Tiago Miranda Gonçalves Figueira Abrantes

Licenciado em Ciências da Engenharia e Gestão Industrial

A methodology to design interoperable METROFOOD Research Infrastructures: the case of the Portuguese Node

Dissertação para obtenção do Grau de Mestre em
Engenharia e Gestão Industrial

Orientador: Doutor Izunildo Fernandes Cabral, Professor Auxiliar Convidado da Faculdade de Ciências e Tecnologia da Universidade NOVA de Lisboa

Coorientadora: Doutora Ana Sofia Leonardo Vilela de Matos, Professora Associada da Faculdade de Ciências e Tecnologia da Universidade NOVA de Lisboa

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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Fevereiro, 2021

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DEDICATORY

This dissertation is dedicated to the life and joy of my Avô António.

Avô, todos os dias me lembro de ti com um sorriso!
Todos os dias me lembro do teu riso inconfundível!
Obrigado pela tua alegria!

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To finalise, to all my friends, but especially to João Almeida for his support and motivation when we were housemates, a big thank you as well.

ABSTRACT

This dissertation proposes a new methodology to design Interoperable METROFOOD Research Infrastructures. The METROFOOD project aims at creating a distributed global Research Infrastructure (METROFOOD-RI) which will allow all involved entities and countries to successfully collaborate in the field of food quality and safety, by providing high-level metrology services. Portugal is one of the involved countries, with INSA, IPMA and FCT-UNL forming the Portuguese Node and the network which was the object of the Case Study of the dissertation.

The methodology consists of applying the first phase of Quality Function Deployment, known as House of Quality, to identify the Interoperability requirements of the network under analysis and define what solutions can be put in place to render the network fully interoperable. Those solutions are then ranked according to their relevance in achieving Interoperability, allowing priorities to be defined.

To define the METROFOOD-RI's Interoperability requirements, a new Interoperability framework is proposed, reflecting the existing frameworks in the literature and the specific requirements of METROFOOD-RI.

With the results of the Case Study on the Portuguese Node of METROFOOD-RI, it was possible to conclude that the House of Quality can be used as a methodology to design Interoperable METROFOOD Research Infrastructures. As this is the first time the QFD methodology has been used to design Interoperable networks and the first time that Interoperability has been formally studied in the scope of METROFOOD-RI, there might be limitations in the final conclusions of the study. Therefore, future research is advised and expected.

Keywords: Interoperability; METROFOOD-RI; Quality Function Deployment; House of Quality; Customer and Technical Requirements; Research Infrastructures

RESUMO

Esta dissertação propõe uma nova metodologia para a concepção de Infra-estruturas Interoperáveis de Investigação METROFOOD. O projecto METROFOOD visa a criação de uma Infra-estrutura de Investigação distribuída a nível mundial (METROFOOD-RI) que permitirá a todas as entidades e países envolvidos colaborar com sucesso no campo da qualidade e segurança alimentar, fornecendo serviços de metrologia de alto nível. Portugal é um dos países envolvidos, com INSA, IPMA e FCT-UNL a formarem o Nó Português e a rede que foi objecto do Estudo de Caso da dissertação.

A metodologia consiste em aplicar a primeira fase da metodologia Quality Function Deployment, conhecida como Casa da Qualidade, para identificar os requisitos de Interoperabilidade da rede em análise e definir que soluções podem ser postas em prática para tornar a rede totalmente interoperável. Essas soluções são então classificadas de acordo com a sua relevância para alcançar a Interoperabilidade, permitindo a definição de prioridades.

Para definir os requisitos de interoperabilidade do METROFOOD-RI, é proposto um novo quadro de interoperabilidade, reflectindo os quadros existentes na literatura e os requisitos específicos do METROFOOD-RI.

Com os resultados do Estudo de Caso sobre o Nó Português de MÉTOFOOD-RI, foi possível concluir que a Casa da Qualidade pode ser utilizada como uma metodologia para conceber infra-estruturas de Investigação Interoperáveis de METROFOOD. Sendo esta a primeira vez que a metodologia QFD foi utilizada para conceber redes Interoperáveis e a primeira vez que a Interoperabilidade foi formalmente estudada no âmbito do METROFOOD-RI, pode haver limitações nas conclusões finais do estudo. Por conseguinte, a investigação futura é aconselhada e esperada.

Termos Chave: Interoperabilidade; METROFOOD-RI; Desdobramento da Função Qualidade; Casa da Qualidade; Requisitos do Cliente e Técnicos; Infraestruturas de Investigação

ABBREVIATIONS

e-RI – Electronic Research Infrastructure

ESFRI - European Strategy Forum on Research Infrastructures

EU – European Union

FBOs – Food Business Operators

FCT-UNL – Faculdade de Ciências e Tecnologia - Universidade Nova de Lisboa

HoQ – House of Quality

ICTs – Information and Communication Technologies

INSA – Instituto Nacional de Saúde Doutor Ricardo Jorge

IPMA – Instituto Português do Mar e da Atmosfera

KPI – Key Performance Indicator

METROFOOD-RI - Research Infrastructure for Promoting Metrology in Food and Nutrition

P-RI – Physical Research Infrastructure

QFD – Quality Function Deployment

SMEs – Small and Medium-sized Enterprises

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1. INTRODUCTION

1.1. Outline of the dissertation

This dissertation is divided in five chapters, with the current and first one being the Introduction. On this chapter, the problem background and motivation are explained, clarifying the relevance of the dissertation, and introducing METROFOOD-RI, the project in which it is involved. Furthermore, the research purposes and the methodological approach followed are presented.

Chapter 2 consists of the Literature review on Interoperability. A first introduction of the fundamental concepts and definitions is given in Section 2.1, followed by Section 2.2 which presents existing Interoperability models and frameworks.

Chapter 3 describes the proposed Methodology to design Interoperable METROFOOD Research Infrastructures, starting by presenting the utilized Interoperability Framework in Section 3.1, followed by a literature review on Quality Function Deployment (QFD) and House of Quality (HoQ) (the reference methodologies) and, finally, the explanation of the proposed Methodology.

Chapter 4 addresses the case study conducted to validate the proposed methodology. As the case study is on the Portuguese Node of METROFOOD-RI, overviews of both the METROFOOD-RI project and the Portuguese Node are provided in Section 4.1. The case study is presented in Section 4.2.

Finally, Chapter 5 presents the final conclusions reached and connects them with the initial research purposes and hypothesis. Advices for future research and next steps are also suggested. Additionally, the main challenges and constraints faced throughout the dissertation development are referred.

1.2. Problem background and motivation

The agri-food (agriculture and food) sector represents one of the most relevant economic activities in the European Union, having a considerable social importance for several reasons, besides supplying healthy and quality food: it ensures employment throughout the food value chain, allows Small and Medium-sized Enterprises (SMEs) to be part of the international food chain, helps preserving rural public goods and, particularly in Portugal, stimulates the economy of less populated areas which depend mostly on agriculture and farming.

According to the European Commission, 7% of the total value of exported goods by the European Union in 2018 corresponds to agriculture products, only ranking behind machinery, other manufactured goods and chemicals. Furthermore, along with agriculture, industries and services related to food provide about 44 million jobs in Europe. The chain between food production and processing ensures 7,5% of total employment and 3,7% of total value added in the EU (European Commision 2019).

In the modern society, healthy food, nutrition and health have become major concerns for a great part of the general population. While in past times most people simply limited themselves to buying food according to their habits and tastes, nowadays nutritional information, food composition, place of origin, quality certificates and other specific factors have a considerable and ever-growing importance in the process of choosing what items are going to be part of one's diet. Thereby, food traceability and safety have become crucial elements of countries' public health programs. In this regard, it is fundamental to have high-quality data throughout the entire food chain with which the modern and future data technologies and electronic infrastructures shall be filled, allowing further research on food and food metrology.

It is within this context that the European Strategy Forum on Research Infrastructures, ESFRI, has brought about METROFOOD-RI (Research Infrastructure for Promoting Metrology in Food and Nutrition). It is a distributed research infrastructure for promoting Metrology in Food and Nutrition, aiming to improve food quality and safety as well as supporting traceability and sustainability of the agri-food systems. The main objective of this pan-European project is to promote and increase scientific collaboration between all stakeholders of the agri-food sector through (not exclusively) the creation of a shared database and a platform for sharing information and knowledge on the topic. The infrastructure is meant to provide food and nutrition with high-quality metrology services which will cover many interconnected fields all along the food value chain (agri-food, food safety, quality, traceability and authenticity, sustainable development, environmental safety, human health and consumer sciences)(ESFRI 2018b; 2018a).

This research infrastructure will be addressed and accessible to all users and stakeholders of the food chain, namely the following: laboratories and other entities involved in food data gathering and measurement reliability and basic edge research in food and nutrition; Food Business Operators (FBOs) and producers associations; policy makers, food inspectors and control entities; consumers and consumer associations (ESFRI 2018b).

Being a European Union project, at least 18 countries are and will be involved, representing a total of 48 entities working together (Zoani 2016). For a project with such complexity to deliver the desired results on time and according to the settled objectives, all these 48 entities need to be effectively coordinated and aligned. This is no simple task, as each entity has its own business processes, workflows, schedules and deadlines, communication channels, information systems and platforms, language, geographical location and other different factors. Therefore, it is very hard to create a smooth and work-efficient network.

It is due to the complexity of this network and the inherent difficulty to make it work-efficient that arises the importance of this dissertation's main topic: **Interoperability**. Further, in Chapter 2, this concept and its definition will be thoroughly explored, but a short definition proposed by ATHENA (2007) is "*the organisational and operational ability of an enterprise to cooperate with its business partners and to efficiently establish, conduct and develop IT-supported business relationships with the objective to create value".* For the specific case of the METROFOOD-RI, the "enterprise" mentioned in the definition will be each of the 48 entities included in the METROFOOD project

and its business partners will be the remaining entities. The business relationships will be all the relationships established between the 48 entities and the objective will be to create value for the METROFOOD-RI.

Thus, Interoperability becomes a major concern for the METROFOOD-RI to be successful and to meet the EU expectations. In other words, the whole network must become interoperable and, therefore, each National Node (entities of the same country) must be supported by an interoperable network first and foremost. This, in turn, will help to ensure interoperability between the National Nodes, contributing to make the METROFOOD-RI fully interoperable.

This dissertation and all the work developed throughout its preparation, will be the starting point to turn the Portuguese Node into an Interoperable network, thereafter, transmitting the acquired knowledge and processes to help the remaining national nodes reach the same status and, subsequently, helping the full METROFOOD-RI become an Interoperable network.

Multiple authors have investigated and developed work on the topic of Interoperability, with Cabral 2015; Cruz 2016; Cabral and Grilo 2018; Espadinha-Cruz and Grilo 2019 aggregating all developed knowledge in their works. These investigations have been done in the context of standard Business Interoperability, encompassing situations like cooperative Supply Chain Networks (SCNs) and Buyer-Supplier dyads. None of these contexts include the specific case of the METROFOOD-RI, where Interoperability needs to be achieved in a network composed by approximately fifty entities which has the objective of generating scientific knowledge through collaboration. This dissertation attempts to fulfil this gap by proposing a new methodology to design Interoperable METROFOOD Research Infrastructures.

1.3. Research Purposes

Considering the highly interdisciplinary, collaborative, and complex nature of the METROFOOD-RI project, which comprises multiple entities from several countries with different languages and work methodologies, it essential to design an interoperable network infrastructure which takes into account all entities and all their relationships. Otherwise, efficient scientific collaboration at a European level will not be possible.

Due to the already mentioned complexity of the European network, the case study presented in this dissertation only addresses the Portuguese Node. However, if the case study reveals positive results, the proposed methodology can be used in other Nodes and, ultimately, in the whole network. Therefore, **the main purpose of the dissertation is the following:**

To propose a viable methodology to develop design Interoperable METROFOOD Research Infrastructures.

To fulfil this purpose, the **following assumption has been established**:

It is possible to apply the Quality Function Deployment (QFD) methodology to design an Interoperability configuration suited to the METROFOOD network's requirements.

Specific and secondary purposes will need to be accomplished for the main purpose to be fulfilled:

- To understand and identify each Portuguese entity's role in the project and how they affect each other;
- To define the interoperability requirements that all entities of the Portuguese Node will need to fulfil in order to make the node interoperable;
- To validate the defined interoperability requirements with the entities comprising the Portuguese Node;
- To evaluate these interoperability requirements' relevance in the scope of the METROFOOD-RI project;
- To assess how the interoperability requirements can be fulfilled, controlled and improved by the entities.

1.4. Methodological approach

To develop this research, a deductive approach was followed, given that a review of the latest theoretical literature was firstly done, having resulted in a theoretical basis which was considered to then formulate the assumption "It is possible to apply the Quality Function Deployment (QFD) methodology to design an Interoperability configuration suited to the METROFOOD network's requirements".

The assumption was assessed by validating the network's requirements with the entities which form that network and then assessing the feasibility of using the QFD methodology to create a framework which fulfils those requirements.

In a more detailed perspective, with two different tasks' levels, Figure 1.1 shows the entire workflow followed conduct this research.

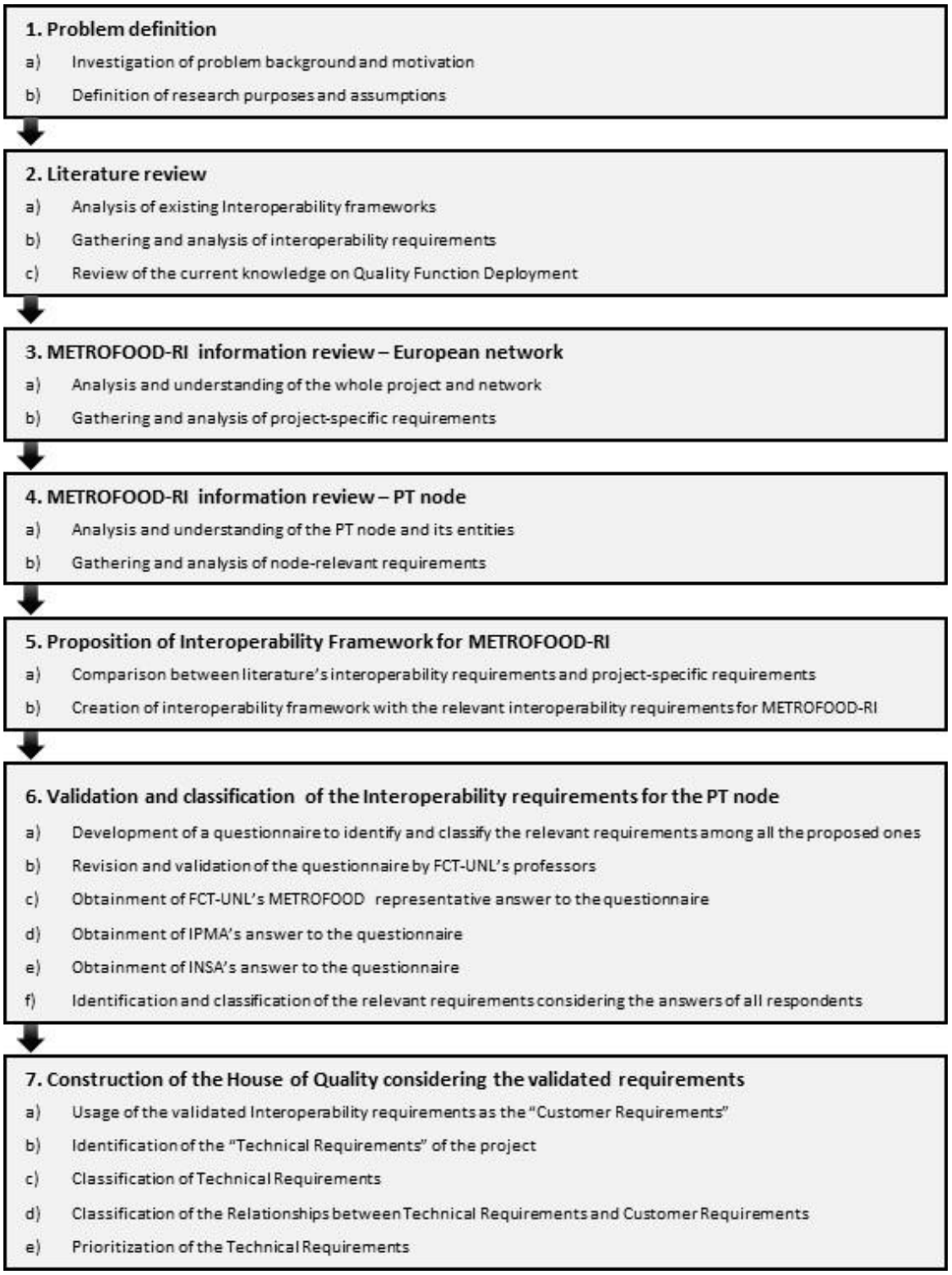


Figure 1.1 - Detailed methodological approach

In Figure 1.2, it is possible to see the association between these steps and the standard phases of a deductive approach, from the review of prior scientific knowledge to assessing assumptions, with the final objective of creating new knowledge in the subjected area of Interoperability.

