# *D1.1*

# *FITMAN Use Case Scenarios and Business Requirements*

## *WP1 FITMAN Baseline System*

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**Version history**

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| **0.1** | **22/04/2013** | **TABLE OF CONTENTS AND RESPONSABILITIES** |
| 0.2 | 07/06/2013 | SECTIONS 3 AND 4 |
| 0.3 | 28/06/2013 | FIRST VERSION READY FOR INTERNAL REVIEW |
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**Deliverable Peer Review Summary**

| ID | Comments | Addressed (✔) Answered (A) |
|---|---|---|
| 1 | The Deliverable gives detailed descriptions and information on the trials regarding objectives, business scenarios, business requirements and impact, etc.. This is very useful in WP2. | ✔ |
| 2 | Chapter 5 delivers a large statistical analysis of the collected information. A section describing how this statistical information will be used later on in FITMAN would be beneficial. | ✔ |
| 3 | Some “Word Track Changes and Comments” have been inserted in the text regarding minor issues. These need to be checked. | ✔ |
| 4 | For easier reading and browsing of the document, please insert numbering of pictures/graphs and tables. | ✔ |
| 5 | A very good document! | ✔ |

| ID | Comments | Addressed (✔) Answered (A) |
|---|---|---|
| 1 | The deliverable is fully adressing the analysis of trails business characteristics, features and expectation. In order to exploit these information for WP2 (D2.2+D2.4) and WP7 a strucutred and synoptic representation of objectives should help to benchmark results of trials (especially numeric values) | (A) |

| | | |
|---|---|---|
| 2 | Very accurate and appealing look of the document.. In section 5 could help a schema for navigation of pictures | ✔ |
| 3 | See comments inserted | ✔ |
| 4 | Industrial exploitation and impact potentials: Was discussed with trial owner access to real data for V&V process ? | The access to bechmark reference data was not dealt with in WP1 questioning process. This could be the subject of analysis in WP2 and WP3 tasks. |

## Table of Contents

## Executive Summary

Current factories are nowadays going through a transformation that should respond to major megatrends taking place worldwide. To address such challenges, future enterprises are developing new capabilities in their three dimensions smarter, digital and virtual factories. These advanced business capabilities can be achieved providing improved technologies for interoperability, connectivity, mobility and intelligence, which make enterprises smarter, more agile, mobile and collaborative. Future Internet technologies present enterprises with a new instrument to implement highly efficient business processes that leverage a competitive advantage for the enterprise.

The document carry out an insight into the business processes and business requirements that have been identified in the 11 trials defined in FITMAN to trigger the use of Future Internet technologies in the factories of the future, focusing on the production, engineering and technical support as the main departments within the enterprise that will provide the business requirements.

The document provides a clear understanding of which are the business processes (and the value behind), use cases that are driven by Future Internet technology adoption and the business requirements that drive the adoption.

The document provides a good vision into the motivation for companies of different sizes, departments within such companies and different sectors to engage in a digital business transformation and summarises the results taken when comparing the main studied values (business objectives, bottlenecks and weaknesses, and business requirements), among trials, regarding type of factory (Smart vs. Digital vs. Virtual).

The results obtained in this document have been obtained following an adaptation of the Wellington methodology, which is an iterative methodology based on 4 steps. FITMAN has defined 4 major phases to realise the analysis (1) Conceptual design. Approach discussion and agreement (2) Classifying and categorising the content (3) Creation of the template / interview (4) Template and Interview schedule. The complexity of the analysis (11 trials and up to 44 processes) demanded an agile and parallel approach. To address this issue, the FITMAN methodology has combined the use of a questionnaire, an interview process and the notion of trial handbook to perform two analysis iterations. The most challenging aspect has been the realisation and communication of the methodology and the coordination of the surveys in 11

sites with the short period of time available (3 months to complete methodology definition and perform two iterations of analysis).

This document presents a comprehensive introduction to business activity of the company involved in the trial, the current IT systems, the weaknesses to be addressed in the current operation and the foreseen innovative FITMAN solutions. The focus is also on the formulation of business objectives and business drivers for FITMAN and FI-WARE technology adoption.

FITMAN findings reveal that the general business objectives behind FI technology adoption seek to (1) Improve communications/collaboration (2) Reduce production costs (3) Reduce time to market (4) Improve the usefulness of the information (5) Increase production capacity. The main business drivers; i.e. business cases, behind FITMAN technology adoption are related to (a) reduction of costs and (b) improvement in efficiency. FITMAN has also found that the main rationale to start or propose the adoption of innovative ICT technology in the manufacturing context is related to the ability to show improvement in the areas of data interoperability, removal of rigid and static procedures and inefficient data processing methods. This rationale is fully supported by manufacturing, technical support and management departments in the factories that are the areas that are most represented among the divisions involved in the FITMAN trials.

One of the most interesting findings relates to the different interests that move Large enterprises and SMEs, which are sensible to different aspects of the business processes. While LEs have a larger interest in increasing the production capacity and improving work safety and security, LEs find it less significant than SMEs to improve communication and collaboration.

Finally, the three types of trials FITMAN has analysed (smart, digital and virtual) coincide in identifying efficiency as the main improvement that could be leveraged by FITMAN platforms. FITMAN has also derived some recommendations for further work from the analysis of the results obtained. In particular, it is important that FI-WARE GEs, FITMAN SEs/TSCs are not perceived as isolated modules in the FITMAN context, but as a source of competitive advantage generation. Hence, it is recommended that the business requirements, business processes defined in D1.1 are further traced down to GE, SE and TSC implementation in future project developments. Thus, FITMAN should be able to present the value proposition of the GEs to the different domains (Smart, Digital and Virtual). This contextual information is critical to foster future adoption of the GEs, since potential users will better understand which value the use of a particular GE, SE or TSC is bringing to the customer.

# 1. INTRODUCTION

## 1.1. Introduction

Current factories are nowadays going through a transformation that should respond to major megatrends taking place worldwide. These megatrends have been identified by various road mapping and strategic research activities, such as the ones detailed in Annex I; e.g. FInES, EFFRA. Such global megatrends include for instance:

- Urbanisation, megalopolis and a growing middle class in developing countries are fuelling demand for niche industrial products.
- Purchase decisions are being made based on brand perception of safety, quality and personalised/customisable products.
- Within Europe, the problem of an aging workforce is becoming critical and action must be taken to facilitate transfer of knowledge from the aged workforce to the younger workers, and to assist their daily work with user-friendly ICT tools.
- Globalisation has led to the emergence of smaller dynamic enterprises able to put innovation into practice more rapidly than their bigger – and slow-moving – counterparts.
- European enterprises must acknowledge the importance of innovation and put it to practice faster.
- Sustainability has become a key topic on the agenda of politicians and corporate executives. It is necessary to transition from a wasteful to a frugal economy.
- Awareness and transformation of industrial processes towards low carbon footprints and energy efficiency.

To address such challenges, future enterprises are developing new capabilities in their 3 dimensions smarter, digital and virtual factories. Such development of the enterprise capabilities heavily rely on innovative application of future ICT technologies. Such Future Internet capabilities should leverage enterprises to respond more effectively to current challenges faced by the enterprises; i.e. Global competition (b) Reducing energy consumption (c) Reducing waste generation (d) Complying with legislation (e) Materials scarcity (f) Constant need for innovation.

To increase their **factory productivity** factories at the smart factory level aim at being able to have better control and optimisation of factory processes in the shopfloor. Similarly, in the digital dimension, the factories aim at increase their **design productivity and knowledge management** capabilities so that they can actually "see" the product before it is produced. Thus, faster times to market can be achieved, better and more efficient product can be produced and design errors can be reduced. Finally, in the virtual factory dimension, **supply chain productivity** is the goal, with better product-service integration and collaboration among stakeholders being unveiled.

Such advanced business capabilities can be achieved providing improved technologies for interoperability, connectivity, mobility and intelligence, which make enterprises smarter, more agile, mobile and collaborative. This is reflected in the different subdomains and enabling technologies identified by FInES and EFFRA – see Annex I for a brief summary on

their 2020 visions. To realise the business processes of the future, different parts of the enterprise (design, engineering, production, supply chain, sales, marketing) should exploit the capabilities of big data, service platforms, information security, cloud computing, etc., in innovative ways. Future Internet technologies present enterprises with a new instrument to implement highly efficient business processes that leverage a competitive advantage for the enterprise.

The aim of this deliverable is to provide an insight into the business processes and business requirements that have been identified to trigger the use of Future Internet technologies in the factories of the future. Although the use Future Internet technologies globally apply to the whole enterprise, FITMAN has focused on the production, engineering and technical support as the main departments within the enterprise that will provide the business requirements and use cases for analysis. These departments are information intensive and could benefit very quickly from the adoption of Future Internet Technologies. A high-level matching between the Future Internet capabilities leveraged by FITMAN in the various trials and the manufacturing capabilities envisaged for future collaborative, mobile, digital, virtual and more energy efficient factories can be found in Annex I.

It is worth noting, while addressing the material in this document that D1.1 does not to aim at representing a comprehensive study on the business requirements that drive the adoption of Future Internet technologies at a sector level. On the contrary, it aims at creating a good and solid background to understand the business rationale behind the adoption of Future Internet technologies by enterprise departments such as those involved in the FITMAN trials. Thus, the reader should obtain a clear understanding of which are the business processes, use cases that are driven by Future Internet technology adoption and the business requirements that drive the adoption. Hence, the business value behind such business processes for such departments can be highlighted and inferred at a sectorial level. Ultimately, the document provides a good insight into the motivation for companies of different sizes, departments within such companies and different sectors to engage in a digital business transformation. Hence, it establishes a very relevant benchmark in terms of the business drivers that should be behind the adoption of FI-WARE in general and FITMAN in particular as a valid innovation platform for ICT for Manufacturing. At the end of the day, companies will have to decide between traditional ICT for manufacturing product and service innovation or a FI-WARE based approach. The one being most competitive will prevail, which ultimately means, the one being able to implement more effectively and efficiently the business requirements on specific business processes with the expected performances.

## 1.2. Document Scope

D1.1 is structured in 6 chapters providing the main information related to the trials and the business requirements, and additionally, several annexes supplying more detailed information on some specific topics.

Chapter 1 is just the introduction to the document. It starts with a general description of FITMAN, the objectives of WP1 in general and specifically the goals of T1.1. It includes also an explanation of the links and contributions of T1.1 with other tasks and work packages in the project. The final topic is related to the methodology applied during T1.1.

Chapter 2 is focused on the description of the trials and the global framework, introducing the companies involved in each trial, the current IT systems in place and the main weaknesses and bottlenecks to be addressed.

Chapter 3 explains the selected business scenarios in detail including current and future pictures, as well as the main objectives and the identification of risks.

Chapter 4 is the detailed description of the business processes and the businesses requirements, together with the justification of the business objectives and the expected impact in the company.

Chapter 5 is focused on the analysis of results. It includes justified comparisons between trials, type of end-user (Large vs. SME), and type of factory (Smart vs. Digital vs. Virtual).

Chapter 6 collects the main conclusions of the document.

Finally, we include a number of annexes increasing detailed information about several topics including the European manufacturing context, the links between FITMAN and FI PPP, FF PPP, FInES and EFFRA, or the methodologies applied in requirements engineering.

## 1.3. General Description

FITMAN is one the 5 Use Case Trials projects selected in the 2nd phase of the FI PPP programme[1].

FITMAN provides the FI/PPP Core Platform with 11 industry-led use case trials which test and assess the suitability, openness and flexibility of FI-WARE Generic Enablers while contributing to the STEEP (social-technological-economical-environmental-political) sustainability of EU Manufacturing Industries.

The FITMAN use case trials belong to several manufacturing sectors such as automotive, aeronautics, white goods, furniture, textile/clothing, LED lighting, plastic, construction, machinery for wood, and manufacturing assets management.

**FITMAN TRIALS SCOPE:**

- **TRIAL 1 (Automotive OEM):** Main goal is to improve the monitoring and control of the production planning processes along car development. It will increase the reliability and the efficiency of production implementation.
- **TRIAL 2 (Automotive Supplier):** The trial aims the evaluation of Future Internet Technologies to support high-performance proactive health and safety management strategies, in order to reduce worker generated incidents and accidents in the factory.
- **TRIAL 3 (Aeronautics OEM):** This trial will support the secure and timely flow of technical knowledge between an original equipment manufacturer and its ecosystem of customers and service stations spread all over the world.

[1] More information on FI PPP in Annex I. European manufacturing context. Links between FITMAN and FI PPP, FF PPP, FInES and EFFRA

- **TRIAL 4 (White Goods OEM):** This trial will improve the integration between process and people on the shop floor through the integration in current platforms of intangible assets constituted by hard and soft skills of the workers with the huge quantity of production and quality data generated in real time.
- **TRIAL 5 (Textile/clothing):** The trial aims at creating agreements between competitors to share production facilities, i.e. core of a cloud production.
- **TRIAL 6 (Plastic industry):** This trial will explore new business processes collaboration capabilities using new IT capabilities.
- **TRIAL 7 (Construction Industry):** The trial aims at optimising the management of the construction projects, by early identification of design and technical mistakes, including on line detection and real time fixing of incongruences using remote collaboration.
- **TRIAL 8 (Manufacturing Resource Management):** The trial aims at monitoring the flow of goods within a manufacturing SME network, and allow the tracking of such products, using smart objects and mobile tracking technology.
- **TRIAL 9 (LED Lighting):** This trial will improve the control components of light systems for locations and plants in terms of software and hardware, analysing requirements and constrains in an early design phase.
- **TRIAL 10 (Machinery for wood):** The trial aims at improving the design and manufacturing process of machinery used for wood transformation by enabling business interoperability between different internal services, by optimizing the management of the suppliers and of the quoting process.
- **TRIAL 11 (Furniture):** The trial aims at capturing fashion trends and turns tem into designs quickly and frequently, make products that follow the trends very quickly, with lots of variety, with very competitive prices, and knowing the user's response, in order to remove or modify unsuccessful products form the market.

All trials are distributed in three types of factory, namely Smart, Digital and Virtual.

***The Smart Factory*** challenge aims at being able to deliver ICT solutions that make production systems more sustainable (greener, safer and more resource efficient). FITMAN trials within the Smart Factories will significantly improve the registration process of industrial sensors and services, facilitating a simpler deployment of smart objects in the factory shop-floor and more intelligent production practices.

***The Digital Factory*** challenge aims at improving the time-to product and time-to-market of products and services of various kinds. FITMAN trials within the Digital Factories will manage more efficiently the product life-cycle information to impact productivity and the new trends and paradigms like an increasing demand for sustainable manufacturing and mass customization.

***The Virtual Factory*** challenge aims at facilitating the collaboration among various organisations involved in industrial supply chains, enabling the efficient flow of information about procurement, inventory, production, delivery, etc. FITMAN trials will demonstrate how basic security functions through FI Security GE can be provided to a large constituency of enterprises, and how collaboration and trust can be constructed over such basic functions inherent to the Future Internet.

## 1.4. WP1 Description

The overall objective of WP1 is to develop a FITMAN baseline system, which will allow filling the Phase I gap with respect to the FI PPP Programme dealing with the following aspects:

- to collect and harmonize Use Case Scenarios in the Smart-Digital-Virtual factory domains
- to analyze and generalize expected domain-specific User and Business Requirements from Trials
- to synthesize common IT Requirements to FI-WARE and Specific IT Requirements for Trials
- to study and select FI-WARE Generic Enablers to be used in Smart-Digital-Virtual Factories Trials
- to instantiate FI-WARE Generic Enablers to the specific Smart-Digital-Virtual Factories Trials
- to study and consolidate the interconnection between FITMAN and the Capacity Building FI PPP Projects

The first task of WP1 is T1.1. Consolidation of use case scenarios and business requirements. The main objective of T1.1 is therefore the development of the business requirements at the trial level. Additionally, this task is the base for subsequent activities. In this context, our document D1.1 is the main outcome of T1.1. Consequently, the main goal of the document will be to define the use case scenarios and business requirements of the FITMAN trials.

In order to provide an efficient solution to identify the business requirements, it is important to analyze several methodologies for requirements compilation. The following section will provide a global overview of those methodologies aligned with the scope of the document.

## 1.5. Contribution to other WPs

The work we have developed within T1.1 summarized in D1.1 can be considered an important starting point for the project. The general results obtained in this document will be connected and will contribute directly to other work packages and to specific deliverables, apart from WP1 FITMAN Baseline System.

In this regard, deliverable D1.1 is directly associated to WP2, especially to task 2.2 FITMAN V&V Business and Technical Indicators, where a selection of business and technical indicators, should be defined. The definition of use cases per trial, as well as the identification of specific business indicators and requirements of each business scenario, will contribute to have a global overview about the specific problems, needs, situations or processes each trial needs to solve through the implementation of the Generic and Specific Enablers. In relation to this second work package, the contribution of D1.1 to task 2.4 is also meaningful.

Taking it into account, these results will be connected with WP3, contributing to plan and prepare the 11 trial Business Cases to be adapted to the FITMAN system, that will take place in Task 3.2. Each Trial will have 1-2 use cases which need to be modelled, detailed and implemented at business ecosystem level, invoking FI GEs, FI SEs and enterprise specific components.

On the other hand, WP7 will be focused on the lessons learned, recommendations and best practices. According to this, the use case trial experiences developed in this document will cover a broad range of contents in terms of industrial domains, business models, operational approaches and management attitudes that will ensure a remarkable data base of information. The deliverable will contribute to get a set of goals in task 7.1, setting up an operational environment for information collection and storing, according to defined methods and methodology, data gathering form Use Case Trials and organization, consolidation and presentation of performance indicators and other relevant data.

T1.1 and D1.1 will also contribute to WP8, more specifically to the task 8.1 FITMAN Use Case Trials comparative evaluation, providing appropriate information and significant hints from heterogeneous industrial/business environments, as well to the task 8.2 FITMAN Expanded Trials Proposition, in charge of evaluate the feasibility for each trial.

## 1.6. Contribution to other Deliverables

Concerning the contribution to other deliverables, D1.1 is mainly linked to D2.2 which is the deliverable in charge of defining and specifying the main business indicators for each trial. Such qualitative and quantitative indicators will be finally used to measure and visualize the level of achievement of the business objectives and requirements identified within D1.1.

In addition to that, as D1.1 has collected and organized wide-ranging information from all 11 trials, it is also a general document contributing to other deliverables requiring specific information from the trials, namely D2.4, D3.2, D7.1, D8.1, D8.2, among other.

## 1.7. Methodology

One of the most important issues to be taken into account when addressing a development of any commissioned solution is to fully understand what the end-user is expecting. If not doing so, customer satisfaction and cost will be affected (Eberlein & Halsall, 1997). In order to assure that what is finally developed meets what the final user wants and to reduce further major modifications that can become very complex, the process of eliciting requirements has to be adequately performed. This is the main reason why requirements' engineering has become an important and very recognized discipline (Gürses, Seguran & Zannone, 2013).

Requirements engineering was probably first used as a term in 1979 in a TRW technical report[2]. Attention to this discipline has been increasing during the last years. The growing attention being paid to stakeholders' needs and desires reflects the growing importance of requirements engineering (RE) in software and systems development (Glinz & Wieringa, 2007).

Regarding the FITMAN project, techniques and methodologies applied in requirements engineering have been analysed, adapted and applied to the requirements acquisition[3]. Several fields of application are currently addressed by requirements engineering, namely

[2] Software Requirements Engineering Methodology (Development) Alfor,M. W. and Lawson,J. T. TRW Defense and Space Systems Group. 1979.
[3] More information on the methodologies in Annex II. Methodologies applied in requirements engineering

software engineering, Data warehouse, business intelligence, e-commerce, telecommunications, automotive, etc. This review included several methodologies, such as:

- **CRISP-DM** (CRoss-Industry Standard Process for Data Mining) (Chatam, et al., 2000)
- **RATS** (Requirements Assistant for Telecommunications Services) (Gerhard, 1997)
- **DoRCU** (Documentation of requirements user centered) (Báez, 2002)
- **DWARF** (Data Warehouse Requirements definition) (Rilston et al. 2003)

### Method of work applied to D1.1

From previous analysis of the different methodologies, it is clear that an iterative approach is the most suitable method when dealing with the definition of requirements, no matter the type of project we are attempting. Some of the methodologies make it clear that the context of a business and the business processes are both very important when defining the business objectives of a certain project. Most of the methodologies propose a sequence for the whole process of requirements definition, including in most cases different steps that can be summarized in: understanding of customers' context, elicitation, analysis, negotiation, and evaluation/definition.

However, although all of the methodologies studied contain and define the importance of an elicitation phase, none of them describes in enough detail the procedures or methods that can be used when actually acquiring the data from the "clients" (in our case, the Trial players). So at the beginning of T1.1 we found it necessary to define a trusted method for this data acquisition.

There are different methods to collect valuable information from different sources. For the elicitation phase of the requirements at FITMAN, we have found that Wellington's methodology is the most simple and directly applicable that can cover our necessities. In this respect, within FITMAN, we are going to adapt and implement the methodology of **Wellington**[4] created in "Research Methods for the Social Sciences". It follows a 4-step method:

1. Brainstorming
2. Classifying and categorising
3. Creation of the guide
4. Interview schedule

The FITMAN revision of Wellington consists on the adaptation of the steps to the real requirements centered on our Trials. Thus the steps to be followed are:

1. **Conceptual design. Approach discussion and agreement**
2. **Classifying and categorising the content**
3. **Creation of the template / interview**
4. **Template and Interview schedule**

[4] Wellington, Jerry, and Marcin Szczerbinski. Research Methods for the Social Sciences. London: Continuum International Publishing, 2007

The specific procedure to gather the information will therefore follow the next steps:

1. **Conceptual design. Approach discussion and agreement**: In this stage, we developed an initial idea to attempt the data gathering and define a first version of the questionnaires that was discussed with the rest of the work packages 1 and 2 participants. After an initial agreement, we planned a schedule for a review and second release of the questionnaires.
2. **Classifying and categorizing the content**: In this phase, we discussed, analyzed and review the content we need to include in the questionnaires and the format of the different paragraphs to achieve a certain degree of harmonization and quality.
3. **Creation of the template / interview**: After the classification and categorization of the content that the questionnaires had to contain, we develop a final version of the questionnaire that was delivered to the Trials. We also planned the preliminary content of the interviews in order to assure accomplishment of schedule and effectiveness.
4. **Template and Interview schedule**: We finally entered in an iterative phase were interaction with the trials was done to assure understanding, length, coherency and quality of the information delivered. This phase hold the delivery and feedback of questionnaires and the interviews for final adjustments, corrections and fulfilment of required information.

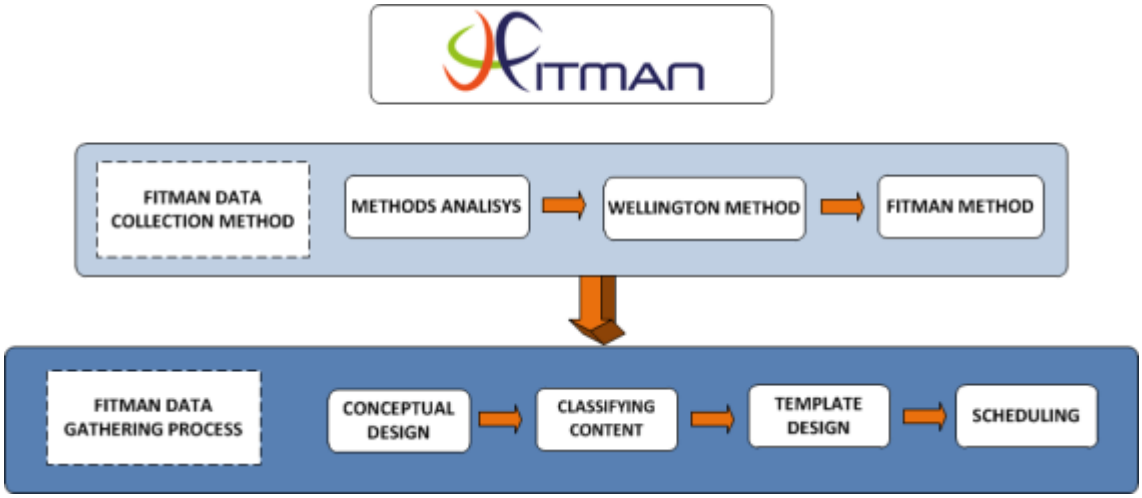



***Figure 1- FITMAN Data Gathering Method***

The main steps are presented in the next picture.

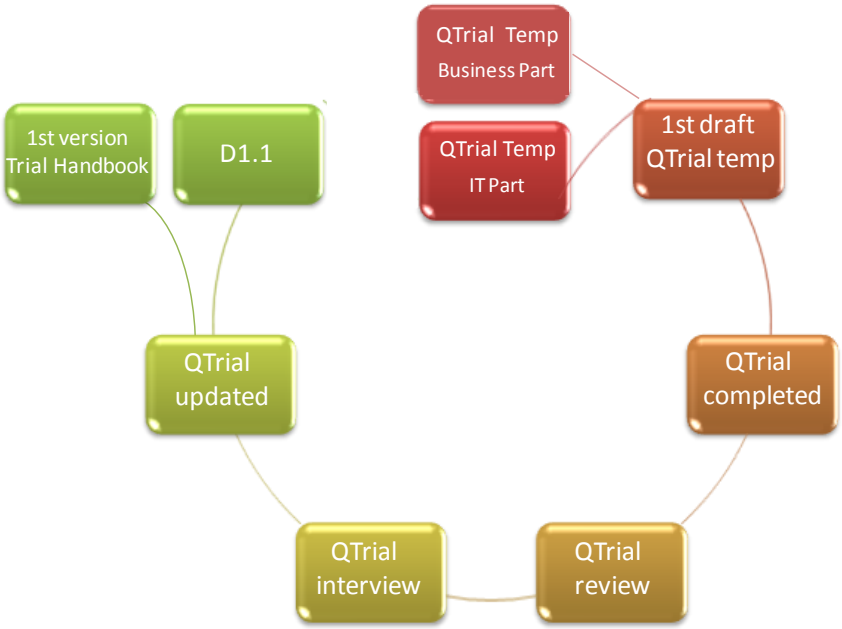



***Figure 2 - FITMAN Data Gathering Method***

The main workflow implemented has consisted in a first collection of information dealing with IT and business aspects. A Questionaire (QTrial) has been implemented for this purpose. The questionnaire has been substantiated with an interview after careful analysis of the inputs in the QTrial document. This interview had the purpose to clarify the contributions made and to fine-tune further refinements in the elicitation process. As a result of a second interarion the QTrial is updated and collected. This information is incorporated into a master document trial specific (The Trial Handbook). The joint analysis of the information gathered by the Trial Handbooks of all sites is then incorporated into D1.1, which extracts the essence of the finding included therein.

# 2. TRIALS GLOBAL FRAMEWORK

## 2.1. General Description

After the general introduction, trying to reflect the context, the importance and the connections of D1.1 to other tasks and deliverables, we are now commencing with the global framework of each trial.

In our case, a TRIAL is basically each of the 11 real industry-led cases involving companies and technology organizations where we are going to develop a real test in order to test and assess for instance the suitability, openness and flexibility of FI-WARE Generic Enablers. The TRIAL will also cater for analysis and evaluation of performance of FITMAN SE and overall operation with Trial Specific Components (TSC).

In the next pages we have organized the description of each trial grouping them around the three main concepts introduced in 1.2. General description:

- Smart Factory
- Digital Factory
- Virtual Factory

Within the proposed Global Framework we will be explaining in detail, for each trial:

- participating organizations
- introduction to the company
- current IT systems
- weaknesses to be addressed
- introduction to the trial (main aims, procedures, general expected results...)

## 2.2. Smart Factory Trials

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | TRW Automotive | INNOVALIA |
| **Automotive Supplier** | **Smart Factory** |  |  |

**General Description**

The Automotive Supplier LE Industrial Trial, led by TRW Automotive (hereinafter TRW) and supported by Innovalia as IT provider, has objectives to improve the health and safety of workers in production workplace through the adoption of FI-Ware technologies in risk prevention and management, which will have great impacts not only on Large Enterprise but also relevant SME with chain effect especially in the context of Smart Factory of the Future. The tremendous benefits of impacts are reflected in the following aspects:

1. **Improvement of workers safety and security:** The implementation of advanced

technologies to integrate a human-centred occupational model focused on the security and safety of the workers will be the main benefit of the TRW Trial.

2. **Enhancement of the competiveness:** The integration of human-centred model will allow getting a significant increase in the companies' productivity by the reduction of accidents and incidents.
3. **Reduction of costs and increase of benefits in production:** Due to the improvement of the health and safety of workers, the number of accidents and incidents that currently occur in the factories will decrease. As a result, a very high amount of costs will be reduced, not only the direct costs but also the indirect ones.
4. **Increase of effectiveness in the industrial processes:** The new technologies will allow the monitoring and detection of the most important risks, such as ergonomics and collisions, in order to inform the workers. As a result, both the worker's safety and security will be increased, and in consequence the effectiveness of the process will be improved.
5. **Improvement in company image:** The enhancement of the working conditions will have a direct effect on the workers, the factory and the society perception, because the current society gives them much importance.

The TRW trial will take place in the Smart Factory application domain. In the Smart Factory domain both tangible (energy, productivity, throughput, and waste) and intangible assets (customer sentiments, workforce, wellness, comfort and safety) will have to be managed. Thus, FITMAN through the technology proposed will trial more efficient knowledge-management strategies leading to more competitive production, such as worker-friendly production.
In the context of TRW, Future Internet technology offers the opportunity to plug such H&S control systems to the FI-WARE services to enhance the proactive capabilities of the system and facilitates immediate deployment in all factories world-wide. The FI technologies such as complex event processing, knowledge management, messaging, and advanced visualisation will allow achieving the expected performance level in terms of risk condition identification and contextualised reaction.

The exploitation of these technologies (related to IoT, data management or security, among others) will permit that the trial demonstrates highly effective and innovative registration of smart objects for smart production, and registration of risk logic and prevention actions. The trial will evaluate the capabilities of the system to register and track all the smart objects (sensors, actuators and web services), including workers, goods, personal protection equipment, moving objects, etc. In addition, it will also consider the registration of the preventive actions and prevention strategies.

**Weakness & Bottlenecks**

One of the main problems of TRW, and the manufacturing sector in general, is the reactive and subordinated to the economic aspects of the current occupational risk prevention systems. The preventive actions have an individualized, partial, rigid and legislative approach of the occupational safety, which impacts in the low efficiency and sustainability from the economic and social points. The main problem is focused on the lack of customized, flexible and real-time actions, which will allow checking the validation of prevention strategies that have been implemented.

On the other hand, there is a lack in collision detection between workers working on

machines, and workers on foot and forklifts that move from and to the lines and warehouse; being these two risks the most feasible and probable in a production and assembly factory.

One of the main weaknesses is the inability to connect a large number of systems and devices to the control system of the factory, so it is not possible to process the amount of data generated. In this way, a full assessment of the real situation of the company cannot be done, having to make use of alternative action as periodic reviews and random inspections. That is, the ergonomic system cannot be used properly because there is no technology to process and detect limits and conditions of risks in a simple way, being applicable to the daily activity of the factory. Furthermore, each of the actors do not get the data related to their work, because operators do not have an active participation in the prevention, while all the work falls on the prevention technicians and H&S coordinators. Current TRW prevention plans are generalists (non-customized), static (not in real time) and rigid (not adapted to the worker's needs).

Taking it into account, the most common weaknesses and bottlenecks identified will be listed below:

- **Limitations in traditional prevention management systems:** Traditional prevention management systems are more focused on general inspections than in the detection of risks before they happen.
- **Incapacity to prevent and detect ergonomic risks in workers:** The ergonomics system developed in the FASyS piloting is not able to process the data as a daily activity.
- **Impossibility to detect collisions between workers on foot and forklifts:** Lack of collision detection (and area manager) systems, which is one of the most probable risks in TRW factory.
- **Inability to connect a large number of systems and devices to the control system**: Current TRW control system has not the capacity to connect different devices and systems as the ergonomic, collision detection or area manager ones.
- **Incapacity to send personalized information to each actor (workers, prevention technician and H&S coordinator):** All the data related to prevention are sending to the H&S coordination centre, without distinguishing between different actors.
- **Impossibility to design a customized prevention strategy:** The prevention strategies are generalist, as the different conditions and limitations of each person are not taken into account.
- **Workers do not participate in the prevention actively:** Current models only use the workers as final actor to whom teach training session.
- **Lack of technology to support the deployment of the proactive human-centred H&S platform:** Current technology is not able to assist on the development of the H&S platform for a daily use.

**Expected Results**

Once the TRW trial is completed, the factory will be able to monitor in real time both assembly lines and low visibility crosses, sending an alarm when predetermined limits are reached. These alerts will identify the risks, levels, areas and possible preventive actions to be implemented by each of the actors, since according to the type of user different information will be sent to their devices. The operator will display the information on the HMI, the prevention technician on a mobile device or tablet, and the H&S coordinator in the office computer. The main expected result, at processes level, is the integration of proactive

prevention management systems and platforms in the factory, i.e. human-centred H&S prevention model.

This requires developing a certain level of artificial "intelligence" to collect, classify and rate the data providing a limited list of alarms to facilitate the work of human experts. More specifically, it aims real time and continuous workers monitoring using the ergonomic, collision detection and area manager systems, which will allow collecting and generating parameters used to measure those risks. By processing the data obtained during the working day, detection of different levels of ergonomic and collisions risks can be done in real time, enabling a proactive prevention system that prevents the appearance of risks by implementing measures.

The real-time and continuous data collecting systems will be the following:

- The **ergonomic system** will monitor the positions performed by workers, identifying the inclination or deflection ranges adopted and the numbers of times per minute were performed during these movements.
- The **collision detector system** objective is detecting multiple moving objects within the same scene, as well as placing them in 3D space relatively to the camera position. This will provide the ability to determine the distance between various objects or persons to avoid collisions.
- The **area manager system** able to identify whether an object / person approaches the machine, in addition to finding the orientation in which is placed a piece, with the objective to know a priori whether a machine movement could cause a collision between machine / piece.

Other principal expected results are on one hand, the connection of a large number of smart H&S control systems to the platform; on the other hand, the use of FI technologies in the continuous evaluation of large amounts of data generated by ergonomic, collision detection and area manager systems. FI complex event detection should assist in the provision to risk prevention managers and workers early warning indications. Moreover, FI technologies should support the operation of personalized safety plans for individual worker training, task re-arrangement or workplace adaptation.

The worker will be monitored and therefore specialized and appropriate prevention techniques will be applied due to their needs and constraints. Depending on the risk level reached, personalized alerts, brochures training, complete training courses, etc will be sent to each worker. This will help preventing the reach of risk dangerous levels, training and changing behaviours before it. In this way the worker will actively participate in the prevention of occupational risks. The prevention technicians will be able to control the problems caused in their areas of supervision, though the individual source or worker who is causing the risk will be anonymous.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDERS | |
|---|---|---|---|---|
| | | Whirlpool | POLIMI | ENG |
| White Woods (OEM) | Smart Factory |  |  |  |

**General Description**

The main objective of WHR trials is to demonstrate how the new technologies will enable a better integration of workforce in the decision phases of a production process along three sub-objectives:

1) Improvement of decision process of shop floor workers, characterized by fast reaction time, usually within takt time (i.e. 40-60 sec) and event driven
2) Improvement of decision process of supervisors, characterized by medium time reaction time, usually within day/shift and pattern driven
3) Improvement of decision process of managers, characterized by long time reaction, usually week / month, and systemic driven

Improvement in decision process can overall lead to those general benefits:

- **Product Quality Improvement**: improving the fault detection ability and to react faster and more effectively to potential quality deterioration state, can lead to an increase Quality for the consumer and a reduction of costs of non-quality (rework, scraps, warranty cost, services etc.). This parameter can be measured using two indicators: FPY (First Pass Yield), the percentage of Good Product produced without any repairs; SIR (Service Incidence Rate) the amount of service calls recorded versus the production. [#calls / unit sold]

- **Productivity**: as time to get to effective decision will take less time and the decision taken being more fact based, we can expect an improvement on the overall efficiency of a production system. This parameter is usually measured through one component of OEE (Overall Equipment Efficiency).

- **Waste Reduction:** a better and fact based decision process will provide reduction of many of seven categories of waste according to Lean Principles:
  1) Overprocessing: e.g. tailor test procedures on a specified product according to the history of data recorded during its manufacture.
  2) Excessive movement: e.g. optimize and improve effectiveness in maintenance activity
  3) Scrap / Rework and Overproduction: e.g. maintenance and supervisor, could take decision about equipment preventive maintenance, or re-routing, which prevent defective pieces to be produced or to be further processed
  4) Idle Times: e.g. idle worker time during production stopped or slowed down

- **Cost Reduction:** more effective decision process could lead to a direct decrease of TCQ Total Cost of Quality, which includes both costs for test, scrap, rework, warranties, product exchange.

- **People Engagement**: by having a system able to integrate workers in the decision

process much more than today, we can expect an improvement in people engagement, that further translates into less absenteeism, and allow each single factory to be more flexible in adapting to changing environment (i.e. change in production plan, in priorities, in New Product Introduction phase).

**Weakness & Bottlenecks**

The present scenario is characterized by:

1) There is an organization in place to take decision
2) There are data available that can be used to help people take the right decision

In the context chosen for the trial, data are generated by a set of workstation displaced along the production line. Each station has been designed by different supplier and thus data are generated in different format (from both syntax and semantic point of view).
The main challenge is to create a system able to allow people take decision based events or meta-events extracted from the available data, in particular the main need is to capture process drift in terms of SPC when dealing with continuous measures, or defect rate when dealing with logical value (e.g. results of pass/fail test).

The main target piece of organization who must be timely informed about those drift are:

1) Production Line Supervisor (for short term period)
2) Quality Manager or Production Manager (for medium term period)

In order to achieve this we must face these generalized weaknesses and bottlenecks:

1) **Data Filtering and Extraction**: Extract the relevant information from the amount of data of different format and content generated during the production process so to separate relevant data from noise and non-relevant data.
2) **Data Harmonization**: unify data format
3) **Event Recognition**: identify trends, relevant events, correlation of events or patterns, in order to generate set of information.
4) **Help Chain mapping**: to know the organization of help chain and roles and skills of its members
5) **Event – People connection**: create the association in the proper timeframe of event and people who need to know.
6) **Event dispatching**: in the proper timeframe dispatch the event to the interested people
7) **Current workstation were implemented using a distributed logic**
8) **Data are gathered in a relational DB** (currently is the bottleneck for response time)
9) **Demo level multiagent system implemented for GRACE** is the current integrating mean.
10) **Legacy software** (layered) which further increase latency and negatively influence the ability of real time (i.e. to have the data / information when it's needed).

**Expected Results**

Through the implementation of specific FI-WARE technologies we are going to improve the following manufacturing process areas:

- **Events generated at shop floor level:** The events generated at shop floor level will be screened and the dispatched to the selected group of people using a mobile device.

This scenario will be characterized by having a short response time. As example we can describe how, in this future scenario, an event generated at a repairing station, such as a potential fault on the product, that has been registered in the functional test area is generating a warning message addressed to the supervisor of that area and this message is then sent to its mobile phone.

- **Big data stored into a DB:** The entity EVEN GENERATOR will elaborate this data in order to extract relevant event from patterns, correlation etc. Once generated the events will be dispatched to the selected group using a mobile device. This scenario is characterized by having a longer response time. As example we can describe how, in the future scenario, the elaboration of the sequence of measures of the insertion force of the bearing on the drum done in the Bearing Insertion Station is correlated with the vibration of the drum measured during functional test.

In order to achieve the aforementioned result the system should be, in principle, able to:

1) Decode contents supplied at each workstation level.
2) Embed into multiagent system algorithms to compute FOM (figures of merit).
3) Deals with amount of data are which are relatively big.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | Piacenza | Softeco |
| Textile/ Clothing | Smart Factory | PIACENZA CASHMERE 1733 | softeco sismat information technology |

**General Description**

At factory level FITMAN trial 5 will deal with the textile intelligent management platform. ERP, PDM, SCM and MES legacy systems. The **objective** of the trial is to demonstrate that, on the basis of FI technologies, textile and clothing "cloud production" can become reality.

Textile and cloths production steps can be grouped into 3 main ones: spinning (from raw materials to yarn), fabric production (from yarn to fabric) and clothing production (from fabric to finished product).

FITMAN trial 4 will focus on yarn dyeing, weaving (warping, weaving and raw control) and finishing (wet finishing, raising and dry finishing). Each of the phases can be object of the trial by itself or as a part of a group (for example raising or wet finishing + raising or the complete finishing process).

Piacenza objective is to improve the exploitation of the production machineries, labour force and infrastructures involved in the project up to a potential 30% improvement in off peak production periods, with a related decrease of fixed costs per meter produced by the implementation of cloud manufacturing, with a proportional extension to all the subjects of the business ecosystem.

Prerequisite to implement cloud computing in real time is to able to have real time monitoring of Piacenza production in these phases in order to provide an the updated data to feed cloud computing by adequate monitoring and capacity estimation instruments,

supported by the application of RF-ID enabling technology.

Monitoring is sufficient but not in real time, capacity monitoring and forecast systems have not been implemented and ERP is not able to see detailed production situation at machine level. The implementation of RF-ID technology will enable the direct interaction of pieces and machineries and the geo location of the pieces will provide the information to operators to trace them effectively.

The joint application of these technologies will allow settling down an effective real time monitoring and capacity estimation legacy systems. Research must also take into consideration the peculiar conditions of textile production: Tag selection will require a specific effort to select those devices which can survive to the peculiar physical and chemical stresses of textile finishing and dyeing while geolocation system must be able to work in adverse conditions caused by magnetic interference of the several electrical engines installed aboard of machineries.

**Weakness & Bottlenecks**

Introducing a new type of production "a facon" for third parties we have different issues to be faced:

- increase of articles variability,
- increased planning effort
- shortage of physical space
- separation of the quantity and quality of internal and "a facon" production

These aspects will reveal four weaknesses to be faced for FITMAN trial implementation:

- **Monitoring system:** The actual monitoring system is not able to provide accurate capacity needs and timing in relation to the list of production orders. At processes level we need to increase the accuracy of production monitoring on each machine to have a more precise timing of working, cleaning, loading, etc.; i.e. updated and detailed set of information about production.

- **Capability:** Missing estimation of capability on all production departments. At processes level we need to implement these feature on the data retrieved from the monitoring.

- **New charge to production manager:** The production manager should organize internal articles as well as the ones of third parties. Normal production can be delayed third party item production.

- **Product position:** New system of location and positioning of the products, with the use of new technology of RFID. In case of increased production and items (especially from third parties) the effort to store and find them can grow more than proportionally to production.

