D3.6
Trials Competencies / Capability Gaps and Open Call Specifications

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VERSION HISTORY

VERSION	DATE	NOTES AND COMMENTS
0.14	14 08 2013	INITIAL VERSION ISSUED FROM I-VLAB
0.19	11 09 2013	REVISED VERSION FOLLOWING STARTING MEETING; INPUT FROM SERGIO GUSMEROLI
0.23	23 09 2013	REVISED VERSION WITH CALL PROPOSAL AND VARIOUS INPUTS
0.25	27 09 2013	REVISED VERSION WITH NEW CONTRIBUTIONS AND UPDATES
0.31	30/09/2013	NEW INPUTS AND FINALISATION
0.36	08/10/2013	UPDATE VERSION BASED ON FEEDBACK FROM PEER REVIEWERS

DELIVERABLE PEER REVIEW SUMMARY

ID	Comments	Addressed (✔) Answered (A)
1	The objectives set out in the DoW are met essentially in chapters 1 and 2. Relationships with other research bodies (chapter 3) are not suggested in the DoW, but nevertheless are relevant in that specifications of Open Calls should clearly be evaluated in relation to this knowledge. Exploitability (chapter 4) is also clearly, if indirectly relevant in justifying the Open call. It may be appropriate to explicitly make the above point about relevance in the introduction (not another huge section – you could just add in the words above, slightly modified for the context).	Done
2	Presentation to be improved: • Spacing between paragraphs changes many times. • Headings sometimes inconsistent • repetition of text • Because of the repetition the numbering of the OCs is inconsistent. • Indenting, bulleting and best of numbering of lists, using consistent style settings would improve the whole thing immensely. • Improve the executive summary	Done
3	Industrial exploitation and impact potentials are considered at length, and constitute a significant part of the report	No comment
4	Figure 1 needs some explanation. At the very least we need to understand why the inputs from WP1, 2 and 3 are needed. Especially, why the Experimentation sites – surely it is the complete trial design that is relevant rather than the limited experiments which only exercise GEs.	Done
5	There are several references saying “see URL” starting around page 11. The URL needs to be inserted.	The URL requires private access and thus we removed it.

6	In Table 1 (page 19) OC5-VF is more relevant to “community oriented” and “agile” than “liquid” or “sustainable”.	Taken in account
7	Referencing • There is no annex of references at the end of the document. • At least 3 different styles of referencing are used (e.g. “(Xu, 2012), [1], and[1]. • Some reference lists appear at the ends of individual sections. • Some references are not given at all (e.g. Xu).	Reference table added Referencing style harmonised
8	Relevance of the work scope, adherence to the target objectives. The content is in the scope of the deliverable.	No comment
9	Chapter 4 addresses thoughtfully impacts of the open calls topics in 3 different domains (business innovation, social environment and potential markets). Some important bibliographic references are missing.	Bibliographic details added.
10	(minor) text style in the deliverable template is “Times New Roman”, while the deliverable style is Arial.	Done
11	Comments and corrections reported along the text.	Take into account.

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Executive Summary

The overall objective of WP3 is to set-up the FITMAN experimentation sites from the organisational and technical viewpoint.

Among the various aspects to be considered, task T3.6 (which produces D3.6) has the objective to analyse critically the constituency of the FITMAN trials with respect to their objectives in order to identify functionality/competencies/capabilities gaps which could be filled by Open Calls.

In fact task T3.6 is decomposed by two activities:

- First to analyse the 11 trials in order to detect any lack in the domains of smart, digital and virtual but also taking in account the state of the art in other research activities as FOF (Factory of the Future) or FInES (Future Internet and Enterprise System).
- Then to prepare the launch of the Open Call by specifying the text of the call and issuing the Announcement of the Open Call.

The accomplishment of the administrative tasks foreseen by the EC guidelines is not included in this task, but it is under the responsibility of the FITMAN Management.

A first analysis has been performed after the collection of Business Requirement (D 1.1) and the IT Requirements (D 1.2) from the FITMAn 11 Trials.
From this initial analysis six potential challenges (Gaps which may be filled through Open Calls) have been identified, two for each Trials' domain: Smart Factory (SF), Digital Factory (DF) and Virtual Factory (VF).
The propositions described in chapter 2 are the following:

- Smart factory:
  - ✓ **SF.1 monitoring and diagnosis** (Advanced Intelligent Manufacturing), including dynamic and re-configurable filtering and processing of real world events, coming from sensor networks embedded in machinery and workplaces, shop floor smart objects and tools, in-bound logistics of tagged products and materials, manual operations and workers wellbeing monitoring and control.
  - ✓ **SF.2 next generation, attractive human-machine interaction** (Human-centred Manufacturing), including devices and software components for advanced automation of the shop floor efficiency and safety as well as a user-friendly, ergonomic and intuitive interaction between workers and machines, including data access on the move.
- Digital factory
  - ✓ **DF.1 product data and knowledge in product life cycle** (standard-based access to PLM – Product Lifecycle Management – and product-item data), including definition and adoption of standard metadata systems for Product Data and Knowledge representation, semantic interoperability transformation services from heterogeneous systems and/or available or de-facto standards, browse & query facilities and web-based modular intuitive decisional and collaboration environments for blue collar workers, managers and engineers.
  - ✓ **DF.2 collaborative product data 3D visualisation** (Collaborative and Mobile PLM), based on a collaborative multi-task project management environment and including devices and software components for a web enabled rendering and interaction with 2D-3D complex manufacturing objects, e.g. CAD solids, points of clouds, large unstructured data-sets including real-time data repositories.
- Virtual Factory
  - ✓ **VF.1 manufacturing assets semantic discovery** (Cloud Manufacturing, Manufacturing as a Service), including extension of existing business-oriented service description languages (such as USDL and Linked USDL) to encompass manufacturing tangible and intangible assets, their semi-automatic generation and clustering from unstructured and semi-structured enterprise resources (such as people CVs and products catalogues) and

their dynamic discovery and composition in advanced business applications in the domains of "production network" and "project team" design.

- ✓ **VF.2 semantic interoperability** (Product-Service Manufacturing Ecosystem), including platforms and software components for dynamic, semantic data formats transformations (e.g. unified interoperability form by means of a common model schema), with a view to achieving ERP (and other Enterprise Systems) compatibility in the supply chain.

Then in chapter 3, a survey of relevant research & innovation roadmaps, projects and initiatives is performed in order to validate the challenges six topics chosen for the FITMAN Open Call with respect to research trends in Europe and other regions of the world:

- Factory of the Future and EFFRA roadmap
- FInES (Future Internet Enterprise system)
- Internet of Things research & innovation
- Industrie 4.0 German programme
- Industrial Internet vision by General Electric

The conclusion is that the propositions of the six topics of FITMAN project could contribute to the most promising research & development trends in Europe and also at the international level.

In chapter 4 an analysis to evaluate the impact of the FITMAN Open Call propositions on Business Innovation, Social Environment and Potential Market has been performed.

Concerning Business Innovation the analysis of the impact of each topic demonstrates that they could contribute to the development of innovative solutions in the Manufacturing industries.

Regarding Social Innovation, an interesting analysis has been performed to evaluate the impact of the FITMAN solutions on some societal challenges in manufacturing (green manufacturing, product/service co-design and co-production, knowledge diffusion, open knowledge access, creation of more work places, curing aging of workforce, workplace safety) and with a Social Innovation perspective (Grassroots Social Innovation, Workplace innovation, Extrovert collaboration).

For the impact on potential markets, the conditions to operate have been analysed. The proposed solutions facilitate flexibility, adaptability, reactivity which are the conditions to succeed in the current globalised market.

In conclusion, the choice of the FITMAN Open Call six topics will contribute to improve the solutions developed by FITMAN and consequently will have a sensible positive impact on the competitiveness of each trials.

1.Introduction

1.1. Objectives of Deliverable D 3.6

The overall objective of WP3 is “to set-up the FITMAN experimentation sites from the organisational and technical viewpoint according various aspects”.

Among the “various aspects”, task T3.6 (which produces D3.6) has an objective to analyse critically the constituency of the FITMAN trials with respect to their objectives in order to identify functionality/competencies/capabilities gaps which could be filled by Open Calls.

So task T3.6 includes two activities:

- The first is to analyse the 11 trials in order to detect any lack from two points of view: the level of significance of Business cases in the frame of various manufacturing domains in the FOF area (smart, digital, virtual) but also taking in account the development of projects in FInES cluster (Future Internet Enterprise System), and also to identify the GEs (Generic Enablers) / SEs (Specific Enablers) which are not tested in the present use cases.

This deliverable report on this first activity.

- The second is to prepare the launch of the Open Call. **This task is under the responsibility of the FITMAN Management.** The activities to develop are the following: to plan and prepare an Open Call for the use cases expansion with additional partners at regional level in order to realize trials extension.

1.2. Method of work

The method of work will be based on analysis depending on various points of view: technical, organisational, social and economic in order to detect potential gaps with references (Best practices…).

We will take in consideration the three basic FOF domains in order to classify the 11 trials:

- Smart Factory (SF) domain cover the shop floor level of manufacturing with the automation of machines, robots, transfer between workstations, collect and management of data at this level with standardization aspects, in order to develop agile manufacturing and to facilitate customization
- Digital Factory (DF) domain covers the digitalization of the product at the design phase then along the manufacturing chain until the production of the products in order to optimize life cycle management
- Virtual Factory (VF) domain covers production by several companies organized in a network, in order to facilitate value creation.

A first analysis has been performed after the collection of Business Requirement (Deliverable D 1.1) and the IT Requirements (Deliverable D 1.2).

From this initial analysis six potential topics (challenges) have been identified, two for each domain: SF, DF and VF.

After this initial choice it is necessary to describe the topics and to consolidate them.

This consolidation phase must be performed by analysing other researchers' results and best practices of projects in the environment of FOF projects (Factory of the Future) and also in the frame of the cluster FInES (Future Internet and Enterprise Systems).

