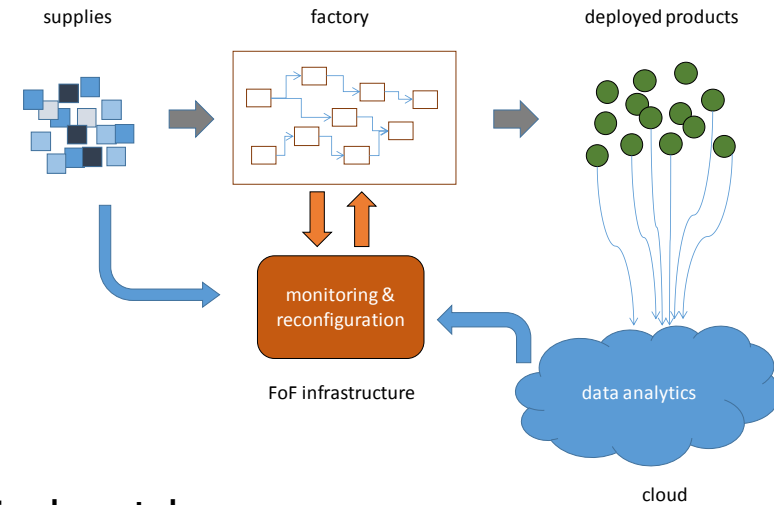# Cloud-based Situational Analysis for Factories providing Real-time Reconfiguration Services

Motivation

- **Manufacturing of products becomes increasingly complex and needs to be flexible**
  - ◆ Increasing diversity of products & product use
  - ◆ Demand for more customised products
  - ◆ Shorter time-to-market requirements

- **Product use and production activities are often separated**
  - ◆ Low efficiency
  - ◆ High costs

Optimisations are required to face these problems

- **Some of these optimisations can be carried out by**
  - ◆ Adjusting production control parameters
  - ◆ Reconfiguration of products