- **Space management is not adequate**: As regards this last aspect already now the operators have some difficult to find a particular product in the company and the present facility is too small (external warehouses for raw materials are already in use). This situation is the direct consequence of the reduction of average production lot and the increase of new design offer to support the successful Piacenza product differentiation strategy. If we add third party items the need for a very efficient location management could became critical. The integration of the present software

with a new positioning system will provide operators with a necessary instrument for FITMAN Trial implementation.

**Expected Results**

With the introduction of the "cloud production" element, the work flow will change. Some production steps may be easily objected to production capacity share, being standard and without direct impact on the perceived quality of the fabric. Textile production involves many steps but only a few of them really characterize the final product.
The adoption of FITMAN "cloud production" model will maximize the benefits for industrial end users production on many aspects. These benefits can be grouped into two main categories: efficiency and efficacy ones.

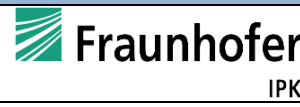
- **Efficiency benefits** regard a direct improvement of resources productivity and/or a reduction of negative effects caused by defects, faults and lack of quality in general. These benefits can be measured by direct indicators, such as reduction and/or volume increase.
- **Efficacy benefits** regard the improvement of accuracy of processes, i.e. of the quality perceived by the customer especially in terms of service and response to requests and needs, and/or quick response of the processes. These benefits can be measured by indirect indicators, such as turnover and /or mark-up increase. They are more difficult to estimate and forecast and, for this reason, in some cases their impact is not taken into correct account.

As regards efficiency FITMAN is expected to lead to a 30% increased saturation of production infrastructure in peak periods. This objective is the result the application of the business model even in the "sale" mode, i.e. the publication of unexploited production capacity, and in the "purchase mode", when a productive bottleneck is faced by the use of external production capacity. The direct consequence of the adoption of "cloud production" is a reduction of costs proportional to the major exploitation of production infrastructure and a volume and turnover increase provided with the available structure.

On the other hand, in the case of European Textile/Cloth, especially in its segments focused on high price and luxury products, intangible aspects such as customized and personalised service and customer satisfaction accompany and complete quality and they are a crucial factor in the choice of textile suppliers. Therefore expected non tangible effects can be predominant, but hardly measurable, for the companies competing in this segment.

In this field, the implementation of FITMAN trial is necessarily supported by the improvement of the information management tools. All the production departments involved in the trial will be subject of an improvement of their IT infrastructure to support an efficient information management, necessary for FITMAN effective implementation.
This activity will improve planning process and customer satisfaction as well as, indirectly, the flexibility of production in the quick reaction to new orders.

In the long run the implementation of FITMAN trial can lead to and enforcement of the company and of the industrial cluster seen as an Ecosystem, which can be seen as the necessary enabling environment where local industries can live and grow, supported by the cooperation, reciprocal support and common culture, sense of internal and external competition.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | COMPlus | Fraunhofer IPK |
| LED Lighting | Smart Factory |  |  |

**General Description**

This Trial, led by COMPlus Automation GmbH and Fraunhofer Institute (Germany), aims to improve the information sharing of the collaborative networked enterprises producing LED - lighting systems private, industrial and public use. The target is to accelerate and insure the accordance of the systems to requirements and constrains already in an early design phase and across all involved partners (supplier). The existing IT application is mostly derived by two research projects: Supply Network Mapping and the FACIT-SME (Facilitate IT-providing SMEs by Operation-related Models and Methods) Research for SME Associations Project.

On the other hand, the TRIAL will improve the control components of light systems for locations and plants in terms of software and hardware. The target is to accelerate and insure the accordance of the systems to requirements and constrains already in an early design phase and across all involved partners (supplier). The existing IT application is mostly derived by two research projects: AMERIGO – Supply Network Mapping and the FACIT-SME (Facilitate IT-providing SMEs by Operation-related Models and Methods) Research for SME Associations Project.

Complus is interested in the exploitation of FI-WARE technologies in the cloud environment for the benefit of the regional SMEs. The economic impact of this Industrial Trial is to be seen of the benefit of the regional SMEs from the use of FI-WARE technologies in the cloud environment. With the use of these technologies, the SMEs have the possibility for networking using reliable information both on desktop and mobile devices. Being able to make the decision upon feasibility of a product configuration in a very early stage, will allow a higher flexibility and faster reaction to the market requirements and improvement of the innovation capability of the regional SMEs. Furthermore, the acquaintance and the implementation of the SME Industrial Trial using the FI-WARE technology will develop the new IT competencies which will be used to broader the provision of IT Services of the local IT market.

The FI-WARE paradigm and solutions are paving the road to an innovative workplace for an informed and smart decision beyond the workshop level. The LED Lighting applies the decision making in a virtual environment at the early design phase, involving all partners in the network, reaching the top level of decision making.
This Trial will explore the functionalities of the knowledge based General Enablers of the FI-Ware Platform. Using the Cloud Functionalities, this trial will enable a collaborative approach for knowledge generating and sharing in a virtual enterprise.

**Weakness & Bottlenecks**

Due to its customized nature, the development of a product is the crucial moment on the network, triggering the process of its configuration. Triggered from both own ideas and customer orders, the network configuration and searching for companies with the corresponding capabilities are continuously performed in the following phases:

- At the design phase,
- During the production phase
- During the modification of the network for new products
- During the service providing for maintenance of the LED-Lighting Systems

The following points are to be noticed as main bottlenecks weaknesses:

1. **Unpredictability of the period of time for close collaboration:** During the entire development time has the standard business of all partners to run. Some partners are involved frequently but the period of time is difficult to predict.
2. **New requirements on applications & technologies:** Business plans change during development time because of new requirements on new possible applications and needed technologies.
3. **Right and latest data:** It is difficult in the current scenario to identify the right and latest data.
4. **Individual communication:** A lot of communication between the involved partners is individual communication (talks or telephone calls).
5. **Knowledge sharing:** Knowledge sharing is difficult because partners / experts are not available anytime.
6. **Different IT landscapes:** Different IT landscapes in the different companies and missing standards for the software as well as different knowledge about using the software.

**Expected Results**

The main expected results of the TRIAL will be to enable the networked companies to access a collaborative environment in order to share knowledge about technological capabilities and best practices in an early design phase. The target is to reduction of the time in the early phase of the engineering project by 50 %. Economic and production feasibility during the early design and configuration phase. Reducing the number of reworks and changes. Decrease of communication time between design changes and decisions.

The FITMAN LED Lighting User Trial focuses on two aspects of the Front-End Loading:

*Network Transparency for a more efficient Supplier Network Configuration*

The process of decision making in supply networks gains on complexity as the number of enterprises, enterprises' capabilities, and the relations between them grows. Furthermore, the distributed nature, the dynamic of the supply networks and the requirements for a holistic approach are challenging the management of the supply networks. In order to support this process it is important to bring all related aspects into one common model that can be deployed for the network visualization. Moreover, visualizing the network will also enable a better understanding of the relations between its members. As a result, this will support the decision making process within the network enabling to establish supply networks with enhanced responsiveness in order to better streamline the logistics and operative processes,

to increase efficiency, to minimize transportation cost, to efficiently manage risk and to improve customer service.

*Communication Platform for an improved transparency of used IT Tools and best practices business processes.*

A SME network like the LED Lightning Network requires supporting the change of members even in a running project. With the approach it can provide information of tools and processes in the network to simplify the change of members and especially the extension of the network. By this way the network can share knowledge about:

- Best practises in terms of covering development, project management, implementation/ deployment process, etc.
- Descriptions of tools used within the network together with ranking information.

## 2.3. Digital Factory Trials

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | Volkswagen | IPK Fraunhofer |
| Automotive OEM | Digital Factory |  |  |

**TRIAL 1 General Description**

The FITMAN-project's automotive OEM industrial trial is focused on improving certainty and reliability of estimated figures of in-house production costs at early phases of the product development process. The costs information is used at early stage of decision making and is based on the digital factory system, tools and planning environment.

The trial focuses on the early phase "Product concept – product design". The information from the Machine Repository is used by the design to consider technological standards in order to evaluate and to minimize the investment costs. The information about each machine facility within the MR will be updated continuously during the entire life cycle and will be used in the following Serial implementation process.

The trial focused on the production equipment life cycle management. The maintenance and the asset history of the machinery are summarized in the machinery repository. The Machinery Repository has strong relations to the PLM-System level, where the aggregated data coming from.

The focus within the VW trial will be on the steps from the product concept decision to the process decision where at the end the Go or No-Go decision for a new product will be prepared. The required concept data from a new product will be manually analyzed and compared with the production planning data and the data from the machine repository too. In the as-is-scenario the MR named only related files on the PLM-level. The update and the

entering of new machinery in the MR will be done manually. The evaluation of an inquiry will be furthermore made manually by engineers. The evaluation results will be entering into the existing report-templates. An evaluation report will be sending for supporting investment decision by upper management.

**Weakness & Bottlenecks**

The FITMAN-project's automotive OEM industrial trial is focused on improving certainty and reliability of estimated figures of in-house production costs at early stage of decision-making. It utilizes and is based on the existing digital factory systems, tools and planning environment.

To better understand and specify this statement, it is necessary to explain the process of determining or estimating these in-house production costs, which is based on two technical "columns":

- Premises on the product concerning e.g. size, drive train, product modules to be installed, i.e. the product concept.
- Available knowledge on production modules (concerning press shop, body shop, paint shop, assembly shop and in-house logistics) which might be required to produce this product.

Aggregated information on these production modules is available in the Machine Repository (MR) which references detailed production equipment information stored in a variety of Planning Systems' databases (e.g. TeamCenter). But the MR is just developed and has now to make available in the production development department for every engineer.

That’s why the major weakness of the present scenarios can be discussed under following sub topics:

- **Availability of the Machinery Repository:** At the moment VW has to determine an investigation manually based on detailed data whether a production module is suitable or required for a certain step of producing a product because of the missed availability of the MR for each engineer. However, this information on production modules stored in the planning system databases is much too detailed to be efficiently utilized for the evaluation. As a result of this weakness, the personnel effort and the time duration required for the investigation and the assessment of the product inquiry is too high.
- **Free planning capacity of the planning engineer:** At the moment the update of the MR is done manually by several engineers of the production planning department. The personnel effort and the time needed for the data gathering (PLM-Level), the aggregation of related information and the update of existing information about machinery in the MR is too high. The personnel effort will be measured by the required engineering hours per machinery. The free planning capacity of the planning engineer is always a bottleneck within car-project. That’s why the update-process of the MR has to be improved.
- **Long Communication processes:** At this time the steering and controlling processes of product inquiries will take too much time and too much effort. Each inquiry is to monitor and to track manually by the responsible planning department. The impacts off this

weakness of the company are the same like mentioned before (sub topics: "Availability of the MR", "Free planning capacity of the planning engineer"). Additional the existing processes could be shortened in order to reduce the time to market of cars.

**Expected Results**

By using FI- technologies the required concept data from a new product will be manually compared with the production planning data and the data from the machine repository too. But the data of the MR will be provided to the engineers using two web-services (based on FIWARE-technologies). The Assessment of the inquiries will be supported by the web service "Support Inquiries". Furthermore in the to-be-scenario the MR will be offline connected with related files on the PLM-level (JT-files) by using the web service "Support MR management". Jt-files will be exported by every kind of planning system used in the automotive industry.
If it succeeds to separate and to read out metadata inside of jt-files by using FIWARE-technologies, a non-proprietary solution for exchanging design data and production planning data is available. That makes it possible to automate the management of the machinery repository as far as possible independent from the used planning systems. On the business level, the personnel expenses for the updating of the machinery repository will be reduced.
The evaluation of an inquiry will be furthermore made manually by engineers, like in the as is situation. The evaluation results will be entering into the existing MR and existing report-templates using the web-service "support inquiry" based on FIWARE technologies.

Using FIWARE technologies the MR will be available in the entire production planning department without any delay or additional communication. The savings are causes by the

- Improved support of the update process of the MR,
- Improved access to the data of the MR and
- Improved support of the communication process during the evaluation of inquiries.

The most important benefits are the reduction of time to market for new products and derivatives, because of reduced time for the evaluation of the product concept carry out by the production planning department of VW brand.
In parallel the required planning capacity for the management of the MR and the assessment of product inquiries will be decrease in the future. Furthermore the planning costs will be reduced because of reduced occupied planning capacity of the engineers. Another effect of saved engineering hours is that more car project can be in progress by the production planning department at the same time. In this way more car models can entry into market at the same time.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | AugustaWestland | TXT Group |
| **Aeronautics (OEM)** | **Digital Factory** | AgustaWestland | TXT |

**General Description**

The AW trial will take place in the FALs (final assembly line) of some AgustaWestland plants and in some Service Station.
FAL is the place where the helicopter is assembled and it represents the final stage of the helicopter manufacturing.
FAL plants collect parts produced by other AgustaWestland plants or by vendors and are used to assembly the helicopter.
The Service Station are dedicate to H/C Maintenance.

**Weakness & Bottlenecks**

N/A

**Expected Results**

The main benefits that the implementation of the trial could be:

- **Effectiveness of processes**:
  - With the smart toolboxes is expected an improvement in term of effectiveness thanks to a better control of tools used in the floor shop. Knowing real time who owns a tool and where it is on the production line will reduce the time spent in researching such information.
  - The paper process for the logbook will remain the same. The e-logbook will reduce the time spent in searching the data needed and reduce the time and cost of the final version delivery of the document. The aggregation of data of different logbook makes easier the tracking and searching of assembled components.
- **Safety:**
  - Using smart toolboxes will reduce the FOD risk thanks to a better control of tools used on the production line and will further reduce the risk of forgetting the tool on the helicopter after its use.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | Consulgal | Uninova |
| Construction Industry | Digital Factory | CONSULGAL | UNINOVA |

**General Description**

This trial handles one specific scenario of various activities involved in the life cycle of construction projects. The implementation of the trial will help in the better management of the construction management process helping in decision making process and avoid (decrease) future risks during the project life cycle.

The work flow remains the same and the information generated at various phases remains the same. But there will be a significant change in the way the generated information is stored,

retrieved, processed and distributed.

A common web platform will be developed for all the stake holders to store and retrieve information and documents generated at different stages of the work flow. Thus a collaborative workspace will be created using standard web and storage technologies. Concerned authorities have access to the results through platform based on their access rights. At the same time the physical objects which are important part of the overall work flow is identified and connected to information system and accessed/tracked using new technologies

Various sources of data that produce information regarding concrete class, concreting plan, slum test result, and concrete sample test results are integrated in the central information system. Things are tagged and integrated to the central system with the help of barcode/rfid readers (the choice is still under discussion). The front end provides web application for entering and viewing information as required and accessibility of the user. Based on the profile of the user (i.e. designer or supervisor or contractor), the application provides varying work spaces to meet their needs. At the same time front end is also supported by mobile application for on-site user.

One of the important scenarios for mobile applications is the case of slum test. The employee at the site can take a digital proof (video or image is still under discussion) of the slump test procedure, which will be sent immediately to the supervisor at remote place, so that he can validate the procedure.

Smart product tracking service will be implemented in the backend which will be used for keeping track of the physical objects involved in the workflow. The overall application is supported by backend apps like statistical analysis and deviation assessment. These apps will implement the statistical methods used in the construction industry based on the defined rules and knowledge of the involved stake holders. At the same time deviation assessment application will be like a decision support tool that will help the supervisors to take further actions based on the results of the test procedures.

Middle ware utilises are the collection of FI-WARE GEs for achieving specific tasks like identity management, cloud storage and things management.

**Weakness & Bottlenecks**

During each of these phases a number of information is produced and needs to be exchanged between various stakeholders involved in the project. There is no specific network software/platform to archive and manage data. Results archived with standard windows file systems and retrieved manually. The data and documents produced at each state of the workflow are stored by the stakeholders in their own system and are exchanged to the other partners through emails or through hard copies as required and use in the other stages of the workflow with manual integration of the previous results.

The major weakness of the trial 7 can be discussed under following sub topics

- **Data storage and retrieval:** In the present scenario, the way data is stored doesn't support quick retrieval, especially when the volume of information increase during the project life cycle. This will increase the time in the decision making process thus might cause some serious bottlenecks in the management process. Usage of efficient storage mechanism can help to detect and mitigate the avoidable future risks. At the same time the storage mechanism in the current scenario will increase the cost for storage and archival of project data as the company grows and gets involved in large complex projects.

- **Information flow:** As described in the scenario, this trial involves flow of information between various activities which involves more than one stake holders. The information created by one user in one activity is very vital for the users involved in the following steps. So, design of an electronic process for efficient flow of information is very vital. The current state of information flow might cause serious communication bottlenecks between stake holders and misunderstanding of information. This will eventually lead to long decision making processes. At the same time accessibility of information is low and highly manual.
- **Information Processing:** The processes like statistical analysis and deviation assessment are very important for decision making and future actions. Making use of automated tools for such tasks will save a large amount of management time and effort. The current practices of using excel for this purpose will not fit very large data and requires more effort.
- **Things management:** Various objects are involved in the activities, which need to be tracked and managed, the efficient management (identification, allocation and tracking) of which will improves the working process. In the current scenario, the things are not connected to the information system, this the management uses for making decisions. This will prevent the involved stake holders to miss the current real-time situation.

**Expected Results**

Through the TRIAL 7 development and the FI technologies implementation, the following benefits are expected:

1. **It will be possible to visualise the concreting zones and obtain visual and textual information on**:
   - concreting operations schedule;
   - distribution of concrete classes;
   - distribution of slump characteristics;
   - distribution of concrete stress values and corresponding sample history;
   - concreting zone status in terms of execution status, slump results availability, concrete characteristic stress results availability, compliance with design

   The purpose is to be able to make the information available in the traditional way, but also in other forms such as:
   - Availability of a full sample history, detailing identification, curing conditions, traceability to an area of the dam, Supervision's involvement, etc., per sample or per groups of samples;
   - Visualisation, through a model, of the specific location in the dam of the concrete corresponding to a specific sample and history related to it;
   - Possibility to visualise information related to the used concrete characteristics and its distribution on the dam, eventually through interaction with a GIS system.

   This will allow a much easier understanding of how the dam "looks like" in terms of structure, the mapping of eventual weaker points and easier access to more systematised information for better informed decisions;
2. **Information on concreting operations, which are an essential part of any construction, particularly dams, easily accessible by relevant stakeholders in "real time".** The type of information that could be made available is:
   - model visualization of concreting operations;
   - concreting operation status;

- Contractor submissions and Supervision approvals status

Usually, this information is compiled in paper and/or electronic files and made available to the Client on a monthly basis, although it is made available to the Supervision on shorter term (maximum weekly).

The system to be developed could lead to the information being made available to all stakeholders in "real time", meaning that the Client or the Designer could easily have access (eventually, visualise) the project status in terms of concreting operations and concrete approval, for example, and be more involved and better informed in decisions concerning the works.

3. **A significant paper load reduction is required and is expected with the new system application**. Results may be fed automatically in the platform by the Contractor or fed by the Supervision based on the information received from the Contractor and be available to all interested parties online in a specific format. The system could analyse the results automatically, relating them with the concrete characteristics defined in the design for that specifically concrete sample and concreting operation. However, the option for printing should be available.
4. **Access to test conditions is documented:** the new system is expected to allow the compilation and availability online of specific records related to the tests. In particular, the new system could allow the connection between a sample and the corresponding slump test visualisation, through a video or photograph testimony. In large work sites, this could eventually be used to allow the test's remote approval by the Supervision, if necessary;
5. **Concrete samples identification** can eventually be improved to allow tracking their location, allowing a quicker registration of a sample and also the inclusion of information related to the storage of samples in the sample's history.

In summary, benefits are expected on what concerns:

- **Access to information**: quicker access to more detailed information and improvement on information processing;
- **More efficient decision process**: a quicker access to information and an improved information handling versatility, will allow decisions to be taken quicker and in a way that is known to all interested parties.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | AIDIMA | Universitat Politècnica de València (UPV) |
| Furniture | Digital Factory | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |

**General Description**

The aim of the Furniture Trial is to develop a set of components so that manufacturing and distributor companies can have access to big volumes of specific information about product market trends. This will allow creating product innovation ideas.

The furniture trial will demonstrate that the design of innovative products can be made more efficient and accessible though FI-WARE platform.

The main objective of the Furniture Trial is to improve the response capability of the furniture manufacturers to the needs of the customers. In order to detect these needs, detecting and analyzing the trends inside the furniture sector getting the necessary information from reliable sources is highly desired. The achievement of this general objective impacts on the benefits for the end furniture users and manufacturers. The furniture consumers can benefit from products better adapted to their needs while the producers are able to safe time and effort in adapt to the market needs.
In this regard, the Furniture Trial is addressing 3 different aspects all related to the product development:

1. **FURNITURE TRENDS FORECASTING**: The general objective is to facilitate the detection and initial analysis of home trends for further product design and development. The addressed user is a trend's analyst, which takes part at initial stages of the collaborative product development process as a key information supplier.
2. **END USER REQUIREMENTS MANAGEMENT:** The general objective is to access to customers latent demands and suggestions expressed as online comments and opinions for improving user-centered product development.
3. **PRODUCT INNOVATION**: Initial analysis of home trends for further product design and development, and discovering weak signals, will greatly improve the process of innovation. Expected users will be the manufacturer designers.

The expected benefits of this are obvious since designers have now a powerful tool that will allow them to have lots of different new alternatives to choose from and to be creative.

**Weakness & Bottlenecks**

There are not tools supporting the typical problems arise when dealing with documents, such as for example, tracking changes between different versions of documents, having a unique repository, version control, security access, centralized registering of rationale. Moreover, there is not a unique access point where other information coming from different existing applications is put together. That involves materialize information on materials and costs, composition of furniture coming for CATe, and so on. When dealing with this problems the limitations are clear, missing documents, processes for retrieving information take longer, exchange of information is inefficient, reuse of previously generated of information is not done, among others.

- **Manually identify weak signals and trends:** They don't benefit of analysis tools to reduce time cycle. The process of trends identification takes longer, more people is required and information is not conveniently digitalized and traced.
- **Fail to exploit opinions of customers or consumers**: They don't analyze and consider information on already existing social media in the innovation of product lifecycle. Valuable information is wasted. New ideas and input from customers and consumers are missed.
- **Lack of document management functionality**: There are not tools supporting the typical problems arise when dealing with documents. Information waste, lack of reuse of information, possibilities to improve efficiency.

**Expected Results**

The Furniture Trial is addressing important results due to the implementation of technologies of the FI-WARE platform. All expected results will be aligned with the objective of the trial:

1. **FURNITURE TRENDS FORECASTING**: Furniture trends forecasting for product development, after the trial implementation home trends observation process will be improved in the following ways:
   - Reduction of time multiple-source search related to home evolution, by means of targeted searches of key variables.
   - Automatic identification of weak signals through identification of relevant repetitions in different sources.
   - Rapid and thorough identification of critical inputs and benchmarking for product development.
   - Printable automatic cards generation of product cases and real examples for further in-group discussion.

At present, home trends identification of weak signals and selection of cases processes takes around three months, time that could be substantially reduced after implementation to one working week, so feeding design and product development in companies would be faster.

2. **END USER REQUIREMENTS MANAGEMENT**: After the trial implementation collaborative product development process will be improved by incorporating end-user critical information in the process. This information will be used by product designers as well as firm managers, as product strategies could be addressed to real latent demands of users. The process will be improved in the following way:
   - Automatic identification of opinions in social networks related to furniture uses.
   - Easier analysis of product related suggestions in the firm online platforms (website, blogs, etc.), reducing times of analysis for community managers.
   - Interpretation of users feeling towards a home trend, category of products or product itself.
3. **PRODUCT INNOVATION**: After the trial implementation designers from ARDI, CM and external ones will be able to access the latest trends and user opinions in order to design new products inside an innovative framework. The process will be improved in the following way:
   - Designer accesses to the complete array of weak signals produced during the UC1 phase, plus full access to material database Materializa, which will return all materials, associated the desired weak signals searched in the first place.

## 2.4. Virtual Factory Trials

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | **Applications Plastiques du Rhône (APR)** | **University Lumiere Lyon 2** |
| **Plastic Industry** | **Virtual Factory** |  |  |

**General Description**

Within FITMAN TRIAL 6 development, the main challenge of APR is "maximizing information quality as support for successful business collaboration". In order to setup FI-IT capabilities to support interaction with partners, our goal consists of the upgrade of existing business collaboration processes by proposing more integrated, service-enabled and fully automated processes.
The identified main goals of developing FI-based collaboration processes are:

- **At the supply chain level**:
  - Maintain information quality and reduce the whole product cycle.
  - Give more flexibility for manufacturing
  - Ensure a coherent connection between business processes
  - Share collaborative capabilities for better communication with partners.
- **At the customer level**:
  - Maintain customer satisfaction level (>95%)
  - Provide more personalised order tracking and monitoring
  - contract with new customers (20 new customers before 2015)
- **At the supplier/producer level**:
  - accelerate the negotiation process within the respect of predefined contracting constraints
  - be predictive in the analysis of raw material cost evolution
  - optimise the inventory level
- **At the IT infrastructure**:
  - consolidate the IT architectural programme in order to upgrade existing IT infrastructure
  - federate recent FI capabilities

**Weakness & Bottlenecks**

Today, interaction is done based mainly paper documents (quote, customer order, purchasing). The current situation don't allows information analysis and generate many additional delays in our global product cycle. The resulting treatment delay is penalizing APR comparing to its competitors. Also, when these documents are introduced manually in our information systems, we need to generate some balanced scorecards, aggregate information in order to make decision (i.e. propose product delay in the quote, etc.)

Regarding to this, some specific weaknesses and bottlenecks have been identified:

- **Lack of formalisation in business collaboration:** In APR, there are many customer's contracts and collaboration policies. The validation process requires a massive and manual interaction between engineering, production and sales staff. Due to the resource time request for order validation, the related cost of this task is very high and can be optimized.

- **Time needed for order validation:** The validation process takes much time than what is expected from APR customers. APR freeze the number of its customers to maintain a good satisfaction level 96%.

- **Lack of traceability**: When quote is sent to the customer as answer to his consultation, there are no traceability processes supporting the end-of-life of the quoting processes. In several cases, APR customers validate the quote, but don't notify the information

- **Customer data integration:** Customer data can be provided in different formats: fax, mails, pdf scanned documents, web portals, etc. The time need for product definition validation by the engineering staff is very costly (identify customer, identify order, identify product and its references, etc.)

- **The order monitoring quality**: In order to offer monitoring capabilities, the current reporting model provide much data as what is respected from customers. Bilateral discussions with sales and production services in order to better understand the provide information and estimate its real impact.

- **The evolution of raw material prices**: Plastic raw material suppliers update their catalogue frequently APR is not able to be in predictive position. The reactive attitude implies that APR should validate raw material cost for each transaction.

**Expected Results**

The expected results from the proposed collaboration model can be summarised in these points :

1. **Effectiveness of the business collaboration**:
   Our customers (National or European groups) are waiting for a specific customer's service. They ask for the same prices they can obtain with "low cost's" lands. They want a better reactivity from their request for quotation to the delivery. Thanks to ours know how, they are able to deal at the very best with their stocks (reduced to their production's needs) and to manage their products according to their customer's satisfaction.
   That's the reason why the most impressive communication is necessary To develop the collaboration with ours providers, we work on the analysis of our requests in order to anticipate the raw materials fluctuations. Thus, our aim is to validate some market orders with our providers and reduce the administrative processing.
   What we are waiting for:
   - to be a recognized partner concerning our quote's quality and our reactivity.
   - to develop some information concerning our production in order to introduce the confidence. This will enable us to guarantee our customer's targets
   - to develop a partnership with our providers in order to optimize the raw materials costs.
   - to increase the processing quality concerning the quotes, the order processing, the communication between production and purchases.

2. **Benefits in production:**
   Accelerate order integration and raw material procurement. Concerning this project, we are waiting for an improvement of the processing quality concerning information and a reduction of the processing times.
   As for the expected impact, we hope to reduce the seizures spots at least and transform them in control and analysis spots, more interesting for everybody.
   Thus, the information processing must be quicker and of better quality.

3. **Reduce the cost of information integration:**
   With more than 2500 business project by year, it is important to setup IT based capabilities to support customer requirements and orders integration. We wish to keep our current numbers of employee.

4. **Setup strategic investment policies:**
   Our strategic investment policy is established in our « CAP 2015 » policy. We invest in various areas. This year, we are changing of computer system. Thus, we will use the latest means of communication and treatments. We are also partners with the CETIM (centre of mechanical research) of Saint Etienne concerning many machining projects.
   We invest in order to be at the leading edge of the innovations concerning information processing and transforming means.

5. **Enhance customer satisfaction:**
   Customer's satisfaction is an essential point in our « CAP 2015 » policy. Our aim is to selection 50 customers "VIP" in order to develop with them a partnership interesting for them. Thus, we have worked on many indicators :
   - non quality < 0,5%
   - service rate > 96%

APR propose and strongly supervise some performance indicators in order to measure the convergence of these scenarios toward these expected results.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | **TANet** | **Coventry University** |
| **Manufacturing Resource Management** | **Virtual Factory** |  |  |

**General Description**

The overall aim of this trial is to identify how and where the services offered to Sematronix' (the Trial end user) clients would be enhanced by exploitation of the FI-WARE architecture in general and the embedded implementation of generic enablers in particular. Sematronix provides services across many SME factories through the SMECluster and INDUSTREWEB portals.
Using the concept of crowd sourcing, The TANet trial will look to source additional resources in the manufacturing domain across the SMECluster Platform provided by Sematronix Limited GE's to be tested include Mediator, registry and repository, marketplace, context broker. The main goal of the TRIAL will be:

- To increase the accuracy of the search engine by the use alternative engines – dynamically select search facility to closer match user parameters
- Create a set of standard times to get results against the number of parameters to be matched
- Minimise the impact of Internet performance Constraints.

- Time to modify configuration to connect to various Tender sites
- Improvement of Quality of data input

It is recognised that some of the functionality is now offered, at least potentially, by the generic enablers (GEs) of the FI-WARE architecture. By accessing this functionality through implementation of the GEs rather than through custom-written services both technology and end-user partners have the objectives of:

- Making platform and service maintenance faster, and more cost effective, and more reliable, since less custom code is used;
- Making the service offering more flexible and adaptable to technology developments, since evolving technology embedded in GE instances will provide access seamlessly.

The Trial will therefore focus on embedding selected GEs within the services offered by Sematronix, establishing the extent to which this can reduce custom software requirement; and the extent to which changes/advances to GE functionality become easily available to the SMECluster platform.
Since two categories of services are offered through Sematronix, and since these are offered through portals linked through a common enterprise service bus, these have been identified as two related, but distinct, use cases.

The client base consists of clusters of SME members (hereafter denoted as members), who subscribe to the clusters in order to access services which may provide support to individual members, but whose full value is best realised where members choose to collaborate with one another. This mode of operation in collaborative enterprise ecosystems is becoming prevalent in the manufacturing SME market where it enables collaborating virtual organisations (VOs) to compete with larger, and even multinational, enterprises to gain business.

**Weakness & Bottlenecks**

Regarding to the weaknesses and bottleneck, there exist some specific situation that should be considered for the implementation of the specific technology. All this debilities are concerned to the general use cases defined:

- **High volume of custom code in portal services**: Cost and complexity of service maintenance results from the high volume of custom code. Requirement for repeated major re-development of service software to adapt as new technologies evolve. Increased cost of platform maintenance, and potential impact on quality of services to members. Restricted ability to adapt to future technology evolution. High cost of maintaining market leadership in services offered. Restricted ability to adapt to future technology evolution.
- **Selection and maintenance of tender opportunity sources:** Heavily dependent on human intervention. Discourages take up by new client clusters through cost and effort of start-up.
- **Addition and maintenance of cluster member's capability knowledge base**: Recognition of new potential cluster members. Automated discovery of potential members offering required, complementary capabilities is difficult. Reduces cluster ability to address tender opportunities.
- **Selection and prioritisation of tender opportunities for consideration:** Lack of precision results in need for increased human intervention. Reduces the number of

tender opportunities that can be analysed, and therefore reduces the number of successful tenders, and so turnover.

- **Selection and prioritisation of consortia to address selected tender opportunities:** Lack of precision results in need for increased human intervention. Reduces the number of consortia which can be considered, and therefore reduces the number of successful tenders, and so turnover.
- **Sensor integration through customised software services:** Requires new service development to access new technologies/protocols. Reduces flexibility, and hampers future expansion.
- **Hybrid commercial enterprise service bus:** Unreliable and inflexible. Reduces potential functionality of service, and therefore impacts on competitiveness.
- **Prototype CEP software services:** Based on early CEP development. Definition, editing and implementation of complex event patterns are cumbersome. Limits efficiency and flexibility of pattern recognition and response, and so limits functionality. This becomes a bottleneck in implementation of CEPs and therefore limits realised functionality.

**Expected Results**

**The main expected results of the Manufacturing Resource Management SME Industrial Trial in Virtual Factory will be the following:**

- Reduced custom-code in portal services, leading to reductions in maintenance costs, and enhanced quality and agility.
- Application of GEs within through portal services allows transparent adoption of evolving technology through selection of most advanced and appropriate GE instances.
- Enhanced automation of tender opportunity selection through application of unstructured data analysis GE, and enhanced service search and orchestration infrastructure. This will result in a greater potential market of new clusters wishing to exploit SMECluster.
- Greatly enhanced automation of the addition and maintenance of cluster member capabilities to the cluster knowledge base, through application of unstructured data analysis GE, and enhanced service search and orchestration infrastructure. This will result in a greater potential market of new members wishing join in existing clusters, and will therefore expand the market for new clusters.
- New capacity to search for and identify potential new cluster members offering necessary complementary capabilities to a cluster, through enhanced service search and orchestration infrastructure. This will result in more flexible capacity to address tender opportunities from within a cluster and so provide new business opportunities to cluster members.
- Enhanced automation of the selection of tender opportunities, through application of unstructured data analysis GE, and enhanced service search and orchestration infrastructure. This will allow more tender opportunities to be realised to the benefit of cluster members.
- Enhanced automation of the selection and prioritisation of potential consortia to address a tender opportunity, through enhanced service search and orchestration infrastructure. This too will allow more tender opportunities to be realised to the benefit of cluster members.
- Integration of sensors through the IoT GEs will add flexibility in management of heterogeneous sensor networks, reducing the implementation and maintenance effort

required.

- Enhanced flexibility and functionality of service integration and orchestration through the replacement of hybrid commercial bus implementation by Application/Service Ecosystems and Delivery Framework GEs
- Enhanced flexibility and functionality realised through implementation of complex event processing and publish subscribe GEs. This will allow more sophistication of event management through the more evolved functionality of the GEs.
- Enhanced flexibility and functionality in services for the editing, definition and implementation of complex event patterns realised through the complex event processing GE.

| TRIAL SECTOR | APLICATION DOMAIN | COMPANY | IT PROVIDER |
|---|---|---|---|
| | | Geoloc systems | Université Bordeaux 1 |
| Geoloc woodfactory | Virtual Factory |  |  |

**General Description**

The challenge addressed in trial 10 is the need of performing rapid and appropriate business collaboration between users (final customers), designers (product engineers), suppliers and co-traitors of SMEs developing special machinery for the wood industry.

Trial 10 focuses on the implementation and experimentation of an open platform providing collaborative services fitting to the business profiles of enterprise's actors (Customers, suppliers, Purchasers, etc) provided either by Web applications (access through Internet browser), or by Web service (digital access to data). The FITMAN Platform will result from the integration of a middleware inherited from FI-WARE enablers and specific FITMAN development with IT solutions that are in use in the Wood factory industry.

By deploying the FITMAN platform, the objectives are:

- to process automatically the workflow which supports the wood factory core activities of machinery engineering in its surrounding eco-system (customers, suppliers and co-traitors), and manage data accordingly,
- to achieve the global integration of the internal and external processes by the facilitation of the information flows among all actors involved in the commercial, design, manufacturing and installation processes.

The benefits expected from the FITMAN Platform are the following:

- significantly reduce the delays of all the activities that are parts of the customer to customer cycle: marketing, quoting, purchasing, engineering, delivery,
- significantly reduce the cost of all the activities which constitute the customer to customer cycle, thanks to a system that can analyze prices and costs together with the partners and disseminate throughout the supply chain in real time.
- facilitate the interaction between the actors of collaborative engineering (quoting, call for tenders, follow-up) through a specific market place or inversed bid linked to CAD and ERP software,
- improve the traceability of the engineering processes to allow more accurate quoting for future affairs,
- spare the manpower which is today devoted to the synchronization of the activities above and to redeploy the manpower released by the implementation of the FITMAN

platform to new tasks with higher added value in the company.

**Weakness & Bottlenecks**

In the current process of order entry and order tracking, various actors are involved in providing information needed to establish the purchase order to a supplier or a subcontractor:

- Internal services define a list of different items to produce the machine. This list is entered into Excel spread sheets and sent to the "collector" or entered into SharePoint.
- The "collector" is a person in charge of collecting and aggregating command requests from different services. Data is entered in SAP BO from orders requests received via Excel and SharePoint.
- From SAP BO, the buyer made the purchase orders and sends them to different suppliers and subcontractors by Fax, Email, and FTP in different formats: PDF, Excel, and Word.

In return, suppliers and subcontractors send to the buyer the price offers by fax, mail or email (PDF, Excel or Doc formats). From these documents, the buyer must enter in SAP BO and SharePoint the items pricelist so all internal actors in the company can access it. The buyer keeps track of the commands and updates command status in SharePoint and SAP BO. The collector informs internal services on pricelist and orders status.
This process of entering and tracking orders as it is done today requires multiple and manual information between different bricks of the corporate information system (example: Excel-> SharePoint-> SAP BO). This entry being made manually, it causes a risk of errors and inconsistencies between the different subsystems. Example, the cost for producing a machine is badly estimated because the price of a part was incorrectly entered. Finally, the additional production costs related to this error is the responsibility of the company. Also, forgetting to update the status of an order (e.g. order delivered) may cause a delay in the manufacture and late penalties for the company.

Regarding to this information, there are two most remarkable bottlenecks along the production process:

- **Relationship to suppliers/subcontractors:** Workflow not automated. Many human interventions to advance the workflow. Many communication support (FTP, email, phone, mail …). Human resources dedicated to non-productive tasks (Instead should negotiate prices for example). Increased time for taking into account the information and its processing.
- **Populate IS with data**: Data management / Life-cycle. Different file format (XLS, DOC, PDF, CSV, etc.). Multiple manual input of data leading to potential input error. Example: input of pricelist Wrong cost assessment and quoting due to errors in pricelist.

**Expected Results**

The objective of this trial is to automate the process of entering / tracking orders and provide a more effective collaboration between the different actors: internal services, buyers, suppliers and subcontractors. At the data level, it allows reliable data by avoiding data entry errors and provides the same information to all actors in the process. Another goal is to have a "market-place" that allows the buyer to publish a tender, receive price quotes and quickly

integrate them into the enterprise information system. The application is intended to notify providers / subcontractors from the publication of a new tender and must allow them to pass the price list by computer.

The expected results are:

- Optimization of human resources. People are assigned to tasks for which they were recruited. In particular, instead of entering price lists in the enterprise information system, the buyer is able to concentrate on the negotiation of prices, on the prospection of new suppliers and more generally on technology watching.
- Reduction of the manufacturing lead times. Internal services being notified in real time of the delivery of orders are able to update production planning.
- The reliability of the data makes it possible to establish more accurate quote and control of the final cost of production.

The evolution of the information system provides more efficient collaboration with external partners and simplifies the tender's response process. For the buyer, this leads to a simplification of the analytical work to carry out to find the best provider for an order.

# 3. BUSINESS SCENARIOS

## 3.1. General Description

Once the General Framework has been established, within chapter 3 we will describe in detail each of the business scenarios.

In our case a BUSINESS SCENARIO is each of the specific selected cases within the TRIAL, in which we can generically improve the current outcome by applying the Future Internet Core Platform (GE and SE). It should define a goal-oriented set of interactions between external users and the system under consideration. Each BUSINESS SCENARIO involves a number of specific processes.

Description of each business scenario within each trial explaining in detail:

- Explanation of the current situation/scenario in the company
- Description of the future scenario
- Business objectives
- Expected benefits
- Business indicators
- Risks

## 3.2. Smart Factory Business Scenarios

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Risk Modelling** | **Occupational safety** | TRW | innovalia ASSOCIATION |
| **LOCATION** | | **Pamplona, Spain** | | |
| **Current Business Scenario:** *Risk Modelling* | | | | |
| In the region of risk analysis, TRW adopts the traditional occupational risk prevention methods which are relying on the prevention technician to observe, evaluate and design prevention plans based on the data of medical examination for workers, regulations of manufacturing in shop floor, records from self-diagnosed equipment.<br><br>For TRW plant in Pamplona, the safety hazards are often produced in manufacturing line and warehouse, mainly caused by collision between machine and worker, or ergonomic problems of operating machine. In present, the specialized training is designed for the operator based on the research results of operating specific machine and working area. It is important to point out risks can be divided into the emergency situation ad n predictive probabilities, and each type should adopt different prevention workflow respectively, in order that the reaction properly matches the related risk characteristic. Currently, the analysis is limited with simple methods of classifying risks, in other words, the predefined risks and work plans only indicate the general methods which neither predict the risk beforehand, nor give the corresponding warning before the risk. | | | | |

The main procedure of current TRW prevention system can be seen from the diagram above. In order to improve and enhance the running mechanism of occupational health and safety, we've identified 6 main objectives for modelling the risk:

- **Objective 1**. To design an easy customized repository with a comprehensive and authorized risks classification and effective prevention plans for the workers along with the whole manufacturing life cycle based on scientific knowledge for active risk prevention technology embedding the human factor as a dynamic and interactive component within the manufacturing processes.
- **Objective 2**. To develop the automatic "Intelligent" risk identification system suits the changing multiple factors of the certain worker, status of machine, impact of the working section, and etc, so as to bridge the gap between existed passive risk control system and a new level of system with the accurate risk prediction and complete work plan generation.
- **Objective 3.** To built the system to collect measure and analyze data during a continuous period of time, in order to evaluate the risks and their evolution. It is important to consolidate the capability of analyzing massive data generated in real-time observation by heterogeneous resources to achieve the proactive risk control. For such solution to become fully effective, risk management system should be developed holistically taking into account an integrated view from sensing devices such as sensing camera, to reasoning mechanisms and intelligence, capable of reacting to extremely dynamic conditions.
- **Objective 4**. To enhance the system with integrated human-factor aware, work with different types of roles including workers, risk experts, doctors and managers, instead of prevention technicians on their own to make the process management engine with information feedback loop support. Additionally comply with the consistency with design and testing are crucial for the system development, since the preventive work plans must be proved to not contradict with the rules of operating machines and running shop floor.
- **Objective 5.** To create the proactive risk model consists of continuous risk assessment, monitoring and management. The concept of the model is to guarantee the worker's health and safety within machining, handling and assembly industries by design which integrates medical and technical risk management disciplines, meanwhile act as a single health model in order to offer a uniform and universal framework for data and information management. Furthermore the new model can be embedded within the company's existed control and management system.
- **Objective 6.** To run proactive warning and training system combined with the autonomous intelligence as a tool for analysis and decision support. As the existed risk management solution can not satisfy the need of anticipating and predicting the occurrence of risk scenarios that can lead to a damaging situation caused either by accident or health threat.

