PROJECT PERIODIC REPORT

Grant Agreement number: 260137

Project acronym: FOFDATION

Project title: The Foundation for the Smart Factory of the Future

Funding Scheme: Large scale Integrating Project (IP)

Date of latest version of Annex I against which the assessment will be made: 2014-04-03

Periodic report: 1st ☐   2nd ☐   3rd ☐   4th X

Period covered: **from**   01/12/2013   **to** 30/10/2014

Name, title and organisation of the scientific representative of the project's coordinator[1]:

Dr. Jean-Bernard Hentz

AIRBUS France SAS

Tel: +33(0) 5 61 18 13 49

Fax: +33(0) 5 61 93 04 42

E-mail: jean-bernard.hentz@airbus.com

Project website[2] address: http://www.fofdation-project.eu

---

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement .

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

1. Publishable Summary (The Final Résumé)

1.1.   Problem statement

In short, FOFdation addresses the need of modern manufacturing enterprises based on a fully "end-to-end Digital Manufacturing Foundation", for simultaneously tackling quality, productivity and sustainability issues through a unique fresh and agile IT concept. Concretely, FOFdation aims at advancing smart factory concepts by means of establishing integrated data access and exploitation through a common manufacturing platform (MIP) which constitutes the basis for Digital Enterprise technologies (DET), thus facilitating manufacturing process optimization including self-adaptive numerical control of machine tools, enhanced energy efficiency, and lean management based on operational data visibility and derived knowledge. The complexity of main future manufacturing concerns calls for novel supporting software tools to pragmatically address all the phases of the factory throughout its lifecycle, but seamlessly linked and accessible at and by all levels and stages.

Many existing software systems are actually proposed by IT market leaders but these systems merely address point solutions and in a separately stand-alone manner like e.g. NC programming, micro-planning, process planning, design, resource management and financial planning etc..., while supporting limited harmonization and interoperability among their respective proprietary platforms.

On the other hand, several other R&D projects and literature address a virtual manufacturing architecture but those works usually attempt to define (only) a common data model and its ontology extension to allow sharing and reusing knowledge within a very conceptual IT framework, not easily adoptable by the on-going business and SMEs.
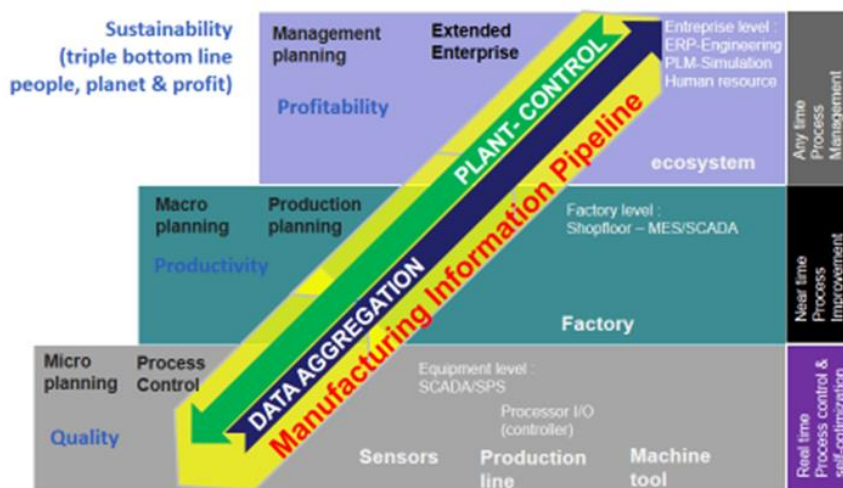

Figure 1: Continuous improvement based on integration, awareness & optimization

1.2. FoFdation approach

The FOFdation approach is embracing both the *bottom-up and top-down investigations*. Concretely, the project consortium adopted an industrial perspective and demonstrated practical "proof-of-concept" solutions based on a *common data model, sharable and reusable within a "legacy" workflow* that can meet real and practical industrial expectations like:

- "How to machine a part better",
- "How to produce greener and leaner", and last but not least
- "How to be aware sufficiently and timely in order to manage intelligently and proactively" the dynamic manufacturing networks imposed by a multi-collaborative economic environment.
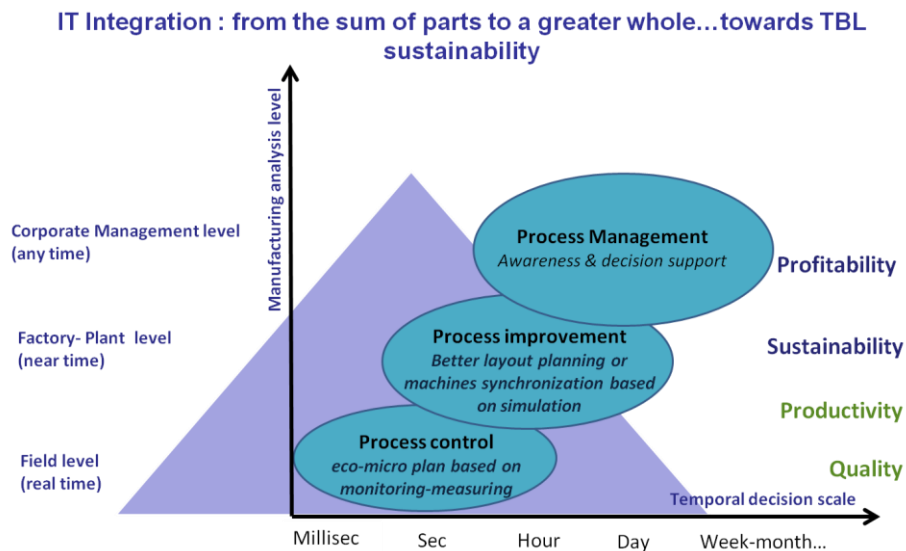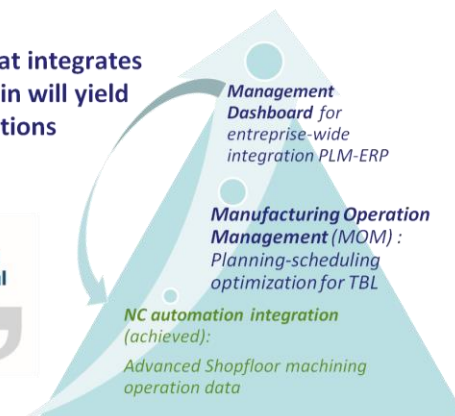