It is then important to consider other dimensions in order to analyse the contribution of these six potential challenges to:

- Business Innovation aspects
- Social Innovation aspects
- Market potential and exploitation analysis

1.3. Structure of the deliverable

The objectives set out in the DoW are met essentially in chapters 1 and 2. Relationships with other research bodies (chapter 3) are not suggested in the DoW, but nevertheless are relevant in that specifications of Open Calls should clearly be evaluated in relation to this knowledge. Exploitability (chapter 4) is also clearly, if indirectly relevant in justifying the Open call.

In consequence, the deliverable is organized as follows:

Chapter 2 analyses the need for new functionalities based on FITMAN 11 trials and proposes topics for Open Call (OC) regarding SF, DF and VF domains.

Chapter 3 considers external sources of information which could bring new ideas for Open Calls topics or validate / reinforce the hypotheses already elaborated by analysing projects developed in other environments (FoF/EFFRA, FInES Cluster).

Chapter 4 analyse the impact of the new topics on business innovation, social innovation and potential market.

The deliverable ends with a conclusion and a bibliography.

1.4. Relations with other WP's

An analysis of the relations with the other WPs will be performed taking into account also the delivery date of the WPs because D 3.6 is due at M6.

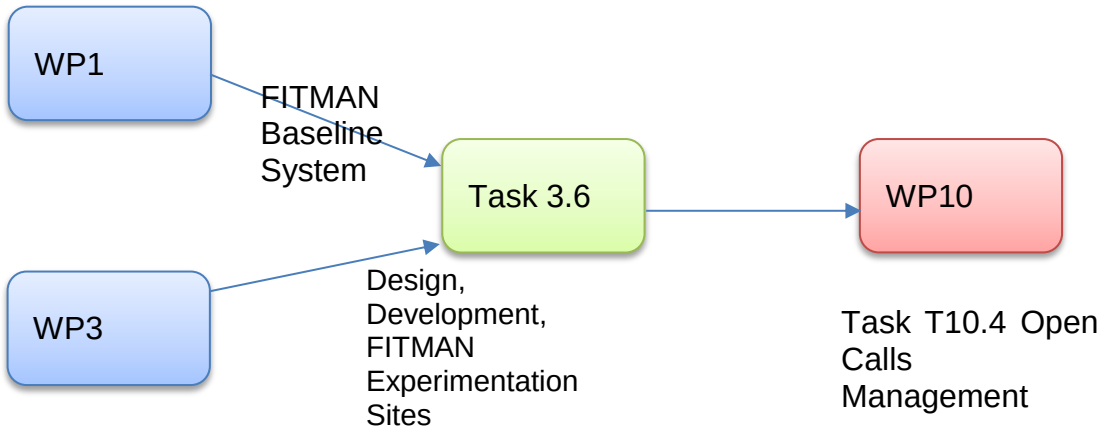

Figure 1 Relations with other WP's

Deliverable D1.1 and D1.2 belongs to WP1 and WP3 give an initial overview on the implementation of the solutions.

2.Smart, digital, virtual Factory analysis and gaps identification

A first analysis has been performed after the collect of Business Requirement (D 1.1) and the IT Requirements (D 1.2).
From this initial analysis six potential challenges (Gaps) have been identified, two for each domain: Smart Factory, Digital Factory and Virtual Factory.

2.1. Smart Factory (SF)

Smart factories use simpler and more streamlined ICT for energy-efficient, reliable and cost-effective production. Future production sites for a large variety of sophisticated products will offer shorter cycle times and the ability to control variables in the manufacturing process. Owing to the increasing convergence of machine control and personal computer technology, important developments in robotics, automation, planning, simulation and optimisation technologies are also foreseen. EFFRA (Roadmap 2010-2013 - Digital Technologies - ICT-enabled Intelligent Manufacturing, 2013)

The main aim of FITMAN SF Trials is to constantly monitor shop floor resources (humans, machines, products, materials), to capture the data generated, to transform them into meaningful events, to extract knowledge from them and to channel back to the shop floor's physical and human resources the relevant actions through actuators, alert systems and human-computer human-machine interaction devices.

Target Outcomes
The business scenario/requirements analysis performed for each of the FITMAN SF trials has identified the need for additional components not covered, or not fully covered, by Fi-Ware Generic Enablers and FITMAN identified Specific Enablers. This FITMAN Smart Factory Objective aims to fill the unsatisfied needs as detailed in the following topics ***both of which*** *are to be addressed by proposers.*

- ***SF.1 monitoring and diagnosis*** *(Advanced Intelligent Manufacturing), including dynamic and re-configurable filtering and processing of real world events, coming from sensor networks embedded in machinery and workplaces, shop floor smart objects and tools, in-bound logistics of tagged products and materials, manual operations and workers wellbeing monitoring and control.*
- ***SF.2 next generation, attractive human-machine interaction*** *(Human-centred Manufacturing), including devices and software components for advanced automation of the shop floor efficiency and safety as well as a user-friendly, ergonomic and intuitive interaction between workers and machines, including data access on the move.*

Evidence of the interoperability of the proposed solutions with Fi-Ware GEs and FITMAN available SEs as reported in the SF Reference Architecture (the SF Catalogue, including the open specs of all the SF selected components) represents a preferential title in the evaluation phase.

Expected Impact
Each proposed solution shall be integrated, deployed and validated in at least 2 FITMAN Trials, preferably belonging to the Smart Factory category (see FITMAN D1.1), and provide measurable impacts on the following aspects:

Reinforced ability to cope with very dynamic and multi-source events, improving reaction times and observing policy-based security constraints

- *More precise and detailed information conveyed back to the shop floor after an event including first causes of an anomaly occurred in a Smart Factory's shop floor and recovering actions (actuators)*
- *Improving the Human Machine and Human-Computer Interaction by considering operational (e.g. hands-free, noisy environment) as well as age constraints*
- *Diminishing the risk of damages and injuries at the shop floor, by improving the amount and the quality of information presented to the worker and the effectiveness of the interaction*

2.2. Digital Factory (DF)

Digital factories help to reduce the need for physical prototyping and the construction of pilot plants when designing future factories. Specialists in fields such as mechanical, software and materials engineering will use digitalised factories to enhance simulation, modelling and knowledge management. Research in this area will also cover the life-cycle management of products, from the design phase all the way through to production, maintenance, disassembly and recycling. EFFRA (Roadmap 2010-2013 - Digital Technologies - ICT-enabled Intelligent Manufacturing, 2013)

The main aim of FITMAN DF Trials is to provide several diverse stakeholders engaged in the Product Life Cycle with harmonised access, intuitive query & advanced decisional-visualisation facilities to the large and disparate set of information, documents and data related to the product along its whole lifecycle. This information is stored in highly heterogeneous and distributed repositories of multimedia data produced independently by several different Enterprise Systems.

Target Outcomes

The business scenario/requirements analysis performed for each of the FITMAN DF trials has identified the need for additional components not covered, or not fully covered, by Fi-Ware Generic Enablers and FITMAN identified Specific Enablers. This FITMAN Digital Factory Objective aims to fill the unsatisfied needs as detailed in the following topics ***both of which*** *are to be addressed by proposers.*

- ***DF.1 product data and knowledge in product life cycle*** *(standard-based access to PLM and product-item data), including definition and adoption of standard metadata systems for Product Data and Knowledge representation, semantic interoperability transformation services from heterogeneous systems and/or available or de-facto standards, browse & query facilities and web-based modular intuitive decisional and collaboration environments for blue collar workers, managers and engineers.*
- ***DF.2 collaborative product data 3D visualisation*** *(Collaborative and Mobile PLM), based on a collaborative multi-task project management environment and including devices and software components for a web enabled rendering and interaction with 2D-3D complex manufacturing objects, e.g. CAD solids, , points of clouds, large unstructured data-sets including real-time data repositories.*

Evidence of the interoperability of the proposed solutions with Fi-Ware GEs and FITMAN available SEs as reported in the DF Reference Architecture (the DF

Catalogue, including the open specs of all the DF selected components) represents a preferential title in the evaluation phase.

Expected Impact
Each proposed solution shall be integrated, deployed and validated in at least 2 FITMAN Trials, preferably belonging to the Digital Factory category (see FITMAN D1.1) and provide measurable impacts on the following aspects:

- *More efficient and effective access to multimedia data repositories generated along the Product Life Cycle (Beginning, Middle and End of Life phases), by common and standard metadata and access mechanisms*
- *Improved interoperability among the different Enterprise Systems involved in the Product Life Cycle, at the level of data, processes and knowledge models, Feedback loops support.*
- *More effective decisional support by collaborative web browser-driven advanced and interactive representations of the products and its components*
- *Easier and more intuitive annotation of and interaction with 3D virtual artefacts of different formats also on mobile devices*

2.3. Virtual Factory (VF)

Virtual factories support the management of ever more complex supply chains between manufacturing plants around the world. They include a network of devices, such as, for example, Radio Frequency Identification (RFID) of work in progress, wireless sensor networks and machine-to-machine communication. These will contribute to real-time monitoring of complex material flows and more efficient use of resources. In addition, they will give rise to further services, such as advanced maintenance technologies for assets used in the manufacturing process. EFFRA (Roadmap 2010-2013 - Digital Technologies - ICT-enabled Intelligent Manufacturing, 2013)

The main aim of FITMAN VF Trials is to manage and harmonise the value network which is around a manufacturing industry, from hierarchical supply chains to peer-to-peer business ecosystems.

Target Outcomes
*The business scenario/requirements analysis performed for each of the FITMAN VF trials has identified the need for additional components not covered, or not fully covered, by Fi-Ware Generic Enablers and FITMAN identified Specific Enablers. This FITMAN Virtual Factory Objective aims to fill the unsatisfied needs as detailed in the following topics, to be **both** addressed by proposers.*

- ***VF.1 manufacturing assets semantic discovery** (Cloud Manufacturing, Manufacturing as a Service), including extension of existing business-oriented service description languages (such as USDL and LinkedUSDL) to encompass manufacturing tangible and intangible assets, their semi-automatic generation and clustering from unstructured and semi-structured enterprise resources (such as people CVs and products catalogues) and their dynamic discovery and composition in advanced business applications in the domains of "production network" and "project team" design.*
- ***VF.2 semantic interoperability** (Product-Service Manufacturing Ecosystem), including platforms and software components for dynamic, semantic data formats transformations (e.g. unified interoperability form by*

means of a common model schema), with a view to achieving ERP (and other Enterprise Systems) compatibility in the supply chain.