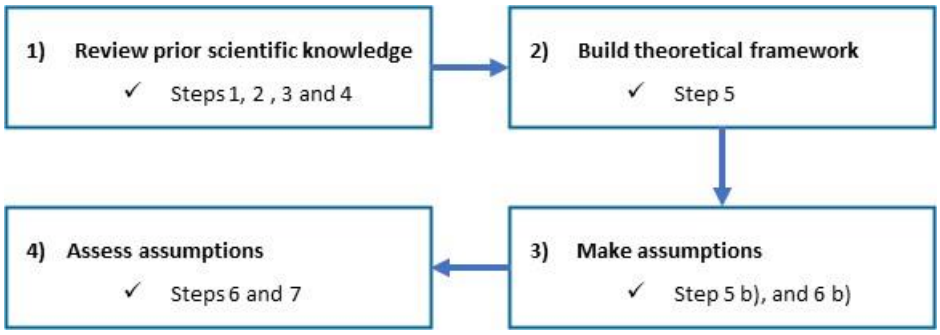


Figure 1.2 - Followed steps per each phase of a deductive approach

2. LITERATURE REVIEW

2.1. Fundamental concepts and definitions of Interoperability

The concept of Interoperability first emerged within the military service of the US Department of Defense (DoD) (1977) and was originally approached from a technical point of view (Cabral 2015b) and mainly associated with information and communication technology (ICT) systems.

Since then, several authors have proposed definitions of interoperability within the context of ICT systems, such as: “systems that are compatible and capable of mutually utilizing the information Exchanged” (Treiber 1981); “the ability of two devices or components to exchange information” (Dictionary of Information Technology); “the condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users” (DoD 2001); “the ability to operate software and exchange information in a heterogeneous network (i.e., one large network made up of several different local area networks)” (Command 2001); “the ability of ICT systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge” (EIF 2004); “the ability to exchange functionality and interpretable data between two software entities” (Luis 2009); etc.

Despite this tendency to associate interoperability with the connection of ICT systems, the concept is much more embracing, as recognized by multiple authors. For instance, Berre et al. (2007) state that interoperability should not only be considered a property of ICT systems, but also concern the business processes and business context of the organization. In fact, the own perspective of business interoperability supports that this matter transcends the connection of information systems between entities or agents, encompassing several other important dimensions like business processes, culture, values and contractual issues (Grilo et al. 2013).

In tune with these and many other authors, definitions of interoperability as a broader concept, not directly related to ICTs, have come about. Some of the most relevant for the scope of this dissertation are “the ability for two systems to understand one another and to use functionality of one another” (Chen, Doumeingts, and Vernadat 2008); “a property of diverse systems and organisations enabling them to work together” (Gottschalk 2009) and “the ability for a system or a product/service to work with other systems or products/services without special effort of the part of the user” (Ducq, Chen, and Doumeingts 2012).

Even though these definitions already suggest a wider perspective of interoperability, escaping from the more traditional and technical point of view, due to their generic scope, they may be difficult to associate with or apply to the context of business relationships, or similarly and in the case of this dissertation, academic/non-profit relationships. Thus, since the early 2000s, research on business interoperability has arisen and definitions proposals have developed to be more business-oriented. After reviewing several authors and works, the definition hereby adopted to

describe business interoperability is the one suggested by ATHENA (2007) where it is defined as “the organisational and operational ability of an enterprise to cooperate with its business partners and to efficiently establish, conduct and develop IT-supported business relationships with the objective to create value”.

2.2. Interoperability models and frameworks

Given the broad and multidisciplinary nature of the concept of interoperability and the complexity of business relationships, frameworks are of the essence for entities to become interoperable. In general terms, they can be defined as “a practical tool for comparing concepts, principles, methods, standards and models in a particular realm” Rezaei et al. (2014a) which attempts to identify the elements and relationships among these elements that must be considered for analysing a phenomenon (Ostrom 2005). In the scope of interoperability, frameworks are “mechanisms for enabling interoperability between entities that mutually pursue an objective”, “sets of assumptions, concepts, values and practices that constitute ways of viewing and addressing interoperability issues” Rezaei et al. (2014a). Essentially, a framework provides a mechanism to identify the requirements for electronic-based business set up, to qualify and quantify interoperability and provides the means to achieve interoperable solutions, either by problem identification or modelling (Cruz 2016).

On the other hand, a model can be defined as a simplified representation or abstraction of reality and describes, reflects or replicates a real event, object or process without explaining it (Cabral 2015b).

In this section, existing and relevant interoperability frameworks and models will be reviewed and characterized.

2.2.1. The IDEAS Interoperability Framework

With the main objective of creating an intuitive framework for as many stakeholders as possible, the IDEAS project proposed the IDEAS Interoperability Framework. The project argues that “inter-enterprise coordination, business process integration, semantic application integration, syntactical application integration and physical integration” (Cabral 2015) are the levels in which interoperability must be achieved. With this scope and definition set, IDEAS decided to build their framework having the ECMA/NIST Toaster Model, ISO 19101 and 19119 as basis, adding quality attributes to improve them and fulfil the framework’s needs (Figure 2.1).

	Framework 1st Level	Framework 2nd Level	ONTOLOGY	QUALITY ATTRIBUTES					
			Semantics	Security	Scalability	Evolution			
ENTERPR. MODEL	Business	Decisional Model							
		Business Model							
		Business Processes							
	Knowledge	Organisation Roles							
		Skills Competencies					QUALITY ATTRIBUTES		
		Knowledge Assets					Performance	Availability	Portability
ARCHITECT PLATFORM	Application	Solution Management							
		Workplace Interaction							
		Application Logic							
		Process Logic							
	Data	Product Data							
		Process Data							
		Knowledge Data							
		Commerce Data							
	Communication								

Figure 2.1 - IDEAS interoperability framework

(source: Cabral 2015)

This framework also suggests 3 different layers over which interoperability between enterprises must be based:

- **Business layer** – business environment and business processes. Where all enterprise organisation and management issues are dealt with, including the organisational structure, how it operates to produce value, relationships management, both internal (personnel) and external (partners, customers and suppliers). Understood as the "organisational and operational capacity of an enterprise to factually cooperate with other entities." (Chen, Doumeingts, and Vernadat 2008)
- **Knowledge layer** – organisational roles, skills, competencies of employees and knowledge resources. Acquiring, structuring and representing the knowledge of an enterprise. Internal aspects like products and administration's management practices for operations and personnel, and also external features such as partners and suppliers, regulatory and legal practices and obligations and relationships with public entities. In this layer, interoperability should be seen as the compatibility of an entity's skills and competencies with those of other entities. This layer takes into account the methods and tools for elicitation, gathering, organisation and diffusion of business knowledge.

- **ICT layer** – applications, data and communication components. Allows enterprises to operate, make decisions and exchange information inside and outside their boundaries. The business process model identified in the Business Layer will command the whole execution of the entity's applications, whereas the Knowledge Layer will be where they are represented and stored. Interoperability in this layer should simply be comprehended as the ability of two enterprises' ICT systems to communicate and cooperate effectively.

The holistic perspective on interoperability requires considering semantics on each layer of an enterprise. For enterprises that want to collaborate with each other and that need interoperability on a specific layer, it is of prime importance to create a mutual understanding (Cabral 2015). For concepts' actual meaning to be fully captured, represented and understood, semantics should be aligned between entities To ensure that semantics are exchangeable and based on a common understanding, ontology and annotation formalism for meaning can be used (Chen and Doumeingts 2003, Chen et al. 2008a).

2.2.2. The ATHENA Interoperability Framework

The ATHENA Interoperability Framework (AIF) consists of a framework with associated reference architecture for obtaining the elements and solutions to interoperability issues which addresses the problem in a holistic way by interrelating relevant information from different perspectives of the entity (Cabral 2015). Three levels of integration are considered in this framework:

- **Conceptual:** focus on concepts, meta models, languages and model relationships. Provides a basis for systemising several factors of interoperability;
- **Applicative:** focus on methodologies, standards and domain models. Offers guidelines, principles and patterns to be used when solving interoperability problems;
- **Technical:** focus on software development and execution. Provides development tools and execution platforms to integrate processes, services and information.

This framework has its focus on the solution approaches that come separately from enterprise modelling, ontology and architectures and platforms, associating them altogether. These solutions will only be successful in achieving interoperability if the involved entities fulfil and provide each other with the requirements identified in Figure 2.2.

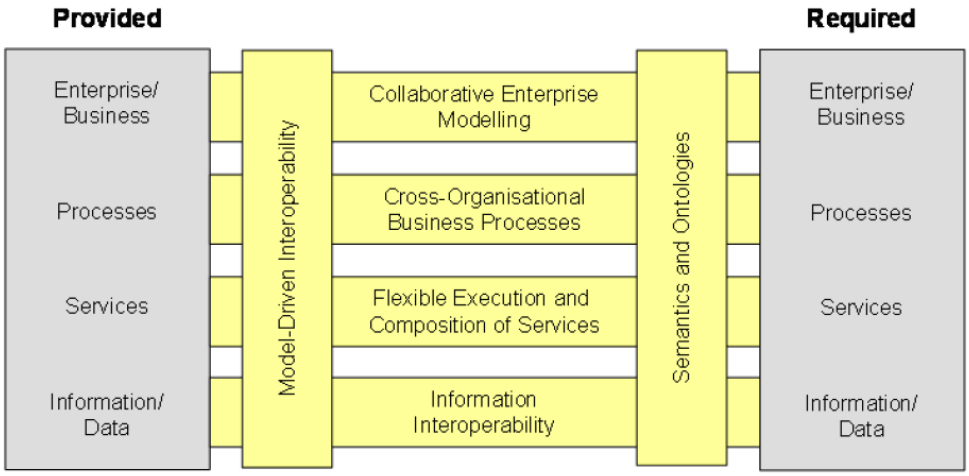


Figure 2.2 - Simplistic perspective of AIF

(source: Cabral 2015)

A model-driven approach is proposed by this framework, where models are used to formalise and allow the trade of requirements needed among the two parties, requirements which shall be discussed and agreed through negotiations and agreements. Written, syntactic descriptions of requirements and exchanged artefacts are very likely to create semantic barriers due to possible misinterpretations and should be avoided. To do so, models must use accurate and computer processable language in all levels, ontologies and standard annotations, with the main objective of ensuring common and total understanding by all parts involved, therefore achieving interoperability among them.

The framework proposes four levels where interoperability between enterprises can occur:

- Interoperability of enterprise/business: organisational and operational capability of two different enterprises to cooperate despite divergent working methods, rules, cultures and commercial decisions;
- Interoperability of processes: making several different processes work together and achieve an objective. Attempting to create cross-organisational processes;
- Interoperability of services: identifying, creating and implementing a variety of applications;
- Interoperability of information/data: managing, exchanging and processing of different documents, communications and structures by and from the involved entities.

2.2.3. The Layers of Coalition Interoperability

Introduced by Tolk (2003), the Layers of Coalition Interoperability model presents 9 layers of interoperability, with them being split into upper and lower layers, each group made up by four of them, and an interface between the two groups. As shown in Figure 2.3, the four upper levels

encompass and deal with organizational interoperability, while the four lower levels approach technical interoperability, meaning the ability to collect, manipulate, distribute and disseminate data and information. Between the two groups, in the middle, lies the knowledge/awareness layer, which should help the communication between both groups to happen smoothly.

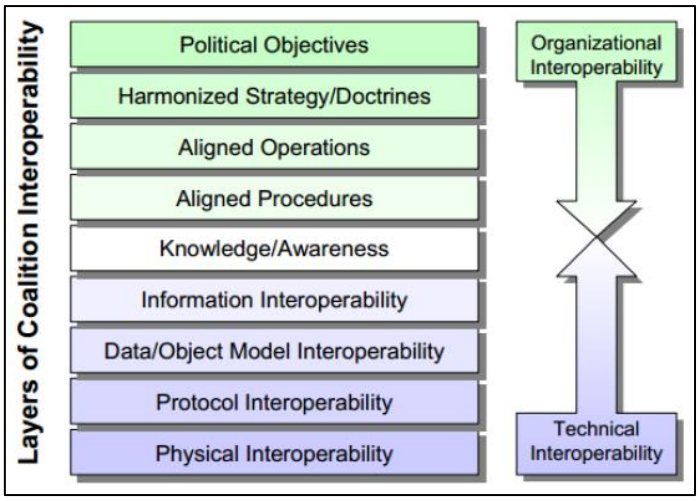


Figure 2.3 - Layers of Coalition Interoperability

(source: Tolk 2003)

Each interoperability level has its own specifications and should be well understood and fulfilled to obtain full interoperability between entities. Each one of them is hereafter explained:

- **Physical interoperability** – physical connection of systems to the network and the procedures of information exchanges;
- **Protocol interoperability** – related to the protocols for communication with other resources in the network;
- **Data/object model interoperability** – encompasses the standard data elements and metadata for information interchanges;
- **Information Interoperability** – includes the dynamic information possible to be mapped between systems and the cause and effect of information's harmonizing;
- **Knowledge/awareness** – should contain a common operational picture, collaboration tools and harmonised views of the operation;
- **Aligned procedures** – refers to the tactics organisations align among them, supported by knowledge and data bases, simulations, models and tactical communication infrastructure;
- **Aligned operations** – contains all the procedures agreed by all parties that can be applied at operational/tactical level;
- **Harmonized strategy/doctrines** – where there should be application and usage of the aligned operations. Social and cultural backgrounds shall be aligned;
- **Political objectives** – the partners' share of same political objectives and coalition values.

2.2.4. The European Interoperability Framework (EIF)

Funded by the European Commission in the scope of a research program for interoperability development in European eGovernment services, this framework intends to define recommendations and guidelines for such services. The main objective is to allow public administrations, enterprises and citizens to interact beyond borders, within a pan-European setting, thus promoting interoperability between them.

