consistent
Option 2	Achieves 2 objectives May achieve 1-2 additional ones	Saving of R&D money, focus of management on other issues	Not consistent
Option 3	Achieves 3 objectives May achieve 1-2 additional ones	Limited effort, high admin burden on MS/Private sector	Not fully consistent
Option 4a	Achieves 8 objectives May achieve 1-2 additional ones	Extensive effort in terms of admin/management and financial	Consistent
Option 4b	Achieves 8 objectives	Focused effort in terms of	Consistent

	May achieve 1-2 additional ones	admin/management and proportionate financial	
Option 5	May achieve 4-5 objectives	Time consuming, saving of R&D money	Consistent

In a way similar to that of the Internet, the pervasiveness of GNSS services is huge. They are expected to lead into new applications in all domains, and to impact dramatically the citizen's ways of life. If it does not become a prominent player as regards to GNSS applications Europe would, even more than today, depend on an infrastructure that it cannot control.

A large, global "GNSS applications" economic sector worth €10 to 20 bn. a year today, just for its core market, and growing double-digits is developing, bringing prospect for extra growth and employment in the European Union. For Europe to grasp the "fair" share of 33% of the market that it should have, and for the European industry to play prominently on the worldwide market, Europe must adopt, as regards to GNSS applications, an aggressive policy such as option 4b. Otherwise, and in view of the efforts untaken by competitors, its market share would fall below 25%.

It is obviously necessary for Europe to build its GNSS in due time. But Europe establishing a leadership position in GNSS will depend not only on its capacity to build the systems, but equally on its capability to enhance the quickest, deepest, broadest development of applications across all domains.

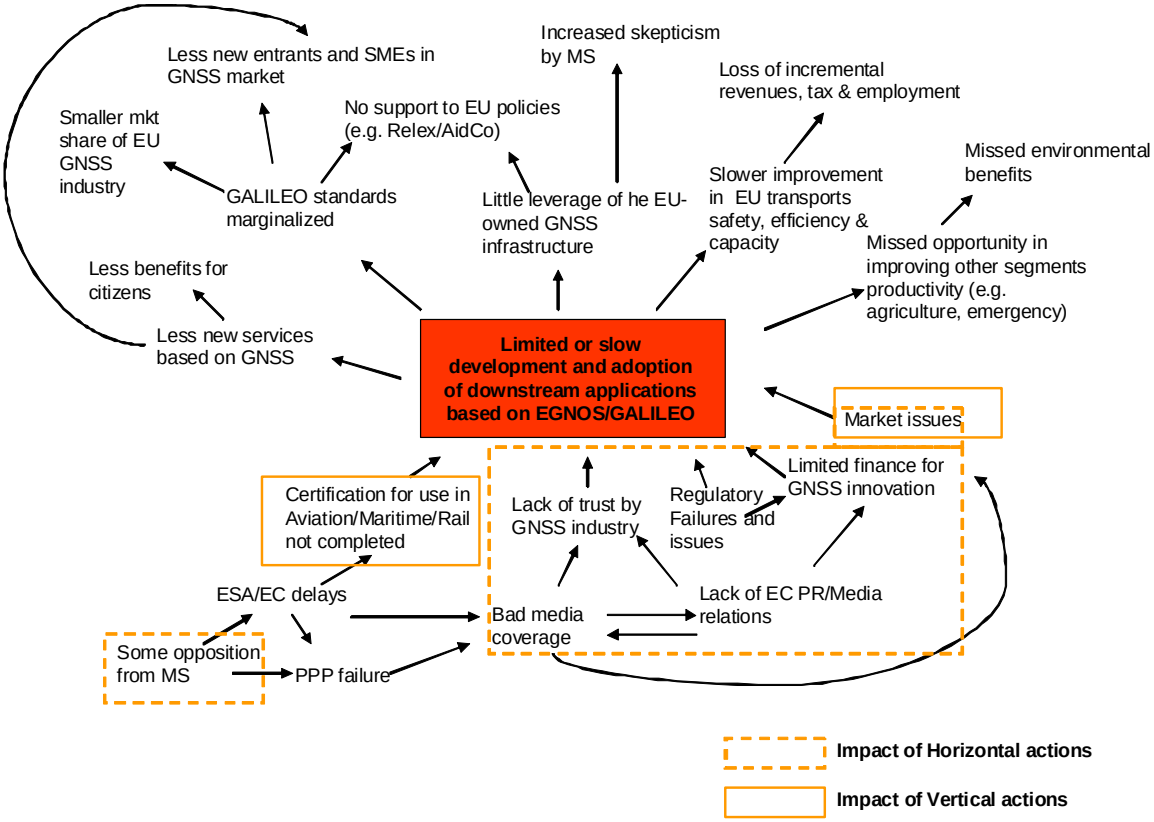


Fig 12: How actions envisaged in the policy option 4b will impact causes linked to the key problem at stake

7. POLICY MONITORING AND EVALUATION

The Commission will monitor the trends on the markets for GNSS services and applications. It will also continuously measure the impact of the actions undertaken to implement the chosen policy option, which will itself be updated regularly as in a rolling programme.

The next table summarizes the impact expected from implementing the actions included in policy option 4b points in terms of progress indicators with respect to the objectives of each action.

As the preferred policy focuses largely on market development, the main indicator of progress to be considered is the share of the market that GALILEO and EGNOS will be able to win, as a newcomer, "against the competition" in each domain targeted by the Action Plan.

Other indicators will vary according to the domains: For instance, in road transport, indicators of success will include the measure of the reduction of casualties or of people injured in accidents relevant in the context of the actions undertaken. In aviation, indicators will include the number of EGNOS-equipped aircraft, and the number of airports having adopted and certified EGNOS procedures. As for applications dedicated to disabled or elderly people, an indicator could be the proportion of European citizens using such services.

Sales, employment, investment and innovative activity created by EU GNSS industry in absolute and relative terms will be monitored all along the implementation of the Action Plan, possibly with the assistance of EUROSTAT, and the development of GNSS downstream applications in Europe will benchmarked against that in other countries through the working groups already established in the context of specific GNSS international agreements, the monitoring of international competitions such as the GALILEO Masters, and the support to several information centres in Asia, Latin America, and the Mediterranean countries.

As indicated in a footnote to the table, a macro-econometric model combining market model and public utility model, will be available by the end of 2009, to measure several aspects of the impact resulting from the adoption of GNSS applications and to track the effect of EC policy.

At any check-points on the various assumptions (e.g. market share of EU GNSS industry, penetration rates of various services, additional employment generated, etc) it will thus be possible to reassess the actual effectiveness of the proposed EC policy.

Reporting will be provided to the Council of the European Union and to the European Parliament. A scoreboard will allow for assessing progress in implementation the Action Plan, which will be broadly shared with stakeholders.