**Future Business Scenario:** *Risk Modelling*

In this section, the characteristics and environment under which risk modelling are detailed and described to support high-performance level of risk condition identification and contextualise reaction. The five main activities and their corresponding deployment procedures including investigation, instalment, evaluation and impacts are proposed below.

**1. Customized Risk Repository for Preventive Measures Design**

There are occupational diagnosis protocols for standardization of health processes, such as

Health Care, Care Plans or Clinical Pathways, designed by health professionals in order to ensure that the process can be understood, repeated and non-ambiguous.
For the purpose to persist the scientific knowledge with normalized specifications, the risk repository is necessary to set up following the procedure of cataloguing, design and evaluating risk. As the contents of the normalization are described as manuals, it is convenient to store their protocols in the common relational SQL Database. The universe catalogue is required to create by health complied with the existing European regulations of analyzing the rules applicable to manufacturing equipment for solutions and technologies that can help overcome the security issues as required.

**2. Complex Event Processing as Decision Making Automatic Assistant**

In the context of Internet of Things (IoT) scenario, the approach lies on the efficient autonomous intelligent reasoning system to handle massive sensing and actuating data with semantic–based distributed reasoning approaches to complex system operation. Thus the design of Complex Event Process (CEP) could be envisaged to not only detect single risk conditions, but also multi-factor conditions as key component of the risk control centre that is able to be continuously requested and transmitted by other module of the system. In addition, the industrial safety reasoning engine work tightly with real-time risk detection tools and personalized decision support tools in order to act as a means for intelligence and analytics after data collection and distribution stages.

**3. Risk Management Workflow Engine for Customized Risk Prevention**

Once the risk is monitored and classified, the next step is to providing prevention protocol for the intervention, thus the workflows are developed to represent the interventions. On one hand, the workflows usually offer a graphical interface which makes the design easier to be understood by technical and none technical users. On the other hand, Workflow has more advantages that can be useful for the design and deployment of care plans. Current workflow systems usually have associated with an engine to automatically execute the processes defined in the graphical way. That means the formally defined processes can be automatically used for deploying the process by using automatic deployment systems.

**4. Assistant Workflow Tool of Personalised Decision Support**

The visualisation assistant tool can offer the model to bring all roles together to work out the best solution in the factory for being able to process as much as information in less time as possible. In particular, the enterprise safety and healthy manager can work with relevant information to make informed decisions, but no need to master the programming skills. Following the reason mentioned above, the tool was decided to create an interface on mobile devices such as tablet or mobile which is intuitive and easy to handle by non technical or specialist aiming at the creation and management of existing workflows in the context of the project.

**5. Human Machine Interface for Effective Risk Communication**

The need of monitoring and control Human Machine Interface (HMI) is therefore envisaged to provide highly visual web interfaces about risk levels. The HMI located in the command and control location of the risk management architecture. Moreover, the system also makes suggestions of the most suitable procedures to be applied when a risk situation is detected, so that the reaction time can be hugely reduced and the user can send a highly effective execution action plan immediately. It is important to design the proper interfaces which could display sensors´ location and sensor network in the simple visual sight for reflecting various kinds of restrictions and limitations, such as power constraints, finite and limited

memory, unreliable communication network and the quality and variability of data received.

**Risk Associated**: *Risk Modelling*

Regarding to this section some specific risks related to the Business Scenario has been considered:

1. **Difficulty to define the trial's functional Scope:** Made too ambitious requirements, ambiguous or repetitive tasks definition without clear targets.
2. **Problems in cooperation with related internal and external personals:** Unsynchronized work plan and targets between technical workers such as technicians, developers and no technical workers like doctor, health and risk experts, and such cases lead to the delay and misunderstanding in development.
3. **Difficulty to process massive data generated continuously from sensing devices network:** Low efficiency to handle large sensing and actuating data with distributed reasoning approaches which causes the lag in risk analyzing and decision making behind the real time expectation.
4. **Challenges of effective preventive measures design**: Risk management system lack proactive capabilities to detect the confluence of several risk factors with potential likelihood to cause an accident, due to the non-scientific design of prevention protocols for this intervention.
5. **Enterprise interoperability with existed systems:** Problems of integrating the new risk prevention and control system with other factoring system such as MES, ERP and etc, difficult to interact with different services for relevant tasks.
6. **Awareness of private data management:** In the TRW trial case would require enhanced methods for privacy and data protection, ensuring no unauthorized and adequate usage of the health information is made.
7. **No use of the new system, continuing with the traditional**: The new system will have more settings and parameters to configure, doing a more exhaustive plan.
8. **Inability of users:** The prevention technicians might have not high IT knowledge.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **2** | **Risk Detection and Information** | **Occupational safety, production line** | TRW | inovalia ASSOCIATION |
| **LOCATION** | | **Pamplona, Spain** | | |

**Current Business Scenario:** *Risk Detection and Information*

In the case of TRW trial, risks are often generated from collision and ergonomic problems during the manufacturing process. For the ergonomic risks, TRW has used some methods of assessment used to identify the risks, such as OCRA for repetitive movements, and OWAS/REBA for postural load assessment. In practical these methods are useful to detect angles, positions in order to evaluate the risk of musculoskeletal disorders. Nevertheless these preventive measures are insufficient to the complicated changing environment in dangerous areas of assembling, handling and shifting products. The multi-factors including the light, sound, moving objects such as forklift, there is no tool designed for deal with large information from resources above and makes a decision on neither the identification of risk, nor prevention plan specially designed for the risk. As to the collision detection, TRW also has applied some traditional way that workers are trained to use the secure transport system

to handle goods, and special paths are indicated for truck and worker to use separately.

Regarding the current situation of risk detection the following new objectives are proposed to meet challenges of finding technologies and methodologies monitor and manage the human factor which is the main responsible role for incidents and accidents nowadays in manufacturing process.

- **Objective 1.** To set the strategy of smart H&S monitoring and controlling centred by the workers which needs to be introduced as an active element in the risk management equation and proactive measures need to be facilitated to increase the effectiveness of the solutions in place and in time. The human centric concept leverages the proactive capabilities to detect the confluence of several risk factors with potential likelihood to cause an accident.
- **Objective 2.** To design wireless sensor network and activity monitoring in order to detect risks continuously from the physical and psychological conditions of workers and environment state of workplace. For the purpose of providing an end-to-end heterogeneous wireless solution that enables the continuous sensing of the working environment in order to detect in advance any potential risks.
- **Objective 3.** To build the framework of information and communications networks, so as to assist to define the new safety requirement including efficiency and reliability imposed by the industrial environment in general. With the development of information and communications networks a new security requirement for privacy protection needs to be defined as well.
- **Objective 4.** To adopt the semantic solutions to built the semantic sensor environment whose mechanism is to represent the data measured or generated by sensors in the form of metadata annotations of semantic information of a temporal, spatial and thematic, accessible through service oriented architecture. Also it is based on the use of a special type of information infrastructure for web-centric collection, modelling, storage, subsequent withdrawal, sharing, manipulation, analysis and visualization of information on sensors.
- **Objective 5.** To provide a smart solution with the ergonomic characterisation. The solution aims at offering intensive and preventive monitoring for workers which includes trapping, falls on a level, awkward postures or repetitive and forceful movements. Then the system will combine with other alarming, messaging and training services in order to avoid injury by correcting the wrong operation in the early stage.
- **Objective 6.** To optimize the existed collision avoidance, in order to be a proactive detection system whose purpose to detect in advance, and avoid potential dangerous situations by adopting the technology in auto-calibration and auto-compensation for large units of objects interacting with each other.

**Future Business Scenario:** *Risk Detection and Information*

In this chapter we will analyze the most relevant techniques and media in the characterization of the different activities that can be utilized by factory employees for risk detection and information transmission. In principle techniques have been chosen according to the theoretical investigation, which is supposed to offer better results in real environments. And in some cases, several techniques have been proposed which could be supplemented depending on internal and external factors such as lighting, cameras available, dimensions of workspace monitoring, and other relevant factors.

**1. Semantic Solutions for Ontology-based Reasoning**

The concept of semantic sensor network is used to organize, manage, interrogate, understand and control the different components of the data gathering process. The Open Geospatial Consortium (OGC), who supports the solution for wireless and location-based services, provides the Sensor Observation Service (SOS) standard which is applicable to use cases in which sensor data needs to be managed in an interoperable way. The use of SOS will satisfy the requirement of dealing with safety in a quite heterogeneous environment in terms of information sources by creating a formal data specification used within ontology structures that support risk management and context. Moreover, in designing the location of the SOS which is better in the gateway node, as near as possible to the control centre in the network, since the data flows that are significantly higher between processing applications and the SOS than between sensors and the SOS and in order to minimize data traffic.

**2. Collision Detector for Active Safety Control**

The idea to design the tool is detecting multiple moving objects within the same scene, as well as placing them in 3D space relatively to the camera position. And also, it provides the ability to determine the distance between various objects or persons to avoid collisions. Therefore, in short, the main objective of the tool is to avoid the collision between worker and moving objects such as forklift truck or wheelbarrow in working area. For the whole system, the tool is proposed with the ability of providing the necessary information SOS for this to be able to obtain the position, speed of movement and direction of movement of objects of different areas and, in turn, perform a management of the distance between the various objects and can perform collision detection monitoring.

**3. Ergonomic System of Automatic Remote Operation**

The main target of the tool is to monitor the positions performed by workers, identifying the inclination or deflection ranges adopted and the numbers of times per minute were performed during these movements. The proposed integrated development environment (IDE) is the Seller Kinect SDK which could be applied for a motion sensing input device by Microsoft. The application will propose some functions like Characterization of the environment, worker, device and session, Network settings, Ergonomic Control, and Module results. Also the technique for describes the positioning and orientation techniques in 3D will be under studying. To do this we will move into the 3D vision system, first with projections and then multi-camera perception of stereo depth. To achieve this goal, in many cases we have to perform a previous calibration of different cameras that we will use.

**4. Area Manager for Priority Risk Detection**

The service is aim at identifying whether an object or person approaches the machine, in addition to finding the orientation in which is placed a piece, with the objective to know a priority whether a machine movement could cause a collision between machine and piece. It is suggested to use the image processing library AForge for development and included a database for facilitating tests, stores the results and the chosen configuration.

**5. Enterprise Services Bus for Services Coordination**

As the personalised risk management requires complicated heterogeneous resources and a large amount of services for Business Process Management, Transaction Manager, Security, Messaging Service and etc. In such a complex architecture, the Enterprise Services Bus (ESB) represents the piece of software that lives between the business applications and enables communication among them.

With the purpose of adapting the reactions of risk prevention to available services at any time and ensure the best possible service performance based on the precedence of the risk to be addressed, the enterprise service bus (ESB) is introduced to load the pre-defined service including the one configured at run-time. Together with the clustering techniques, the ESB allows to optimize selection of services to be orchestrated to serves a particular application in the prevention workflow.

**Risk Associated:** *Risk Detection and Information*

Regarding to this section some specific risks related to the Business Scenario has been considered:

1. **Challenges for automatic remote operation in ergonomic design:** Difficulties are addressed in identifying the inclination or deflection ranges adopted and the numbers of times per minute were performed during these movements.
2. **Challenges for collision detection in environment with complicated personals and vehicles and objects:** The collision detection affected by complex environmental factors which could be changeable constantly such as moving vehicles, mass light resources, or large metallic machinery and obstructing elements placed within a large wood container at the intersection.
3. **Difficult to manage dynamic and real time information:** To achieve the real time risk assessment, the system has high requirements among improvements for powerful industrial safety reasoning engines, efficient real-time risk detection devices and tools, and complete semantic solutions for vast services coordination.
4. **Unstable wireless network communication:** Challenges to design system platform providing reliable wireless sensor network connectivity, in particular when real-time connectivity needs to be ensured across multiple wireless technologies to support the reliable risk management.
5. **Generic/Specific Enablers not consolidated in time:** Problems of incompatible software stack between GE/SE and Trials could result from insufficient interaction and communication with GEs' provides, delay of deployment of related GE/SE, failing to provide a design to easy change component without affecting the rest of the system.
6. **Issues of system safety and privacy:** To transfer large data in a quite heterogeneous environment in terms of information sources, it is necessary to take into account the security data transmission and privacy protective of accessing data.
7. **Distrust of workers in the system:** Workers will not trust in the confidentiality of the system, seeing it as a controlling system.
8. **Ignorance of the advice send to the workers:** Different advice and instructions will be sent to the workers related to the level of risk in which they are involved.
9. **No use of the new system, continuing with the traditional one:** The prevention technicians and H&S coordinator might have not high IT knowledge.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER | |
|---|---|---|---|---|---|
| 1 | Event Scenario | *Help chain on manufacturing production line.* | Whirlpool | POLITECNICO DI MILANO | ENGINEERING INGEGNERIA INFORMATICA |
| LOCATION | | Whirlpool Naples Factory, Italy | | | |

**Current Business Scenario**: *Help chain on manufacturing production line*

Current business scenario is characterized by and sub-optimized decision process in which workers acting at different level of factory organization are asked to take decisions with a poor IT support.
The lower level, Event Level, is where event happens, i.e. production shop floor. It is constituted by intelligent equipment (mainly PLC and Industrial PC who are controlling and gathering signals from production processes).
The middle level, named Data Level, is where signals and raw data are firstly correlated one each other and stored.
In current business scenario, user can access data through interface at both level (SCADA and HMI at Event Level; PC level interface at Data Level) in a voluntary base (i.e. user that wants to know about event, correlation of events and examine related data need to access to the system, query for proper information and take decision)
Despite a huge quantity of events are detected and recorded at shop floor level, very few of them are effectively used to help decision makers. This is causing:

1) Decision makers are involved too late: the information of the events is transferred to the decision maker using informal and unstructured system (e.g. verbally through direct or indirect communication).
2) Decision makers take too long to decide: additional data needed to identify event and to correlate and contextualize it is gathered from DM in autonomy (no direct link between event ad correlated data)
3) Wrong decisions are taken: scarce information and increased urgency can cause DM to act just on its perception and thus decide for an action which is not the optimal one.

This inefficiency could be drivers of poor quality (e.g. inability to detect failures); cost increase (unnecessary rework), customer dissatisfaction (wrong product assembled).

**Future Business Scenario:** *Help chain on manufacturing production line*

In the future business scenario the missing layer between event and data layer is filled up with standard services which enable a fast and reliable recognition of event, a robust correlation between event and data and the dispatching of those to the appropriate level of decision makers.
In this scenario FITMAN trial will provide interface between Event level and data level to put in connection the human decision level (workers at different level of organization).
This communication will be realized through unsolicited communication of events and correlated data, using as much as possible mobile devices, so to reach in appropriate timeframe and with a rich content of information the decision maker.

| **Risk Associated:** *Help chain on manufacturing production line* |
|---|
| According to the business case, some specific risk have been identified, in to take into account future problems or inconveniences:<br>1. **Data confidentiality**: Data gathered at shop floor level and events are to be considered highly confidential.<br>2. **Real time:** Events need to be communicated in the appropriate time frame to be effective.<br>3. **Legacy system**: Current ICT infrastructure is not under discussion and need to be integrated.<br>4. **Security Policies:** Security policies are managed and applied at Corporate level. |

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER | |
|---|---|---|---|---|---|
| **2** | **Big data Scenario** | **Help chain on manufacturing production line.** | Whirlpool | POLITECNICO DI MILANO | ENGINEERING INGEGNERIA INFORMATICA |
| **LOCATION** | | **Whirlpool Naples Factory, Italy** | | | |

| **Current Business Scenario**: *Big data Scenario* |
|---|
| The business scenario for Big Data is similar to the Event Scenario for what is regarding the dynamic of the situation. The only differences are related on:<br>1. **How the events are generated**: in this scenario Events are not generated by consequence of other physical events, but are rather the result of a post processing of data.<br>2. **Timeframe**: since the information extracted from historical data can lead to a different depth of the implication of business decision one can derive from that, the timeframe related in Big Data are broader, both from the point of view of reacting time and from the point of view of the line of sight of the decision.<br>3. **Expected impact of the decision**: From business perspective this means the involvement of different level of people on the shop floor, higher level of decision to be taken and broader and medium term impact of the decision taken on the business performances.<br>4. |
| **Future Business Scenario:** *Big data Scenario* |
| In the future the missing layer between data layer and decision is filled up with standard services which enable a robust correlation between event and data and the dispatching of those to the appropriate level of decision makers.<br><br>In this scenario FITMAN trial will provide interface between Data level Decision Level to put in connection the human decision level (workers at different level of organization).<br>This communication will be realized through unsolicited communication of events and correlated data, using as much as possible mobile devices, so to reach in appropriate timeframe and with a rich content of information the decision maker. |
| **Risk Associated**: *Big data Scenario* |
| According to the business case, some specific risk have been identified, in to take into |

account future problems or inconveniences:

1. **Data confidentiality**: Data gathered at shop floor level and events are to be considered highly confidential.
2. **Real time:** Events need to be communicated in the appropriate time frame to be effective.
3. **Legacy system**: Current ICT infrastructure is not under discussion and need to be integrated.
4. **Security Policies:** Security policies are managed and applied at Corporate level.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Cloud production** | **Textile manufacturing** | PIACENZA CASHMERE | softeco sismat information technology |
| **LOCATION** | | **Biella, Italy** | | |

**Current Business Scenario**: *Cloud production*

The business ecosystem is starting to create agreements between competitors to share production facilities but they are informal and not structured. This could be the first core of what we could call a "cloud manufacturing", which could become reality using IoT to trace the products and the machinery availability and new FI services to share production information and support interoperability.
The time to create this "**cloud production**" is becoming mature, also considering the availability of communication standards (developed in the **Moda-ML** and **e-Biz** EU funded projects), semantic and ontologies to define the vast variety of materials and machineries (**Trame** Italian project, **TexWin** EU-funded one) and state of the art ICT.

To make a specific example two competing companies may have each one its own yarn dyeing machineries, which may not be fully exploited because of typical fluctuations of seasonal textile production. Because order acquisition may not take place at the same time for both of them and they may be specialized in a specific season (winter or summer fabrics), when the production of one is over exploited, the production of the other may be under exploited. Considering the small average dimension of textile accompanies and their focus on specific niches of the market, this case is very common and leads to a general under exploitation of the production facilities. Both enterprises could take a consistent cost advantage from the proposed reciprocal sharing of production capacity, being reciprocal suppliers and competitors at the same time. Considering the strong pressure on production times, the variety of textile productions and quality standards, information share and communication is critical and need the support of state of the art technologies to make this business model widely effective and concretely working.

The **objective** of the pilot is to demonstrate that, on the basis of FI technologies, textile and clothing "cloud production" can become reality.

**Future Business Scenario**: *Cloud production*

Textile production steps can be grouped into 3 main ones: spinning (from raw materials to yarn), fabric production (from yarn to fabric) and clothing production (from fabric to finished product). Fabric production will be the object of FITMAN trial in Piacenza. In relation with the product expected fabric (fantasy, malange or solid colours) it can be divided

into 3 main production flows.

FITMAN trial will focus on yarn dyeing, weaving (warping, weaving and raw control) and finishing (wet finishing, raising and dry finishing). Each of the phases can be object of the trial by itself or as a part of a group (for example raising or wet finishing + raising or the complete finishing process). Ontologies and semantics of the process have been already prepared in Trame project, funded by the Italian state, and are ready to support FITMAN trial implementation.

Company infrastructure is still subject to under or over exploitation in relation with the erratic fluctuations and of demand. Piacenza objective is to improve the exploitation of the production machineries, labour force and infrastructures involved in the project up to a potential 30% improvement in off peak production periods, with a related decrease of fixed costs per meter produced by the implementation of cloud manufacturing, with a proportional extension to all the subjects of the business ecosystem.

**Risk Associated:** *Cloud production*

According to the business case, two specific risk have been identified through cloud production implementation:

1. **Inaccurate description of offered/required process:** Prerequisite to share production capacity is its accurate description at technical level. Because of the vast number of materials, designs and production steps (more than 70) and combinations textile is one of the most complicate sectors. Ontology and semantics must be carefully studied.

2. **Inadequate participation of companies and critical mass:** To create and effectively working ecosystem the participation of a vast number of companies is necessary, in order to provide a significant offer and to cover all required production steps.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Network Transparency for more efficient Supplier Search** | **Network Manager, Product developer, IT administration, IT development and implementation** | COMplus | Fraunhofer IPK |
| **LOCATION** | | **Brandenburg, Germany** | | |

**Current Business Scenario**: *Network Transparency for more efficient Supplier Search*

The current led-network communication infrastructure is based on telephone, meetings and e-mails. All network partners are not using the same version of a document or the same version of software. The IT-Landscape within the led-network is difficult and not standardized.
At the present moment, the communication between the network partners is done mainly verbally based on the knowledge and previous experience of the partner. At a first glance, this seems to be sufficient mainly due to the small number of companies. However, due to the expectations for growth, it is envisaged that this way of communication will be inefficient for the network.

The actual infrastructure of the network communication is based on standard internet technologies such as email communication and file sharing. Also an open source enterprise content management system (ALFRESCO) (www.alfresco.com) is involved. The platform is located at the network partner FMN and used for the file sharing, historicize of data and development.

**Future Business Scenario**: *Network Transparency for more efficient Supplier Search*

The process of decision making in supply networks gains on complexity as the number of enterprises, enterprises' capabilities, and the relations between them grows. Furthermore, the distributed nature, the dynamic of the supply networks and the requirements for a holistic approach are challenging the management of the supply networks. In order to support this process it is important to bring all related aspects into one common model that can be deployed for the network visualization. Moreover, visualizing the network will also enable a better understanding of the relations between its members. As a result, this will support the decision making process within the network enabling to establish supply networks with enhanced responsiveness in order to better streamline the logistics and operative processes, to increase efficiency, to minimize transportation cost, to efficiently manage risk and to improve customer service.

Through the visualizing the enterprises will benefit to overview the network structure, material flows, the interconnections between the companies, their capabilities and competencies. Creating different views will help to visualize a certain aspect of the Network and satisfy particular demands of the involved sides. For example, if technology is observed as a capability of an enterprise, a "technology view" will present the connection of the technology capabilities of the enterprises in the network. Visualizing the network using a supply network map shows the relationships between the enterprises on a strategic level, distinguishing from the operative process or material flow diagrams. Being seen as a "spatial representation of the environment", the supply network map considers the business environment of an enterprise, enhancing the strategic planning including better transparency, monitoring, redesign and optimization of the supply network. The objective of such a map is to provide a common understanding among the enterprises, where information technology and interchanging of information between the member organizations play a crucial role.

**Risk Associated**: *Network Transparency for more efficient Supplier Search*

The risk associated to the Use Case are:

1. **IT Availability / failure:** Web applications are not to be reached for the final user or to the network partners.
2. **Different IT landscape:** In the single network enterprises different applications are in use (CAD, ERP, CMS etc.)

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| 2 | Transparency and consistency of ITs and documents | Management, manufacturing line | COMplus | Fraunhofer IPK |
| LOCATION | | Brandenburg, Germany | | |

**Current Business Scenario**: *Transparency and consistency of ITs and documents*

The processes in the current business processes on enterprise level are the following:

1. Select team and create offer
2. Configure project
3. The following processes run in parallel:
   - Development of electronic
   - Hardware development including casing
   - Software development
   - Technology innovation and development
4. Prototyping & production
5. Marketing and distribution
6. Sales, maintenance & service

This is the whole process from the first inquiry to the network manager, the network configuration, the product development, the supply chain design, the marketing and production as well as the service and maintenance. This requires document exchange and concurrent work processes across organisations currently supported by a heterogeneous set of tools and protocols. However, a major requirement is the privacy of the data nobody is allowed to give data to another organisation without the empowerment of the board members or company owner or a specific contractual basis. Therefore the business scenarios also include the ASP provider for the platform and infrastructure.

**Future Business Scenario**: *Transparency and consistency of ITs and documents*

The future business process on enterprise (network) level will not differ too much. The main difference is the support of two additional services.

- Best Practice Service,
- SME Cloud Service.

The Best Practice Service is derived from FACIT-SME and supports the network with the used tools, formats and processes in terms of practices applied in the network. This will come with an Amazon like evaluation service. In this way the tools and processes used in the network can convert to a standard way of working. This will allow an easier sharing of documents and cooperation product design but it will also simplify the extension and evolution of the network. New network partners will have an easy way to understand tools, formats and processes applied in the network and therefore a better chance to by conform to the network practices. The approach is derived from the EU project FACIT-SME.
It is expected to realise the Best Practice Service via FI-WARE GEs e.g. Apps.Marketplace, Apps.ApplicationMashup.
The SME network services require a dedicated infrastructure which supports data security and trust as well as extensibility in terms of provided services. Currently the software tools in the network are not provided or provide as “software as a service” ASP by the service provider but it is planned to extend the business for the future and provide a virtualisation service of the software. Therefore the scenarios rely on a private cloud concept for the SME network environment.

| **Risk Associated**: *Transparency and consistency of ITs and documents* |
|---|
| The risk associated to the Use Case **Transparency and consistency of ITs and documents** are:<br>1. **IT Availability / failure:** Web applications are not to be reached for the final user or to the network partners.<br>2. **Different IT landscape:** In the single network enterprises different applications are in use (CAD, ERP, CMS etc.) |

## 3.3. Digital Factory Business Scenarios

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Inquiry Service & Machine Repository Support Management** | **Management** | | Fraunhofer IPK |
| **LOCATION** | | **Wolfsburg, Germany** | | |

**Current Business Scenario:** *Inquiry Service & Machine Repository Support Management*

This process goes through the following intermediate steps:

(1) Basic evaluations on what the new product should be and for which markets.
(2) Basic evaluations where it should or could be manufactured and at which costs.
(3) Followed by a Go or No-Go decision, i.e. the product decision.
(4) In case of a Go decision: start of detailed product design.
(5) Start of detailed production planning.
(6) Contracting suppliers of parts and machinery.
(7) Implementing production equipment in-house and at suppliers.
(8) Pre-series.
(9) Start of series production.

The decisions made at step (3) have inevitably to be made on a certain level of uncertainty, because product, supply chain and production conditions cannot totally be clear and detailed at step.

However, these decisions do concern financial volumes of approx. one billion Euro, and thus shall be made on a basis of best possible certainty.

The objectives of the FITMAN-project's automotive trail thus shall contribute to improvement of this certainty. And exactly this improvement of certainty and reliability of these decisions – and the figures they are based on – makes up the business case.
In the current business scenario the decisions made at step (3) not well supported by the machinery repository. The MR is not provided to the each planning engineer of the production planning department, because of missed integration of the MR in the IT-infrastructure. Furthermore the management of the MR spent too much time and money.

**Future Business Scenario:** *Inquiry Service & Machine Repository Support Management*

A product decision at step (3) of above sequence requires information (i.e. figures) covering the following scenario:

- Product concept.
- Market volume.
- Development costs.
- Costs of purchased parts, incl. inbound logistics costs.
- In-house production costs.

The FITMAN-project's automotive OEM industrial trial is focused on improving certainty and reliability of estimated figures of in-house production costs at this early stage of decision-making. It utilizes and is based on the existing digital factory systems, tools and planning environment.

To better understand and specify this statement, it is necessary to explain the process of determining or estimating these in-house production costs, which is based on two technical "columns":

- Premises on the product concerning e.g. size, drive train, product modules to be installed, i.e. the product concept.
- Available knowledge on production modules (concerning press shop, body shop, paint shop, assembly shop and in-house logistics) which might be required to produce this product.

Information on these production modules is available in the Machine Repository (MR) which references detailed production equipment information stored in a variety of Planning Systems' databases (e.g. TeamCenter).

However, this information on production modules is much too detailed to be efficiently utilized for the evaluation whether this module is suitable or required for a certain step of producing this product under investigation.

Therefore, a higher level of abstraction is required in describing/specifying the production modules. This level of abstraction needs be closer to the product in order in can be checked whether a production module in the MR is suitable or required.

In more general terms, the means:

- From detailed production equipment data in Production Planning databases (e.g. bill of material, layout, design data),
- more abstract and product-related, value-adding-process-related data have to be extracted and stored in the machine repository.

This business case requires the following to be checked and implemented:

- Extract different levels of product-related information abstraction from available MR and production-planning databases.
- Support the analysis and evaluation process (product requirements vs. production equipment capabilities), e.g. by creating an evaluation report which can be shown on upper management's iPad.

| **Risk Associated:** *Inquiry Service & Machine Repository Support Management* |
|---|
| The information on production modules stored in the planning system databases are much too detailed to be efficiently utilized for the evaluation. At the moment VW has to determine an investigation manually based on detailed data whether a production module is suitable or required for a certain step of producing a product. A higher level of abstraction is required in describing/specifying the production modules. This level of abstraction needs be closer to the product in order to check whether a production module in the MR is suitable or required. An open question is, whether it is possible to separate and to read out metadata coming from production planning systems like ProcessDesigner and stored and managed in the Product Data Management System by using FIWARE-technologies. The data are available in the JT-file format.<br>A challenging barrier for the process is that the product and the production-equipment data dealt with in this process is highly confidential, thus any toll can only if there is a level of safety being guaranteed by VPN connections.<br>Another socio-legal barrier is the acceptance of provides web-services for the production development process and the fact that these services will replace some "manually" processes.<br><br>Regarding to this, some specific risks related to the Business Scenario has been considered:<br>- **No GEs or SEs available to handle jt-Files**: Update Machine Repository by use of jt-Data.<br>- **Highly confidential business processes:** The processes described in the use cases diagrams are confidential. The described services handle with highly confidential production data and product data.<br>- **Acceptance of proposed Web-services:** The web-services will be accepted only by the user, if the effort will be reduced for each user the business processes. |

| **BUSINESS SCENARIO** | | **Activity AREA** | **COMPANY** | **IT PROVIDER** |
|---|---|---|---|---|
| **1** | **Helicopter Final Assembly (FAL)** | **Manufacturing** | AgustaWestland | TXT |
| **LOCATION** | | **AW FALs** | | |
| **Current Business Scenario:** *Helicopter Final Assembly (FAL)* | | | | |
| The trial will take place principally in the FALs (final assembly line) of some AgustaWestland plants.<br><br>FAL is the place where the helicopter is assembled and it represents the final stage of the helicopter manufacturing.<br><br>FAL plants collect parts produced by other AgustaWestland plants or by vendors and are used to assembly the helicopter<br>The FAL is designed with stages: fuselage starts on the first stage and in each stage a group of parts are installed.<br>The helicopter assembly is performed in several stages, at each stage a group of components are installed and a set of activities is done accordingly to the instruction defined for the stage.<br>At the final stage, the helicopter is completely assembled and ready for flight. | | | | |

In H/C assembly several process and information systems are involved:

- Starting point is the production engineering department where BoM (Bill of Material) and routing are created. BoM is a hierarchical list of components that have to be installed on the helicopter based on configuration and customer requirements.
- Linked to BoM is Routing: it is a list of detailed instruction that describes how to handle and install components.
- Technicians in the shop floor perform their activities using papers which contain all the info prepared by production engineering department.
- For each serialized components installed on the helicopters a paper is created and signed off.
- The detailed assembly instructions with drawings are created using the IT tool FAST (Final Assembly System Tool) where a Job Card is prepared.
  A Job Card contains the info of all the materials to be installed, detailed instructions on how to install the component (with the help of drawings) and the tools needed to perform the job.
  The Job Card created is approved and lunched into the shop to start an assembly activity in a particular stage. Here it is printed out and used by technicians to perform the activity on the helicopter stage.
- SAP is used to create the work order which is mainly used to withdraw the components from the warehouse to the final assembly.
- A timekeeping system is used to declare the start, stop and finish of each activity in order to tack the labour hours spent by each instruction.
  Every time an instruction listed on the Job Card is completed, it is manually signed and marked on the paper by the technician who performed the activity and by the quality supervisor who certified the correctness of the job performed.
- All the papers with components installed are collected at the last stage and certified by quality departments. This list is used to create a document called “logbook” which is delivered to the customer when the helicopter is accepted.
- The logbook contains all the serialized components installed in the FAL with the addition of serialized subcomponents (coming from other AgustaWestland plants or vendors).
- Copy of the paper version of the logbook delivered to the customer is also filed and kept in AgustaWestland.

**Future Business Scenario:** *Helicopter Final Assembly (FAL)*

The TOBE scenario has the aims to create an electronic version of the logbook starting from its paper format. This e-logbook has to be archived and accessible in the system for future search.

The process to produce the Logbook and the referring procedure and process linked to it will remain the same, but the new process will introduce a technology change that allows to instantly digitize the logbook when it is ready for the mapping of all the components and sub-component installed on each helicopter and to maintain the paper copy, necessary for the H/C delivery.

Once the paper logbook is created and certified by quality it has to be scanned and loaded to a searchable document management system. During the scanning, the system will identify main data on the paper and create an electronic record of it.

For each helicopter the system will create a serialized BoM that will be useful for a better control of the helicopter configuration.

Possible samples of questions that rise during the customer support/maintenance processes are:

1. Which components are installed on this helicopter (as part number, serial number, as description)?
2. This component (as part number, serial number, description) in which helicopter is installed?
3. When the customer requires a component substitution under guarantee the customer support as to inquiry the system to check if the serialize component was originally installed on the helicopter

In the TOBE scenario the system will be able to answer to this kind of questions in a better and more efficient way.

**Risk Associated:** *Helicopter Final Assembly (FAL)*

**Risk:** GE with limited or not availability in time
**Description:** delay in having them at disposal can be a great difficult for the development and experimentation delivery

**Risk and description:** Software solutions that couldn't improve the actual scenario

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **2** | • **FALs**<br>❖ **Helicopter Service Station Maintenance** | • **Manufacturing**<br>❖ **Maintenance** | AgustaWestland | TXT |
| **LOCATION** | **FALs and /or Service Station** | | | |

**Current Business Scenario:** *Helicopter Service Station Maintenance*

The second scenario is the use of smart toolbox in a FAL and in a Service Station.
Actually the use of them is limited and as it is.

The correct use and management of tools is a very important point for the assembly and the future maintenance of the H/C.
Safety and control of tolls are a priority.
The tools that are needed to perform the activity are listed in the Job Card, and manually requested at the tool crib. Every time a technician needs a tool, he has to go to the tool crib and book the tool.
Once the tool is used, values and tools used are recorded on the paper of the Job Card.

There are certified procedures and training courses that explain and teach the correct use of tools and the prevention of possible risk of FOD (foreign object damage) linked to the incorrect use of them.
In fact the use of the tools on the helicopter could be a risk of FOD with big implication for the

safety. Currently this is controlled by a dedicated team with specific procedures.

Sometimes, there are limited soon available info on availability and location (who owns a tool and where it is located on the production line). In this case of issue, long time could be necessary to research where a tool was used (info is on paper only).

**Future Business Scenario:** *Helicopter Service Station Maintenance*

The monitoring of the tools usage to accomplish the current FOD preventions and efficiency of the maintenance/final assembly process will be improved by the future implementation carried out through the FITMAN project.
Actually the use of smarts tools box is limited and as it is.

The goal of the future scenario is to develop sensors and applications that could help the technicians and the company to better support the technicians in taking under control the tools they are using for the tasks automatic monitoring of tools and their usage by the technician by usage of a smart environment.

The possible TOBE scenario is represented in the figure (see AW Doc); during the daily activities the technician will have at his disposal an intelligent toolbox, sensor equipped that will record any activity the user will do (for example: item XX issued, item YY returned, etc.). This environment will not only register what is happening but, a back end level, will manage the events coming from the smart toolbox and will act accordingly following business rules and allowing the access by the quality team for monitoring issues. Business rules will provide supporting services for FOD prevention and improve the efficiency of the processes.
The information of the real environment can be useful for collect data for dedicated the training materials preparation that can be used for the technicians training.

It is planned to connect to the business rules the training material under construction in the TELLME project (www.tellme-ip.eu) So TELL ME, helping training company purpose, can make technicians more aware of the importance of FOD prevention linked to the correct use of Tools, FITMAN can give technicians new instruments to make their works more effective and can support company to improve some aspect of its processes.

**Risk Associated:** *Helicopter Service Station Maintenance*

**Risk:** GE with limited or not availability in time
**Description:** delay in having them at disposal can be a great difficult for the development and experimentation delivery

**Risk and description:** Software solutions that couldn't improve the actual scenario

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| 1 | Control of Concrete | Management and Supervision | CONSULGAL | UNINOVA |
| LOCATION | | Oeiras, Portugal | | |

**Current Business Scenario**: *Control of Concrete*

The business scenario under consideration involves of phases for concrete planning, concrete sample collection, testing of the samples and analysis of the test results. In each of these steps various stake holders like designer, contractor, supervisors are involved directly and clients are involved indirectly. In the present scenario, the integration between these various processes are performed by manual process i.e. data needed for each of the processes are provided with the involvement of human, instead of automated process. At the same time, all the involved stakeholders' store, retrieve and exchange information with tradition means via emails or hard copies.

In the current scenario there is no specific network software/platform to archive and manage data. Results archived with standard windows file systems and retrieved manually. The data and documents produced at each state of the workflow are stored by the stakeholders in their own system and are exchanged to the other partners through emails or through hard copies as required and use in the other stages of the workflow with manual integration of the previous results. At the same time the objects like slump, concrete cubes which are important part of the overall workflow are not connected to the information system. The record regarding them are created, stored and retrieved making use of the paper documents.

**Future Business Scenario**: *Control of Concrete*

The major focus for the future scenario is the automation of the concrete handling procedure with a well-defined information management system. The sequence of activities to be performed will not be affected, but the methodology for the stakeholders to take part in the activities will change in the future scenario.

Based on the trial scenario and the work flow involved the future scenario is as show in the figure below. The work flow remains the same and the information generated at various phases remains the same. But there will be a significant change in the way the generated information is stored, retrieved, processed and distributed.

A common web platform will be developed for all the stake holders to store and retrieve information and documents generated at different stages of the work flow. Thus a collaborative workspace will be created using standard web and storage technologies. Concerned authorities have access to the results through platform based on their access rights.

At the same time the physical objects which are important part of the overall work flow is identified and connected to information system and accessed/tracked using new technologies.

Various sources of data that produce information regarding concrete class, concreting plan, slum test result, and concrete sample test results are integrated in the central information system. Things are tagged and integrated to the central system with the help of barcode/rfid readers (the choice is still under discussion). The front end provides web application for

entering and viewing information as required and accessibility of the user. Based on the profile of the user (i.e. designer or supervisor or contractor), the application provides varying work spaces to meet their needs. At the same time front end is also supported by mobile application for on-site user. One of the important scenarios for mobile applications is the case of slum test. The employee at the site can take a digital proof (video or image is still under discussion) of the slump test procedure, which will be sent immediately to the supervisor at remote place, so that he can validate the procedure.

**Risk Associated**: *Control of Concrete*

Some specific risks have been identified based on the use case characteristics:

1. **Information security and trust:** The risk of the unauthorized access of the information is critical in the proposed business scenario, which involves confidential information regarding construction project.
2. **Poor design/coordination/management (governance) of the construction process:** Since the construction project has the involvement of various stake holders it's important to have a coordinated workflow and defined cooperative business processes.
3. **Any stakeholder drops out of the network in the middle of the project:** If any stakeholder decides to leave the project in the middle of the work progress then, this causes a huge problem in the overall project.
4. **Integration-technology**: Integration with the legacy system of the end user.
5. **Integration-workforce:** Integration of the existing workforce of the end-user with the new technology. The changes in the way activities are performed might cause some problems to the employees.
6. **Data Loss**: Data produced during the activities of each of these steps are of great importance for the project execution, future reference and legal proceedings (if necessary). So, loss of data is of very high risk in this business scenario.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Furniture Trends Forecasting for product development** | **Market Research and Strategy** | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |
| **LOCATION** | | **Valencia, Spain** | | |

**Current Business Scenario:** *Furniture Trends Forecasting for product development*

UC1, Furniture trends forecasting for product development, AIDIMA performs a thorough analysis of market variables in order to determine trend signals that are related to the current furniture movements. From there, an extensive work is done in order to obtain the *Annual Trends Report* that is used by the companies in the sector as an indispensable guide to develop future products. This is a manual process based on internet searches, furniture fair and events, media, etc.

Objectives to achieve are easy detection and initial analysis of home trends for further product design and development.

| **Future Business Scenario:** *Furniture Trends Forecasting for product development* |
|---|
| The future way of carrying out the process will be similar as the current way but in a streamed and automated mode. First of all, the UC is focused on a given a specific knowledge area and for a specific variable, so that the first process will not be done. The software module to be developed (Furniture Trends Forecasting for product development) will analyse automatically the already existing sources of information (textual and if GEs or SE make it possible also images and videos) and will<br>- (i) generate a list of weak signals (words, adjectives, pronominal sentences) with statistics about its relevance and<br>- (ii) for each term submitted a number of references (sentences where the word appears) will be returned.<br>The remaining processes are kept the same way, as far as the processes required intellectual action and human decision taking. |
| **Risk Associated:** *Furniture Trends Forecasting for product development* |
| The risks identified to this specific use case are:<br>1. **Information sources in an incompatible format:** Analyst will be able to add new sources of information.<br>2. **Weak signals not repeated in different languages:** The tool is not expected to group different terms that mean the same in different language under the same unified term.<br>3. **Filters for trimming results wrongly configured:** Filters will require some knowledge to express them properly by the analyst. |

| BUSINESS SCENARIO 2 | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| 2 | End user requirements management | Market Research and Strategy Product Design | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |
| LOCATION | | Valencia, Spain | | |
| **Current Business Scenario:** *End user requirements management* | | | | |
| Retailer collects user inputs at its stores by asking customers about their tastes, product uses, type of family, special needs, and how much they want to spend. With this in mind, they perform the sale by looking at the catalogue, and customizing the product and ordering it. Retailer also collects user inputs thanks to their sometimes limited social media presence and activity. Such inputs are used by designers in order to attend the real user needs. Everything is done manually. | | | | |
| **Future Business Scenario:** *End user requirements management* | | | | |
| The goal of the deployment of this second use case is to make use of already available information in distinct social media managed by ARDI and Circulo Mobiliario. Both companies have already different blogs and social sites such as Facebook where final customers post comments on already bought products, opinions and ideas on new products. All this information is not included in the product innovation process nowadays and doing it | | | | |

is the main concern of the "End user requirements management" use case.
The introduction of this module will include consequently a new process on analysis this social and unstructured information and the generation of reports with customer or potential customer requirements that will empower the discussion among CM, ARDI and third party designers.