According to the EIF, to set up eGovernment services at such pan-European level, three aspects should be considered in interoperability matters (Cruz 2016):

- **Organizational Interoperability**: about defining business goals, modelling business processes and promoting collaboration among administrations wishing to trade information while having different structures and processes. In addition, it is intended to make services available, identifiable, accessible and user-oriented, attempting to match the user's community requirements.
- **Semantic Interoperability:** to ensure total comprehension of the meaning of the exchanged information by applications which were not made for this purpose. Semantic interoperability allows systems to combine input information and produce understandable, meaningful outputs.
- **Technical Interoperability:** covering technical issues related to linking computer systems and services. Open interfaces, interconnection services, data integration and middleware, data presentation and exchange, accessibility and security services are all key elements.

Although the three considered aspects are similar to those from earlier frameworks, the EIF addresses the main issues found in public administrations, exposing common services and their inherent business processes, specification and communication of information elements and dictionaries and standard s for technical interoperability of front and back-office services (Cruz 2016). Accessibility, security and privacy are the technical aspects that the framework proposes to cover the main requirements for users to access systems. Despite the respect for the European Union's multiculturalism and individuality of each one of its members, cultural aspects shall be ensured by the neutrality of linguistics used in information architectures and systems, so that multilingualism does not become a barrier to deliver e-Government services. (Cruz 2016)

One of the statements of the EIF is that no framework should be static, as it should always be adapted to new technologies, standards and requirements (Cruz 2016). This is a fundamental principle of every framework – it should not be static and should rather be responsive to external factors.

2.2.5. The Framework for Enterprise Interoperability (FEI)

Developed within the scope of INTEROP Network of Excellence, the Framework for Enterprise Interoperability (FEI) has the purposes of identifying all the basic dimensions related to enterprise interoperability, defining its research domain and identifying and structuring the knowledge of this same domain (Cabral, 2015). The FEI suggests a classification system for interoperability knowledge considering three dimensions – interoperability barriers, approaches and concerns.

According to the FEI, to establish interoperability, all known barriers must be removed or overcome (Cabral 2015). They are categorized in three separate sets (Chen et Al. 2008)) – conceptual, technological and organizational. The first one concerns syntactic and semantic differences of the exchanged information. Technological barriers are related to the incompatibility of information technologies and take into consideration the standards to present, store, process and communicate data with computers. Organizational barriers refer to responsibility designation, authority to perform actions and the irreconcilability of organizational structures.

Moreover, interoperability between or within enterprises must concern 4 major areas: interoperability of data – finding and sharing information from different and various data sources, which can also exist on different machines and within different operating and data management systems; interoperability of services (both computer based and companies' functions) – making various applications function together (separately designed and implemented); interoperability of processes – making diverse business processes work together and, ideally, to create a common process; interoperability of business – efficiently and smoothly collaborating at the level of organization and company so that business can be developed between entities.

Finally, interoperability approaches define the way in which barriers are removed (Chen et Al. 2008) and may be divided in three different kinds: integrated approach – there is a common and agreed by all parties format to elaborate models and build systems; unified approach – a common format exists but only at a meta level, allowing to map semantic equivalence across all models; federated approach – no common format, interoperability exists and is managed in an *ad-hoc* way as no entity imposes models, language or methods.

Besides being a framework for interoperability and falling under the scope of enterprise architectures, FEI is considered to be a good methodology to find solutions for problems and concerns which disallow interoperability between entities (Cruz 2016).

2.2.6. The Business Interoperability Framework (BIF)

Developed within the scope of the ATHENA project and with the purpose of studying the cooperation between enterprises (ATHENA, 2007), the Business Interoperability Framework is dedicated to organizational and management layers of interoperability. The BIF structures interoperability issues into four different categories: management of external relationships; employees and culture; collaborative business processes; information systems. Even though

information systems are taken into account, this is a rather business-centred framework which has its main focus on non-technical issues. Besides the four categories, internal and external contingencies are identified and should be addressed, as they impact the organisational design needed for interoperability between entities. The four categories and contingencies are shown in Table 2.1.

Table 2.1 - Business Interoperability Framework

(Source: Cabral 2015)

Business Interoperability (organisational design of business relationships)		
Category	Perspective	Description
Management of external relationships	"How do we manage and control business relationships?" (Governance perspective)	Interoperable organisations manage and monitor their business relationships.
Employees and culture	"How do we behave towards our business partners?" (Behavioural perspective)	Interoperable organisations promote relationships with business partners at an individual, team-based and organisational level.
Collaborative business processes	"How do we collaborate with business partners?"	Interoperable organisations can quickly and inexpensively establish and conduct electronic collaboration with business partners.
Information Systems	"How do we connect with business partners?" (Technical perspective)	Interoperable ICT systems can be linked up to other ICT systems quickly and inexpensively and support the cooperation strate
Contingencies (factors which impact the organisational design)		
Category	Perspective	Description
Internal	"What are the characteristics of the business relationships?"	Cooperation targets and transactional characteristics impact the optimum level of business interoperability.
External	"Which environmental factors affect the business relationships?"	E-Business maturity, legislation and industry dynamics determine preconditions in the specific context.

In addition to the different categories and contingencies, the framework decomposes each category into sets of criteria which enlighten the key business decisions companies or entities need to solve when setting up interoperable electronic business relationships (Cruz 2016)). These criteria are described in Table 2.2

Table 2.2 - Categories' criteria in the BIF

(source: Cabral 2015)

Category	Criterion	Description
Management of external relationships	Cooperation model	Describes to what extent an enterprise defines its role within a business network and clear rules of engagement, which underlie any cooperation.
	Cooperation targets	Plans and objectives that partners pursue in the cooperation; questions whether there is reciprocity within the relationships and whether both parties feel that they are gaining (win-to-win situation).
	Cooperation management	Defines the roles and processes for initiation, realisation, control and monitoring of the cooperation. It takes previsions for the management of risk and conflicts as well as for the protection of property rights.
Employees and culture	Trust	Characterises the mutual respect, openness, reliability and confidence between the employees involved in the collaborative relationship.
	Visibility	Describes the degree to which information is shared with partners and which external partners gain visibility of the business processes.
Collaborative business processes	Public processes	Represent an abstract view of the cross-organisational business processes which focuses on the interaction between the partners (e.g. activities, roles, inputs/outputs)
	Business semantics	Questions whether there is a common understanding of the structure and significance of the information to be exchanged.
Information systems	Type of interaction	Describes the type of interaction during the process of exchanging/gathering information. It can be: “human-to-human”, which describes traditional forms of interacting between humans which may be supported by fax, phone, or e-mail communication; “human-to-machine” (e.g. customer or supplier portals bundle data and applications on the basis of users and roles; “machine-to-machine”, which denotes consistently automated processes (e.g. EDI).
	Connectivity	Characterises the cooperation architecture which supports the electronic interaction, i.e. the type of connection established among the ICT systems. It can be point-to-point (1:1), one-to-many (1:n) or many-to-many (m:n).
	Security and privacy	Cover authentication and authorisation as well as the encryption of messages. In addition, privacy and legal requirements have to be respected, e.g. In electronic contracting and invoicing, since they deal with sensitive data and additionally need to comply with e-business legislation.
Internal contingencies	Coordination area and targets	Associated with specific coordination requirements and resulting interaction frequency and intensity. For instance, the goal of SCM is to handle operative planning and execution processes as efficiently as possible. It multiplies clearly defined outputs and tries to utilise the effects of economies of scale in order to achieve profit. The goal of the coordination area innovation is the rapid creation of new products, which requires a dynamic environment in the early phases.
	Business partners	Characterises the size and number of partners as well as their diversity regarding industry and regional focus. For example, SMEs are reluctant to higher levels of electronic integration due to significant investments and their lacking

Table 2.2 - Categories' criteria in the BIF (source: (Cabral 2015)) (continuity)

Category	Criterion	Description
		organisational readiness for inter-organisational systems adoption. In general, ICT systems of large companies obviously tend to be more powerful and sophisticated than those of small companies.
	Cooperation dynamics	Characterise the duration and the intensity of the relationships among partners; can be stable or dynamic. For example, supply networks in the automotive industry are in place for several years –stable network; on the other hand, companies in the construction industry usually cooperate only for the given period of a project – dynamic networks.
	Network governance	Characterises the basic mechanisms with which decisions are made within a network; it can be hierarchical or heterarchical.
	Interdependence	The type of interdependence among the collaborating partners (pooled, sequential, or reciprocal)
	Specificity	Questions whether investments made for the business relationship are non-specific, mixed or idiosyncratic. It also describes the dependency between business partners, as more specific upfront investments result in higher dependency (unidirectional or bidirectional).
	Frequency	The frequency of transactions within a business relationship can be one-time, occasional and recurrent.
External contingencies	Legislation and regulation	National and international legislation as well as industry-specific, national or international regulation and standards increasingly oblige companies to become more interoperable.
	Degree of standardisation	The availability of standards, for example, the one that enable the unique identification of product increases the interoperability between for instance retailers and their suppliers.
	E-business maturity	Doing business in an e-business-mature industry will imply that certain prerequisites for electronic collaboration exist (e.g. banking industry).

2.2.7. The Business Interoperability Quotient Measurement Model (BIQMM)

Developed by Zutshi et Al. (2012), the BIQMM is a framework that attempts to evaluate the level of business interoperability between two entities through the identification of interoperability parameters and sub-parameters, as well as the relationships among them (Zutshi et Al. 2012).

Making use of an interdisciplinary and holistic approach, the BIQMM has identified not only eight Business Interoperability Parameters (BIPs), which illustrate the levels of interaction in which entities can engage, but also sub-parameters that allow performance measure for each one of the BIPs. These parameters and sub-parameters can be observed in Figure 2.4.

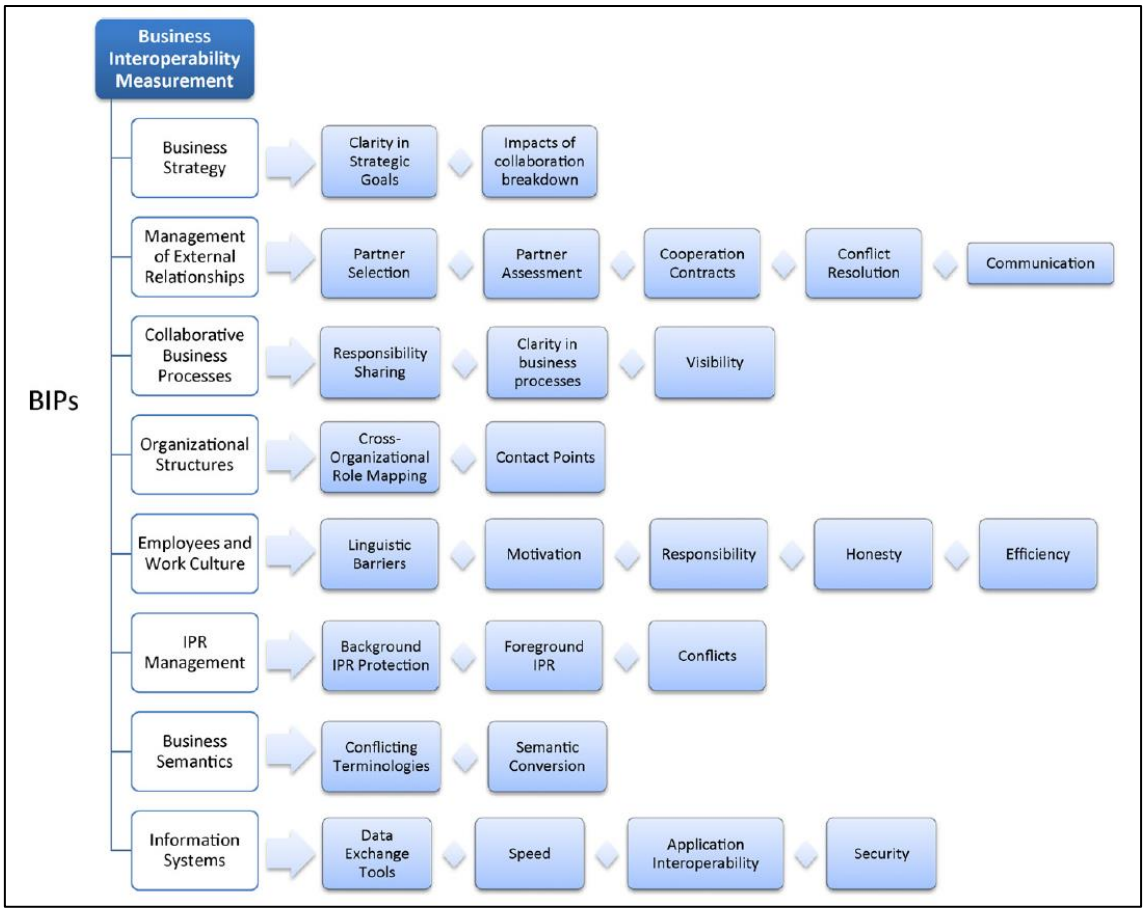


Figure 2.4 - BIPs from BIQMM

(source: Zutshi et Al. 2012)

Regarding **Business Strategy**, it is where the highest level of interoperability should be reflected. At high strategic decision making levels, the objectives and scope of collaboration should be as clear as possible. For the mutual interests of the two collaborating parties to be identified and respected, conflicting interests should be openly addressed.

This parameter may be evaluated through the following sub-parameters: Clarity In Strategic Goals, concerning the resolution of possible conflicts of interests in the collaboration between the entities; Impacts Of Collaboration Breakdown, tackling matters such as formal commitments to the collaboration's duration, possible consequences of the anticipated ceasing of the collaboration or if there are measures to prevent such event or back up actions in case it really occurs. (Zutshi et Al. 2012)

The **Management of External Relationships** represents one of the most critical factors to achieve interoperability. Planning and defining cooperation is the starting point for cooperation management as it concerns cooperation aspects like contracts, managing conflicts, managing change and communication (Zutshi et Al. 2012). Once cooperation has ended, management tasks such as obtaining feedback, analysing both good and bad experiences, maintaining healthy

relationships with cooperation partners and following up on cooperation-derived outcomes, should be completed.

To evaluate this parameter, five sub-parameters are proposed: Partner Selection**,** regarding the existence or not of a mechanism to choose the best partner possible and he fulfils all requirements; Partner Assessment**,** concerning mechanisms to evaluate the selected partners' quality and their suitability for the organisation; Cooperation Contracts**,** aiming at the existence of clearly defined contracts that state conditions and vulnerabilities, thus reducing conflicts' probabilities; Conflict Resolution**,** focusing in conflicts' frequency and the existence of mechanisms to solve them; Communication, looking for possible barriers to fluid inter-organisational communication.

Collaborative Business Processes are of the essence in B2B relationships, as they may help avoid common issues such as unclear partner responsibilities and consequential conflict of resources and uncoordinated efforts. Corresponding partner processes are meant to accelerate and facilitate the establishment and continuity of a coordinated relationship. In addition to aligning business processes, actions should be taken to improve transparency between organisations (minimum processes' visibility is likely to provide benefits to both partners.

The sub-parameters to assess Collaborative Business Processes are the following: Responsibility Sharing**,** analysing if there are clearly divided responsibilities between partners; Clarity In Business Processes**,** regarding if business processes for collaborative work are well settled and responsibilities well distributed and if the information transmission is smooth; Visibility**,** checking if processes within an organisation are easily perceived by the other.

Depending on their size, organizations might have very different **Organisational Structures**. Smaller, more dynamic organizations tend to have mostly flat structures, whereas larger and more departmentalized are normally hierarchically structured. Therefore, inter-organisational mapping becomes essential to avoid communication obstacles between different organisational structures and to make sure agents from both organisations recognise their counterparts.