supplies   factory   deployed products

monitoring & reconfiguration

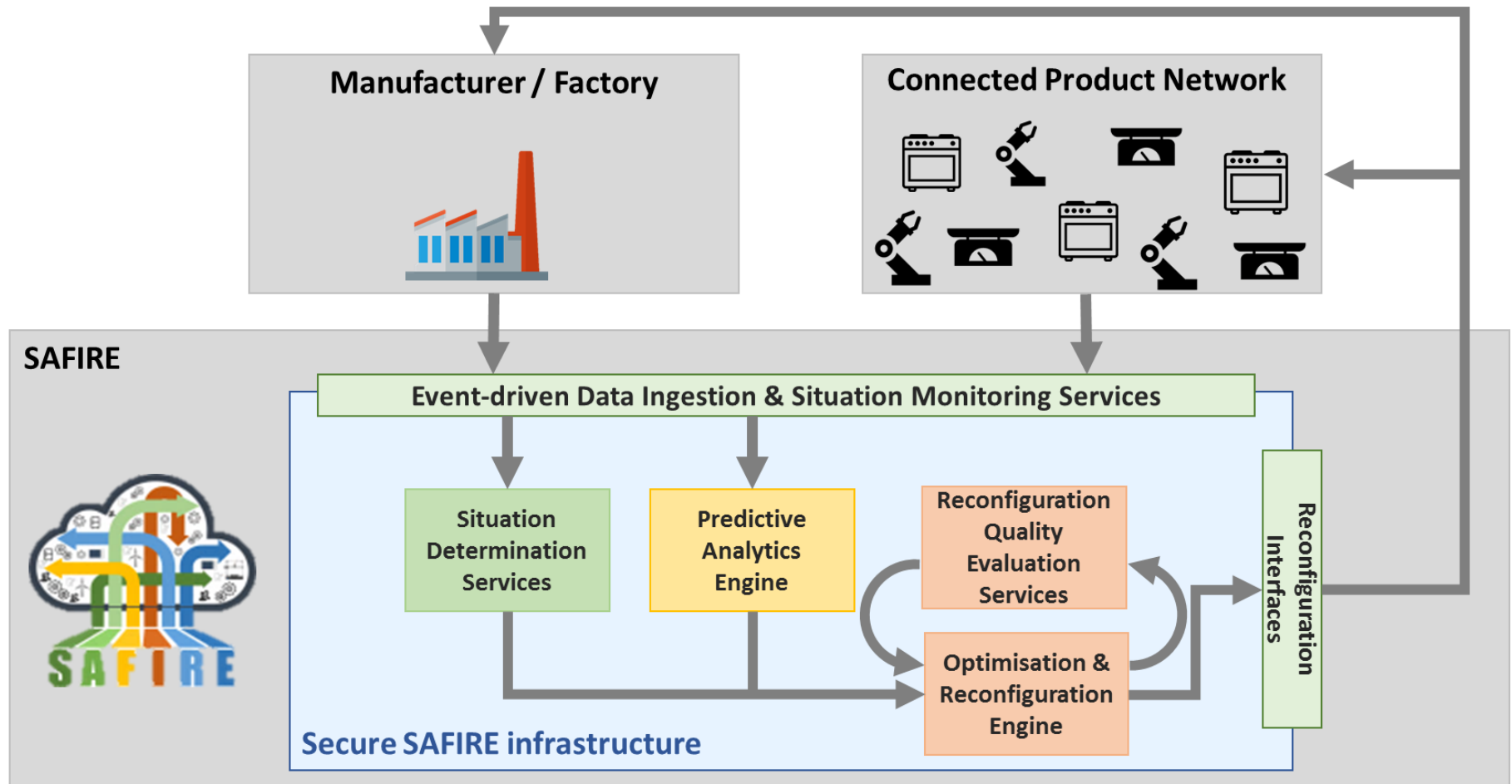FoF infrastructure   data analytics

cloud

Project Objectives

- **Methodology for reconfiguration and optimisation of products and factories based on predictive big data analytics**
  - Address technical and organisational issues for extension and introduction of tools and services
  - Emphasising security, privacy & trust

- **Set of tools and services to support**
  - Predictive big data analytics
  - Dynamic reconfiguration and optimisation
  - Situational awareness
  - Cloud resource management

- **Cloud-based secure infrastructure**
  - SAFIRE infrastructure will be an add-on for existing production systems or next generation smart factory operating systems

SAFIRE Concept

Manufacturer / Factory

Connected Product Network

SAFIRE

Event-driven Data Ingestion & Situation Monitoring Services

Situation Determination Services

Predictive Analytics Engine

Reconfiguration Quality Evaluation Services

Optimisation & Reconfiguration Engine

Reconfiguration Interfaces

Secure SAFIRE infrastructure

Consortium Partners

THE Open GROUP
United Kingdom

ATB Institut für angewandte Systemtechnik Bremen GmbH
Germany

IK4 IKERLAN
Research Alliance
Spain

UNIVERSITY of York
United Kingdom

Electrolux
Italy

OAS
AKTIENGESELLSCHAFT
Germany

ONA
Spain

Technical Objectives

- Targeting two technology challenges for factories of the future for improving production, products and services

  - **Interconnected Systems of Production Systems**

  - **Connected Product Networks**

- Key objective is to develop cloud-based analytics and reconfiguration capabilities

  - Reactive and predictive reconfiguration for production systems and smart products

  - Flexible run-time reconfiguration decisions during production rather than pre-planned at production planning

  - Real-time reconfiguration decisions for optimisation of performance and real-time production and product functions

Relations to previous projects

♦ Explored how context awareness can be used to assure both self-adaptation of production systems, with integrated control & maintenance, and quality of software services implementing self-adapting solutions

♦ Provided a novel methodology and a comprehensive ICT solution for collaborative design of product-services and their production processes

♦ Addressed dynamic resource allocation in many-core embedded and high performance systems while providing appropriate guarantees on performance and energy efficiency


