D2.3 – Report on Business Viewpoint

WP2 – WP DESIGN: I4Q Framework Design

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	- D2.5 Report on Functional Viewpoint (M9) - D2.6 Report on Implementation Viewpoint (M9) - D2.7 i4Q Reference Architecture and Viewpoints Analysis v2 (M9)
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ABSTRACT	Concerning the i4Q Reference Architecture definition, different perspectives (viewpoints) have been analysed. The main objective of T2.3 is to provide, within the i4Q design activities, a business point of view so as to avoid the risk of a 'technology-centric' approach. To this end, with regard to IIRA approach, business analysis was performed. As stated in the viewpoints' methodology, the task focused on framing stakeholders' identification and point of view, and their vision, values and key objectives. Stakeholders were defined taking into account two mainly perspectives: a global view of a company's processes, to identify the main business areas of interest for i4Q Solutions and the relevant actors they are connected to; the level of 'involvement' and participation of actors with respect to the development and use of i4Q Solutions. The identification was also based on business partners' and technical providers' feedback, captured through the submission of dedicated questionnaires, following an iterative approach. This assessment allowed to identify the capabilities and recommendations for the consortium technical team, which provide the basis for usage, functional and implementation analysis in order to develop i4Q RIDS.

Document History

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS/ACRONYMS

AI	Artificial Intelligence
B2B	Business-to-Business
B2C	Business-to-Consumer
CIM	Computer Integrated Manufacturing
EC	European Commission
EU	European Union
ERP	Enterprise Resource Planning
GDPR	General Data Protection Regulation
ICT	Information and Communication Technologies
IEC	International Electrotechnical Commission
IIAF	Industrial Internet Architecture Framework
IIC	Industrial Internet Consortium
IIoT	Industrial Internet of Things
IIRA	Industrial Internet Reference Architecture
ISA	Internation Society of Automation
MES	Manufacturing Execution System
MOM	Manufacturing Operations Management
MO&C	Manufacturing operations and control
NIS	Network and Information Systems
PMI	Project Management Institute
RA	Reference Architecture
RIDS	Reliable Industrial Data Services

Executive summary

i4Q Project aims to provide a complete set of solutions consisting of **IoT-based Reliable Industrial Data Services (RIDS)**, the so called 22 i4Q Solutions, able to manage the huge amount of industrial data coming from cheap cost-effective, smart, and small size interconnected factory devices for supporting manufacturing online monitoring and control.

One of the challenges in implementing quality control processes and solutions is the development of the **i4Q Reference Architecture (i4Q RA)** for industrial data services in smart manufacturing, based on innovative technologies and on relevant sector-specific standards.

For this purpose in the Work Plan, WP2 aims at providing a holistic approach to the design of the i4Q Framework, based on a clear and detailed Reference Architecture for i4Q. The first version of i4Q RA was delivered at M3 in D2.1 "i4Q Reference Architecture and Viewpoints Analysis"; the second final version of RA is in progress, and the reference framework will be then described using multiple perspectives, such as the viewpoints related to business, usage, functional and implementation.

The i4Q RA is not designed from scratch, being strongly based on the most relevant outcomes of other previous Research and Innovation activities and releases of International Communities. As presented in D2.1 the preliminary version of the i4Q RA is mainly inspired by IIRA architectural model, based on the three-tiers approach.

According to IIRA approach, the task of i4Q RA definition will be performed in parallel with those of its viewpoints analysis, namely T2.3 "Business Viewpoint", T2.4 "Usage Viewpoint", T2.5 "Functional Viewpoint", T2.6 "Implementation Viewpoint"; viewpoints offer a framework to think iteratively through the architectural issues that may arise during its conception.

The main objective of T2.3 is to provide, within the i4Q design activities, a business point of view so as to avoid the risk of a 'technology-centric' approach. This will allow us to incorporate already in the (early) design requirements and needs that are closer to real-world, operation needs.

To this end, a preliminary analysis concerning the main elements in IIRA approach was performed. As stated in the viewpoints' methodology, the task focused on framing stakeholders' identification and point of view, and their vision, values and key objectives. This assessment allowed to identify the capabilities and recommendations for the consortium technical team to develop i4Q RIDS. **Stakeholders** were defined taking into account two mainly perspectives: a global view of a company's processes, in order to identify the main business areas of interest for i4Q Solutions and the relevant actors they are connected to; the level of 'involvement' and participation of actors with respect to the development and use of i4Q Solutions.

After having identified the main stakeholders for the i4Q RIDS, they were examined to define their vision and objectives, both technical and business, to derive the functional capabilities and recommendations that will have to be considered in defining solutions' features.

To enhance the effectiveness of the task, focused input from experienced business partners closer to the industry and also technology providers was captured through the submission of dedicated questionnaires, following an iterative approach.

Deliverable D2.3 “Report on Business Viewpoint” summarises the achievements deriving from this business analysis in the context of i4Q Reference Framework Design.

All of the information gathered in this deliverable will lay the groundwork for future project steps, with specific attention to Usage Viewpoint analysis and definition of the Reference Architecture.

Document structure

Section 1 Methodological Approach: Definition of the activity approach, based on Viewpoints concepts according to IIRA: business, usage, functional, implantation viewpoint.

Section 2 Business Viewpoint: Analysis of the main elements that characterise the business viewpoint according to IIRA. The stakeholder investigation, which represents the starting point, is approached according to a twofold perspective: business processes that describe a company in order to understand the operating scenario, and the degree of participation of the actors involved in the processes. On the basis of these two directions, the stakeholders of the i4Q RIDS are identified. Finally, the methodology that will be adopted for the analysis of these stakeholders is presented.

Section 3 Vision and Value-Driven Model for i4Q RIDS: Based on the identified stakeholders and the presented methodology, a detailed analysis of all i4Q RIDS stakeholders is carried out to identify their vision, values, business and technical objectives, functional capabilities and recommendations.

Section 4 Conclusions: Activities planned for the next periods are reported in terms of links and synergies with other viewpoints.

1. Methodological Approach

As we stated in D2.1 "Reference Architecture and Viewpoints Analysis", a reference architecture provides guidance for the development of the system, solution, and application architectures. It provides common and consistent definitions for the system of interest, its decompositions and design patterns, and a common vocabulary with which to discuss the specification of implementations and compare options. Based on analysis performed in D2.1, i4Q Reference Architecture (RA) is mainly inspired by Industrial Internet Reference Architecture (IIRA).

The IIRA is a standards-based open architecture for IIoT systems. The IIRA maximizes its value by having broad industry applicability to drive interoperability, map applicable technologies, and guide technology and standard development. The architecture description and representation are generic and at a high level of abstraction to support the requisite broad industry applicability. The IIRA distils and abstracts common characteristics, features and patterns from use cases defined in the IIC (Industrial Internet Consortium) as well as elsewhere. It will be refined and revised continually as feedback is gathered from its application in the testbeds developed in IIC as well as real-world deployment of IIoT systems.

The IIRA documents the outcome of applying the Industrial Internet Architecture Framework (IIAF) to its intended class of systems of interest: Industrial Internet of Things (IIoT) systems. It adopts the general concepts and constructs in the ISO/IEC/IEEE architecture specification, specifically, concern, stakeholder, and viewpoint as its architecture frame, and views and models as its architecture representation in describing and analyzing important common architecture concerns for IIoT systems.

The core of the IIRA methodology lies in a set of system conceptualization tools called viewpoints that enable architects and engineers to identify and resolve key design issues. Thus, the IIRA design starts with defining the shapes and forms of an Industrial Internet of Things Architecture by starting with the viewpoints of the stakeholders. These IIRA viewpoints are arranged in a particular order to reflect the pattern of interactions that occurs between them because the decisions from a higher-level viewpoint impose requirements on the viewpoints below it (IIC, 2019).

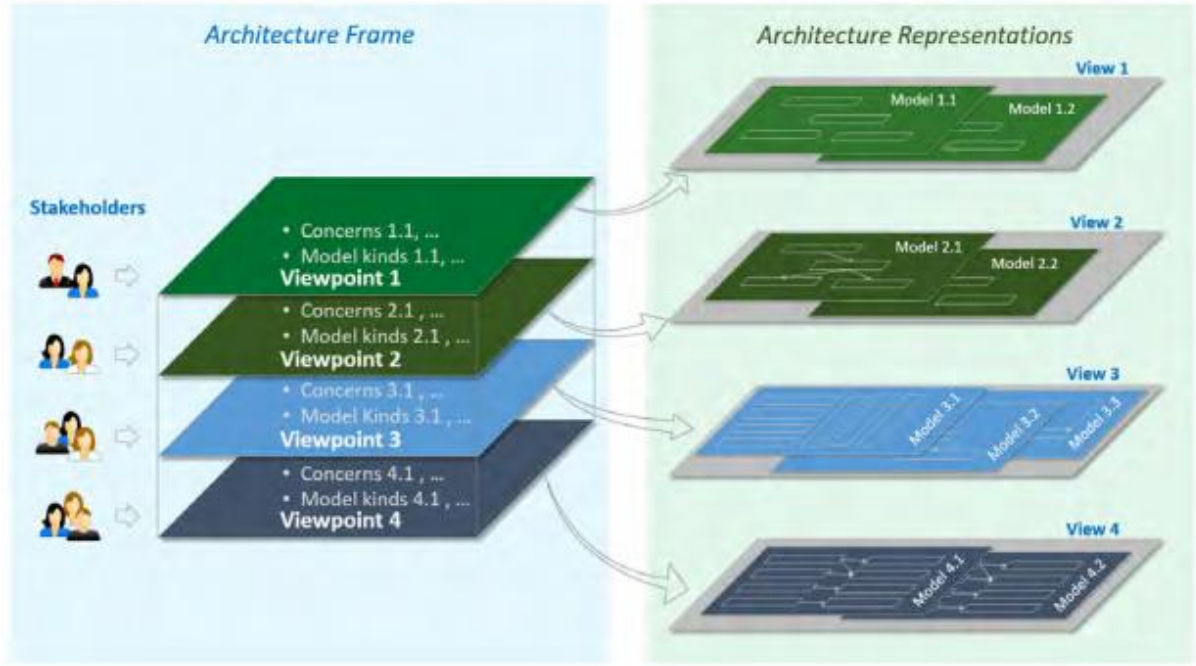

Figure 1. IIRA Architecture Framework

i4Q approach exactly reflects this methodology: the RA is based on viewpoints defined according to an iterative synergic approach, detailed in next paragraphs.

1.1 Viewpoints

The IIRA viewpoints are defined by analyzing the various IIoT use cases developed by the IIC and elsewhere, identifying the relevant stakeholders of IIoT systems and determining the proper framing of concerns.

The four viewpoints are:

- Business Viewpoint
- Usage Viewpoint
- Functional Viewpoint
- Implementation Viewpoint

As shown in **Figure 2**, these four viewpoints form the basis for a detailed viewpoint-by viewpoint analysis of individual sets of IIoT system concerns.

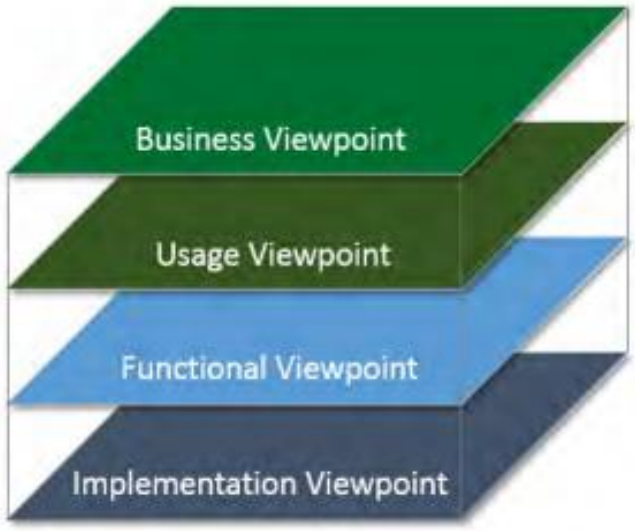

Figure 2. Industrial Internet Architecture Viewpoints

The i4Q RA will incorporate all the relevant perspectives (which in i4Q we also call 'viewpoints') involved in the smart manufacturing process and in particular related to addressing the data reliability challenges in turn related to the smart manufacturing, high quality production process. i4Q RA will be structured around four viewpoints in order to offer a framework to think iteratively through the architectural issues that may arise during its conception. According to IIRA, which focuses on the capabilities from the perspective of the software and their business processes, main characteristics of viewpoints which will drive the refinement and implementation of the i4Q Reference Framework are summarised as follows (IIC, 2019):

- The business viewpoint, which identifies the stakeholders that engage in the development, deployment and operation of an IoT system, including their business vision and objectives. The business viewpoint takes into account the overall business and regulatory context, in which the IoT system operates.
- The usage viewpoint, which specifies the actual usage of the IoT system. This usage is illustrated based on sequences of activities that may be performed by human actors and/or logical components (e.g., system or system components).
- The functional viewpoint, which specifies the functionalities of the IoT system. To this end, it illustrates the functional components that comprise an IoT system along with their interfaces and interactions. It also presents any interactions with external logical modules (e.g., external subsystems).
- The implementation viewpoint, which comprises the implementation technologies that are used to implement the functional components, along with information about their lifecycle and the realization of the communication between them.

1.2 Viewpoints Iterations and Validation

The order in which the business, usage, functional and implementation viewpoints are arranged, from top to bottom, as depicted in **Figure 2**, reflects a general interaction pattern between the viewpoints. Broadly speaking, decisions from a higher-level viewpoint guide and impose

requirements on the viewpoints below it. For example, the decisions resulting from the business viewpoint has a direct influence on the deliberations in the usage viewpoint and so forth. On the other hand, the deliberation of the concerns in a lower viewpoint, including implementing requirements from the viewpoints above it, validate and in some cases cause revisions to the analysis and possibly the decisions in the viewpoint above it. For example, the deliberation in the usage viewpoint may validate if some of the fundamental system capabilities proposed in the business viewpoint can be realized. Therefore, the development of the viewpoints must be done collaboratively and iteratively to guarantee this interaction pattern is implemented.

To this end, a common iteration and validation procedure has been developed and applied to all the viewpoints development and will be taken forward till the final definition of all the i4Q viewpoints at M9. The development of each viewpoint follows an incremental and iterative approach where different iterations are foreseen. At each iteration (sprint) successive refinements and increments are done.

Each sprint starts with a sprint planning event in which a sprint goal is crafted. This event involves all the partners engaged in the viewpoints development included in the sprint and it is also a key step for the alignment of the viewpoints to guarantee the interaction pattern foreseen by IIRA.

Each sprint ends with a sprint validation, where the viewpoints are released and the feedback is elicitated, and a sprint retrospective, where the lessons and the improvement for the following iteration are identified for each viewpoint. Each sprint lasts 20 days from the planning meeting to the retrospective.

The sprint validation is performed by an Experts' panel formed by a representative from pilots and technology providers partners. A simple survey is prepared to collect feedback and suggestions, the aim is to validate the work done during the sprint development, clarify doubts and collect information useful for the following sprint. The survey contains simple questions relevant to the development of viewpoints in the current and following sprints. It is implemented using Google Forms[1].

After the presentation of the main achievement of the sprint, the survey is sent to the panel. The first version of the questionnaire is reported in Annex. The answers are analysed by the viewpoints development team providing insights for both the retrospective and the following sprint planning meeting. The representation of the Viewpoints Sprint Cycle is shown in **Figure 3**.

[1] https://www.google.com/forms/about/

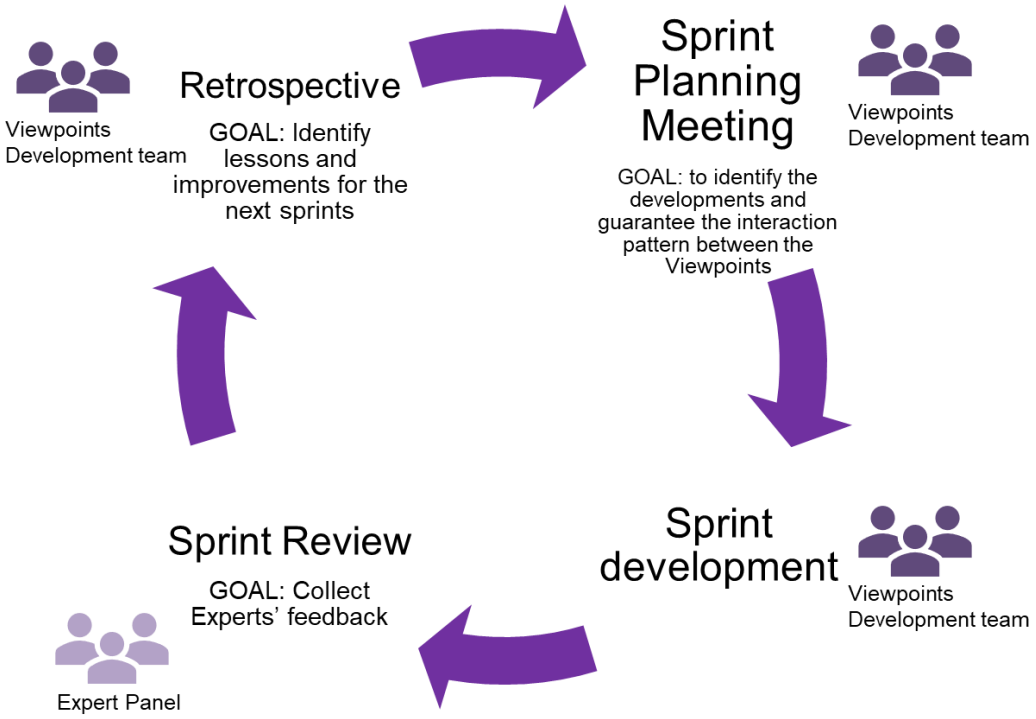

Figure 3. Viewpoints Sprint Cycle

Following IIRA principles and the Viewpoint iteration process described above, a plan for the development of the Viewpoints has been designed and agreed upon between the Viewpoint Development Team. The development of the viewpoints started from the Business Viewpoint (in line also with the tasks of the GANNT) allowing identifying the stakeholders and the essential ability of the i4Q RIDS. The other Viewpoints have taken place in the following iterations. Each Viewpoint is implemented in three complete sprints, by delivering four versions till the final release. The first iteration includes only the Business Viewpoint, the second one the Business and the Usage Viewpoints, while during the third one all Viewpoints are developed as represented in **Figure 4**.