Two sub-parameters should be used to study Organisational Structures: **C**ross-Organisational Role Mapping**,** which assesses the easiness to find and contact the right point of contact within the organisation for each type of matter; Contact Points, which analyses the amount of contact points per level and if they are enough to promote unified collaboration between organisations.

Employees and Work Culture both play important roles in attaining interoperability. Cooperation between enterprises should be promoted through openness to change and based on trust relationships between partners and counterparts. Thus, change management is vital to ensure the smooth acceptance of new business solutions by all employees of both entities. Work cultures from both sides should also be aligned to easily deal with questions like level of formality, will to innovate, failure tolerance, communication issues in international contexts, among others.

The Employees and Culture parameter can be assessed with multiple sub-parameters: Linguistic Barriers**,** evaluating if different languages are used among both companies' employees and if that

harms the fluid communication between them; Motivation**,** looking at the motivation of all employees from the two parties and if they all have the same incentives to improve collaborative work and projects; Responsibility**,** questioning if employees take account for their tasks or if they tend to pass on their responsibilities; Honesty**,** assessing if employees from both organisations have the same level of honesty and openness with each other; Efficiency**,** analysing if employees from both sides share the same level of training, performance and efficiency.

Intellectual Property Rights Management is of upmost relevance, as conflicts on Intellectual Property Rights (IPR) may harm trust between parties and projects' efficiency. Proper communication and justification of IPR, proposition and discussion of IPR sharing agreements are all crucial to achieve interoperability.

There are three applicable sub-parameters to weigh Intellectual Property Rights Management: Background IPR Protection, focusing on how existing IPRs are dealt with and what is in the collaboration agreement regarding this subject; Foreground IPR**,** evaluating if potential collaboration-originated IPRs have been noted and their sharing rights have been settled; Conflicts**,** looking into the possible existence of IPR-related conflicts.

A common understanding of the structure and significance of the exchanged information is vital for inter-organisational collaboration (Zutshi et Al. 2012). If **Business Semantics** are not understood by both sides, it will be impossible for processes to be fully aligned and functional.

The Business Semantics parameter can be looked into using two sub-parameters: Conflicting Terminologies**,** checking if partner entities use different business-related terminologies; Semantic Conversion, confirming if partners have normalised tools to process semantic conversions, thus avoiding operational issues caused by diverging terms.

Interoperability of Information Systems is the most easily achievable interoperability requirement, as nowadays most organisations perform transactions and information exchanges through electronic networks. Although these exchanges have been and keep happening mainly by means of portal solutions, it is expected that in the future (medium/long term) companies will collaborate through business collaboration infrastructures, due to their better efficiency potentials.

To evaluate the Information Systems parameter, four sub-parameters may be utilised: Data Exchange Tools, assessing the existence and suitability of an IT infrastructure for easily exchanging data and files; Speed, investigating if the information system is fast enough for communications to be fluid and information to be synchronous; Application Interoperability, evaluating if there are conversion applications to access data between entities; Security, concerning how confident users from both organisations feel when passing on confidential information and carry on secure operations.

This framework proposes ANP (Analytical Network Process) as the method to measure all these parameters, since it is a multi-criteria method that only requires measuring by comparison, instead of measuring by value functions, which would be difficult considering the subjective nature of some of the used parameters. (Zutshi et Al. 2012)

2.2.8. Recent developments and improvements

To bridge the gaps of BIF and BIQMM on their implementation in networks contexts where three or more entities are involved, and on their lack of coverage of Interoperability Dimensions (Information Quality is not considered in neither) and Sub-dimensions, Cabral (2015), using BIQMM as a basis, proposed additional Dimensions and Sub-dimensions of Business Interoperability in the context of collaborative Supply Chain Networks (SCNs). These dimensions are listed in Table 2.3.

Table 2.3 - The Dimensions of Business Interoperability

(source: Cabral 2015)

Dimensions of business interoperability	**Key sub-dimensions**
Business strategy	Clarity, visibility, and alignment of cooperation goals.
Management of external relationships	Partner selection, inter-organisational trust, cooperation contracts, communication paths, cooperation monitoring, cooperation duration, management of inter organisational conflicts, and relationship power and reciprocity.
Collaborative business processes	Clarity, visibility, alignment, coordination, synchronization, integration, flexibility and monitoring of collaborative business processes.
Products and services exchange	Specificity, frequency, and financial exchange.
Employees and work culture	Cultural differences, linguistic barriers, interpersonal trust, motivation, competences, authorities/responsibilities and interpersonal conflicts.
Knowledge management	IPR protection, foreground IPR, IPR-related conflicts, organisational learning and individual learning capability.
Business semantics	Conflicting terminologies, and semantic conversion.
Information systems	Information system model, interaction type, connectivity/architecture, security and privacy, information systems breakdown, IT platforms, synchronization (speed), database structure, user interface, type of application and devices, and programming languages.
Information quality	Accuracy, reliability, timeliness, completeness, conciseness, relevance, understandability, and readily usable format.
Network minute details	Network governance (hierarchical networks, heterarchical networks), network dimension and diversity, type of relationships/interdependence, power relations, cooperation dynamics (entry and exit of partners), industry dynamics, maturity of industry, legislations, regulations, complexity, cooperation architecture, and external cooperation mechanisms.

Later, Cabral and Grilo 2018, proposed a conceptual framework based on the dimensions listed in Table 2.3, adding the Network Effect as a dimension and impact factor on SCNs (see Figure 2.5).

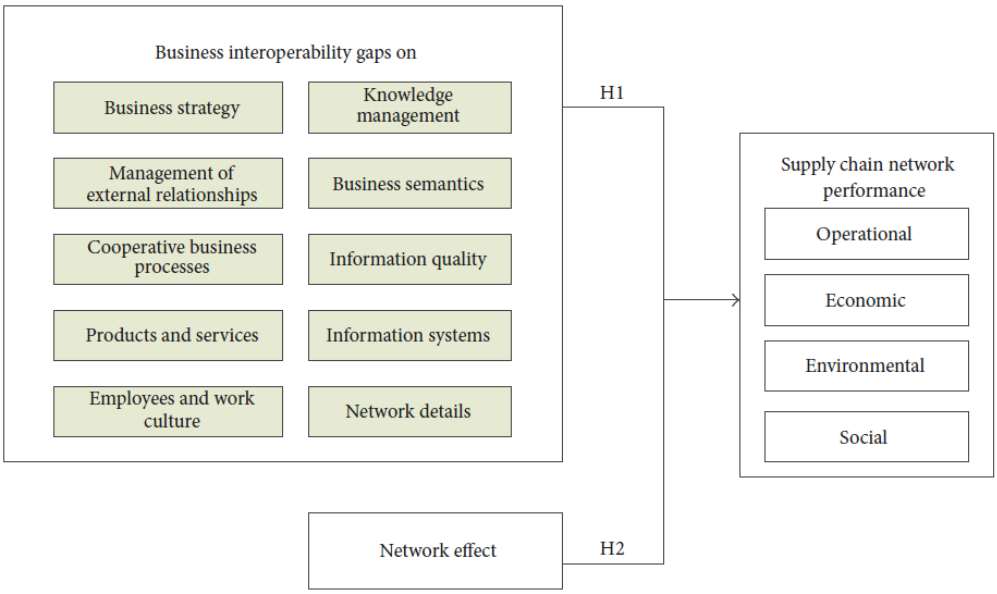


Figure 2.5 - Conceptual framework for Interoperability on SCNs

(source: Cabral and Grilo 2018)

By establishing inter-dependencies between the Interoperability types (equivalent to dimensions) and adapting them to the context of Buyer-Supplier dyads, Espadinha-Cruz and Grilo, 2019, proposed the Business Interoperability Decomposition Framework (BIDF) illustrated in Figure 2.6.

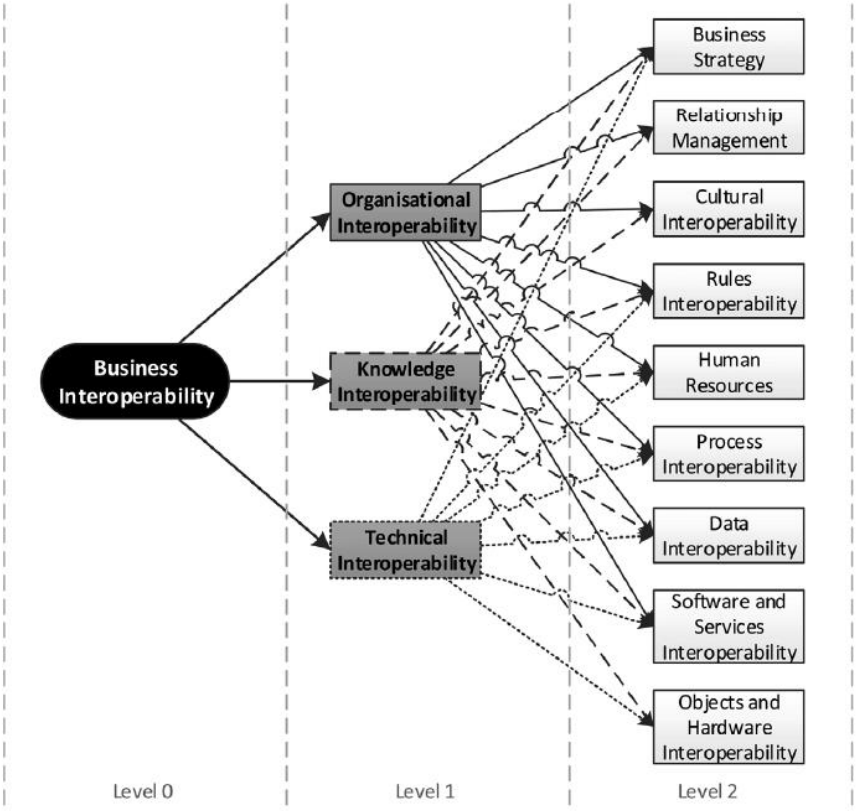


Figure 2.6 - Business Interoperability Decomposition Framework (BIDF)

(source: Espadinha-Cruz and Grilo 2019)

3. DESCRIPTION OF THE PROPOSED METHODOLOGY

In this chapter, a detailed and step-by-step explanation of the proposed methodology to design Interoperable METROFOOD Research Infrastructures is presented. The methodology consists of an adaptation of the HoQ to the context of Interoperability. The rationale for choosing this methodology and the followed steps are explained in Section 3.3.

Before explaining the methodology itself, the Interoperability requirements utilized as framework are presented in Section 3.1.

A literature review on Quality Function Deployment (QFD) and HoQ is presented in Section 0. As the QFD has been a widely studied and implemented methodology in multiple contexts since the 1960s, only a brief review is done, with more details exposed in the explanation of the proposed methodology in Section 3.3.

3.1. Utilized Interoperability framework

For the definition of the METROFOOD-RI's Interoperability requirements, a first analysis of the requirements proposed in the literature was done. For this purpose, several documents by different authors were thoroughly analysed and used as reference to define the most suited requirements for the network being studied. The main authors and works considered were the following:

- Zutshi et al, 2012;
- Cabral, 2015;
- Cabral et al, 2016;
- Cruz, 2016;
- Cabral and Grilo, 2018;
- Espadinha and Grilo, 2019.

Although all authors were considered, the main references used to define the proposed Interoperability Framework were Zutshi et al, 2012, Cabral, 2015, and Cabral and Grilo, 2018. Having these works as a basis and considering that the METROFOOD-RI network and its entities do not aim at generating financial profit, but rather intend to create added-value in a public service European Union project that intends to generate knowledge, the relevant Interoperability requirements for the METROFOOD-RI network were defined.

Adapted from Zutshi et al. 2012, and Cabral, 2015, Figure 3.1 represents the relevant Interoperability requirements for the METROFOOD-RI network. Some adaptations have been done from both authors' propositions, namely: "Business Strategy" was changed to "Business and Project Strategy" to also cover entities' strategy on the METROFOOD-RI project; "Knowledge

Management" was altered to "Knowledge and Data management" to also cover produced Data from the Node's activities; "Information Quality" was transformed into "Information Quality and Standards" to better reflect the need for standardization across all entities; "Business Semantics" was changed to "Business and Project Semantics" due to the many project-specific terms used in METROFOOD-RI; "Information Systems" was altered to "Information Systems and Communication Channels" to cover all means of communication within the project. For the same reasons and based on the same authors, the Sub-requirements listed in Table 3.1 are the ones considered as relevant for METROFOOD-RI.

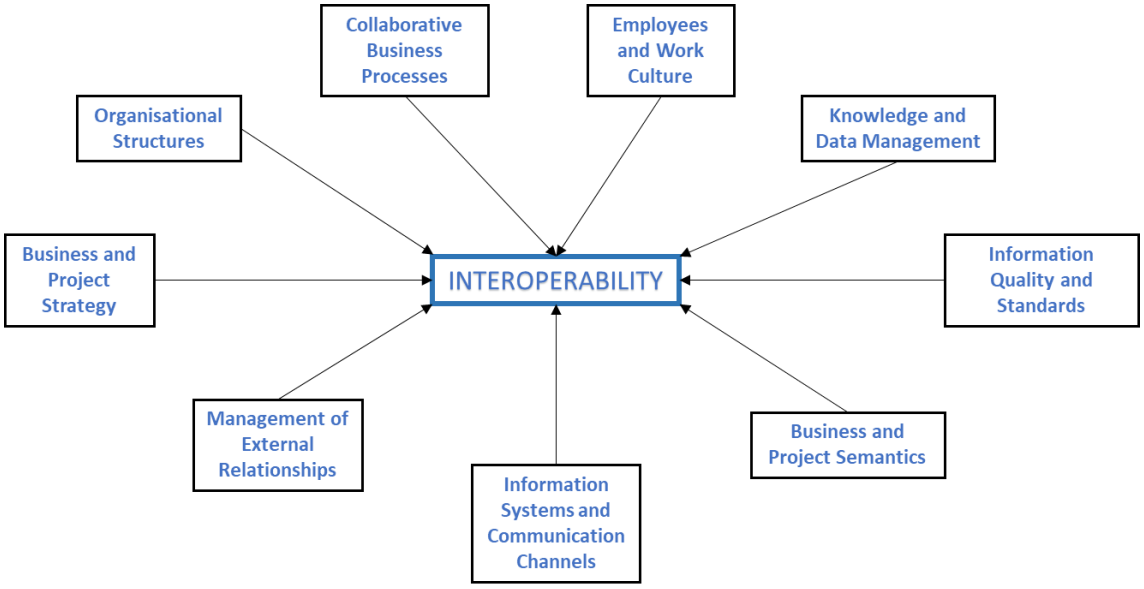


Figure 3.1 - Interoperability requirements relevant for METROFOOD-RI

Table 3.1 - METROFOOD-RI's Interoperability Requirements and Sub-requirements

Interoperability requirements	Interoperability sub-requirements
Business and project strategy	Objectivity; Transparency; Alignment and coordination among partners; Compliance with Project's requirements;
Management of external relationships	New partners' selection; Partner continuous assessment; Cooperation agreements; Inter-organisational communication; Conflict management; Mutual trust
Collaborative business processes	Roles, responsibilities and authorisations; Clarity in business processes; Accessibility and visibility of business processes; Harmony of business processes; Integration of business processes; Flexibility of business processes
Organisational structures	Cross-Organisational Role Mapping; Points of contact
Employees and work culture	Interpersonal trust; Interpersonal conflicts; Cultural differences; Work methods; Motivation; Responsibility; Honesty; Respect; Efficiency
Knowledge and data management	Protection of existing IPR; Protection of Cooperation-originated IPR; IPR conflicts; Encouragement for knowledge and data sharing; Knowledge and data vulnerability
Business and project semantics	Conflicting terminologies; Semantic conversion and standardisation; Linguistic barriers
Information systems and communication channels	Security; Privacy (partners' and project's); Speed and synchronicity; Type of interaction; Connectivity; User interface; Data exchange and accessibility platforms; Information system's adaptability; Preventive and reactive maintenance; Information Systems' Integration
Information quality and standards	Completeness; Cleanness; Accuracy; Punctuality; Freshness; Relevance; Reliability; Understandability; Usability

3.2. Literature review of Quality Function Deployment and House of Quality

Conceptualized for the first time by Yoji Akao (1966), Quality Function Deployment (QFD) is a systematic methodology for quality improvement and product and service development (Shen, Tan, and Xie 2000). QFD was successfully applied for the first time in 1972 by the Kobe Shipyards of Mitsubishi Heavy Industry (Akao 1997), having been further developed and implemented in Japan in the following years until its introduction in the United States in 1983. Multi-national companies from several different industries like Hewlett-Packard, AT&T, Ford, General Motors started successfully implementing the methodology and, together with Toyota, greatly developed it in numerous ways (Hauser and Clausing 1988). Many other companies from other countries have since applied it and continue to successfully use it today, accounting for the methodology's viability and applicability.