	Domain	Qualitative Description	Quantitative Description	Monetized value
Economic impacts	Road Transport	- improve road safety, especially in cases of emergencies, for cars, coaches and transport of dangerous goods - improve road management and reduce congestion, help drivers with travel, road, traffic real-time information - improve tolling and electronic fee collection - improve level of services to travellers	Reduction of travel time and of fuel consumption	TBM[56]
	Logistics	- improve management efficiency of containers in ports or train stations - improve the level of service to clients	Cut transport time	n.a.
	Maritime Transport	- improve traffic management, especially in ports or high-traffic corridors - improve safety of maritime traffic - improve control of police authorities on maritime transport, making controls faster - provide help to vessels in danger	Improve port handling capacity Reduce administrative burden and delays	n.a.
	Air Transport	- facilitate use of the less equipped airports by civil aviation - contribute to the general objectives of the Single Sky policy and of SESAR - improve traffic management and safety in airports	Less cancelled flights, improved airport capacity, especially at small ones	TBM
	Agriculture	- improve design and update of cadastre - allow precision agriculture, and production monitoring - improve control of the use of EU subsidies	Increase farmers' productivity by 10-20%, reduce CAP enforcement costs	TBM
	Fisheries	- vessel monitoring	Reduce administrative burden and delays	n.a.
	Assistance to third countries	- provide developing countries with easy-to-maintain infrastructure to cover basic needs, especially in transport	Additional foreign policy tool	n.a.

[56] TBM: to be monitored on a regular basis from end-2009 on, using the market forecasting and public utility model developed in the European Commission and the GNSS Supervisory Authority

Social impacts	Mobile com.	- improve number and quality of services on telecom handset	New service offering	TBM
	Maritime activities	- improve search and rescue	Reduce casualties	n.a.
	Security	- help Member States to fight terrorism, crime and illegal immigration	Increase safety	TBM
	Disabled, sick, and elderly people	- improve the assistance tools to elderly, disabled and sick people on the move, favouring their mobility	Increase quality of life	TBM
Environmental impacts	Fisheries and Maritime Transport	- vessel monitoring - monitoring of rescue operations	Enable monitoring Limit occurrence and impact of oil spills	n.a.
	Energy	- energy transport monitoring - participate in the security of energy plants	Optimize grid	n.a.
	Environmental and civil protection	- improve crisis management, including in third countries - increase safety of rescue teams	Reduce intervention time Enhance monitoring	n.a.

Fig 13: Summary table of the impact expected from implementing option 4b

ANNEX A

Framework Program research projects used to gather information

GIANT, MARUSE, GRAIL, FIELDFACT, M-TRADE, MONITOR, GIANT 2 (under execution), HEDGE (under execution), GIGA

ANNEX B

CONSULTATION OF THE GALILEO GREEN PAPER

Contributors and stakeholders consulted in the Green Paper process

Further to the written official contribution by EU Member States a number[57] of organisations and individuals contributed in the Green Paper process, including:

- East Midland Development Agency
- UK Space
- Project INVESAT (cluster of SMEs)
- T-Systems
- Department for Transport
- GALILEO Services
- Location and Timing Transfer Network
- Transport for London
- Institut européen du géopositionnement
- Aerospace Valley Midi Pyrénées
- Alcatel Alenia Space
- Radio Society of Great Britain
- Guide Dogs for the Blind
- Institut Français de Navigation
- Oracle Europe Middle East and Africa
- Vienna University of Technology
- T-Mobile
- Aerospace Valley (Toulouse and Bordeaux Regions)
- Toll Collect
- via Donau - Österreichische Wasserstraßen-GmbH
- GIROADS Club
- EuroTeleServ
- State Surveying Authorities of Germany (AdV)
- EUREF – IAG Sub-commission for Europe
- TRL
- GMV
- EUMETSAT
- CER
- Air Navigation Services of the Czech Republic
- Sogei
- Primesphere SA
- CTAE
- Telematica.
- Eurocontrol
- ESPO
- IRA

[57] Organisations listed in no specific order. The list is not expected to be exhaustive, but only indicative. Some 80 organizations, government, or individuals contributed overall.

- ITS United Kingdom
- Inland navigation Europe
- European Ports associations
- International Association of Aircraft Owners and Pilots
- Union Internationale des Chemins de Fer
- ASECAP
- International Road Transport Union
- Association of Motorways Operators,
- European Marine Equipment Council
- European Car Manufacturers
- European Shipowners

Quotes from contributions: highlights

"The upgrading of the American and Russian satellite navigation systems and the setting up of a Chinese system mean that the competitive advantage will be lost in just a few years."

"There is no sufficient visibility on the public sector recognition and planned use of GALILEO which would undoubtedly promote the system. Accompanying actions to foster downstream application developments should be continued."

"The downstream industry has much shorter product life cycles than the space industry and cannot invest in 2007 for a return in 2012."

"GPS III will most likely match or beat GALILEO in terms of performance and services."

"For aviation, the transition period to GNSS will last at least 15 years due to safety, economic reasons and operational aspects"

"Aviation is a small but significant segment of the GNSS market. […] Unless GALILEO becomes available within the next few years, the market for GALILEO related applications is reduced."

"Europe needs a Radio Navigation Plan especially in the area of transport"

"Par rapport à certains autres pays comme le Japon, le budget consacré à al recherche en Europe est dérisoire. Il est également essentiel que la pérennisation des budgets soit garantie"

"Current 5$ GPS chipsets are considered far too expensive to be used in low end mobile phones. Some applications like children tracking will only be adopted when available on the lowest priced handsets on the market."

"[Even €100 million would be] insufficient for an annual basis for research effort, compared to what is made in other parts of the world. The EU R&D effort should balance the technology support that the US provides to their industry."

"The Directive on European Universal Services should constitute an interesting starting point to feed the ideas on new legal tools to foster the business on downstream GNSS markets"

"Member States should become clients of GALILEO and EGNOS"

"Wherever there is a contribution of positioning applications to the overall security, health and wealth (Dangerous goods, livestock, busses, E112…), the EU should take measures to accelerate the introduction of such services and technologies"

"An effective regulatory framework is essential to ensure compatible and interoperable solutions are rolled out across Europe."

"Create an ecosystem of SMEs around the downstream market of GNSS"

"We urge the EC to attain the agility and the efficiency SMEs must attain to survive"

"We propose the establishment of national centres of excellence that provide complimentary skills, capabilities and facilities to others around Europe"

"SMEs are well positioned to create most of the 100.000 jobs expected in Europe from the development of the GALILEO market"

"There will be only a few 'GALILEO alone' applications and receivers"

Synthesis of the responses

Protection of privacy:

It is necessary to give guarantees to the citizens regarding the respect of their life deprived by the direct applications or indirect each portable telephone should comprise a GALILEO flea, the use of which could be activated or be deactivated at will by the user.