♦ Created a Java Platform that can support a range of high performance Big Data driven application domains that seek real-time processing of streaming data, or real-time access to stored data
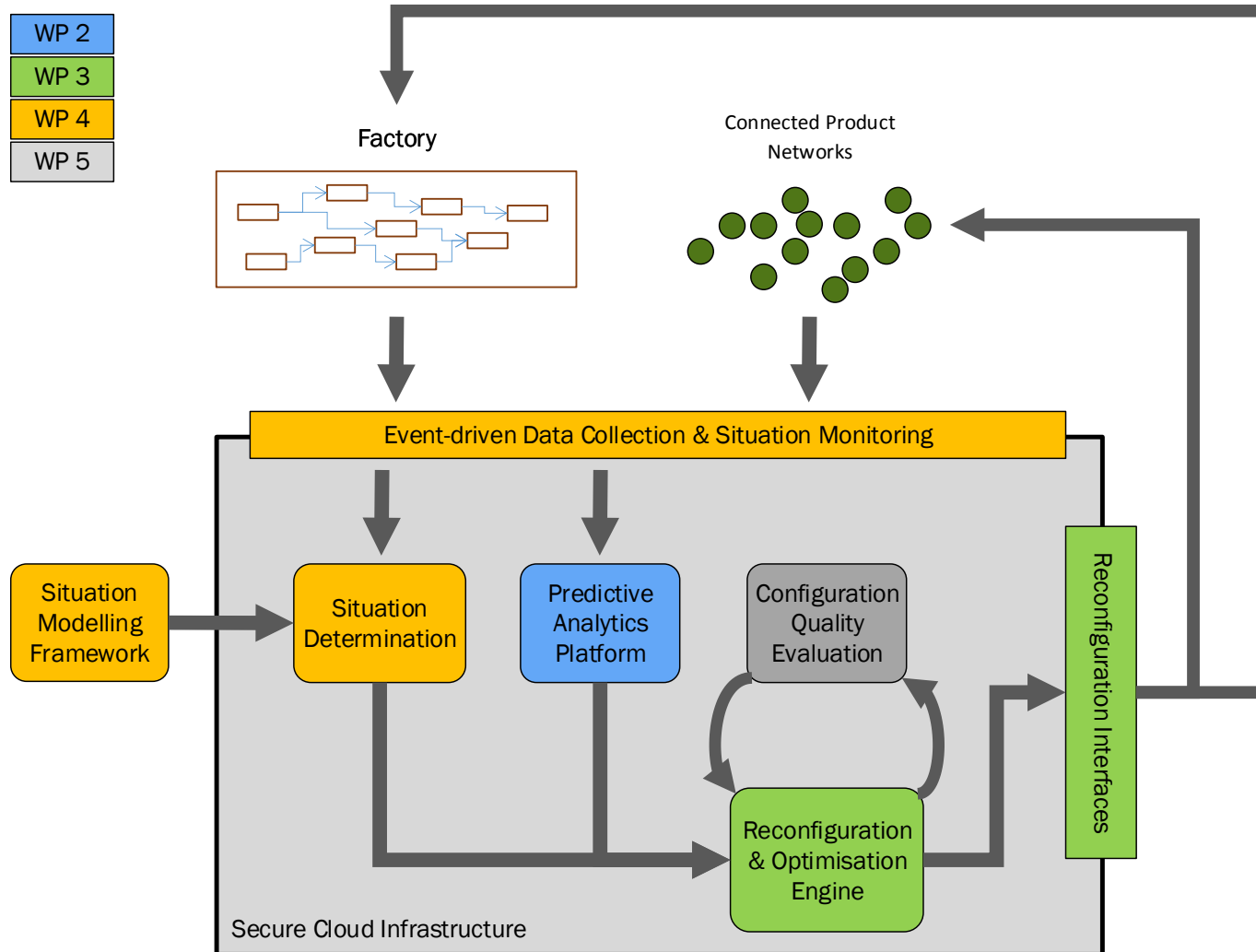
Technical Concept