QFD converts customers' requirements into quality characteristics of products, processes and services in order to reach customer satisfaction (Bernal et al. 2009). It may also be defined as "developing a quality design for the finished product by systematically deploying the relationships between demands and characteristics, starting with the quality of each functional component and extending the deployment to the quality of each part and process" (Shen, Tan, and Xie 2000). The methodology is divided into four inter-linked phases: product planning, part deployment, process planning, and production planning (Liu and Wang 2010). The four phases are shown in Figure 3.2 in a generic way.

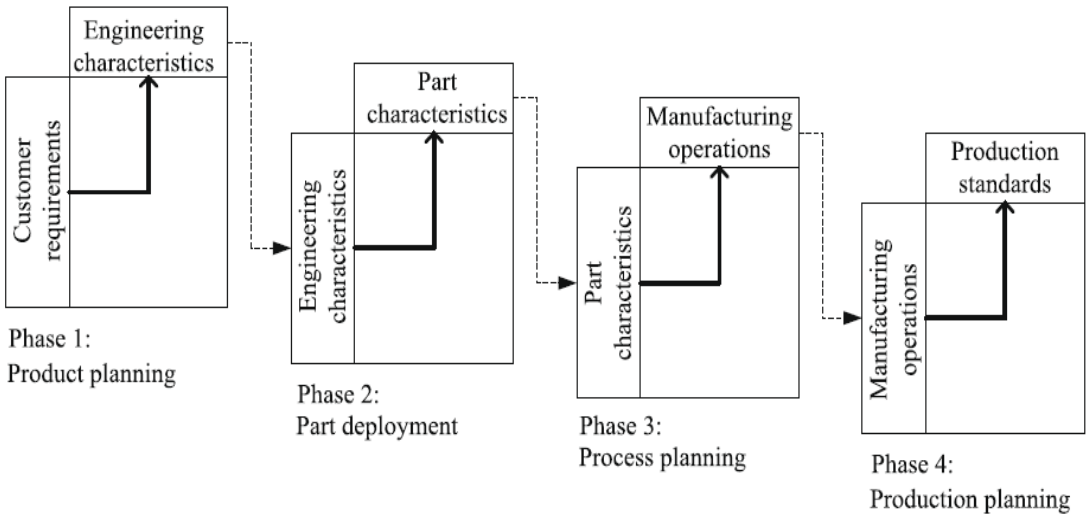


Figure 3.2 - The four phases of QFD

(source: Liu and Wang 2010)

The product planning phase, also known as HoQ, is a matrix-style chart that translates qualitative customer requirements into measurable engineering characteristics (Liu and Wang 2010). Depending on the context in which HoQ is being implemented, the term "measurable engineering characteristics" might not be appropriate. In the scenario of the HoQ being applied to a service or process, more accurate designations can be "measurable technical characteristics" or "measurable technical requirements".

The HoQ has been adapted multiple times in the literature and in professional contexts to the specific needs of the project under study. The one shown in Figure 3.3 has been adapted from several authors.

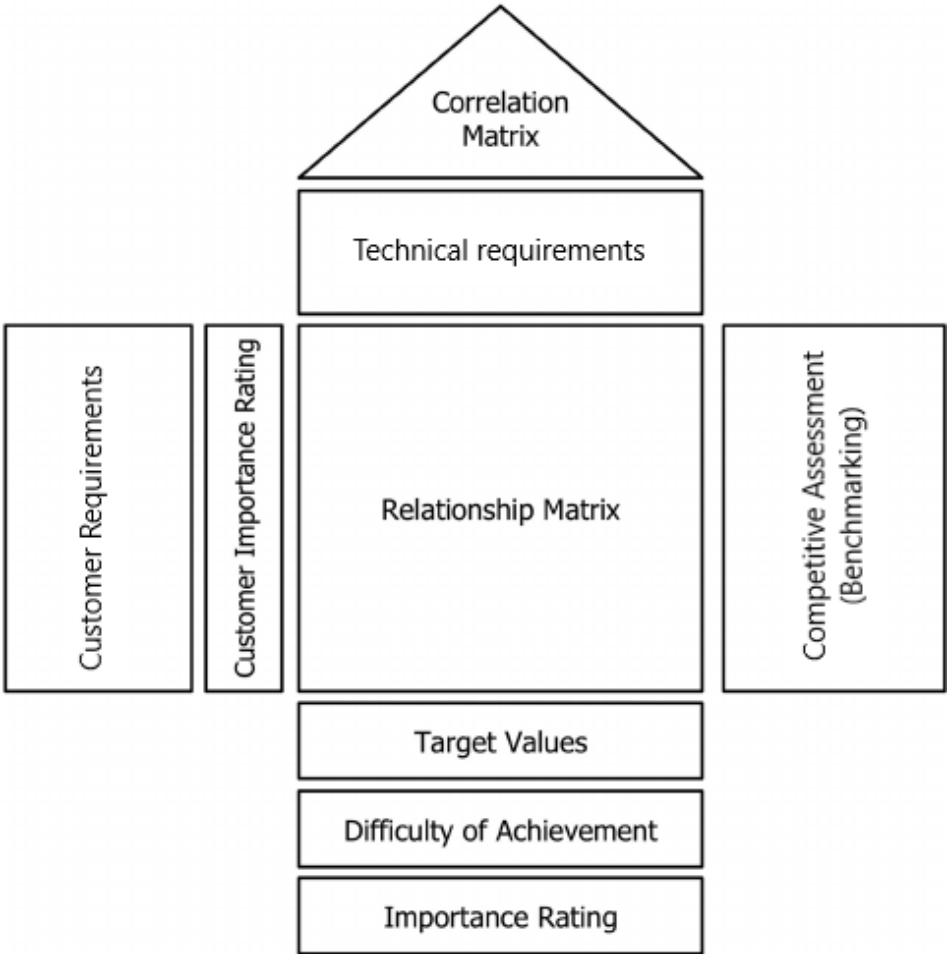


Figure 3.3 - Structure of the House of Quality

(adapted from: Shen, Tan, and Xie 2000; Wu, Liu, and Wang 2017; Liu and Wang 2010)

The House of Quality can be divided in several phases, as explained below:

- Definition of Customer Requirements and their Importance Rating – normally defined through market surveys or customers' interviews (Liu and Wang 2010);
- Technical Requirements, their Target Values and the Difficulty of Achievement – normally defined by a Research and Development team and/or based on previous knowledge and experience, they should answer the Customer Requirements and be measurable characteristics;
- Correlations Matrix – understanding and defining how Technical Requirements influence each other;
- Relationships Matrix – defining how much each Technical Requirement affects each Customer Requirement (Hauser and Clausing 1988)
- Competitive Assessment – Customer's perception and evaluation of the competitors.

The following phases of QFD continue to deploy the Customers' Requirements through to Parts' characteristics, Manufacturing operations and Production standards, which are all normally

associated with product development and manufacturing lines. They will not be relevant to this dissertation and therefore will not be further explored.

3.3. Methodology explanation

The methodology, fully represented in Figure 3.4, consists of an adaptation of the HoQ to the context of Interoperability. While the HoQ is normally utilized for Product or Service planning, here it will be used to define what measurable characteristics of the network being studied should be improved and controlled to achieve Interoperability within the network.

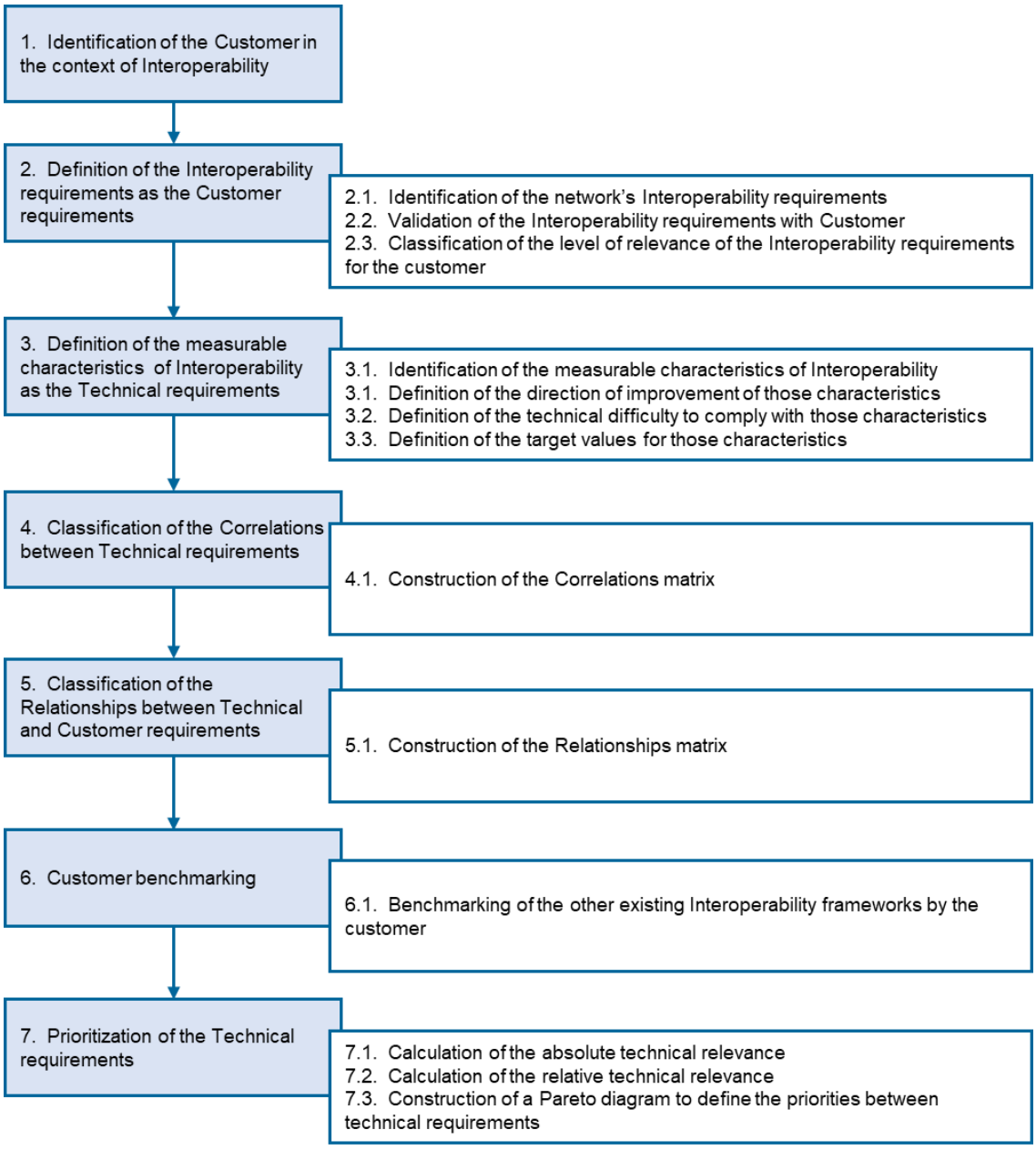


Figure 3.4 - Proposed methodology to design Interoperable METROFOOD Research Infrastructures

First of all, the Customer must be defined in the context of Interoperability. The idea is for the Customer to represent the network under analysis. Therefore, it should either be defined to be the leader of the network, or, if possible, the whole network. In the case of the latter, a viable method needs to be defined to aggregate the inputs of all entities composing the network.

Secondly, the Customer requirements need to be defined, which will be the identified Interoperability requirements of the network. To do so, firstly the whole network needs to be analysed to understand and define which should be the Interoperability requirements to be fulfilled. This analysis is done using the Interoperability requirements and sub-requirements identified in Section 3.1 as a framework. Then, these requirements must be formally validated by the Customer, who should confirm if all proposed requirements are valid and relevant for the network. The level of relevance of those requirements must also be defined by the customer according to the scale explained in Table 3.2.

Table 3.2 - Relevance levels of the Customer requirements

Level	Level designation	Level description
1	Barely relevant	The requirement facilitates interoperability, but it is not vital to achieve it.
2	Slightly relevant	The requirement facilitates interoperability and without its alignment it might be difficult to achieve interoperability.
3	Relevant	The requirement is important for Interoperability and without its alignment it will be difficult to achieve interoperability.
4	Very Relevant	The requirement is very important for Interoperability. It will be very difficult to achieve Interoperability without the complete alignment of this requirement between the entities.
5	Imperatively Relevant	The requirement is vital to interoperability. The network cannot become fully interoperable without the complete alignment of this requirement between entities.

Having properly defined the Customer requirements, the Technical requirements must then be also defined. In this methodology, they will be the measurable characteristics of Interoperability of the network. To identify the adequate characteristics, each Customer requirement must be analysed to understand which characteristics allow its fulfilment and control. Additionally, all technical requirements must be created in a way that they can be improved, be it by maximizing their nominal value, minimizing, or aiming at a certain value. The defined direction of improvement shows the entities how to work on each requirement to try and achieve Interoperability. Symbology to identify the direction of improvement should be used, as exemplified in Table 3.3.

Table 3.3 - Symbology to identify the direction of improvement of the technical requirements

Symbol	Direction of Improvement
↑	Maximize
X	Target
↓	Minimize

Nonetheless, complying with these requirements and controlling them can represent additional work or complexity for the network, hence it is important to assess the technical difficulty of each one of them. As this assessment normally requires prior and deep knowledge of the network and

the work developed within it, it is suggested to work with the Customer on it, or to obtain and analyse relevant data from previous investigations on the topic. These suggestions also apply to finally setting target values for the defined Technical requirements to help establishing specific goals by requirement. Depending on the scope of each Customer requirement and the extent to which the defined Technical requirement covers it, there might be the need for multiple technical requirements to fulfil one single customer requirement. The same goes the other way around, as multiple customer requirements might be covered by one single technical requirement. The full process for the definition of a Technical requirement is explained in Figure 3.5.