Evidence of the interoperability of the proposed solutions with Fi-Ware GEs and FITMAN available SEs as reported in the VF Reference Architecture (the VF Catalogue, including the open specs of all the VF selected components) represents a preferential title in the evaluation phase.

Expected Impact
Each proposed solution shall be integrated, deployed and validated in at least 2 FITMAN Trials, preferably belonging to the Virtual Factory category (see FITMAN D1.1) and provide measurable impacts on the following aspects:

- *Heavy reduction of manual data entry for the population of business service registries and stores by semi-structured and un-structured enterprise datasets*
- *More intuitive and user friendly composition of business services by non-IT experts*
- *Improved and faster generation of data transformation services by use of common ontologies and light annotation mechanisms*
- *Enhanced compatibility at the level of payload, data formats and processes among the different Enterprise Applications involved in a Supply Chain or Business Ecosystem*

3.Comparison of FITMAN propositions with the State of the Art

This chapter has for objective to compare the six topics chosen for the FITMAN Open Call with research in Europe and other regions of the world:

- Factory of the Future and EFFRA roadmap
- FInES (Future Internet Enterprise system)
- Internet of Thing research and innovation
- Industrie 4.0 German programme
- Industrial Internet vision according General Electric

3.1. FITMAN Open Call topics and Factory of the Future domain

The European Commission's H2020 strategy for a knowledge- and innovation-based economy identified advanced manufacturing systems as a key pillar for growth and investment for an eventual recovery of economic status. In this context use of information and communication technology (ICT) is crucial for designing, producing, testing, distributing and recycling new products.
To this purpose, an ad-hoc Industrial Advisory Group of the Factories of the Future PPP and EFFRA, the European Factories of the Future Research Association, worked to define a Factories of the Future FoF 2020 Roadmap[1]
This activity aimed at developing the multiannual roadmap with research and innovation priorities for the Factories of the Future PPP, in line with the Horizon 2020 proposal from the European Commission.

The Factories of the Future (FoF) multi-annual Strategic Roadmap identifies in "**ICT-enabled intelligent manufacturing**" as one of the four pillars to support European manufacturing industry in the challenging transition from post-crisis recovery to a European STEEP (Social, Technological, Economic, Environmental and Political) sustainability and regain competitive advantage in the global market competition. This area is referred as ICT for Manufacturing and in 2012 the ActionPlanT (ICT for Manufacturing The ActionPlanT Roadmap for Manufacturing 2.0) project developed a Roadmap to achieve such a vision where research priorities address manufacturing challenges and opportunities and identify which technologies and enablers should be developed and deployed in Horizon 2020 – the next Framework Programme for research and innovation, set to run from 2014 to 2020.

The roadmap is structured through five main clusters of research topics:

1. **Towards agile manufacturing systems & processes**. This priority requires a seamless interoperability of manufacturing systems and processes as well as the capability to connect real world resources, manage in real time huge amounts of data and distribute the decisional processes at the very edge of the manufacturing network. This is mostly related to the **Digital Factory** concept and involves FI-WARE chapters and GEs related to Internet of Things and Data/Context Management.
2. **Seamless factory lifecycle management**. This priority calls for an engineered management of factories and their tangible assets through their whole life cycle, similarly to PLM for products. A multiplant factory is a system of systems which needs to be understood, modelled, measured and simulated in order to forecast problematic situations and decrease of performances via a system of factory KPIs. This is mostly related to the **Smart Factory** concept and involves FI-

[1] Factories of the Future PPP FoF 2020 Roadmap

WARE chapters and GEs related to Interface to Network and Devices as well as Service Delivery platforms.

3. **People at the forefront**. This priority addresses the problem of knowledge sharing and circulation by assuming a human-centric perspective to manufacturing. Generational skill gap challenges, as well as data/knowledge protection issues need to be solved in order to put again intangibles at the centre of any manufacturing process. This is related to all the three basic concepts. **Smart** (blue collar workers), **Digital** (engineers) and **Virtual** (managers) Factory and involves FI-WARE chapters and GEs related to Data/Context Management in a secure and privacy preserving environment.
4. **Collaborative supply network**. This priority envisages new industrial and business models deriving from new forms of enterprise collaboration, such as Business Ecosystems, where open innovation and co-creation are at the basis of any exchange of data and knowledge. In particular, service innovation manufacturing ecosystems represent a form to reconcile technology push and market pull trends to innovation via the "at your service" logic. This is mostly related to the **Virtual Factory** and involves FI-WARE chapters and GEs related to service ecosystems and marketplaces.
5. **Customer centric design & manufacturing**. This priority requires new forms of customer/consumer involvement in the design and production of goods, emphasising the metaproduct concept (product+service) and the extreme customisation and individualisation of goods, while respecting optimisations and economies of scale. This is mostly related to the **Digital Factory** concept and involves FI-WARE chapters and GEs related to Data/Context Management and Cloud Hosting.

The factories of the future need to take collaboration and management of their supply-chain stakeholders into account and also make new business models for provision of after-sales service, in addition to improving engineering and production, and integrating customers in their feedback loop for design and iterative improvements of products.
The ActionPlanT Roadmap for Manufacturing 2.0 illustrates the different operations within a future enterprise.

The 6 envisaged topics for FITMAN open call are in line with such vision as they are fully compliant with the FITMAN proposed architecture and structured in accord to the Smart-Digital-Virtual Factory perspective of Manufacturing Industry.

Moreover the addressed topics match with the key research streams and Research Priorities (RPs) identified in the FoF Roadmap and in ActionPlanT, as detailed in the next paragraphs.

3..1.1. SF.1: Smart Factory Dynamic CEP (Complex Event Processing), Monitoring and Diagnosis

The SF.1 topic deals with monitoring and diagnosis platform (Advanced Intelligent Manufacturing), including dynamic and re-configurable filtering and processing of real world events, coming from sensor networks embedded in machinery and workplaces, shop floor smart objects and tools, in-bound logistics of tagged products and materials, manual operations and workers wellbeing monitoring and control.
This open call is mapping the Research Priority (RP) in Cluster 1 and specifically RP1.5 – Monitoring, perception and awareness on the shop floor and in Cluster 4, RP4.5 – Complex event processing for state detection and analysis in supply networks. RP refers to ActionPlanT (ICT for Manufacturing The ActionPlanT Roadmap for Manufacturing 2.0)

3..1.2. SF.2: Smart Factory Workers, Actuators, AmI (Ambient Intelligence), Smart Spaces

The SF.2 topic deals with next generation, attractive human-machine interaction services (Human-centred Manufacturing), including devices and software components for advanced automation of the shop floor efficiency and safety as well as a user-friendly, ergonomic and intuitive interaction between workers and machines.
This open call is mapping the Research Priority in Cluster 1 and specifically RP1.8 – Intuitive interfaces, mobility and rich user experience at the shop floor[2]

3..1.3. DF.1: Digital Factory Product Lifecycle & Metadata Management

The DF.1 topic deals with Product and Services data and knowledge platform (standard-based access to PLM data), including definition and adoption of standard metadata systems for Product Data and Knowledge representation, semantic interoperability transformation services from available de-facto standards, browse & query facilities and intuitive decisional and collaboration environments for blue collar's workers, managers and engineers.
This open call is mapping the Research Priority in Cluster 2 and specifically RP2.3 – Integrated high-performance computing in factory and product lifecycle management and RP2.5 – Multi-level simulation and analysis for improving production quality and throughput

3..1.4. DF.2: Digital Factory Product Data Visualisation & 3D Rendering

The DF.2 topic deals with collaborative product 3D visualisation services (Collaborative and Mobile PLM), including devices and software components for a web enabled rendering and interaction with 2D-3D complex manufacturing objects in a collaborative multi-task project management environment.
This open call is mapping the Research Priority in Cluster 3 and specifically RP3.1 – Enhanced visualisation of complex manufacturing and production data

3..1.5. VF.1: Virtual Factory manufacturing assets platform

The VF.1 topic deals with manufacturing assets platform (Cloud Manufacturing, Manufacturing as a Service), including extension of existing business-oriented service description languages (such as USDL and Linked USDL) to encompass manufacturing tangible and intangible assets, their semi-automatic generation from unstructured and semi-structured enterprise resources (such as people CVs and products catalogues) and their dynamic discovery and composition in advanced business applications in the domains of "production network" and "project team" design.
This open call is mapping the Research Priority in Cluster 4 and specifically RP4.1 – Cloud-based MBW for supply-network collaboration and RP4.4 – Connected objects for assets and enterprises in the supply networks

3..1.6. VF.2: Virtual Factory semantic interoperability services

The VF.2 topic deals with semantic interoperability services (Product-Service Manufacturing Ecosystem), including platforms and software components for dynamic, semantic data formats transformations with a view to achieving ERP (and other Enterprise or Legacy Systems) compatibility in the supply chain.
This open call is mapping the Research Priority in Cluster 1, 2 and 5 and specifically RP1.3 – Adaptive process automation and control for a sensing shop floor, RP2.1 – Integrated factory models for evolvable manufacturing systems, RP5.3 – Collaborative design environments for SME involvement.

[2] The ActionPlanT Roadmap for Manufacturing 2.0

3.2. FITMAN Open Call topics and FInES Research Roadmap

The topics proposed for the Open Calls are strongly connected to the FInES Research Roadmap (FInES, 2012) (FRR). The central part of the FRR illustrates three major research spaces.

.a. The first space refers to the traits of the enterprise of the future, referred to as **Qualities of Being**; such qualities are: *Inventive, Humanistic, Cognitive, Community-oriented, Liquid, Agile, Sensing, Glocal, Sustainable*.