**Risk Associated:** *End user requirements management*

The risks identified to this specific use case are:

1. **Changes in social APIs**: Social network providers can modify APIs for retrieving information.
2. **Social information is security sensitive:** Problems with handling social information can due to legal problems.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **3** | **Product Innovation** | **Product Development** | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |
| **LOCATION** | | **Valencia, Spain** | | |

**Current Business Scenario:** *Product Innovation*

This Use Case follows the Open Innovation approach focused on the furniture product definition. At this moment there is almost no implementation of this product definition approach in the furniture industry. Some furniture manufacturers organize different design contests in order to receive innovative ideas for a given product typology. The selected proposals are awarded, evaluated and at least one of them finally implemented. These calls bring benefits for the manufacturer and the awarded designers.

**Future Business Scenario:** *Product Innovation*

The TO-BE way of performing this innovation process is somewhat different from the current one. UC1 weak signals' index cards will be available to be searched and matched with database Materializa in order to give designers a total innovative way to be creative when designing new products. The remaining processes are kept the same way, as far as the processes required intellectual action and human decision taking.
The implementation of this use case is about recovering information generated in use case 1 from AIDIMA and offers it to ARDI and its designers. The information generated in use case 1 could have materials associated to them. It's extremely important to map the information of materials (prices, properties, conditions, etc.) with the ideas, trends and signals to accelerate the process of generating new products. Knocking down bad ideas could swift the innovative process in months and save thousands of dollars.
The introduction of this module will include consequently a new process on analysis this social and unstructured information and the generation of reports with customer or potential customer requirements that will empower the discussion among CM, ARDI and third party designers.

| **Risk Associated:** *Product Innovation* |
|---|
| The risks identified to this specific use case are:<br>1. **Information sources in an incompatible format:** Analyst will be able to add new sources of information.<br>2. **Weak signals not repeated in different languages:** The tool is not expected to group different terms that mean the same in different language under the same unified term.<br>3. **Filters for trimming results wrongly configured**: Filters will require some knowledge to express them properly by the analyst.<br>4. **Weak signal too abstract to yield material match:** Some potential trends may be too abstract to be translated into possible materials to be used. |

## 3.4. Virtual Factory Business Scenarios

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Enhance Information Quality** | **Manufacturing in plastic industry** | APR | UNIVERSITÉ LUMIÈRE LYON 2 |
| **LOCATION** | | **Saint Symphorien d'Ozon-Lyon,–France** | | |

**Current Business Scenario:** *Enhance Information Quality*

**Commercial Scenario:**

- **Reception quotation**: If the customer or prospect sends us its price request by fax, the commercial assistant must print the fax (quotes, orders, others) and then deliver them to the relevant departments for processing. If the customer or prospect sends the RFQ by mail to the business address, the assistant prints the documents for processing.
- **Administrative process:** Once the documents printed, the sales assistant creates a quote number and then consults the database manually to enter the administrative data and verify the accounting data.
- **Technical Process:** The production manager retrieves the requests. Then, he looks at the map and then distributes them to the business managers. They process by taking the request on their stack. At that time, they check the type of the request, if such a part has already be made in APR with this index or not, if the quantity changes.
- **Commercial Process:** The business manager gives the documents to the sales manager, who looks them and discusses the quotation with the business manager. To validate this offer, they must remember the more information. Once this validation done, the business manager makes an offer again if needed and sends it to the customer.
- **Quoting recovery:** The quotations to revive are given to people by the sales manager. They must keep the documents and be aware of the files "to recover" in order to validate the quotations to revive in the day.

**Business Scenario Input order:**

- **Reception order**: If the customer or prospect sends us the order by fax, the commercial assistant must print different fax (quotes, orders, others) and then deliver them to the relevant departments for processing.
- **Administrative processing**: Once the documents printed, the launch department creates an order number and then consults the database manually to enter the administrative data and verify the accounting data. These paper documents are then forwarded to the sales manager for approval. Once this information is validated, the orders return to the sales assistant.
- **Order quotations Processing**: The business manager retrieves orders (a different stack from the one for the quote) then analyses the type of processing to be performed (Index Validation, price validation, method of processing validation). He sends the new quotation if required to the customer. Once the information is validated, he returns the order to the launch department.
- **Order needs Processing:** Once all elements of the order are entered, the launch department, if there is some stock of finished piece, prints preparation requests for the store and passed them to the store.
- **Parts Stock Processing:** The storekeeper retrieves the documents and manages the stock processing and he returns the documents to the launch department.
- **Order launch processing:** The launch department retrieves documents to validate bookings of finished parts on the order (counter order, partial order). Then it generates needs (OF and OA) and give the needs documents to the scheduling department.
- **Scheduling Order Processing:** The scheduling department retrieves the OFs then processes the information, taking into account the availabilities of materials and equipment to inform the date of the production end. At that time, it manually adds a safety delay of about two days and then it gives the information to the launch department.
- **Order AR Processing**: During the receipt of the AR information, the launch department controls the delay relative to customer expectations. If a gap between the customer request and the production date set by the scheduling department is found, the launch department contacts the scheduling department to modify if possible this time. The scheduling department converts the data into his schedule and sends it back to the launch department. Once the AR validated, the launch department sends the AR document to the customer.

**Order AR Monitoring Output Scenario:**

- **Order AR Monitoring Request Reception:** If the customer asks for a time validation by phone, the launch department takes note of the customer requests, sees if the case is finished or in progress. If the customer sends the request by fax or email, the launch department printed the request. It then consults the database to see if the parts are finished and it notes on the request for information parts remaining to be delivered.
- **Order AR Scheduling Processing:** The department looks at the progress of the implementation and planning of this achievement, and it validates the delay or the request to change the time. Once this processing done, it returns the documents to the launch department.
- **Order AR Information:** Depending on the nature of the emergency period, the launch department calls the customer or sends an email response.
- **Quotation Processing Scenario:** The purchasing department generates these RFQs

via our ERP and then sends these requests to suppliers by email. It retrieves printed RFQs answers via fax or it prints the responses received by email. If after 24 hours, it does not have all the answers, it revives the suppliers. This revival is done by pointing the documents received in relation to submitted requests.

Once it has this information, it analyses the best deal (price and time) and validates it in our system to order. The purchasing department keeps the paper requests in a pocket during 1 month in case of delivery problems of raw material, and then it puts them in scrap when the order is processed.

**Future Business Scenario:** *Enhance Information Quality*

In order to support the development of our business scenario, as introduced previously, we are proposing and architecture, which will implement FI-WARE capabilities such as the mediator (generic enabler) to cover business and data services.

Additional functionalities (business process applications, data analysis, etc.) will be implemented in this TRIAL by the development of new components or the integration of existing ones (such us the integration of OCR component).

**Risk Associated:** *Enhance Information Quality*

In this section are listed the common risks associated to the Business Case:

1. **The setup (time/effort) of the new organisation model to integrate the APR trial:** The different roles defined within the collaborative business processes.
2. **The large use of internet based capabilities (APR collaborators, Collaborators at partners' side):** The appropriation of the new IT environment.
3. **The capacity of new IT-based infrastructure to support the collaboration process**: Cover all contracting facilities with their details.
4. **The ability of existing system to be aligned with IT capabilities provided by Fi-Ware:** Synchronize IT capabilities between technologies**.**
5. **Customers' approbation of the new collaboration processes:** Cover and enhance all important phases of the interaction process with personalised profiles.
6. **Don't valorise the added value of the FI-based technology for business collaboration with partners**: Bugs in platform use

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| 1 | Call for Tender Opportunities | Manufacturing | TAVET technology application network | Coventry University |
| LOCATION | | South Wales, England | | |

**Current Business Scenario**. *Call for Tender Opportunities*

SMECluster is a privately owned network cluster of like-minded SME companies that want to share resource and ideas to reduce costs and increase profits. Although SMECluster exists and is active, it is still not performing the role that it was set up to do. It is meant to enable the member SME's to concentrate on their core offerings without worrying about the bureaucratic nightmare of filling in numerous repetitive forms and business to meet the criteria that larger private companies and public bodies demand from business today. Since there are no automated services available currently, members are no better off by joining SMECluster as they are still required to do repetitive paperwork.

**Main Goals**

The competitive feature is to be able to react quickly to a demand with a reference of pass performance. Peer referrals can also play a part in performance capabilities and also the opportunity to post local job opportunities that may not reach the tender sites.

As with any project, the way to prove that the objectives are met is to demonstrate the final results through case studies.

- **Requirements 1 – Winning a tender through SMECluster**

A clear way to demonstrate that SMECluster is working is if a member company was to reply to a tender posted on a European site and win new business with less effort and resource than would normally be required. By matching capability of SMECluster with the tender requirement, the proposed system should at least be able to answer the request for tender with a pre-questionnaire.

- **Requirements 2- Advertise SMECluster capability – Allow Large and Medium sized companies to post requirements** (Via telephone or other methods).

Both Case studies require a combination of services that depend upon a capability register that is attuned to the specific sector of the Cluster and is usable by an SME (a real SME!). It is expected to be dynamic in nature as the data associated with the tenders is fast changing and will be time dependant. The capability of the cluster and the individual members needs to be demonstrated.

**Future Business Scenario**: *Call for Tender Opportunities*

The aim of the Trial is to leave the ways in which the IT appears to and is used by end-users and Sematronix unchanged, as far as is possible, whilst re-structuring the underlying system architecture as depicted below to exploit the FI-WARE architecture in general, and selected GEs in particular. The commercial benefits to be achieved through this include:

- making platform and service maintenance faster, and more cost effective, and more reliable, since less custom code is used;
- making the service offering more flexible and adaptable to technology developments, since evolving technology embedded in GE instances will provide access seamlessly.

Thus the future business scenario from the perspective of Sematronix and it's end-user clients, is characterised by unchanged procedures, but

- costs of use of IT may be reduced as a result of reduction in costs of maintenance and support to the IT provider (Control 2K);
- IT service quality and functionality will evolve continuously through adoption of

evolving GEs.

From the perspective of Control 2K:

- Cost and complexity of maintenance and support of the platform is reduced;
- By passing on some of this benefit to end-users, the potential market for new cluster clients is expanded;
- Introduction of new advanced IT software service technology, and indeed introduction of entirely new products through the platform, is simplified by adoption through evolving selected GEs.

**Risk Associated:** *Call for Tender Opportunities*

The risks associated to the business scenario are listed below:

1. **Failure of the FI-WARE programme:** The provision (and terms of provision) of GEs is not successfully promoted as a widely used structure for service delivery in the future internet, resulting in the failure of maintenance, development and evolution of GEs.
2. **Difficulty in selection of appropriate implemented GEs for the trial:** Candidate GEs for inclusion in Trial 8 are too numerous for all to be included in the time and with the resource available. Selection is necessary.
3. **Unanticipated difficulty in embedding GEs to replace existing code:** Whilst documentation has been examined to understand the implications of GE exploitation, there is no current experience of this. General related experience indicates that unexpected problems are not unusual in the adoption of third party software.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| 2 | Decision Process Support: INDUSTRYWEB | Manufacturing | TAMET | Coventry University |
| LOCATION | | South Wales, England | | |

**Current Business Scenario**: *Decision Process Support: INDUSTRYWEB*

The Industreweb Suite of software provides a complete set of tools and services for business improvement. Its advantage over other systems on the market is flexibility, scalability and low implementation costs. The Industreweb Suite provides a uniquely comprehensive set of Tools that can be applied to a process, a single line, an entire plant or a complete global organisation. Industreweb links data collection systems and allows the data to be presented in the most appropriate way for an organisation.

It combines the data available from Industreweb Collect and HMI units and allows the data to be presented on a browser so that it is available anytime, anywhere and to the personnel that need it. Industreweb helps improve skills, reach production targets, monitor plant performance and much, much more...

**How it all works**

A central collect engine is at the core of the system pulling data from a range of data inputs and typically storing the information collected to an SQL Database. Industreweb Collect has DLL's created for most common protocols and it can connect to almost system.

Information is displayed on a pc and via a web browser in clear understandable formats.

The information can be tailored for engineers, managers, supervisors and directors showing them exactly what they need to know and when they need to know it.

Industreweb can communicate via email, mobile or tablet devices.
Within Industreweb, information is being logged constantly, building up a picture of an organisation over time. Information is available as it happens via Industreweb.
The hardware consists of the Industreweb Collect unit and input devices. Input devices can be sensors, barcode readers, HUI or any existing control systems device on the site. Industreweb can connect to almost any data source.

**Future Business Scenario**: *Decision Process Support: INDUSTRYWEB*

The aim of the Trial is to leave the ways in which the IT appears to and is used by end-users and Sematronix unchanged, as far as is possible, whilst re-structuring the underlying system architecture as depicted below to exploit the FI-WARE architecture in general, and selected GEs in particular. The commercial benefits to be achieved through this include:

- making platform and service maintenance faster, and more cost effective, and more reliable, since less custom code is used;
- making the service offering more flexible and adaptable to technology developments, since evolving technology embedded in GE instances will provide access seamlessly.

Thus the future business scenario from the perspective of Sematronix and it's end-user clients, is characterised by unchanged procedures, but

- costs of use of IT may be reduced as a result of reduction in costs of maintenance and support to the IT provider (Control 2K);
- IT service quality and functionality will evolve continuously through adoption of evolving GEs.

From the perspective of Control 2K:

- Cost and complexity of maintenance and support of the platform is reduced;
- By passing on some of this benefit to end-users, the potential market for new cluster clients is expanded;
- Introduction of new advanced IT software service technology, and indeed introduction of entirely new products through the platform, is simplified by adoption through evolving selected GEs.

**Risk Associated:** *Decision Process Support: INDUSTRYWEB*

The risks associated to the business scenario are listed below:

1. **Failure of the FI-WARE programme:** The provision (and terms of provision) of GEs is not successfully promoted as a widely used structure for service delivery in the future internet, resulting in the failure of maintenance, development and evolution of GEs.
2. **Difficulty in selection of appropriate implemented GEs for the trial:** Candidate GEs for inclusion in Trial 8 are too numerous for all to be included in the time and with the resource available. Selection is necessary.

**Unanticipated difficulty in embedding GEs to replace existing code:** Whilst documentation has been examined to understand the implications of GE exploitation, there is no current experience of this. General related experience indicates that unexpected problems are not unusual in the adoption of third party software.

| BUSINESS SCENARIO | | Activity AREA | COMPANY | IT PROVIDER |
|---|---|---|---|---|
| **1** | **Management of quotes and orders** | **Purchasing, Data Management** | | |
| **LOCATION** | | **Bordeaux, France** | | |

**Current Business Scenario:** *Management of quotes and orders*

Managing quotes and orders is far to be done automatically today. The current business scenario involves three internal actors (Internal Services, Collector, Buyers) in interaction with the external providers/suppliers. Feeding the collaborative solutions SAP Business One and Microsoft SharePoint is done manually and various communication means and formats are used.

Clearly, the As Is scenario suffers from a lack of Workflow modelling. The quality of data, in particular, the liability of component price lists is uncertain. The consequence is the bad quoting of new affairs, the multiplication of contacts to update prices and to re-negotiate with suppliers and customers.

Globally, there is room for improvement regarding the competitiveness of the enterprise:

- a better technology watch,
- a more accurate pricing,
- a reduced time to market,
- a higher purchase performance.

**Future Business Scenario:** *Management of quotes and orders*

It is expected from the FITMAN platform services a significant improvement of data quality, by minimizing the risks of errors when entering data, by eliminating the time wasted through multiple acquisitions, and by ensuring data update and liability.

According to the To Be scenario, the management of quotes and orders will be modified, in order to transmit them automatically throughout the internal Information System of the enterprise, as well as towards and from the external suppliers and co-traitors.

By using the FITMAN platform, the Internal Services will enter the items related to the components of the machine to be designed. This list of items will then be consolidated by the buyer to allow him to launch a call for tenders and publish it on the Web. Simultaneously, the platform sends notifications to the regular suppliers with which the wood factory company makes it a practice to deal with.

Then the platform centralizes the offers made by the answering suppliers and notifies the Buyer that lists of prices are available. The Buyer may also assess, together with the Internal Services, the cost and delivering delay of the machine to be delivered and optimize its design accordingly.

Once a supplier is selected, the Buyer issues a purchase order through the FITMAN Platform. The complete order cycle may be followed by each of the internal actors and by the supplier. Simultaneously, the Business Engineers are able to establish the final pricing and provide the customer with a quote.

When the quote is followed by an order, the Internal Services are notified and may plan the final design and manufacturing phases.

Note that, by pre-establishing a list of commonly used components, the platform may periodically ask the regular supplier to update their prices. Obtaining an update list of component prices from the Information System of the enterprise is a core requisite of the

wood factory activity.
The benefits expected from the To Be business scenario lies in the unique data entry for each affair, securely accessible by each authorized actor in the company and in its eco-system. Whether the data are stored in a data-base or in the Cloud, the collaborative value-adding activities will be based on update and shared data.

**Risk Associated:** *Management of quotes and orders*

The risk associated to the Use Case will be the followings:

1. **Technical risks:**
- Technical services required to be composed are not available on time.
- A loss of data occurs.
- Platform Piracy attacks due to system shortcomings.
2. **Temporal risks:** The project complete development is not feasible in the time frame of the project.
3. **Legal risks:** The service can be technically developed but information rights and/or Partners data rights, country laws prevent to realize the service.
4. **Social risks (human resources):** The migration tasks, the appropriation of new tools by users in the EMS, difficulty to convince customers, and suppliers, to use the system.

# 4. BUSINESS PROCESSES AND REQUIREMENTS

## 4.1. General Description

The final chapter before analysing the main results obtained is the one describing the business processes and the business requirements of each trial.

In our case a BUSINESS PROCESS is each of the specific selected procedures within a BUSINESS CASE in a TRIAL in which we are going to detect clear, potential and measurable improvements if applying the Future Internet Core Platform (GE and SE).

In our case a BUSINESS REQUIREMENT is each of the business physical or functional need detected when improving each BUSINESS PROCESS selected above. The purpose of a business requirement is to clearly describe what must be accomplished from a business perspective.

Description of business processes and requirements explaining:

- Explanation of each business process
- Expected value/benefits for the company
- Description of the business objectives
- Expected impact of the objectives
- list of requirements selecting the type of priority for the company

## 4.2. Smart Factory Business Processes and Requirements

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Risk Modelling | TRW | innovalia ASSOCIATION |
| BUSINESS PROCESS | | | |

The business processes that will take place in the risk modelling business scenario will be the following.

**Business Process 1: Risk Cataloguing**

In a first step, the risks are not catalogued for a particular factory, but are generally defined through studies and the experience of the cataloguers (risk prevention technicians). Afterwards, the concrete risks regarding the TRW factory are selected, customizing the data base and the catalogue for a specific company. The elements that will be catalogued are the following:

- Risks: they define a hazard based on a mathematical formula, having up to five levels of dangerousness.
- Preventive actions: they describe an actuation plan aiming to eliminate or minimize the consequences of the risk, being possible their association with specific level of risk.

**Business Process 2: Evaluating Consistency of the Preventive Process**

After designing the prevention strategy, the consistency of the plan has to be assessed to assure that there is no contradiction between the proposed actions. The main objective will

be to evaluate the whole preventive process ensuring its coherency. For that reason, the formula and preventive actions related to each of the workplaces and machines will be evaluated, checking that there are no opposed orders or actions for the same success. The same tool that will allow the risk cataloguing, will also confirm that the preventive process is possible, without any error due to a wrong plan.

| BUSINESS OBJECTIVE 1 | Effective and consistent prevention strategy |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| With the new risk catalogue, the prevention technicians will be able to design and set the risks that can happen in the factory, with different preventive actions associated to each risk level. In addition, the evaluation tool will verify the coherence of the prevention strategy, due to the conditions and limitations that the factory and possible inconsistencies in the designed actions. | TRW will be able to design a complete and coherent prevention strategy that will be checked not only by the technicians but also by the system. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| None of the risks of the factory should be skipped | Critical |
| Cataloguing system should model the risks, using formula with multipliers. | Critical |
| Cataloguing system should model and design the preventive actions linked with different levels of risks. | Critical |
| Cataloguing system should be consistent and efficient enough to facilitate the design of the plan | Critical |
| Prevention technicians should be trained for an effective use of the cataloguing system. | Preferred |
| Evaluation system should check the consistency of the preventive strategy, founding incoherencies in the actions. | Critical |
| Information system technician should configure the new system | Preferred |
| Information system technician should be trained to use the new systems | Preferred |
| Workers should be trained for the deployment of the new system | Preferred |
| The manager should promote the use of the new system | Optional |

| BUSINESS OBJECTIVE 2 | Optimization of prevention costs |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Due to an inefficient prevention strategy, awful consequences can happen, which are mainly based on the no prevention of accidents and incidents of the factory. Because of these events, the company may lost a huge amount of money regarding the workers sick leave, reduction of the productivity, waste of materials, or administrative costs, among others. | The investment in the prevention strategy will be exploited and the benefits will return. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| None of the risks of the factory should be skipped | Critical |
| Cataloguing system should set up the risks, to assure that they are detected. | Critical |
| Evaluation system should check the consistency of the preventive strategy, founding incoherencies in the actions. | Critical |
| Wastes of materials and parts due to accidents and incidents should be reduced. | Preferred |
| Evaluation system should confirm the efficiency of the preventive plan. | Critical |

| BUSINESS SCENARIO 2 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 2 | Risk Detection and Information | TRW | innovalia ASSOCIATION |

**BUSINESS PROCESS**

The business processes that will take place will be the following:

**Business Process 1: Risk Monitoring**

Nowadays the prevention strategy is based on periodic inspections and "planned observations" by the charge of the section controller and prevention technicians. These inspections are insufficient, considering that neither can be guaranteed that the supervisor has the training or the time enough, nor is it possible to detect all the risks by a simple visual inspection. In addition, the measuring and monitoring systems are not customized to the limitations or characteristics of the workers, so the results are not trustworthy in all the cases.

**Business Process 2: Risk Intervention and Communication**

Nowadays, when the prevention technician observes a risk, the concrete action previously decided on the prevention plan is made. However, the same actions are implemented for the different kind of workers that can be in the factory, so the prevention measures are not effective enough. Moreover, the workers don't receive a customized plan due to their occupational conditions, or they are not informed if they have done risky actions.

| BUSINESS OBJECTIVE 1 | Reduction of accidents and incidents |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| The business objective to be achieved is the implementation of "zero-accident workplace", through proactive monitoring of workers, goods, processes and machines; i.e., the aim of this scenario will be decrease of the daily accidents and incidents due to human or mechanical errors. | As a result, the workers, technicians and coordinators will have real information and the instructions they have to follow in order to assure that the risks disappear or that the consequences are minimized. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Ergonomic system should monitor the positions performed by workers | Critical |
| Ergonomic system should identify the worker's inclination ranges and the numbers of times per minute | Critical |
| Ergonomic system should send alerts when a determined ergonomic level risk is achieved | Critical |
| Collision detector system should detect multiple moving objects (worker, forklift, wheelbarrow) within the same scene | Critical |
| Collision detector system should determine the distance between those objects to avoid collisions | Critical |
| Collision detector system send alerts when a determined collision level risk is achieved | Critical |
| Area manager system should identify whether an object or person approaches the machine, and find the orientation in which is placed a piece | Critical |
| Area manager system should know a priori whether a machine movement could cause a collision between machine/piece | Critical |
| Area manager system should send alerts when a determined collision level risk is achieved | Critical |
| Workers should be informed about the data protection | Critical |

| BUSINESS OBJECTIVE 2 | Increase of the productivity |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| The new scenario will reduce the number of accidents and incidents, improving the health and safety of the workers. Workplace comfort and wellness should become drivers of improved productivity. | The improvement of H&S of the workers in the factory and the reduction of dangerous situations will directly affect to the productivity. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Sensor data should be processed to detect different risks | Critical |
| Workers should receive personal messages and instructions related to the risks in which they are involved | Critical |
| Workers should access to their customized actions using credentials | Critical |
| Prevention technicians should receive data about the line/area in which a risk happens | Critical |
| H&S coordinators should monitor and control all the risks of the factory | Critical |
| Information systems technician should optimize and maintain the new network | Preferred |

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER | |
|---|---|---|---|---|
| 1 | Event Scenario | Whirlpool | POLITECNICO DI MILANO | ENGINEERING INGEGNERIA INFORMATICA |
| 2 | Big Data Scenario | | | |

**BUSINESS PROCESS**

The help chain model is the operational process and organization reference structure supporting Whirlpool Production System which covers both execution and supporting functions, ensuring the stability of the value stream flow and sustainability of problem solving and continuous improvement.
Main element of WPS help chain models is the *Problem solving and escalation* system that ensures that problems are solved efficiently and completely, wherever they originate. The problem is escalated to the level that has the right skills to address the real root cause and eradicate the problem forever. This happens at different level:

- Help chain level 0: prompt intervention to support team members, provided by team leaders at Andon occurrence, for any deviation from the defined Standards.
- Help chain level 1: prompt intervention to support team leaders on issue management escalation, provided by functional group.
- Help chain level 2: structural process to support problem solving and continuous improvement at group level, value stream level and factory to definitively solve issues and update and consolidate operational standards, with factory resources.
- Help chain level 3: ad hoc project initiative to manage big issues, promoted by plant managers and staff, with local and central resources (cross functional teams)

Immediate reaction to support team members in case of deviation from pre-defined standards (Andon), ensuring the continuity of the flow (within a few Takt Times) and basic problem solving. Structure to support team leaders in case specific competencies or responsibilities are needed, ensuring fast flow re-establishment and effective problem solving initiation. Resources are those within the shift and the value stream.

| BUSINESS OBJECTIVE 1 | Improve the communication effectiveness along the help chain organization |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| The help chain organization can be improved with a system able to directly communicate events and related information at the right level of resolution**.** | Help chain can react faster and more effectively, thus reducing waste time and improve problem solving process. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Users are classified according to their role | Critical |
| Events on the shop floor are classified | Critical |
| Events on the shop floor are gathered | Critical |
| Events on the shop floor are filtered | Critical |
| Events are communicated to interested user through mobile device | Critical |
| Events are linked to correlated data | Preferred |
| Status of the System is known by the user | Optional |
| Status of Users is known by the system | Preferred |
| System administrator can configure users – events | Critical |
| History of event communicated is stored in DB | Preferred |

| BUSINESS OBJECTIVE 2 | Improve the effectiveness of decision makers along their role in help chain |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Each single member of help chain can be helped in their decision through a faster and reliable way to provide the right data at the right time linked to the event they must be aware of**.** | Workers will be more involved and aware in taking right decision at the right time and hence overall effectiveness of managing variation in the production line will be improved. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Users are classified according to their role | Critical |
| Data on the shop floor are analyzed | Critical |
| Data Driven Events are created | Critical |
| Events are linked interested user | Critical |
| Events are communicated to interested user through mobile device | Critical |
| System administrator manage (create, modify) correlation rules | Critical |
| Status of the System is known by the user | Optional |
| Status of Users is known by the system | Preferred |
| System administrator can configure users – events | Critical |
| History of event communicated is stored in DB | Preferred |

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Cloud production | PIACENZA CASHMERE | softeco sismat information technology |

**BUSINESS PROCESS**

As we have seen FITMAN textile trial will be implemented into dyeing, weaving (warping, weaving and raw control) and finishing (wet finishing, raising and dry finishing).
While warping and weaving departments are already ready for FITMAN trial implementation because their MES and ERP software are state of the art and RF-ID technology is not needed (in fact at this stage a real fabric is not existing yet, but only its components and warp), wet finishing, dyeing and raising and dry finishing are still far away to be able to provide updated information. Monitoring is sufficient but not in real time, capacity monitoring and forecast systems have not been implemented and ERP is not able to see detailed production situation at machine level. The implementation of RF-ID technology will enable the direct interaction of pieces and machineries and the geo location of the pieces will provide the information to operators to trace them effectively. The joint application of these technologies will allow settling down an effective real time monitoring and capacity estimation legacy systems. Research must also take into consideration the peculiar conditions of textile production: Tag selection will require a specific effort to select those devices which can survive to the peculiar physical and chemical stresses of textile finishing and dyeing while geolocation system must be able to work in adverse conditions caused by magnetic interference of the several electrical engines installed aboard of machineries.

| BUSINESS OBJECTIVE 1 | Better exploitation of internal and external production capacity |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| By cloud production companies of the same sector can share their production capacity**.** | Improved ROI in production infrastructure, better service and shorter time to market, higher customer satisfaction. |

| BUSINESS OBJECTIVE 2 | Improved monitoring of production capacity |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| The implementation of RF-ID and Geo Localisation based monitoring systems a more accurate and better optimized management of production at department and company levels. | Increased data update and accuracy, improved efficacy of MES and ERP to manage production. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Production manager should have access to updated information about internal production available capacity | Critical |
| Production manager should have access to updated information about external production available capacity | Critical |
| Sales department can check available production capacity | Preferred |
| Administration can have access to internal and external production information (quantity, cost) | Preferred |
| Administration can have access to internal and external pollution statistics per meter | Preferred |

| BUSINESS SCENARIO | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Network Transparency for more efficient Supplier Search | COMplus | Fraunhofer IPK |

**BUSINESS PROCESS**

The business process of the LED Lighting Network management is anchored on the main activities of design, development and maintenance of the LED Lighting Systems. After the decision about the new product development is being made, a preliminary selection about possible supplier is being made. This is primarily based about previous information. At this point, it is the first time when a supplier are being selected and involved in the further development process. The information is retrieved from different information systems. At the same stage, the further development is divided into the development of LED System parts, like electronics, casing, design and LED –software development.

After the development process is finished, the suppliers are identified and the production network is being configured. New technologies are being considered with a high effort for identifying and allocating new potential suppliers. This is mainly done using different sources of information, After the Production is completed, and the LED Network is also involved in the maintenance of the LED system. Based on a adhoc needs and requirements, the suppliers of maintenance services are being identified and allocated.

| BUSINESS OBJECTIVE 1 | Improvement of Front-end Loading |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Reduction of the development time of 3 years now for 1.5 years for the development of a new product on the network**.** The expectation is to reduce the time in the early phase of the engineering project by 50%. | Products are faster developed and can be brought therefore faster to the mark maturity. |

| BUSINESS OBJECTIVE 2 | Reduction of mistakes and errors |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Containment of mistakes with support of the IT and supporting tools**.** | Reduction of the costs and the development time. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Developing tools as a web application | Critical |
| Communication by web application | Preferred |
| Uniform supplier's search on the network | Critical |
| Developers work with the new applications | Preferred |
| Security of the data | Preferred |
| Access restriction to the web system | Preferred |
| Flexibility and scalability | Preferred |
| Integration of information from distributed information source | Preferred |
| Support creating different views of the network | Preferred |

| BUSINESS SCENARIO | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 2 | Transparency and consistency of ITs and documents | COMplus | Fraunhofer IPK |

**BUSINESS PROCESS**

The processes in the current business processes on enterprise level are the following:

1. Select team and create offer
2. Configure project
3. The following processes run in parallel:
   - Development of electronic
   - Hardware development including casing
   - Software development
   - Technology innovation and development
4. Prototyping & production
5. Marketing and distribution
6. Sales, maintenance & service

This is the whole process from the first inquiry to the network manager, the network configuration, the product development, the supply chain design, the marketing and production as well as the service and maintenance. This requires document exchange and concurrent work processes across organisations currently supported by a heterogeneous set of tools and protocols. However, a major requirement is the privacy of the data nobody is allowed to give data to another organisation without the empowerment of the board members or company owner or a specific contractual basis. Therefore the business scenarios also include the ASP provider for the platform and infrastructure.
The future business process on enterprise (network) level will not differ too much. The main difference is the support of two additional services.

- Best Practice Service,
- SME Cloud Service.

| BUSINESS OBJECTIVE 1 | Reduction of the development time about 50% |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Reduction of the development time of 3 years now for 1.5 years for the development of a new product on the network**.** | Products are faster can be developed and brought therefore faster to the mark maturity. |

| BUSINESS OBJECTIVE 2 | Reduction of mistakes and errors |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Containment of mistakes and errors with support of the IT and supporting tools. | Reduction of the costs and the development time. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Uniform IT landscape on the network | Preferred |
| Developing tools as a web application | Critical |
| Communication by web application | Preferred |
| Document management on the network | Preferred |
| Developers work with the new applications | Preferred |
| Reduction of the interfaces | Preferred |
| Security of the data | Preferred |
| Access restriction to the web system | Preferred |

## 4.3. Digital Factory Business Processes and Requirements

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Inquiry Service & Machine Repository Support Management |  |  |

| BUSINESS PROCESS |
|---|
| A general inquiry has only the following information as input entered by the user in an Email using an inquiry form (template):<br>• the product part, like the left or right side frame of a car and<br>• alternative production reference sites.<br><br>The email will be received and processed by a planning engineer using planning systems like ProcessDesigner, Catia and the Machinery Repository. There is no further workflow-support, that's why these applications are connected only by a dotted line with the use case "Analyse MR". For a "Special inquiry" more information about the product are needed in order to respond to the inquiry. The inquiry reports will be elaborated using a further report-template and send to the user via email. |

| BUSINESS OBJECTIVE 1 | Reduction of time needed for the assessment of product related inquiries |
|---|---|
| DESCRIPTION | IMPACT |
| Decisions about product features and finally the Go or No Go decision for the car concept can be taken earlier. In that way the product development time and the time to market will be shortened. A further benefit is the improved efficiency and effectiveness of related assessment processes. | Reduced Product development time → reduced time to market |

| BUSINESS OBJECTIVE 2 | Reduction of costs, spend for the assessment of product related inquiries and for the management of the Machinery Repository |
|---|---|
| DESCRIPTION | IMPACT |
| Each cost reduction within the production planning process and the product development process improves the competitive capability of the Volkswagen brand and of the products of Volkswagen.<br>The benefits result from saved engineers hours for the assessment of product related inquiries and from saved engineers hours for the management of MR<br>Another benefit of saved engineering hours is that more car project can be in progress by the production planning department at the same time. In this way more car models can be developed and later entry into market at the same time. | Reduced cost impact |

| BUSINESS OBJECTIVE 3 | Immediate accessibility of experts knowledge about production equipment |
|---|---|
| DESCRIPTION | IMPACT |
| The quality, resilience and reliability of cost estimations in early phases of the product development process will be improved because of the improved ad-hoc availability of related information. In parallel the effort of communication will be reduced because of decreasing search times for the acquisition of knowledge. | Reduced cost impact |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Functions to customize the web pages (buttons, dialogs, pull-down menu etc.) | Preferred |
| Access to SQL-Server only with VPN-connection | Preferred |
| Mobil Service available on device (iPad) and on Laptop | Optional |
| User authentication. based on specific roles (profiles) | Critical |
| predefined evaluation inquiries only | Preferred |
| Machinery specifications are available in SQL-Server. Web-Services have to be able to access SQL Server | Preferred |
| Pictures have to be stored! Format is to specify! | Preferred |
| Management of different forms for entering data and reports | Critical |
| the data has to be send according to an distribution list | Preferred |
| More than one user should be able to access at the same time | Preferred |
| Access to TeamCenter only with VPN-connection to the TC-server | Preferred |
| Ad-hoc check of the entered pat | Preferred |
| read out metadata of jt-files has to be supported | Critical |
| No significant changes on existing business processes | Critical |

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Location: FALs | AgustaWestland | TXT |
| BUSINESS PROCESS | | | |
| E LOGBOOK | | | |
| BUSINESS OBJECTIVE 1 | • Reduction of time of final version of logbook preparation and relevant data<br>• Improvement of H/C Configuration Control | | |
| DESCRIPTION | IMPACT | | |
| / | Improvement of the actual procedure | | |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Possibility to scan the paper document | Optional |
| Search base on data in the paper document | Optional |
| Print out logbook | Optional |

| BUSINESS SCENARIO 2 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 2 | Location: FALs and /or Maintenance Service Station | AgustaWestland | TXT |
| BUSINESS PROCESS | | | |
| SMART TOOLBOX | | | |
| BUSINESS OBJECTIVE 1 | • Support and improvement of FOD prevention management<br>• Improvement of the tools tracking management | | |

| DESCRIPTION | IMPACT |
|---|---|
| / | Improvement of the actual procedure |
| | |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Withdrawal of the tool, check of the tool that is in use, check of the availability of the tools and who used it | Preferred |

| BUSINESS SCENARIO | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Control of Concrete | CONSULGAL | UNINOVA INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS |

**BUSINESS PROCESS**

The business process can be divided into three distinct parts, which are as described below:

**Part 1 - Identification of concrete characteristics and Concreting Plan**

The Designer, or the Client, provides the design requirements on what the concrete is concerned. This is done by specifying the required concrete classes and consistency (measured by the slump test). The definition of concrete classes sets the concrete's characteristic stress values.

**Part 2 – Samples collection and testing**

Once the concreting plan is approved, the number of slump tests is also defined (one per truck load). Additionally, the number of samples for the compression tests can be set by the Designer, through the definition of a specific sample plan or by referring to the applicable standards, or may eventually be set by the Contractor and approved by the Supervision. Upon arrival of a truck, a sample is collected for the slump test and this is carried out in the presence of an element of the Supervision team.