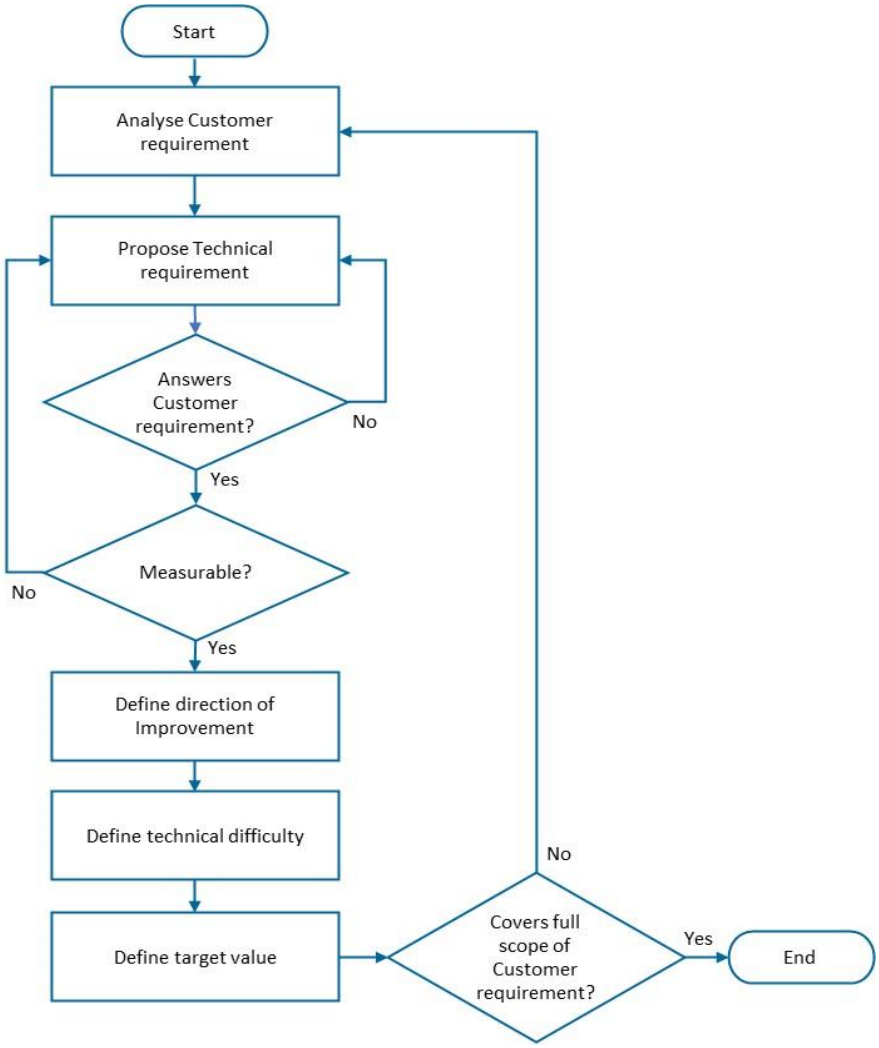


Figure 3.5 - Flowchart of the definition of a Technical requirement

After defining the Technical requirements, the correlations between them need to be classified. For that purpose, the Correlations Matrix is used, establishing correlations between Technical requirements and classifying the impact that each one has on all others as Positive or Negative. Positive correlations mean that fulfilling or improving one technical requirement, will help fulfilling or improving the other. Negative correlations represent a trade-off between two technical requirements, i.e. if one is improved, the other will suffer a negative impact. To increase the accuracy of these correlations, the four-level symbology demonstrated in Table 3.4 might be used.

Figure 3.6 is an example of a Correlations matrix with the proposed symbology.

Table 3.4 – Symbology to classify the correlations between technical requirements

Symbol	Correlation
‡	Strong Positive Correlation
†	Positive Correlation
|	Negative Correlation
‖	Strong Negative Correlation

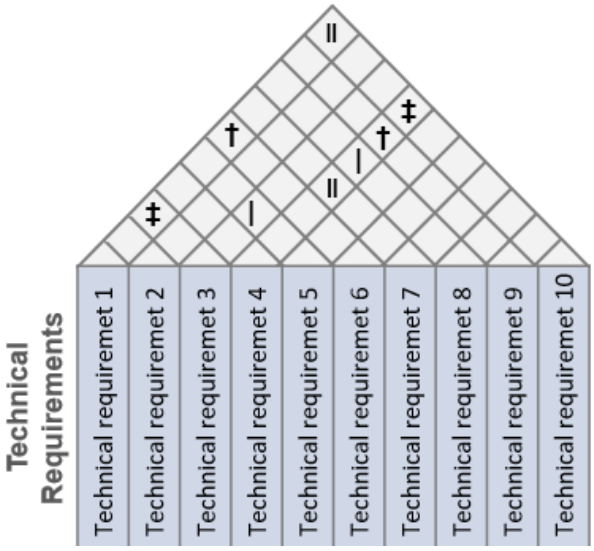


Figure 3.6 - Example of a Correlations matrix

The next step after the Correlations matrix, is classifying the Relationships between the Technical and Customer requirements. These relationships are normally complex, with varying levels of strength (Bernal et al. 2009). To analyse and quantify those relationships, the Relationships Matrix needs to be constructed - by assessing the impact of each technical requirement in the fulfilment of all customer requirements and classifying those relationships as Light, Medium or Strong. One Technical requirement might have an impact on multiple Customer requirements. Likewise, one Customer requirement might be impacted by multiple Technical requirements. To quantify these relationships, a scale needs to be used as reference. With that objective in mind, in Table 3.5, four different levels of relationships are proposed. Figure 3.7 is an example of Relationships matrix with the mentioned conditions.

Table 3.5 - Levels of strength of Relationships between Technical and Customer Requirements

Relationship description	Level of strength
Strong relationship	9
Medium relationship	3
Light Relationship	1
No relationship	0 (or blank space)

	COLUMN #	1	2	3	4	5	6	7	8	9
ROW #	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	Technical requiremet 1	Technical requiremet 2	Technical requiremet 3	Technical requiremet 4	Technical requiremet 5	Technical requiremet 6	Technical requiremet 7	Technical requiremet 8	Technical requiremet 9
1	Requirement 1	9	9						1	
2	Requirement 2	3	1	9						
3	Requirement 3	1	3		9	3				3
4	Requirement 4				1	9	1			
5	Requirement 5			3			9	9	1	
6	Requirement 6	1	3		1				9	
7	Requirement 7						1	1	1	

Figure 3.7 - Example of a Relationships matrix

A competitor assessment through benchmarking is the next step of the methodology. Consulting the customer, the competitive benchmarking of the other available Interoperability frameworks needs to be done. This will reflect the Customer's perception on how the framework helps fulfilling the Interoperability requirements when compared to other existing frameworks. It is important to ensure that in this step, the consulted Customer has a broad knowledge of the requirements of the entire network, as well as of the different existing frameworks' characteristics. To quantify and compare the fulfilment level of each Customer requirement by each existing framework, the utilization of a scale is suggested, as well as the development of a conceptual map to facilitate the comparison with the other frameworks. In Figure 3.8, a scale from 1 to 5 was used for this purpose and a conceptual map with those classifications was designed.

Customer Requirements	Our Framework	Framework 1	Framework 2	Framework 3	Framework 4	Framework 5
Requirement 1	3	4	2	5	5	2
Requirement 2	5	1	3	4	2	4
Requirement 3	4	3	5	2	3	3
Requirement 4	2	5	4	3	4	5
Requirement 5	1	2	3	5	1	1
Requirement 6	3	4	5	1	2	3
Requirement 7	5	4	3	2	5	5

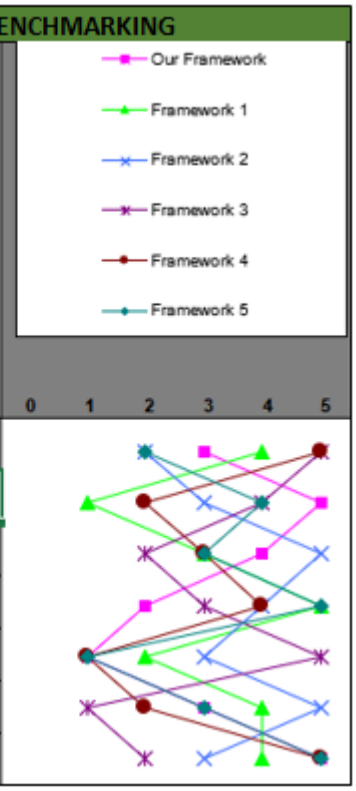


Figure 3.8 - Example of Competitive benchmarking by the Customer

The final step of the methodology is to define the Prioritization of the Technical requirements. In the context of Interoperability and this methodology, this means identifying the most relevant measurable characteristics of the network to be controlled and improved to achieve Interoperability.

To do such prioritization, the Technical Relevance and Relative Technical Relevance of each Technical requirement need to be calculated. Considering the Customer requirements' previously attributed relevance and the Relationships matrix, the below formulas must be applied for each column of the House of Quality:

$$\textit{Technical relevance} = \sum \textit{(Customer Requirement's Relevance x Relationship Strength Level)}$$

$$\textit{Relative Technical Relevance} = \textit{Technical Relevance} \ / \ \sum \textit{Technical Relevance}$$

With all the calculations finished, it is possible to identify the most relevant Technical requirements to be controlled and improved to achieve Interoperability. Figure 3.9 is an example of a relationships matrix with the Technical Relevance values already calculated.

To help define the priorities among Technical requirements, it is suggested to apply Pareto's principle and give priority to 20% of the Technical Requirements with the highest Technical Relevance. These will represent the most relevant measurable characteristics to achieve Interoperability within the network. As already well known, the 80/20 rule of Pareto's principle is hard to find in practical examples of real situations. In the example of Figure 3.9, this would mean prioritizing Technical Requirements 1 and 2 and achieving an Interoperability level of 34,6%.

			COLUMN #	1	2	3	4	5	6	7	8	9
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↓	↑	↑	X	↑	X	↑	↑	↑
ROW #	RELATIVE WEIGHT	RELEVANCE	Technical Requirements / Customer Requirements	Technical requirement 1	Technical requirement 2	Technical requirement 3	Technical requirement 4	Technical requirement 5	Technical requirement 6	Technical requirement 7	Technical requirement 8	Technical requirement 9
1	17.2%	5	Requirement 1	9	9						1	
2	10.3%	3	Requirement 2	3	1	9						1
3	17.2%	5	Requirement 3	1	3		9	3				
4	10.3%	3	Requirement 4				1	9	1			
5	13.8%	4	Requirement 5			3			9	9	1	
6	13.8%	4	Requirement 6	1	3		1				3	
7	17.2%	5	Requirement 7						1	1	1	3
			TECHNICAL RELEVANCE	63	75	39	52	42	44	41	26	18
			RELATIVE TECHNICAL RELEVANCE	15.8%	18.8%	9.8%	13.0%	10.5%	11.0%	10.3%	6.5%	4.5%

Figure 3.9 - Example of a Relationships matrix with calculated values of Technical Relevance

No prior work has been done in this context, making this approach an exploratory one, with uncertain outcomes which will be studied and analysed in Section 4.2 and concluded upon in Chapter 5.

4. CASE STUDY: THE PORTUGUESE NODE OF METROFOOD-RI

To test the applicability of the proposed methodology and understand if the HoQ is a valid methodology to design Interoperable METROFOOD Research Infrastructures, a case study was conducted on the Portuguese Node of the METROFOOD-RI. The opportunity to conduct the case study on this subject came about because FCT-NOVA is, at the same time, the faculty in which this dissertation was done, and a participating entity of the Portuguese Node of METROFOOD-RI. Thus, the communications with all entities of the Node and the gathering of information about METROFOOD and the Portuguese Node was easier than it would be if these were not the conditions.

In section 4.1, METROFOOD-RI and the Portuguese Node are described in detail.

Section 4.2 explains the case study shows the respective obtained results.

4.1. METROFOOD Project And Network

4.1.1. Overview and EU-level analysis

As explained in section 1.2, METROFOOD-RI aims to solidify scientific knowledge on metrology in food and nutrition by promoting cooperation and interaction between all the stakeholders involved in the project, creating in parallel a common and shared base of data, information and knowledge.

In practice, as shown in Figure 4.1, METROFOOOD-RI is composed of a physical infrastructure (P-RI) and an electronic one (E-RI), the two of them different but interactive and mutually dependent infrastructures.

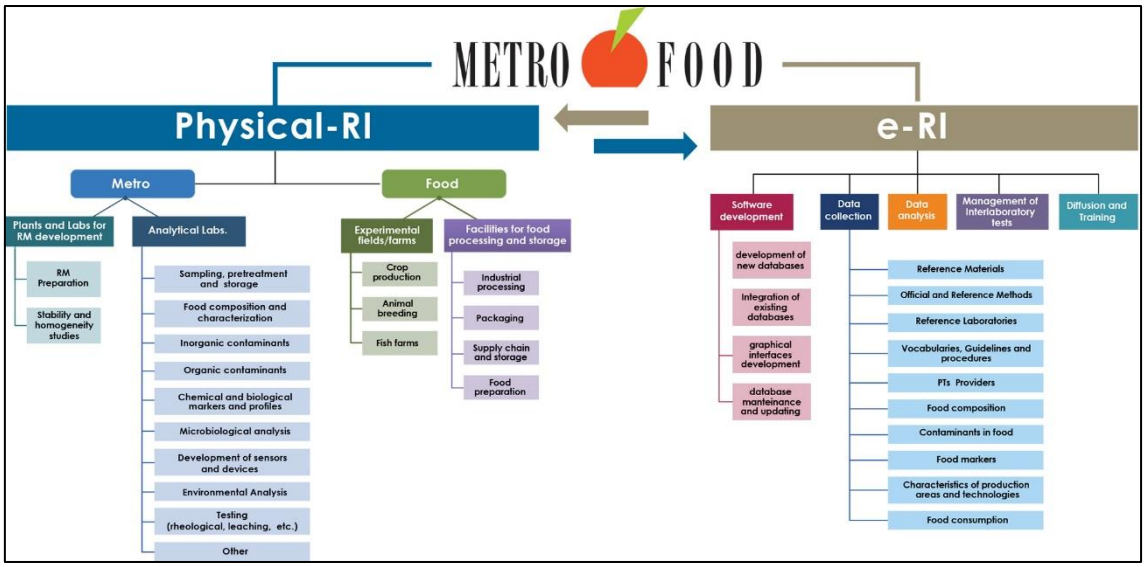


Figure 4.1 - METROFOOD-RI

(source: Zoani 2016)

As demonstrated in Figure 4.2, the P-RI consists of both Metrology and Food facilities, forming a European network of plants, laboratories, experimental fields and farms, and facilities for food processing and storage which interact with each other to perform all infrastructure's activities.