Research and innovation

The SMEs which develop applications must be supported, as SMEs are the most innovative part of the European industry, by easier access to the FPs, in particular by reserving to them a more important share of the funds and by simplifying the administrative complexity of the operation rule of the FPs.

A strong accent has to be put on the financing of research, but it has to be ensured that increasing FP money does not decrease the national funding at the same level. 15% for SMEs as within FP7 is far too little.

Research has to achieve marketable products, and not only prototypes.

Hybrid technologies open important grounds for research that EC should encourage (indoor).

The massive development of applications relies on the proper interconnections of systems (i.e. the development of systems of systems) such as: Information technologies and databases; Observation systems, Communications systems; Navigation systems. The above systems interoperability implies that activities related to standardization need to be further promoted and developed.

Greater connections are needed between R&D and High Level European Policy (for instance between research programs related to Electronic Fee Collection and ongoing European efforts to establish an Electronic Toll Collection service).

Financing structures need to be extended to cover the needs of downstream applications, especially in the critical phase where SMEs have to proceed from prototyping to industrial products, investing without return on investment.

The current level of investment foreseen by the EC to support the introduction of GALILEO and EGNOS on the market, especially in the domains of accompanying technologies like receivers and in application domains is totally insufficient, out of the range of magnitude expected for such an ambition. It will not allow the European industry to compete efficiently against other parts of the world in favour of the European GNSS.

Industry expects a return on investment less than two years on products placed on the mass market or in the general public, as the life time of such products is scarcely limited to 2 to 3 years. Industry will not consider GALILEO as an option in their investment before it is secured on the technical and commercial conditions of use of it, and receives a trustable time line for its start of operations.

SMEs, excellence centres

It is important to establish initiatives aimed at stimulating innovation through the creation of an ecosystem of SMEs. Such initiatives are keys in stimulating the creation of innovative start-ups in the positioning application sector. Often, in fact, SMEs and start-ups in high-tech and highly innovative fields must concentrate on their specific innovation break-through and unique technological know-how in order to keep development costs under control and accelerate their time-to-market. On the other hand, they largely benefit from partnering with large corporations capable of providing a stable technological and commercial environment, complementing the flexibility, innovative capabilities and flexibility often found in SMEs. Therefore, it would be beneficial if the European Commission, through agencies such as the European GNSS Supervisory Authority, could set up specific support actions for the kinds of partnership and ecosystem development initiatives referenced previously. The support could be targeted to the SMEs with specific characteristics in terms of innovation and technology used while also encouraging efforts by large corporations who seek cooperation with these SMEs. Such a mechanism could have the double benefit of financially supporting SMEs engaged in such programs and validate the large corporate programme itself.

Public authorities should support the emergence of shared Technical Operational Platforms in order to allow the industry focus on innovation and not generic costly test tools (thus indirectly contributing to each SME, labs, universities investments in R&D). More resources could then be put by the Private Sector in innovative products and services to the users, improving performances, reducing development cycles (time-to-market) and access-cost from the users. To maximize the European industry competitiveness, EC should favour programs supporting both SMEs and major companies with evenly shared contributions.

The life cycle of product development is largely ignored, and there should be a support network along the entire value chain. Also SMEs should be federated in some way so that they can use their USP and contribute to consortia, without doing endless administrative tasks. Workshops and regular networking events could be useful to form partnerships. The workshops should help articulate the needs and skill sets of the SMEs and the calls should in turn be directed at the findings of the workshops, instead of the other way around. Since there is not enough market knowledge, this could be facilitated as well.

There should be an independent association that is endorsed by the EC. There are so many shortcoming in the present system that could be instantly resolved. Management issues, knowledge sharing, and networking to name a few. Also, if an association of SMEs existed, there would be an instant and transparent pool of talent that could save years of time-to-market. Such a simple organizational structure proposes huge benefits to the entire network, and replaces the pseudo-associations that the GOC companies use as PR vehicles.

An excellence centre needs to include market knowledge as well as technology. If such an association existed, or excellence centre, it is easy to imagine the funding opportunities that it would attract, from both European institutions (EIB) as well as the private sector. If the EC's market growth statistics are to be believed (€400 bn in 2025), then there could be a flood of capital to a correctly positioned federated body.

International Cooperation

International cooperation should keep in mind that there will be only a few "GALILEO-alone" applications and receivers; so cooperation has to focus on interoperability with GPS and GLONASS and to establish contacts with China (potential COMPASS system) to become a "recognized" partner Europe has to establish GALILEO as soon as possible.

International cooperation is essential to ease GALILEO integration in standards, in telecoms as well as in transport. Promoting GALILEO internationally will help the European suppliers to penetrate wider markets, benefiting from GALILEO awareness.

The EU should:

- Enhance its international cooperation scheme and have third countries commit to support their industries on GALILEO downstream markets
- Favour GALILEO regional segment through EGNOS, MRS, EGSIC to enable international development
- Financially support European players to collaborate with non European companies. Especially countries that invest on GALILEO on a long term basis (China, Latin America, Africa…)
- Develop a differentiated strategy with third countries depending on
    - Their existing infra (e.g. US, Russia)
    - "US oriented" new comers (e.g. India)
    - New comers (Latin America, Africa, Middle East…)

- Make sure that third countries do pay their tribute to the EC (e.g. annual fees against TBD privileges)

- Make sure that third countries apply the same standards, regulations, IPRs rules as Europe

At system level, cooperation with other GNSS initiatives will help to solve compatibility (frequency coordination), and will ease interoperability (signals and common time and geodesy references). Concerning the down stream activities, clear international regulations must be set up to define terms and conditions facilitating access to signals. Some applications will benefit from a common roadmap (or navigation plan) shared at the international level. As an example, ICAO has developed a long term vision for the use of GNSS in Civil Aviation.

From geodetic point of view, the cooperation with international organisations namely the „International Earth Rotation and Reference Systems Service"(IERS) and the „International GNSS Service" (IGS) is indispensable. Therefore, all activities to enhance the acceptance of a new GNSS (especially GALILEO in future) in such international bodies should be encouraged, in particular the unrestricted access to the data and all observation types which are necessary to meet the accuracy requirements.

Standards, certification and liability

New applications can be supported by standards, e.g. transportation of dangerous goods (through United Nations) and fee collection through a harmonised approach in Europe.

Great efforts should to be achieved, not only regarding the GALILEO interfaces, but also in the field of the applications, in particular to encourage the development of the services (for example standardisation of the data provided by public transport, schedules, events, network…)

The certification of equipment must be developed, in particular to ensure the validity of the chain of the responsibilities in the service provision, to avoid jamming and lures.

Every life-critical application should be properly certified; applications with potential environment risks should also be considered for certification.

The need for strict legislation and certification processes for safety of life applications is indisputable

The major concern regarding liabilities is to establish the processes allowing extending the liability scheme for the full liability chain (from the signal provision to the final user application)

Frequencies

Europe has to be a relevant partner in ITU and to establish the necessary contacts to international authorities interested in keeping the spectrum for all GNSS services.

