



# 1. Publishable Summary

## 1.1. Summary of the context and overall objectives of the project

**Inertial Reference System/Inertial Navigation System (IRS/INS)** is a navigation aid that uses a self-contained navigation technique to track the position and orientation of an object, thanks to the information provided by an Inertial Measurement Unit, which measures the accelerations on the 3 axes, and 3 gyros, which measure angular velocities relative to the inertial space. **The IRS market for civil aircraft applications currently suffers from two major limitations:**

### 1) ITAR regulations affect the business of high performance INS/IRS solutions

“International Traffic in Arms Regulation” is a regulation defined by the US government and controlled by the US Department of State for the control of the export of US-origin items specifically designed, modified, configured or adapted for sensitive dual-use applications, as well as related technical data and services.

ITAR regulations represent a real showstopper for industry players due to the export restrictions and complex rules for respecting ITAR-compliance during the whole life-cycle of the equipment. The industry is then expected to favour suppliers that do not have any export restriction.

### 2) At present for civil airborne applications, most of ITAR-free IRS solutions are based on RLG technology

RLG technology is a consolidated but yet very expensive technology as it is based on delicate manufacturing processes with very specific components, which requires:

- large and complex production facilities,
- expensive maintenance

**RLG is considered an obsolete technology that will be progressively replaced by FOG technology in the next decades. NICENAV IRS product (P/N PCFN050AC)** will be the first IRS on the market to find a solution for the above mentioned market limitations, since:

- It does not rely on any component or design/development service or data to be provided by US under the ITAR regulations and will not depend on US export licensing rules;
- It is based on FOG technology;
- It guarantees the best peak performance on the market with lower production and maintenance costs, lower weight and smaller size than competing solutions on the same target application,
- It will be provided with embedded GPS-WAAS aids.

This will grant the product to be compliant at the highest safety level to airworthiness requirements and ETSO certified by EASA and FAA.

NICENAV is the pivotal entrepreneurial project of Civitanavi over the next decade, forecasted to position the company among top 10 Navigation solution providers worldwide and top 3 in Europe. **The goal is to accelerate the entry-time in the market (16 months) to respond to the growing interest from clients.** The achievement of **TRL 9 is the natural target of NICENAV** and SME-Instrument is the best route to reduce the time-to-market while maintaining the technological and market advantage over competitors.



## 1.2. Work performed and main results achieved so far

The following activities were performed by the beneficiary during P1:

Under **WP1**, CNS carried out the complete re-engineering of both hardware and software baseline configuration of the available IRS products for airborne application, with the aim to realize a new generation of compact and lighter IRS, with even more reliable and accurate performance. The system technical description was complemented with information regarding HW/SW interfaces of the product and with the details of the calibration process of FOG-based inertial measurement units developed at the company, showing the comparison of standard approaches with the advanced calibration procedure adopted for the NICENAV high performance IRS. A Test Equipment was developed with the purpose of supporting the system acceptance test automation and the SW verification tests of NICENAV product.

Under **WP2**, efforts were devoted to the creation of a solid basis for the overall, complex process of HW certification, dictated by the DO-254 guidelines. A plan for HW aspects of certification was released, constituting the master plan to define the compliance with the DO-254 requirements. Hardware requirements were collected to formally define the specification of the programmable logic of the PCFN050AC unit derived from higher level requirements.

A similar plan was adopted for the SW aspects of the NICENAV development under **WP3**: SW certification aspects, dictated by the DO-178C guidelines, were analysed and detailed, and a SW requirements document, providing consistent and complete description of the high-level requirements for the NAV CSCI of the NICENAV product was drafted. The new PCFN050AC model, target of NICENAV project, was designed starting from the existing airborne INS, and two prototypes were developed and tested in their functionalities, performance and reliability.

In parallel, efforts and resources have been devoted to planning and performing of customer development activities (**WP5**); purpose of such activities is the establishment and the consolidation of contacts and strategic partnership with potential adopters of the NICENAV product. These activities will facilitate the introduction of NICENAV in the target market areas identified by the business development team at the company.