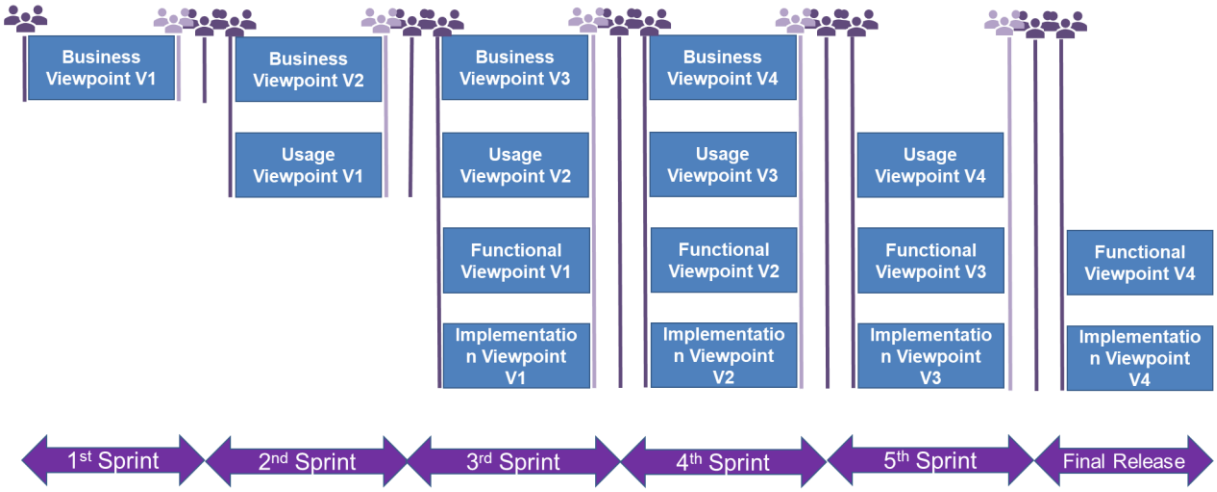

Figure 4. Viewpoints Development Plan

2. Business Viewpoint

The Business Viewpoint provides a high-level, yet specific description of the processes that characterize human services operations. A typical process description mainly includes involved stakeholders, activities and actions, information flow and interactions between processes. One audience for this viewpoint is the developers of the other Viewpoints; in particular we refer to those who are charged with developing strategies and plans for providing architectures and systems.

In fact, this viewpoint defines actors, objectives and main capabilities that motivate the services identified in the other Viewpoints and the information exchanges identified in the Information Viewpoint.

As explained in sections below, the i4Q business viewpoint:

- provides a characterization of business operations that applies across several companies;
- highlights common processes and opportunities for information sharing and re-use;
- captures the basic functionality of human services operations and suggests how processes could be adapted to leverage these capabilities.

2.1 IIRA key concepts

In the RA definition, one of the main objective is to avoid the risk of a "technology-centric"' approach; for this reason, the viewpoints' definition started with the analysis of a business point of view. This has allowed incorporating already in the (early) design requirements and needs that are closer to real-world, operation needs.

According to IIRA approach, the business viewpoint has been defined in this task and focused on framing the stakeholders, vision, values, and key objectives (IIC, 2019).

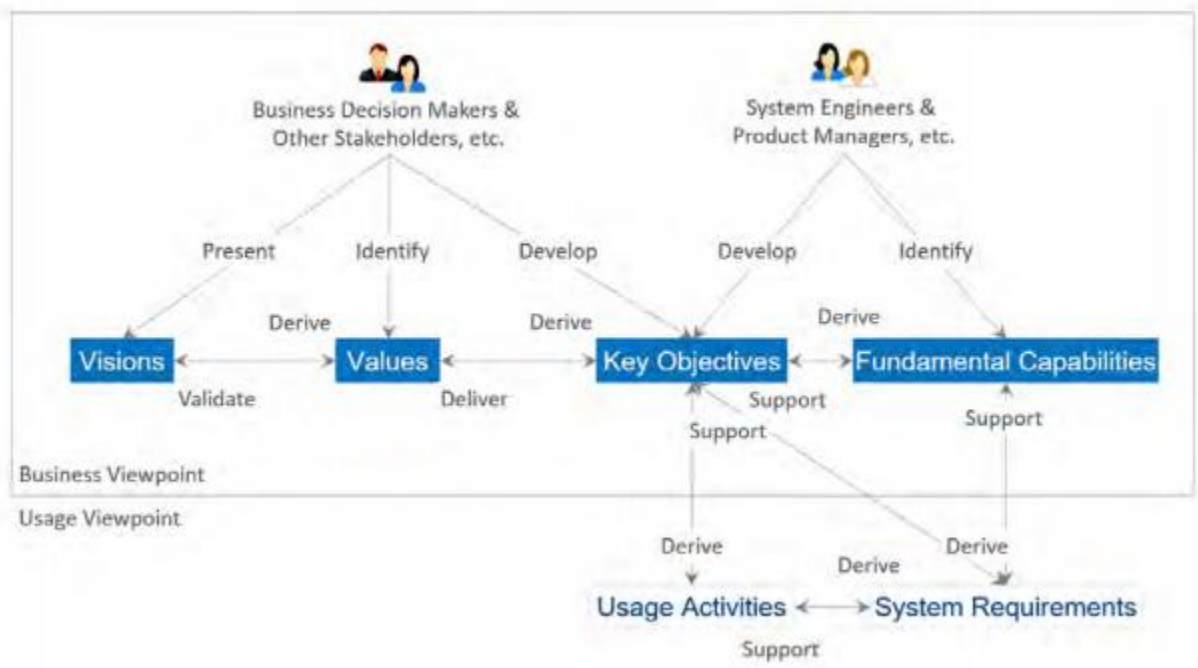

Figure 5. Vision and Value-Driven Model *(IIC, 2019)*

Stakeholders have a major stake in the business and a strong influence in its direction. It has been important to identify major i4Q stakeholders and engage them early in the process of evaluating the business-oriented concerns that i4Q Solutions must address. So, in conceptualizing and defining the i4Q Solutions, technological and business factors have been considered, including external influences from technological trends, specific market condition and potential, customer inputs, and regulatory requirements (in the areas of, e.g., safety, privacy, environmental and labour).

According to IIRA two main types of stakeholders have to be identified:

- Business Decision-Makers, defining the business objectives;
- Product Managers and System Engineers, defining the technical goals and functional capabilities needed to reach the business objectives.

Business-oriented concerns such as business value, expected return on investment, cost of maintenance and product quality have been investigated and connected to technical evaluations for the i4Q RIDS to solve business problems.

For the business viewpoint definition, starting from stakeholders' classification main elements have been considered:

- **Vision**, describing a future state of an organization or an industry, including the business direction toward which an organization executes and providing values reflecting how the vision may be perceived.
- **Values**, reflecting how the vision may be perceived by the stakeholders involved in funding the implementation of the i4Q Solutions as well as by the users of the resulting project tools.

- **Key objectives**, quantifiable high-level technical and ultimately business outcomes expected of the i4Q Solutions in the context of delivering the values.
- **Fundamental capabilities**, referring to high-level specifications of the essential ability of the i4Q Solutions to complete specific major business tasks. Key objectives are the basis for identifying the fundamental capabilities. Capabilities are specified independently of how they are to be implemented (neutral to both the architecture and technology choices) so that system designers and implementers are not unduly constrained at this stage.

For the i4Q objectives, both types of stakeholders (business and technical) have been analysed in different phases to identify these fundamental elements.

Output in terms of objectives and functional capabilities represent the input for the Usage Viewpoint analysis.

2.2 Stakeholder identification

In order to identify stakeholders, which represent one of the most important elements characterising the business viewpoint definition, two mainly perspectives have been considered: a global view of a company's processes, in order to identify the main business areas of interest for i4Q Solutions and the relevant actors they are connected to; the level of 'involvement' and participation of actors with respect to the development and use of i4Q Solutions.

2.2.1 Business processes analysis

Business Viewpoint artifacts include an evaluation of business areas and business processes relevant for the solutions application.

Analysis of business activities is extremely relevant in terms of stakeholders' identification; stakeholders involved in each business process must be specified in order to have a clear overview of who is involved in processes and must be accounted for by access and confidentiality services provided by i4Q RIDS.

To develop this analysis, the business viewpoint activity started from relevant achievements in T2.2 and its output D2.2 "Digital Models and Ontologies". According to the survey performed in this deliverable and the state of the art of standards potentially relevant for i4Q, the attention for the business viewpoint definition focused on ISA-95.

ISA-95 is the international standard for the integration of enterprise and control systems; it consists of models and terminology. Its official name is "ANSI/ISA-95 Enterprise-Control System Integration" (known internationally as IEC/ISO 62264). Leveraging this standard can bring company-wide perspective to system integration that allows to take thousands of actions and data points and boil them down in an understandable framework. It focuses on activities - and it is meant to define and integrate the activities between business and ERP (Enterprise Resource Planning) on one hand and MES (Manufacturing Execution System), MOM (Manufacturing Operations Management) and operations management on the other. The standard even covers the detailed level of sensors and the physical processes.

The ISA-95 standard can be used for several purposes, for example as a guide for the definition of user requirements, for the selection of MES suppliers, or as a basis for the development of MES systems and databases.

ISA-95 incorporates the layers model of technology and business process for manufacturing enterprises as levels for the standard. These levels are (ISA, 2010):

- Level 0: Defines the actual physical processes.
- Level 1: Defines the activities involved in sensing and manipulating the physical processes.
- Level 2: Defines the activities of monitoring and controlling the physical processes.
- Level 3: Defines the activities of workflow to produce the desired end products.
- Level 4: Defines the business-related activities needed to manage a manufacturing operation.

Manufacturing Operations Management systems reside in Level 3 of the model.

MOM systems address the following critical manufacturing functionalities: quality, safety, reliability, efficiency, and regulatory compliance. ISA-95 Part 3 defines the activities that occur in Manufacturing Operations Management systems as follows:

- Production operations management
- Maintenance operations management
- Laboratory (i.e., quality) operations management
- Material handling and storage management (including inventory control)
- Supporting activities, including management of security, information, configuration, documentation, regulatory compliance, and incidents/deviations.

Today's MOM systems allow manufacturers to standardize and optimize processes across the enterprise, minimizing lead times, optimizing asset utilization, speeding time-to-market, and increasing both production visibility and collaborative abilities. In the global marketplace - dispersed over vast geographies, ever more reliant on manufacturing networks - MOM systems are taking an increasingly central role in enabling manufacturers to compete efficiently and profitably. ISA-95 Part 3 defines MOM as "activities, functions, and exchanges within level 3 of a manufacturing facility that coordinate the personnel, equipment, and material in manufacturing."

Using the ISA-95.00.01-2010 (IEC 62264-1:2013) conceptual standard for manufacturing operations (resource management, planning, scheduling, control, recipe management) is useful to identify key users of i4Q Solutions in manufacturing operations and maintenance. This will ensure that the architectural definitions are aligned with the standard frameworks for vertical integration.

In fact, for purposes of IEC 62264-1, the manufacturing and control domain includes manufacturing operations management systems, manufacturing control systems, and other associated systems and equipment associated with manufacturing. The terms "enterprise,"

"controls," "process control," and "manufacturing" are used in their most general sense and are held to be applicable to a broad sector of industries. This part of IEC 62264 provides standard models and terminology for describing the interfaces between the business systems of an enterprise and its manufacturing operations and control systems.

Part of IEC 62264 standard is based upon the Purdue Reference Model for CIM (hierarchical form) as published by ISA.

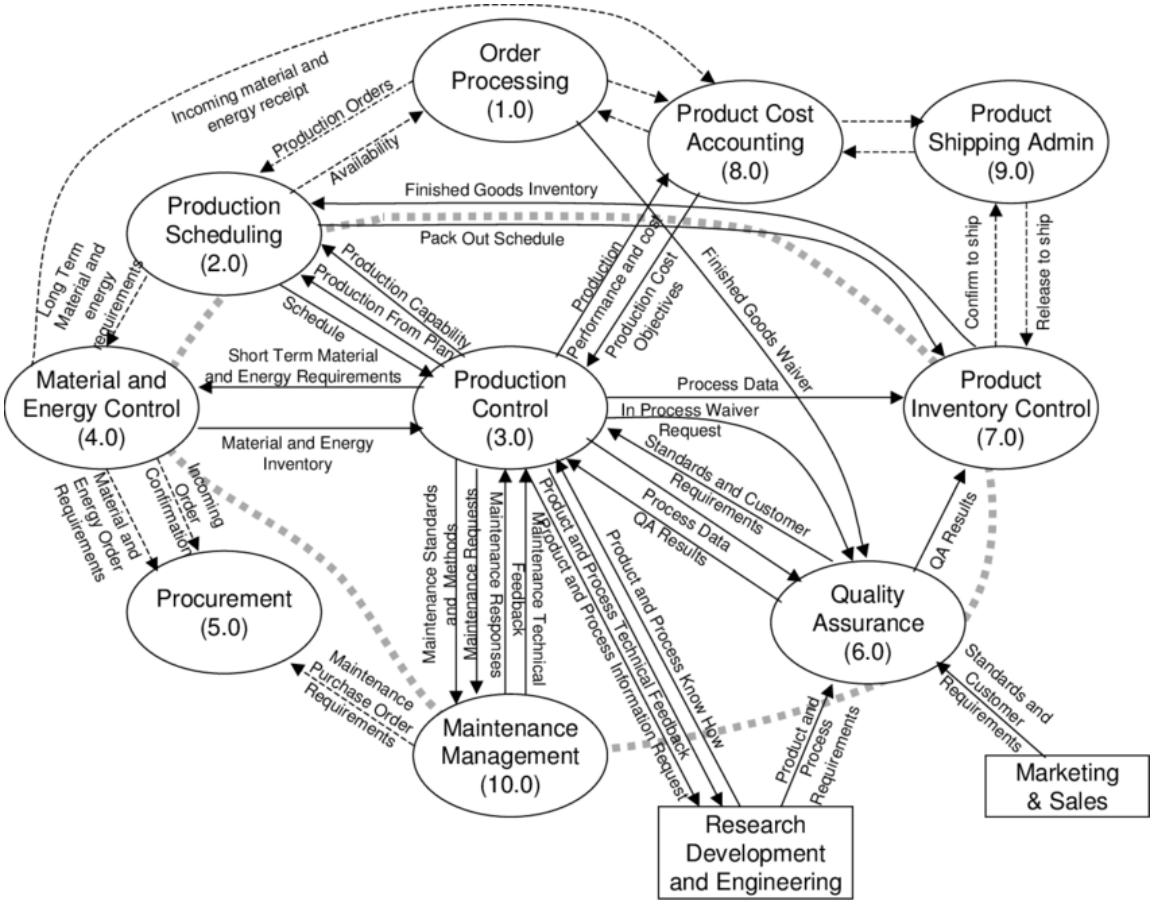

Figure 6. Functional enterprise-control model *(ISA, 2010)*

The model includes main operations to be examined in i4Q application scenarios, such as production management, maintenance management, quality management, inventory management (ISA, 2010).

Order processing. The general functions of order processing typically include: customer order handling, acceptance and confirmation; sales forecasting; waiver and reservation handling; gross margin reporting; determining production orders.

Production scheduling. Production scheduling functions interface to the manufacturing operations and control system functions through a production schedule, actual production information, and production capability information. The general functions of production scheduling typically include: the determination of production schedule; the identification of long-term raw material requirements; the determination of the pack-out schedule for end-products; the determination of the available product for sales.

Production control. It includes Production control main functions, Process support engineering, Production operations control, Production operations planning, Material and energy control.

- *Production control main functions* typically include controlling the transformation of raw materials into the end-product; issuing requirements for raw materials; producing reports of performance and costs; evaluating constraints to capacity and quality; self-testing and diagnosis of production and control equipment.
- *Process support engineering* typically includes issuing requests for modification or maintenance; coordinating maintenance and engineering functions; providing technical standards and methods to operations and maintenance functions;
- *Production operations control* is the collection of functions that manages all production within a site or area. The functions of production operations control typically include producing the product according to the schedule and specifications; reporting production, process, and resource information; monitoring equipment, validating operational measurements, and determining the need for maintenance; possible local site or area labor management and document management.
- *Production operations planning* typically includes setting up a short-term production plan based on the production schedule; checking the schedule against raw material availability, product storage capacity, equipment and personnel availability.
- *Material and energy control* typically includes managing inventory, transfers, and quality of material and energy; generating requests for purchasing of materials and energy based on short- and long-term requirements; receiving incoming material.

Procurement. The functions of procuring resources typically include: placing orders with suppliers for raw materials, supplies, spare parts, tools, equipment and other required materials; releasing incoming invoices; collecting and processing of unit requests.

Quality assurance. The functions of quality assurance typically include: testing and classification of materials; setting standards for material quality; certifying that the product was produced according to standard process conditions; relaying material deviations to process engineering for re-evaluation to - reconfigure processes to ensure process capability and product quality.

Product inventory control. The functions of product inventory control typically include: managing the inventory of finished products; making reservations for specific product in accordance with product selling directives; arranging physical loading/shipment of goods in coordination with product shipping administration.

Product cost accounting: The functions of cost accounting typically include: calculating and reporting on total product cost; reporting cost results to production for adjustment; calculating and reporting on total production cost, reporting cost results to production for adjustment.

Product shipping administration: The functions of product shipping administration typically include: organizing transport for product shipment in accordance with accepted orders requirements.

Maintenance management: The functions of maintenance management typically include: providing maintenance for existing installations; providing equipment monitoring to anticipate

failure, providing status and technical feedback on performance and reliability to process support engineering.

Marketing and sales: The general functions of marketing and sales typically include: generating sales plans and marketing plans; interacting with customers.

Research, development, and engineering: The general functions of research, development and engineering typically include: development of new products; definition of process and product requirements.

The analysis of operations reported by the IEC (International Electrotechnical Commission) and ISA (International Society of Automation) helped to examine in detail the principal activities and key actors involved in a more comprehensive production process applicable to multiple contexts.

2.2.2 Stakeholder's classification

The term *stakeholder* is used as a general term to describe individuals, groups, or organizations that have an interest in the project and can mobilize resources to affect its outcome in some way. According to PMI (Project Management Institute), a formal definition of a stakeholder is: "individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion" (Smith, 2000).

In a broad sense, stakeholder is the individual, entity, or group of people whose interest can be affected by the business or they have the power to give impact to business benefit.

Every stakeholder is important for a business entity but some stakeholders exert more influence and are therefore considered more important than others. On the basis of importance, stakeholders of a business are usually categorized as primary stakeholders and secondary stakeholders.