Figure 2: FoFdation: a holistic investigation

Figure 3: FoFdation: manufacturing awareness and visibility

There are four conceptual innovations, under which, the FoFdation modules and developments can be grouped. These are depicted below:

- **Smart Enterprise Content Management (SECM)**
  - Turning data into knowledge throughout the product-process-resource lifecycle
- **Smart Manufacturing Execution System (SMES)**
  - Enabling the collection and processing of sustainability indicators to evaluate the sustainability of a production process
- **Smart Manufacturing Optimizer (SMO)**
  - Offline generation of optimized and predictable cutter paths enabling monitoring to secure productivity and product quality
- **Smart Manufacturing Controller (SMC)**
  - A Next Generation numerical controller able to come up with the most efficient way to produce a product

Figure 4: FoFdation: four conceptual innovations

The achievements are quantifiable and are presented below:

- ✓ **Enhanced interoperability and flexibility**
- ✓ Support for **data collection** strategy and implementation
- ✓ **Enhanced Part quality control and monitoring, simulation, micro-optimization**
- ▪ **Sustainability** measurement through **KPIs (TBL) and** Improved **production awareness**
- ▪ **Production line behavior prediction and macro-optimization**
- ▪ **Support decision making and PLM viewer**

Figure 5: FoFdation achievements

1.3.   FoFdation Benefits

The project entitled FoFdation envisioned a "Digital and Smart Factory" architecture and implementation. Below, the progress is summarized presenting the benefits of its modules.

- Strategic vision, road mapping & dissemination
  - Internet
  - Conferences, press releases and scientific publications

- Commercial exploitation
  - Software
  - Machine providers & NC controllers

- Benefits for the industrial partners
  - Airbus
  - Fiat

- Exploitation via standards - standardisation
  - STEP NC implementation

Figure 6: FoFdation benefits

Commercial Exploitation
Software
Machine providers & NC controllers

On the software side:
- Supporting improvement of Siemens PLM
- Supporting software innovations at DELCAM/Autodesk
- Supporting highly qualified solutions like ARTIS-MARPOSS
- Supporting extension to the manufacturing sector by Paragon
- Supporting newcomers "KI SMEs" like SIGMAtools
- Supporting specific solution and service development at CADCAMation
- Leveraging the capabilities of GF machines
- Improving and Promoting Academic software

On the NC controllers side
- Improving capabilities of FIDIA controllers thanks to STEP-NC based SMC Toolkit

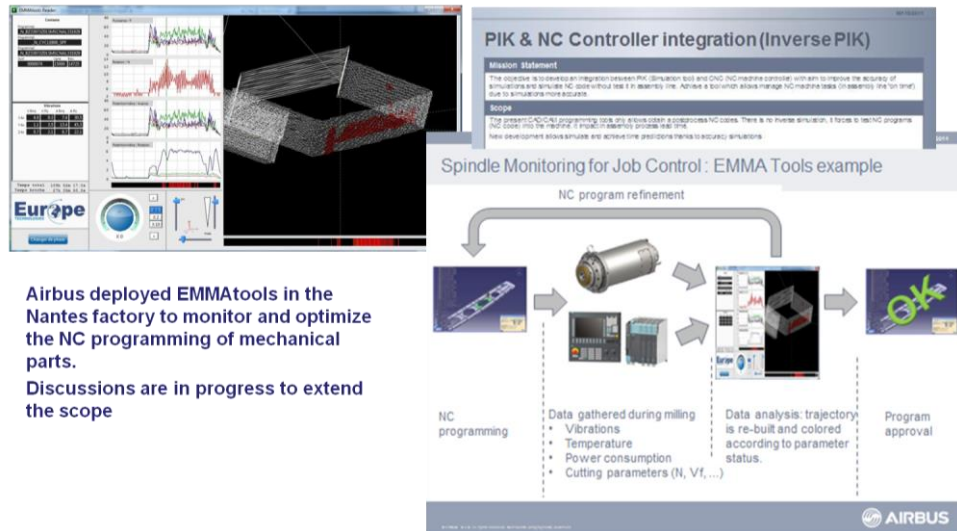**Figure 7: FoFdation benefits to the partners (D7.4 contains more information)**

Figure 8: Airbus NC improvement initiative

Figure 9: FoFdation benefits for FIAT