.b. The second space refers to the **Research Challenges** (RC) for the Future Internet Enterprise Information Systems, organized according to 3 main dimensions: *Knowledge dimension* (RC1 to RC3), *Enterprise Applications dimension* (RC4 to RC6), *Engineering dimension* (RC7 to RC9).

.c. Finally the report addresses the **Technology** space, identifying the 5 FInES key **technological dimensions**: *Networking, Knowledge, Enterprise Applications, Storage and Computing, Human-Machine Interaction*.

Here we list the 6 Open Call topics and we indicate the key supporting dimensions and elements that come from the FRR.

Topic	Qualities of Being for Enterprises	FInES Research Challenges	FInES Future Technologies	Comments
SF.1	Sensing	RC6. Cooperation and collaboration platforms	Evolution of Sensor networks	RC6 includes the seamless integration of any sort of networking solution
	Humanistic	RC6. Cooperation and collaboration platforms	Knowledge Human-Machine Interaction	The workers 'wellbeing' aspect is central here
SF.2	Humanistic	RC8. Autonomic Computing Components and Subsystems	Human-Machine Interaction	We expect new forms of cooperation among humans and between Humans and Machine
DF.1	Cognisant	RC2. Linked Open Knowledge RC3. Complex Systems Modelling	Networking and Knowledge technologies	An holistic approach in addressing enterprise knowledge (including Internet of Knowledge and Content
	Community-oriented	RC6. Cooperation and collaboration platforms	Networking technologies	Collaborative decision making is central here
DF.2	Agile	RC1. Unified Digital Enterprise RC7. Proactive FInES Mashup	Knowledge technologies Human-Machine interaction	3D rendering of virtual reality and linked knowledge, with an important role of proactive components
	Community-oriented	RC5. Unified Digital Enterprise (UDE) Management System	Enterprise Application technologies	Collaborative project management is central here
VF.1	Community-oriented	RC3. Complex Systems Modelling RC7. Proactive FInES Mashup RC8. Autonomic Computing Components and Subsystems	Networking technologies, Enterprise Application technologies	The important role of modelling languages, for services and production processes, together with proactive enterprise (Sw) components. Possibly selected from pre-existing repositories

	Agile	RC2. Linked Open Knowledge RC6. Cooperation and collaboration platforms	Networking technologies,	Dynamic asset composition needs to be sustainable over time
VF.2	Cognisant	RC1. Unified Digital Enterprise RC2. Linked Open Knowledge	Knowledge technologies	The semantic dimension requires advanced approaches to knowledge management
	Liquid	RC9. Flexible Execution platforms	Enterprise Application technologies	In semantic interoperability liquidity implies agile behaviour and application/ services spanning beyond enterprise boundaries

Table 1 FInES trends relevancy regarding OC themes

Please note that in an enterprise, in particular in a virtual enterprise, all is connected in a tight networked holistic pattern. Therefore, the table is not exhaustive in mentioning the FRR connections, in fact it reports only the primary connections, while the reader familiar with the FRR can easily extend the reported references.

3.3. FITMAN Open Call topics and Internet of Thing (IoT) for manufacturing

The term "Internet of Things" (IoT) actually covers a wide variety of concepts, domains and applications. In essence it can be characterized by the deployment in everyday objects of computing and networking capabilities. As sketched in the following figure (source (N. Fantana T. R., 2013)**Error! Reference source not found.**) IoT focuses on the following three aspects:

- **The network and addressability aspects**: where real world objects are provided with computing and communication facilities that enable them to connect to each other and support "High Resolution" data acquisition;
- **The ambient intelligence aspect**: where communicating intelligent objects realize/support control loops. The focus here is on control;
- Finally, **the ambient assistance aspect**: where the *high resolution* data acquisition and ubiquitous computing offer context sensitive services to the human. The focus here is on humans and their interactions with the "smart environment".

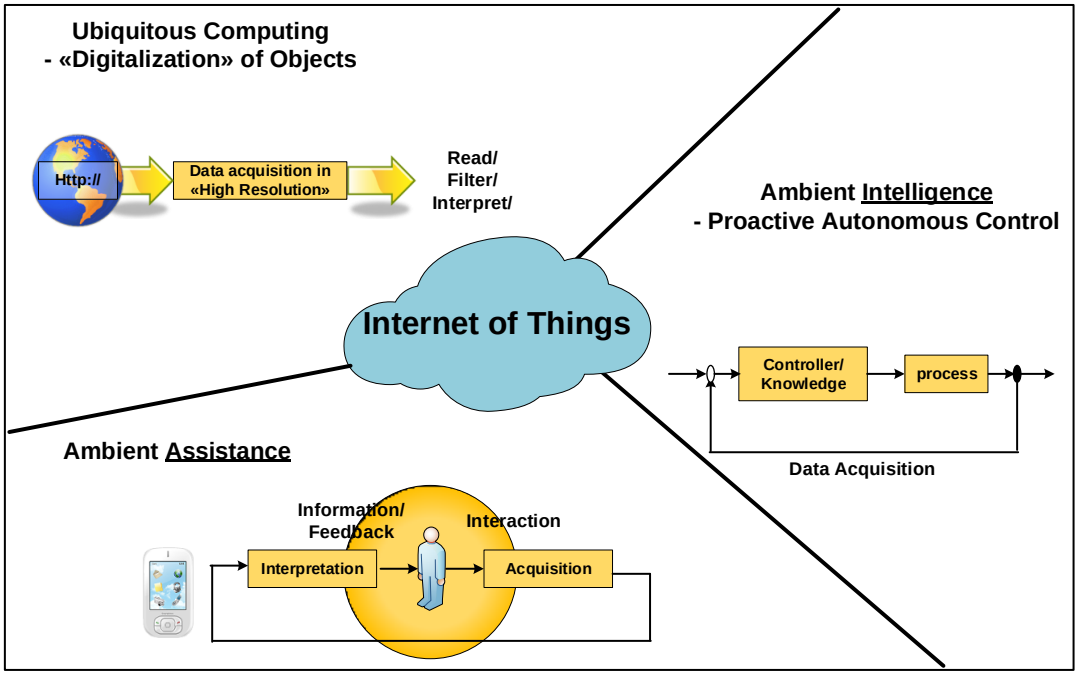

Figure 2 IoT for manufacturing

In the manufacturing environment, IoT technologies and approaches are envisaged as a way to address issues such as: globalization, technological evolution, dynamization of the product life cycles, aging of work forces, shortage of resources, and green production.

IoT therefore constitutes one of the keystones of future manufacturing systems, even if "… the mere availability of information does not create any added value by itself. The availability of information is only the basis for the optimization of technological and organizational processes. The optimization itself has to be initiated and conducted by humans" (see previous reference).

Thanks to their capability to substantially increase the availability of information and interoperability among devices, IoT technologies must be considered as an instrument to improve the work of human operators (engineers, white and blue collars, managers) in their daily and routine work, to improve the safety and security of workplaces, and finally reduce the environmental footprints of industries.

As stated by Fantana and his co-authors thanks to IoT technologies "humans will be able to concentrate on their unique capability of defining the right strategy and defining the right goals to operate the factory effectively within the triangle of tension between costs, quality and output. In this context the ambient intelligence aspect gets a new meaning. Following the nature of the IoT of making information available, ambient intelligence is the instrument to release the human from routine tasks concerning information retrieval and analysis. Autonomous behaviour results from the defined reaction of equipment or infrastructure to the results of this analysis. So autonomy of equipment is no contradiction to the need of deterministic behaviour at all".

Future manufacturing will be heavily based on smart equipment and smart infrastructure. *Smartness* will be not only assured by the networking and computing facilities that devices and infrastructures will have, but mainly by a degree of autonomy of these systems to react to a wide range of events observed in the contexts in which those equipment and infrastructures operate. The ultimate goal of the smart equipment in the manufacturing domain is therefore to autonomously determine the appropriate processing tasks, or adapt it, to address new situations (e.g., faults, workloads, etc.), or needs. The smart infrastructure therefore captures and communicates the environmental changes to allow equipment and production services to properly react and adapt their behaviours, procedures, etc. to the changing environment.

A big challenge for IoT is "interoperability". As stated in (IoT Semantic Interoperability: Research Challenges, Best Practices, Solutions and Next Steps - IERC AC4 Manifesto – 'Present and Future, 2013) "Interoperability can be generalized as the feature for providing seamless exchange of information … that other systems can use for improving performance, enable and create services, control operations and information processing". The wide deployment of smart devices, their wide potential diversity, as well as the huge amount of collected data, will require new approaches and technologies to effectively support interoperability, as discussed and analysed in (IoT Semantic Interoperability: Research Challenges, Best Practices, Solutions and Next Steps - IERC AC4 Manifesto – 'Present and Future, 2013). Semantic web of things technologies, frameworks and information models are envisaged as necessary to support data interoperability in the Future Internet and IoT.

Finally, naming, addressing and discovery are further issues IoT environments (Soldatos, 2013) have to face to actually deploy and take benefits from *smart things*. This is especially true for manufacturing environments in which the management of (even dynamic) supply chain networks, virtual factories, smart products, etc. will see a substantial increase of the number of identifiable, addressable and active components in production systems. These issues, partially analysed in IERC FP7 projects, will require further flexibility and knowledge management in future manufacturing systems.

The FITMAN project does not have to research new IoT-driven approaches and technologies for the manufacturing domains, but has to move along the roadmap sketched above, assuring that the pilot solutions it will deploy and experiment are compliant with the most advanced state-of-the-art of the technologies.

The FITMAN Open Calls are another piece of the puzzle to pave the road toward the future manufacturing systems.

The following table summarizes how the IoT technologies affect the FITMAN Open Call topics.