- **Primary stakeholders:** Stakeholders that hold a direct interest in a business or organization and its dealings are known as primary stakeholders. Examples of primary stakeholders include shareholders, employees, customers, suppliers, vendors and business partners. This group of people will have a direct impact due to the company's performance and is able to impact the company performance as well.
- **Secondary stakeholders:** Stakeholders that do not hold direct interests in a business but can have a reasonable influence over a business's dealings are known as secondary stakeholders. An organization does not directly depend upon these stakeholders for survival of its immediate interests. Business competitors, trade unions, pressure groups and state or local government organizations are some examples of secondary stakeholders. However, they have enough power to influence over company benefit. For example, the government or regulator can close down the company if we do not comply with the law and regulation.

The main points of difference between primary stakeholders and secondary stakeholders are as follows:

1. Primary nature:

Primary stakeholders of any organization are those stakeholders without which the organization cannot survive or sustain in the foreseeable future. This is because these stakeholders have a direct and immediate impact upon the financial and/or non-financial matters of the business. On the other hand, secondary stakeholders are those stakeholders that neither have a direct stake in the business nor do these face a direct financial impact due to decisions made by the business, but these stakeholders may have a strong or weak influence over the commercial activities and the decisions made by the business.

2. Importance:

Primary stakeholders, as the name suggests, are very vital for an organization because these stakeholders are important for its continued survival. An organization needs to make sure that it maps its primary stakeholders very effectively so that it meets their requirements and act according to their respective demands. Secondary stakeholders are less important than primary stakeholders but they are not completely irrelevant, therefore mostly businesses need to put effort to keep these stakeholders satisfied. However, many secondary stakeholders like governments and tax authorities may convert into primary stakeholders based on the jurisdiction and the extent of power they can exert over the business entity. A business must keep track of the respective interests of such secondary stakeholders and maintain a liaison with them to ensure that they remain satisfy in the best interest of the business to the maximum possible extent.

3. Identification and scope:

Primary stakeholders are normally easily identifiable because of their financial dealings with the company but secondary stakeholders are not always easily traceable. The reason behind this is that primary stakeholders are more likely to have a monetary stake in the company where secondary stakeholders may only have a degree of influence. Normally, many secondary stakeholders are not recognized by a business until they become vocal and criticize a certain decision or initiative taken by the business.

The scope for being a secondary stakeholder is wider as compared to a primary stakeholder. The importance of key secondary stakeholders must not be undermined because their identification is crucial for continuous and smooth business operations.

A tabular comparison of primary and secondary stockholders is given below.

Primary stakeholders	Secondary stakeholders
Primary nature	
Can directly impact the commercial activities of an organization/business/solution (shareholders, employees, directors, customers, suppliers etc.)	Can exercise influence over the commercial activities of an organization/business/solution (government, pressure groups, trade unions etc.)
Importance	
Are very important to sustain its business activities	An organization/business/solution must keep these stakeholders satisfied

Primary stakeholders	Secondary stakeholders
Identification	
Are easily identifiable because of a financial stake within the business.	Are sometimes difficult to identify because of their inactivity.

Table 1. Primary vs Secondary Stakeholders

According to this analysis, we can conclude that also i4Q RIDS development has various stakeholders attached to it in one or another way. These stakeholders vary according to the degree of influence they can exercise based on their respective standings.

The key thresholds used for discovering the stakeholders and gauging their influence on i4Q are based upon two basic aspects - the interest of a stakeholder in the activities of i4Q RIDS development and usage, and the power or influence he can exercise upon its activities.

2.2.3 i4Q Stakeholders' representation

As we said, the definition of the business viewpoint starts with the analysis of stakeholders.

According to the analysis performed in terms of business processes and types of actors involved, stakeholders have been gathered into two main categories:

- Primary stakeholders, people and organizations who seek, receive, manage and provide IoT based services for quality improvement, having a direct impact on defining main i4Q Solutions' functionalities;
- Secondary stakeholders, users of information maintained by the primary stakeholders' systems or providers of information needed by the primary stakeholders.

For each category, main actors involved in i4Q RIDS definition, implementation and use have been identified.

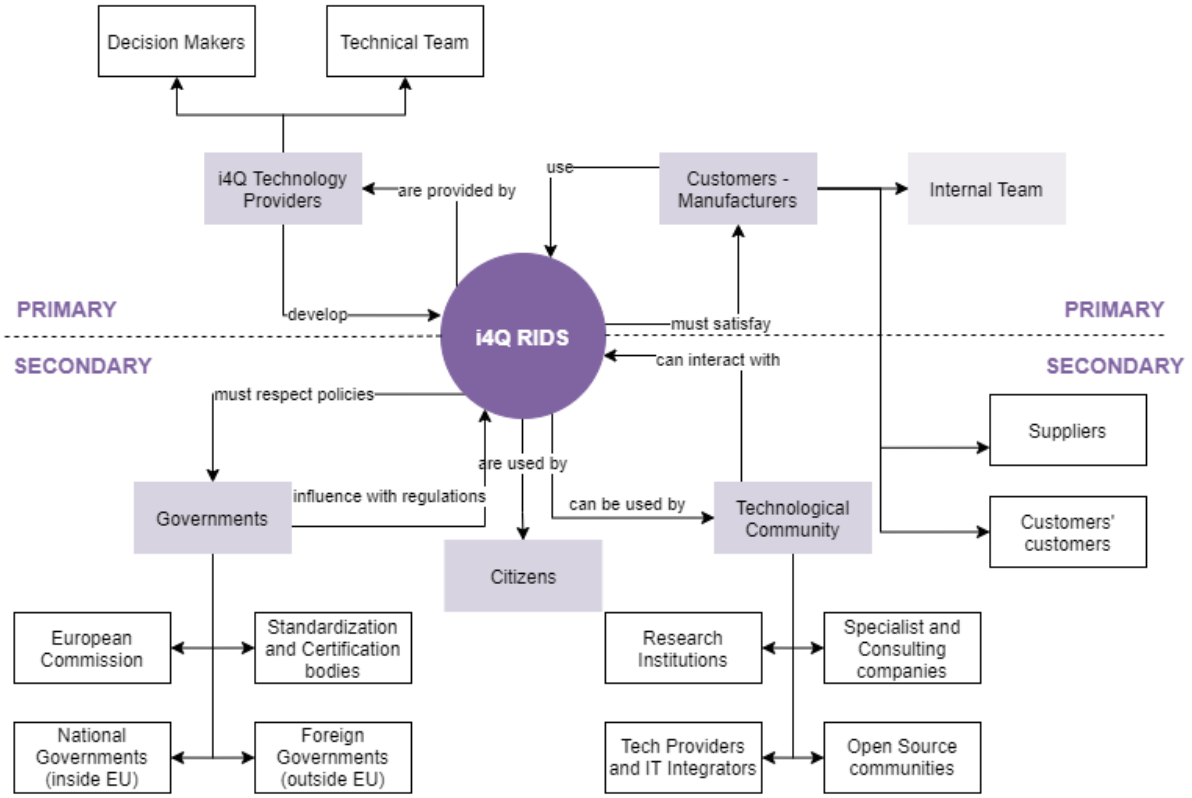

Figure 7. i4Q Primary & Secondary Stakeholders

i4Q Technology Provider: Inside the i4Q consortium, this is the team in charge of offering a solution to the problems exposed, realising i4Q RIDS. They consult with manufacturers in order to identify problems or areas that can be improved. Solutions will contribute to enhance manufacturing processes. They are considered primary stakeholders and are mainly divided into:

- *Decision Maker*: defining the general business strategy for the technology provider
- *Technical Team*: as part of the i4Q solution providers, this team develops and implements algorithms and solutions to improve production processes.

Customers – Manufacturers: They represent the main users of i4Q RIDS, and express a strong interest and involvement in solutions design and implementation phases. In i4Q possible potential customers are mainly represented by companies operating in the manufacturing domain (e.g., pilots involved in the project). Here we can identify:

- *Internal team*: represented by different departments and working groups inside an organisation; they are a particularly active part of the definition of i4Q RIDS, and further details will be provided later. Because of this involvement they are part of the primary categorization;
- *Suppliers*: in the value chain perspective, they are represented by other companies interacting with solutions' customers providing whatever is needed (e.g., raw material, subcomponents, etc.). Their interest in i4Q RIDS is not direct, but they have an inferred impact derived from the use of i4Q solutions by manufactures (e.g., concerning functionalities for incoming material inspection); they are considered secondary stakeholders;

- *Customers' customers*: in B2B scenarios, they represent clients of manufacturing companies (e.g., buyers of equipment produced by i4Q customers and used in their production processes). Also in this case, the involvement on i4Q RIDS is not direct, but they can potentially benefit of advantages derived from solutions' use (e.g., high machinery quality); they are secondary stakeholders.

Government: it is the system governing the state or community where i4Q RIDS are developed and applied. They establish policies and rules to be respected also for software development, so they are secondary stakeholders. Four levels of legislation can impact on i4Q RIDS:

- *European Commission*: it represents the executive branch of the European Union, responsible for proposing legislation, enforcing EU laws and directing the union's administrative operations. Its executive bodies propose new laws and enforce existing ones that influence and affect the i4Q framework and RIDS.
- *National Governments (inside EU)*: in addition to the directives of the European Commission, the i4Q RIDS must comply with the regulations of the countries in which they are adopted, and which may therefore influence their development on the basis of the regulations in force
- *Foreign Governments (outside EU):* if solutions are also adopted in countries outside the European Community, the regulatory constraints of those countries, which may differ from those of European nations, must be considered and complied with i4Q RIDS.
- *Standardization and Certification bodies*: they are organizations whose primary function is developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise producing technical standards to address the needs of a group of affected adopters. Considering that such an organization works to create uniformity across producers, consumers, government agencies, and other relevant parties regarding terminology, product specifications (e.g. size, including units of measure), protocols, and more, they can affect i4Q RIDS development promoting the adoption of specific standards.

Technology community: considering the variety of tools that can be adopted by an organisation, it is necessary for i4Q RIDS to interface with other solutions provided by different technology providers; this need for communication can influence the development of solutions. Here we can identify:

- *Specialist and Consulting companies*: these companies provide their services to the users of the i4Q Solutions. These services are specialized, such as solving narrow technical and configuration problems, or consulting-based.
- *Research Institutions*: they can be involved in activities for testing and broadening the application of i4Q Solutions.
- *Tech Providers and IT Integrators*: they represent various IT organizations that sell software they developed, and they need to connect their own solutions to i4Q solutions.
- *Open Source communities*: they can benefit of i4Q Solutions and cause an incentive for publicly interest of further development on innovative features, stabilization of robustness of i4Q systems, etc.

Citizens: in addition to the B2B (Business-to-Business) context which is widely used in the potential operational scenarios, a part of the applications is also positioned in B2C (Business-to-Consumer) scenarios, where therefore customers' needs (generally considered as citizens being part of society) can influence the development of i4Q RIDS.

As we said, a special attention is dedicated to internal team of manufacturers, directly involved in i4Q RIDS development.

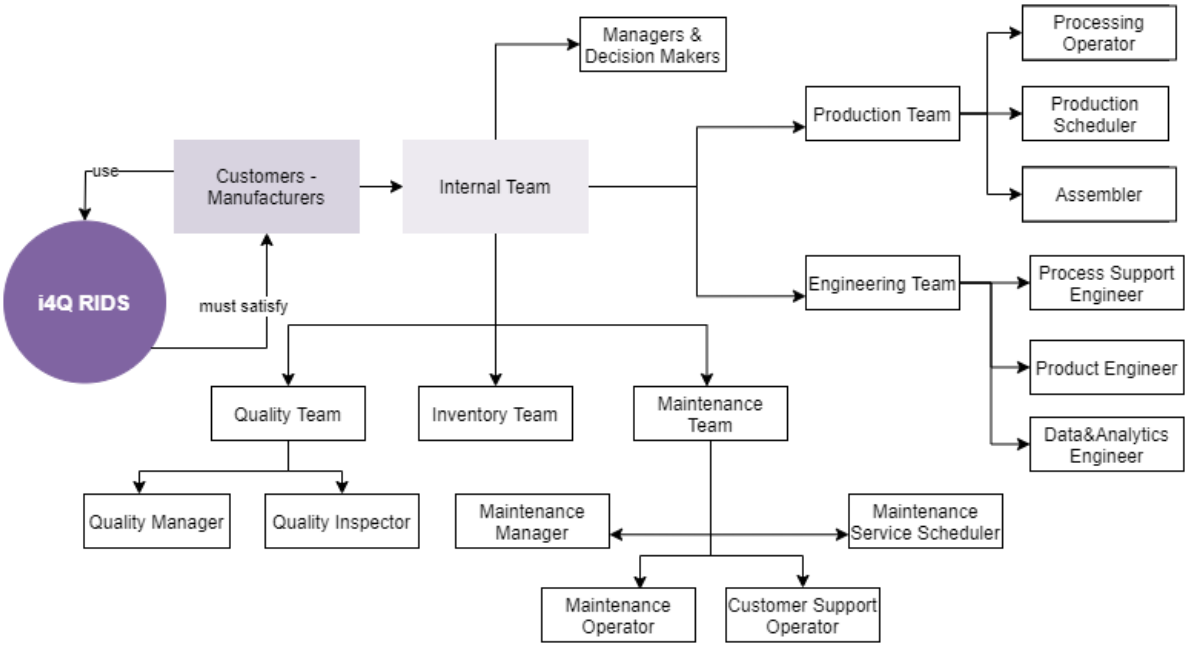

Figure 8. i4Q Primary Stakeholders - Internal Team

Manager and Decision Makers: in the organisation, they represent people defining strategic objectives and responsible of tactical decisions, e.g., they can set global goals pursued using i4Q RIDS.

Production Team: it encompasses most of the functions associated with manufacturing operations and control, manage the production planning:

- *Processing operator*: It is the one in charge of directly operating with the production machinery. It controls the status of production requests, configures production parameters, control the status of resources and process history, intervenes when a problem occurs in the production process and asks for support if it is needed.
- *Production scheduler*: It manages the overall production process. It is the one in charge of the production plant schedule and decides the best course of action depending on the current situation; in particular: sets up a short-term production plan based on the production schedule; checks the schedule against raw material availability and product storage capacity; checks the schedule against equipment and personnel availability; modifies the production plan hourly to account for equipment outage, manpower and raw materials availability.
- *Assembler*: It is in charge of assembling a machine or a product. It monitors the status of all subcomponents in order to verify the availability and the quality for the final output.

Quality Team: it is a group of professionals dealing with quality control and assurance in several areas (e.g., for final products, for raw material, etc.). It inspects, measures and tests produced items comparing them with the expected item deciding if the production is working as it should or something should be changed.

- *Quality manager*: It is in charge of planning quality check procedures, issuing to manufacturing and testing laboratories in accordance with requirements from technology, marketing and customer services, applying standards and customer requirements for material quality, setting standards for material quality, collecting and maintaining material quality data, certifying that the product was produced according to standard process conditions.
- *Quality inspector*: It performs specialized tests in a laboratory to measure the quality of production samples, both raw material and finished product. These tests can be related to the production process, for internal quality evaluation or to respond to customer complaints, for instance. As part of the quality assurance team it makes sure that manufactured items meet the defined quality standards using specific machines.

Inventory Team: Every asset, machine and produced item must be controlled and properly stored. The functions of product inventory control typically include: managing the inventory of finished products; reporting on inventory to production scheduling; arranging physical loading/shipment of goods in coordination with product shipping administration.

Maintenance Team: The main responsibility of this group is to keep machinery and assets functional and up to date. When a faulty production equipment blocks the production team, the maintenance team is in charge of providing a solution so the production can keep up with customer needs.

- *Maintenance manager*: It develops maintenance cost reports, and coordinates outside contract work effort, providing a preventative maintenance program.
- *Maintenance operator*: It provides maintenance for existing installations. If a problem arises in the machine, it realizes specific maintenance procedures, so the assets are functional and up to date.
- *Maintenance service scheduler*: It is responsible of the state of the machinery and assets involved in the production process, and specifies the plan for future work orders. It provides equipment monitoring to anticipate failure, including self-check and diagnostic programs. Together with the production scheduler, plan and prepare assets maintenance so all the assets in the production process are up to date and fully functional as required by the business processes.
- *Customer support operator*: It provides support to customers attending to their needs and demands. It is the person that directly communicates with customers. It also provides status and technical feedback on performance and reliability to process support engineering.

Engineering Team: This is the technical group in charge of product development, mainly acting in the design phase and in strong connection with Production Team and Maintenance Team.

- *Product engineer*: It is in charge of products development, defining process and product requirements and also equipment and resource requirements, as related to the production of the products. It follows up on technological developments, issuing requests for modification (e.g., new design drawings, maintenance; minor equipment and process modifications).
- *Process support engineer*: It coordinates engineering functions, also providing technical support to operators and instructions on how to handle equipment. This may include engineering standards for process equipment design techniques and process operational methods; operating instructions on how to make products; production rules and the standard materials, equipment, and other resources used; material safety data sheets; environmental and safety operating limits and constraints.
- *Data&Analytics engineer*: it is the job of building data products that enable the rest of the team to do their jobs effectively and answer their own questions. It manages core data infrastructure, ensuring data is available and accessible across the organisation, and partners with business stakeholders to answer questions with data, build dashboards and reporting, and carry out exploratory analysis. It uses statistics and machine learning to extract value from data (e.g., solving optimization problems, building prediction models and more).

Starting from the stakeholders here identified, the analysis conducted in the next paragraphs is based on IIRA Business Viewpoint principles, as explained in the methodology (section 2.3).

2.3 Methodology

Starting from IIRA key concepts presented above a methodology to define the Business Viewpoint has been defined providing also the tools to collect the relevant information presented in the following sections.

This methodology has been integrated with the viewpoints iterations and validation plan described in section 1.2.

The first activity focused on stakeholder identifications, after this first definition, the stakeholders have been analysed and classified into primary and secondary stakeholders based on their interest and their potential impact on the project (see section 2.2). Following IIRA concepts the primary stakeholders have been spilt into Business and Decision Makers and Technical Personnel.

Figure 9. i4Q RIDS Stakeholders classification

As defined in the IIRA, Business Decision-Makers present the visions, identify the values and develop the business objectives, while the Technical Personnel, starting from the business objectives, develops the more technical objectives and identifies the fundamental capabilities of the i4Q RIDS, according to that, a new graph describing Vision and Value-Driven Model for i4Q RIDS for primary stakeholders has been derived from IIRA representation and presented in **Figure 10**.

