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States and companies throughout the world have shaped the environment by trading on a global scale bringing the economies closer together. One part of the swift development in the last decade effecting economic growth is the domain of space. On a daily basis taken for granted, but it is gaining more and more importance to maintain the assets in space. In the beginning of the 21 century the European Union (EU) declared that Europe countries saw a new opportunity in space and decided to form a constellation of satellites to be able to navigate using these satellites just like the US Global Positioning System (GPS). This project called Galileo was reconfirmed in 2010¹. In this paper a closer look will be given to the economic gains and therefore ways to reverse European economic degradation, from the proposed constellation of Galileo as follow-on of the European Geostationary Navigational Overlay Service (EGNOS) in space. To specify economic benefits deriving from Galileo, EU investments will be accounted for and four sections of public interest will be expressed to show economic revenues the new satellite constellation will realize for companies and users in the EU.

The growth in space technology and especially in the global navigation satellite systems (GNSS) in the EU will create a huge market by introducing Galileo. It will not only promote and require skilled and qualified workers in building the satellites, but the creation of the Galileo system will also create a spillover to all kinds of industrial sectors in the future.² By creating and gaining knowledge of how to build space objects new industrial branches will be developed. The strong global competitive will be ensured by a strong European skill base, meaning a highly qualified work force.³ In times of economic drawbacks due to the financial crisis in 2008-2009 the Council of the European Space Agency (ESA) has reaffirmed their support for a long-term development of a European Space Program in November 2009.⁴ The EU will be investing about 3.4 billion Euros that have already been earmarked in the budget till 2013 in the Galileo System.

This project will enhance the recovery of the economy in the years to come.⁵ Investments of these magnitudes within the EU will encourage small and medium-sized enterprises (SME) to invest as well and to produce excellent products and ideas helping the economy grow.

Signing a framework contract in 2009 the European Commission gave a 566 million Euro contract to two companies in Germany, which will build the first 14 of 32 satellites for the Galileo system. The contract to launch the satellites into orbit was also given to Arianespace. This contract has a value of 397 million Euros.⁶ These great investments will drive the economy of Europe and the SME that contribute to the big Galileo project. By standing up Galileo, jobs will be created in the space industry, but mainly the jobs will evolve in the downstream industry. Just in the production of the 14 satellites by OHB in northern Germany will guarantee the workplace for 1.300 jobs in the next years.⁷ Applications and services using satellite navigational inputs will increase dramatically and the effects in satellite navigation business in Europe will be fostered by the European high-tech industry to be a leading edge competitor to the US GPS and Russian GLONASS system.⁸ The projected economic potential before the crisis was about 100 billion Euros in revenues in the period 2005-2030 and thereby a creation of at least 100.000 jobs. Now though, revenues predict to be 55 to 62 billion Euros and a creation of 1.400 jobs, within the Galileo operation, and up to 21.000 jobs, in services providers and manufacturing of products, in a time period from 2008-2030.⁹ The last figures are a pessimistic look at the economic situation. Momentary trends predict that markets are slowly but steadily recovering in the last two years, meaning that revenues and opening job market will probably be in the middle of the above mentioned numbers.

The four key market segments that benefit from the creation of Galileo are the Road, Location Based Services (LBS), Aviation and Agriculture. In all four categories the economic

growth in the GNSS market will estimate about 250 billion Euros by 2030. Galileo will share this market with about 5.6 percent equals to about 14 billion Euros in the next 17 years.¹⁰ Most of the effect will be seen in the road segment with 57 percent of overall revenues, followed by LBS with 39 percent. Aviation and agriculture will only be a small part together making up the last five percent. The public benefit from GNSS is to be forecasted to reach 800 billion Euros in the EU-27 in the next 17 years, while Galileo will have its share to estimates about 58 billion Euros within the period 2010-2027.¹¹ And again the majority of benefits will be from the road sector projected to be more than 70 percent, followed by LBS 14 percent and an almost equal share between aviation and agriculture.

Having talked about the four different segments and there potential growth within the next 17 years we will now take a closer look in how each segment will be able to accomplish this. Galileo will be unlike to GPS or GLONASS systems under full civilian control. The signal will be available even during crisis and will not be shut down if military needs arise, which would create negative impacts to the civilian world, that rely on the global navigational component to safely conduct their business. By creating the Galileo system it will counteract the GPS monopoly. This will open a new set of opportunities to the European industry.

The road segment is one of these opportunities and will incorporate innovations like Road User Charging (RUC) what presently exists on German Autobahn with a similar system. By using Galileo satellites Autobahn/highway charging could be possible in the commercial lane using trucks throughout Europe. Using Galileo as a GNSS traffic can be managed more effective producing fewer empty truck runs, charging actual road usage and also reduce the environmental impact caused by vehicle CO production. Creating such revenues will certainly increase benefits from producing receivers specialized for this kind of tracking. For the past 5 years Germany has

generated over 14 billion Euros using a GNSS-based RUC system. Advanced Driver Assistant Systems (ADAS), tracking of dangerous good will be achieved more accurate by using EGNOS in combination with Galileo.¹² The road segment will experience the fastest growth rate once Galileo is operational and will produce a vast number of opportunities to increase economic wealth within the EU.