	FITMAN Open Call Themes					
IoT relevance	SF.1: Monitoring and Diagnosing Platform	SF.2 : Next generation HMI	DF.1: Product and Data Knowledge Platform	DF.2: Collaborative Product 3D visualization services	VF.1: Manufacturing Assets Platform	VF.2: Semantic interoperability services
Very High	X		X			X
High				X	X	
Relevant		X				
	Smart Factories		**Digital Factories**		**Virtual Factories**	

Table 2 IoT relevance regarding OC themes

3.4. FITMAN Open Call topics and Industrie 4.0

According to the Industrie 4.0 (from now on Industry 4.0) Vision (Bundesministerium für Bildung und Forschung, 2013), it is not more an option to consider smart factory resources capable to control, coordinate and trigger actions autonomously within the manufacturing environment and drive a completely new way of understanding. The integration of the **Cyber-Physical Systems** within the production systems will drive a completely new understanding about the manufacturing processes, control, supply chains and resource efficiency. The development of smart machines, storage systems and production facilities are already shaping the envisaged Cyber-Physical-Systems and contribute to the fundamental development Smart Factories.

The huge potential of the Industry 4.0 lies on the following three key features:

- Horizontal integration through the value networks,
- End-to-end digital integration of engineering across the entire value chain,
- Vertical integration and networked manufacturing systems

If Industry 4.0 is to be successfully implemented, research and development activities will need to be accompanied by the appropriate industrial and industrial policy decisions. The Industry 4.0 Working group believes that action is needed in the following eight key areas:

- ***Standardization and reference architecture*** *- Industry 4.0 will involve networking and integration of several different companies through value networks.*
- ***Managing complex systems*** *- Products and manufacturing systems are becoming more and more complex. Appropriate planning and explanatory models can provide a basis for managing this growing complexity.*
- ***A comprehensive broadband infrastructure for industry*** *- Reliable, comprehensive and high-quality communication networks are a key requirement for Industry 4.0.*
- ***Safety and Security*** *- are both critical to the success of smart manufacturing systems. Work organization and design - In smart factories the role of employees will change significantly. Increasingly real-time oriented control will transform work content, work processes and the working environment.*

- ***Training and continuing professional development*** *- Industry 4.0 will radically transform workers' job and competence profiles. It will therefore be necessary to implement appropriate training strategies and to organise work in a way that fosters learning*
- ***Regulatory Framework*** *-Whilst the new manufacturing processes and horizontal business networks found in Industry 4.0 will need to comply with the law, existing legislation will also need to be adapted to take account of new innovations.*
- ***Resource Efficiency*** *- Quite apart from the high costs, manufacturing industry's consumption of large amounts of raw materials and energy also poses a number of threats to the environment and security of supply.* (Zukunftsprojekt Industrie 4.0, 2013)

The Topics proposed in the Open Calls of FITMAN are covering some of the objectives and the identified key research areas of the Industry 4.0. This can be concluded with the following:

FITMAN Open Call Topic	Industry 4.0 Key Features / Research Areas
SF.1: Smart Factory Monitoring and Diagnosis	• Vertical integration and networked manufacturing systems • Managing complex systems • Resource Efficiency
SF.2: Smart Factory next generation, attractive human-machine interaction	• Managing complex systems • Safety and Security • Training and continuing professional development -
DF.1: Digital Factory product data and knowledge in product life cycle	• Resource Efficiency • End-to-end digital integration of engineering across the entire value chain,
DF.2: Digital Factory collaborative product data 3D visualization	• End-to-end digital integration of engineering across the entire value chain, • Managing complex systems
VF.1: Virtual Factory manufacturing assets semantic discovery	• Resource Efficiency • Managing complex systems
VF.2:Virtual Factory semantic interoperability	• Horizontal integration through the value networks, • End-to-end digital integration of engineering across the entire value chain, • Vertical integration and networked manufacturing systems • Standardization and reference architecture

Table 3 Relevance and Contribution to the Industry 4.0 Key Features and Key Research Areas

3.5. FITMAN Open Call topics and Industrial Internet from GE

The first non-academic voice raised to support and foster the revolution of Internet of Things has been most probably the white paper published by General Electric on November 26, 2012 (Industrial Internet: Pushing the Boundaries of Minds and Machines) and reported in a MIT Business Report of January 2013 entitled The Next Wave of Manufacturing.
The General Electric paper, authored by Peter Evans, Director of Global Strategy and Analytics, Marco Annunziata, Chief Economist and Executive Director of Global Market Insight, entitled "Industrial Internet: Pushing the Boundaries of Minds and Machines" is a sort of independent declaration of intent made by a private company and, quite curiously, not based, according to the reference pages, to any of the source document already cited in this deliverable.
The paper aims to highlight how the big next wave of development, after the Industrial Revolution (1st wave) and Internet Revolution (2nd wave), will be the so called Industrial Internet, and how this new wave will be able to open big opportunities of economic saving in the industry and, finally, the potential benefit of an Industrial Internet when pervading the General Electric business ecosystem.

According to the paper, this 3rd wave will be characterized by three key elements:

1 **Intelligent machine**	2 **Advanced Analytics**	3 **People at work**
• Connect the world's machines, facilities and networks with advanced sensors controls and sofware applications	• Combines the power of physics-based analytics, predictive algorithms and deep domain expertise	• Connecting people at work or on the move any time to support more intelligent design, operations, maintenance and higher service quality and safety

Table 4 Industrial Internet from GE Key elements

More in detail, the vision of General Electric Industrial Internet is based on the definition of three levels of intelligent things: **Intelligent Devices, Intelligent System, Intelligent Decisioning** and of course with the integration of these three levels together. Also some Enablers, Catalysts and Condition are listed at the level of expected Innovations (such as equipment, advanced analytics, system platforms, business processes) of infrastructure, stakeholders and talent development.

The six topics for FITMAN project open call can be matched, even though with different level of detail, with most of the definition enclosed in Industrial Internet:

SF.1: Monitoring and Diagnosis Platform. The themes of the call are in perfect concordance with the expressed need of Intelligent Devices that can provide big data volumes to the upper level.

SF.2: Next generation HMI. The importance of human interaction with the Industrial Internet is expressed through the entire document in many contexts ranging from the expectation that the Industrial Internet will enhance the human work experience to the fact that Intelligent "Decisioning" will be made still by humans.

DF.1 Product and Data Knowledge Platform and DF.2 Collaborative Product 3D visualization services: these topics are in line both with the Intelligent System and Intelligent "Decisioning" themes, since they will enable the connection of two world (engineering and manufacturing) still distant in terms of culture, language, tools etc.

VF.1: Manufacturing Assets Platform: the capability of capturing and sharing knowledge of tangible and intangible asset is perfectly expressed in the need of building Intelligent System, able thus to integrate supply chain.

VF.2 Semantic Interoperability Services: this topic is aligned with both Intelligent Devices (i.e. devices able to interconnect and share data with different format or different ontologies) and with Intelligent Systems (i.e. services act as enabler to build Intelligent System from Intelligent Devices)

	FITMAN Open Call Themes					
Industrial Internet level	SF.1: Monitoring and Diagnosing Platform	SF.2: Next generation HMI	DF.1: Product and Data Knowledge Platform	DF.2: Collaborative Product 3D visualization services	VF.1: Manufacturing Assets Platform	VF.2: Semantic interoperability services
Intelligent Devices	X					x
Intelligent System	x	x	X	x	X	X
Intelligent Decisioning		X	x	X	x	
	Smart Factories		Digital Factories		Virtual factories	

Table 5 relevance of the industrial Internet from GE regarding OC themes

4.Impact to Business / Social Innovation & , Potential Market

This chapter analyse the impact of the 6 topics of the OC concerning three domains:

- Business Innovation
- Social Innovation
- Potential Market

4.1. Business Innovation aspects

This section discusses business innovation in the manufacturing industry and how the open call can address the challenges faced by the market. Firstly a short discussion on business innovation is provided. With this discussion in mind, the potential of the open call to provide innovative solutions to the European manufacturing industry follows.

4..1.1. Business Innovation

Innovation is critical to ensuring companies remain competitive in an ever changing world. There exist many definitions of business innovation, for instance Lorente et al (TQM and business innovation. European, 1999) define business innovation as “the adaption of management systems to the changing conditions of the environment”. However regardless of the exact definition, it is generally agreed that innovation is critical to ensuring companies remain competitive. The fast paced development of technological capabilities and increased global competition mean that companies which do not embrace innovation will be left behind.

Using this definition by Lorente et al. we firstly need to understand the changing conditions of the environment within which the European manufacturing industry exists. With this knowledge of the environment we can then understand how the open call may help to adapt management systems to address these challenges.

There currently exist several megatrends which are having a large impact on manufacturing industry. These megatrends characterise the changing conditions of the environment within which the industry operates. European manufacturers therefore need to address these megatrends with innovative solutions to ensure they remain competitive. The open call will address elements of the following mega trends:

Demographics & Consumption

- Increased importance in brand perception (safety, quality)
- An aging workforce requiring improved knowledge transfer

All-round Sustainability

- Environmental awareness of consumers
- Transition to Greener Manufacturing

Dynamic Collaboration

- Collaboration between numerous stakeholders in an efficient & secure environment

The open call proposes six topics across the three factory types which will help manufacturers to address these trends. In the following sections each of the proposed topics is discussed in relation to these trends and their potential business impact.

4..1.2. Business Innovation in the Smart Factory

4..1.2.1 SF.1: Monitoring and diagnosis platform (Advanced Intelligent Manufacturing)

The additional components developed through this topic will go beyond the GE's & SE's already developed, by relaying more precise and detailed information back to the shop floor following an event. The ability to cope with very dynamic multi-source events will also be reinforced, improving reaction times and observing policy-based security constraints.

The development of these additional components has the potential to enable greener and more sustainable manufacturing processes in the smart factory. Through the real time monitoring of tools, improved fault detection and reactive quality management can be achieved. Improved fault detection would enable a manufacturer to identify below par products earlier in the production process, and allow the product to be either removed from the production line, or the fault rectified. Similarly through the real time monitoring of tools, equipment which needs servicing can be identified earlier. This would lead to less wastage due to faulty equipment in the production line.