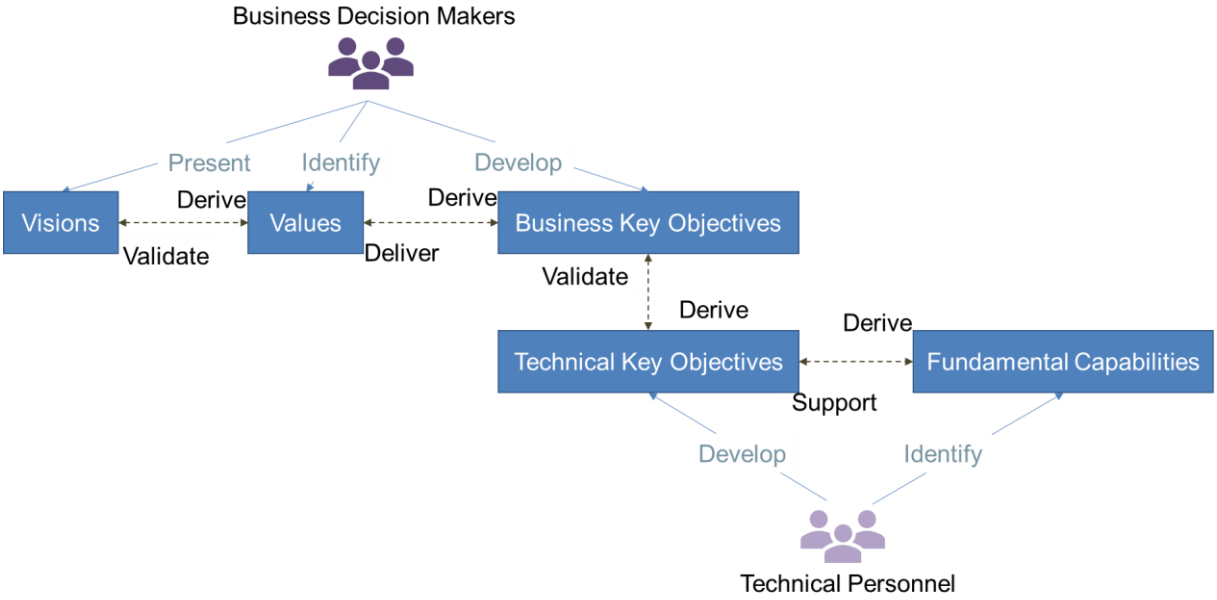

Figure 10. Vision and Value-Driven Model for i4Q RIDS – Primary stakeholders

Secondary stakeholders can be considered equivalent to other stakeholders in the IIRA model, they, as the business decision-makers, present the visions, identify the values and develop the business objectives. To provide more hints to the other viewpoints, a new field has been derived with the aim to offer recommendations to reach the specific objective (see **Figure 11**).

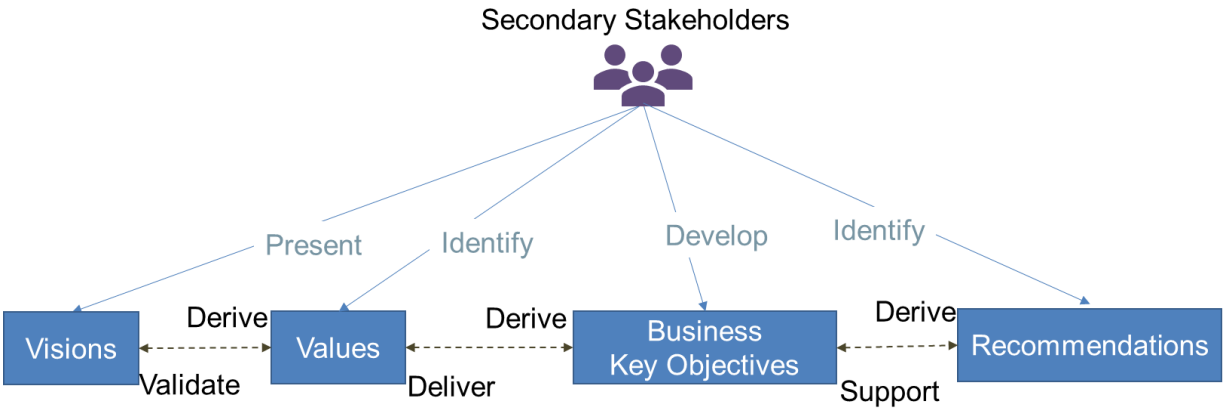

Figure 11. Vision and Value-Driven Model for i4Q RIDS – Secondary stakeholders

Whenever possible stakeholders belonging to the technical personnel category identifies fundamental capabilities of the system, the only exception is represented by i4Q Technology Providers – Technical Development team who identify recommendations for the development, test and deployment of i4Q solutions. For some secondary stakeholders, legal and strategic objectives have been identified according to their specific peculiarities.

In line with the defined vision and value-driven model, for each category of stakeholders (Business and decision-makers, technical personnel and secondary stakeholders), different tables have been designed to collect the details represented in **Figure 10** and **Figure 11**.

Stakeholder Name	The name of the stakeholder
Vision	Describing a future state of an organization or an industry, including the business direction toward which an organization executes and providing values reflecting how the vision may be perceived
Values and experiences	Reflecting how the vision may be perceived by the stakeholders involved in funding the implementation of the i4Q Solutions as well as by the users of the resulting project tools.
Key objectives - business	List of quantifiable high-level business outcomes expected of the i4Q Solutions in the context of delivering the values
Processes to focus on	List of the processes involved in the achievement of the business objectives

Table 2. Template for Business & Decision makers

Stakeholder Name	The name of the stakeholder
Scenario and Processes involvement	List of the processes involved in the achievement of the business objectives
Key objectives – business	List of the business outcomes, already defined by the business and decision-makers, from which the technical objectives are derived
Key objective 1 – technical	List of quantifiable high-level technical outcomes expected of the i4Q Solutions in the context of delivering the values
Fundamental capabilities	High-level specifications of the essential ability of the i4Q Solutions to complete the technical objectives 1 tasks I want to: • Functional capability 1 • … • Functional capability N
…	
Key objective N – technical	List of quantifiable high-level technical outcomes expected of the i4Q Solutions in the context of delivering the values
Fundamental capabilities	High-level specifications of the essential ability of the i4Q Solutions to complete the technical objectives N tasks I want to: • Functional capability 1 • … • Functional capability N

Table 3. Template for Technical Personnel

Stakeholder Name	The name of the stakeholder
Vision	Describing a future state of an organization or an industry, including the business direction toward which an organization executes and providing values reflecting how the vision may be perceived
Values and experiences	Reflecting how the vision may be perceived by the stakeholders involved in funding the implementation of the i4Q Solutions as

Stakeholder Name	The name of the stakeholder
	well as by the users of the resulting project tools.
Key objectives	List of quantifiable high-level business outcomes expected of the i4Q Solutions in the context of delivering the values
Recommendations to reach the objectives	List of recommendations to reach the key objectives reported above

Table 4. Template for Secondary Stakeholders

For each examined primary stakeholder also a graphical representation has been provided collecting all the information inserted in the template table. An example is reported in the figure below: the blue arrows indicate either the business and the technical key objectives developed by the managers or the technical team, while the black dashed arrows indicate the key technical objectives derived from the business key objectives and the fundamental capabilities derived from the key objectives.

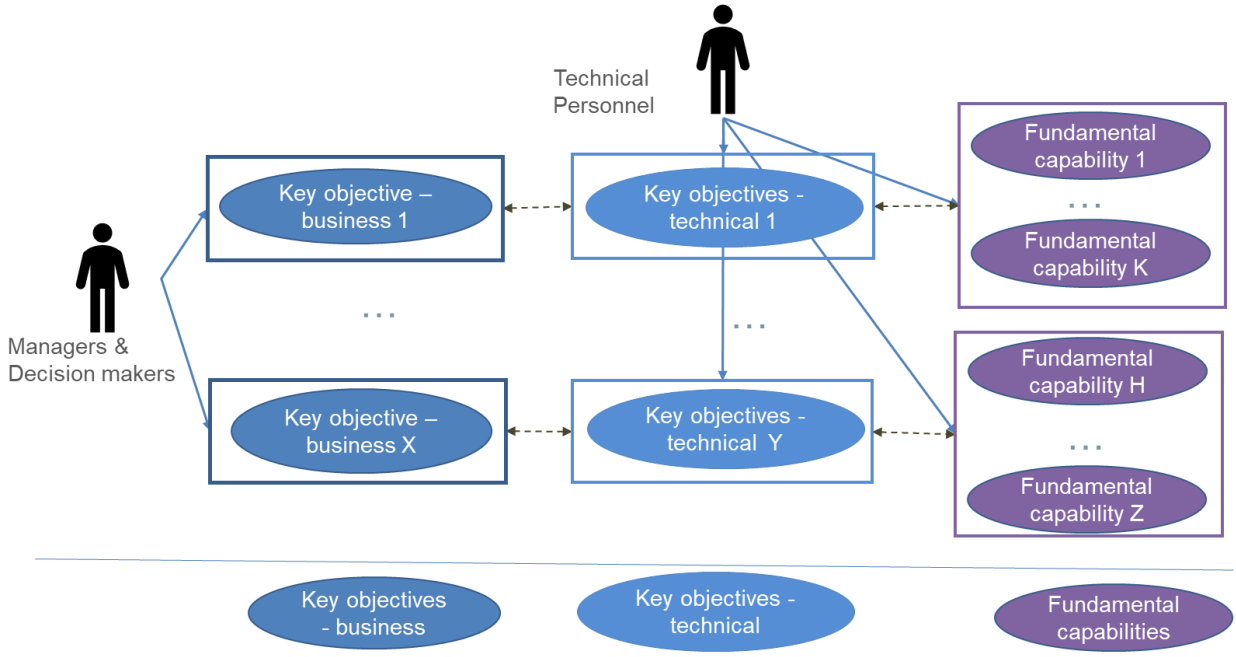

Figure 12. Graphical representation for Primary Stakeholders

After collecting all the information for the identified stakeholder an overview has been prepared and presented in 3.8.

3. Vision and Value-Driven Model for i4Q RIDS

On the basis of the identified stakeholders and the presented methodology (section 2.2 and 2.3), a detailed analysis of all i4Q RIDS stakeholders is carried out to identify their vision, values, business and technical objectives, functional capabilities and recommendations.

3.1 Customers: Manufacturers - Internal Team

3.1.1 Managers and Decision Makers

Stakeholder Name	Manufacturers – Managers & Decision Maker
Vision	To be recognized as a reliable manufacturer offering a high-level quality output
Values and experiences	The company could benefit from data-driven services contributing to early identify anomalies and problems of final products. For this purpose, it could be useful to track and virtualize different stages: monitoring the quality of raw material; monitoring production process parameters; automatizing the quality detection process for all the produced parts; performing virtual tests on final parts. This way the company could reduce additional costs related to waste and parts to be re-worked and could increase the final customer satisfaction by offering a 100% compliant product.
Key objectives - business	• Minimize waste • Reduce costs • Improve final product quality • Increase customer satisfaction • Meet deadlines
Processes to focus on	• Production control • Quality assurance • Material and energy control • Maintenance management activities • Research development and engineering activities

Table 5. Business & Decision makers - Key Objectives

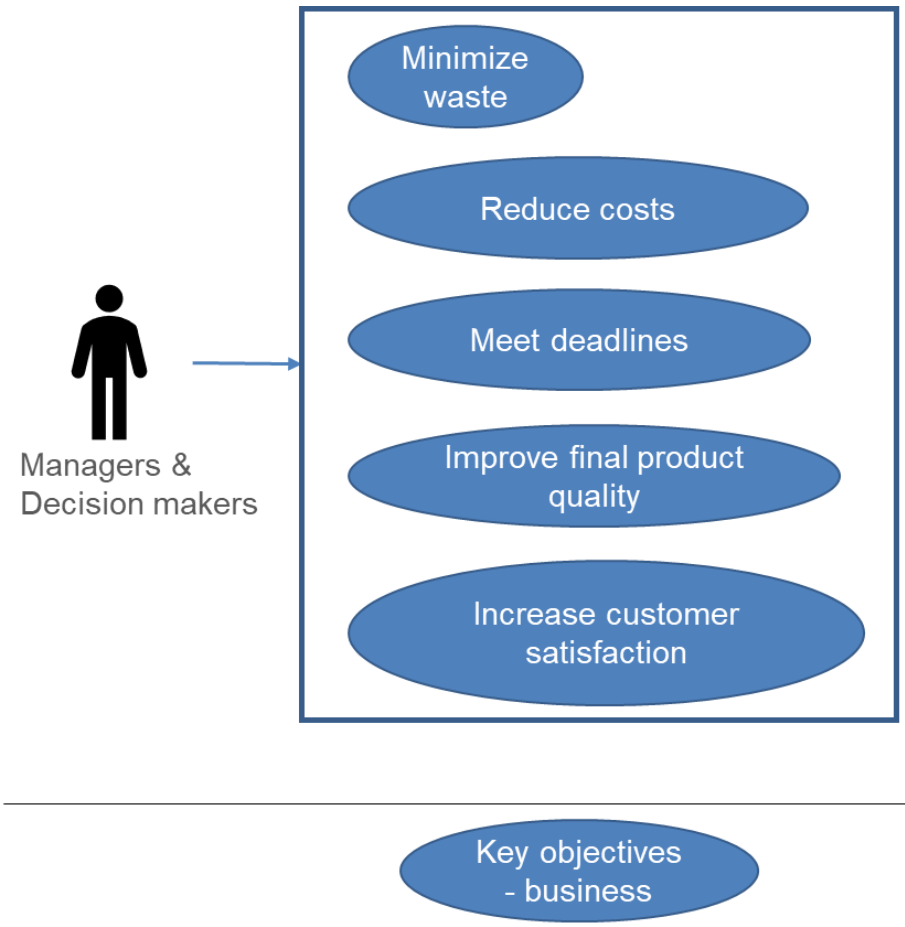

Figure 13. Managers & Decision Makers – Key Objectives

3.1.2 Production Team

Stakeholder Name	Processing Operator
Scenario and Processes involvement	Production control activities
Key objectives – business	• Minimize waste • Reduce costs for re-working activities
Key objective 1 – technical	Intervene as soon as possible on the production process when a problem occurs
Fundamental capabilities	I want to: • be notified when deviations from standard functioning values occur
Key objective 2 – technical	Reconfigure process parameters quickly and easily
Fundamental capabilities	I want to: • simply modify process input configurations

Table 6. Processing Operator - Key Objectives and Fundamental Capabilities

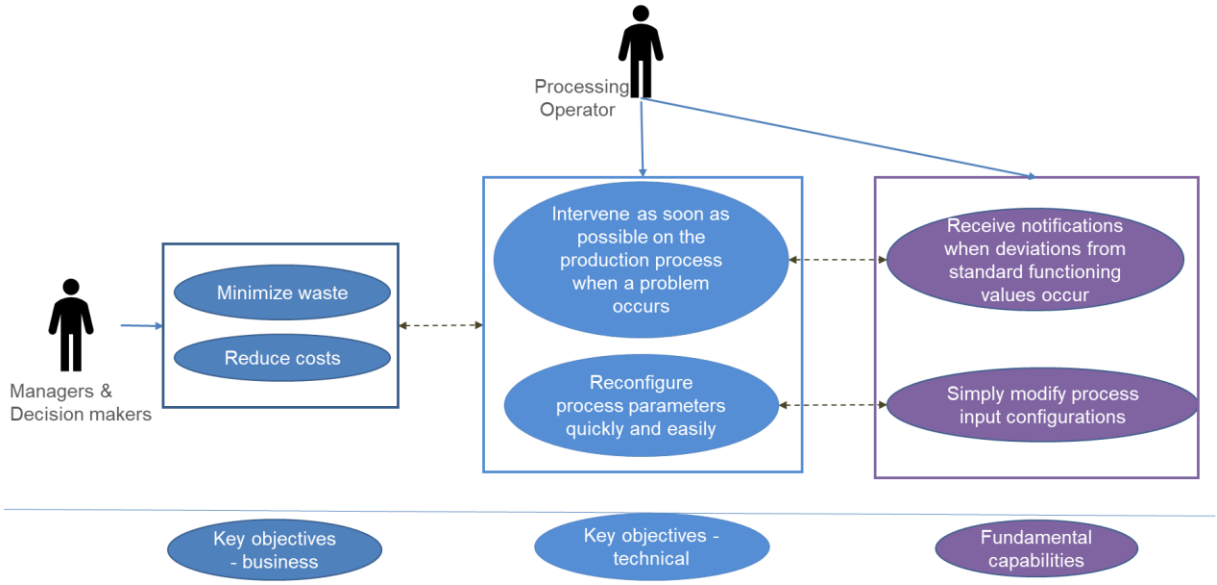

Figure 14. Processing Operator – Key Objectives and Fundamental Capabilities

Stakeholder Name	Production scheduler
Scenario and Processes involvement	Production control activities
Key objectives – business	• Minimize waste • Reduce costs • Meet deadlines • Improve final product quality
Key objective 1 – technical	Create a production schedule collecting actual production information and production capability information
Fundamental capabilities	I want to: • receive information on the production capacity and resource availability • have support and suggestions for the production schedule definition
Key objective 2 – technical	Monitor the production flow and enable scenario data-driven decision making
Fundamental capabilities	I want to: • receive feedback from actual production • receive feedback on the quality of the final product • have support for the production schedule update