### 1.3. Progress beyond the state of the art and expected potential impact

There are currently two options applicable in high-end navigation grade solutions for airborne applications, *Ring Laser Gyro* and *Fiber Optic Gyro* technology. A technological alternative, based on *Micro Electro-Mechanical Systems* gyros has presently become state-of-the-art technology for low accuracy solutions, while *Hemispherical Resonating Gyroscope technology* is emerging, which however proves **very expensive, and is then used mainly for space applications**. FOG and RLG technologies are based on the same physical principle called Sagnac effect, but their **designs are very different technologically speaking**. FOG has the following advantages respect to RLG:

- **Simple And Controllable Manufacturing:** FOG uses optical component technologies developed for the telecom industry and whose lifetime and reliability are proven on a large scale. Manufacturing is an assembly of these standard components and is competitive even with small production quantities. Manufacturing costs 20-30% cheaper than RLG;
- **Mean Time between Failures = 10-12 years:** FOG is a solid-state device and as such it does not generate any acoustic vibration, it is highly reliable over a very long period of time and does not require any preventive maintenance. Maintenance costs 40% cheaper than RLG;
- **Easily scalable:** FOG technology is easily scalable just changing the length and diameter of the coil while keeping the same other optical components.

It is clear there is **business opportunity to enter the IRS market for civil aircraft application with an innovative solution based on FOG technology**. RLG technology is likely to grow slightly but also to lose market share due to advancements in lower cost FOG technology.

Considering the segmentation of the IRS market for civil aircrafts depending on geographic area, about 50% of the total end-user market is outside America. On the other hand, production is concentrated in America (85%) evidencing the large export problems related to ITAR regulation in this sector. This confirms that opportunity exists for EU producers to cover the portion of EU and Asian market presently covered by US production, subject to ITAR regulations.

**ITAR-free request count for approx. 52% of the total IRS market for civil applications** (conservative hypothesis, since additional demand of ITAR-free INS could be due to the request of US companies).

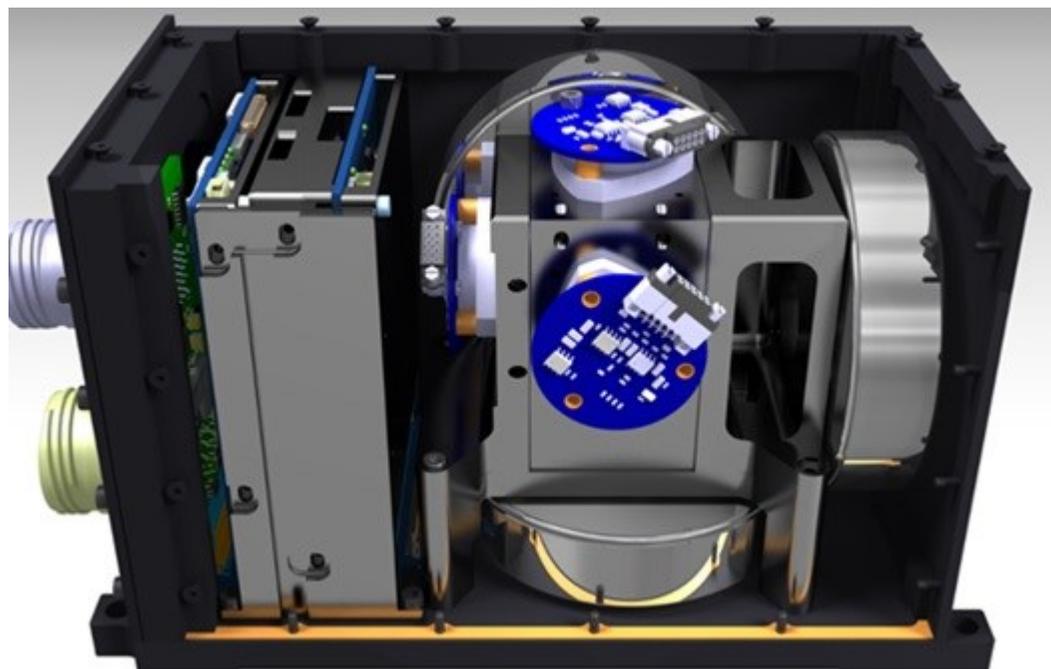
CNS has programmed an investment for R&D of 10% of the expected turnover in the next 3 years (18 M€). The 50% of this value will be targeted to NICENAV product line development, covering the part of the project budget not funded by EC. **The cumulated EBIT from the NICENAV product line, after 5 years from the launch of the project will amount to 14.09M€, 7 times the investment required.**



**1.4. Address (URL) of the project's public website**

[www.civitanavi.com](http://www.civitanavi.com).

**1.5. Images attached to the summary for publication**



**Compact INS/AHRS.**