**Part 3 - Test results analysis and concrete characteristic stress calculation**

The Works Contractor and Supervision treat the results statistically. Based on this statistical treatment, the Contractor calculates the concrete characteristic stress. Deviations are assessed by Contractor and Supervision; individual non-compliant results may have no or reduced impact on the final characteristic stress calculation.

| BUSINESS OBJECTIVE 1 | Improving readability of the concreting zones with the combination of visual and textual information. |
|---|---|

| DESCRIPTION | IMPACT |
|---|---|
| It is possible to visualise the concreting zones and obtain visual and textual information | Will have a huge impact in the way the concreting operation is performed and managed. At the same time the effect of the operations can be foreseen easily and future actions are defined one time. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| User should have standard way to store/access information regarding concreting zones | Critical |
| Platform should have efficient way for data archival for future reference to regarding the concreting operation | Critical |
| Platform should have efficient way for data encryption/decryption | Critical |
| Users should be trained to make use of the portal to store and retrieve information regarding the concreting zones | Preferred |
| | |

| BUSINESS OBJECTIVE 2 | Decrease the time for access to information on concreting operations and eventually help in quick decision making |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Information on concreting operations, which are an essential part of any construction, particularly dams, easily accessible by relevant stakeholders in "real time" | Will have a great impact in the way the information is stored, accessed and disseminated among the stakeholders. This will help in keeping all the stakeholders well informed and take immediate actions as necessary. This will reduce the future risks and eventually decrease the overhead cost incurred by unforeseen results. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| System should provide an well defined methodology for information flow and inter-process (different sub-activities of concreting activity) so as stakeholders responsible at each step can access information in real-time as the concreting activities are performed. | Critical |
| It should be possible to track objects and physical entities so as to provide real time information to project manager | Preferred |
| It should be possible to integrate information obtained from the concreting activity with existing project management tool | Optional |
| Time for sharing of information between the stakeholders has to be reduced | Preferred |

| BUSINESS OBJECTIVE 3 | Reduction in the use of paper |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Reduction of the use of paper for storage and archival of test results and also for dissemination**.** | This objective though is not the major objective, but will be achieved with the automation of the business scenario under consideration. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Platform should make use of communication technologies for exchange of information rather than hard copies | Preferred |
| Users should be trained to make efficient use of the platform and use hard copies only when very necessary | Critical |

| BUSINESS OBJECTIVE 4 | Ensuring Secure Access |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Ensure secure access of information for all the stakeholders based on their roles. | The new scenario will integrated and improve the existing authentication and authorization mechanism by implement security measures and introducing access based on roles. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| The platform admin should be able to register users and assign roles | Critical |
| System should provide authentication based on the credentials of the users (can be users acting as various stakeholders) | Critical |
| System should provide authorization based on the roles and credentials of the user | Critical |
| Active Directory based authentication | Preferred |

| | |
|---|---|
| Electronic card, Biometric Authentication | Optional |
| | |

| BUSINESS OBJECTIVE 5 | Improve the methodology for performing test activity, recoding of test results and analysis of the of test results. |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Access to test operations and results are well documented and automatically analyzed | This is an important objective to be achieved with the new scenario. The test operations are well documented with visual proofs wherever necessary which might be very useful for future actions. At the same time test results are achieved with proper storage mechanism. The new platform will allow for automatic analysis (statistically and deviation) of the test results, thus decreasing the repetitive work-load for standard operations. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Stake holders should be able to have the visual proof of the test operations. | Preferred |
| Supervisor should be able to view the status of the test operations and validate the results as soon as the test results are available. | Critical |
| Project leader should be able assign work to the users and keep track of the status of the work. | Preferred |
| Platform should provide functionality for various statistical analysis with ease | Critical |

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Furniture Trends Forecasting for product development | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |

**BUSINESS PROCESS**

- **Weak signals discovery**: Currently this is achieved by a manual process where data is collected, compiled and processed all manually. Expected evolution comes from a very manual scenario, we are migrating to an automatic one. There is a possibility to perform a search by inputting sources and keywords, what is called a conditioned search, and also by inputting excluding terminology out of the search, or non-conditioned search. Search engines will do this automatically and totally in contrast with the former scenario where the analyst must search over and over.
- **Weak signal index cards**: Originally, each weak signal is placed on paper index cards, where analyst placed them on a wall for group discussions. Again, a manual process. The new application comes with a functionality that makes this process automatic since from the search screens, analysts can add and delete search results by choosing potential weak signals, making the card, with all the necessary information printed on it.

| BUSINESS OBJECTIVE 1 | Facilitate the detection and initial analysis of home trends for further product design and development |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| It pretends to analyze critical sources and the organization of new found information in order to be used by a trend's analyst or a designer. There are 2 levels of analysis. The first one is the identification of weak signals by a conditioning | The expected impact for discovering *Weak Signals* are related to automation and improvement of the effectiveness of the trends analysis process, by means of a quickly analysis of sources, |

| | |
|---|---|
| factor or by relevant repetitions. The second one is getting specific documentation of examples and uses by searching in specific web sources. | unveiling of hot spots and preliminary identification of cases and examples. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Analyst will be able to introduce and configure information sources where identification of weak signals will be done. | Preferred |
| Analyst will be able to search references by search words | Critical |
| Obtained a pondered list of weak signals according to recurrence | Critical |
| Allow identification of different users within the system | Critical |
| Permit the generation of a report with all the references and the possibility to print it | Critical |
| Keep information sources private to different analysts | Preferred |
| Allow the filtering of weak signals using a set of rules | Critical |
| Provide a REST service to retrieve the list of signals from external systems | Critical |
| Allow software installation on premise PCs | Preferred |
| Permit the connection with Postgresql | Preferred |

| BUSINESS SCENARIO 2 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 2 | End user requirements management | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |

**BUSINESS PROCESS**

Analysis of user opinions. Currently done at stores, or by paying attention to the company's social media presence. The outputs generated from these processes are somewhat limited. Evolution, as mentioned before, will come from a more in depth analysis by concentrating in real sources of end users such as blogs, specialized forums and any social media where furniture is mentioned. In here, we will differentiate from comments coming from the company's online platforms and from the web in general.

| BUSINESS OBJECTIVE 1 | Identify customers latent demands and suggestions: Delve where end user opinions are |
|---|---|

| DESCRIPTION | IMPACT |
|---|---|
| To have access to customers latent demands and suggestions expressed as online comments and opinions for improving user-centered product development**.** | Since this is based on content and sentiment analysis in Internet, designers will have access to real customer needs, having a very positive impact on enhancement of product quality and demand response skills of product designers. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Obtained a pondered list customer or potential customer requirements | Critical |
| Filter and drive the analysis by a list of words | Preferred |
| Make possible the attachment of new blogs or social sites | optional |
| Allow the identification of different users within the system | Critical |
| Permit the generation and print of different kind of reports | Critical |
| Blind personal information from retrieved information | Critical |
| Allow the connection with Facebook API | Critical |
| Provide a REST service to retrieve the list of requirements by external systems | Critical |
| Allow the installation of the software on premise PCs | Preferred |
| Permit the connection with Postgresql | Preferred |

| BUSINESS SCENARIO | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 3 | Product Innovation | AIDIMA FURNITURE, WOOD AND PACKAGING TECHNOLOGY INSTITUTE | UNIVERSITAT POLITÈCNICA DE VALÈNCIA |

**BUSINESS PROCESS**

- **Weak signals discovery search**: produced at UC1, they are used to build trends report, but not all of them make always the cut. Some are rejected in the way since they may not be as influential as others in the eyes of trend's analysts, but designers may want them in order to explore innovative ideas of their own, therefore, creating new trends. These will be available when searching on UC3. Expected evolution comes from a very manual scenario of having hardcopies of trends reports, to have a fully customized and automatic scenario where designers have full availability of all potential trends right at their fingertips.
- **Materiliza matching query based on weak signals**: Along with access to all index cards reflecting weak signals, an automatic search is also performed within materials database, Materializa. The idea is to use search strings to detect and select which material fits better with the initial search (weak signals returned). This is a big leap forward and value added since it gives designers a powerful tool to be creative. It makes a lot of their thinking for them, thus allowing creativity based on current trends.

| BUSINESS OBJECTIVE 1 | **Increasing sales and obtaining customer's satisfaction by using all results obtained in UC1, i.e.: all weak signals encountered, in combination with BD of materials.** |
|---|---|

| DESCRIPTION | IMPACT |
|---|---|
| Offers designers pure innovation since they have complete access to all outputs form UC1, even though some may not even have made it into the trends report, but they are available to UC3, and match those to what materials can be used to respond to those trends. Facilitates designers their work and helps them be creative and innovative. | The expected impact for putting at the designers' fingertips carefully handpicked sources of future trends and the possibility to match materials associated with them are related to innovation that yields to a huge improvement that will allow them to face, in the best possible way, the current markets demands. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| All UC1 requirements should be inherited | Critical |
| Designers will be able to search all weak signals found in UC1 no matter if these made the final cut (e.g.: they were selected as trends to be included in the trends report) | Critical |
| Access behind the scenes to the Materializa database where materials matching the potential trend signals will occur | Critical |
| Allow report generation with all weak signals involved in the initial search | Critical |
| Allow intelligent search of weak signals when performing initial search by designers | Critical |

## 4.4. Virtual Factory Business Processes and Requirements

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Enhance Information Quality |  |  |

**BUSINESS PROCESS**

- ***Quoting definition:*** The quoting process defines the first interaction steps with customers in order to integrate and validate their requirements. In compliance with to contracting policies, when production data are collected with a first level of validation, APR propose a quote for final confirmation.
- ***Quoting recovery:*** Some customers are developing several products and prototypes. We propose a quoting recovery process to manage quote lifecycle until final customer decision.
- ***Customer Order preparation:*** When a quote is validated, customer confirms the related order. In several cases, the received order defines some different data than the quote (modification in quantity, delivery day, etc.). In all cases, an industrial validation (design data, production data, etc.) is required for each customer order before production data generation in the ERP system.
- ***Customer order monitoring:*** In order to enhance customer satisfaction, we propose to share some monitoring capabilities adapted to each customer specificities and commitments. Therefore, we propose to formalise first these profiles in order to automate the information sharing model in monitoring.
- ***Procurement order:*** For procurement orders (PO) generated through MRP process, the procurement manager should choose the best supplier for each order before PO validation. The supplier selection process with negotiation steps is proposed in the following process.
- ***Strategic investment:*** The massive analysis of a set procurement orders can be done according to the history of transaction with raw materials suppliers and producers. Data mining capabilities are explored in order to integrate disparate data sources and levels in order to optimize order decision making and refine the inventory level of each raw material.

| BUSINESS OBJECTIVE 1 | decrease the order processing time |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| As explained in the earlier sections, the order process covers many functionalities and covers: quoting preparation (validation of product data), information integration, quoting validation, order injection, etc. We aim to decrease the command processing time from 5 days to 3 days | Enhance the capacity of order treatment and address new customers markets |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Formalize product quoting and ordering interaction | Critical |
| Automate the integration product definition | Critical |

| BUSINESS OBJECTIVE 2 | Improve the quality of the relationship |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Structure the interaction process with | Reduce the redundancy of information |

| | |
|---|---|
| customers and suppliers/producers. | verification in the validation of customer orders (product design verification, contracting constraints, etc.). |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Defined personalized customer's templates | Preferred |
| Propose product tracking facilities | Critical |
| Enhance customer satisfaction and commitment reliability | Preferred |

| BUSINESS OBJECTIVE 3 | Improve price competitiveness |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Decries product lifecycle by reducing treatment cycles and better negotiate the procurement process**.** | 5% gain on purchases |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Reduce product cost throughout manufacturing process | Critical |
| Reduce raw material cost | Preferred |

| BUSINESS OBJECTIVE 4 | Improve the contracting facilities with partners |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Better structuring of the contracting facilities by IT based business rules. | Reduction of the negotiation steps (time) within the consultation process in procurement. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Formalize contracting facilities | Critical |
| Analyse the transactions history | Preferred |

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| **1** | **Call for Tender Opportunities** | TAMET technology application network | Coventry University |

**BUSINESS PROCESS**

Sematronix is the Facilitator for SMECluster and is responsible for operating the portal on behalf of its members. This involves the activity of finding business opportunities for its members which combines both automated search facilities to find Calls for Tender and manual identification and input of business opportunities. The automated search facility utilises components developed within the Synergy Project to semantically match the requirements for Calls for Tenders to the capabilities of its members which are stored in the system database. These results include matches for groups of companies suggested to tender for opportunities collaboratively and this occurs where the system has determined that their combined capabilities fulfil the requirements of the opportunity.

These results are displayed to the Facilitator in order for them to assess the results and to accept or reject based on their assessment. To help with their assessment of the results additional tools are available that use Synergy components to conduct a risk assessment of the suitability of the collaboration.

To supplement the automated search results the Facilitator is able to submit business opportunities. These opportunities are found by manually searching the web, by conducting day-to-day business and from access to suitable business trade publications. The details of the opportunity are manually entered and once submitted the Synergy components

responsible for Semantic matching are triggered and make the results available to the Facilitator to accept or reject proposed companies or collaborations.
Some of the issues with this process are that firstly it is time consuming requiring a lot of "man hours" to deliver an accurate set of results for its members and secondly it is inflexible in terms of expansion or changes to functionality.

| BUSINESS OBJECTIVE 1 | **SMECluster: Improve the search capability in order to find a suitable tender opportunity for a closer match to a customer profile: Faster, and more cost effective, and more reliable platform and service maintenance** |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Exploitation of GEs to provide platform functionality wherever possible will reduce the volume of custom developed code. | Reduced cost of maintenance, and improved service to end-user and its clients |

| BUSINESS OBJECTIVE 2 | **SMECluster: Improve the search capability in order to find a suitable tender opportunity for a closer match to a customer profile: Agile, evolving service offering, adaptable to technology developments.** |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Evolving technology embedded in selected GE instances to provide seamless access to new technological approaches to manufacturing SME collaboration. | Higher value service, offering progressively more competitiveness to end user clusters and VOs. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| To increase the accuracy of the search engine by the use alternative engines – dynamically select search facility to closer match user parameters. | Critical |
| Create a set of standard times to get results against the number of parameters to be matched. | Preferred |
| Minimise the impact of Internet performance Constraints. | Preferred |
| Time to modify configuration to connect to various Tender sites | Critical |
| Improvement of Quality of data input | Preferred |

| BUSINESS SCENARIO 2 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 2 | **Decision Process Support: INDUSTRYWEB** | TAMET technology application network | Coventry University |

**BUSINESS PROCESS**

The second Use Case has been outlined previously as involving the monitoring of manufacturing processes in real-time in order to check the condition of key elements of the machine. This is achieved using the Industreweb platform which is installed locally within the manufacturing facility of members of SMECluster.
Specifically within the second Use Case Industreweb Collect gathers condition monitoring data from the Drilling Assembly with a key manufacturing process. It does this firstly using the current drawn by the drill motor which is sampled at regular intervals, and secondly by recording the subsequent data from the gauging station. The combined condition and

gauging data allows the situation where the tooling condition is impacting upon the quality of the finished product to be identified, therefore triggering alerts to various supporting business processes including procuring replacement drill assemblies.

| BUSINESS OBJECTIVE 1 | INDUSTREWEB Maximise the cutting time of the drill assembly: Faster, and more cost effective, and more reliable platform and service maintenance |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Exploitation of GEs to provide platform functionality wherever possible will reduce the volume of custom developed code. | Reduced cost of maintenance, and improved service to end-user and its clients. |

| BUSINESS OBJECTIVE 2 | INDUSTREWEB Maximise the cutting time of the drill assembly: Agile, evolving service offering, adaptable to technology developments. |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Evolving technology embedded in selected GE instances to provide seamless access to new technological approaches to manufacturing SME collaboration. | Higher value service, offering progressively more competitiveness to end user clusters and VOs. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Predicted tool life – need to monitor against standard predictions and look at measured currents for each variant of material and associated cutter to be drilled | Critical |
| Read identification of cutter and match to correct tool for job | Critical |
| Predict tool failure and procure replacement | Critical |
| Identify and present alternative replacement sources | preferred |
| Tool record Database for analysis | Critical |

| BUSINESS SCENARIO 1 | | COMPANY | IT PROVIDER |
|---|---|---|---|
| 1 | Management of quotes and orders |  |  |

**BUSINESS PROCESS**

Two business processes are impacted by the Business Scenario:

- **The Business process *Purchasing:*** A significant improvement of competiveness will be achieved by several concurring factors: better purchasing leads to better manufacturing prices; better quoting minimizes the risk of losses when starting new affairs. Moreover, implementing a collaborative platform allows the actors to anticipate their implication in the process, before the business becomes contractual. Migrating from a sequential and iterative Management of quotes and orders towards a more concurrent process with less iteration between customers and suppliers is the major evolution expected from the FITMAN Platform.

- **The Business process *Data management*** is a technical process supporting the Business Scenario "Management of quotes and orders". In its existing organization, the Data management process is poorly systemized. The information system in the

company is not fully integrated and the absence of updated database for pricing is a real limitation of Buyers' efficiency. The Data management process concretely ensures the interoperability of the pre-existing applications (SharePoint, Business One) in the company to constitute the integrated Information System of the SME which is natively open to its eco-system.

| BUSINESS OBJECTIVE 1 | Reduce quoting lead time and increase accuracy |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Reduce the lead time of pricing each time a new opportunity of affair occurs. | The quality of pricing, in terms of lead time and cost assessment, is a core performance factor of the wood factory in its market. |

| BUSINESS OBJECTIVE 2 | Reduce Call for Tender cycle |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Provide a "Market Place" to facilitate call for tenders and optimize purchasing**.** | Dealing with the most efficient suppliers is a critical activity in the wood factory engineering business. Easier exploring new suppliers and technologies beyond SME's regular suppliers. |

| BUSINESS OBJECTIVE 3 | Automate Data management Process |
|---|---|
| **DESCRIPTION** | **IMPACT** |
| Fully dematerialize the wood factories workflow supporting its quoting and purchasing processes. | Provide the company with internal and external interoperability for collaborative business. |

| BUSINESS REQUIREMENTS | PRIORITY |
|---|---|
| Users should be aware of the delivery of their order | Critical |
| Users must have access to order status | Preferred |
| The buyer must be able to quickly publish calls for tenders | Preferred |
| Providers should be aware of the publication of a tender | Preferred |
| The price list should be more easily integrated in the IT of the company | Critical |
| Reduce quoting delays | Preferred |
| Eliminate manual multiple information entries | Critical |
| Release time for the buyer to negotiate prices | Preferred |
| Provide indicators to monitor production costs and profitability of business | Optional |
| Follow in real-time raw material and provider prices | Optional |

# 5. ANALISYS OF RESULTS

Within the fifth chapter devoted to the analysis of results we are going to provide a description of the findings mainly related to the bottlenecks and weaknesses identified, the business objectives selected, the business requirements required and the business indicators recognized. Comparisons between trials, type of end-user (Large vs. SME), and type of factory (Smart vs. Digital vs. Virtual) will be made.

As a first overview of the trials we can distribute them into 3 different categories:

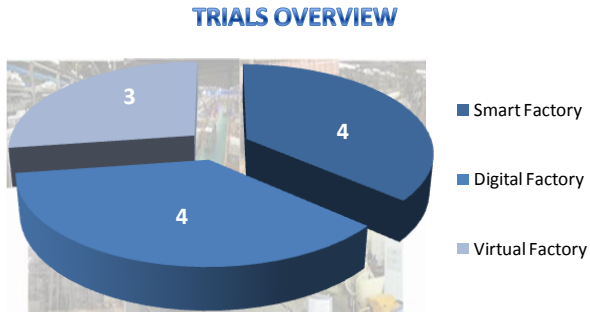



***Figure 3 – Trial distribution***

The analysis included in this Section is an important foundation for the future developments in the FITMAN project. The clear identification of the prevalence and precedence of the business requirements are key to make a good connection between the IT performance and capabilities leveraged by FI GEs and SEs and the actual business impacts expected by different type of companies. From this point of view, this Section highlights the areas which are more relevant to the FITMAN trials and the business capabilities that they expect to see reinforced by business processes supported by a FITMAN platform. Thus, the future use and acceptance of platforms and enablers is interlinked with the ability of such IT functionalities to exhibit and/or leverage an enhanced behaviour in selected business processes. In subsequent activities GEs, SE and Trial Specific Components (TSC) will ultimately demonstrate their business value demonstrating improvements (significant) in the areas and processes under analysis. FITMAN should therefore go through complete sets of innovation cycles. At the end of each of these innovation cycles, improvements should be tracked and the business viability evaluated, not simply the technical feasibility. Hence, within a complex context like the FITMAN project, business requirements are the reference point where all advanced capabilities (GE,SE,TSC functionalities, enhanced business processes) should converge.

The following Sections deal with the analysis of 4 major areas (1) trial business objectives, (2) trial impact expected (3) trial business processes weaknesses and (4) trial business requirements. As much as possible the trial level information is discussed. However, the insights in terms of Large Enteprise vs SME sensitivities are mainly discussed explored. Moreover, the different interests and priorities among different domains (Smart-digital-virtual factory) are also analysed. Since the scope of FITMAN is large, this Section also aims at setting up the scope in terms of the various enterprise/factory divisions that are most relevant to the FITMAN analysis and their business requirements in this respect. The information provided, although quantitative, it does not yet reaches the stage of establishing specific improvement performance targets but sets clear indications on the criticality of the

business processes functions to be supported and the sensitivity to specific business values (cost, sustainability, efficiency, innovation…) that should be expected from FITMAN processes.

## 5.1. Business objectives

### 5.1.1. General overview

We can start reviewing the business objectives of the trials distinguishing between primary – single and critical- and secondary (many and subsidiary) objectives for each trial, and aggregating them in order to have a full picture of the project.