- Situation Modelling and Situation Awareness technologies

- Reconfiguration and Optimisation technologies

- Predictive Analytics technologies

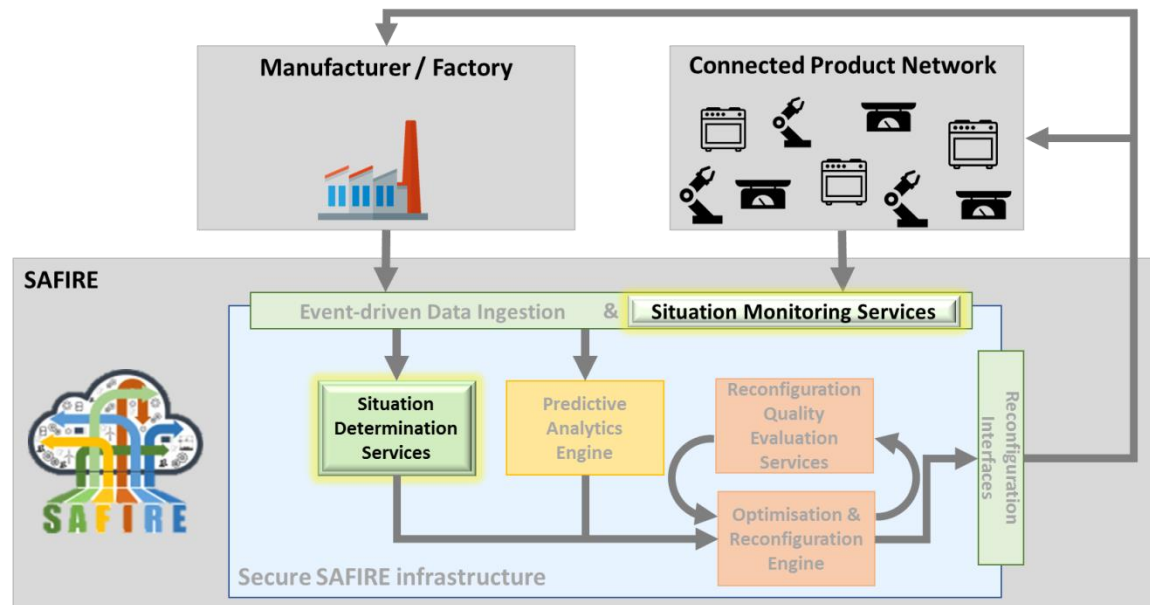- Security, Privacy and Trust technologies
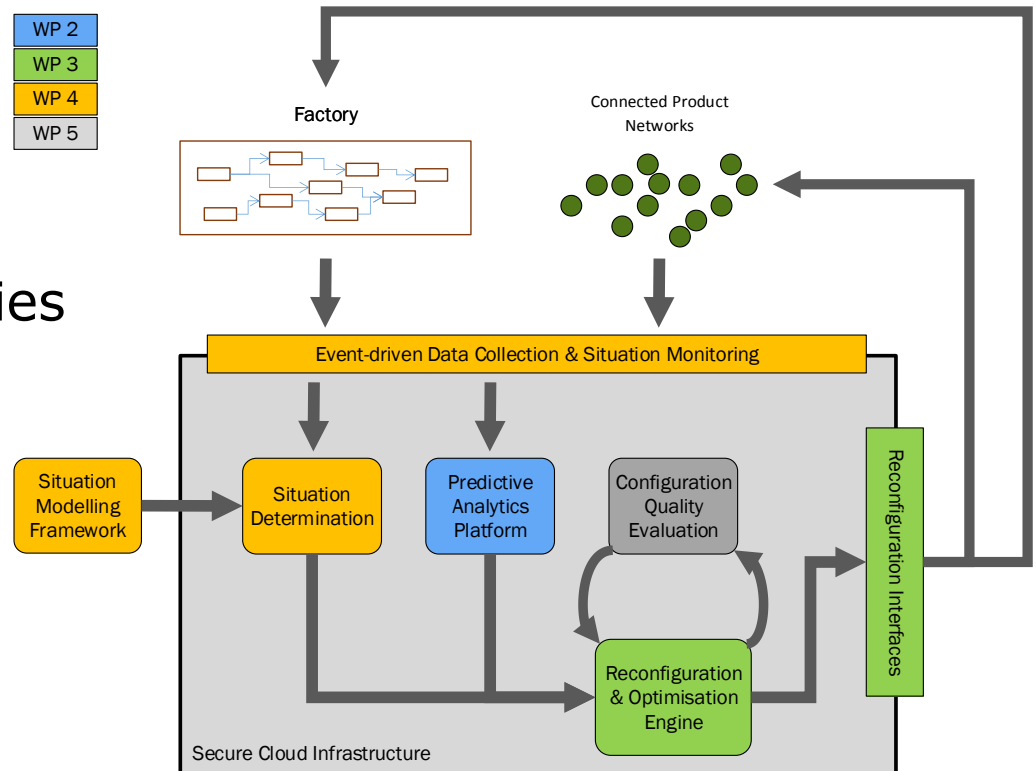
Technical Concept

# Situation Modelling and Situation Awareness technologies

Situational Awareness

- Analyses correlations between production and products including situational information to dynamically monitor and identify situations based on process information from various sensors, products and databases

- Analysis results make it possible to adapt configurations to specific factory and product situations