“The term Location Based Services (LBS) covers a broad range of applications that are triggered according to the location of the end user, or are otherwise dependent on the location of the users or objects being tracked. LBS has been identified as the main initial market for GALILEO, in terms of number of users and potential revenues.”¹³ By integrating the navigational system in handheld devices, like PDAs, mp3 players, cell phones of any kind, PCs or video devices Galileo with its remarkable accuracy will generate a new kind of innovative usage of the GNSS. New businesses including “Mobil Yellow Pages” will be introduced, telling the user where and what to find in a certain location. In 2009 “[T]he Navigation & Location Europe conference was held 10-11 June in Amsterdam, Holland, and attracted about 100 participants in the LBS market. Market analyst Berg Insight forecasts that the LBS market in Europe will grow from 20 million users in 2008 at a compound annual growth rate of about 37% to reach 130 million in 2014. Berg estimates that about 20% of the mobile handsets shipped in 2009 will feature GNSS capability. More than 50% of handsets in Europe will be GNSS-enabled by 2013.”¹⁴ This is just one example of using GNSS like Galileo in the future and how the economic market will use these new systems to create applications for commercial use and help drive the European economy to higher revenues and wealth.

Using Galileo in the agriculture will enhance profits due to better efficiency in the use of chemicals. Through the exact position, farmers can determine where to plant and apply fertilizer.

“The improved accuracy of EGNOS can also be used by farmers for what is called Variable Rate Application (VRA), a practice used in precision farming. VRA requires the use of GNSS sensors, aerial images, and other information management tools for determining optimum herbicide doses, fertilizer requirements and other inputs to help farmers save money, reduce their impact on the environment and increase crop yields. With VRA farmers adjust their doses in field operations to the observed variability in the field. For example, only sections of a field with weeds are treated with a herbicide.”¹⁵ With using GNSS farming costs can be reduced almost 30 percent in organic farming.¹⁶ Galileo will open these new ways of cutting cost and increasing economic growth in the agricultural domain.

Galileo in conjunction with EGNOS will have an economic impact on civilian aviation. The accuracy of EGNOS at the moment is much better than with GPS or GLONASS alone and with the integration of Galileo, with its more precise timing devices on board, the accuracy will be phenomenal.¹⁷ So knowing this, civilian aviation will be able to dismiss the receiver autonomous integrity monitoring system (RAIMS), because EGNOS already provides this and also reports positions more exact. In the same line this will not only decrease noise for the population at nearby airports because of different approaches possible now, but more slots times are manageable due to precise navigation positions, which in turn will reduce delays and unnecessary holding time blocking arrivals and departures. “Studies have shown that the full adoption of EGNOS-enabled flight procedures, such as localised performance with vertical guidance (LPV), could produce savings of up to €4 billion in Europe.”¹⁸

In conclusion, this paper has shown the versatile use of the new GNSS Galileo. All key segments already profit significantly from GNSS and will increase their profits even more with

greater accuracy from Galileo. In addition, producing the satellites within the EU and having necessary downstream industry set up for the challenges to come will create new ways of revenue for Europe. Galileo will create many new jobs and businesses downstream. Because it's a long-term project and investment and not only a short term bandage, the economy will profit from the new GNSS. The steady growth rate of GNSS even after a global economic decline is a very good indicator that the EU has made the right decision by standing up a civilian European navigation system. Therefore economic wealth in GNSS businesses will be increasing in the years to come and will aid in recovering from the recession faced not only in Europe, but globally.

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- ¹ <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/7&format=HTML&aged=0&language=EN>.
 - ² Guenter Verheugen, Interview, *Aerospace America*, May 2009.
 - ³ Ibid.
 - ⁴ Ibid.
 - ⁵ <http://galileo.uic.asso.fr/pages/faq.html>.
 - ⁶ <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/7&type=HTML&aged=0&language=EN&guiLanguage=en>.
 - ⁷ <http://www.ohb-technology.de/corporate-in-brief.html>,
 - ⁸ <http://galileo.uic.asso.fr/pages/faq.html>.
 - ⁹ Anita Pietka and Bernardo Urrutia, "Can Galileo Help Europe's Economy", *Inside GNSS Journal* January/February 2010.
 - ¹⁰ <http://www.gsa.europa.eu/go/news/gnss-market-monitor>.
 - ¹¹ <http://www.gsa.europa.eu/go/news/gnss-market-monitor>.
 - ¹² <http://ec.europa.eu/transport/egnoss>.
 - ¹³ <http://www.gsa.europa.eu/go/galileo/applications>.
 - ¹⁴ <http://www.gsa.europa.eu/go/news/location-based-services-market-ready-for-takeoff>.
 - ¹⁵ <http://www.gsa.europa.eu/go/news/harvesting-egnoss-and-galileo-for-use-in-agriculture>.
 - ¹⁶ Ibid.
 - ¹⁷ http://www.esa.int/esaNA/SEM50DU8E_galileo_0.html.
 - ¹⁸ <http://www.gsa.europa.eu/go/news/egnoss-and-aviation-ready-for-take-off-in-2010>.

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