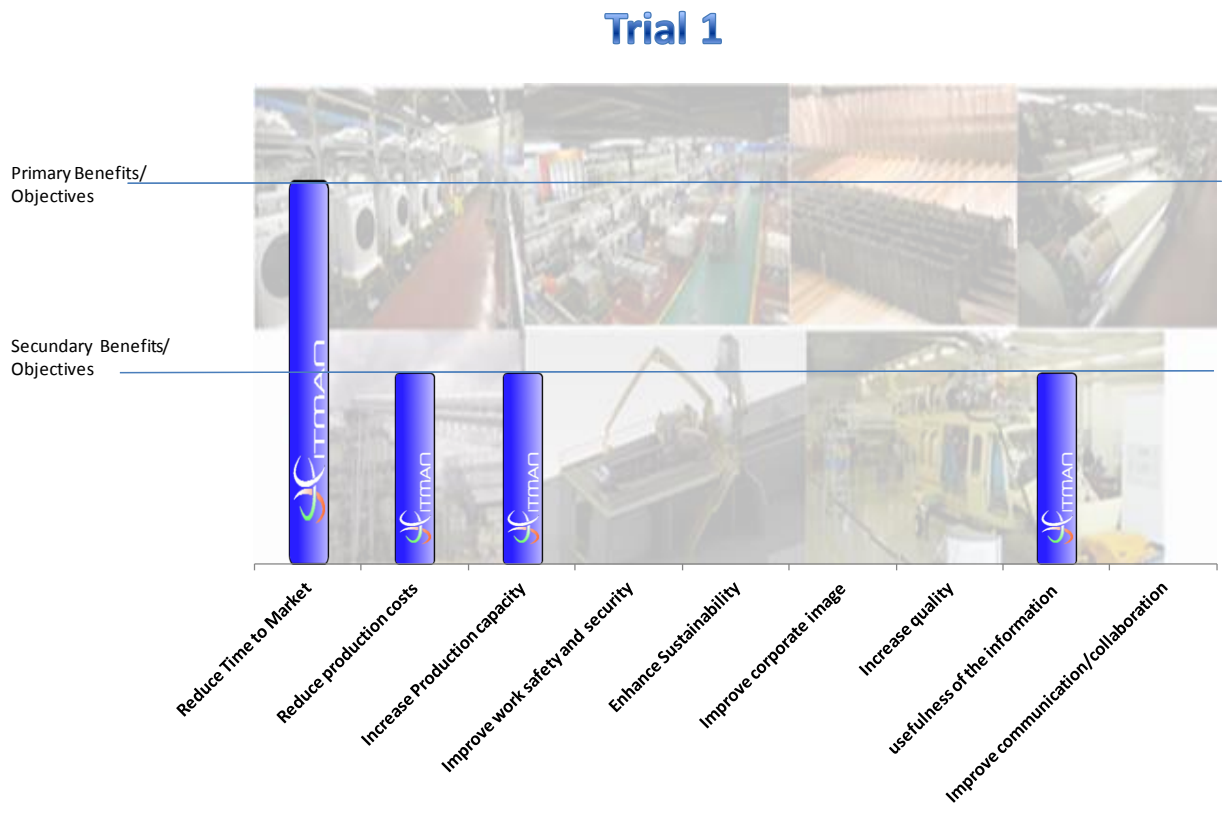



***Figure 4 – Trial 1 General Objectives***

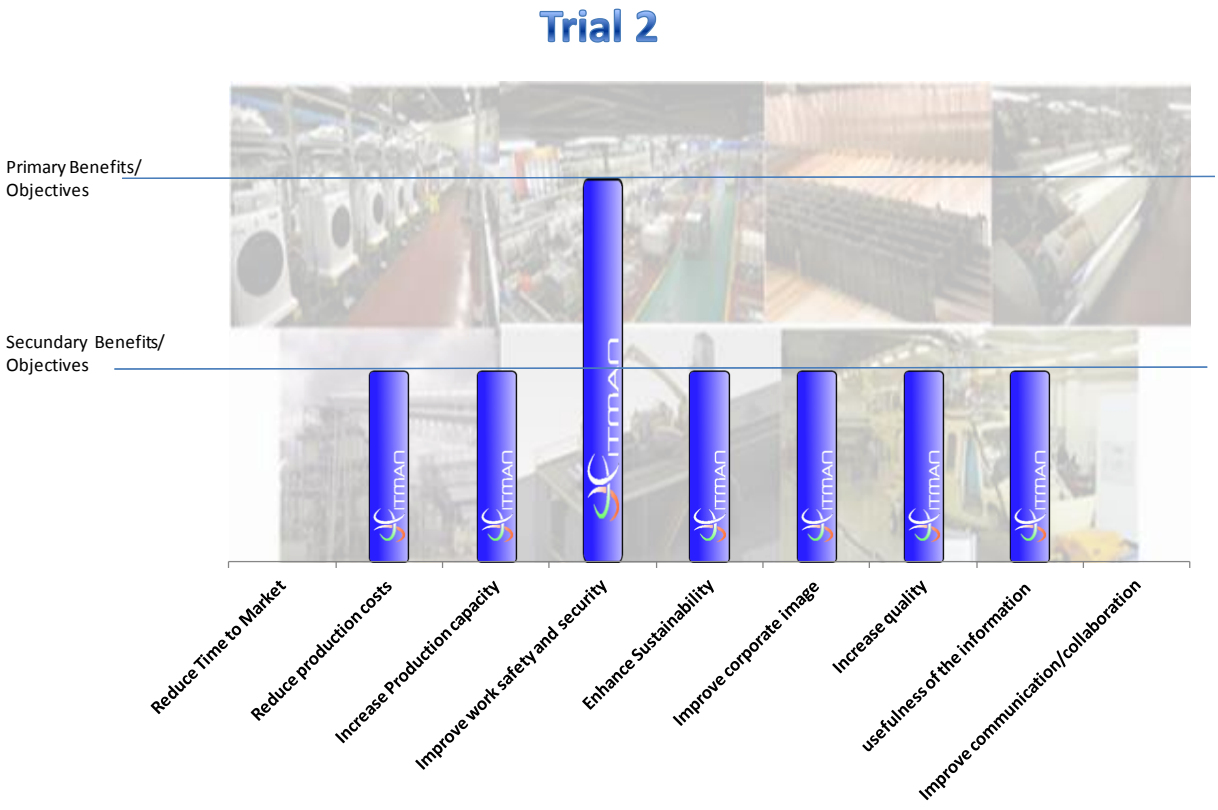



*Figure 5– Trial 2 General Objectives*

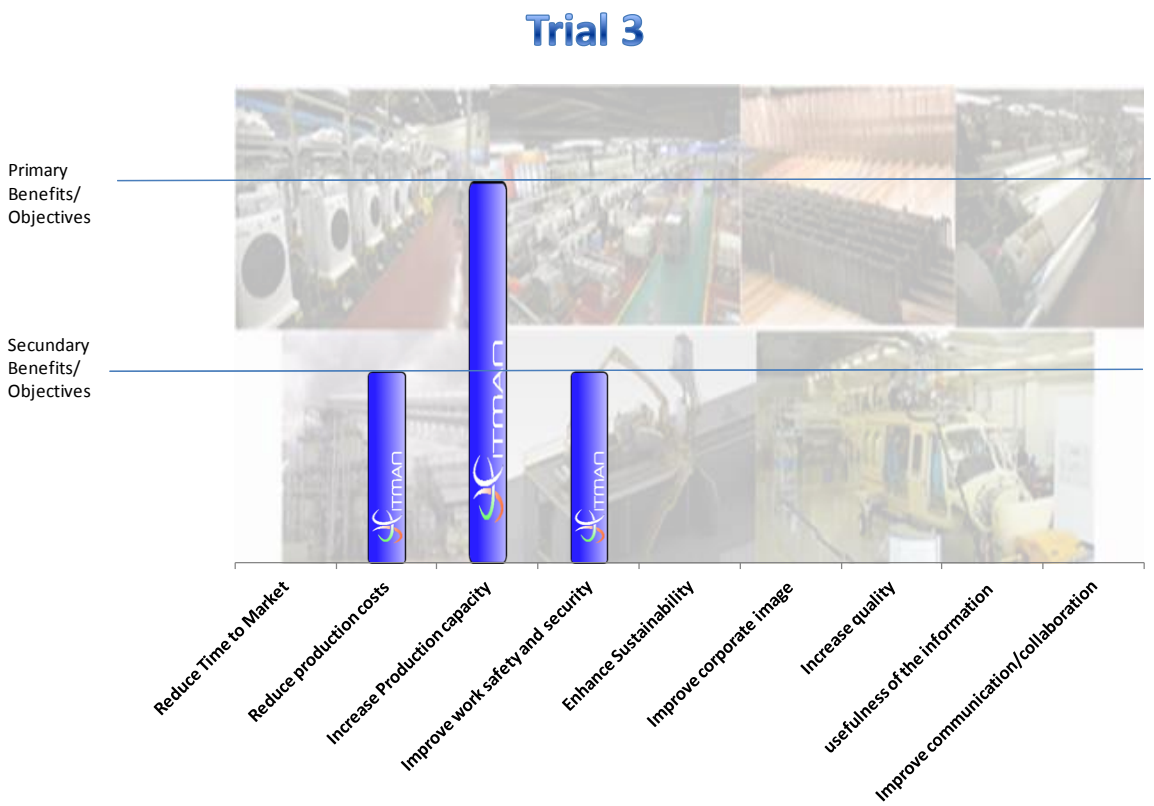



*Figure 6– Trial 3 General Objectives*

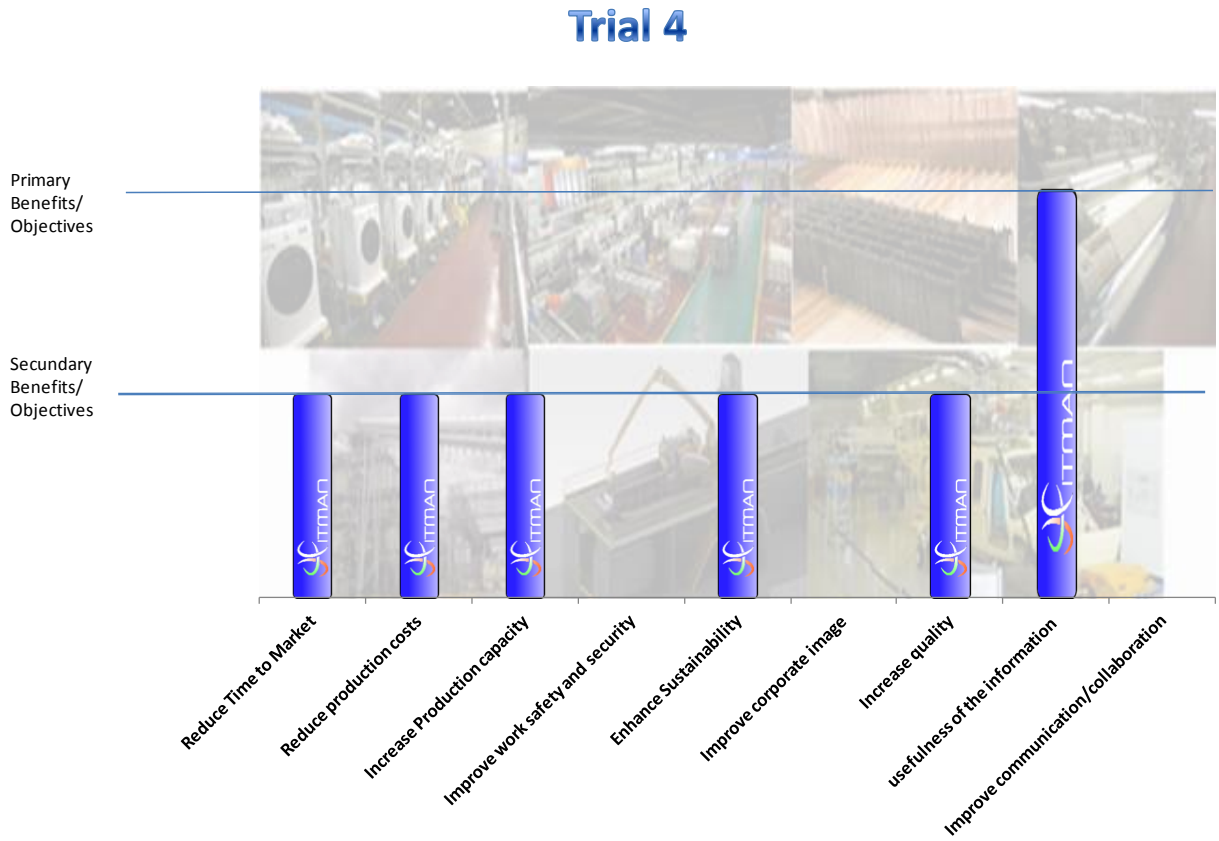



*Figure 7– Trial 4 General Objectives*

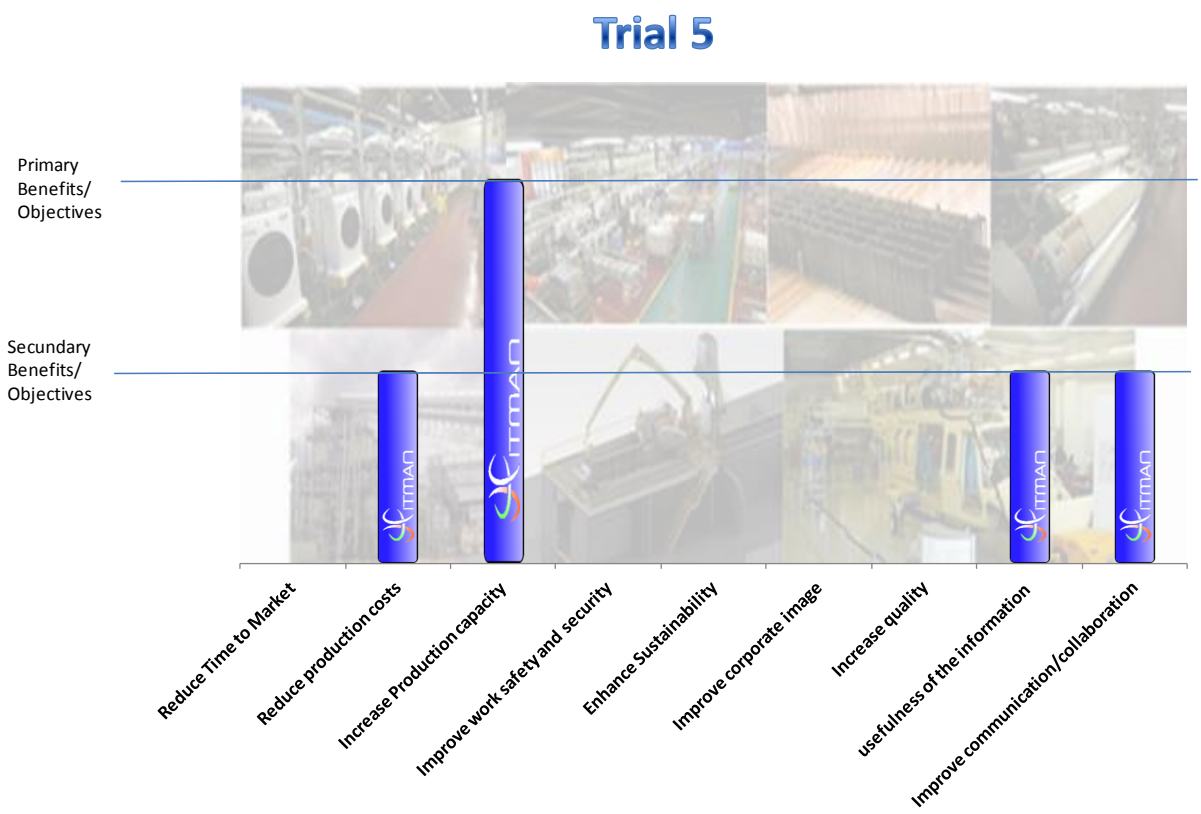



*Figure 8– Trial 5 General Objectives*

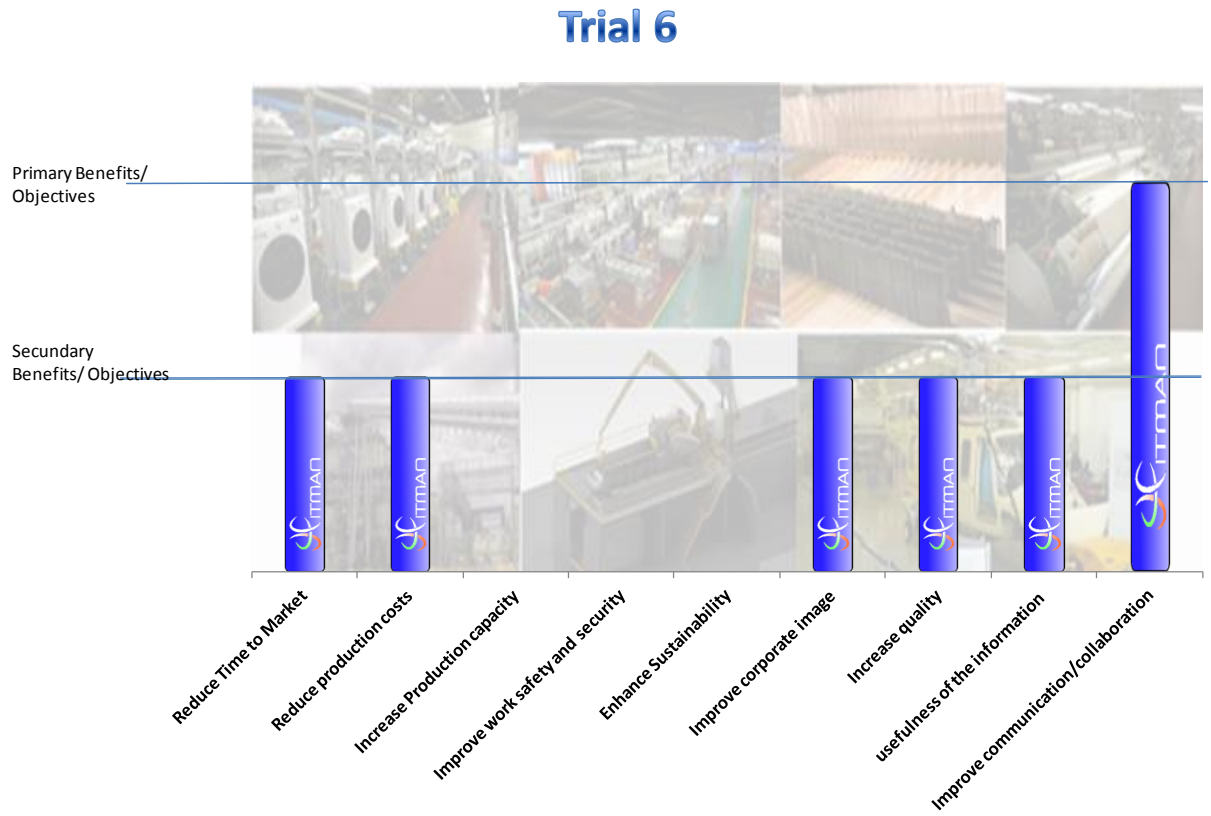



***Figure 9- – Trial 6 General Objectives***

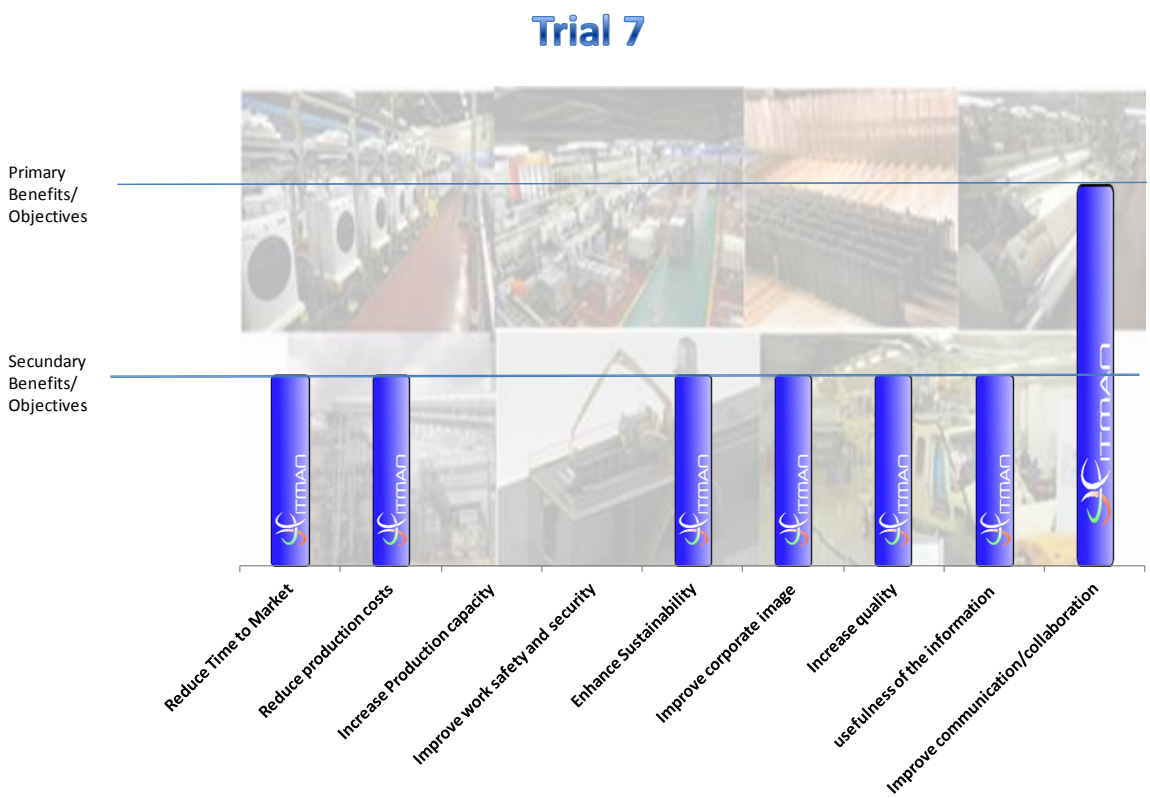



***Figure 10– Trial 7 General Objectives***

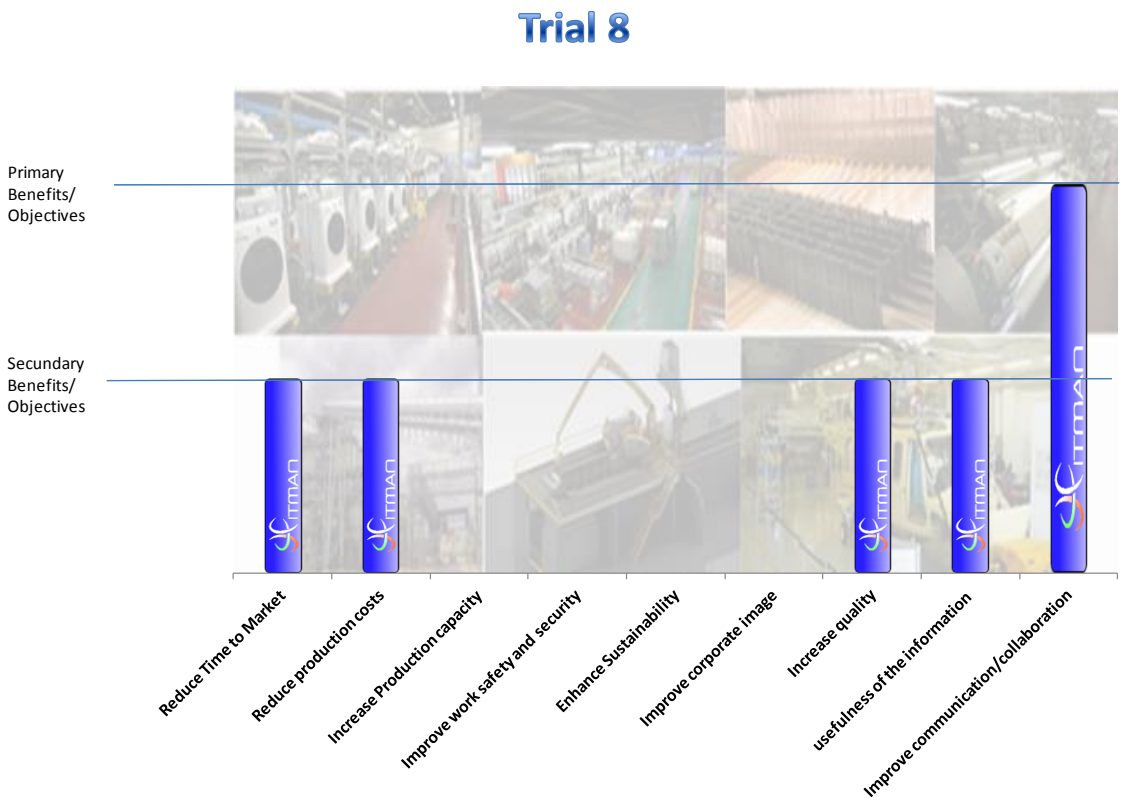



***Figure 11– Trial 8 General Objectives***

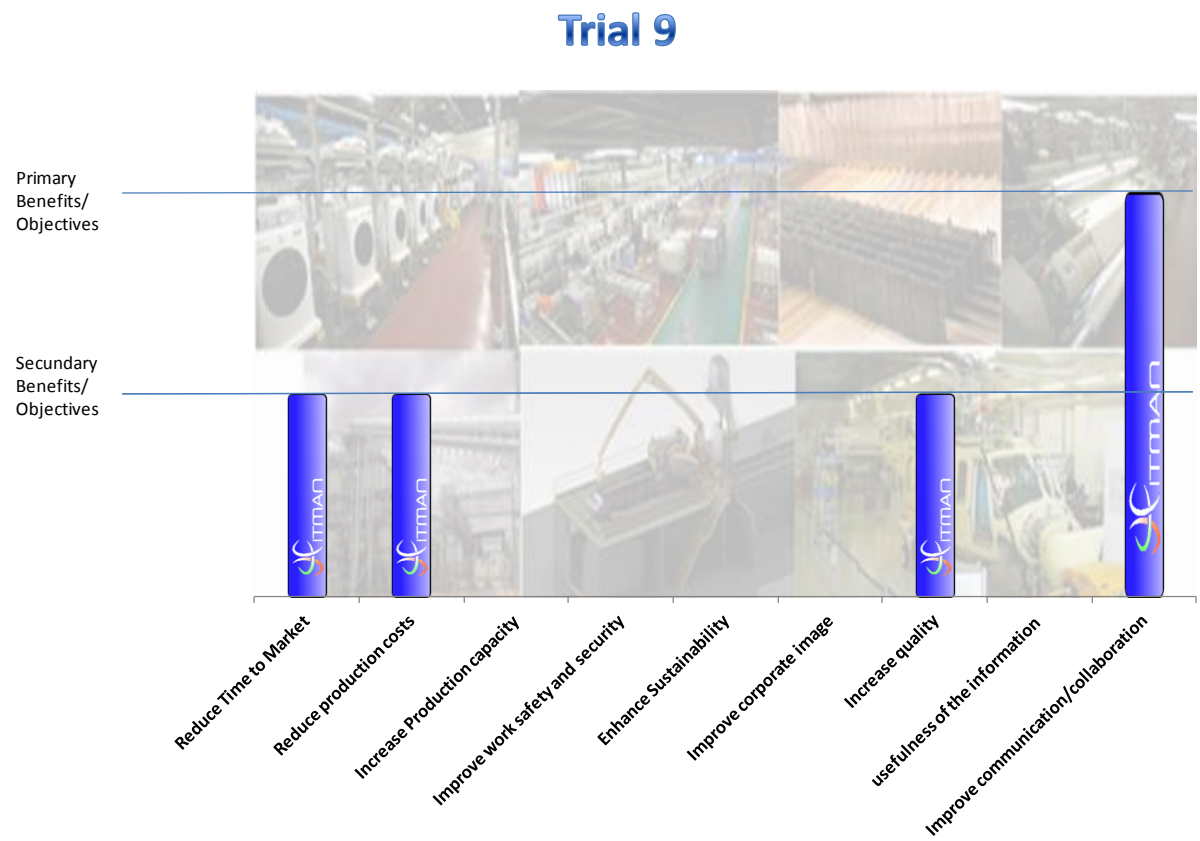



***Figure 12 – Trial 9 General Objectives***

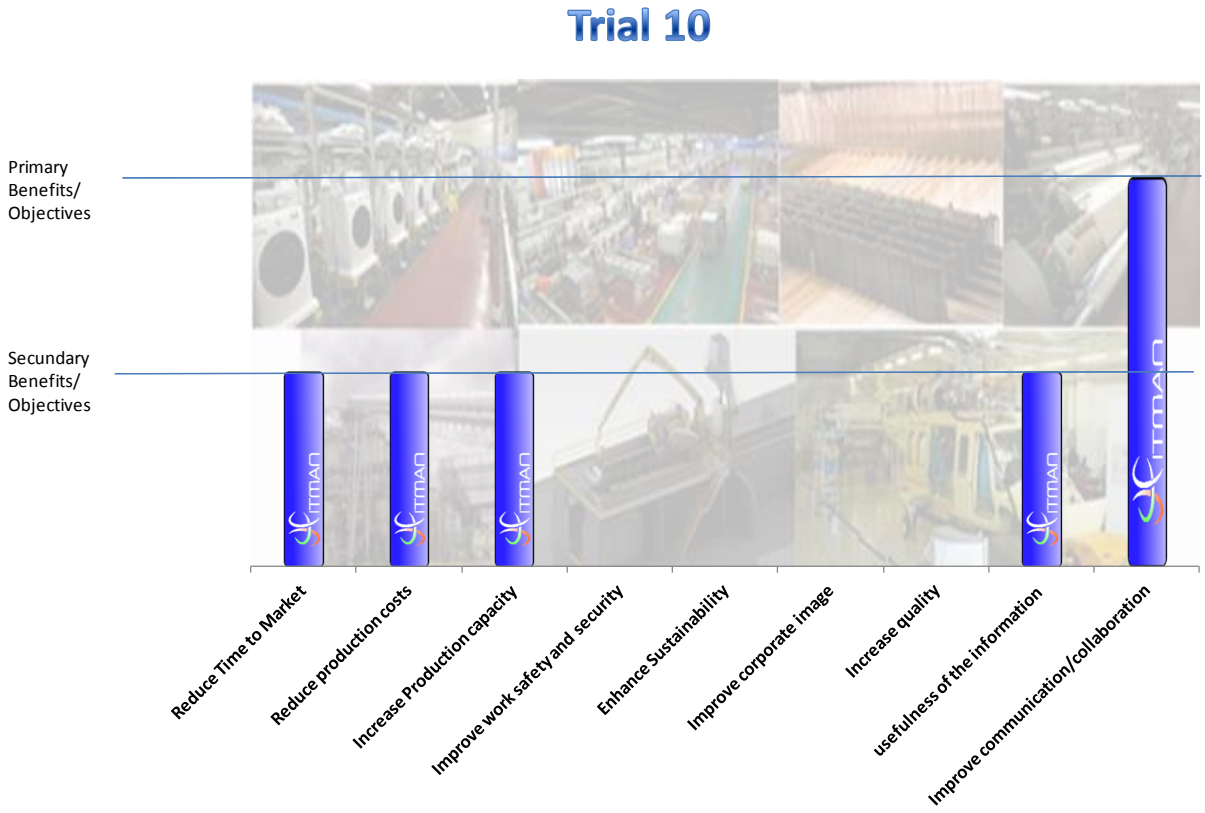



*Figure 13– Trial 10 General Objectives*

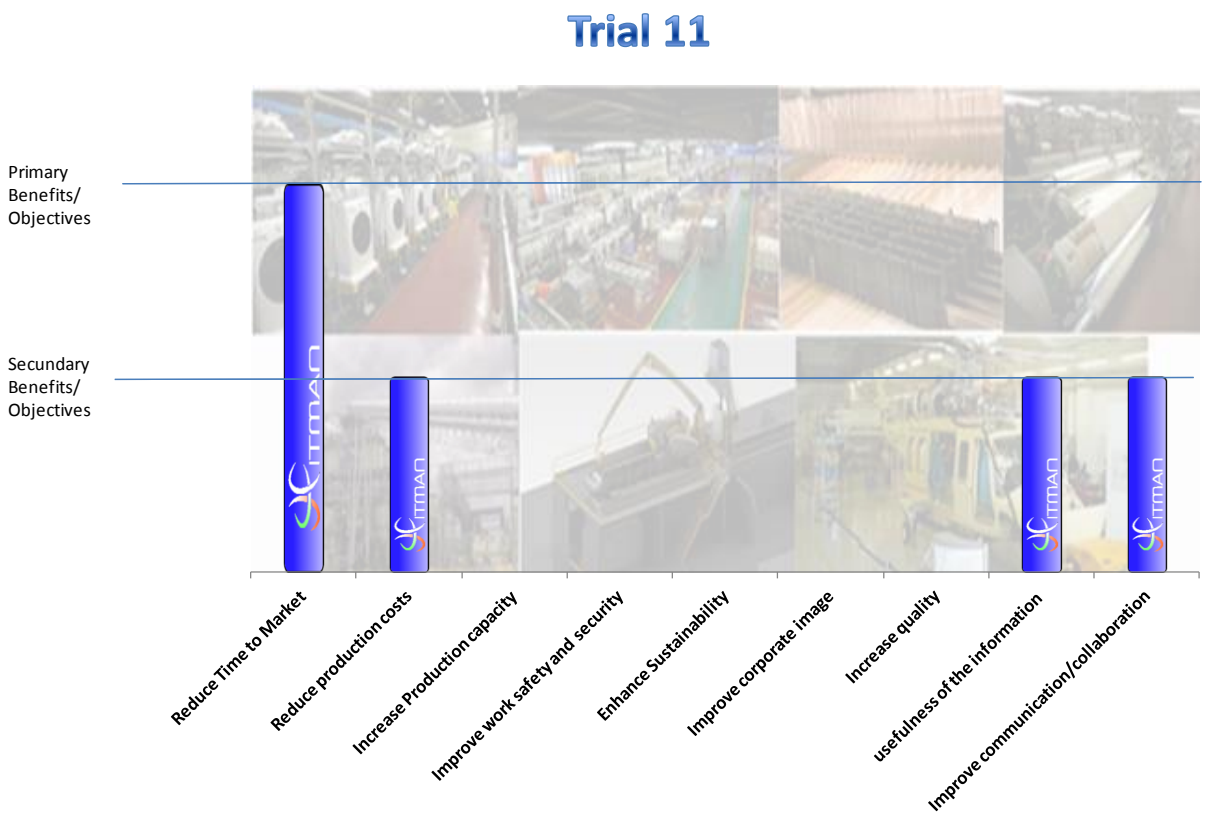



*Figure 14– Trial 11 General Objectives*

In the next chart we can see the aggregation of all business objectives so we can identify the main objectives to be achieved.

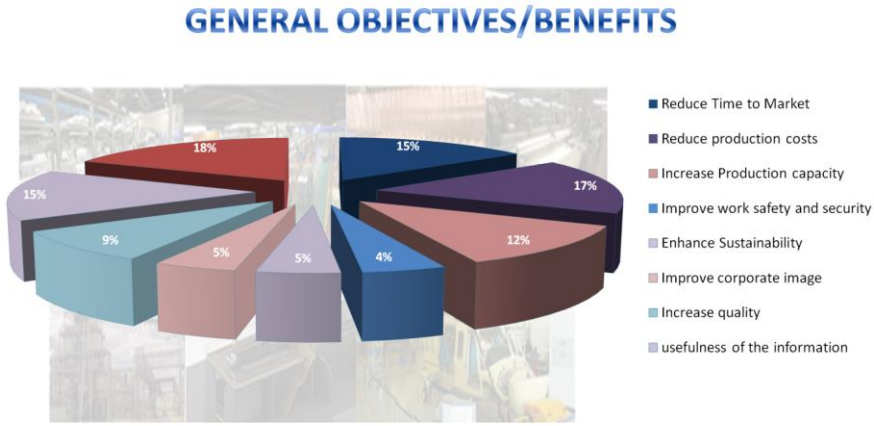



***Figure 15 – General objective distribution***

Although we see that the main objectives are quite well distributed among all trials, we could somewhat say that there are probably 5 objectives taking the lead over the rest:

- Improve communications/collaboration
- Reduce production costs
- Reduce time to market
- Improve the usefulness of the information
- Increase production capacity

### 5.1.2. LEs vs. SMEs

If we make the analysis between Large Enterprises (LE) and SMEs, we get the next results.

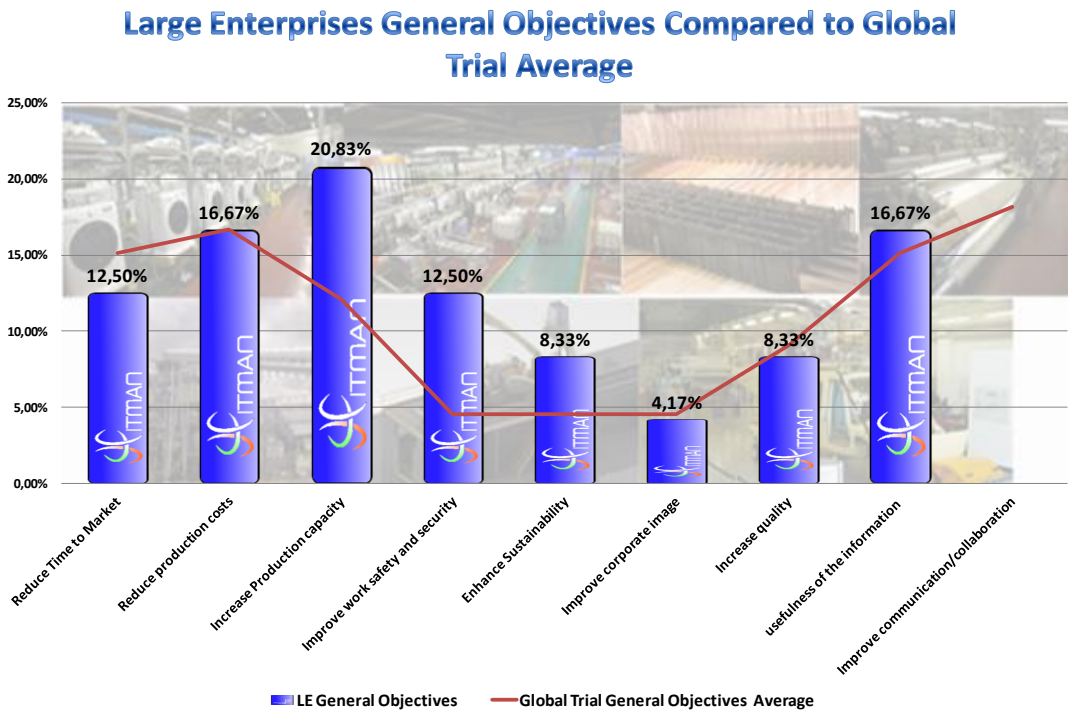



***Figure 16– Large Enterprise Objectives vs Average***

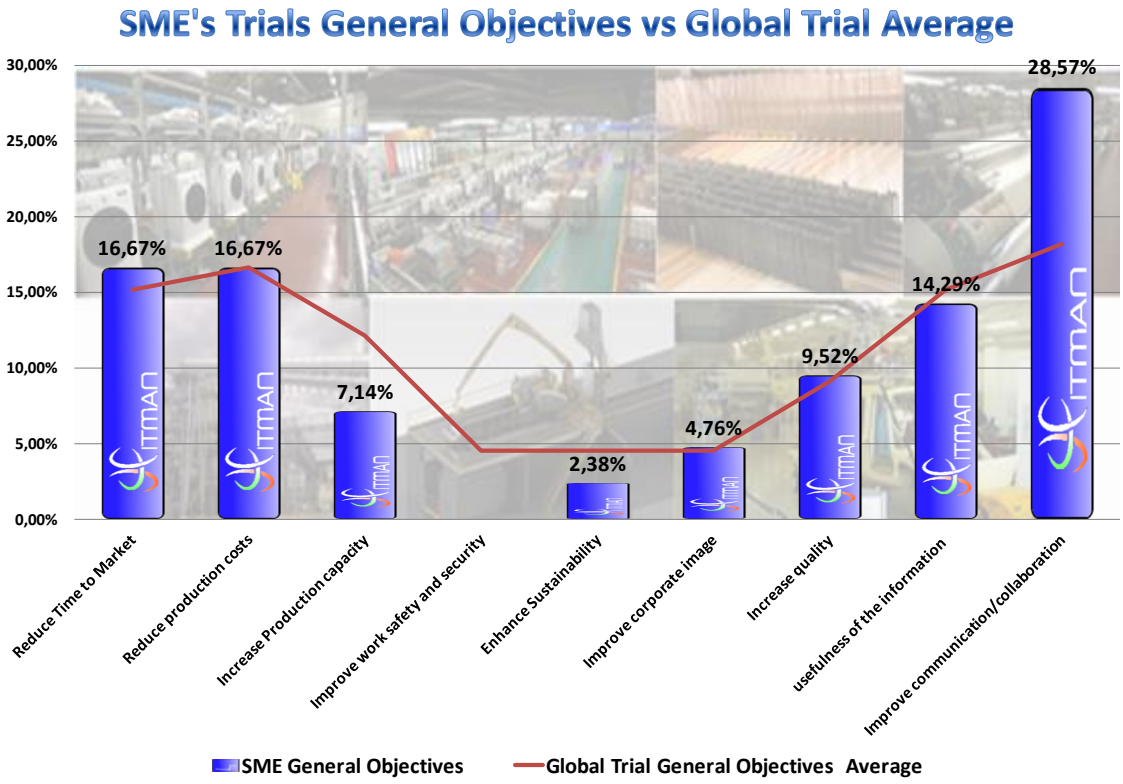



*Figure 17– SME Objectives vs Average*

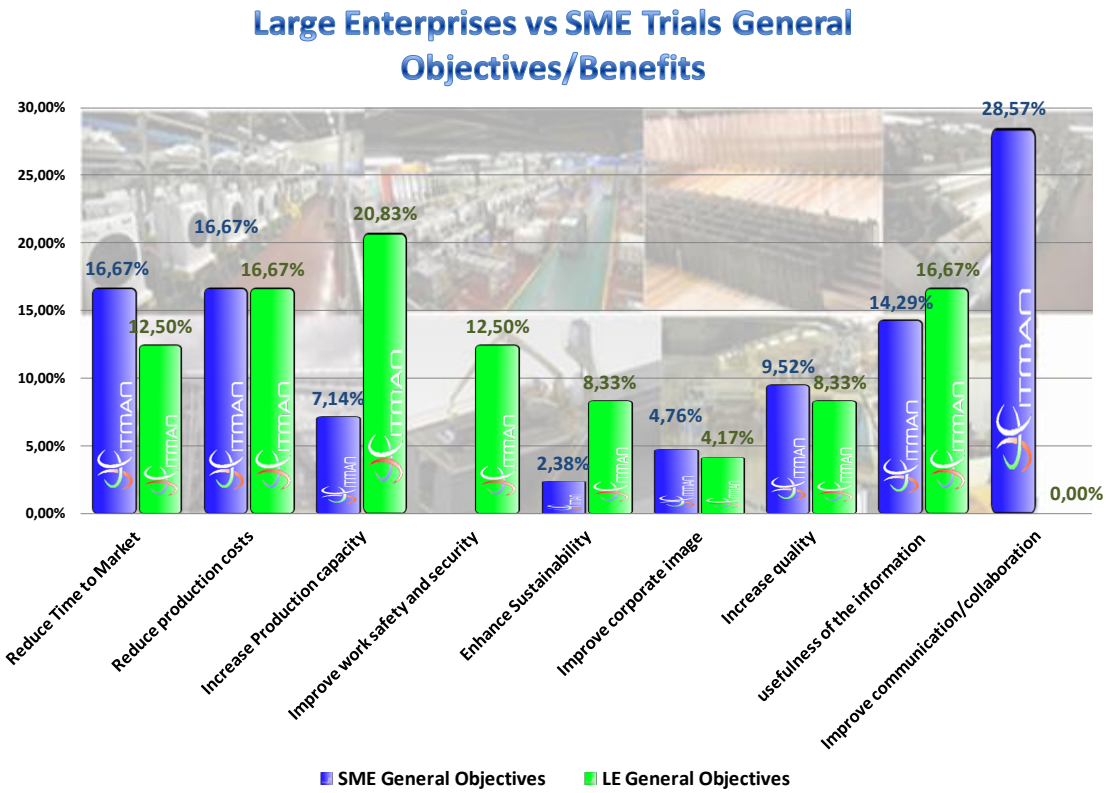



*Figure 18– Large Enterprise vs SME Objectives*

Most of the objectives are similarly shared between LEs and SMEs, but we can detect the next divergences.

As LEs' trials are more specific than SMEs' we see that LEs have a larger interest in increasing the production capacity and improving work safety and security, on the contrary LEs find it less significant than SMEs to improve communication and collaboration.

On the other side, SMEs are much more interested in improving communication and collaboration. In fact, for SMEs this is the most important business objective, while the most important goal for LEs is increasing the production capacity.

It is worth noting that the observations and conclusions made are limited and constrained to the sample used in the project. The sample used should serve to drive some interesting conclusions, but in some critical aspects, the reader should be detached from generalising the findings of the studies. What is actually true is that for the departments and type of companies involved the statements hold true. Addressing similar departments of the same type of industries in such sectors will drive to similar conclusions.

### 5.1.3. Smart vs. Digital vs. Virtual

Reviewing the results obtained by each type of Factory, we see that all three are quite similar but there are a few points to be highlighted.

- Smart Factory's trials are less focused on reducing time to market and improving communications and collaboration than average. Their main objectives are reducing production costs, increasing production capacity and increasing the usefulness of information.
- Digital Factory's trials are likewise less focused on improving communications and collaboration than average, while reducing time to market is the most critical objective.
- Virtual Factory's trials are mostly centered on the improvement of communications/collaboration.

Such results are well in line with the main concept behind each of the Factories.

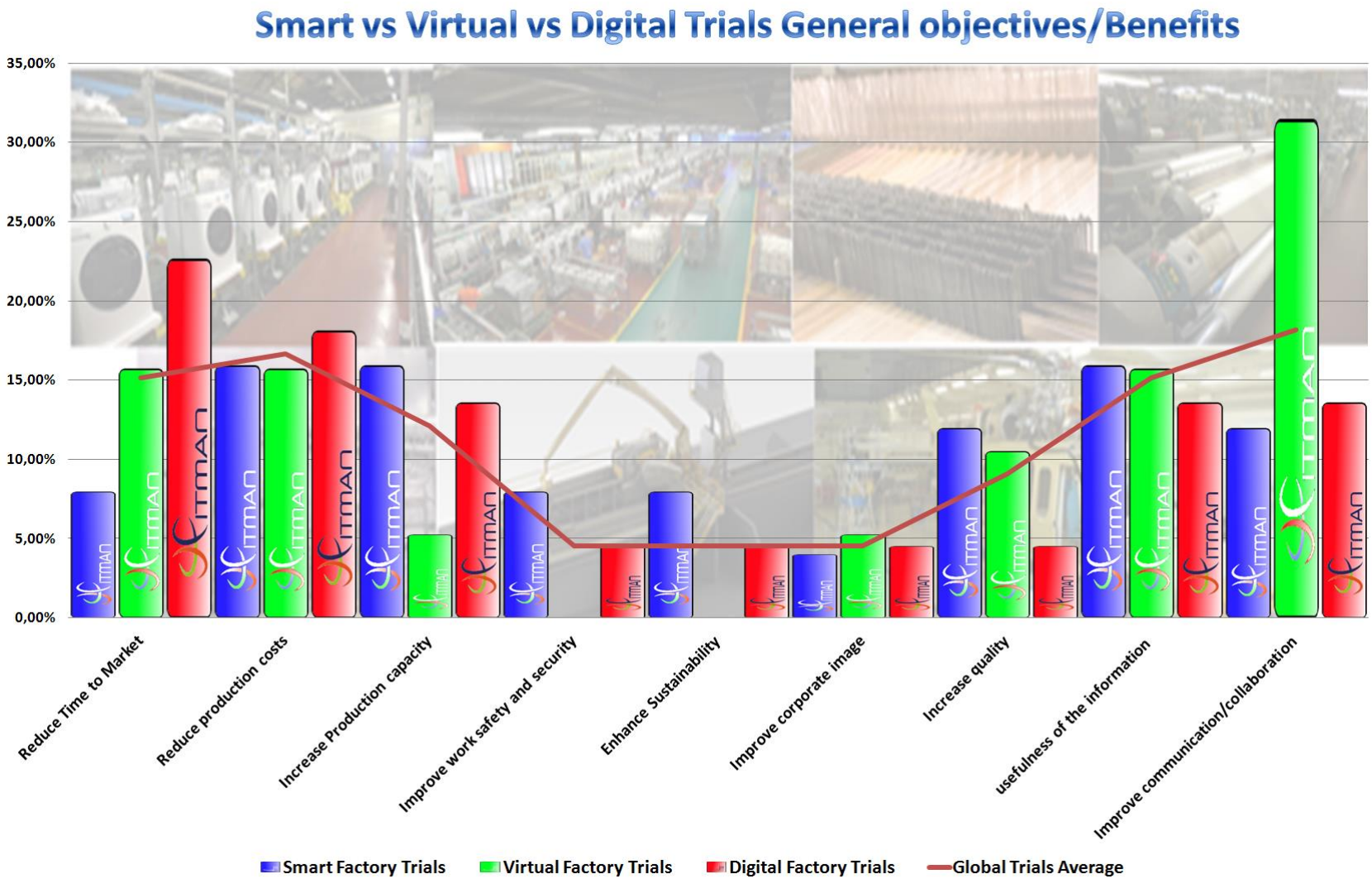



*Figure 19– Smart vs Digital vs Virtual Factory Trial Objectives*

## 5.2. Business impact

Within this topic we will be analysing the expected impact in the end-user of the business objectives previously defined. The business impact is also studied from 6 different but complementary perspectives: costs, efficiency, flexibility, sustainability, quality and innovation. Such objectives a fully cover the STEEP dimensions set up by the FITMAN vision and the digital business transformation of the manufacturing industry. Moreover, these impact categories are supported by relevant and well know competitive studies in the field.

### 5.2.1. General

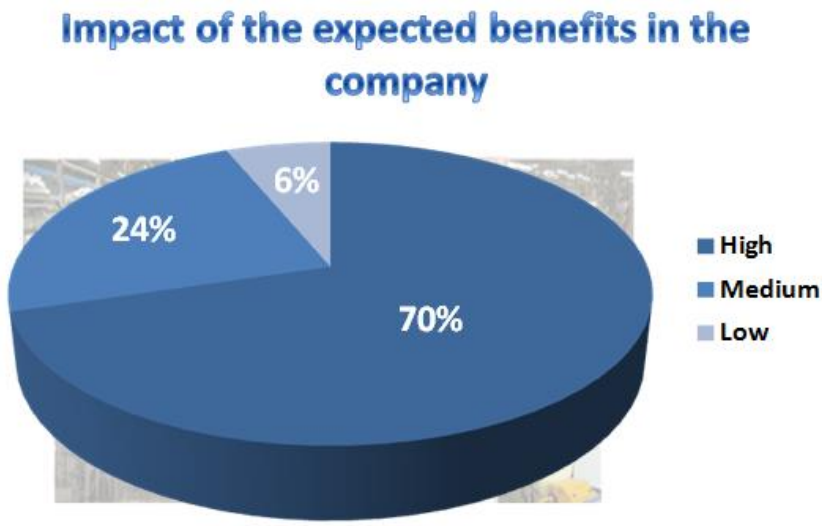



*Figure 20 – Expected FI Enabler impact on Trial*

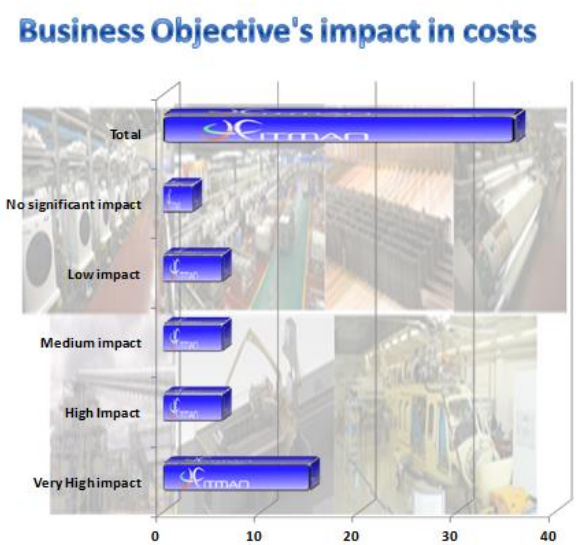



*Figure 21-Expected impact in cost*

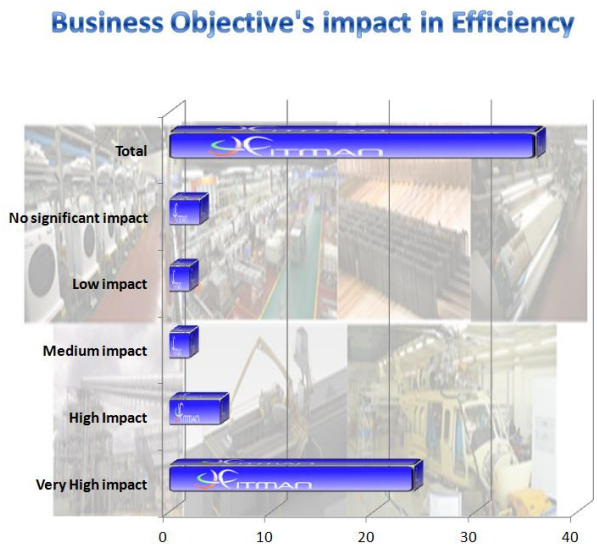



*Figure 22 – Expected impact on Efficiency*

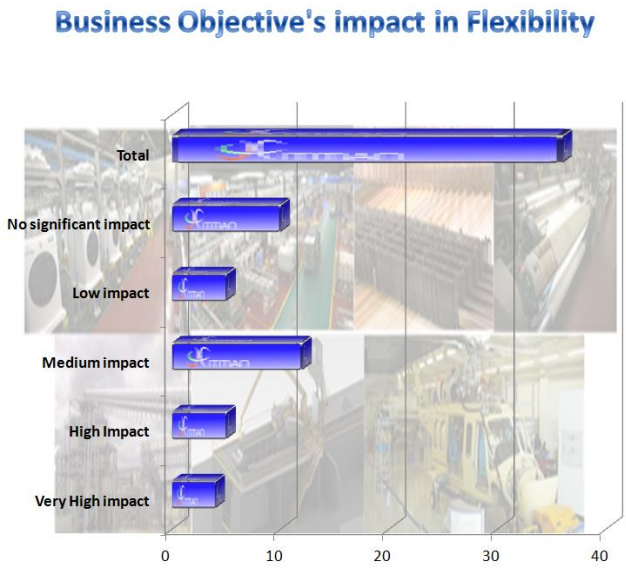



*Figure 23- Expected impact on Flexibility*

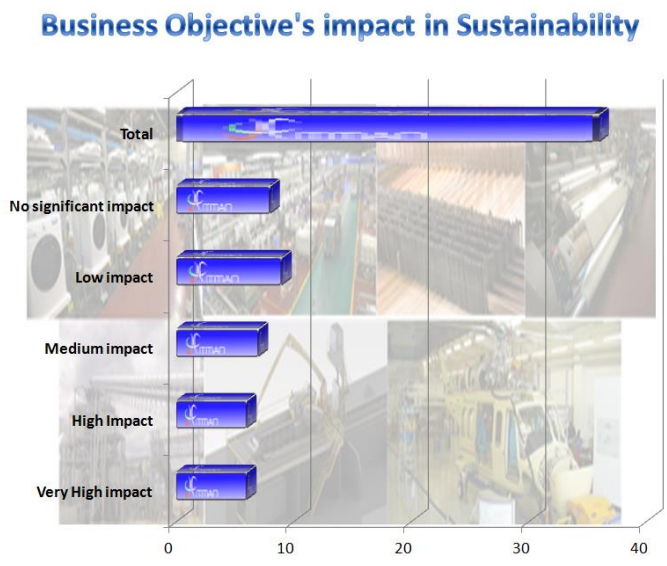



*Figure 24 – Expected impact on Sustainability*

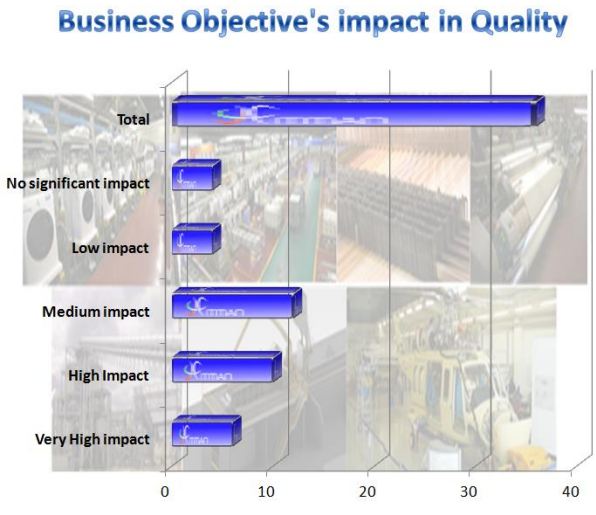



*Figure 25 – Expected impact on Quality*

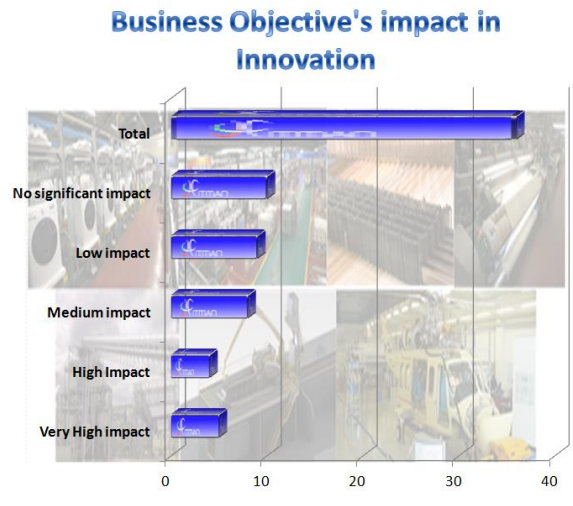



*Figure 26 Expected impact on Innovation*

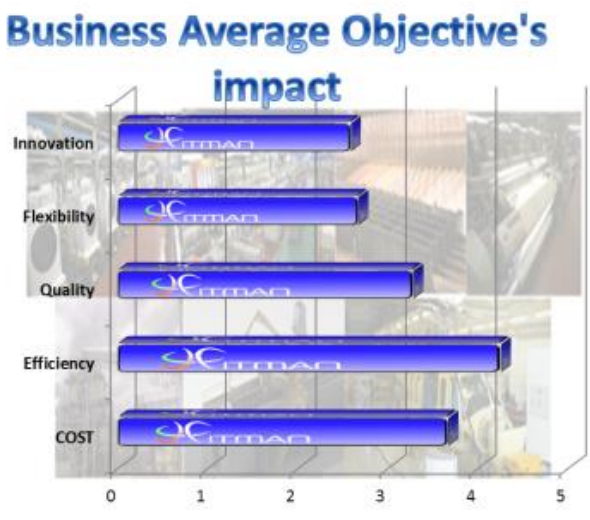



*Figure 27 – Expected impact quantification*

From these figures we see that the expected impact is quite high, and that the two main impacts are linked to the reduction of costs and the improvement in efficiency.

### 5.2.2. LEs vs. SMEs

We also found that there are no meaningful variations if we make the analysis between Large Enterprises (LE) and SMEs.

### 5.2.3. Smart vs. Digital vs. Virtual

With respect to the impact of the objectives in the business we see that all Smart, Digital and Virtual Factories coincide in identifying efficiency as the main improvement.

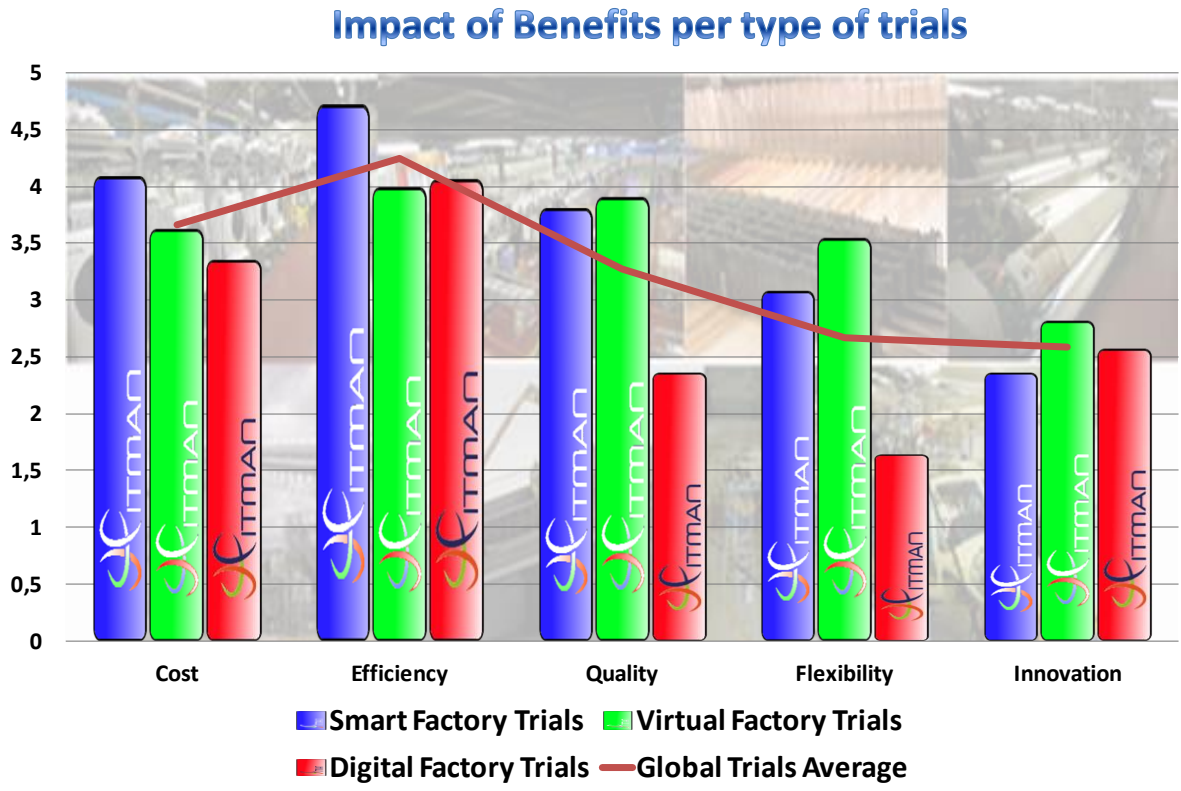
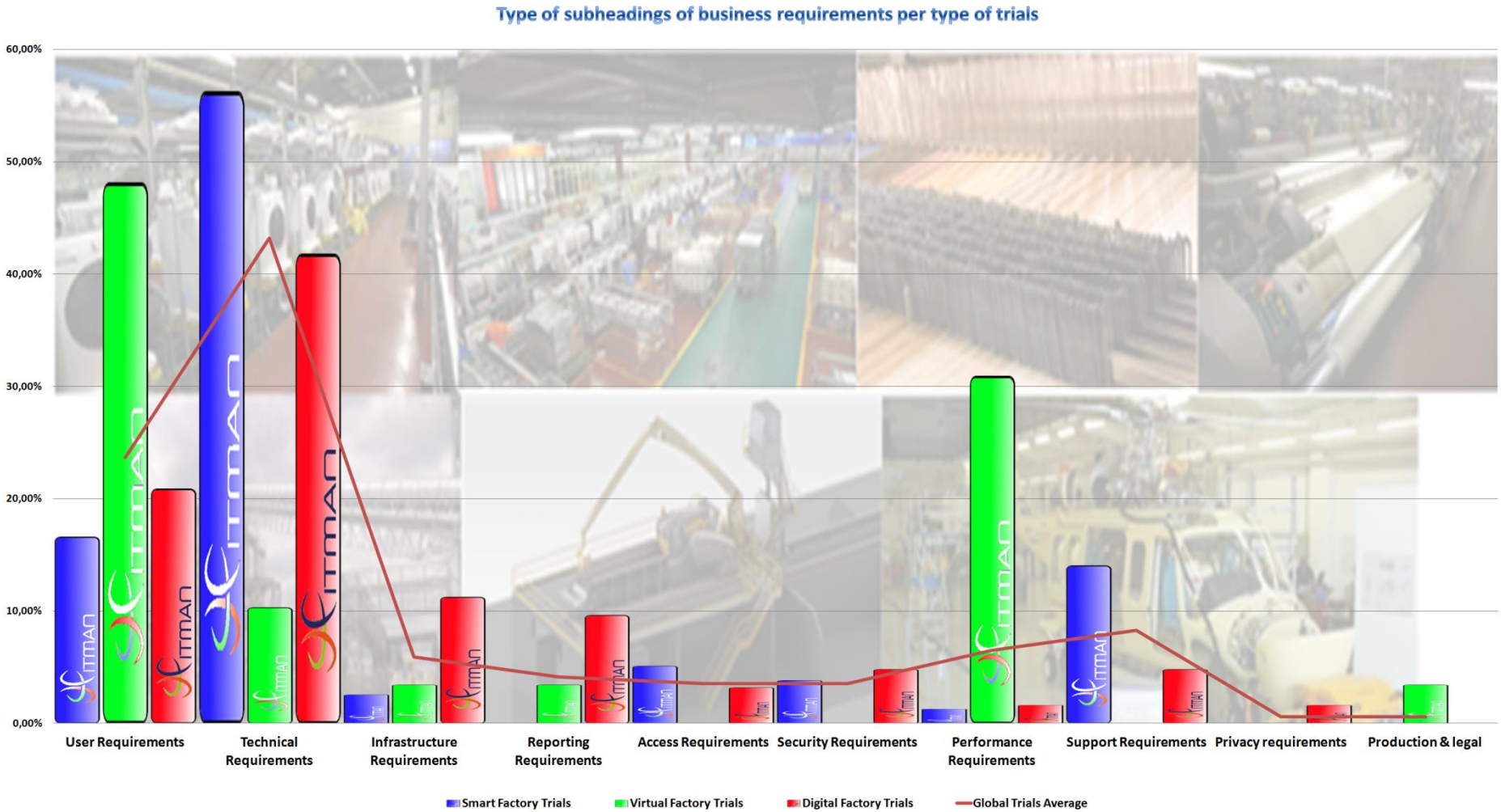



*Figure 28 - Expected impact per type of trial (smart, digital, virtual factory).*

With respect to the typology of the impact the Virtual Factory is more oriented to the user requirements followed by performance requisites, while both Smart and Digital Factories are mostly centred on technical requirements.


Type of subheadings of business requirements per type of trials
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
User Requirements
Technical Requirements
Infrastructure Requirements
Reporting Requirements
Access Requirements
Security Requirements
Performance Requirements
Support Requirements
Privacy requirements
Production & legal
Smart Factory Trials
Virtual Factory Trials
Digital Factory Trials
Global Trials Average

## 5.3. Weaknesses and bottlenecks

### 5.3.1. General

In the next chart we can see which are the main weaknesses and bottlenecks identified in the end-users running the 11 trials.

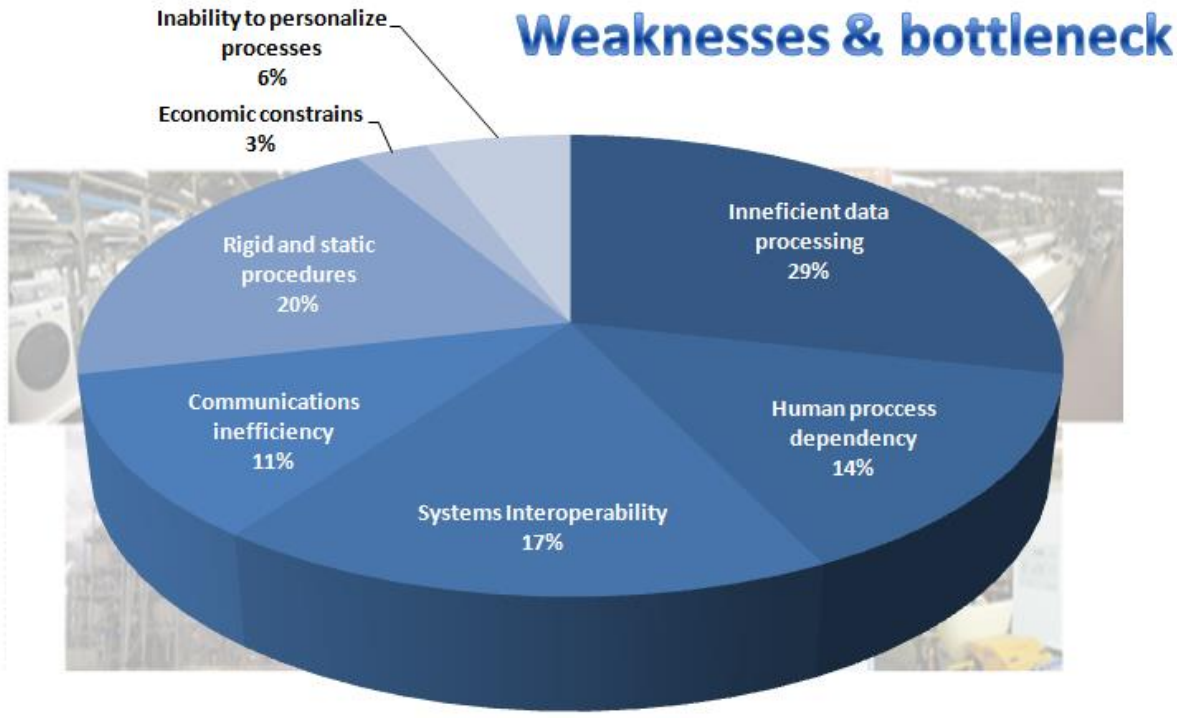



***Figure 29 – Weakness & Bottlenecks***

The main problems detected are related to the inefficient data processing, the existence of rigid and static procedures and the challenging systems interoperability. All three weaknesses (mostly the first and third ones) can be addressed by the proper analysis, selection and implementation of the right IT tools.