Predictive Analytics technologies


Predictive Analytics
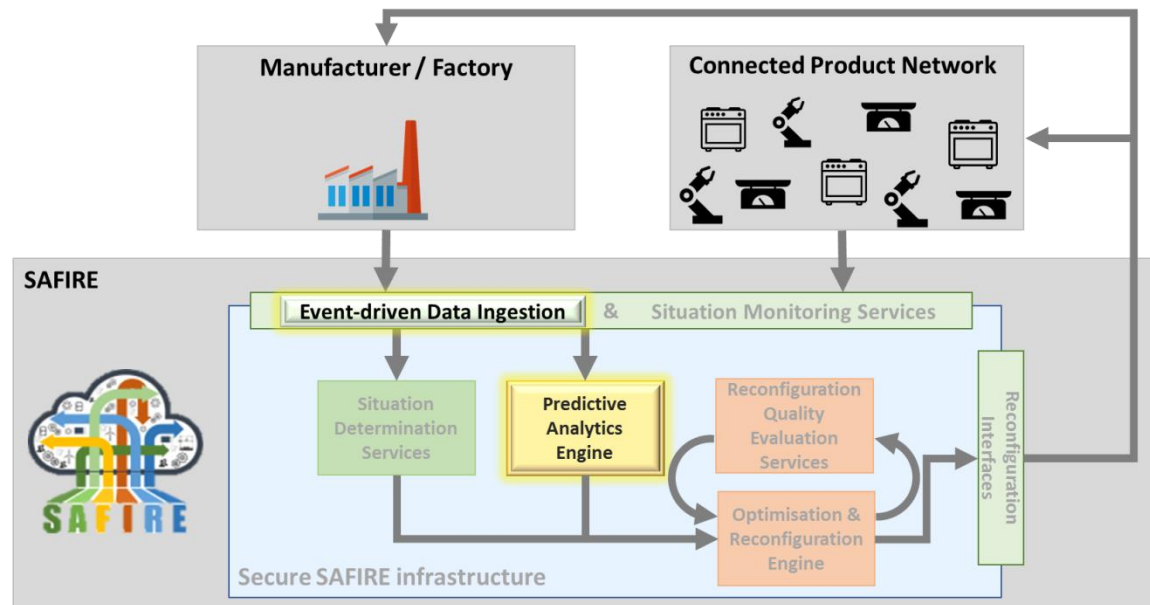
- Provides support for real-time big data analytics based on the Lambda+ architecture offering data aggregation, filtering, mapping, storage and processing

- The engine is capable of using machine learning algorithms to extract valuable knowledge and provide tolerance to failures enabling continuous operation despite hardware or software failures

Reconfiguration and Optimisation technologies

Optimisation / Reconfiguration
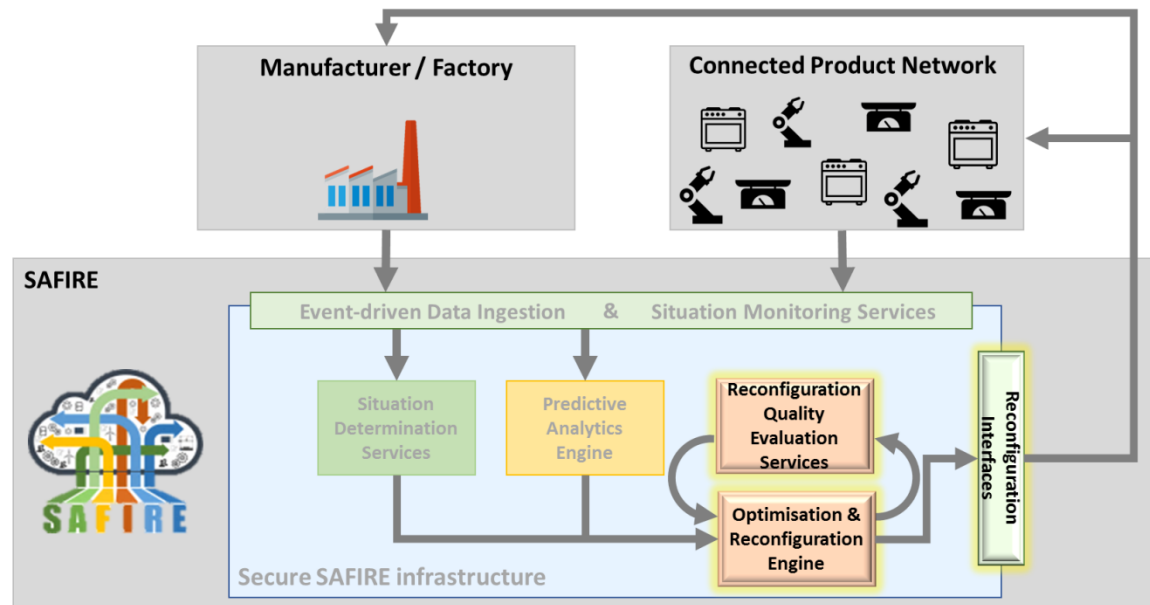
- Delivers reactive and predictive optimisations of production assets and product configurations within real-time constraints