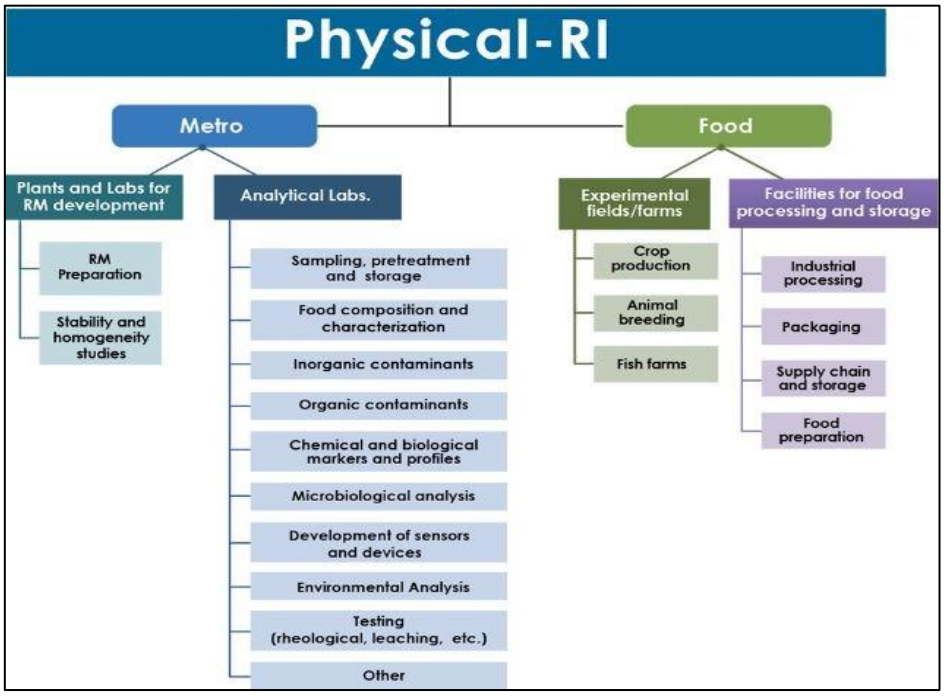


Figure 4.2 - P-RI - Physical Infrastructure

(source: Zoani 2016)

Metrology and Food related activities of this network are mutually dependent, as Metro labs will need data and samples from Food facilities to perform their activities and consequently

communicate conclusions and provide methods to the food chain. Both groups of activities are further explained in Figure 4.3.

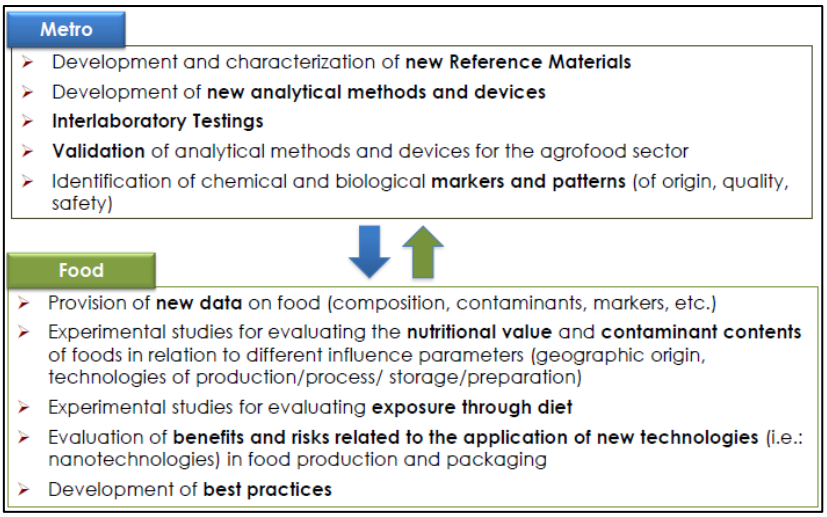


Figure 4.3 - P-RI activities

(source: Zoani 2016)

E-RI (Figure 4.4) on the other hand, will consist of an electronic access platform where all competent entities involved will be able to share and gather information and data on metrological tools for food examination, with special focus on composition, nutritional values, levels of contaminants and markers.

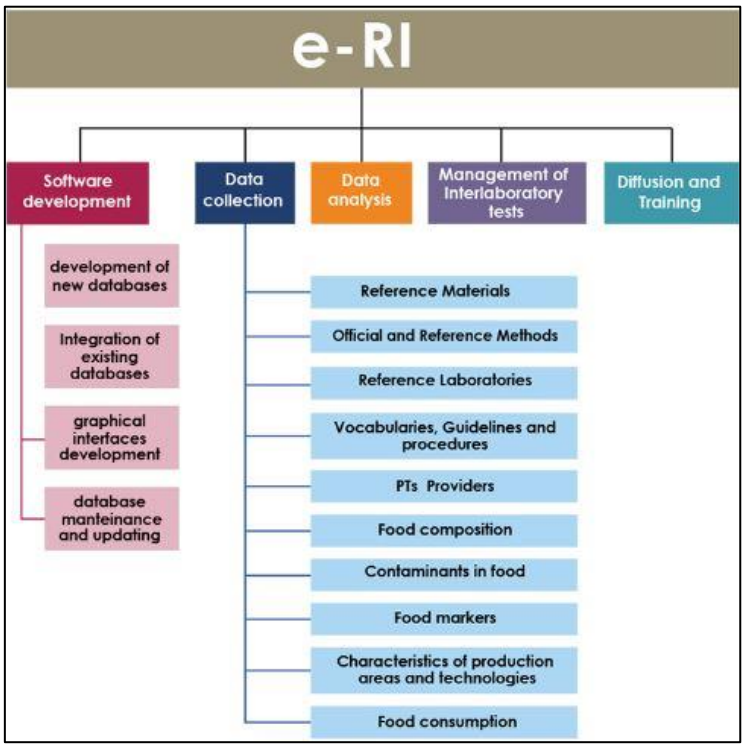


Figure 4.4 - e-RI - Electronic Infrastructure

(source: Zoani 2016)

As a transversal infrastructure, the activities that e-RI encompasses are also transversal. Inputs come (not exclusively) from and outputs serve (not exclusively) the P-RI, as it can be observed in Figure 4.5. There are four main activities planned for this infrastructure:

- Construction and maintenance of a website that will serve as a data base with all the required data to standardize and harmonize all food analyses, such as reference materials, official methods, reference and threshold values, reference laboratories, proficiency testing providers and quality assurance strategies;
- Diffusion of information and training on metrological terminology, tools, principles and procedures;
- Gathering of information about countries' needs on metrology for food and nutrition;
- Collection of data on food composition, nutritional contents and levels of contaminants. In addition, analysis of rising concerns about new technologies and techniques used in the production of food across different geographical regions.

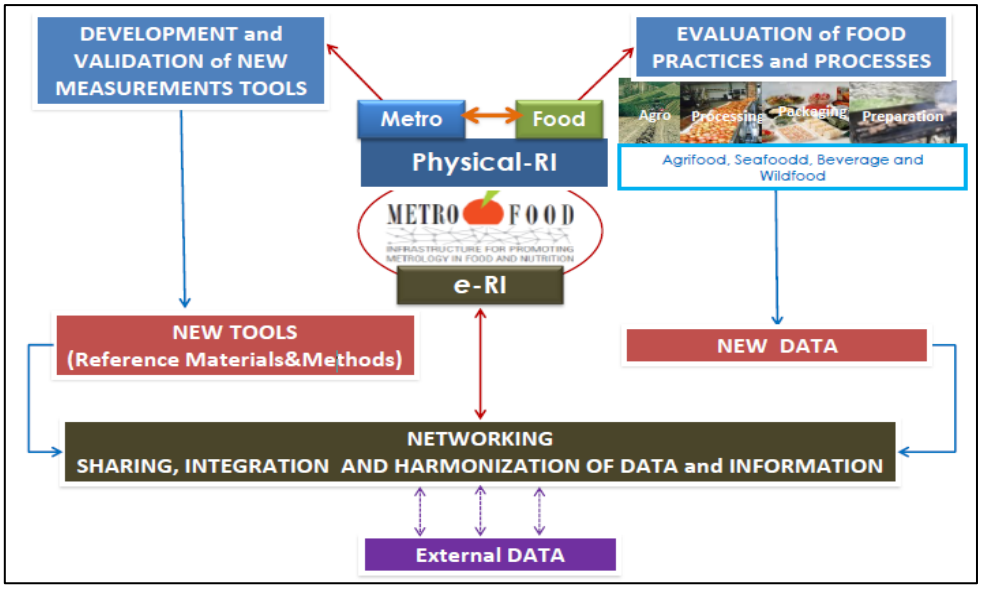


Figure 4.5 - Link between P-RI and E-RI

(source: Zoani 2016)

METROFOOD-RI strictly interconnects both the P-RI and the e-RI, consequently connecting the 48 institutes from 18 countries that form the total Consortium of the project. The consortium is organized in a Hub and Nodes model, as illustrated in Figure 4.6. Italy, being the Coordinator country, is considered to be the Central Hub of the project, having at the same time its own National Node. All other participating countries represent the remaining National Nodes of the model.

National Nodes with multiple partner institutes, like Portugal, are then organized in networks. In section 4.1.2, the Portuguese National Node is described in further detail, as this is the node under which scope this dissertation has been developed.

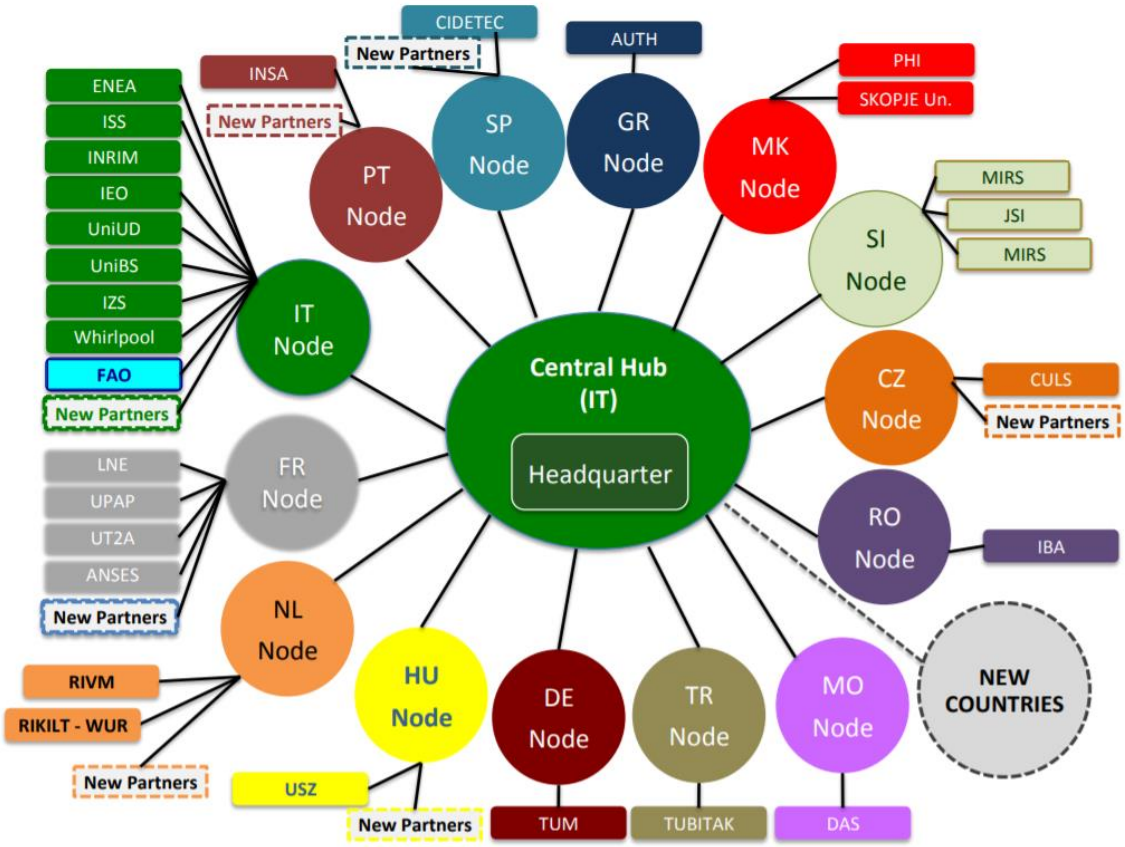


Figure 4.6 - METROFOOD-RI Hub and Nodes model

(source: Zoani 2016)

4.1.2. Portuguese National Node

The Portuguese Node is currently composed by a network of three public entities which together contribute to METROFOOD's both P-RI and e-RI. As noticeable in Figure 4.7, on the P-RI side, the Node is involved in both Metro (providing Plants and Laboratories for Reference Materials development, and Analytical Laboratories) and Food (providing Facilities for food processing and storage) areas. On the e-RI side, Software development and Data collection are the areas to which the Node is contributing.

The National Node provides METROFOOD-RI with Metrological and Standardization Services, such as reference materials development, improvement of measurement methods and devices, harmonization and standardization of methods and procedures. Furthermore, agro-ecosystem characterization, food analyses, and food packaging testing and characterization are some of key services provided by the Node to the whole METROFOOD-RI.

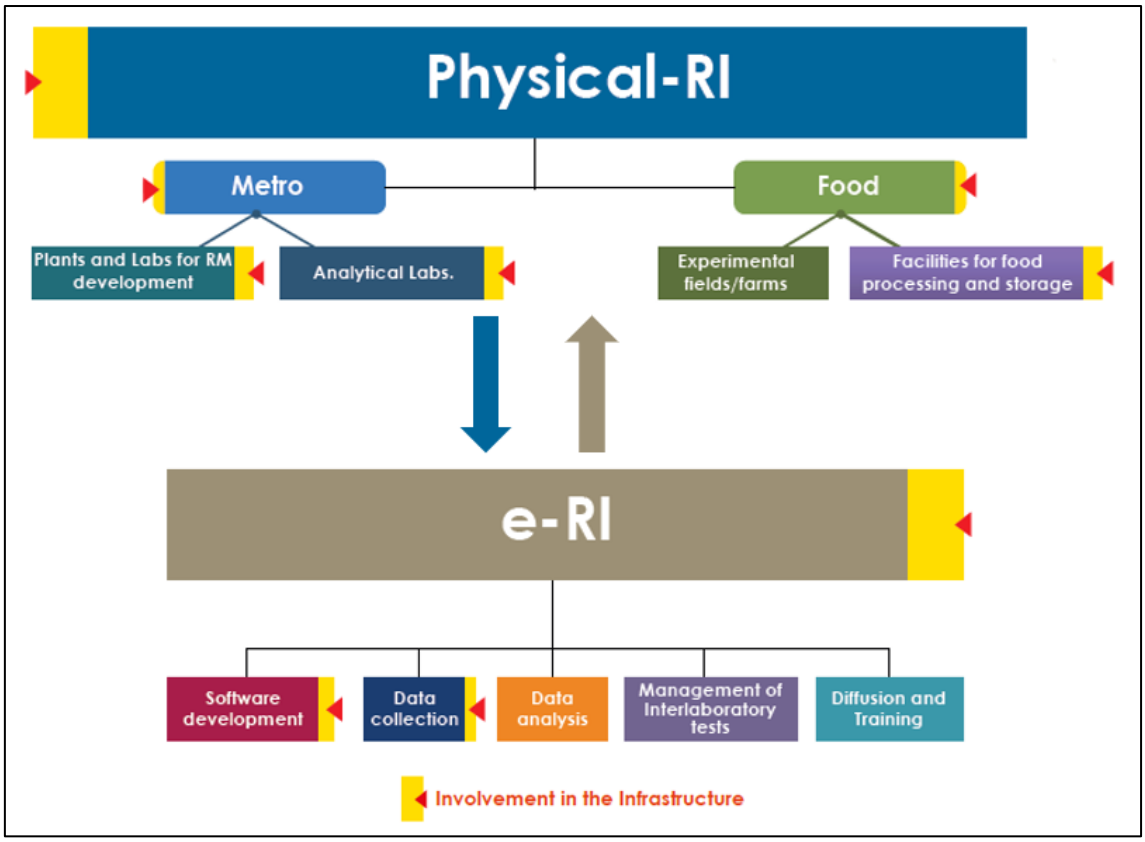


Figure 4.7 - Portuguese Node's involvement in METROFOOD-RI

(source: Castanheira 2020)

The three public entities involved are INSA, FCT-UNL and IPMA and in Figure 4.8 we can see the hierarchical structure of the node, as well as the METROFOOD leaders and main points of contact from each entity. INSA is the node's project leader, with FCT-UNL and IPMA being hierarchically equivalent and reporting to INSA.