In the next picture we can see the departments that are mainly affected by such weaknesses and bottlenecks.

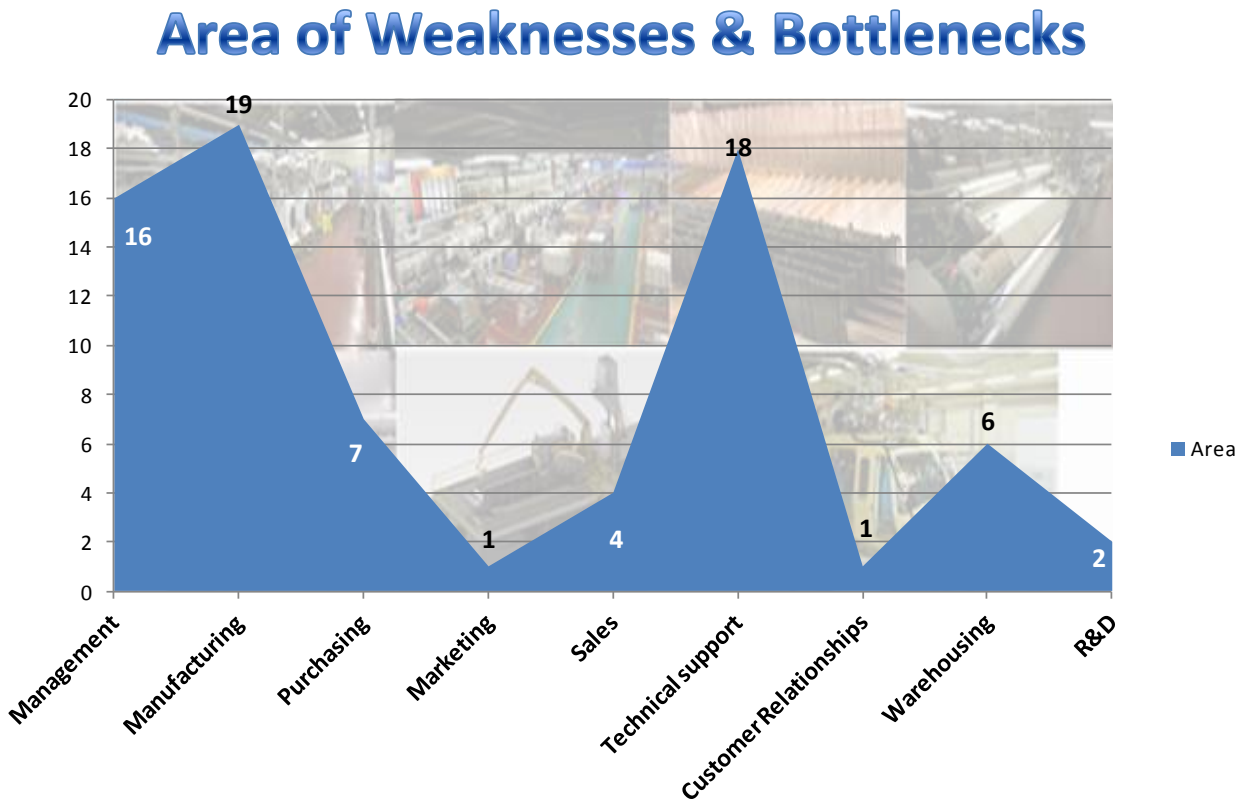



***Figure 30 – Areas with trial impact.***

There are three departments leading the list, they are Manufacturing, Technical support and Management. All three critical areas are our main targets within FITMAN.

### 5.3.2. LEs vs. SMEs

If we make the analysis between Large Enterprises (LE) and SMEs we see that there are not significant differences in the main weaknesses, while when studying the departments involved, we find out that the technical support department is more affected in the case of LEs than it is for SMEs. We can deduce this conclusion from the next images.

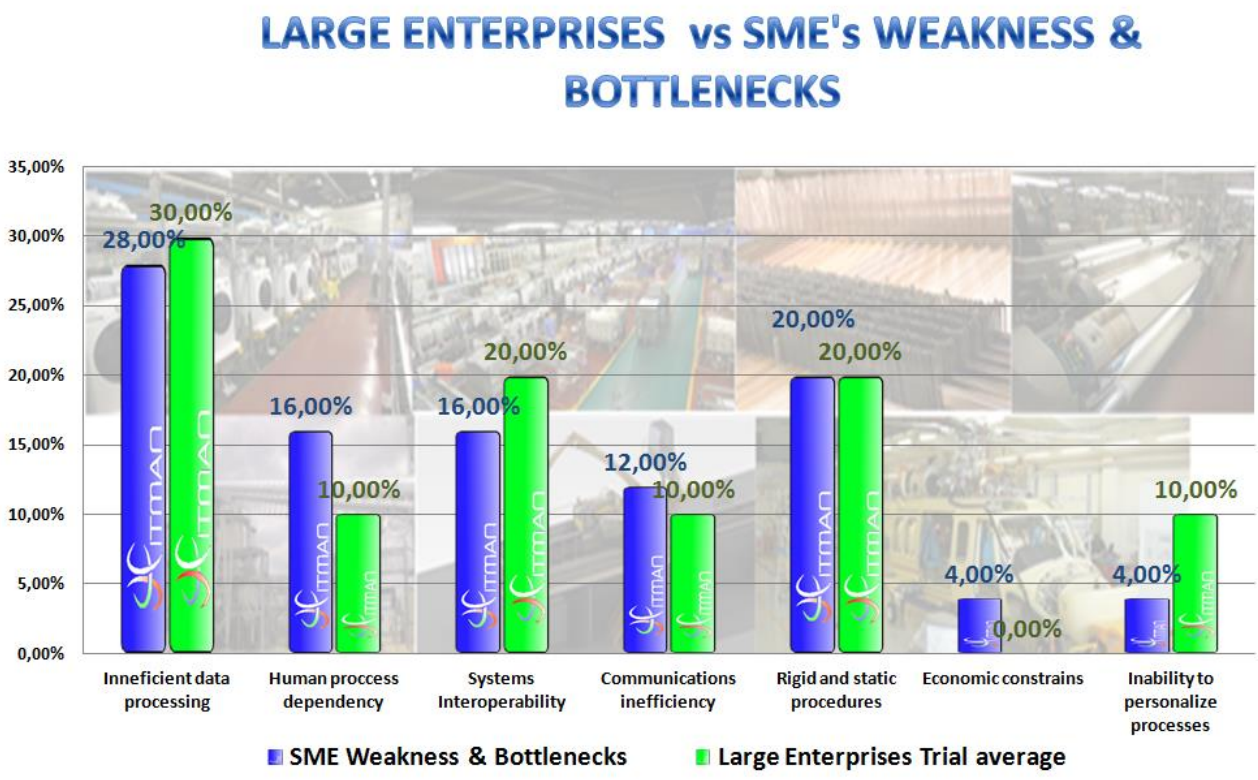



*Figure 31 – FITMAN Trial Large Enterprise business weaknesses*

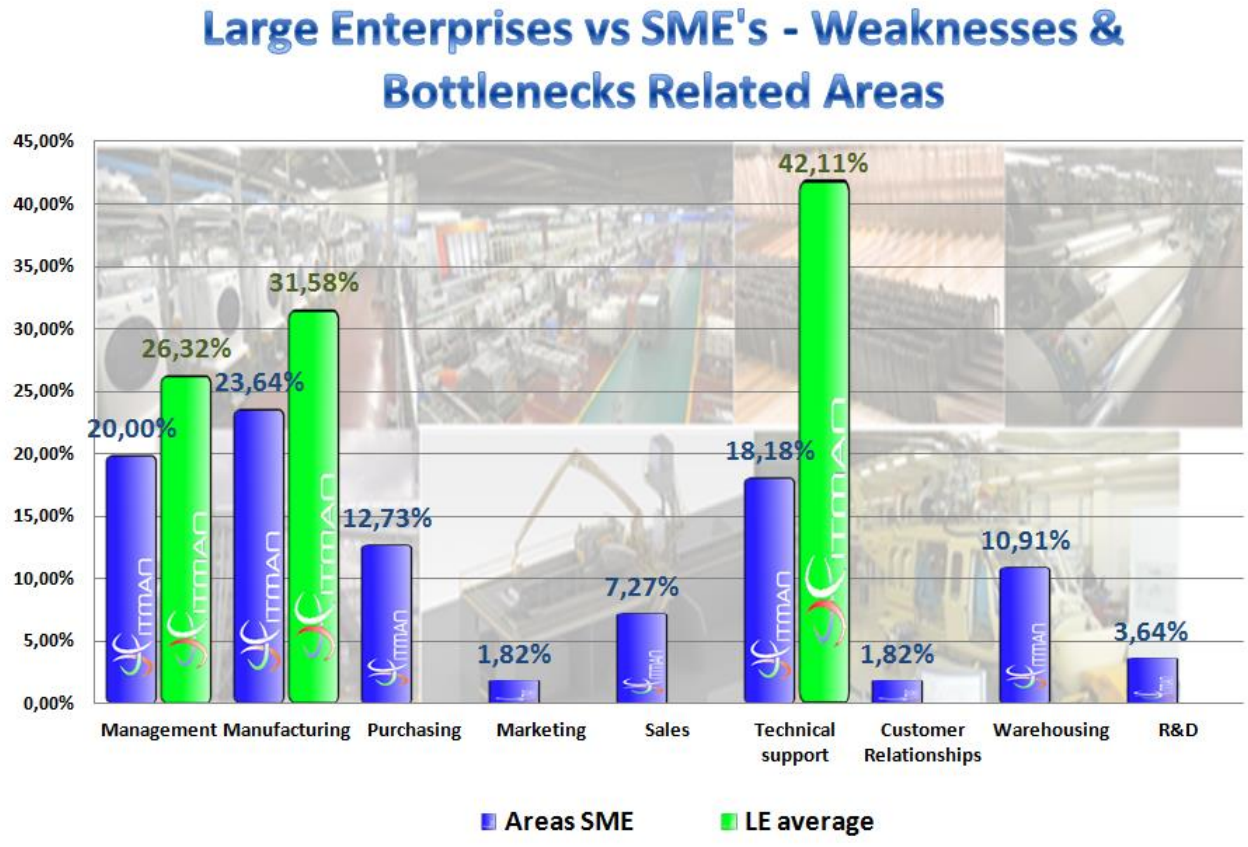



*Figure 32– FITMAN Trial SME business weaknesses*

### 5.3.3. Smart vs. Digital vs. Virtual

Concerning weaknesses and bottlenecks the main results are quite predictable, given that, as we can see in the next picture Digital Factory's trials have important bottlenecks related to the inefficient data processing, while human process dependency seems not to be a weakness for the Smart Factory's trials.

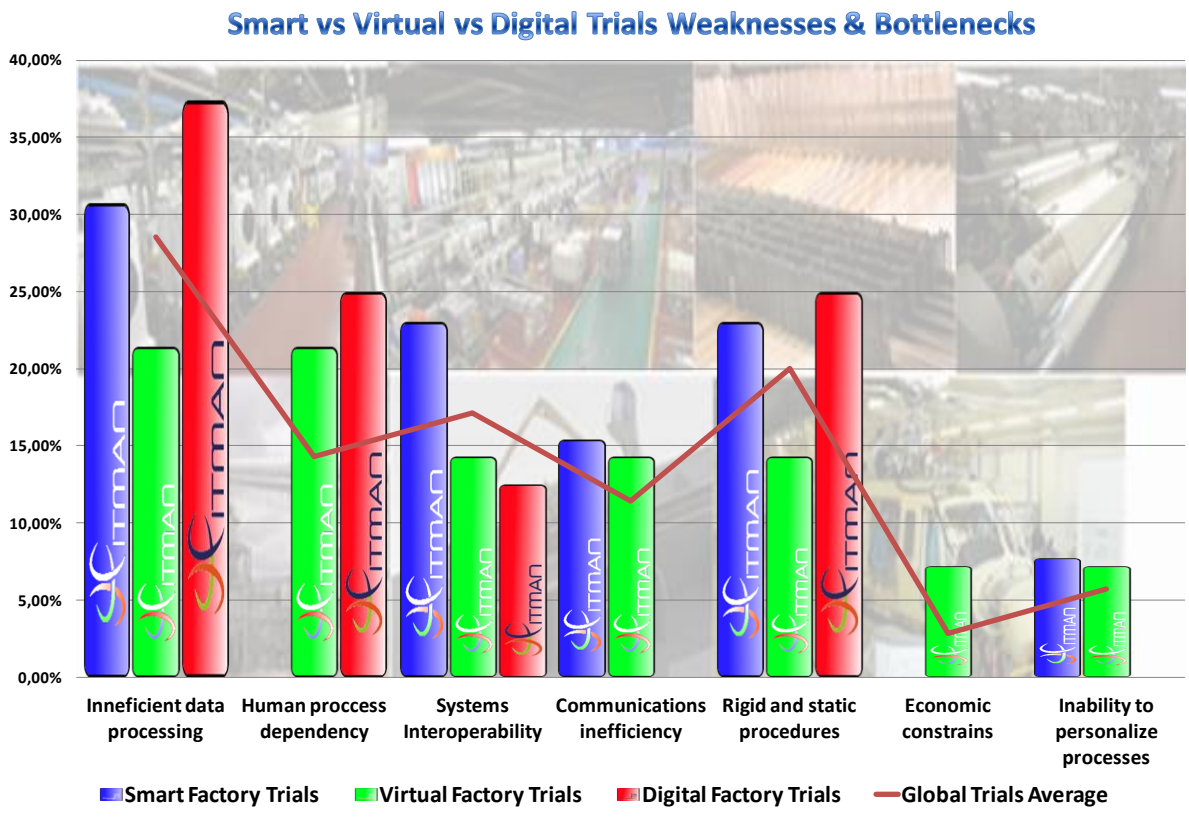



***Figure 33 – FITMAN business weaknesses per trial type (smart, digital, virtual).***

Concerning the departments being affected by the weaknesses and bottlenecks we notice that for Virtual Factory's trials the most affected area is Technical support, while Management is the most affected area for the Digital Factory, and Manufacturing is the key one for the Smart Factory.

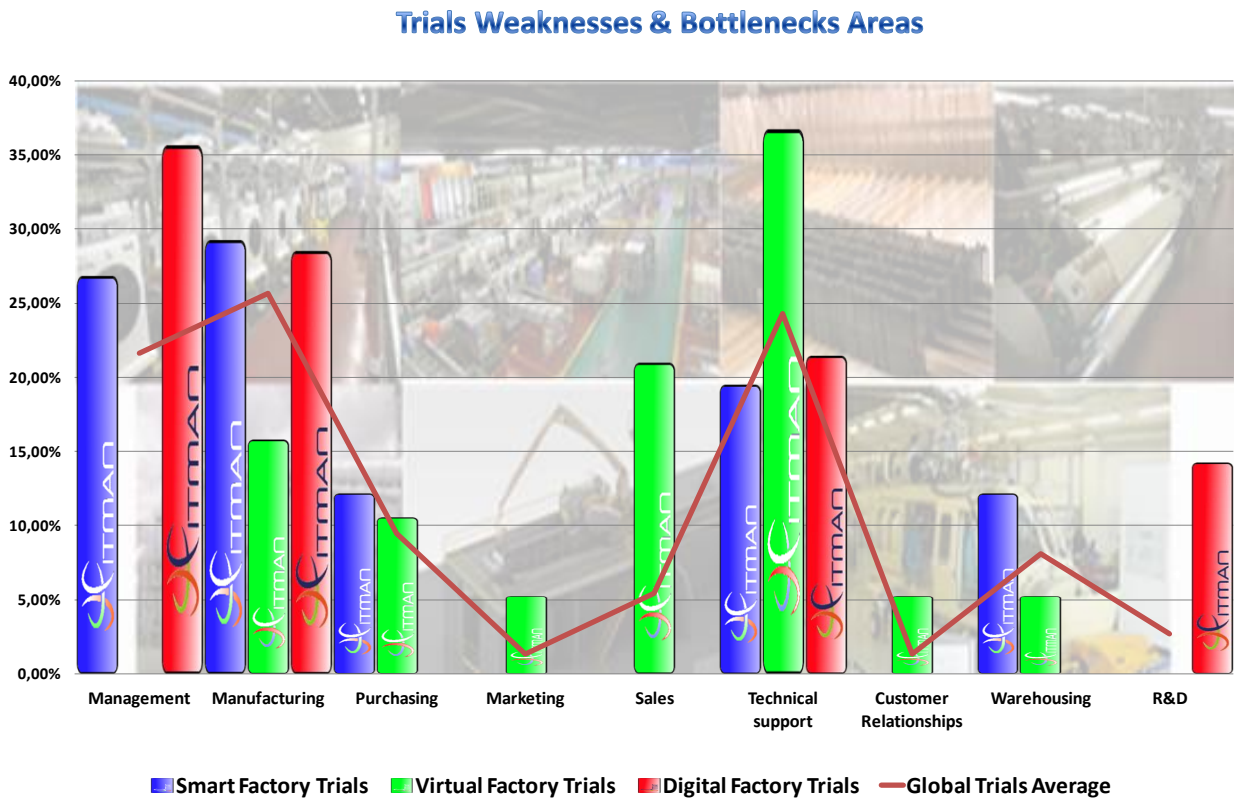



*Figure 34 – Company areas affected by business weaknesses and trial type*

## 5.4. Business requirements

### 5.4.1. General

If we evaluate the business requirements to achieve the expected business objectives we see that the main business areas to which the requirements are related to are IT and R&D, while management, production control, H&S and production are following behind. We may also say that the least affected business areas are marketing, finance, quality, logistics, human resources, maintenance, security and service delivery.

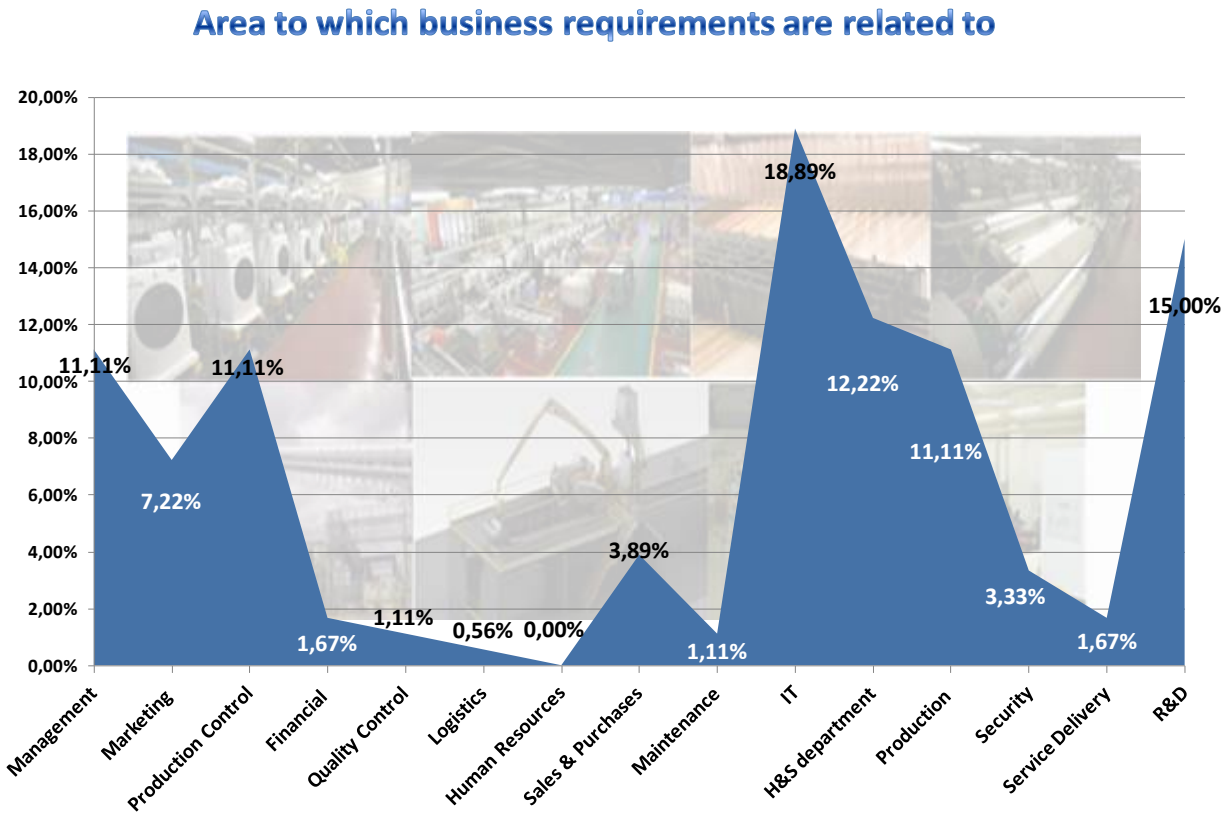



*Figure 35 – Business requirements (areas involved)*

Going deeper into the type of requisites we can remark that most of the requisites are functional and user and technical-based as we can see in the next figures.

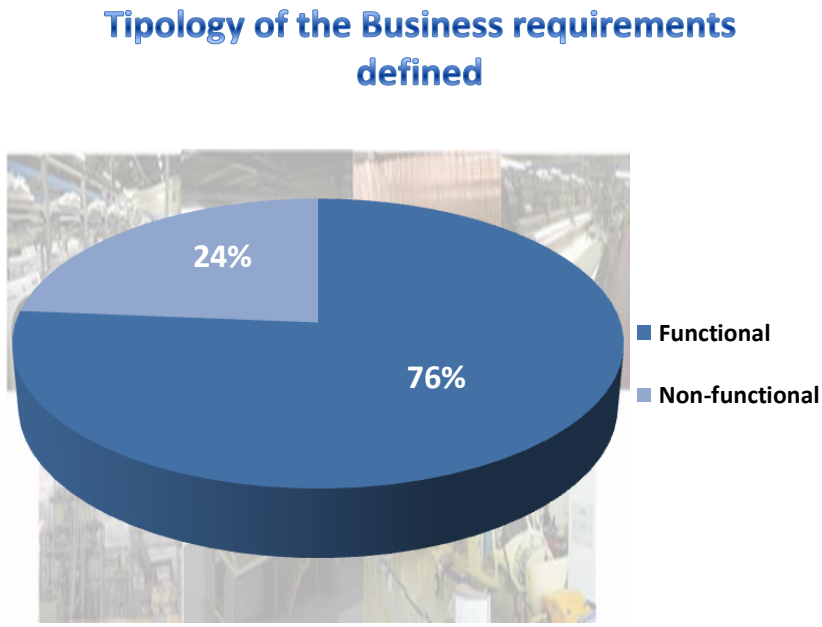



*Figure 36 – Tipology of business requirements*

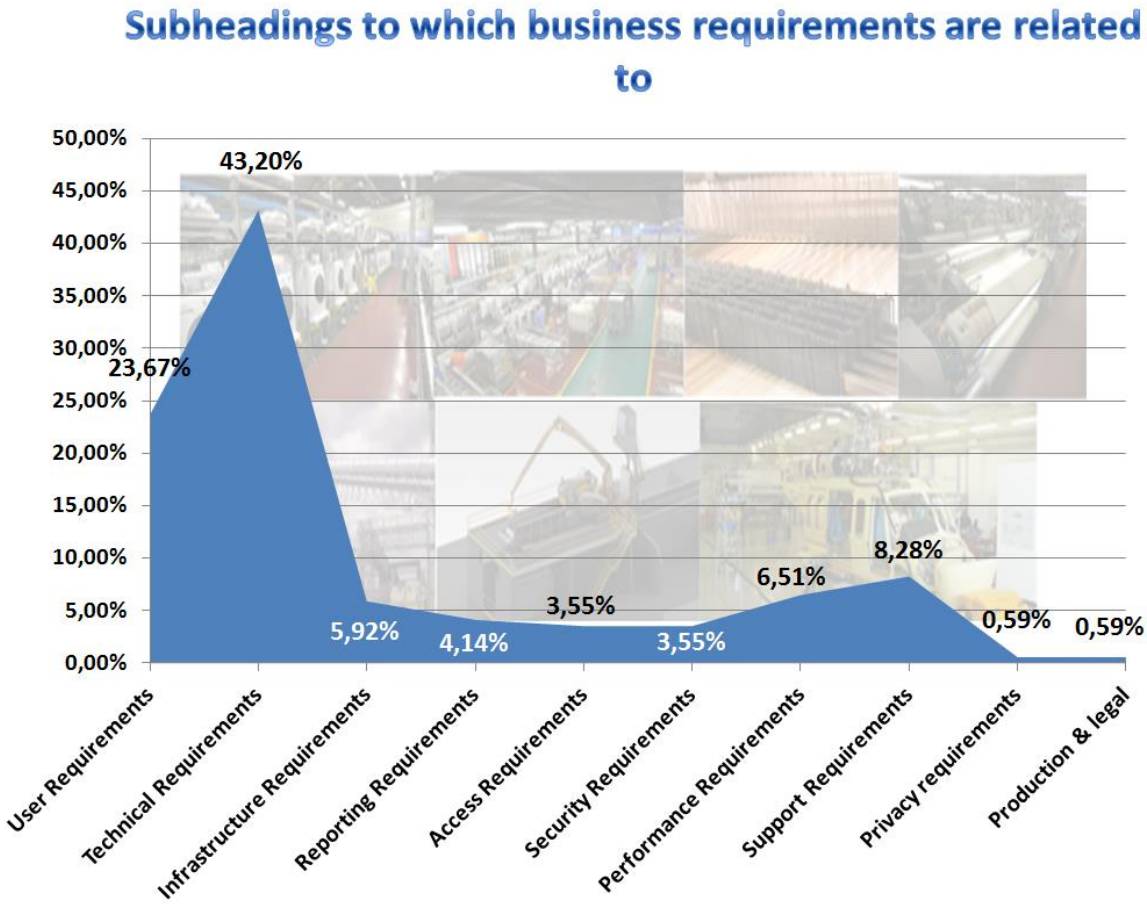



*Figure 37 – Business requirement categorisation*

Most of the business requirements identified are critical.

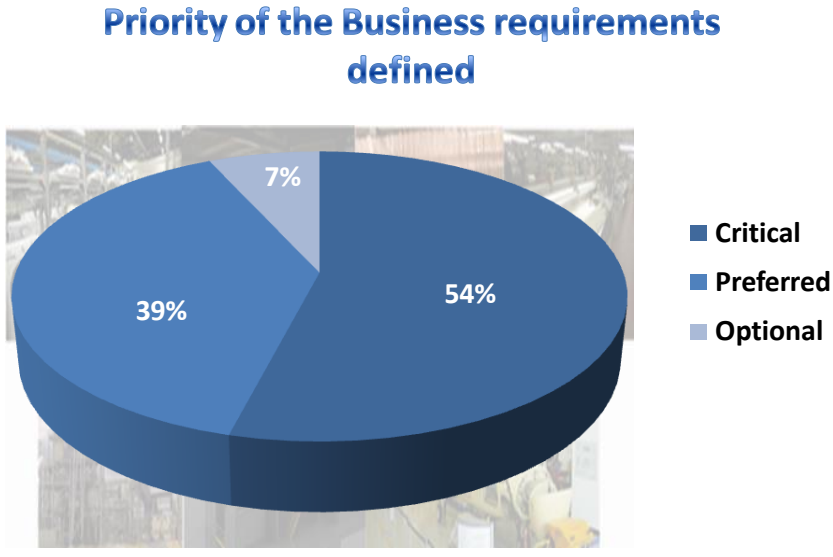



*Figure 38 - Business requirement criticality*

### 5.4.2. LEs vs. SMEs

If we compare the results for LEs vs. SMEs we see that with respect to the business area involved in the requirements, LEs' requirements are significantly more centered on production control and H&S, while SMEs' requirements are more focused on R&D. We may say that requirements related to the IT department are similar in average in both cases.

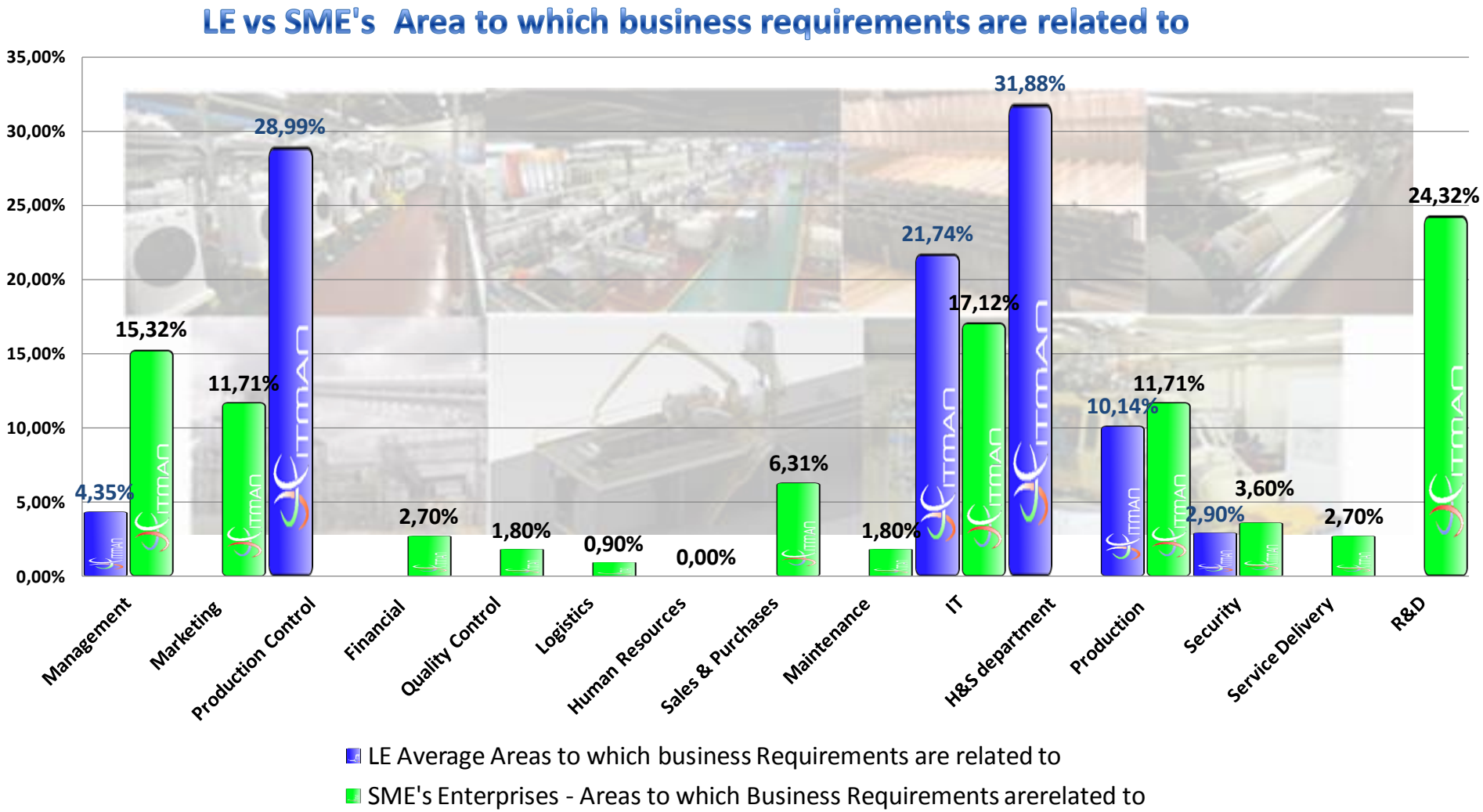



*Figure 39- Business requirements Large industry vs SME*

Concerning the typology of the business requirements, they are similar in both types of companies (more functional than non-functional).

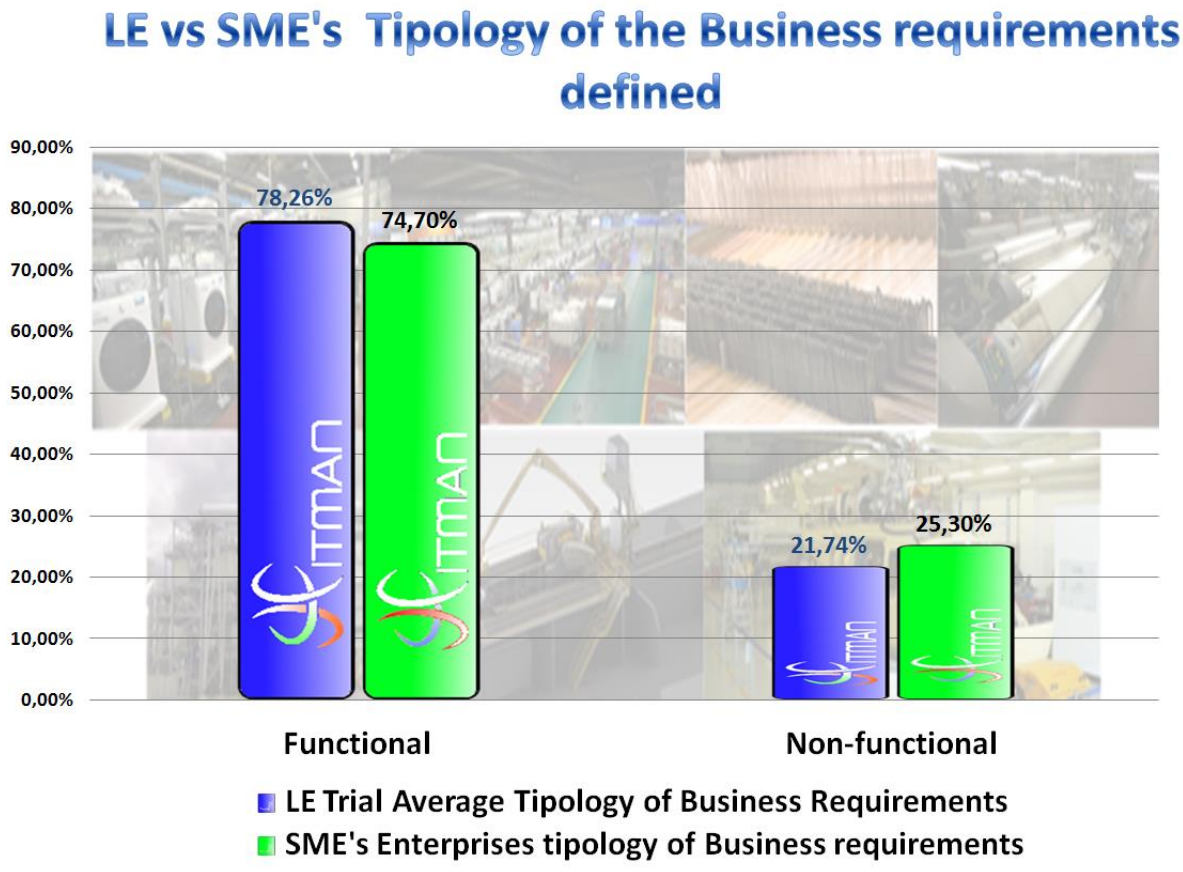



*Figure 40 – Business requirement and enterprise type relationship*

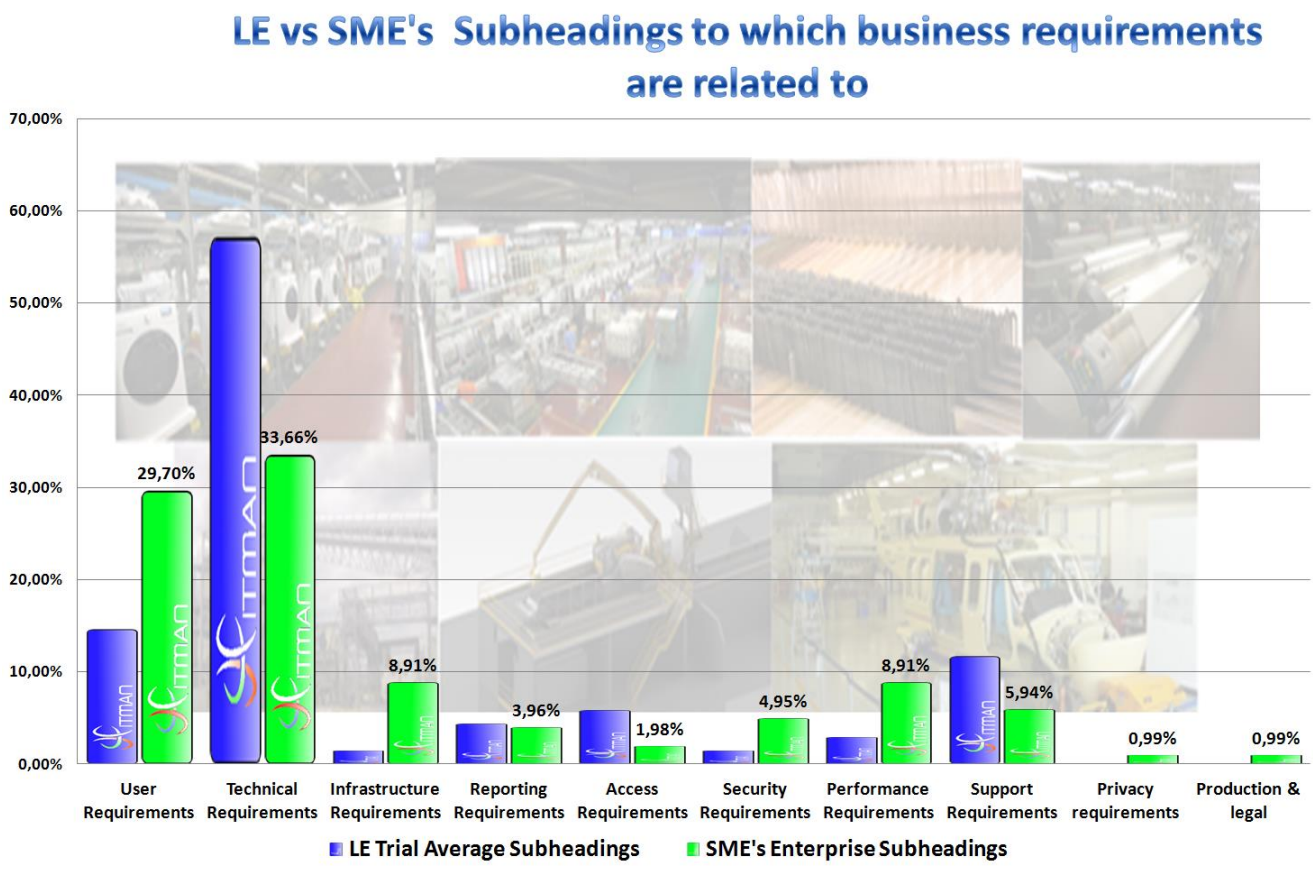


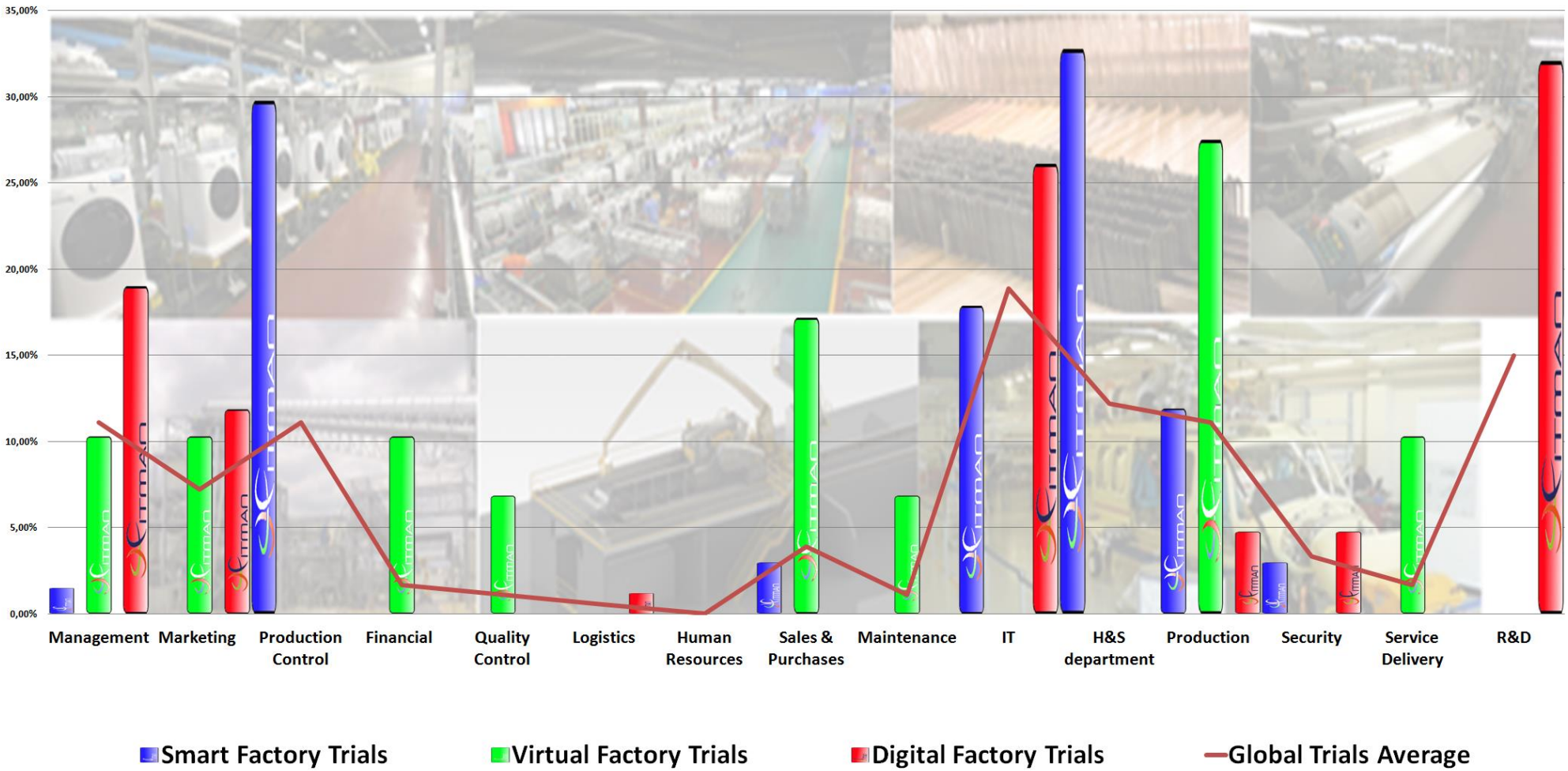

*Figure 41- Business requirement headings*

In the previous figure we see that for SMEs technical and user requirements are similar while for LEs technical requirements are much more important in quantitative terms than user requirements.