Intellectual property rights

Some wish their disappearance for any result of research financed by the public funds.

The actual IPR rules are contrary to the following basic legal instruments:

- Articles II(d) and VII(b) of the ESA Convention
- Article 81(3) of the EC Treaty of Rome, formerly known as Article 85(3) (renumbered)
- Commission Regulation (EC) 2659/2000 on the application of Article 81(3) to categories of Research and Development Agreements
- Commission Regulation (EC) 772/2004 on the application of Article 81(3) to Technology Transfer Agreements

The goal of the current IPR Rules is clearly to limit or control Contractors' use of the IPR in any other circumstances than the GALILEO development program.

- According to Art. 81.2 EC Treaty, any such agreement is void.
- The Commission Regulation (EC) 2659/2000 of 29 November 2000 on the application of Art. 81(3) of the Treaty to categories of R&D agreements, states in the preamble paragraph 3 that agreements which specify that a Party shall not carry out other R&D in the same field, thereby foregoing the opportunity of gaining competitive advantages, would fall within the scope of Article 81(1).
- In a closely related matter of application of Art. 81(3) of the Treaty to technology transfer agreements, the Commission Regulation (EC)772/2004 of 27 April 2004 includes in its Article 5 a list of Excluded Restrictions.
- In Art. 5.1(b) is prohibited any direct or indirect obligation on a licensee to assign in whole or in part, its rights to its own severable improvements (or inventions) or its own new applications.
- In the Commission Notice of 27.4.2004 (2004/C101/02), paragraph 109, the above Excluded Restriction of Art. 5.1(b) of the Commission Regulation on Technology Transfer is explained as follows: "An obligation to grant the licensor an exclusive license… or to assign such improvements to licensor is likely to reduce the licensees' incentive to innovate since it hinders the licensee in exploiting his improvements, including by way of licensing to third parties". In the above, replace "Licensor" by ESA, EC, or GJU and "Licensee" by Contractor and the result is the same.

In conclusion, the current IPR rules are likely to continue to stifle innovation as long as they are not amended to allow innovators to directly benefit from their inventions. At the moment, negotiations between the GSA and the GOC are blocked on the question of IPR among others. The IPR scheme as imagined by GJU and ESA does not seem to afford any reliable revenue stream. In the meanwhile, terminal manufacturers are demanding to know the licensing conditions of the relevant IPR and their requests are at a standstill because the GSA still has no clear licensing policy.

Regulations

The European Radio Navigation Plan (ERNP) should provide a global and coherent vision for all navigation aids and GNSS. In particular, it is obvious that a global GNSS system cannot comply with all navigation requirements. To be compliant with most of requirements expressed by the various communities of users, the GNSS need augmentations (on regional

and local basis), and quite often, hybridisation with non GNSS systems (inertia, terrestrial navigation aids). The ERNP as the document defining which will be the role for GNSS as a worldwide system, and which performance enhancements can be brought by regional and local augmentation. The ERNP should also provide a long term vision defining the respective role of the different radio navigation aids, anticipating the technological obsolescence and evolutions. Furthermore, it is more than known that standardization is one of the ways to stimulate the market. In particular, the LBS market required strong standardization to insure in the next future, interoperability of the application, portability of the development on the different user platforms etc. Strong effort on standardization is required to prepare future services such as E112. This standardization in various application domains should be prepared with and by application developers. EC should consider that the participation to the relevant standardization committees is mandatory for the success of innovative products. To insure the commercial success of some key developments, EC should allocate an important budget to enable the SME to actively participate and contribute to these standardization meetings.

The Commission can take regulations in the following fields:

- necessitate the service guarantee and the responsibility for the service operators in certain fields

- necessitate the monitoring of the transport of dangerous substances

- facilitate the access of the operators of services in geographical data of the infrastructure networks (such as public transport), in order to allow the development of the services geo-located or based on navigation,

Market

The majority of the listed applications correspond to a market ranging between 100 and 1 million receivers (seems astonishing to me). The scopes are those that the Green Paper presents. To be added: humanitarian aid (no example), the "law enforcement", register it, in particular in the emerging countries or it do not exist yet but become essential, and customs (not an example).

Free service

Also because of its financing by the public funds, the GALILEO service should be free for certain of the respondents.

Various proposals

- strengthen the link of the GALILEO and the GMES program as they are complementary enabling technologies for many applications

- strengthen cooperation with the Canadian industry which does not have to be seen like dependent on that of the United States,

- create a European Agency of the Radionavigation Systems.

- it is important that the terms and conditions (e.g. Certification and accreditation processes, standards, entity in charge and funding scheme), associated with the products and services

offered by the GALILEO concessionaire, is known sufficiently in advance from the GALILEO system deployment in order, for the downstream markets and products, to know the rules and develop accordingly.

ANNEX C

Services consulted in the preparation of the Impact Assessment

TREN "GNSS" units, TREN units on Road transport (Road Safety, Public Transport, ITS and logistics), TREN unit on SESAR and Single Sky, TREN unit on Rail Transport, TREN unit on Maritime Transport, TREN unit on Nuclear Energy, TREN unit on Electricity and GAS energy, TREN unit on conventional energies, coil and oil, TREN Agency for GNSS Supervisory Authority (GSA), TREN European Aviation Safety Agency (EASA), ENTR unit on space policy, ENTR unit on GMES, ENTR unit on industrial policy for space applications, ENV, INFSO unit on ICT for road, INFSO unit on mobile telephony, INFSO unit on health and disabilities, AGRI, FISH Maritime Task Force, FISH (MARE), SANCO, JLS, the JRC, RTD unit on air research, RELEX, DEV on expansion of EGNOS.

ANNEX D

Key studies and similar work carried out by external consultants and used for this Impact Assessment

Sponsored by EU Institutions:

(1) post-FOC Exploitation Study (Roland Berger, 2009, work in progress)

(2) EGNOS cost benefit analysis (LEK, 2009 work in progress)

(3) EGNOS extension to Africa, cost benefit analysis (Workpackage on aviation) (LEK, 2009)

(4) Market Monitoring Forecasting Tool (VVA, 2009) and related bids documentation (2008)

(5) GNSS Strategy (LEK, 2008)

(6) EGNOS "super-contract" (Helios, 2008) Workpackage 8 (Service Extension and International Business Development), Workpackage 4 (EGNOS Commercial Data Distribution Service) Workpackage 7 (EGNOS in LBS, Road and General Aviation)

(7) EGNOS study (FDC, Esys, Telespazio, 2008)

(8) Cost Benefit Analysis and Enabler Roadmaps included in the FP6 projects scoping needs of the different user segments (GRAIL, GIANT, GIANT2, HEDGE, MARUSE, 2007-08)