Consider a monitoring & diagnosis platform which allowed a pro-active based approach to health & safety based on the monitoring of current events such as in FITMAN Trial 2. Improving the ability to cope with dynamic multi-source events will improve the reaction times and has the potential to reduce accidents in the factory greatly. This innovative approach to health & safety would lead to a reduction in accidents and injuries impacting several areas of the business. Not only would the employees benefit from a safer work place but a cost saving would also result through a reduction in employee sick days.

With the trend of an aging and more diverse workforce, identification of potential injuries such as Repetitive Strain Injuries (RSI's) may become more important. By using new technology, the industry will be able to move away from the one size fits all approach to health and safety.

An enterprise adopting new technologies such as this would also be at the cutting edge, developing Health & Safety practices in the industry. Increasingly customers are making purchase decisions based on brand perception. By adopting and developing health & safety best practice across the industry the perception of an enterprise by customers can be improved.

4..1.2.2 SF.2: Next generation, attractive human-machine interaction services (Human-centred Manufacturing)

In a human-centred approach the role of the operator or worker is regarded as crucial to the manufacturing process being successful. There has in the past, been a drive in the manufacturing industry towards greater automation. However more

recently, opinion on the role of the human in the manufacturing process has changed. The human-machine interaction services developed in this topic will aim to put the worker at the centre of the manufacturing process.

Through the deployment of human-machine interaction services in the smart factory, improved fact based decision making by staff can be achieved. Symon (Human-Centred computer integrated manufacturing., 1990) argues that by incorporating staff into the decision making process through improved situational awareness and better data management, manufacturers can create an environment which stimulates innovation and creativity and allows the exercise of skill.

The additional components developed in this topic will improve human-machine interaction by considering operational and employee constraints. Employees with different roles in a factory work in different environments. Operational constraints such as the background noise and employee constraints such as age, will affect the best means of communicating information to the worker. Combined with this, the role of an employee in a factory affects their information requirements.

By understanding the operational & employee constraints, improved situational awareness and decision making can be achieved. Trial 4 (white goods OEM) involves workers with many different roles, in varying environments. Besides this the information required by different workers is characterised by the time interval within which decisions need to be made. For instance shop floor workers are required to make decisions quickly (in the order of 40 – 60 sec), whereas the decision process of a manager takes place over a much longer period, typically a couple of weeks to a month.

Beyond the worker empowerment and improved job satisfaction highlighted by Symon (1990), improved decision making by staff may lead to improved sustainability of the manufacturing process. By ensuring the workers have the correct quantity and quality of information to make timely decisions, waste can be reduced through reduction in over processing, improved maintenance activities and reduced scrap/rework.

Improved situational awareness at the shop floor can also help reduce the risk of accidents and injuries, further improving health and safety in the smart factory. The benefits of this for the enterprise as a whole have been discussed above.

4..1.3. Business Innovation in the Digital Factory

4..1.3.1 DF.1: Product data and knowledge platform (standard-based access to PLM data)

The product data and knowledge platform will enhance dynamic collaboration on large manufacturing projects which involve numerous stakeholders. Tavola (A Roadmap of ICT for Manufacturing in the 'Horizon 2020' Prospective, 2012) highlight a need for efficient and secure environments for this collaboration, and that it will become crucial for the operations of large and small enterprises in the years to come. The components in this topic will create more efficient and effective access to multimedia data repositories generated along the Product Life Cycle.

Large engineering projects can involve a long and complicated Product Life Cycle, where the secure and timely flow of technical knowledge between the manufacturer

and its ecosystem of customers is of paramount importance. By ensuring all parties involved in a project have access to the information they require in a timely fashion costs can be reduced for the original manufacturer and its ecosystem of customers. For instance engineers will spend less time searching for the product information they require, streamlining maintenance activities.

Trial 7 involves the management of large construction projects where many stakeholders exist. The additional components developed in this topic will go beyond the GE's and SE's already created by improving interoperability among the different Enterprise Systems. With a large stakeholder community decision making processes can be long and laborious. By developing semantic interoperability transformation services, greater and more timely access to data can be achieved. Through increased interoperability of services the risk of long and costly delays to large manufacturing projects can be reduced.

4..1.3.2 DF.2: Collaborative product 3D visualisation services (Collaborative and Mobile PLM)

The 3D visualisation services developed through this topic will provide an innovative method for displaying data which will move beyond traditional methods. Combined with this, the ability to provide the services on mobile devices will allow on site users to access the data.

The business impacts of this component can be most easily understood whilst considering a specific trial. Trial 7 aims at developing better construction management processes by providing the information required to decision makers in a timely fashion. On large construction projects involving a multitude of partners, data management is a significant issue. Traditional document based methods of providing this information inhibit an efficient decision process. Significant paper loads are produced and accessing specific information required by decision makers can be a lengthy process.

The deployment of 3D visualisation services would reduce this paper load and significantly improve the timely access to information. Increased timely access to information would lead to reduced future risks throughout the project life cycle and progress of the project would be easily available to stakeholders.

4..1.4. Business Innovation in the Virtual Factory

4..1.4.1 VF.1: Manufacturing assets platform (Cloud Manufacturing, Manufacturing as a Service)

One of the major trends in the manufacturing industry in future years is captured by Xu (From cloud computing to cloud manufacturing., 2012) as the philosophy of "Design Anywhere, Manufacture Anywhere (DAMA)". Cloud computing and the Future Internet will be enablers of this philosophy enabling design and manufacturing data to be exchanged across multiple sites.

The additional components developed in this topic will help enable dynamic collaboration by reducing the delays in many business activities such as creating a quote for a customer, or submitting a purchase request to a supplier. A reduction in manual data entry throughout many of these business processes will enable

collaborative networks of manufacturers to work together more effectively. This will have a positive impact on enterprises all through the supplier network.

Through reduced manual data entry the burden of administration tasks can be reduced, streamlining business processes. This will in turn provide multiple benefits such as reduced overheads, improved customer service, improved procurement procedures and accelerated recruitment. In trial 6, the new components could also help to provide a more personalised order tracking and monitoring service further improving customer service and in the longer term brand perception.

Trial 10 aims to perform rapid collaboration between users, designers and suppliers developing special machinery. The reduced need for manual data entry will significantly reduce the delays of activities through the customer to customer cycle. This will facilitate the interaction between enterprises which are collaborating in enterprise ecosystems. In turn this may lead to improved competition in the market, allowing groups of smaller SMEs to complete with larger enterprises for business.

4..1.4.2 VF.2: Semantic interoperability services (Product-Service Manufacturing Ecosystem

The semantic interoperability services component will also help enable the dynamic collaboration of manufacturers. The use of common ontologies and light annotation mechanisms will ensure improved data transformation services, enhancing the supply of information.

The business impacts of this are twofold. Firstly, manufacturing supply chains are often long and complex. Improved interoperability will ensure a stream lined procurement process, reducing overheads to individual projects and enterprises as a whole.

Secondly, enterprise system compatibility will enable collaborating virtual organisations to compete with larger (and possibly multi-national) organisations to gain business. This will lead to more competition throughout the manufacturing industry, and give organisations who embrace the new technology a competitive edge.

For instance FITMAN Trial 8 aims at monitoring the flow of goods within a manufacturing SME network allowing the tracking of products. The components developed through this topic will enable SME's with varying Enterprise Systems to collaborate more effectively by enhancing compatibility at the level of data formats and processes.

4.2. Social Innovation aspects

4..2.1. Introduction

Social innovation is a relative new term that has been coined to express the collaborative and joint effort of people, which is in many cases performed with the support of Web2.0 ICT tools, towards achieving goals that are beneficial to all engaged stakeholders and are responding to various societal needs of our time. As stated in the Open Book of Social Innovation (Murray, Caulier-Grice, & Mulgan, 2010), *"Social innovations are new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create*

new social relationships or collaborations." Through social innovations, society is able to find answers to persisting problems and demands, via a coordinated collaborative approach where individuals and organisations sit together and offer their tangible and intangible assets to each other, aiming to identify the most proper way that they can be used complementary to other ones, in order to fight for a greater cause.

These coordinated attempts, as the definition also suggests, aim to connect different entities and domains, resulting into multi-disciplinary actions and activities that can be seen as a coalition of best practices of diverse ecosystems. Therefore, the three main pillars that are considered to be of critical importance for social innovation include:

- The utilisation, assembling and combination of existing elements coming from diverse domains of knowledge, resulting in working products/services that are not subject to intense experimentation due to the already tested results of their components.
- The openness of knowledge and the undisrupted flow of information as a direct outcome from bypassing the solid, strictly defined organisational boundaries that exist in organisations.
- The communication of teams/individuals of different background and the establishment of new relationships between individuals and organisations that collaborate for a achieving a common target.

The above mentioned points are the ones that characterise the process of social innovation as:

- Open, as it calls for open results that could be re-used by anyone in order to generate added value services and products.
- Collaborative, as the whole process calls for the vast participation of individuals, following a bottom-up approach.
- Demand-driven as the motivation derives directly from persisting or emerging societal challenges that need to be tackled.
- Multi-disciplinary, as it combines the know-how of various diverse domains and backgrounds.
- Specific and not generic, as there are various factors (like localisation) that diversify the nature of societal challenges and cannot be dealt with the application of a one-fits-all solution.

The overall process of social innovation can be summarized in four logical and interconnected phases, which follow the traditional problem solving path. As such, these steps are the following

- Identification of societal challenges that need to be tackled
- Implementations of solutions that are in a position to address partly or fully these challenges
- Assessment of the effectiveness of the proposed solutions
- Roll-out and scaling up of the most effective innovations

The outcome of social innovation is the development of innovative products and services which, in turn, are able to generate new, sustainable business models. One quite known example, but perhaps not directly linked with the rise of social innovation, is the business model of NGOs that deal with issues like the environment, etc. who are operating with the aim to deliver solutions that can help society overcome the huge challenges it faces in these domains.