### 5.4.3. Smart vs. Digital vs. Virtual

In the next picture we see the areas to which the business requirements are related to per type of trial. We notice that Digital Factory is the one mostly related to the R&D area, Smart Factory is largely related to H&S and Production control, and Virtual Factory is primarily related to Production.

## Areas to which the business requirements are related to per type of trials



# 6. CONCLUSIONS

Within this final chapter we are going to summarise the main conclusions obtained from the previous section focused on the analysis of results. So, if you want to access the whole pack of information, examining in detail chapter 5 is recommended.

We are going to summarise the results taken when comparing the main studied values (business objectives, bottlenecks and weaknesses, and business requirements), among trials, regarding type of end-user (Large vs. SME), and type of factory (Smart vs. Digital vs. Virtual).

## 6.1. Trials

First conclusions come out from the study of the trials individually and the aggregation of results.

Concerning the ***General Business Objectives***, although we see that the main objectives are quite well distributed among all trials, we could somewhat say that there are probably 5 objectives taking the lead over the rest:

- Improve communications/collaboration
- Reduce production costs
- Reduce time to market
- Improve the usefulness of the information
- Increase production capacity

With respect to the ***Business Impact*** from the analysis we conclude that the expected impact is quite high, and that the two main impacts are linked to the reduction of costs and the improvement in efficiency.

Going into detail the ***Weaknesses and Bottlenecks*** the main problems detected are related to the inefficient data processing, the existence of rigid and static procedures and the challenging systems interoperability. All three weaknesses (mostly the first and third ones) can be addressed by the proper analysis, selection and implementation of the right IT tools. There are three departments in the companies being mainly affected by the detected weaknesses and bottlenecks: Manufacturing, Technical Support and Management. All three critical areas are our main targets within FITMAN.

Analysing the ***Business Requirements*** we deduce that the main business areas to which the requirements are related to, are IT and R&D, while management, production control, H&S and production are following behind. We may also say that the least affected business areas are marketing, finance, quality, logistics, human resources, maintenance, security and service delivery. With respect to the type of requisites we can remark that most of the requisites are functional and user and technical-based.

## 6.2. Large Enterprises vs. SMEs

At this point we will summarise the analysis made concerning the size of the company.

Concerning the ***General Business Objectives*** most of the them are similarly shared between LEs and SMEs, but we can detect the next divergences.

As LEs' trials are more specific than SMEs' we see that LEs have a larger interest in increasing the production capacity and improving work safety and security, on the contrary LEs find it less significant than SMEs to improve communication and collaboration.

On the other side, SMEs are much more interested in improving communication and collaboration. In fact, for SMEs this is the most important business objective, while the most important goal for LEs is increasing the production capacity.

With respect to the ***Business Impact*** we found that there are no meaningful variations if we take into account the size of the company.

Analysing the **Weaknesses and Bottlenecks** we conclude that there are not significant differences in the main weaknesses, while when studying the departments involved, we find out that the technical support department is more affected in the case of LEs than it is for SMEs.

Finally, regarding ***Business Requirements*** if we compare the results for LEs vs. SMEs we see that with respect to the business area involved in the requirements, LEs' requirements are significantly more centered on production control and H&S, while SMEs' requirements are more focused on R&D. We may say that requirements related to the IT department are similar in average in both cases.

## 6.3. Smart vs. Digital vs. Virtual Factories

The last analysis is focused on the type of factory[5] (Smart - Digital - Virtual).

With respect to the ***General Business Objectives*** we see that all three types of Factories are quite similar but there are a few points to be highlighted.

- Smart Factory's trials are less focused on reducing time to market and improving communications and collaboration than average. Their main objectives are reducing production costs, increasing production capacity and increasing the usefulness of information.
- Digital Factory's trials are likewise less focused on improving communications and collaboration than average, while reducing time to market is the most critical objective.
- Virtual Factory's trials are mostly centered on the improvement of communications/collaboration.

Such results are well in line with the main concept behind each of the Factories.

[5] Details about each type of Factory can be taken from subchapter 1.2 General Description

Taken into account the ***Business Impact*** we see that all Smart, Digital and Virtual Factories coincide in identifying efficiency as the main improvement. With respect to the typology of the impact the Virtual Factory is more oriented to the user requirements followed by performance requisites, while both Smart and Digital Factories are mostly centered on technical requirements.

Concerning ***Weaknesses and Bottlenecks*** the main results are quite predictable, given that Digital Factory's trials have important bottlenecks related to the inefficient data processing, while human process dependency seems not to be a weakness for the Smart Factory's trials. Concerning the departments being affected by the weaknesses and bottlenecks we notice that for Virtual Factory's trials the most affected area is Technical support, while Management is the most affected area for the Digital Factory, and Manufacturing is the key one for the Smart Factory.

To finish, regarding ***Business Requirements*** and specifically which are the areas to which they are related to, we notice that Digital Factory is the one mostly related to the R&D area, Smart Factory is largely related to H&S and Production control, and Virtual Factory is primarily related to Production.

## 6.4. Take Away Messages and Future Work

The previous sections have provided some discussions about the main findings obtained during the business requirements elicitation phase. This Section is devoted to provide some guidance and useful information that can be exploited by other WPs of the FITMAN project and the FI-PPP Programme.

The first conclusion is that drivers for digital business transformation through ICT in manufacturing differ from SMEs and LE. As highlighted by various studies and the results of this document, cost remains the main decisive factor for SME adoption of innovative ICT solutions. It should also be noted that being engineering and production departments the majority of the departments taken active part in FITMAN, sales and marketing needs may not have been sufficiently highlighted by the results. After discussion with industry it became clear that enablers dealing with social media and customer-centric design are equally important and should be carefully addressed.

The second important conclusion of D1.1 is that the business value perceived from GEs, SEs and Trial Specific Components (TSC) will differ based on the category of application/service considered (Smart, Digital and Virtual). For instance, one GE could be perceived as enabler to cost reduction in a Smart Factory context and as a manufacturing flexibility enabler in a different context; e.g. Digital Factory. For this reason it is important that the GE is not perceived as an isolated module in the FITMAN context, but as a source of competitive advantage generation. Hence, it is recommended that the business requirements, business processes defined in D1.1 are further traced down to GE, SE and TSC implementation in future project developments. Thus, FITMAN should be able to present the value proposition of the GEs to the different domains (Smart, Digital and Virtual). This contextual information is critical to foster future adoption of the GEs, since potential users will better understand which value the use of a particular GE,SE or TSC is bringing to the customer.

The third important conclusion lies on the fact that industry perceives FI enablers as a contributor in their business strategy implementation (particularly large enterprises). In this

respect, GEs and SEs are an instrument, a means and not an end in the manufacturing innovation strategy. This observation reinforces the importance of presenting GEs as providers of business capabilities and not simply as technical functionality enablers. This entails a further complexity in the characterisation of the enablers developed.
The forth important conclusion lies in the fact that infrastructures for manufacturing innovation go beyond IT and connectivity infrastructures. FITMAN innovation demands that a suitable environment with the required data, equipment and IT infrastructure is available for experimentation. Failing to provide such complete infrastructure will impact on the value perception and innovation adoption of future FITMAN apps. The deployment of innovative apps and services over this types of infrastructures will accelerate the take up of the solutions.

The fifth conclusion is that business requirements for the enhanced business processes defined by FITMAN could be addressed by complementary actions. On one hand they can be addressed by introduction of new technology. However, there is also an important part in terms of providing the right digital skills to the users. It is important to indicate in future work, which requirements will be met by FITMAN solutions and which requirements will be met by improved process implementation and training.

# 7. ANNEXES

## 7.1. ANNEX I. European manufacturing context. Links between FITMAN and FI PPP, FF PPP, FInES and EFFRA

The European manufacturing sector faces an intense and growing competitive pressure in global markets. European companies continuously face a fierce competition from more technologically developed economies, such as the U.S., Japan and Korea.

There is an increasing demand for consumer goods. Therefore, the European manufacturing sector has to address the challenge of producing more products with less material, less energy and less waste, while improving quality. These means, innovation activity of EU manufacturing companies has to improve. Many of the manufacturing companies are SMEs and only a few of them have research capacity and the financial potential to implement high-risk innovative manufacturing technologies.

In this respect, we are going to review the existing links between FITMAN and the expected results of the project with a number of ongoing European initiatives supporting EU companies competing Worldwide, namely Future Internet PPP, Factories of the Future PPP, and both FInES and EFFRA roadmaps.

### 7.1.1. Future Internet (FI) PPP

**The European Commission is running the Future Internet Public-Private Partnership Programme (FI-PPP)**, which main goal is to advance a shared vision for harmonized European-scale technology platforms and their implementation, as well as the integration and harmonization of the relevant policy, legal, political and regulatory frameworks[6]. The Programme aims are to increase the effectiveness of business processes and infrastructures supporting applications in areas such as transport, health, and energy. On the other hand, the programme will foster the search of innovative business models strengthening the competitive position of European industry in sectors such as telecommunication, mobile devices, software and services, and content provision and media. The FI-PPP Programme will be implemented via three phases:

- **Phase 1**, which main is to establish the ***technology foundation*** (FI-WARE), define the "use case scenarios" in different industry sectors (8 use case projects), make an inventory of available (public) infrastructures through capacity building (INFINITY) and programme support (CONCORD).
- **Phase 2** will contribute to develop use case pilots and platforms (i.e. FITMAN) and setting up infrastructures.
- **Phase 3** will be focus on the expansion of the use cases by developing applications and services and the expansion of the technology foundation (FI-WARE).

FI-WARE is considered the ***Technology Foundation*** and the cornerstone of the Future Internet Public Private Partnership (PPP) Programme. It will deliver a novel service

[6] http://www.fi-ppp.eu/about/

infrastructure, building upon elements, called ***Generic Enablers***, which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications – building a true foundation for the Future Internet[7].
The project will develop Open Specifications of these Generic Enablers, together with a reference implementation of them available for testing. This way, it is aimed to develop working specifications that influence Future Internet standards.

### 7.1.2. FI-WARE & FITMAN

In this context FITMAN will play an important role providing the FI/PPP Core Platform with 11 industry-led use case trials which will test and assess the suitability, openness and flexibility of ***FI-WARE Generic Enablers,*** while contributing to the STEEP (social-technological-economical-environmental-political) sustainability of EU Manufacturing Industries[8].

In addition to the **FI PPP**, FITMAN project is aligned with other two initiatives represented by Future Internet Enterprise Systems (**FInES)** and Factories of the Future PPP, through the European Factories of the Future Research Association **(EFFRA)**. Thus, the work developed in the FITMAN project will contribute to establish a solid base between the FI PPP and the manufacturing sector.

Taking into account the general goals of the 11 trial that will be developed in FITMAN project, we can assure the right alignment with the main research priorities and challenges of the FInES and EFFRA future roadmaps.

In order to provide a global overview of this status, in this section we will analyse the relation between the main research domains and challenges of FINES and EFFRA (reflected in their roadmaps) and our FITMAN trials.

### 7.1.3. FInES

**FInES (Future Internet Enterprise Systems)** is a community of numerous stakeholders, ranging from enterprises, users, providers, intermediaries and public authorities to the research community. The Cluster has a strong focus on cross-domain co-operation, whereas natural links with standardization bodies (CEN, ETSI and de facto standardization initiatives) and EU Enterprise policy exist, as well as cooperation with the other Commission Directorates-General. FINES research field aims identifying the mutual influence and interaction between FI and Enterprises and between FI and next generation Enterprise Software and Applications.
FInES have foreseen the strategic future direction to achieve the Future Internet based Enterprises in the Research Roadmap 2025, which is organized in four knowledge spaces:

- **Socio-economic space**: that represents the larger context in which enterprises operate, interacting with the other players and the environments, aiming at the increasing of wealth while satisfying customers' needs.

[7] http://www.fi-ware.eu/about/
[8] http://www.FITMAN-fi.eu/front-page

- **Enterprise Space:** Where 9 paradigmatic enterprise profiles or **Quality of Being** of the future internet-based enterprise are contain (*Humanistic, inventive, agile, cognizant, sensing, community-oriented, liquid, glocal and sustainable*).

- **Enterprise System**: Where 9 Research Challenges (RC) have been defined, organized in three key dimensions: Knowledge dimension (**RC1**: Unified Digital Enterprise, **RC2**: Linked Open Knowledge, **RC3**: Complex systems modelling), Functional dimension (RC4: Innovation oriented enterprise platform, **RC5**: Unified Digital Enterprise Management System, **RC6**: Cooperation and collaboration platforms), Engineering dimension (**RC7:** Proactive Fines Mashup, **RC8**: Autonomic Computing Components and Subsystems, **RC9**: Flexible Execution Platforms).

- **Enabling Technology**: In this space, the possible evolution of ICT from a FInES oriented point of view is defined. This desired evolution is grouped in five technological fields: Future Networking technologies, Future Knowledge technologies, Future Application technologies, Future Computation and Storage technologies and Future Natural interaction.

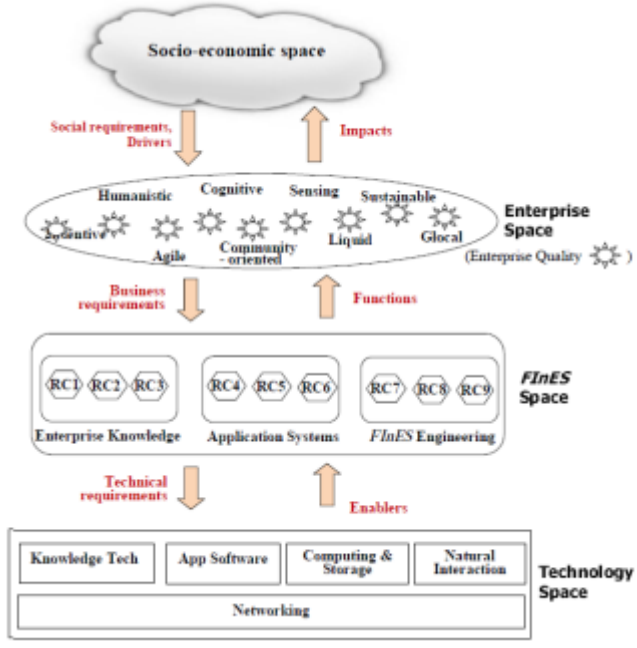



***Figure 42 - FInES Vision Roadmap 2025***

FITMAN will contribute, through its trials and testing opportunities, towards the realization of the vision of all the Qualities of Being defined in the enterprise space. Furthermore, it will also contribute to the advancement of the research state of art of the 9 Research Challenges:

- **Knowledge dimension** (**RC1**: Unified Digital Enterprise, **RC2**: Linked Open Knowledge, **RC3**: Complex systems modelling)

- **Functional dimension** **(RC4:** Innovation oriented enterprise platform, **RC5**: Unified Digital Enterprise Management System, **RC6**: Cooperation and collaboration platforms)

- **Engineering dimension** (**RC7:** Proactive Fines Mashup, **RC8**: Autonomic Computing Components and Subsystems, **RC9**: Flexible Execution Platforms).

### 7.1.4. EFFRA

**European Factories of the Future Research Association (EFFRA),** established jointly by the MANUFUTURE[9] technology platform and key industrial associations, the non-for-profit industry driven association EFFRA, was created to shape, promote and support the implementation of the 'Factories of the Future' public-private partnership.

EFFRA has defined an ambitious and far-sighted strategic multi-annual research roadmap for the partnership. From a set of Megatrends identified (e.g. climate change, energy and food security, health and an ageing population...), EFFRA detects a group of challenges and opportunities (Manufacturing future products, Economic, Social and environmental sustainability) that will entail a structural transformation of the European manufacturing sector. Once identified these challenges, the technologies and enablers (Advance manufacturing processes, Mechatronic for advanced manufacturing systems, ICT, Manufacturing strategies, knowledge workers and Modelling, simulation and forecasting) will have to be evolve to achieve the needed transformation. To address this, EFFRA defines 6 research domains in the roadmap 2020:

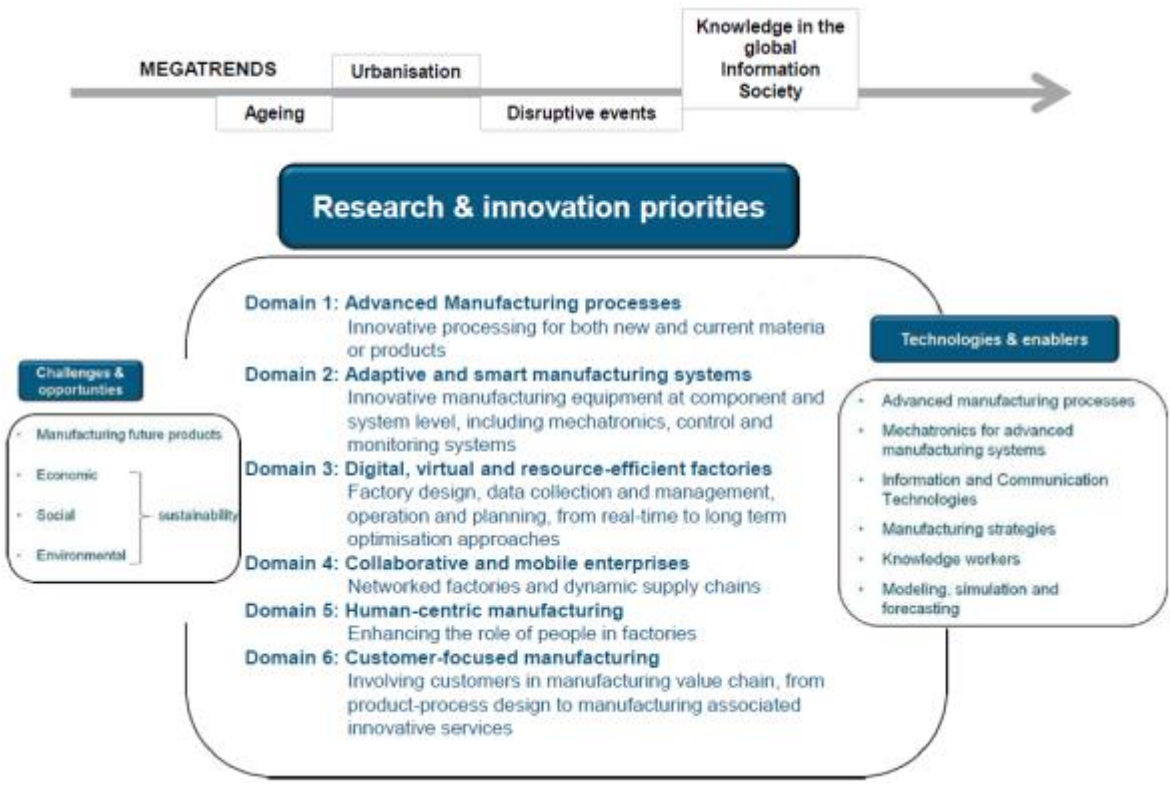



***Figure 43 - EFFRA Vision Roadmap 2020***

Regarding to this, FITMAN will be aligned with the following domains:

[9] http://www.manufuture.org/

**Domain 1: Advanced Manufacturing processes**

The research priorities under this domain will be focused on innovative processes for efficient and high quality manufacturing for either, new and current materials or products.

- **Sub-Domain 1.1: Processing novel materials and structures (into products)**
  - Customization is a key differentiator within high value manufacturing, to provide competitive products and deliver new services and localized functionalities. It requires new strategies to be developed integrating design with manufacturing and incorporating appropriate control methodologies.
  - In this context, **TRIAL 11** (Furniture) is aligned with this domain, as the main goal will be to improve the manufacturing process, capturing fashion trends, adapting new customization process and allowing flexible and rapid change according to the market needs.

**Domain 2: Adaptive and smart manufacturing systems**

The research priorities under this domain aim at future European Manufacturing systems and processes that adapt In an agile manner to varying market and factory demands thanks to intelligent robots and machines that cooperate both among them and with persons in a safe, autonomous and reliable manner. Regarding to this domain two are the main areas aligned with FITMAN project goals.

- **Sub-Domain 2.1: Adaptive and smart manufacturing devices, components and machines**
  - Immersive and symbiotic collaboration between human workers and robots leads to a more efficient and flexible manufacturing environment. Cognition-based intelligent features and prediction-based reactive control strategies within machinery and robots will radically change their interfacing towards human workers in manufacturing environments in a manner that the humanrobot- system will be dynamic, will safely act in a shared working space, will follow an intuitive cooperation and will be aware of its work and of its environment.
  - Regarding to this, **TRIAL 2** will support high-performance proactive Health and Safety (H&S) management strategies through the deployment and evaluation of Future Internet technologies, in order to reduce workers generated incidents and accidents in the factory. The trial will demonstrate how FI technologies can be of use in the evaluation of large amounts of data generated by ergonomic, collision avoidance and work place risk control system.
- **Sub-Domain 2.2: Dynamic Production systems and Shop Floors**
  - The problems of remote device management, high-volume data collection, and processing are going to become intractable in the future with the rapid proliferation of "connected devices" across European shop floors. Development of faster distributed publish-subscribe broker systems in the cloud for devices to subscribe to and consume data and real-time event repository based on fast in-memory processing technologies would make consumption and processing of device data faster and more efficient.
  - **TRIAL 4** will improve the integration between process and people on the shop floor through the integration of intangible assets and quality data generated in real time.

**Domain 3: Digital, virtual and resource-efficient factories**

- The set of research priorities under this domain focuses on factory design, data collection and management, operation and planning, from real-time to long term optimization approaches. Factories are becoming much more complex, expensive, distributed and fast evolving than in the past and manufacturers are struggling to put management of factory lifecycle management into practice. New paradigms in the way plants are designed and managed leveraging the best practices of enabling technologies are required to cope with competition and sustainability related issues.
- According to this domain, should be remarkable a trial that will be developed following the research priorities of this domain:
    - The **TRIAL 1** has the objective to improve monitoring and control of the production planning processes along car development which will increase the reliability and the efficiency of production implementation.

**Domain 4: Collaborative and mobile enterprises**

- The set of research priorities under this domain focuses on networked factories and dynamic supply chains. The trend of collaboration between multiple manufacturing enterprises is becoming essential for day-to-day operations of any manufacturing enterprise irrespective of its size. Both SMEs and large enterprises stand to gain from collaboration solutions in their network. As part of the extended collaboration paradigm, OEMs will be able to sell 'products as a service' and certified suppliers or subcontractors will be able to offer value-added services to customers.
  Some outstanding challenges which future manufacturing enterprises will have to encounter through innovative ICT are the following:
    - Facilitating secure data exchange for collaboration in design, engineering, services, and supply chain between multiple stakeholders.
    - Visualization & tracking of processes, delays, and inventory flow.
    - Accommodating dynamically changing orders & requirements from customers and suppliers.
    - Encompassing new product take back laws and asymmetric information distribution for closed-loop lifecycle management and especially for End-of-Life (EoL) services for products.
    - Capturing complexity and multidimensionality of supply networks

- Some specifics trials will be developed in line with the research priorities established in this domain:
    - **TRIAL 3** aims at supporting the secure and timely flow technical knowledge between an original equipment manufacturer and customers and service stations spread all over the world.
    - **TRIAL 5** will develop a collaboration platform between competitors to share production facilities.
    - **TRIAL 6** will develop new business processes collaboration capabilities using new IT capabilities.
    - **TRIAL 7** will use remote collaboration in order to identify design and technical mistakes, including online detection and real time fixing of incongruences between a project and construction.
    - **TRIAL 8** will contribute to the Visualization & tracking of processes, delays, and inventory flow, at monitoring the flow of goods within a manufacturing

SME network and allow the tracking of such products from supply to the end customer.

**Domain 5: Human-centred manufacturing**

- The set of research priorities in this domain focuses on enhancing the role and utilizing the potential of people working in factories. 'Human-centricity' will be needed in factories of the future in order to increase flexibility, agility, and competitiveness.
- Future enterprises will be better equipped for transferring skills to new generations of workers, and also proficient in assisting aging, disabled and multi-cultural workers with better information and communication technology.
- Mobile and ubiquitous ICT will allow workers to remotely control and supervise manufacturing operations. New safety systems will allow full adaptation of worker–robot collaboration that will enhance competitiveness and compensate for age- or inexperience-related worker limitations.
- Taking into account the research priorities of this domain is important to describe the objective of two trials that are contributing to trends defined in this domain:
    - The **TRIAL 2** focused on reduced incidents and accidents in the factory using Future Internet technologies, and supporting the operation of personalizes safety plans for individual worker training and workplace adaptation.
    - The **TRIAL 4** will integrate intangible assets constituted by hard and soft skill of the workers with the huge quantity of production and quality data generated in real time. The main challenge is to create a system able to allow people take decision based events or meta-events extracted from the available data.

**Domain 6: Customer-focused manufacturing**

- The set of research priorities under this domain focuses on involving customers in manufacturing value chain, from product-process design to manufacturing-associated innovative services. Manufacturing enterprises that design and develop products without involving customers in the loop are likely to end up with commercially unsuccessful products. Future manufacturing enterprises would collect explicit as well as tacit customer requirements, analyze them and make the right product and service model. It would extract customer feedback from all possible sources, including real time product usage, social media and incorporate it into engineering and manufacturing processes. ICT for manufacturing intelligence should enable the integration between engineering and manufacturing phases of products by integrating CAD, CAM and PDM/PLM tools.
    - According to this, the **TRIAL 10** is focused on the full integration of customer related processes with internal technical processes, unifying CRM, CAD and ERP within a collaborative platform accessible from clients, design department, production department and after sale services.

## 7.2. ANNEX II. Methodologies applied in requirements engineering

We have revised the next methodologies:

- CRISP-DM (CRoss-Industry Standard Process for Data Mining) (Chatam, et al., 2000)
- RATS (Requirements Assistant for Telecommunications Services) (Gerhard, 1997)
- DoRCU (Documentation of requirements user centered) (Báez, 2002)
- DWARF (Data Warehouse Requirements definition) (Rilston et al. 2003)
- URN (User Requirements Notation) (Recommendation Z.151 ITU)
- The i*framework (Yu et al. 2010)
- UML (Unified Modelling language) (Hamilton, 1999)

We are providing more specific details and the application to D1.1 of the main methodologies in the next pages.

### 7.2.1. CRISP-DM

This is a methodology addressed for the implementation of data mining technologies in a company. Although this methodology is not the most new or the best, it is very useful for guiding us in the purpose of modelling a business for FITMAN.

The standard includes a model and a guide, which are structured in six phases, some of these stages are bidirectional, which means that some phases will allow to partially or completely revise the previous phases.

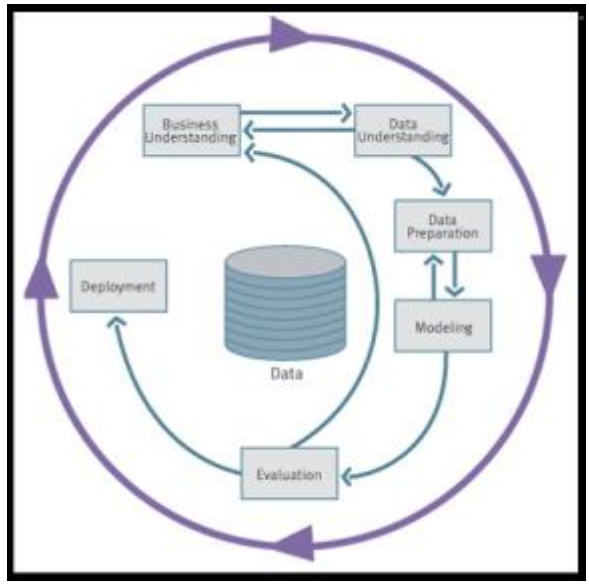



***Figure 44 Figure. CRISP-DM requirements definition approach***

**Business understanding (Objectives and requirements from a non-technical point of view)**.

- Establishing business objectives (initial Context, objectives, success criteria)
- Situation assessment (inventory of resources, requirements, assumptions, terminologies own business, ...)

- Establishment of the objectives of data mining (objectives and success criteria)
- Generation of the project plan (plan, tools, equipment and techniques)

**Understanding the data (getting to know all data while keeping in mind the business objectives)**

- Initial data collection
- Description of the data
- Data scan
- Verification of data quality

**Data preparation (Get the minable view or dataset)**

- Data Selection
- Data cleaning
- Data Construction
- Data integration
- Data formatting

**Modelling (Applying data mining techniques to the dataset)**

- Modelling Techniques selection
- Design of the Evaluation
- Building of the model
- Evaluation of the model

**Evaluation (previous phase models are evaluated to determine if they are really useful for achieving business needs)**

- Evaluation of the results
- Review the process
- Establish the following steps or actions

**Deployment (Exploit utility models, integrating them into the decision-making tasks of the organization)**

- Deployment Planning
- Planning monitoring and maintenance
- Generating final report
- Project Review

***Relevance of CRSIP-DM methodology to the FITMAN's D1.1. deliverable**: The FITMAN project really doesn't deal with a data mining implementation in a company, it encompasses a wide range of different implementations, however, CRISP-DM settles an interesting procedure to elicitate requirements from a business perspective and helps us to identify those business aspects that are required to assure the correct definition of coherent business objectives and their subsequent business requirements. In this sense, the different steps of the CRISP-DM methodology help us to compile the information needed to be gathered from the Trials in order to fully understand and evaluate the business objectives defined for each of the trials.*

### 7.2.2. RATS (Eberlein & Halsall,1997):

This is really not a methodology but a set of tools that advises the service developer during all stages of the service development and on different levels of abstraction, and provides requirements management facilities, like traceability, impact analysis and document generation. RATS tools supports requirements elicitation and early analysis, while providing a smooth transition to SDL-based formal methods. The aim is thus to introduce formality at an earlier stage of the development life cycle without restricting innovation. This

methodology main characteristic is that it is announced to be requirement-based rather than document-based; assuring that it is centered in the requirements but provides facilities for document creation.

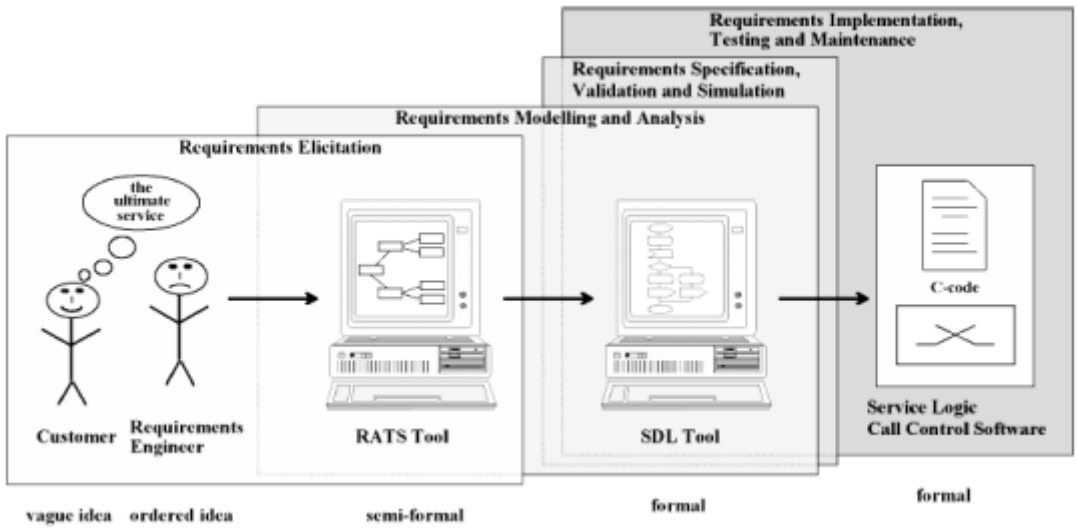



***Figure 45 - Overall methodology for telecommunications service design (RATS) (source: Eberlein & Halsall,1997)***

The development process proposed by RATS encompasses three dimensions as a framework for the methodology.

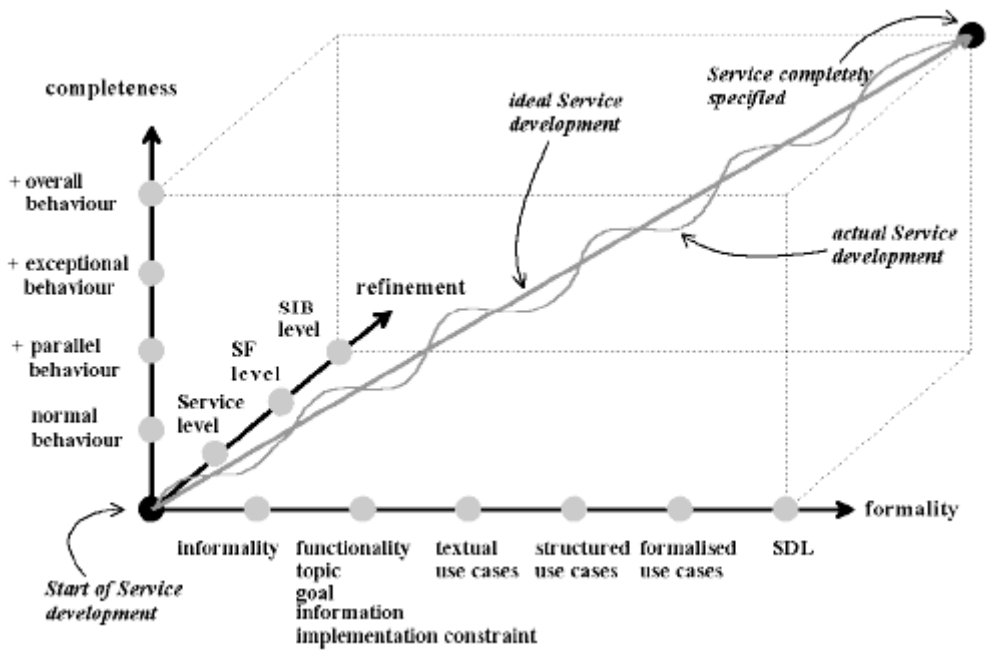



***Figure 46 - The three dimensions of the development of the RATS (source: Eberlein & Halsall,1997)***

1. ***Completeness:*** RATS methodology states that completeness is when all requirements regarding the development of the telecommunications service has been stated. The methodology provides some means which help in completely defining a service. Therefore, the methodology includes requirements documentation, aim to enforce a minimum degree of completeness.

The methodology attempts to achieve completeness by a three step approach to the requirements definition, the Initial Customer description (ICD), that will be followed by the definition of a brainstorming list (BL) and finally completed with the fulfil of a Service Definition Template (SDT). The methodology also introduces the consideration for non-functional requirements (NFR), which are described as those system constraints, goals or quality attributes and can be seen as the driving force behind design decisions and states that they must be satisfied by either functional requirements or implementation constraints.

2. ***Refinement***: In this dimension, the methodology proposes a very practical approach of building services out of service features (SFs) and service features out of sub-features, approaching the mapping process from one level of refinement to another.
3. ***Formality***: To achieve the formality in the requirements definition, as a mean to facilitate automated analysis and verification of specifications and design steps with mathematically clear proofs, automated code and test case generation, as well as concise descriptions of the intended software system, the methodology inserts semi-formal steps to facilitate transition from the informal exposure of the clients idea to the formal needed requirements required for the use of automated tools. The methodology facilitates the transit from informal to formal requirements by, first, assigning each requirement to a certain sub-class (functionality, topic, goal, information, implementation constraint). This will channel the further development of each specific requirement by providing requirement specific guidance. The functional requirements in the methodology will be specified with a use case design process that gradually increases the formality attempting to facilitate a smooth transition to a fully formalised service specification using SDL.

***Relevance of RATS to the FITMAN's D1.1. deliverable****: The three dimensions proposed by the RATS methodology/tools are perfectly adaptable to the D1.1. purpose of defining the business requirements of all the FITMAN's trials. The importance of the completeness of the requirements, the proposed iterative process to assure this completeness has been taken into account in the definition of the information elicitation and is reflected in the Data gathering approach proposed in section $ of this document. The refinement dimension has facilitated the structuring of the questionnaires' content that has been delivered for each trial at the first stage of the data gathering approach. The formality dimension has been taken into account in order to define some of the specific tables contained in the mentioned questionnaires, setting a limit set of options to respond in some of the sections that will permit us a certain degree of formality towards homogenization.*

### 7.2.3. DoRCU:

This requirements engineering methodology is characterized by its flexibility and to be user oriented. It really supports in already define techniques, methods and tools from other authors, focusing them to a user orientation approach. The methodology defines four stages for the definition of requirements: Elicitation, Analysis and Specification, being:

- ***Elicitation***: The stage in which there is more interaction with the final user, and where different techniques such as observation, documental review, interviews, etc. take place, the objective of this stage is to understand the clients necessities, and the constrains that may affect the development at an environmental level.
- ***Analysis***: In this stage, from the information gathered from the first stage, the analyst represents the information domain in a more formal language in order to reduce

ambiguities. The objective of this stage is to detect contradictory requirements, areas that haven't been specified enough and petitions that seem irrelevant or vague.

- ***Specification***: In this final stage, the analyst defines the definite requirements that will guide the development. The importance of this stage is universally accepted. In case there is an important difficulty to define a certain requirement, a previous stage must be repeated.
- ***Validation and certification***: This is the final stage of the methodology and is where all the results of the previous stages are recollected into a final requirement document. This document is not actually one; it usually means the development of at least two isomorphic documents, one addressed to the client for certification purposes and the other with a more technical content addressed to nourishing the rest stages of the software engineering. As in the case of the specification stage, this stage also should identify the need to go back to a previous stage for clarifications or rewordings.

***Relevance of DoRCU to the FITMAN's D1.1. deliverable****: As in the case of the RATS, the DoRCU methodology approaches the requirements setting as an iterative process in which the final user in a key position, and must be involved as much as possible at this early stage of the project to assure the accomplishment of the expectative and the reduction of last minute tuning in the solution in order to reduce costs and client's dissatisfaction. This methodology therefore reinforces our approach for requirements elicitation from the trials and the subsequent analysis and definitions of business requirements.*

### 7.2.4. DWARF:

This is stated more as a technique than as a methodology for requirements definition. *It is structured in a set of phases. Each phase follows in depth the functionality of the application, as the project requirements are gathered to arrange a baseline for the requirements. Encompassing this cycle is a backbone phase named Requirements Management Control addressed to perform a continuous quality evolution assessment control.*
*In parallel, warehouse requirements documents templates with a pre-defined structure help to record facts and cutting-edge point for the system development.*

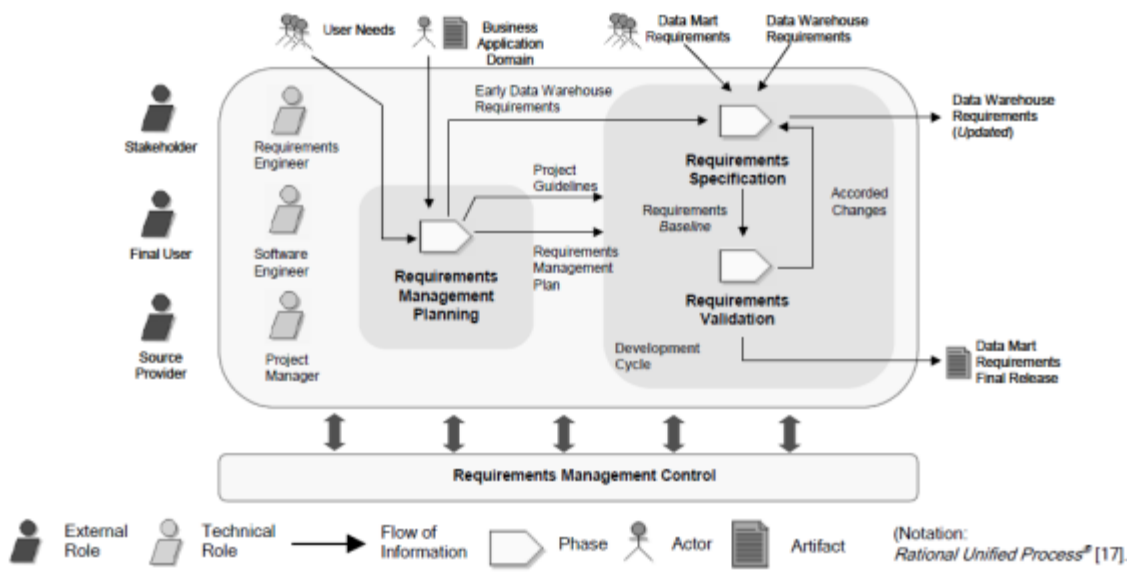



***Figure 47 -Phase-Oriented Framework of the DWARF Technique (source: Rilston et al. 2003)***

- **Requirements Management Planning**: In this phase, some guide to assure the effective requirements engineering process are set, these rules will guide the correct implementation of the DWARF techniques, avoiding inconsistencies in acquisition, documentation and management activities. Guidelines can be defined in terms of business rules, procedures and processes commonly agreed to clarify, among others, Multidimensional Requirements Focus, Source Integration Premises and Project Objectives.
- **Requirements Specification**: this second phase underpins a cyclic approach of acquisition, representation and evaluation of requirements to gradually yield a system specification. Taking the initial elicited (raw) requirements as an starting point, during this phase, a sequence of iterations where initial requirements are analysed, negotiated, registered and conformed to a broader data warehouse specification. This phase encompasses some sub-processes:
    - **Requirements elicitation:** The objective of this phase is to discover requirements by several ways: communicating with stakeholders, describing the systems interaction with counterparts, simulating behaviour, investigating architectural trade-off. For elicitation, several techniques can be applied: Interviews, Workshops, Prototyping, Use cases, Non-Functional Requirements.
    - **Requirements Analysis & Negotiation**: In this phase, initial requirements are put into an analysed aimed to assure that specifications accomplishes some requirements regarding: quality standards, multidimensional constraints, tool restrictions and integration premises.
    - **Requirements Documentation**: These phase deals with the fulfilment of templates to register all data warehouse functional, non-functional and domain specific requirements which are based in similar model proposed in the Rational Unified Process. These templates include: Requirements Management Plan, Project Glossary, Data Warehouse Vision, Data Mart Vision, Use Cases Specification, Multidimensional Requirements Specification, Non-Functional Requirements Specification, Business Rules Specification and Revision Report.
    - **Requirements Conformance**: This phase is inherent to data warehouse specifications and deals with assuring resilience to an evolving requirements scheme.
- **Requirements Validation**: This phase is in charge of correcting the last remaining misunderstanding and misconceptions.
- **Requirements Management Control**: This last phase deals with traceability and change management. This phase helps to evaluate and integrate changes in requirements easier.

***Relevance of DWRAF to the FITMAN's D1.1. deliverable**: Again we find ourselves with a methodology that defines an iterative approach to requirements definition. This comes to reinforce the data gathering approach defined for the D1.1. where trials responsible (end users and It providers) are contacted for information depuration and misunderstandings clarifications.*

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