Table 7. Production Scheduler - Key Objectives and Fundamental Capabilities

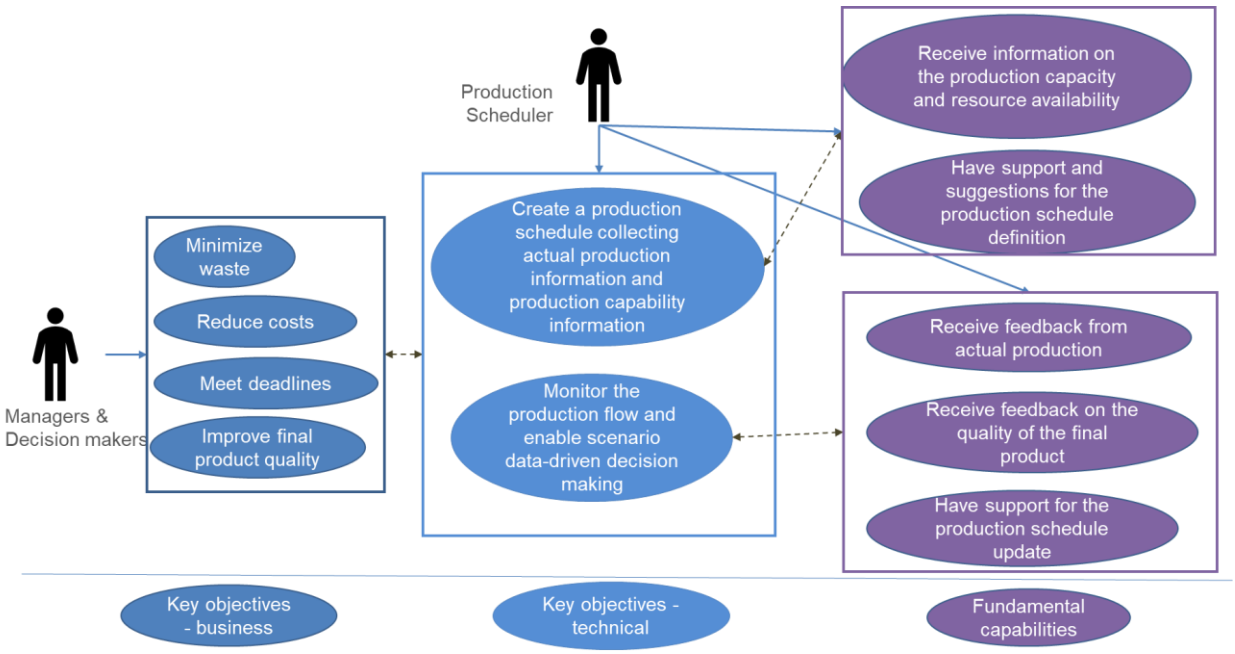

Figure 15. Production Scheduler – Key Objectives and Fundamental Capabilities

Stakeholder Name	Assembler
Scenario and Processes involvement	Production control activities
Key objectives – business	• Meet deadlines • Improve final product quality
Key objective 1 – technical	Perform the product assembly activity on time guaranteeing the highest quality
Fundamental capabilities	I want to: • have support to test the output to ensure the highest quality • receive feedback and suggestions for improving the quality of the output • report on issues, malfunction or defective parts

Table 8. Assembler - Key Objectives and Fundamental Capabilities

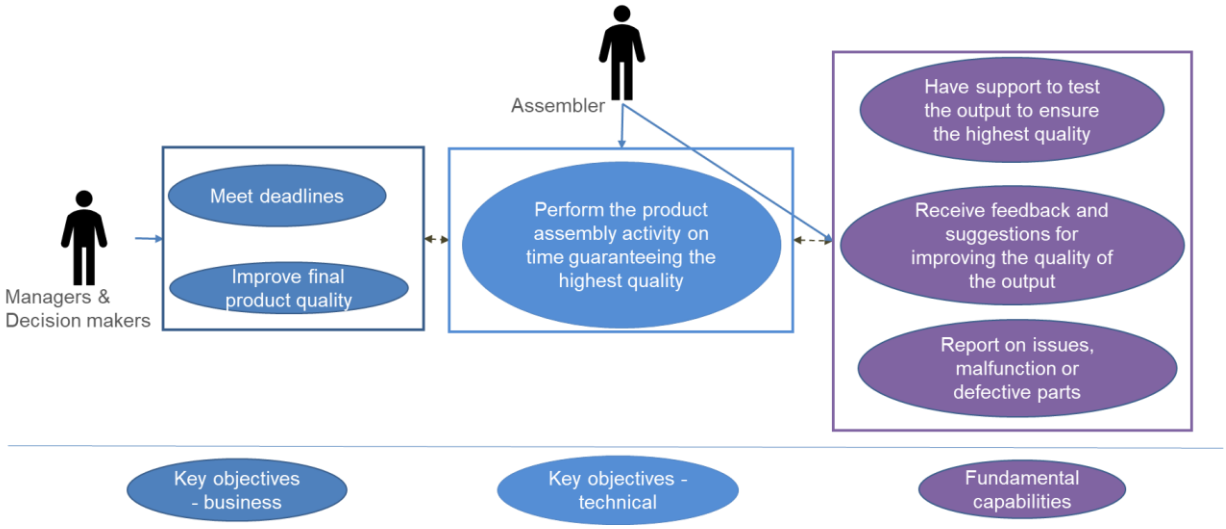

Figure 16. Assembler – Key Objectives and Fundamental Capabilities

3.1.3 Engineering Team

Stakeholder Name	Process Support Engineer
Scenario and Processes involvement	Production control activities
Key objectives – business	• Minimize waste • Reduce costs • Meet deadlines
Key objective – technical	Anticipate problems that may occur throughout a production batch before the end of the process
Fundamental capabilities	I want to: • identify factors that influence quality • predict possible product problems

Table 9. Process Support Engineer - Key Objectives and Fundamental Capabilities

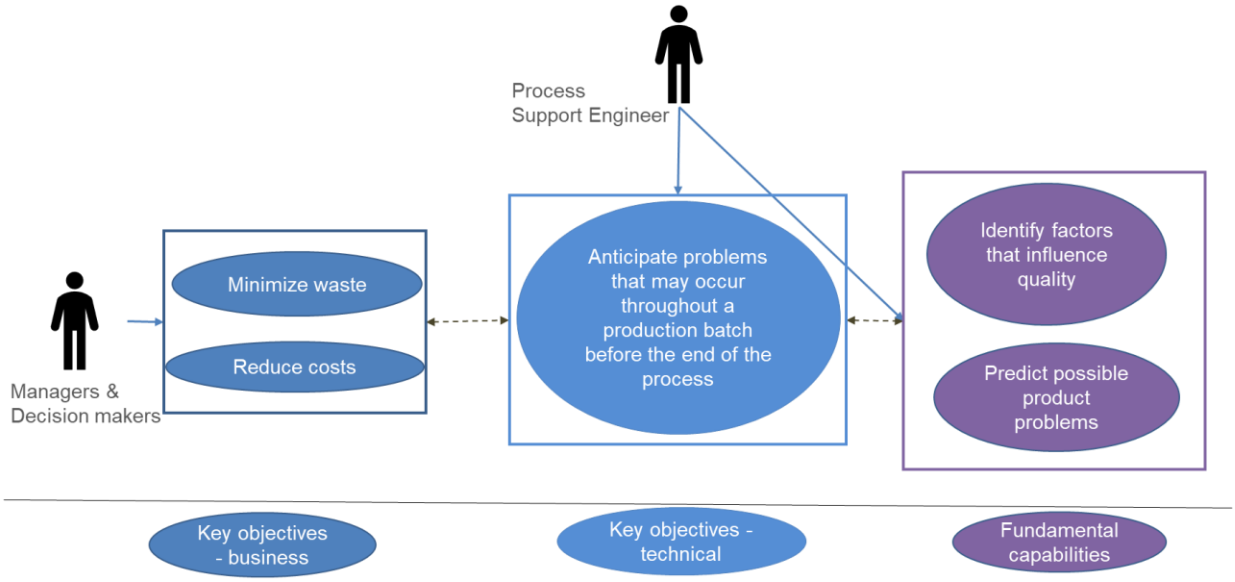

Figure 17. Process Support Engineer – Key Objectives and Fundamental Capabilities

Stakeholder Name	Product Engineer
Scenario and Processes involvement	Research development and engineering activities
Key objectives – business	• Improve final product quality • Reduce costs
Key objective 1 – technical	Improve product design for increased performance and functionality
Fundamental capabilities	I want to: • identify factors that influence the quality and/or functionality of a product • evaluate the new/updated product in terms of functionality and quality
Key objective 2 – technical	Determining manufacturing requirements and processes
Fundamental capabilities	I want to: • visualise and compare performance, reliability and costs of materials and/or suppliers
Key objective 3 – technical	Control costs and budget for the new/improved product
Fundamental capabilities	I want to: • have support to determine production costs of the new/improved product

Table 10. Product Engineer - Key Objectives and Fundamental Capabilities

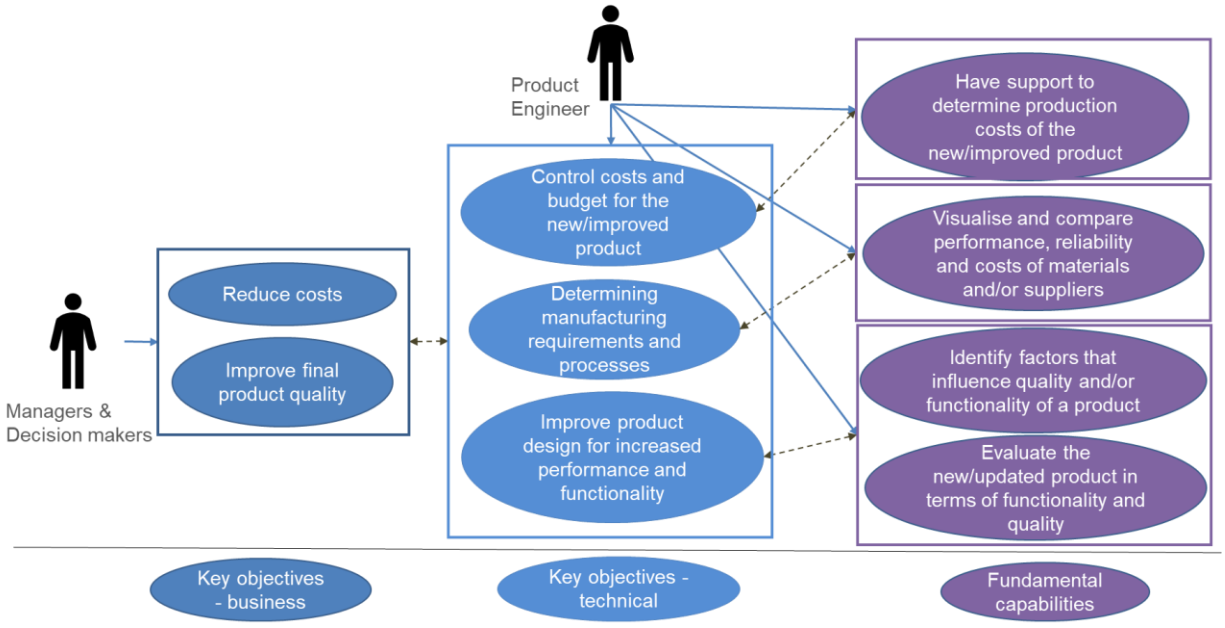

Figure 18. Product Engineer – Key Objectives and Fundamental Capabilities

Stakeholder Name	Data & Analytics Engineer
Scenario and Processes involvement	Research development and engineering activities
Key objectives – business	• Reduce costs • Meet deadlines • Improve final product quality
Key objective 1 – technical	Monitor production processes using data coming from multiple sources
Fundamental capabilities	I want to: • develop high-performance data pipelines to support complex data integration • oversee ETL (extract, transform, load) • build and train data models • analyse multiple data source in detail to identify quality trends and problem indicators
Key objective 2 – technical	Improve existing processes to streamline efforts
Fundamental capabilities	I want to: • receive suggestions for processes improvement

Table 11. Data & Analytics Engineer - Key Objectives and Fundamental Capabilities

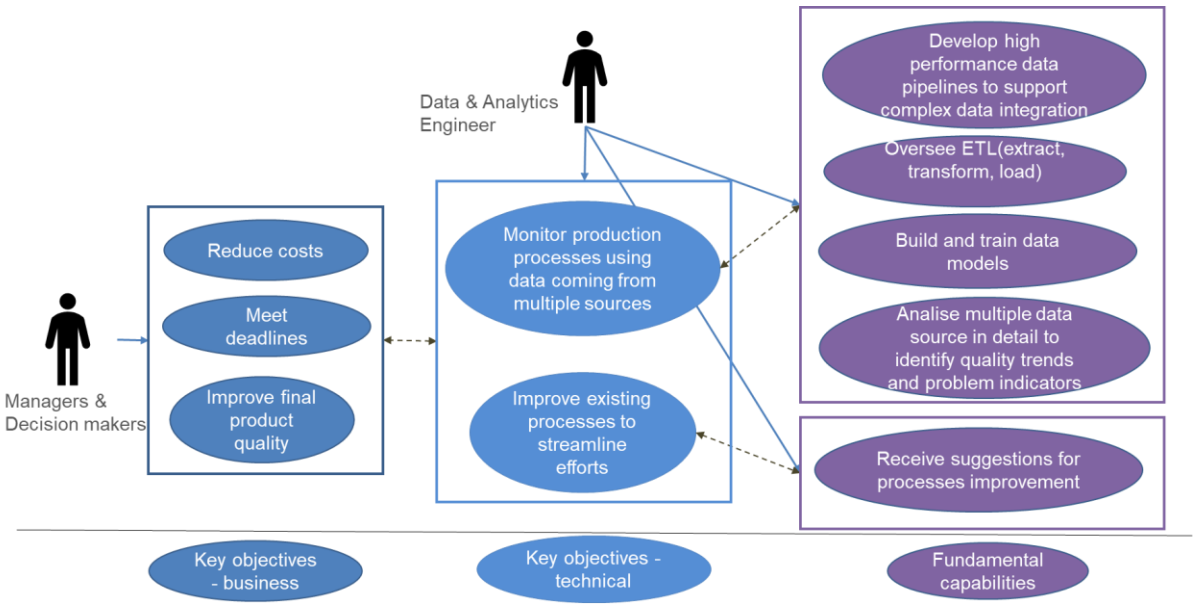

Figure 19. Data & Analytics Engineer – Key Objectives and Fundamental Capabilities

3.1.4 Quality Team

Stakeholder Name	Quality Manager
Scenario and Processes involvement	Quality Assurance activities
Key objectives – business	• Increase customer satisfaction • Improve final product quality
Key objective 1 – technical	Certify that the product was produced according to standard process conditions
Fundamental capabilities	I want to: • certify the quality of the process in a simple and verifiable way
Key objective 2 – technical	Check of product data versus customer's requirements
Fundamental capabilities	I want to: • certify product quality in a simple and verifiable way
Key objectives – business	• Reduce costs • Minimise waste • Meet deadlines
Key objective 3 – technical	Minimise the time for releasing material for further use (delivery or further processing)
Fundamental capabilities	I want to: • visualise information about the quality of item or process • identify potential origin of an issue in a simple way • have support for the final decision on a quality issue

Table 12. Quality Manager - Key Objectives and Fundamental Capabilities

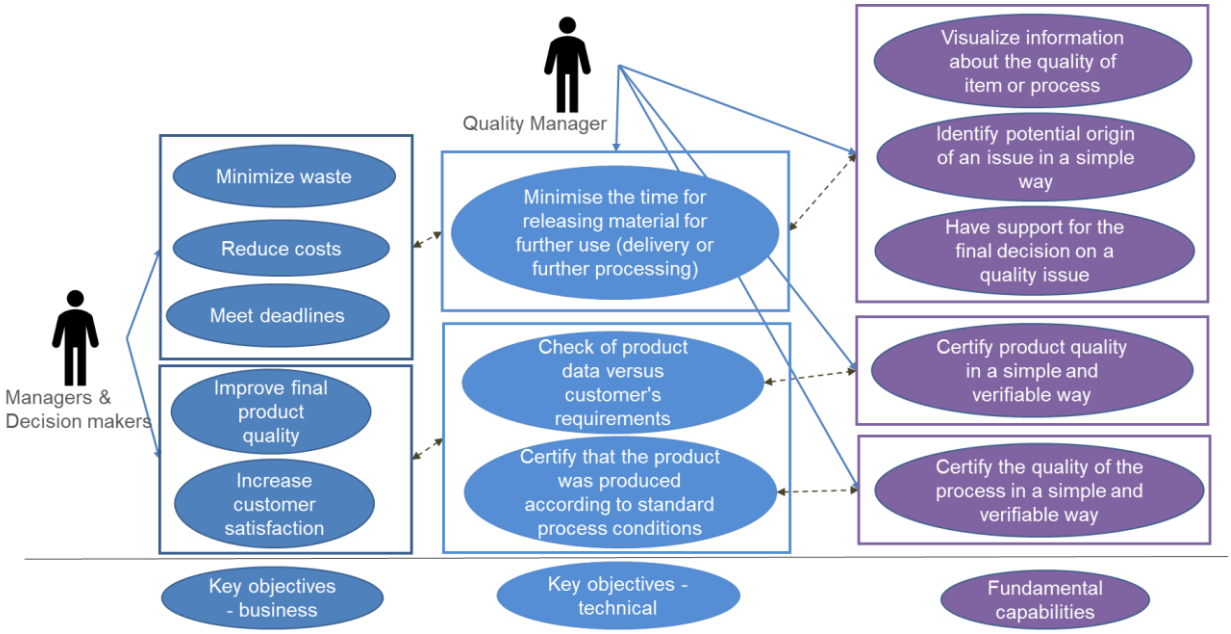

Figure 20. Quality Manager – Key Objectives and Fundamental Capabilities

Stakeholder Name	Quality Inspector
Scenario and Processes involvement	Quality Assurance activities
Key objectives – business	• Reduce costs • Improve final product quality • Minimise waste • Meet deadlines
Key objective 1 – technical	Test and verify the quality of materials (raw, final and intermediate) to ensure that quality goals are met while respecting the deadlines for the activity
Fundamental capabilities	I want to: • visualise information about an item or process • perform the testing of incoming raw material in a simple but accurate way • perform testing of a product in a simple but accurate way • report and save the result of the evaluation • have support on decision concerning escalation

Table 13. Quality Inspector - Key Objectives and Fundamental Capabilities

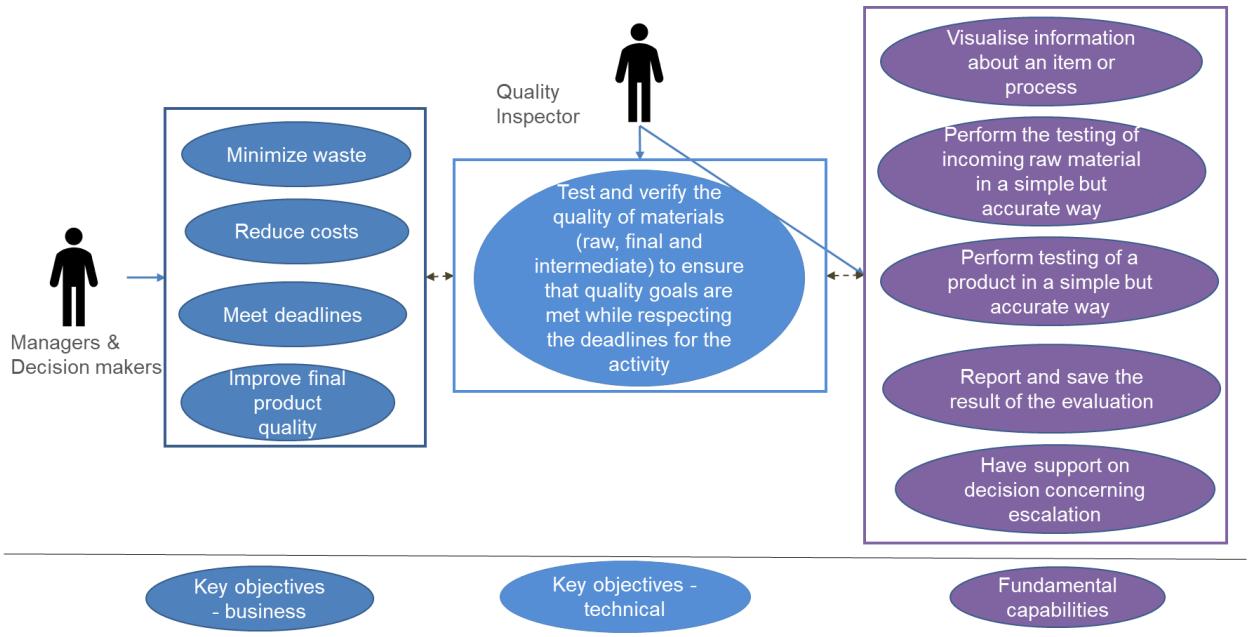

Figure 21. Quality Inspector – Key Objectives and Fundamental Capabilities

3.1.5 Maintenance Team

Stakeholder Name	Maintenance Manager
Scenario and Processes involvement	Maintenance management activities
Key objectives – business	• Reduce costs • Meet deadlines
Key objective – technical	• Control costs and budget for maintenance • Enhance, through modifications, extensions, or new low-cost items, the productivity of existing equipment or production capacity
Fundamental capabilities	I want to: • forecast the maintenance expenditure and prepare a budget to ensure that maintenance expenditure is as per planned budget • receive information and suggestions regarding the maintenance activities