(9) Proddage (2005)

(10) GALILEO consortium bids (2004, 2005)

(11) GNSS market introduction plan (Booz, Allen & Hamilton, 2004)

Others:

(1) UK GNSS CBA for Transport (June 2009)

(2) US FAA (2008), Japanese Ministry of Economy, Trade and Industry (METI, 2008)

(3) FDC for CNES ("Etat des lieux des usages des systèmes GNSS et panorama des marchés associés de produits et de services", 2008)

(4) France Ministry of Transport (“GNSS Applications to Transport”, 2007)

(5) UK Department of Transport GNSS Downstream Benefits Assessment ("Macroeconomic impacts of GALILEO", 2005)

(6) France Ministry of Transport ("Case for APV in Aviation", 2004)

(7) Thales Research (2002)

ANNEX E

List of actions in policy option 4a (Comprehensive Action Plan)

Area & Actions
GENERAL POLICY OF THE GALILEO PROGRAMME 2.1. Time Schedule 2.2. Public Relations Recommendation 1: European Institutions should develop a new public relations policy presenting all the characteristics of the two elements of the European GNSS programme, GALILEO and EGNOS. In particular, an Information Center should be implemented to liaise with market players, especially with developers of applications or system integrators. 2.3. Liability of the Concessionaire R 2: EU Authorities should define clearly the liability policy for the different GALILEO services, taking into account that the first responsibility of an application is on the application service provider, not on the providers of one of its sub-components. R 3: Furthermore, the liability policy shall have to take into account the right for all government to jam or suppress the GNSS signals in times of crisis. Such decision is not limited to the authorities of the country where jamming occurs, as other national authorities (especially military ones) may easily jam the signal out of their territory. 2.4. Pricing policy R 4: EU Authorities should define urgently the political objectives and the principles of a clear pricing policy for all GALILEO services, taking into account competition on the market and all potential indirect benefits and returns on investments for the European public investors. 2.5. The "Big Brother" fear 2.6. Time schedule for investments 2.7. Stabilizing the environment Different other policy elements might help the development of GALILEO applications : - stability of system definition, technical specifications and interfaces - integration of GALILEO in international standards - open access policy to Intellectual Property Rights (see below) - the regulatory framework around the GALILEO applications should protect the SMEs, avoiding that the market is taken by large industrial actors with sufficient financial robustness to cover the risk. R 5: European Institutions and EU Member States should take all necessary measures to stabilize the environment of the GALILEO Programme in relation with the bullet points here above. Then, EU Member States authorities should act also as customers, and should implement rules to help the SMEs entering on this market. 2.8 Certification of equipment R 6: GSA should continue the certification and accreditation policy of GALILEO and EGNOS. Certification processes need to be defined in detail at European level with the stakeholders of each market segment and they

should enable the widest possible number of applications for GALILEO and EGNOS. Certification labels need to be pan-European or preferably international, depending on the application domain.

2.9 Rules of the Single Market, interoperability and standardization

R 7: In respect of the rules of the Single Market, regulations and recommendations should be adopted by the European Commission and by Member States in order to ensure interoperability of location-based services, at technical, and at business level.

R 8: ESOs should determine in coordination with the European Commission services, the fields in which a standardization programme is required, and should implement these programs.

R 9: In the domain of receivers, European Commission should ensure that all industrials may have a free and equal access to all specifications needed to produce receivers for EGNOS and GALILEO.

2.10. IPR policy

R 10: In order to help the European SMEs to patent their ideas and protect their IPR, European Institutions should foresee possible support for the financing of the related expenses.

R 11: Furthermore a complete IPR policy should be defined for the GALILEO programme. For what concerns applications, the basic principle could be that the ownership of the application stays with the developing company, without any royalty, even if the public sector has supported the developments. This rule should however not apply if it would lead to a monopolistic situation detrimental to the market development in this sector.

2.11. Protection of the spectrum

R 12: Protection of the spectrum is an essential element for the contractual guarantee of service. It should occur on two dimensions :

- GALILEO frequency bands should be protected against any possible interference from other applications or GNSS systems, by international cooperation with interested countries,

- local jamming, spoofing or interference should be fought against in a cooperative manner with local authorities.

There is also a necessity for a European regulation harmonizing and reinforcing the role of national or local agencies responsible for spectrum monitoring, and establishing the necessary mechanisms for coordination between them. This regulation should request local authorities to exchange data on identified frauds and cooperate on the identification and prosecution of offences.

2.12 International management of GNSS and legal statute

R 13: Create inside the United Nations UNCOPUOS a Specific office dealing with Satellite Navigation, and provide to GNSS the statute of a public service, in order to ensure a minimum service level at any time and any location.

R 14: Being given the legal statute of a public service of general interest for its open services, GNSS should get the corresponding advantages concerning public grants and competition distortion in the WTO agreements.

3. INDUSTRIAL AND RESEARCH POLICY

3.1. SMEs and Research

R 15: A European network of regional clusters should be established to become a key element of the creation of a powerful industry of SMEs dealing with GALILEO applications. Support should be provided also to the development of regional centers of excellence able to create synergies between SMEs and start-up companies. This action should be coordinated with ESA, and use existing initiatives.

R 16: The GALILEO FPs should be more focused on trials, pilots and market access than on prototyping. Criteria to elect proposals should put emphasis on commercial strategy and a well-argued business plan. Results of previous projects should be capitalized by GSA to be accessible for further developments. Access to FPs for SMEs and start-up companies should be improved by a simplification of the procedures. Furthermore, FPs or other sources of funding should help the industry to validate the services and products before their entry on the market.

R 17: There is a need to establish a complete information policy for dissemination of information to the SMEs and other industrial actors or service providers about all researches, technical specifications and services available with GALILEO. A specific information center and a technology platform should be established inside the GSA to disseminate the results of research activities, help in liaisons between stakeholders, and ensure the maximum profitability of the knowledge acquired on GNSS in Europe as well as in other parts of the world.

3.2. Link between SMEs and start-ups with financial investors

R 18: establish inside the GSA a permanent Technology Transfer Office to link investors, SMEs, start-up companies and research centers in order to develop the industrialization and the business based on new applications of GNSS. This structure would:

- link with clusters of start-up companies

- screen potential new business inside the clusters

- select SMEs and start-ups to fund and develop

- coach their development, liaising with investors.

R 19: On behalf of the European Commission, GSA together with the Committee of the Regions and the Council should put in place a specific tool focused on the establishment of synergies between the development programmes at national or regional level, and between the European SMEs and start-ups working in the domain of GNSS applications. This activity might be based on the clusters of SMEs already developed inside the European regions and inside the programmes of other European Commission services.

3.3. Cooperation between GALILEO and GMES

R 20. In the short term, synergies between GALILEO and GMES should be developed for the management of the FP 7. A common action line should be created in the FP7 for applications covering GMES and GALILEO together.