- The engine calculates new configurations that meet required system metrics including real-time constraints, communications bandwidths and latencies, power dissipation, maintenance cycles, and optimised reconfigurations are sent to connected production assets and products

Security, Privacy and Trust technologies
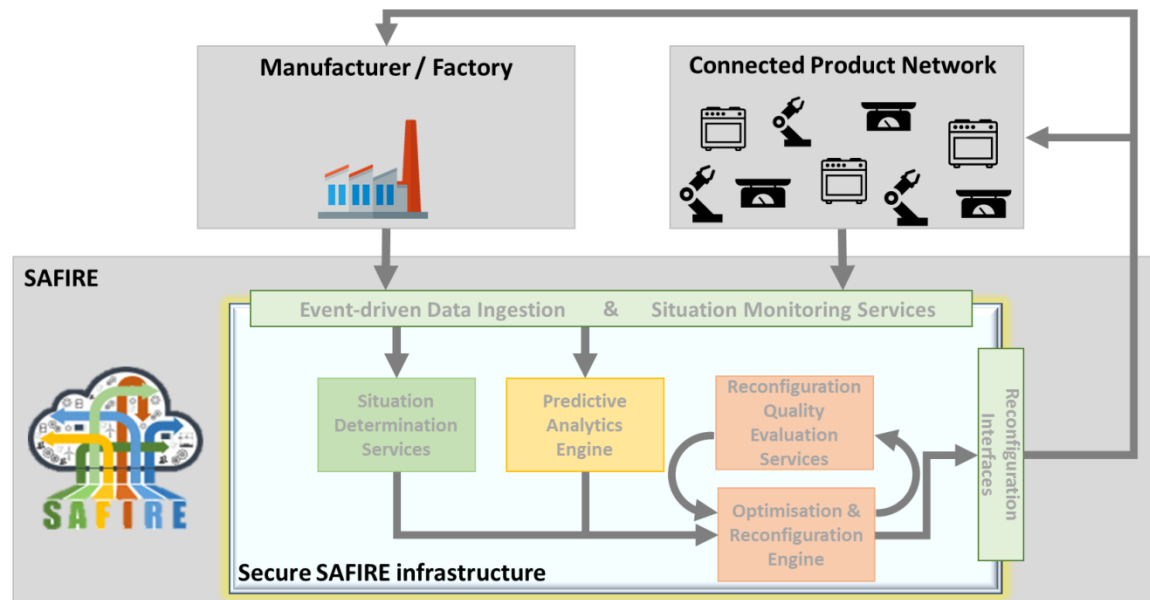
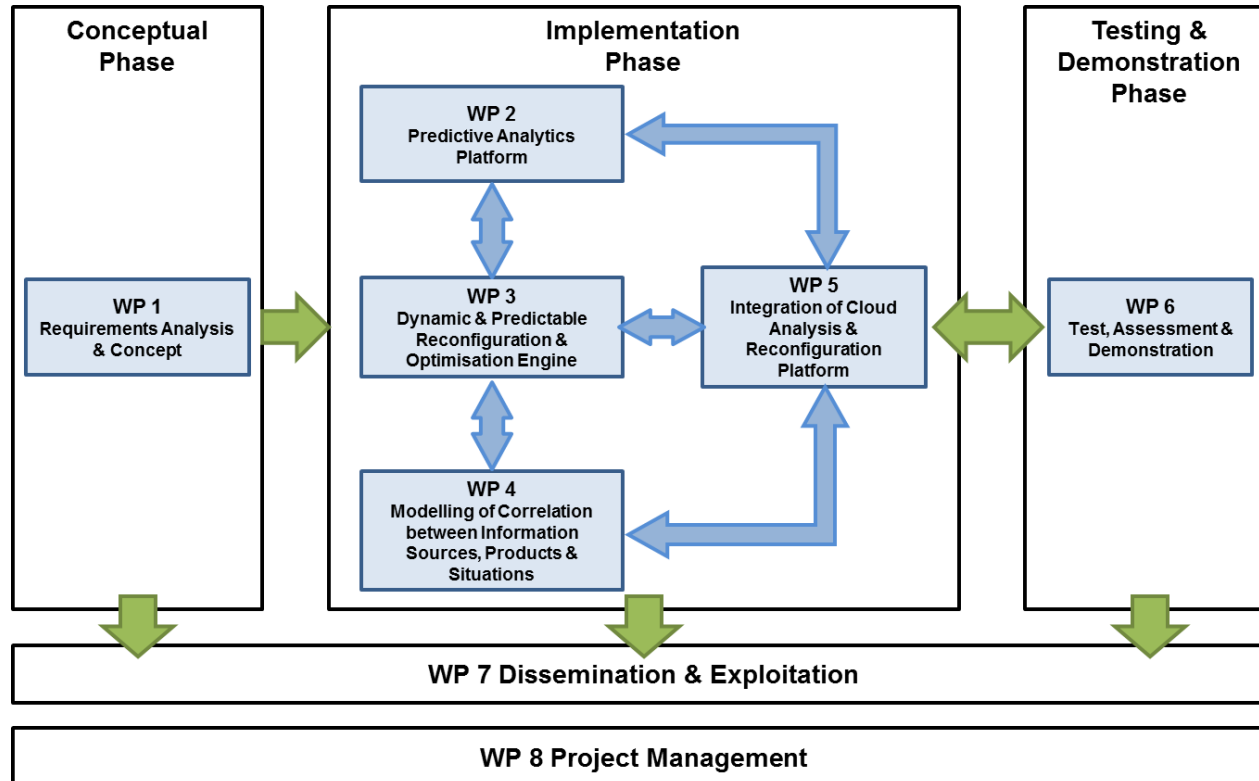- A Security, Privacy, and Trust Framework that enables the identification of security requirements, prioritisation of security objectives and selection of technologies for implementation