Table 14. Maintenance Manager - Key Objectives and Fundamental Capabilities

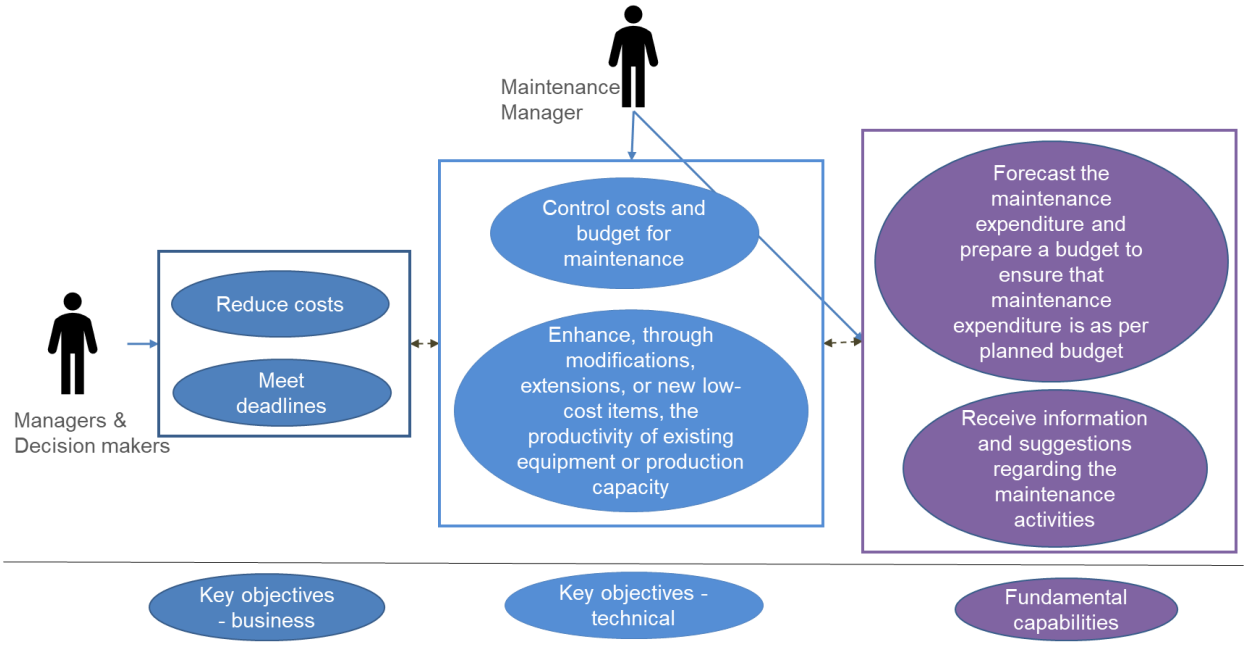

Figure 22. Maintenance Manager – Key Objectives and Fundamental Capabilities

Stakeholder Name	Maintenance Service Scheduler
Scenario and Processes involvement	Maintenance management activities
Key objectives – business	• Reduce costs • Meet deadlines
Key objective 1 – technical	• Plan Maintenance Work
Fundamental capabilities	I want to: • receive suggestions to schedule the maintenance work (after due consultation with the concerned production departments)
Key objective 2 – technical	• Respect the operating times of the system
Fundamental capabilities	I want to: • prepare inventory list of spare parts and materials required for maintenance • ensure proper inventory control of spare parts and other materials required
Key objective 3 – technical	• Minimize Equipment Failure and Production Downtime • Optimize the reliability of equipment and infrastructure • Extend Useful Machine Life

Stakeholder Name	Maintenance Service Scheduler
Fundamental capabilities	I want to: • monitor the equipment condition at regular intervals

Table 15. Maintenance Service Scheduler - Key Objectives and Fundamental Capabilities

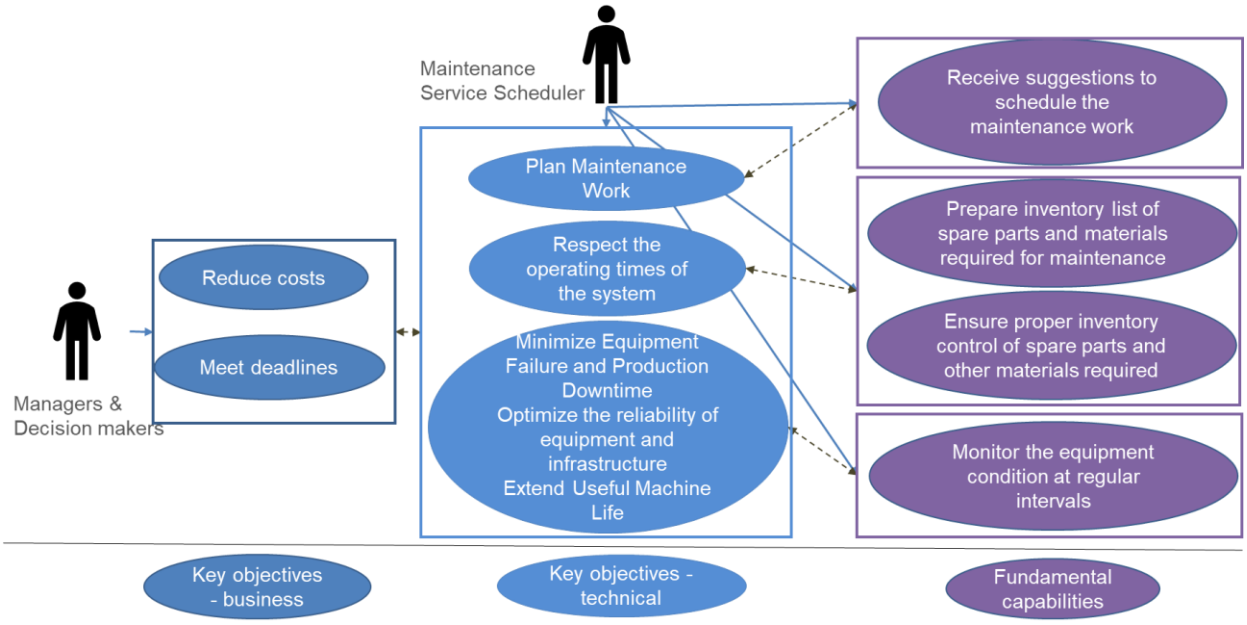

Figure 23. Maintenance Service Scheduler – Key Objectives and Fundamental Capabilities

Stakeholder Name	Maintenance Operator
Scenario and Processes involvement	Maintenance management activities
Key objectives – business	• Meet deadlines
Key objective 1 – technical	• Carry out prompt emergency repair of equipment and infrastructure to secure the best possible availability for production
Fundamental capabilities	I want to: • receive information and support to carry out repairs • provide feedback concerning the maintenance suggestions • be notified of the acquisition, installation and operation of machinery
Key objective 2 – technical	• Ensure scheduled inspection and adjustment of plant machinery and equipment • Ensure that equipment and infrastructure are always in good condition

Stakeholder Name	Maintenance Operator
Fundamental capabilities	I want to: • document and maintain a record of each maintenance activity (i.e., repairs, replacement, overhauls, modifications and lubrication etc.)

Table 16. Maintenance Operator - Key Objectives and Fundamental Capabilities

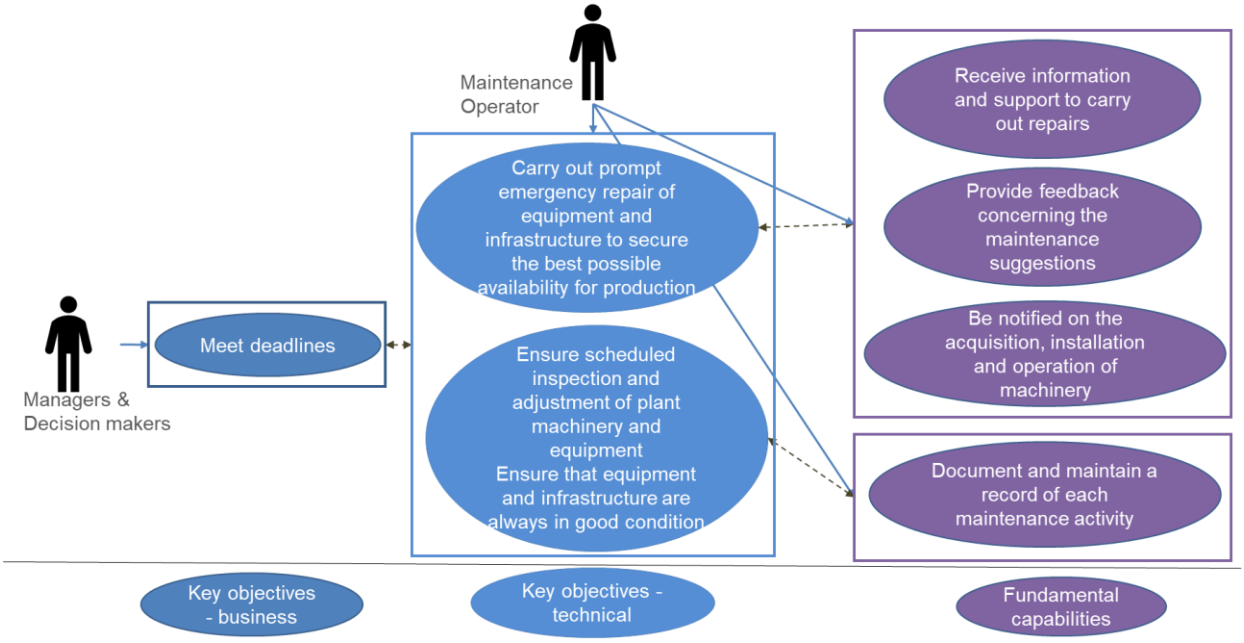

Figure 24. Maintenance Operator – Key Objectives and Fundamental Capabilities

Stakeholder Name	Customer support operator
Scenario and Processes involvement	Maintenance management activities
Key objectives – business	• Minimize waste • Reduce costs • Increase customer satisfaction • Meet deadlines
Key objective 1 – technical	• Support customers using the equipment when a problem occurs
Fundamental capabilities	I want to: • manage customer reports (ticketing system) • receive information and support to analyse the problem • have support to decide whether to implement maintenance procedures

Table 17. Customer Support Operator - Key Objectives and Fundamental Capabilities

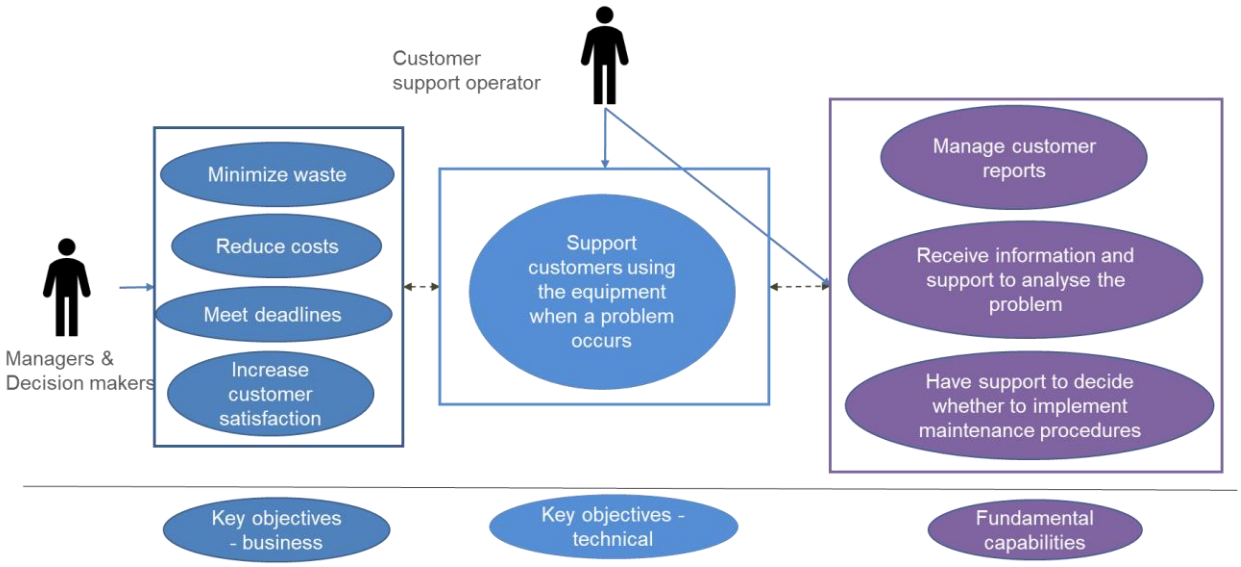

Figure 25. Customer Support Operator – Key Objectives and Fundamental Capabilities

3.1.6 Inventory Team

Stakeholder Name	Inventory Team
Scenario and Processes involvement	Material and Energy control Product Inventory control
Key objectives – business	• Minimize waste • Reduce costs • Improve final product quality • Meet deadlines
Key objective – technical	• Avoid Stock-Outs and Lost Sales, keeping goods moving efficiently Ensure the quality of supplies, raw material and final products
Fundamental capabilities	I want to: • examine the levels of supplies, raw material and final products to determine shortages • receive feedback on the quality of raw material • visualise and compare performance, reliability and costs of materials and/or suppliers • receive support for preparing the notification of the quality of the material to the supplier • receive information to prepare detailed reports on inventory operations, stock levels, and adjustments • perform daily analysis to predict potential inventory problems

Table 18. Inventory Team - Key Objectives and Fundamental Capabilities

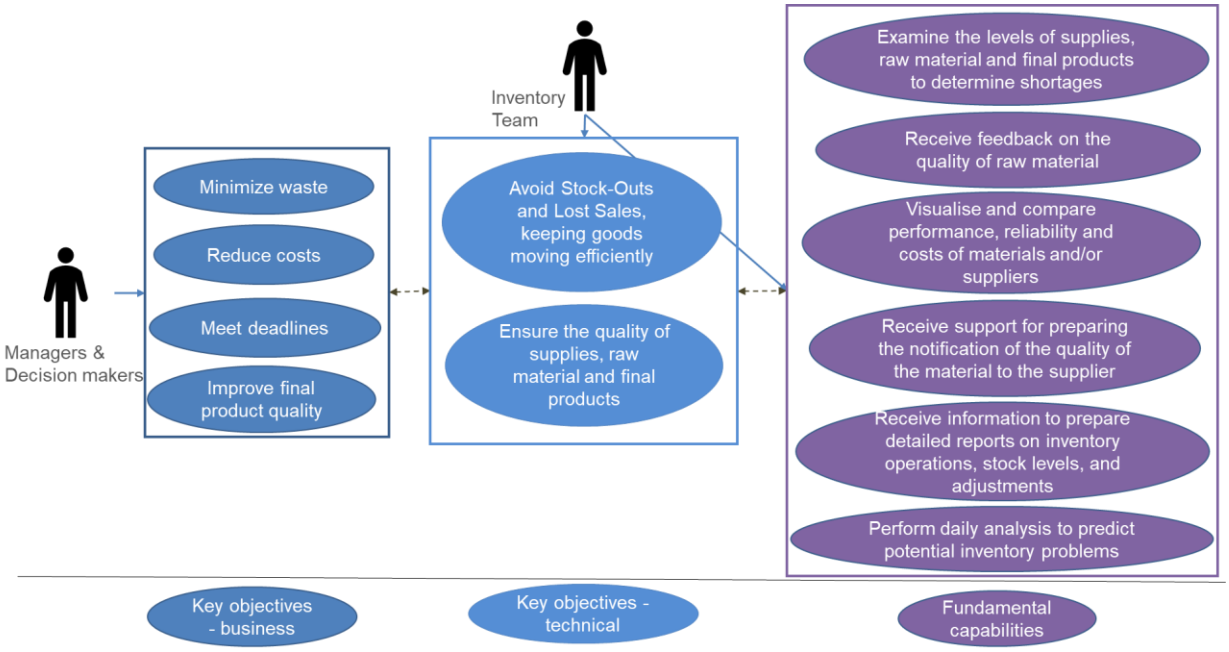

Figure 26. Inventory Team – Key Objectives and Fundamental Capabilities

3.2 Customers: Manufacturers – Suppliers

Stakeholder Name	Supplier
Vision	To be recognized as a reliable supplier providing a high-level quality material/product while respecting the deadline
Values and experiences	Products are nowadays produced in global and complex supply chains and companies are very dependent on the performance of their suppliers. A lot of time is wasted in creating reports or waiting for someone to send some critical information, moreover, the use of multiple systems for different companies increases the complexity and the probability of errors and issues. Reducing manual work and ensuring that the needed information is easily available are the main challenges to maintain a good relationship with the supplier and thus improving the company's overall performance.
Key objectives – business	• Improve the quality of the supplied product/material • Increase customer satisfaction • Meet deadlines
Key objectives – technical	• Receive feedback on the quality of the supplied product/material • Receive suggestions to improve the quality of the supplied product/material

Stakeholder Name	Supplier
Recommendations to reach the objectives	• Provide comprehensive reports concerning the quality of the supplied product/material • Incorporate in the report the result of the performed tests and suggestions for improvement • Allow providing feedback and clarifications concerning reports and product • Ensure transparent communication