Looking at the **manufacturing landscape** one can also distinguish various issues that are affecting the industry and are deeply rooted into the long-standing societal problems of the modern word. Issues such as environmental protection, energy efficiency, unemployment, population migration, population aging, health issues, etc., are all factors which are heavily impacting manufacturing industries. Such problems cannot be solved by the industries themselves, only by initiating endoscopic procedures for identifying the causes of these issues, as these are greater problems and need to be tackled by the society as a whole.

When analysing the above mentioned crucial societal issues of our time, one can see a reflection of most of them on the manufacturing domain, which constitute problems, but also opportunities, that need to be tackled by the manufacturing industry, not only for improving their productivity, but also for demonstrating a caring attitude towards society. The latter is of crucial importance in the information era, as consumers tend to become really sensitive to the social character of enterprises and, with the Web2.0 and social media power they can tap, they may directly express their concerns and criticism for enterprises that are put in target. As a result and inspired from the **Guide to Social Innovation** (European Commission, 2013), manufacturing industries are nowadays aiming at tackling issues such as:

- **Green Manufacturing**, which includes all related environmental and energy efficiency issues that need to be considered by the manufacturing industry.
- **Product/Service Co-design and Co-production**, which aims at seeking ways to engage customers to the whole product lifecycle in order to produce results of improved usage and of higher impact.
- **Knowledge Diffusion**, that deals with the unrestricted exchange of knowledge between people/departments that work together within the same or a different organization.
- **Open Knowledge Access** that deals with the opening of knowledge to the general public for encouraging and accelerating the generation of third-party results that could be of value.
- **Creation of more work places**, aiming at fighting unemployment.
- **Curing the aging of workforce**, in order to lower the media age of workers by hiring and collaborating with young persons.
- **Workplace safety**, which deals with the improvement of safety and health conditions in the work place that have a direct impact on the productivity and mentality of employees.

Based on the above, it becomes evident that social innovation is closely coupled with manufacturing excellence, although at first sight these two terms seem quite unrelated. It is today, as most manufacturers seek to find a way out of the recent financial crisis, that there is a general belief that collaboration, powered by the recent technological advancements, is the main vessel that will drive innovation. This form of collaboration can be seen from three different perspectives which are the following:

- **Grassroots Social Innovation** - How can customers collaborate to improve the impact and the quality of products and services? This perspective is based on the "**wisdom of the crowd**" approach, where customers who are the actual end users of products/services collaborate among themselves and with the manufacturer in order to develop new or improved products/services that could have a greater impact to their lives.
- **Workplace Innovation** - How can an organisation be restructured internally to allow its employees to become more creative and collaborative? This perspective deals with the internal needs of enterprise in terms of

reorganisation from the decision-making process to the innovation process. Its aim is to improve and strengthen the workforces relationships and the working conditions which allow a **continuous flow of information and ideas** between employees of all levels, in order to infuse a collaboration mentality that will drive forward innovations coming from within the firm.

- **Extrovert Enterprise Collaboration** - How can organisations work together and offer their assets for added value products and services to the society? From this last perspective, different enterprises are seen as individual entities that collaborate with each other, building **virtual alliances**, with an effort to combine their offered products/services to improve their final offerings. So in this case, it is not only the individuals that get engaged in a social kind of collaboration, but it is enterprises (or complete divisions and departments of those) who build new relationships with other enterprises or the public.

The following table provides a mapping between the different social innovation perspectives and the societal challenges evident in manufacturing, as not all perspectives are able to equally tackle these issues.

Social Innovation Perspectives / Societal Challenges in Manufacturing	**Grassroots Social Innovation**	**Workplace Innovation**	**Extrovert Enterprise Collaboration**
Green Manufacturing	X	X	X
Product/Service Co-design and Co-production	X		X
Knowledge Diffusion		X	X
Open Knowledge Access	X		X
Creation of more work places		X	X
Curing aging of workforce		X	X
Workplace safety		X	

Table 6 Societal Challenges on Manufacturing and Social Innovation Perspectives

4..2.2. Social Innovation benefits of the OC objectives

Based on the above, it becomes obvious that social innovation can provide a number of benefits to modern manufacturing and vice versa. In line with this statement, the OCs that will be launched by the FITMAN consortium aim also at stimulating some of these benefits by paving the way for further social innovation activities that are related with the manufacturing domain. A summary of the indicative benefits that spring out of the OC objectives is provided in the next paragraphs.

4..2.2.1 Social Innovation in Smart Factories

Smart Factories are characterised by the intense usage of advanced ICT tools and infrastructures to analyse big amounts of data coming from various inputs (in most cases from the shop floor) and to employ complex decision-making mechanisms for the optimisation of various aspects of the manufacturing lifecycle. The FITMAN SF trials and the topics that are oriented towards the needs of these trials aim at creating an ecosystem of tools that are in the position to constantly monitor, consume and digest information and to turn it into knowledge that is essential for taking important decisions that will maximize the input of the production lines and increase the competencies and safety of employees while at the same time minimizing other important figures, such as energy consumption, CO2 footprint, machinery malfunction rates, etc.

The following table provides an overview of potential social innovation opportunities that may derive from the Smart Factory Objective of the OCs, as reflected on the major manufacturing challenges identified in the previous section while it also presents the different social innovation directions that could be fuelled by these OCs.

	SF.1 Monitoring and diagnosis	SF.2 Next generation, attractive human-machine interaction
Societal Challenges reflected on Manufacturing		
Green Manufacturing	Energy Efficiency Optimised Logistics	
Product/Service Co-design and Co-production		
Knowledge Diffusion	Increased Information Sharing	Exchange of know-how
Open Knowledge Access		
Creation of more work places		Distant Working
Curing aging of workforce		Limiting Age Constraints
Workplace safety	Well-being monitoring Notification of shop floor events	Improved Ergonomics Notification of shop floor events
Social Innovation Perspectives		
Grassroots Social Innovation		
Workplace Innovation	X	X
Extrovert Enterprise Collaboration	X	

Table 7 Societal Innovation potential around SF.1 & SF.2

4..2.2.2 Social Innovation in Digital Factories

Digital factories are characterised by their aim to invest more in the generation of digital goods while at the same time reducing the need for producing tangible assets. The FITMAN DF trials and the OCs oriented towards these trials aim at creating and providing tools that are able to allow access, advanced analytics (visual or not) and decision support mechanisms to the large data elements related to products of digital factories, whether they constitute datasets, documents, knowledge etc. This will allow strengthening the collaboration bonds between departments of the same organisation, with other enterprises and even with the general public (customers).

The following table provides an overview of potential social innovation opportunities that may derive from the Smart Factory Objective of the OCs, as reflected on the major manufacturing challenges identified in the previous section while it also presents the different social innovation directions that could be fuelled by these OCs.

	DF.1 Product and Data Knowledge in product life cycle	DF.2 Collaborative Product 3D visualization
Societal Challenges reflected on Manufacturing		
Green Manufacturing	n/a	n/a
Product/Service Co-design and Co-production	Collaborative Production	Collaborative Production
Knowledge Diffusion	Access to knowledge repositories Knowledge Mapping Common Understanding of Knowledge	Access to knowledge repositories Interactive Representations
Open Knowledge Access	n/a	Feedback loop from public
Creation of more work places	n/a	n/a
Curing aging of workforce	n/a	n/a
Workplace safety	n/a	n/a
Social Innovation Perspectives		
Grassroots Social Innovation		X
Workplace Innovation	X	X
Extrovert Enterprise Collaboration	X	X

Table 8 Societal Innovation potential around DF.1 & DF.2

4..2.2.3 Social Innovation in Virtual Factories

Virtual Factories deal with the management of the collaboration of manufacturing plants around the world and take advantage of various ICT developments that are able to interconnect various resources (such as objects, infrastructures and people) to achieve this objective. The FITMAN VF trials and the OCs that are oriented towards these trials aim delivering tools that will support the vision of virtual factories and their daily operation by realising ways of sharing information and interconnecting systems in an easy and efficient manner. This may have a great impact on social innovation, as information and knowledge will be shared with a large number of stakeholders who in turn may be able to build on top of this knowledge to deliver high quality results and at the same time to respond to challenges such as unemployment, information scarcity, low penetration of entrepreneurship in manufacturing etc.

The following table provides an overview of potential social innovation opportunities that may derive from the Virtual Factory Objective of the OCs, as reflected on the major manufacturing challenges identified in the previous section while it also presents the different social innovation directions that could be fuelled by these OCs.

	VF.1 Manufacturing Assets Semantic Discovery	VF.2 Semantic Interoperability
Societal Challenges reflected on Manufacturing		
Green Manufacturing	Efficient use of Resources	n/a
Product/Service Co-design and Co-production	Collaboration based on shared assets	n/a
Knowledge Diffusion	Automated discovery of Information Automated data entry Improved knowledge sharing	Knowledge mapping System Interconnection
Open Knowledge Access	Public Information on manufacturing Assets	n/a
Creation of more work places	Increased Business Opportunities Improved Market visibility Entrepreneurship	n/a
Curing aging of workforce	n/a	n/a
Workplace safety	n/a	n/a
Social Innovation Perspectives		
Grassroots Social Innovation	X	
Workplace Innovation	X	X
Extrovert Enterprise Collaboration	X	X

Table 9 Societal Innovation potential around VF.1 & VF.2

4.3. Market potential and exploitation analysis

An increasingly automated world that will continue to rely less on labour-intensive mechanical processes and more on sophisticated information-technology-intensive processes is foreseen for the next decades. Future manufacturing will be more energy and resource efficient as companies strive to integrate sustainable manufacturing techniques into their business practices to reduce costs, to decrease supply-chain risks, and to enhance product appeal to some customers (Emerging Global Trends in Advanced Manufacturing, 2012).
The transition from mass production to personalized, customer-oriented and eco-efficient manufacturing is considered to be a promising approach to improve and secure the future competitiveness of the European manufacturing industries, which constitute an important pillar of European prosperity. The availability of agile IT systems, capable of supporting this level of flexibility on the production network layer, as well as on the factory and process levels, are essential to realise this promise.
In the last decades we have been witness to significant changes in the digital computing, communications (i.e. ICT). The ICT revolution has had a profound impact across manufacturing industries, shifting them towards more agile, just-in-time processing, high-performance manufacturing, and accelerated introduction of new products. The convergence of nanotechnology, biotechnology, cognitive and neuroscience with ICT is expected to cause similar disruptive changes (Trends in manufacturing to 2020 - A foresighting discussion paper, 2011). The increased use of ICT will allow manufacturers to adapt and exploit new technological product and service offerings, opening new opportunities for competitiveness and wealth creation for European manufacturers. ICT improves the efficiency, adaptability and sustainability of production systems and allows these to be incorporated into flexible business models and agile manufacturing processes. In addition, it enables industry to adapt to an increasingly globalised market which requires constant innovation in terms of production, process and output (EFFRA Research Priorities, 2013).