R 21. In the long term, synergies should be developed in the governance of the two projects, in order to ensure the coherence of the EC policy towards end users. These synergies should be developed by the GSA from the GALILEO side.

R 22. In the long term also, all the actions proposed in this action plan should be assessed for their compliance to the GMES interests and should be handled for the two programmes together.

4. ROAD TRANSPORT DOMAIN

R 23: Member States and the EC should fasten the implementation the Directive 2004/52/CE on interoperability of electronic fee collection. Especially, it is necessary to ensure that the implementation of the European Electronic Toll Service (EETS) will, in compliance with the CESARE III model, lead to an open market of service operators, able to propose to their clients a full range a location based services including road tolling.

R 24: Member States should avoid developing national tolling schemes out of the frame of an interoperable service in Europe. They should introduce interoperability with neighbouring countries as a top priority requirement in all their national plans.

R 25: Member States administrations and ESO should work together for a fast adoption of the standard ISO 17575 defining a pan-European application for satellite tolling in Europe, and complement this standard with all required documents. This standard is instrumental in the development of satellite based tolling in Europe, and shall avoid the design of national systems unable to communicate with each others.

R 26: Inside the frame of FP 7, a field test should demonstrate the added value of GALILEO and EGNOS in satellite tolling systems and as well as on other applications (road navigation for instance), especially in urban environment, in order to promote this technology for all future urban pricing schemes in Europe.

R 27: In order to foster the development of location based services to travellers, the Commission should issue a Regulation which ensures an open competition on the market of service provision : all data measured on the domains under public concessions, for all means of land transports (road, public transport, rail…) and all kinds of data, including geographical data, time schedules, real-time traffic conditions, events, … should be publicly available to information service operators under the same conditions.

R 28: in order to develop new location based services, an emphasis should be put by the EC and the Member States on the technical and financial support to the development of service operators.

R 29: The TEN-T and FP 7 programmes, should focus on the development of all applications of satellite positioning in relation to traffic monitoring and management, real-time information of travellers on the traffic conditions in the area where they are, and all other location based services to travellers.

R 30: HMI. There is a need to improve the HMI of all terminals onboard vehicles in order that their use is not dangerous, especially in urban environment, where the distraction of drivers causes many accidents.

4.4 Cost sensitivity

R 31: EC and GSA should support the industry in the FP7 for the integration of onboard telematic platforms at minimal costs. Such platforms shall be satellite based, and will support a number of telematic services.

R 32: Partnership of GSA with future potential markets stakeholders (institutional or big private companies) might help pushing the industry to lower the costs, standardize the interfaces, and thus make the use of satellite based technologies common in all vehicles in the coming years.

4.5 Digital maps

R 33: inside FP7, GSA should promote actions to improve the current update process for digital maps, in cooperation with other EC services interested in that issue.

R 34: The EC should propose a Commission recommendation to push Member States to develop national or local geographic data bases for the development of location based services, not only in transport domain, but more generally in all domains of applications. Applications of these data bases also concern GMES.

R 35: Member States and the EC should mandate standardization bodies to reach a sufficient level of standardization in digital maps in order to build an open market of digital maps.

4.6 Proposed actions for "REAL-TIME" activities :

R 36: In addition to other initiatives and regulations for the deployment of eCall, inside the FP7 research activities (in both eCall and GNSS programmes), and inside the TEN-T implementation programmes, focus should be put on demonstrating the added value of EGNOS and GALILEO on the performance of eCall or E112 services for both vehicles and pedestrians.

R 37: eCall requirements should highlight the accuracy range between 20 and 5 meters, and add to the location information an estimate of the uncertainty.

4.7 Proposed actions for "SAFETY"

R 38: The EC should issue a Commission Regulation requiring mandatory equipment of all coaches transporting passengers, especially school coaches, with a service allowing a real-time tracking of the vehicle with immediate emergency call in case of accident, incident or non-respect of road signalization. The device should allow reconstructing the circumstances of the accident. The service should be pan-European.

R 39: The EC should issue a similar recommendation for the transport of dangerous materials by road or by rail. In

this case, the service and the related equipment might be recommended and not mandatory.

R 40: The EC could issue a Commission Recommendation for the implementation in vehicles of an electronic module which would facilitate :

- electronic identification of the vehicle

- location of stolen vehicles

- accident data recorder.

The device should be accessible only to police forces. The first target would be professional vehicles, and the service might be extended to private vehicles on a voluntary basis.

R 41: Location information should be added to the future generations of the digital tachograph.

5. PUBLIC TRANSPORT SERVICES

6. LOGISTICS

R 42: As foreseen by the logistics action plan, the development of interoperable data processing between modes of transport should be considered in order to offer new services to clients on the tracing of their goods during the journeys.

R 43: The identification and localization of containers should be promoted with a device containing a GNSS receiver, and being able to communicate its identity and location upon request thru an appropriate and standardized means of communications.

7. RAIL TRANSPORT

7. 1. Train positioning

R 44: GSA should liaise with ERA in order to define GNSS minimal requirements for rail applications.

7.2. Localization of wagons

7.3. GNSS market in the rail domain

R 45: On behalf of the EC, GSA should study in depth the potential of the rail market segment and then define a specific action plan for this domain.

8. MARITIME TRANSPORT AND WATERWAY MANAGEMENT

R 46: On behalf of the EC, GSA should promote to the IMO, actions on harmonization at international level, of systems and procedures related to vessel location, traffic management and surveillance, and also to facilitate the customs operation at the arrival port.

R 47: EC should study whether or not the specifications of the "Safety of Life" service of GALILEO could handle the telecommunication facility required by the eNavigation system to be implemented around 2012 by IMO, if there is really a business interest in this evolution. It should also examine if it can be exploited to the benefit of LRIT.

R 48: Onboard equipment delivered for compliance with the future European Vessel Monitoring Systems should be GALILEO-compatible.

R 49: GSA should discuss with the EMSA and with the insurance companies, the fitting of all vessels including the smaller ones, with an equipment recording routes and positions in order to reconstruct accidents or define responsibilities in case of pollution.

R 50: GSA should promote to the Member States the use of pilot assistance devices for automatic pilot operations in ports.

R 51: GSA shall continue with IMO, IEC, IALA and RTCM, all procedures required to allow the use of these systems for maritime transport, and it should ensure the inclusion of EGNOS and GALILEO in the SOLAS convention, with the help of its Committee of Experts on Certification.

9. AIR TRANSPORT

R 52: GSA should continue discussing and agreeing with European NSAs regional framework agreements for the use of GALILEO and EGNOS in aviation.

R 53: GSA should achieve the certification process of EGNOS for the needs of SESAR with the objective of 2009. Then, it should launch the certification process for GALILEO.

R 54: Research activities should standardize and demonstrate the use of satellite technology for vehicle navigation in airport domains, in order to optimize the traffic flows in airports, and avoid risks of collision with departing or landing aircrafts on runways.