Table 19. Suppliers - Key Objectives and Recommendations

3.3 Customers: Manufacturers – Customers' customers

Stakeholder Name	Customers' Customer
Vision	Customers need a product or service to function the way they need to solve their problem or desire. Customers have unique budgets with which they can purchase a product or service.
Values and experiences	Consumers have become increasingly demanding and many factors influence their choice. They should have enough and comprehensive information about the product in order to evaluate the possible purchase.
Key objectives	Purchase a product/service: • to solve his/her need or desire • which is convenient • easy to use or at least with clear documentation • which performs correctly • which is compatible with other products Receive the needed information and support about the purchased product
Recommendations to reach the objectives	• Provide clear and comprehensive documentation about the products/services • Provide functionalities and quality report • Provide customers support • Ensure transparent communication

Table 20. Customers' customer - Key Objectives and Recommendations

3.4 i4Q Technology Providers

Stakeholder Name	i4Q Technology Providers – Decision Maker
Vision	To be recognized as a reliable technology provider offering solutions for specific problems
Values and experiences	Company's vision is to develop in a constant manner and grow as a major IT service provider to become a leading performer, in providing quality Web and Software Development solutions in the competitive global marketplace. The company aims to enhance the business growth of customers delivering high-quality solutions that create value and reliable competitive advantage for several clients. The mission is to deliver optimal solutions with quality and services at reasonable prices. Customer satisfaction is given top place.
Key objectives - business	• Figure out New Products and Services to Offer to Customers, giving tools that improve their work quality and productivity • Automate customers' work to reduce cost and improve efficiency and productivity • Create New Business Models to Deliver Products and Services to Customers • Keep low cost for development, maintenance and integration with existing tools/infrastructure • Meet deadlines • Qualify as a trusted provider for the offered service/technology

Table 21. i4Q Technology Providers – Decision Maker - Key Objectives

Stakeholder Name	i4Q Technology Providers – Tech development team
Key objectives – business	• Figure out New Products and Services to Offer to Customers, giving tools that improve their work quality and productivity • Automate customers' work to reduce cost and improve efficiency and productivity • Create New Business Models to Deliver Products and Services to Customers
Key objective 1 – technical	Deliver Advanced Capabilities to Foster Collaboration, Knowledge Management, and Analytics.
Recommendations to reach the objective	• Develop an optimized set of steps for solving business problems (algorithms) • Ensure the availability of and access to information that

Stakeholder Name	i4Q Technology Providers – Tech development team
	enables customers to make timely, informed decisions by strengthening data and knowledge management approaches. • Provide self-service tools for customers • Provide tools and processes that are pleasing and productive to use (User experience)
Key objectives – business	• Qualify as trusted provider for the offered service/technology • Meet deadlines
Key objective 2 – technical	• Provide high quality support to the customers • Deliver quality solution respecting the deadlines and the requirements
Recommendations to reach the objective	• Provide documentation • Using a proven methodology of disciplined agility and a sequence of activities that you know works • Involve potential customers since the very beginning of the project • Perform data validation and exhaustive testing
Key objective 3 – technical	• Monitor and address data-related risk
Recommendations to reach the objective	• Stay current on software updates and patches (to protect data from potential hacks, I will need to regularly update security software and download patches to deal with any vulnerabilities that are found). • Maintain records of all data processing activities (according to European GDPR regulation and deleting all irrelevant data as soon as possible) • Implement security protocols in place that allow to identify, investigate and report data breaches within 72 hours. • Use encryption for data transfers (TLS - transport layer security - to prevent potential interception). • Schedule annual system penetration testing to identify vulnerabilities and to address them
Key objectives – business	• Keep low cost for development, maintenance and integration with existing tools/infrastructure
Key objective 4 – technical	Boost potential integration with other solutions.

Stakeholder Name	i4Q Technology Providers – Tech development team
Recommendations to reach the objective	• Use standard data model to enable data exchange • Make REST API available in order to get things working together • Use available libraries/assets or Open Source SW
Key objective 5 – technical	Provide a robust and secure IT infrastructure that supports n-demand access to information
Recommendations to reach the objective	• Deploy a modernized IT infrastructure that enables seamless access to information resources. • Protect the integrity of the company information and IT assets by strengthening our cybersecurity posture. • Drive centralized and streamlined cloud adoption to meet the business needs of the company. • Improve secure mobile and remote access to appropriate company resources.

Table 22. i4Q Technology Providers – Tech development team - Key Objectives and Recommendations

3.5 Governments

Three kinds of governments influence the i4Q framework, i.e., the European Commission (EC), and national and foreign governments. They are executive bodies that propose new laws and enforce existing ones. These powers allow governments to affect the i4Q framework in two ways. First, proposing laws may **create future requirements and obligations** affecting exploitability. An example is the proposal for the regulation of Artificial Intelligence (AI Act).[2] Second, existing laws **constrain the framework's instantiation** (e.g., some components may not be usable). An example is the General Data Protection Regulation (GDPR) that outlines how organizations must manage personal data. The figure below illustrates the three government types in a shell-model.

[2] https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

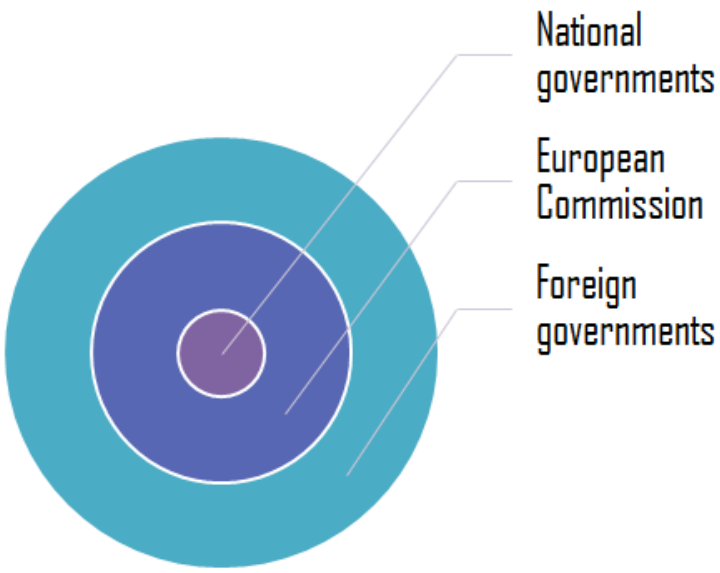

Figure 27. Government layer model for i4Q business viewpoint

The core are the national governments of the European Union acting in-line with the EC. They may regulate stricter compared to EC regulations. Foreign governments are all bodies outside the European Union, in particular the USA and China. The latter two are most relevant because of their market size and their political ambitions to lead (and control) IT innovations. Foreign laws affect the operation of i4Q solutions similar to the EU's laws but not necessarily in alignment. Chinese laws, for instance, may target European organizations to enforce a technology and knowhow transfer as experienced in the automotive, wind turbine, and aviation industry before. In addition, foreign governments possess the power to declare and enforce sanctions that limit the access to (large) markets. The government **focus in i4Q is on the EC and its influence** on the framework. This government level is most concrete and relevant for the entire European market.

There are at least four policy vectors to consider: AI ethics and regulated AI applications, national security, sovereignty, and digital inclusion. The following paragraphs briefly outline these vectors and their influence on the i4Q framework.

AI ethics and regulated AI applications. In April 2021, the European Parliament and the council published a proposal for the regulation of artificial intelligence (AI) applications[3]. Its goal is to create a uniform legal framework for the development, marketing and use of AI in conformity with Union values. This regulation focuses on:

[3] https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai

a) **providers** placing on the market or putting into service AI systems in the Union, irrespective of whether those providers are established within the Union or in a third country;
b) **users** of AI systems located within the Union;
c) providers and users of AI systems that are located **in a third country**, where the output produced by the system is used in the Union;

The EC's proposal could **enter into forced starting from the second half of 2022**. From second half of 2024, it could be applicable to operators/providers and be enforced. i4Q solutions could be affected by this regulation in two ways. *First*, an i4Q solution with an AI component could be considered a "high-risk" AI application and, therefore, must meet specific requirements regarding risk assessment, monitoring and documentation. *Second*, future regulation changes (e.g., during the transition period between 2022 and 2024) could introduce new requirements regarding, for instance, the documentation of the AI system and the need for a feature to explain AI decisions.

Most relevant at this point is the first impact. The AI Act proposal already outlines when AI systems pose high risk. A **high-risk AI system** is used in:

- Critical infrastructures.
- Educational or vocational training.
- Safety components of products.
- Employment, workers management and access to self-employment.
- Essential private and public services.
- Law enforcement that may interfere with people's fundamental rights.
- Migration, asylum and border control management.
- Administration of justice and democratic processes.

The use of AI in safety components of products could become a leverage to consider an i4Q solution as a high-risk application. Several pilots indicated in a survey that their products are safety-critical components for other products. If an i4Q solution uses an AI system to decide if a safety-critical item passes the final quality test, a flawed AI system may not recognize all unfit products. In consequence, if the safety-critical component fails because of this oversight, significant damage could result. Even though the AI system does not fulfil a safety-critical function as, e.g., the AI in a surgery robot, it can have a significant impact on the rate of unfit products reaching the market.

The recommendation for i4Q is to assess how an AI component affects item quality. This assessment is a first step to assign a risk to the use of the AI in quality management and a preparatory step for a potential increase in regulation.

Strategic Sovereignty is "*[…] the ability to act autonomously, to rely on one's own resources in key strategic areas and to cooperate with partners when needed*".[4] It does not imply self-

[4] https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2020)652069

sufficiency but aims at reducing external dependencies. This policy vector is less dependent on regulation. In i4Q, one of the key aspects to contribute to sovereignty is that its framework is flexible through software interoperability. Standards define common data-related requirements and as long as solutions follow them, they remain compatible with the framework. Since there is no central authority needed to operate i4Q solutions (e.g., a software platform), dependencies can be reduced by-design.

The recommendation for i4Q to further contribute to sovereignty is the use of Open Source software and software solutions developed in Europe. Solutions should assess the use of cloud-services outside of Europe, e.g., Google's and Amazon's cloud services, and identify alternatives usable if needed.

National Security (cyber security). In i4Q, the most relevant branch of national security is cybersecurity. In 2020, the EC outlined its EU Security Union Strategy covering the period from 2020 to 2025.[5] It has four strategic priorities:

1. A future proof security environment
2. Tackling evolving threats
3. Protecting Europeans from terrorism and organised crime
4. A strong European security ecosystem

The **first two priorities** are most relevant for i4Q, since they directly concern cybersecurity and cybercrime. A first concrete legislation step is the *Network and Information Systems* (NIS) Directive[6]. It outlined important procedures to follow in the case of cyber incidents. These incidents are relevant for i4Q because product quality information could attract criminals and foreign intelligence services for looking for espionage, ransom, and sabotage. The revised **NIS Directive (NIS2)**[7] will emphasize risk management, minimum security elements to be applied, and details about incident reporting, content of reports, and timelines. Besides, the EC outlines a framework for supply chains to coordinate incident reporting and counter measures.

The recommendation for i4Q is to 1) prepare procedures to inform national authorities and supply chain partners about cyber incidents and 2) consider implementing procedures to recover from incidents quickly.

Digital Inclusion. The EC has an interest in letting everybody contribute to and benefit from digital services. This policy vector is less dependent on regulation. Key initiatives are:

- Increasing the accessibility of ICT.
- Supporting the development of ICT that assists people with disabilities.
- Empowering citizens by teaching digital skills.
- Increase participation rate of disadvantaged people.

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[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1596452256370&uri=CELEX:52020DC0605

[6] https://digital-strategy.ec.europa.eu/en/policies/nis-directive

[7] https://digital-strategy.ec.europa.eu/en/library/proposal-directive-measures-high-common-level-cybersecurity-across-union

The recommendation for i4Q is 1) to reduce the skill floor for using i4Q solutions, 2) consider integrating user interface alternatives, and 3) teaching users the digital skills needed to use solutions (including skills to understand the importance of data quality).

Stakeholder Name	European Commission
Vision	Allow Europeans to benefit from new technologies developed and functioning according to Union values, fundamental rights and principles.
Values and experiences	The four policy vectors indicate important areas where the EC seeks or considers regulation. They include AI ethics, strategic sovereignty, national security, and digital inclusion.
Key objectives (legal)	• Propose and enforce harmonized rules for designing, developing, and operating AI systems in the EU • Propose and enforce rules for cybersecurity to minimize damages
Recommendations to reach the objective	• Seek legal advice • Follow good practices and acknowledged standards
Key objectives (strategic)	• Facilitate the use of digital services and infrastructures developed in the EU
Recommendations to reach the objective	• Avoid foreign infrastructure services • Use software with Open Source licenses

Table 23. European Commission –- Key Objectives and Recommendations

Stakeholder Name	National governments (inside EU)
Vision	Allow citizens to benefit from new technologies developed and functioning according to national government's values.
Values and experiences	Depending on the political system (how the government is selected and controlled) values range from EU-like values to competing values as in the case of China
Key objectives (legal)	• Propose and enforce harmonized rules for designing, developing, and operating AI systems • Propose and enforce rules for cybersecurity to minimize damages • May introduce stricter laws compared to EU-level
Recommendations to reach the objective	• Take into account not only the European regulations but also those specific to the countries being addressed in the project

Table 24. National governments (inside EU) –- Key Objectives and Recommendations

Stakeholder Name	Foreign governments (outside EU)
Vision	Allow citizens to benefit from new technologies developed and functioning according to national government's values, fundamental rights and principles.
Values and experiences	Very heterogeneous and therefore not possible to generalize. Values may be completely incompatible with values in the EU or partially.
Key objectives (business)	• Foreign governments may use sanctions to partially or completely restrict access to domestic markets. For state-controlled companies, industrial espionage is a viable option to acquire knowledge about production and quality management processes to copy competitive advantages.
Recommendations to reach the objective	• Propose and enforce laws that regulate the use of i4Q solutions to address own vision (e.g., reveal source code, mandate features, share data) • Propose and enforce laws to protect domestic market (e.g., restrict distribution or use of i4Q-related software, consultancy services, and infrastructure services)

Table 25. Foreign governments (outside EU) –- Key Objectives and Recommendations

Stakeholder Name	Standardization and Certification bodies
Vision	Standardize design principles for i4Q IIoT systems to ensure a common guideline on safe and standardized IIoT (and AI) solutions.
Values and experiences	Standardization is mostly driven by actors that bring best-practices from companies to transform them into applicable processes. The first who can standardize will get early access to methods and processes that will receive an uptake by many.
Key objectives (business)	• Drive best-practices and processes to (certifiable) standards allow others, either complementary solution or competitive solutions, to follow and gain a leverage on the interoperability of solutions • Cross-domain and -sector solutions will be more and more relevant and be more applicable with the use of standards

Stakeholder Name	Standardization and Certification bodies
Recommendations to reach the objective	• Generate standards at an early stage is important to strengthen market position • Evolve and promote standards over time and include new technologies over time and be compliant with previous standard's versions/releases

Table 26. Standardization and Certification bodies –- Key Objectives and Recommendations

3.6 Technology Community

Stakeholder Name	Specialist and Consulting companies
Vision	They want to earn money from knowledge about i4Q solutions, enlarging their business
Values and experiences	These companies provide their services to the users of the i4Q solution. These services are specialized, such as solving narrow technical and configuration problems, or consulting-based. The latter could focus on supporting client companies in deploying, configuring, and operating i4Q solutions.
Key objectives (business)	• Acquire knowledge and experience about i4Q solutions to sell it to client companies (as a service) • Solve client's problems faster and cheaper compared to an in-house expert
Recommendations to reach the objective	• Build an (open) documentation for third-parties • Develop templates and demonstration applications that others can quickly reuse and configure

Table 27. Specialist and Consulting companies –- Key Objectives and Recommendations

Stakeholder Name	Research institutions
Vision	Drive innovation and foster full potential as well as exceed current limitations on existing technological solutions
Values and experiences	i4Q solutions will be tested and analysed to identify boundaries and limitations (e.g., timeliness, capacity, possible malfunctioning/system fatigue, etc.). Furthermore, the integration and solution space for applying i4Q solutions will be broadened.
Key objectives (business)	• Uptake and early adoption of innovative solutions and cross integrations with other / complementary systems • Maturity test in field is required before transferring solutions to production • Rely to standard-based innovations that leverage legacy

Stakeholder Name	Research institutions
	solutions
Recommendations to reach the objective	• Initiate research project and participate in inter-regional DIHs (digital innovation hubs) • Piloting i4Q solutions and validate system - and integration readiness

Table 28. Research institutions –- Key Objectives and Recommendations

Stakeholder Name	Tech providers and IT integrators
Vision	Provide valuable results for clients by connecting own solution to existing i4Q solutions
Values and experiences	This stakeholder represents various IT organizations that sell software they developed. These companies may also act as vendors for software developed elsewhere, and they may integrate services into their offer (see consulting companies). Besides, IT integrators may build connectors to allow third-party software access to i4Q solutions.
Key objectives (business)	• Ensure easily accessible and reliable information exchange between i4Q and distributed software.
Recommendations to reach the objective	• Provide open documentation of interfaces • Follow interface standards • Inform about interface capacity (how many queries, how often, etc.)
Key objectives (technical)	• Ensure open data exchange interfaces per solution (easily accessible) • Ensure i4Q solutions support acknowledged, widely-used data exchange and storage standards (also on semantic level)
Recommendations to reach the objective	• Make connectors Open Source to become transparent and attract a community of supporters • Use standards and acknowledged practices, and widely-used Opensource tools with large communities

Table 29. Tech providers and IT integrators –- Key Objectives and Recommendations

Stakeholder Name	Open Source communities
Vision	Benefits of i4Q solutions are that predominant which causes an incentive for publicly interest of further development on

Stakeholder Name	Open Source communities
	innovative solutions
Values and experiences	Positive user experiences and the willingness for good solutions will drive enthusiasts and actors in Open Source communities to develop further features and stabilize robustness of i4Q systems.
Key objectives (business)	• Present benefits of i4Q solutions in field tests • Generate improvements of solutions on company-external level; test user behaviour and i4Q systems' user experience • Giving the possibility to interlink an interoperable i4Q solution to other complementary goods / products / systems
Recommendations to reach the objective	• Grant early access to end-users and beta testing (addressing tech-enthusiasts)

Table 30. Open-Source communities –- Key Objectives and Recommendations

3.7 Citizens

Stakeholder Name	Citizens
Vision	i4Q solutions will provide more convenience and better quality of life for citizens
Values and experiences	User feedback can be generated by various communication and/or distribution channels.
Key objectives - business	• Generated user feedback from citizens can be used to improve i4Q processes and solutions • Improve customer loyalty and user experience
Recommendations to reach the objective	• Establish communication channels along the value chain of i4Q solutions, which will direct the information flow always to the right point of interest to process feedback

Table 31. Citizens –- Key Objectives and Recommendations

3.8 Overview

This section provides an overview of the Business Viewpoint reporting all the functional capabilities and recommendations identified in the sections above.