- Security services builds an overall solution delivering security, privacy and trust for production and product data and authentication and verification services to ensure the integrity of optimised configurations

Workpackage Structure

Conceptual Phase

WP 1
Requirements Analysis & Concept

Implementation Phase

WP 2
Predictive Analytics Platform

WP 3
Dynamic & Predictable Reconfiguration & Optimisation Engine

WP 5
Integration of Cloud Analysis & Reconfiguration Platform

WP 4
Modelling of Correlation between Information Sources, Products & Situations

Testing & Demonstration Phase

WP 6
Test, Assessment & Demonstration

WP 7 Dissemination & Exploitation

WP 8 Project Management

- **Tasks Timeline**
  - ♦ Methodologies (M7-21)
  - ♦ Specifications (M7-24)
  - ♦ Prototypes (M10-27)
  - ♦ Integration (M13-36)

- **Deliverables**
  - ♦ March 2018: Early Specifications
  - ♦ June 2018: Methodologies and Early Prototypes
  - ♦ September 2018: Final Specifications
  - ♦ December 2018: Full Prototypes
  - ♦ September 2019: Full Industrial Assessments

Manufacturing Assessments

Electrolux

- Products connected to a cloud-based system can be optimised through a reconfiguration process i.e. Cloud-driven product optimisation

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- Optimise production processes and preventive maintenance activities through reconfiguration of processes based on Big Data analysis in the Cloud

ONA

- Improvements in Adaptive Machining, Part Quality and Sustainability, based on analysing machine usage behaviour compared to nominal machine usage behaviour

Expected Project Impacts

- **Machine/Product differentiation through reconfiguration features**
  - Machine/Product interconnection extension
  - Machine/Product digitalisation
  - Machine/Product optimised through a reconfiguration process

- **Adaptive machining capability**

- **Reconfiguration process generates new knowledge for new optimised Machine/Product Design**

- **Manufacturing quality improvement through automated reconfiguration process**

- **Sustainability improvements during machine use with reconfiguration capability**

- **Machine integration in new environments with reconfiguration features**

- **Third-party Apps development around machines and products**

- **New business opportunities around reconfiguration services**

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More info: www.safire-factories.org