R 55: GSA should launch a technical forum with stakeholders (airline companies, airports, aeronautics industry, EASA), to implement the necessary cooperation to optimize the R&D projects, to develop applications for civil aviation, and finally to get a large consensus on the use of GNSS for civil aviation.

10. PRICING POLICY

R 56: The pricing policy for EGNOS and GALILEO should be carefully studied for each proposed services in order to ensure that each domain of application will contribute according to the benefits it gets from the use of EGNOS and GALILEO.

11. MOBILE PHONES AND CHIPSETS

R 57: The public sector could support the introduction of GALILEO in the mass market of mobile phones by a help to the private sector in developing the range of location-based services and the promotion of GALILEO-compatible devices in all parts of the world. A first step towards this strategy should be to permanently and deeply liaise between the different industrial worlds: space telecoms, mobile phone industry, daily-life service providers, transport service providers…

R 58: Research actions should help the industry to provide GALILEO receivers at the cheapest possible cost, and should also start to demonstrate the use of EGNOS on current mobile phones equipped with a GPS receiver. EU funds should also be used for serial validation and qualification of pre-industrial services and products.

12. AGRICULTURE, CADASTRE, LAND SURVEY

R 59: A technology platform should be created by the EC for the use of GNSS in agriculture, in order to enhance cross-fertilization between stakeholders, putting together farmers (especially associations of Young Farmers), high-tech SMEs, European institutions, and financial investors. The aim of the platform should be to identify the applications, the actions required in research and development, in pilot projects and in funding of deployment tools, then to cross-fertilize the experiences gained in the different countries.

R 60: Together with the SMEs, research actions should be developed inside the frame of the FP7, for new machines handling precision agriculture based on the association of GMES and GNSS.

R 61: All these applications should be started with EGNOS in Europe, as EGNOS has all the required characteristics to pave the way for GALILEO in this domain.

13. FISHERIES

R 62: The EC should, in liaison with European Maritime Safety Agency (EMSA), develop the specifications for the GALILEO "Search and Rescue" Service, and ensure that EGNOS and GALILEO will be used for maritime

transport and fisheries.

14. ENERGY

R 63: Penetration of EGNOS and GALILEO in the energy market is essentially a question of ensuring that receivers used for applications in all energy domains should contain interfaces for GALILEO as well as for GPS.

15. CIVIL PROTECTION

R 64: Member States authorities at local or national level should take benefit of GALILEO for the improvement of the efficiency of their civil protection teams, and also to prevent natural disasters and alert populations.

16. SECURITY AND LAW ENFORCEMENT

R 65: EC should establish links between the different agencies concerned with sea security, promote the use of GALILEO in this field, and establish the necessary contractual and technical framework.

R 66: European Commission should establish the regulatory framework and technical architecture for the use of the PRS for European Crisis Management.

17. SOCIAL SERVICES FOR HEALTH AND DISABILITIES

R 67: Research and Development actions in the Health and Disabilities domain are essential, to provide a cheap service and ensure an equal treatment of all disabled persons. Financial instruments like FP7 and CIP (Competitive Implementation Programme) should be used for that purpose.

R 68: Liaison should be established with the stakeholders of this very promising domain of application, in order to promote EGNOS and GALILEO for the development of future services and products, especially inside the calls for CIP and FP7.

R 69: The European Commission should develop an action to harmonize certification criteria for end products between the Member States in order to have pan-European certification labels.

18. EXTERNAL RELATIONS AND DEVELOPMENT

R 70: Bilateral contacts with external countries should be continued even if there is no direct participation of these countries in the GALILEO programme, in order to promote the use of GALILEO in the competition between GNSS systems, be aware of their needs, and develop compliant products.

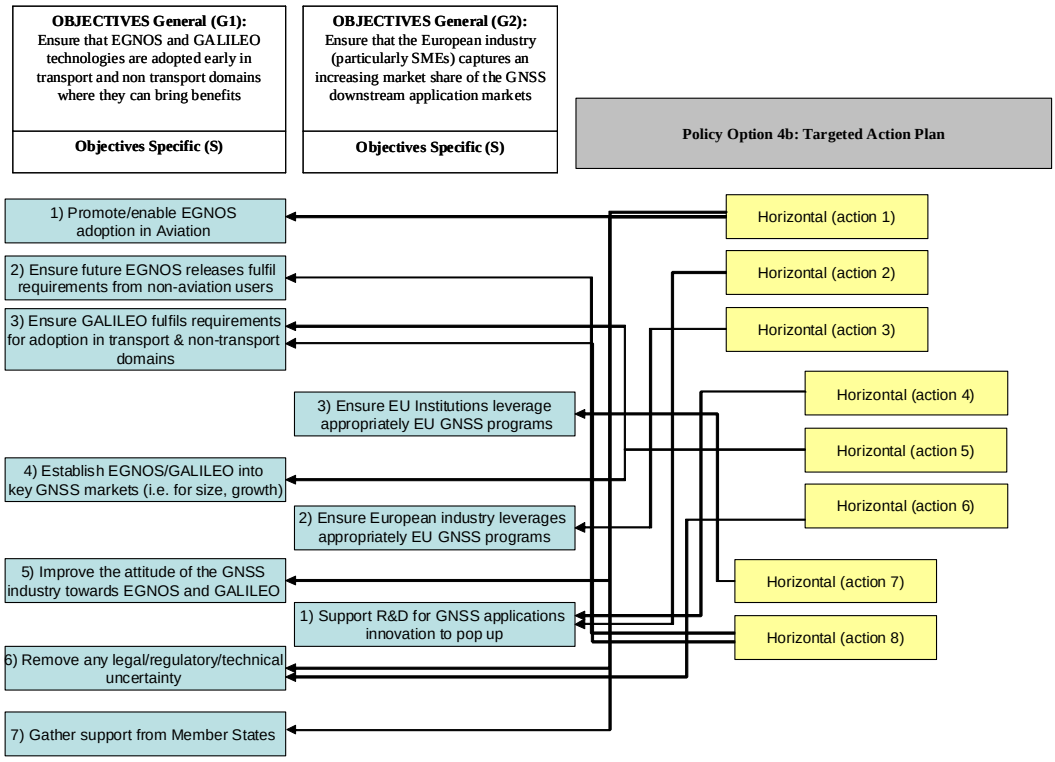
R 71: cooperation with GPS III, GLONASS and COMPASS should aim at getting GALILEO as a back-up for these systems: interfaces developed for end-user applications should include processing of the GALILEO signal, whatever the country of development of the interface or application. Interoperability of interfaces should be developed between these systems for non-PRS applications.

R72: therefore, receiver specifications should be provided openly to the industry as soon as possible.