Stakeholder Name	Key Objectives		Functional Capabilities I want to:
	Business	Technical	
Process Support Engineer	Minimize waste Reduce costs Meet deadlines	Anticipate problems that may occur throughout a production batch before the end of the process	Identify factors that influence the quality
			Predict possible product problems
Processing Operator	Minimize waste Reduce costs Meet deadlines	Intervene as soon as possible on the production process when a problem occurs	Be notified when deviations from standard functioning values occur
		Reconfigure process parameters quickly and easily	Simply modify process input configurations
Production Scheduler	Minimize waste Reduce costs Meet deadlines	Create a production schedule collecting actual production information and production capability information	Receive information on the production capacity and resource availability
			Have support and suggestions for the production schedule definition
		Monitor the production flow and enable scenario data-driven decision making	Receive feedback from actual production
			Receive feedback on the quality of the final product
			Have support for the production schedule update
Assembler	Meet deadlines	Perform the product assembly	Have support to test the output to ensure the highest

Stakeholder Name	Key Objectives		Functional Capabilities I want to:
	Business	Technical	
		activity on time guaranteeing the highest quality	quality
			Receive feedback and suggestions for improving the quality of the output
			Report on issues, malfunction or defective parts
Product Engineer	Reduce costs Improve final product quality	Improve product design for increased performance and functionality	Identify factors that influence the quality and/or functionality of a product
			Evaluate the new/updated product in terms of functionality and quality
		Determining manufacturing requirements and processes	Visualise and compare performance, reliability and costs of materials and/or suppliers
		Control costs and budget for the new/improved product	Have support to determine production costs of the new/improved product
Data & Analytics Engineer	Reduce costs Meet deadlines Improve final product quality	Monitor production processes using data coming from multiple sources	Develop high performance data pipelines to support complex data integration
			Oversee ETL (extract, transform, load)
			Build and train data models
			Analise multiple data sources in detail to identify quality trends and problem indicators
		Improve existing processes to streamline efforts	Receive suggestions for processes improvement

Stakeholder Name	Key Objectives		Functional Capabilities I want to:
	Business	Technical	
Quality Manager	Increase customer satisfaction Improve final product quality	Certify that the product was produced according to standard process conditions	Certify the quality of the process in a simple and verifiable way
		Check of product data versus customer's requirements	Certify product quality in a simple and verifiable way
	Reduce costs Minimise waste Meet deadlines	- Minimise the time for releasing material for further use (delivery or further processing)	Visualize information about the quality of item or process
			Identify the potential origin of an issue in a simple way
			Have support for the final decision on a quality issue
Quality Inspector	Reduce costs Improve final product quality Minimise waste Meet deadlines	- Test and verify the quality of materials (raw, final and intermediate) to ensure that quality goals are met while respecting the deadlines for the activity	Visualise information about an item or process
			Perform the testing of incoming raw material in a simple but accurate way
			Perform testing of a product in a simple but accurate way
			Report and save the result of the evaluation
			Have support on decision concerning escalation

Stakeholder Name	Key Objectives		Functional Capabilities I want to:
	Business	Technical	
Maintenance Manager	Reduce costs Meet deadlines	- Control costs and budget for maintenance - Enhance, through modifications, extensions, or new low-cost items, the productivity of existing equipment or production capacity	Forecast the maintenance expenditure and prepare a budget to ensure that maintenance expenditure is as per planned budget
			Receive information and suggestions regarding the maintenance activities
Maintenance Service Scheduler	Reduce costs Meet deadlines	Plan Maintenance Work	Receive suggestions to schedule the maintenance work (after due consultation with the concerned production departments)
		Respect the operating times of the system	Prepare an inventory list of spare parts and materials required for maintenance
			Ensure proper inventory control of spare parts and other materials required
		Minimize Equipment Failure and Production Downtime Optimize the reliability of equipment and infrastructure Extend Useful Machine Life	Monitor the equipment condition at regular intervals
Maintenance Operator	Meet deadlines	Carry out prompt emergency repair of equipment and infrastructure to secure the best possible availability for production	Receive information and support to carry out repairs
			Provide feedback concerning the maintenance suggestions
			Be notified of the acquisition, installation and operation of machinery

Stakeholder Name	Key Objectives		Functional Capabilities I want to:
	Business	Technical	
		- Ensure scheduled inspection and adjustment of plant machinery and equipment - Ensure that equipment and infrastructure are always in good condition	Document and maintain a record of each maintenance activity (i.e., repairs, replacement, overhauls, modifications and lubrication etc.)
Customer support operator	Minimize waste Reduce costs Improve final product quality Increase customer satisfaction Meet deadlines	Support customers using the equipment when a problem occurs	Manage customer reports (ticketing system)
			Receive information and support to analyse the problem
			Have support to decide whether to implement maintenance procedures
Inventory Team	Minimize waste Reduce costs Meet deadlines Improve final product quality	Avoid Stock-Outs and Lost Sales, keeping goods moving efficiently Ensure the quality of supplies, raw material and final products	Examine the levels of supplies, raw material and final products to determine shortages
			Receive feedback on the quality of raw material
			Visualise and compare performance, reliability and costs of materials and/or suppliers
			Receive support for preparing the notification of the quality of the material to the supplier
			Receive information to prepare detailed reports on inventory operations, stock levels, and adjustments

Stakeholder Name	Key Objectives		Functional Capabilities I want to:
	Business	Technical	
			Perform daily analysis to predict potential inventory problems

Table 32. Overview of Functional Capabilities

Stakeholder Name	Key Objectives	Recommendations
Supplier	- Receive feedback on the quality of the supplied product/material - Receive suggestions to improve the quality of the supplied product/material	- Provide comprehensive reports concerning the quality of the supplied product/material - Incorporate in the report the result of the performed tests and suggestions for improvement - Allow providing feedback and clarifications concerning reports and product - Ensure transparent communication
Customers' customer	Purchase a product/service: - to solve his/her need or desire - which is convenient - easy to use or at least with clear documentation - which performs correctly - which is compatible with other products Receive the needed information and support about the purchased product	- Provide clear and comprehensive documentation about the products/services - Provide functionalities and quality report - Provide customer support - Ensure transparent communication
i4Q Technology Providers – Tech development team	- Deliver Advanced Capabilities to Foster Collaboration, Knowledge Management, and Analytics.	- Develop an optimized set of steps for solving business problems (algorithms) - Ensure the availability of and access to information that

Stakeholder Name	Key Objectives	Recommendations
		enables customers to make timely, informed decisions by strengthening data and knowledge management approaches. - Provide self-service tools for customers - Provide tools and processes that are pleasing and productive to use (User experience)
	- Provide high-quality support to the customers - Deliver quality solutions respecting the deadlines and the requirements	- Provide documentation - Using a proven methodology of disciplined agility and a sequence of activities that you know works - Involve potential customers since the very beginning of the project - Perform data validation and exhaustive testing
	- Monitor and address data-related risk	- Stay current on software updates and patches (to protect data from potential hacks, I will need to regularly update security software and download patches to deal with any vulnerabilities that are found). - Maintain records of all data processing activities (according to European GDPR regulation and deleting all irrelevant data as soon as possible) - Implement security protocols in place that allow to identify, investigate and report data breaches within 72 hours. - Use encryption for data transfers (TLS - transport layer security - to prevent potential interception). - Schedule annual system penetration testing to identify vulnerabilities and to address them

Stakeholder Name	Key Objectives	Recommendations
	Boost potential integration with other solutions.	- Use standard data model to enable data exchange - Make REST API available to get things working together - Use available libraries/assets or Open Source SW
	Provide a robust and secure IT infrastructure that supports n-demand access to information	- Deploy a modernized IT infrastructure that enables seamless access to information resources. - Protect the integrity of the company information and IT assets by strengthening our cybersecurity posture. - Drive centralized and streamlined cloud adoption to meet the business needs of the company. - Improve secure mobile and remote access to appropriate company resources.
European Commission	- Proposing and enforcing harmonized rules for designing, developing, and operating AI systems in the EU. - Proposing and enforcing rules for cybersecurity to minimize damages	- Seek legal advice - Follow good practices and acknowledged standards
	- Facilitating the use of digital services and infrastructures developed in the EU.	- Avoid foreign infrastructure services - Use software with Opensource licenses
National governments (inside EU)	- Propose and enforce harmonized rules for designing, developing, and operating AI systems - Propose and enforce rules for cybersecurity to minimize damages - May introduce stricter laws compared to	- Take into account not only the European regulations but also those specific to the countries being addressed in the project

Stakeholder Name	Key Objectives	Recommendations
	EU-level	
Foreign governments (outside EU)	- Foreign governments may use sanctions to partially or completely restrict access to domestic markets. For state-controlled companies, industrial espionage is a viable option to acquire knowledge about production and quality management processes to copy competitive advantages.	- Propose and enforce laws that regulate the use of i4Q solutions to address own vision (e.g., reveal source code, mandate features, share data) - Propose and enforce laws to protect domestic market (e.g., restrict distribution or use of i4Q-related software, consultancy services, and infrastructure services)
Standardization and Certification bodies	- Drive best-practices and processes to (certifiable) standards allow others, either complementary solution or competitive solutions, to follow and gain a leverage on the interoperability of solutions - Cross-domain and -sector solutions will be more and more relevant and be more applicable with the use of standards	- Generate standards at an early stage is important to strengthen market position - Evolve and promote standards over time and include new technologies over time and be compliant with previous standard's versions/releases
Specialist and Consulting companies	- Acquire knowledge and experience about i4Q solutions to sell it to client companies (as a service) - Solve client's problems faster and cheaper compared to an in-house expert	- Build an (open) documentation for third-parties - Develop templates and demonstration applications that others can quickly reuse and configure

Stakeholder Name	Key Objectives	Recommendations
Research institutions	- Uptake and early adoption of innovative solutions and cross integrations with other / complementary systems - Maturity test in field is required before transferring solutions to production - Rely upon standard-based innovations that leverage legacy solutions	- Initiate research project and participate in inter-regional DIHs (digital innovation hubs) - Piloting i4Q solutions and validate system - and integration readiness
Tech providers and IT integrators	- Ensure easily accessible and reliable information exchange between i4Q and distributed software	- Provide open documentation of interfaces - Follow interface standards - Inform about interface capacity (how many queries, how often, etc.)
	- Ensure open data exchange interfaces per solution (easily accessible) - Ensure i4Q solutions support acknowledged, widely-used data exchange and storage standards (also on semantic level)	- Make connectors Opensource to become transparent and attract a community of supporters - Use standards and acknowledged practices, and widely-used Opensource tools with large communities
Open Source communities	- Present benefits of i4Q solutions in field tests - Generate improvements of solutions on company-external level; test user behaviour and i4Q systems' user experience - Giving the possibility to interlink an	- Grant early access to end-users and beta testing (addressing tech-enthusiasts)

Stakeholder Name	Key Objectives	Recommendations
	interoperable i4Q solution to other complementary goods / products / systems	
Citizens	- Generated user feedback from citizens can be used to improve i4Q processes and solutions - Improve customer loyalty and user experience	- Establish communication channels along the value chain of i4Q solutions, which will direct the information flow always to the right point of interest to process feedback

Table 33. Overview of Recommendations

4. Conclusions and next steps

This deliverable deals with the business analysis performed in designing i4Q Refence Framework. In fact, for the purpose of defining i4Q Reference Architecture, the objective is to avoid a technologic-centric perspective. So, this task T2.3 investigated in business related considerations, leading to a different analysis of i4Q RIDS.

After the initial **Stakeholders**' classification, main elements have been considered: **Vision**, describing a future state of an organization; **Values**, reflecting how the vision may be perceived by the stakeholders involved in the implementation and usage of the i4Q Solutions; **Key objectives**, quantifiable high-level technical and ultimately business outcomes; **Fundamental capabilities**, referring to high-level specifications of the essential ability of the i4Q Solutions to complete specific major business tasks.

Starting from the Business Viewpoint, the Usage Viewpoint will consolidate various aspect of the system's usage, continuing the initial design efforts made in T2.3.

- Stakeholders' analysis will support to identify tasks (the basic unit of work), roles (dealing with the responsibilities of executing a task) and parties (intended as an agent, human or automated, that has autonomy, interest and responsibility in the execution of tasks), considering both users and software systems.
- At the same time, the key objectives, fundamental capabilities and recommendations here identified will help to derive usage activities and system requirements of the Usage Viewpoint.

According to IIRA layered-perspective and the adopted iterative approach, the Usage Viewpoint will guide the development of the Functional and Implementation Viewpoints. The link between these works will be defined within each task's functional map and implementation map which links each task with the different functions and implementation components.

The functional viewpoint will focuse on the functional aspects of i4Q Solutions. It will consider their internal functional structure, defining its internal functional components, as well as the interfaces and interrelations with other solutions and external systems. These elements will be coordinated with the usage viewpoint, linked to the user activities and with the business viewpoint, describing how the fundamental system capabilities are implemented from a functional view point.

Finally, the Implementation viewpoint will describe the IIoT i4Q Architecture, its technologies, system components and interconnections between them for its implementation. In order to achieve this, it will have as inputs: from Business viewpoint its business-oriented approach that identifies stakeholders and their business vision, values and objectives to map them to system capabilities; from Usage Viewpoint the activities and tasks identified to implement the capabilities and structure of the i4Q Framework for which will provide implementation maps with their associated components; finally, from Functional viewpoint the identified functional components, flows circulating among them and their typical operations.

The design of the i4Q Reference Architecture will be an iterative and parallel process, in which the results provided by the analysis across the four key viewpoints (business, usage, functional and implementation) will serve as input for such architecture, which at the same time will

condition them. The combination of the results obtained from the different viewpoints will derive into a detailed reference architecture (D2.7), including business, regulatory and stakeholders' key inputs, here defined.

References

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Smith, L. (2000). Stakeholder analysis: a pivotal practice of successful projects. *Project Management Institute Annual Seminars & Symposium.* Houston, TX.

Annex I

Viewpoints Validation Questionnaire - 1st iteration

This is the first iteration of the Viewpoints Validation Questionnaire.

Thanks to your participation in this questionnaire, we would like to reach the following goals:

- Validate the work done on the first iteration of the Viewpoints development
- Collect valuable feedback for the following iteration
- Test the validation process and tools

The questionnaire takes about five minutes to complete.

The outcome will contribute to the development of the Business, Usage, Functional and Implementation Viewpoints.

Any information or answers to the questionnaire you provide will not be used for other purposes except the development of the i4Q activities and will not be sold, rented, leased or forwarded to any third party.

Thank you for your time and input! *Mandatory field

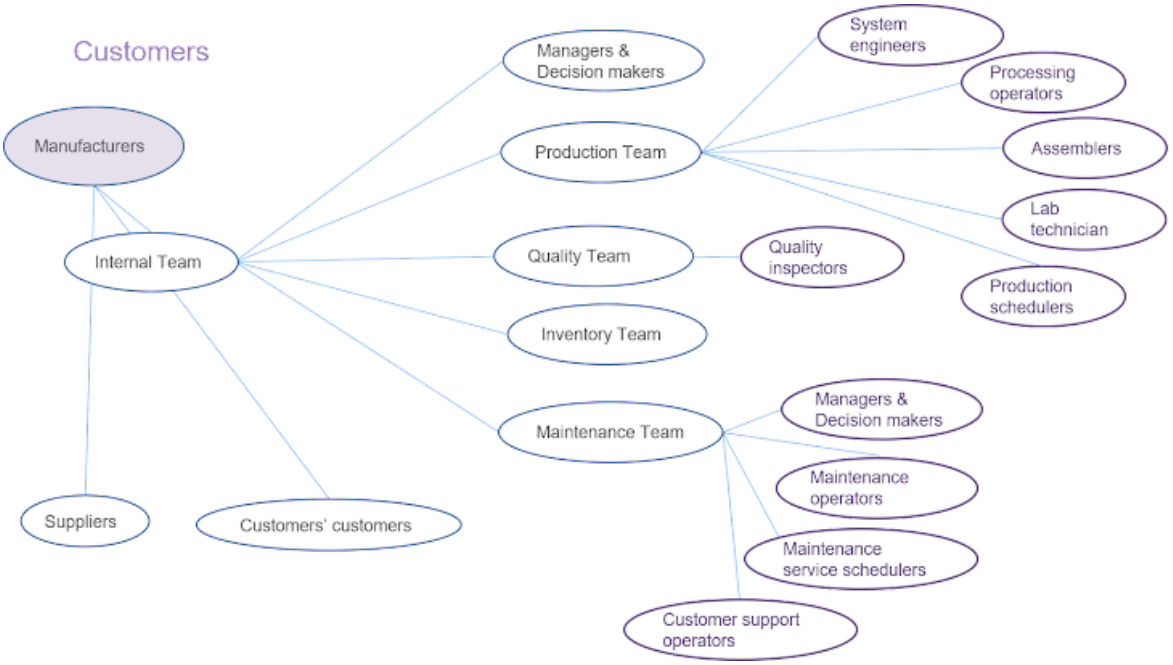
1. Name *

2. email address *

Stakeholders

The following picture represents the relevant stakeholders for i4Q RIDS belonging to a generic manufacturer customer.

Manufacturers' Stakeholders



3. Does the list of "Internal Team" cover all the relevant stakeholders which could have specific needs with respect to i4Q RIDS? * *Select only one option.*

Yes

No

I don't know

Other:

4. If no, please specify what are the missing stakeholders and/or teams

5. In your experience, are there any suppliers which could have specific needs that can impact the i4Q RIDS functional capabilities? * *Select only one option.*

Yes

No

I don't know

Other:

6. If yes, please specify the suppliers and the reasons

7. In your experience, are there any particular customers which could have specific needs that can impact the i4Q RIDS functional capabilities? * *Select only one option.*

- Yes
- No
- I don't know

Other:

8. If yes, please specify the customers and the reasons

9. To be recognized as a reliable manufacturer offering a high-level quality output, a company must: *

Please rank the following options on a scale from 1 to 5, with 5 being the highest

	1	2	3	4	5
Minimize waste					
Reduce costs for re-working activities					
Improve final product quality					
Increase customer satisfaction					
Other					

10. Other: please, specify