The current market is characterised by demands for increasingly complex products, higher quality, faster delivery and shorter lag times between successive product generations. ICT innovations needed to address these demands include new high performance technologies such as continuous monitoring of condition and performance (i.e. sensor networks), autonomous diagnosis capabilities and context-awareness (i.e. inference algorithms), intelligent machinery components (i.e. machine learning), an open and service-oriented platforms (i.e. Software as a Service), better connectivity and infrastructure technologies (i.e. Infrastructure as a Service, Software Defined Networks), mobility, data storage (i.e. unstructured data), information mining and analytics (i.e. Big Data), high performance (i.e. Cloud Computing), collaborative and decentralized application architectures and development tools and semantic. These technologies are becoming *mainstream*, and in a couple of years, their costs will fall making it possible for small companies to accelerate their product innovation, streamline production cycles and an efficient process planning, guaranteeing a rapid market adoption of their products. SME are clear winners to which competition against large companies in global markets will be facilitated.
In recent years, manufacturing has been conceptualized as a system that goes beyond the factory floor, and paradigms of “manufacturing as an ecosystem” have emerged.

Future manufacturing will be human-centric and based on four main technological pillars, i) collaboration, ii) mobility, iii) connectivity and iv) intelligence. Smart, Digital and Virtual factory concepts are based on those foundations (Factories of the Future 2020 Roadmap, 2013).

The term “smart factory” encompasses enterprises that create and use data and information throughout the product life cycle with the goal of creating flexible manufacturing processes that respond rapidly to changes in demand at low cost to the firm without damage to the environment. For this vision to become a reality several processes have to be changed or adapted. The supply chain risk management has to move from reactive to proactive. Intelligent technology and continuous monitoring of condition and performance, autonomous diagnosis capabilities and context-awareness technologies have to be in place, in order to empower manufacturers to react faster to disruptive events by monitoring risks and identifying alternate suppliers (SF.1 monitoring and diagnosis). Moreover shop-floor automation and efficiency and safety procedures as well as a user-friendly interaction between workers and machines should be in place (SF.2 next generation, attractive HMI). Mobility will deliver digitized workflows and real-time operational process visibility into operation manufacturing intelligence.

Digital factories help to reduce the need for physical prototyping and the construction of pilot plants when designing future factories. A harmonized access, from the different stakeholders, to the Product Life Cycle and the existence of intuitive query and advanced decisional-visualization (DF.1 product data and knowledge) associated with the use of collaborative product data and 3D visualization (DF.2 collaborative product data 3D visualisation) are essential to create a flexible manufacturing process that respond rapidly to changes in demand at low cost to the firm, as well as to the environment, maintaining, at the same time, the human-centric approach. These processes facilitate the flow of information across all business functions inside the enterprise and manage the connections to suppliers, customers and other stakeholders outside the enterprise, guaranteeing the a common and standard access mechanism and language, improving the interoperability between enterprises. The interoperability aspect, based on the intensive use of the correct ICT technologies, is fundamental to create a clustering effects (i.e. connectivity and opportunities), between enterprises and SMEs in supporting global multi-national companies. On the human side the new collaborative visualization tools, merged with the BYOD (Bring Your Own Device) tendency, creates new effective decisional support systems and improves the worker’s involvement.

Virtual factories support the management of complex supply chains between manufacturing plants around the world. They include context-awareness technologies, such as a network of devices, usually a wireless sensor networks and machine-to-machine communication that contribute to the real-time monitoring of complex material flows which results in a more efficient use of them. The ability to add new functionalities to plant floor software systems and quickly adjust production systems to new requirements is a concept centred on an inter-factory model that serves as a marketplace for virtualized manufacturing services. The implementation of a cloud-like architecture concept vision will provide users with the ability to utilize the manufacturing capabilities of configurable, virtualized production networks, based on cloud-enabled, federated factories, supported by a set of software-as-a-service applications. In such scenario the need for coherent assets semantic discovery languages and procedures (VF.1 manufacturing assets semantic discovery) and semantic data transformation (VF.2 semantic interoperability) is

essential to achieve compatibility in the supply chain. In addition, they will give rise to further services, such as advanced maintenance technologies for assets used in the manufacturing process.

The FITMAN Open Call components are expected to have an immediate impact on different manufacturing domains, not addressed in FITMAN trials, which includes Ceramics and Footwear, among others. Both are chasing the Future Manufacturing concept (defined previously), in particular, the supervision of the production data with instant diagnosis, management of production lots and simplified human-machine interaction are fundamental to guarantee higher performance, overall reduction in direct costs and waste and boost companies competiveness. In both scenarios the asset discovery process is critical to minimising the risk associated with investment decisions. Those decisions may also be based on analytics which bring to organisations the possibility to build dashboards that provide real time views of Key Performance Indicators (KPI) to deliver strategic and management level insights. Both are fashionable demanded and with high customized potential what increases the need to use collaborative product data, interoperability, user's feedback (i.e. usually coming from web services without semantic annotation – unstructured data) and intuitive annotation of 3D virtual artefacts.

The ICT and, in particular the topics covered by the Open Calls, impact several aspects of business performance that have direct impact in the manufacturing market development, including productivity growth, enhanced profitability and costs reduction.
ICT increases productivity through its capacity to reduce costs, increase the capability of machinery, and provide increased flexibility in production planning and scheduling. ICT allows for increased scale and speed of machinery operations as well as an expanded management span of control/coordination.
In fast moving consumer goods industries, ICT has enabled companies to move from a product focus to a customer focus by being able to manufacture more closely to customer preferences/requirements rather than to production possibilities, this change in the market is only possible if a collaboration platform associated with the product development and planning and real time monitoring functionalities are in place.
In globally oriented and highly competitive industries, businesses need to keep up with the technological change and developments in order to stay in the market. The functionalities identified in the call objectives are essential ICT functionalities to keep-up enterprises in the market and/or to open new market opportunities by getting a clear differentiation from the concurrency.
The engagement that technology allows with clients, following the production, delivery and sale procedures, enables information on product performance to be relayed to manufacturers for monitoring, quality assurance and triggering service and maintenance actions, these information feedback the system what open new opportunities for market development and new business opportunities. With the correct use of the ICT technologies, presented in this document, companies are able to cater for smaller niches and specialist product markets.

5. Conclusion

We recall that the goal of deliverable D 3.6 is to report on the critically analysis of the constituency of the FITMAN trials with respect to their objectives in order to identify functionality/competencies/capabilities gaps which could be filled by Open Calls.

The initial analysis of the deliverables D 1.1 (Business Requirements) and D 1.2 (IT Requirements) put in evidence that six potential challenges (Gaps) have not been fully addressed by current FITMAN solutions yet, two for each domain: Smart Factory, Digital Factory and Virtual Factory:

- Smart Factory:
  - ✓ **SF.1 monitoring and diagnosis** (Advanced Intelligent Manufacturing),
  - ✓ **SF.2 next generation, attractive human-machine interaction** (Human-centred Manufacturing),
- Digital Factory
  - ✓ **DF.1 product data and knowledge in product life cycle** (standard-based access to PLM and product-item data),
  - ✓ **DF.2 collaborative product data 3D visualisation** (Collaborative and Mobile PLM),
- Virtual Factory
  - ✓ **VF.1 manufacturing assets semantic discovery** (Cloud Manufacturing, Manufacturing as a Service)
  - ✓ **VF.2 semantic interoperability** (Product-Service Manufacturing Ecosystem),

In this deliverable, we aimed at demonstrating that these choices are pertinent because they contribute to develop functions and applications that are declared as absolutely relevant for the development of manufacturing enterprise and Factory of the Future:

- **Factory of the Future** and **EFFRA** roadmap: one of the most important studies developed by European Industry in liaison with the European Commission. The strategic Roadmap identifies “ICT-enabled intelligent manufacturing” as one of the four pillars to support European manufacturing industry. This pillar is a key driver in the challenging transition from post-crisis recovery to a European STEEP (Social, Technological, Economical, Environmental and Political) sustainability to regain competitive advantage in the global market competition.

- **FInES (Future Internet Enterprise system)** roadmap: this cluster of DG Connect has developed several studies since 2007 in order to analyse the evolution of the Enterprise particularly Enterprise 3.0. In the most recent roadmap two “spaces” are defined to categorise enterprises. The first space refers to the traits of the enterprise of the future: Inventive, Humanistic, Cognitive, Community-oriented, Liquid, Agile, Sensing, Glocal, Sustainable. The second space refers to several characteristics: Networking, Knowledge, Human-Machine Interaction.

- **Internet of Things (IoT)**: In the manufacturing environment, IoT technologies and approaches are envisaged as a way to address issues such as: globalization, technological evolution, dynamization of the product lifecycle, aging of workforces, shortage of resources, and green production development.

- **Industry 4.0**: the well-known proposition of the German Manufacturing Authority which promotes a Horizontal integration through the value networks, an End-to-end digital integration of engineering across the entire value chain, and the vertical integration and networked manufacturing systems.

- **Industrial Internet** according General Electric, the first non-academic voice raised to support and foster the revolution of Internet of Things "Pushing the Boundaries of Minds and Machines".

However the six topics proposed for the Open Call will allow impact on Business Innovation, Social Innovation and Potential market.

Out of these advantages, the six topics will allow extension of the trials and development of more advanced solutions.

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