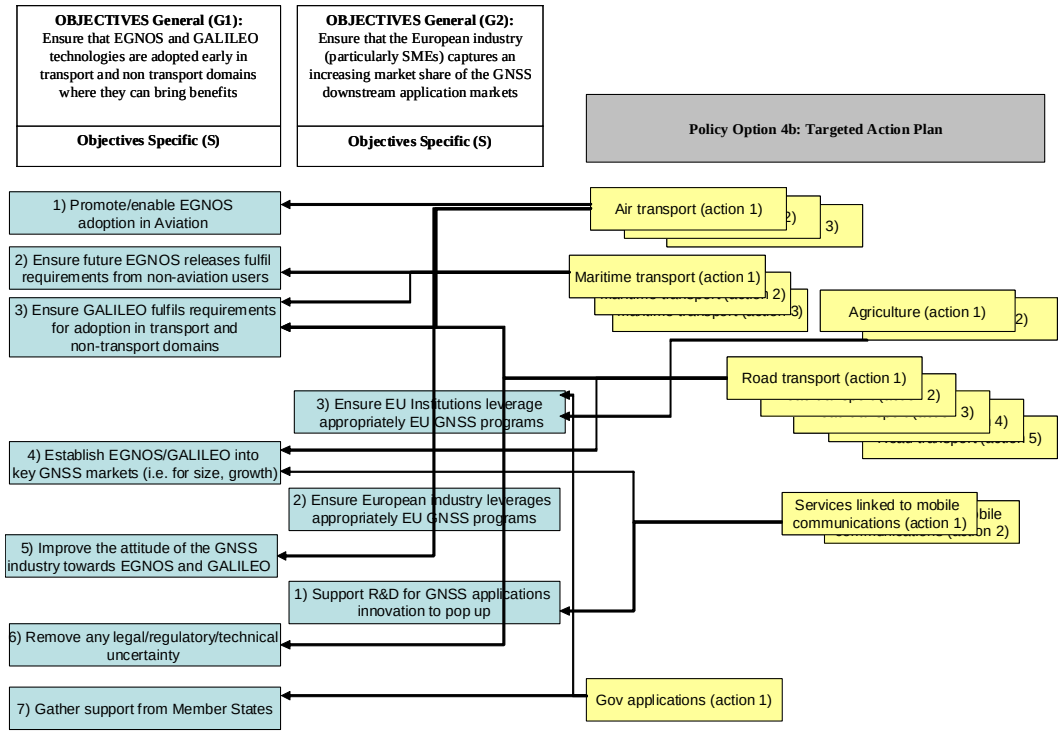
R 73: EU authorities should support EGNOS use in ACP countries, notably through the ISA project in Africa, as a precursor of GALILEO services. Therefore, it is required to accelerate the technical (ESA), programmatic (GSA/contractors) and financial (GSA, EC) preparation of the ISA project.

ANNEX F

Pictures of the interactions between the 24 actions of option 4b and our objectives



Policy Option 4b: main lines of interaction between HORIZONTAL actions and specific objectives



Policy Option 4b: main lines of interaction between VERTICAL actions and specific objectives

ANNEX G

Methodology for monitoring the impacts against the baseline in monetary terms

The assessment of the direct and indirect benefits in monetary terms, of the development of GNSS downstream applications and diffusion in Europe and beyond, is being prepared and should become available by the end of 2009. The macro-econometric model underlying the methodology will measure the impact of actions intended to achieve a wider, deeper and faster adoption of GNSS applications, through its two components:

- The market model will measure the increase of the GNSS markets size, therefore incremental revenues by EU downstream applications providers and increased usage by the general public

- The public utility model: will estimate direct and indirect social benefits taking hypothesis and output of the market forecasting model

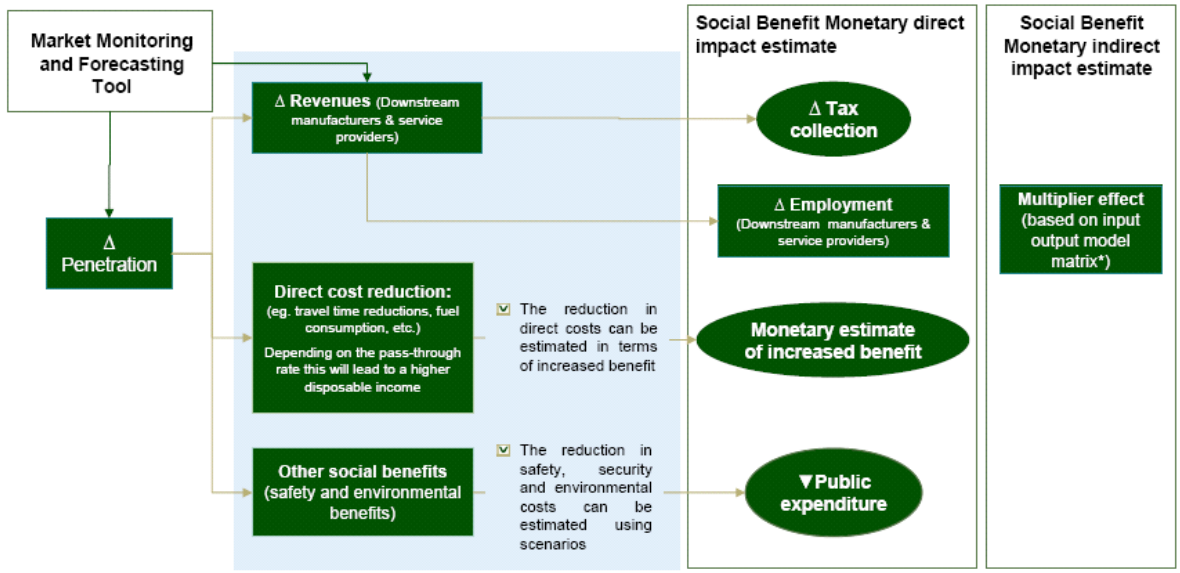


Fig: Interaction between market and public benefits components in the forecasting model (first available for aviation, road, LBS, high precision, PRS)

A preliminary version of the model has been used in 2008 to assess the impacts of some similar measures in non-EU countries:

- In the 10 Mediterranean countries the direct and indirect benefits of EGNOS applications just in aviation, maritime and multimodal transport have been measured[58] to amount €200 million (NPV) over a period of 30 years

- Only direct benefits of the introduction of EGNOS just in civil aviation across the whole African continent have been estimated between €101 and €174 million[59]

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58 METIS Regional Plan in Turkey, Syria, Lebanon, Jordan, Israel, Palestinian Authority, Egypt, Algeria, Tunisia, Morocco, 2008

To function within the EU the model is being adapted to consider a larger variety of segments since EGNOS and GALILEO will impact more domains, and will consider the incremental revenues and employment generated in the EU GNSS downstream industry.

[59] Impact of Satellite Based Augmentation System extension in Africa, Helios (2008) and LEK (2009)