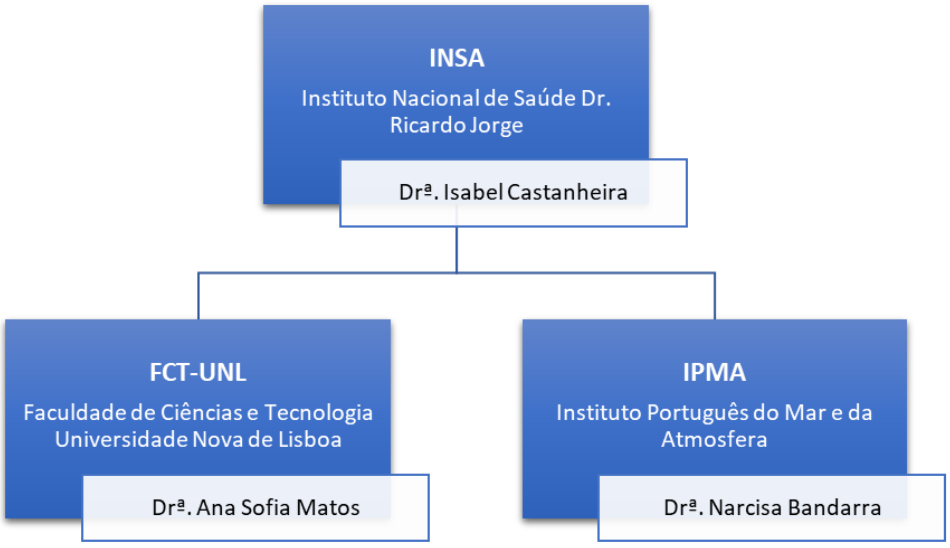


Figure 4.8 - Hierarchical structure of the Portuguese Node

The initial role of FCT-UNL, under which scope this dissertation has been elaborated, essentially consists of providing the National Node with tools to render the network fully interoperable. Other tasks and responsibilities are expected to be assigned in the scope of the project, but being Interoperability the topic explored in this dissertation, no relevance is found in deviating from it.

Although these are the current three entities composing the Portuguese Node and forming this hierarchical structure, more entities are likely to join the node and increase the complexity of the network and the relationships within it.

Considering this growing complexity and the current heterogeneity of the node's entities, the need for the node to become an interoperable network is clear. To efficiently create added value for METROFOOD-RI, all entities must be able to collaborate with all partners and successfully establish IT-supported business relationships.

After Interoperability is successfully achieved within the Portuguese Node, the framework used for that purpose may be shared with the other nodes of the METROFOOD-RI with the main goal of developing the whole METROFOOD-RI into an interoperable network.

That being said, in Section 4.2 is exposed the Case Study developed on the Portuguese Node.

4.2. Case Study Development

In this section, the methodology explained in Section 3.3 is applied to the Portuguese Node of the METROFOOD-RI considering the Interoperability framework presented in Section 3.1.

For the construction of the House of Quality, the Interoperability Requirements identified were used as the **Customer Requirements**, as they represent what the participating entities consider to be important for the Portuguese Node to become Interoperable. The participating entities were considered to be the Customer, meaning that the Node itself, being composed by those entities, will be the Customer. These Customer requirements are also classified according to their level of Relevance for the Interoperability of the Node, classification which is done by the entities themselves, thus validating the proposed Customer requirements.

The **Technical or Project requirements** have been thought of as the solutions to fulfil the Interoperability requirements, meaning the measurable actions the Node needs to take in order to achieve Interoperability among all entities. Those solutions should be measured regularly to keep track of the network's level of Interoperability.

The **Correlations Matrix**, normally used in the House of Quality to establish correlations between Technical requirements, intends to analyse and define the impact that each technical requirement has on all others, by classifying the relations between them as Positive or Negative. Positive correlations mean that fulfilling or improving one technical requirement, will help fulfilling or

improving the other. Negative correlations represent a trade-off between two technical requirements, i.e. if one is improved, the other will suffer a negative impact.

This matrix has not been constructed for this dissertation, because defining these correlations requires previous experience and/or experimental studies and tests on the technical requirements. As all the steps of this framework are being done for the first time for METROFOOD-RI, there is no previous experience or any experimental study that helps understanding the impacts of each proposed technical requirement on the others. Only with the development and evolution of the project within the Portuguese Node, it will be possible to assess these impacts and classify them accordingly. Setting these correlations right now, would be a merely arbitrary process that could result in wrong conclusions about the proposed framework.

For the same reasons, Technical Difficulty and Project Specifications were not calculated.

The relationships between the Technical and Customer requirements are normally complex, with varying levels of strength (Bernal et al. 2009). To analyse and quantify those relationships, the **Relationships Matrix** needs to be constructed - by assessing the impact of each technical requirement in the fulfilment of all customer requirements and classifying those relationships as Light, Medium or Strong. One Technical requirement might have an impact on multiple Customer requirements. Likewise, one Customer requirement might be impacted by multiple Technical requirements.

In standard Houses of Quality, competitors' assessment is done through **Benchmarking**, from both Customer and Technical perspectives. Similarly to the Correlations Matrix, for this dissertation, this step was not elaborated. To be possible to perform benchmarking, other frameworks by other entities/investigators would have needed to be proposed, which has not yet happened. Thus, it was not possible to conduct this step of the House of Quality.

Finally, by multiplying the Relevance level of each Customer requirement by the level of relationship with the Technical requirements and summing all the values, the **Technical Relevance** of each Technical requirement is found, allowing the identification of the most relevant Technical requirements to fulfil with the objective of achieving Interoperability within the Portuguese Node.

All the followed steps are explained between sub-sections 4.2.1 and 4.2.5

4.2.1. Definition of Interoperability requirements – Customer requirements

For the definition of the Portuguese Node's Interoperability requirements, as stated in Section 3.1, the Interoperability requirements and sub-requirements for METROFOOD-RI are the ones stated in Table 3.1. A more detailed explanation and adaptation of these requirements is given in this Section.

Concerning **Business and Project Strategy**, as stated in subsection 2.2.7 it is where the highest level of interoperability should be reflected. At high strategic decision-making levels, the

objectives and scope of collaboration on METROFOOD-RI should be as clear as possible. For the mutual interests of the collaborating entities to be identified and respected, as well as for the interests of Portuguese Node for METROFOOD-RI itself, conflicting interests should be openly addressed. The cooperation goals of the Node should be objectively defined, transparently communicated to all entities (inside and outside the Portuguese Node), aligned and coordinated among all entities of the Node and, finally, fully compliant with METROFOOD-RI's requirements and goals. These sub-requirements of Business and project Strategy are explained in Table 4.1.

Table 4.1 - Sub-requirements of Business and Project Strategy

(adapted from Cabral, 2015)

Sub-requirements of Business and Project Strategy	**Description**
Objectivity	The extent to which the cooperation goals are clear and objectively defined from the point of view of the cooperating entities and leave no margin for different interpretations.
Transparency	The extent to which the defined cooperation goals are transparently communicated within and outside the Node.
Alignment and coordination among entities	The extent to which the goals of each cooperating partner are aligned with those of the whole Node, i.e. the extent to which the goals set for the Node satisfy the interests of all cooperating entities.
Compliance with METROFOOD-RI's requirements	The extent to which the goals of the Node are complying with METROFOOD-RI's general goals defined for the whole network.

Management of External Relationships, as said in subsection 2.2.7, concerns managing cooperation aspects such as agreements and contracts, managing conflicts, managing change and most importantly assuring frequent, useful and efficient communication, both within the Portuguese Node and outside it (with other National Nodes, the Central Hub and possible external partners). The sub-requirements of Management of External Relationships are stated and described in Table 4.2.

Table 4.2 - Sub-requirements of Management of External Relationships

(adapted from Cabral, 2015)

Sub-requirements of Management of External Relationships	**Description**
New entities' selection	Assesses if there are mechanisms for selecting the best external entities available and if they meet the defined minimum requirements to join the Node.
Partner entities' continuous assessment	Assesses if there are regular mechanisms for evaluating the performance of the current partner entities and their appropriateness for the cooperation.
Cooperation agreements	Considers if there are clear, well-defined cooperation agreements with partner entities spelling out all terms and conditions to avoid conflicts and misunderstandings.
Inter-organisational communication	Evaluates if there are barriers to free inter-organisational communication.
Conflict management	Addresses the existence and frequency of conflicts, and in the event that they exist, if mechanisms for quick resolution are in place.
Mutual trust	The extent to which an entity trusts that a partner's actions and developed work will meet expectations, be trustworthy, and free of opportunistic behaviour.

Collaborative Business Processes, as previously mentioned in subsection 2.2.7, have great importance in relationships between partner entities, as their proper alignment may help avoid issues like conflicts of resources or uncoordinated efforts. If properly aligned, they accelerate and facilitate the establishment and continuity of coordinated relationships between entities with originally different business processes. The associated sub-requirements are shown in Table 4.3.

Table 4.3 - Sub-requirements of Collaborative Business Processes

(adapted from Cabral, 2015)

Sub-requirements of Collaborative Business Processes	Description
Roles, responsibilities and authorisations	Addresses whether there is a clear division of roles and responsibilities between the collaborating entities.
Clarity in business processes	Questions if business processes for collaborative work are well-defined and documented, i.e. whether there is a clear and logic flows of materials and information within the network.
Accessibility and visibility of business processes	Considers whether the status of processing within one company is easily visible to the collaborating entities, i.e. whether the information which they consider as key or useful to their operations is easily visible to the collaborating entities.
Harmony of business processes	Addresses whether the business processes of each collaborating partner are aligned with those of the whole Node, i.e. whether there is an alignment of activities for mutual benefit, avoiding gaps and overlaps, in order to achieve efficiency gains.
Integration of business processes	Addresses whether the business processes of the collaborating entities are well connected and synchronised so that they can be viewed as a single process.
Flexibility of business processes	Analyses whether the collaborating entities are able to respond to new collaboration requirements and change collaborative business processes quickly without interrupting the course of business.

Concerning the entities' **Organisational Structures,** these tend to be different from entity to entity, as they greatly depend on size and level of departmentalization. Thus, as acknowledged in subsection 2.2.7, inter-organisational mapping has great importance to avoid communication and counterparts' identification issues within the Portuguese Node. The corresponding sub-requirements are stated and explained in Table 4.4.

Table 4.4 - Sub-requirements of Organisational Structures

(adapted from Cabral, 2015)

Sub-requirements of Organisational Structures	Description
Cross-Organisational Role Mapping	Questions whether there is clarity between entities regarding the proper person for the collaborating entity to contact for different types of subjects or if there are significant delays for obtaining information from the collaborating entity due to uncertainty on whom to contact.
Points of contact	Considers whether there are sufficient contact points at different levels of the Portuguese Node that can allow the different organisational structures to collaborate flawlessly.

Employees and Work Culture have important roles when aiming to achieve Interoperability within the Node. Openness to change and mutual trust between and within entities are crucial factors to add value to the project. Also, equal or similar work competencies across entities, inclusive, not gender-biased and collaborative work environments within and between entities, all play important roles towards Interoperability. The corresponding sub-requirements are in figured Table 4.5.

Table 4.5 - Sub-requirements of Employees and Work Culture

(adapted from Cabral, 2015)

Sub-requirements of Employees and Work Culture	Description
Interpersonal trust	Questions whether employees of Node's entities trust each other and whether they believe that their counterparts will not follow opportunistic behaviour.
Interpersonal conflicts	Addresses the existence and frequency of conflicts between employees of different Node's entities, and if they exist, if mechanisms for quick resolution are in place.
Cultural differences	Considers whether employees involved in the collaboration are from different cultures, and in case of differences, if it causes problems in the normal interaction of employees.
Work methods	Assesses whether there are differences in the applied work methods between entities, and in case of differences, if it can cause problems in the development of tasks.
Motivation	Addresses whether employees from all entities are motivated, or if they have incentives and encouragement to take leadership roles and introduce initiatives for improving ongoing collaborative work processes.
Responsibility	Focuses on assessing if employees from all entities take responsibility for tasks or if there is a tendency to push responsibilities to employees from other entities.
Honesty	Considers if employees from all entities share the same level of honesty and openness with their peers and counterparts.
Respect	Questions whether employees from all entities respect each other.
Efficiency	Addresses the issue of whether employees from all entities are productive in terms of having the required training, performance, and working efficiency.

Knowledge and Data Management is especially important in knowledge and data-based collaborations, which is the case of METROFOOD's Portuguese Node. Proper mechanisms and agreements for sharing Intellectual Property, be it in the form of developed knowledge or acquired data from tests, must exist to avoid conflicts related to knowledge and/or data ownership and rights (IPR – Intellectual Property Rights). The sub-requirements of Knowledge and Data Management are explained in Table 4.6.

Table 4.6 - Sub-requirements of Knowledge and Data Management

(adapted from Cabral, 2015)

Sub-requirements of Management of External Relationships	Description
Protection of existing IPR	Questions whether the there is an agreement which clearly spells out existing IPRs to be provided by each entity and the conditions of use, and whether any compensation for the same is clearly agreed upon.
Protection of Collaboration-originated IPR	Considers whether the potential IPRs emerging from the collaboration on METROFOOD have been identified and the use and sharing of rights has been agreed upon.
IPR conflicts	Addresses whether there are any conflicts related to IPR sharing or use implied in the collaboration.
Encouragement for knowledge and data sharing	Evaluates if there are well-established mechanisms that encourage all entities' employees to share knowledge and relate the contribution of sharing knowledge with performance assessment.
Knowledge and data vulnerability	Assesses whether there are well-established mechanisms to avoid a large amount of knowledge loss (because of employee's resignation).

As stated in subsection 2.2.7, **Business and Project Semantics** are indispensable and need to be perfectly aligned and understood by all entities, otherwise it will be impossible for processes to be aligned and functional, with Interoperability being compromised. "Project" was added to this requirement because of the specificity of numerous terms directly related to the METROFOOD project which need to be aligned and fully acknowledged by all Node's entities. That being said, these sub-requirements are listed in Table 4.7.

Table 4.7 - Sub-requirements of Business and Project Semantics

(adapted from Cabral, 2015)

Sub-requirements of Organisational Structures	Description
Conflicting terminologies	Questions whether the Node's entities have different terminologies within the same areas of knowledge.
Semantic conversion and standardisation	Evaluates if the Node's entities have standardised processes to undertake the process of semantic conversion, so that differing terms in different entities do not create operational difficulties.
Linguistic barriers	Assesses if all Node's entities and their employees use the same language in both written and oral communication (in informal and formal moments), and, if not, what is the impact of that difference.

Information Quality and Standards is a requirement which intends to evaluate degree to which the exchanged information from one entity to another is fulfilling that entity's pre-determined needs (Cabral 2015). For that fulfilment to be possible, the exchanged information needs to comply with several parameters which will dictate the quality level of the information. Having that in mind, standards should be defined for those parameters, as well as for each type of information. For the Node's entities to effectively exchange information, meeting one another's needs, the sub-requirements explained in Table 4.8 should be addressed.

Table 4.8 - Sub-requirements of Information Quality and Standards

(adapted from Cabral, 2015)

Sub-requirements of Employees and Work Culture	**Description**
Completeness	The extent to which the information that has been exchanged is of sufficient breadth, and scope for the task on hand. Describes the completeness of the information comparing with the requirements for the receiver to make his analyses and decisions.
Cleanness	Questions whether the information that has been exchanged can be used directly, without a need or reworking before use, in terms of content and/or structure, i.e. clear and well formatted.
Accuracy	Addresses whether the information that has been exchanged is error-free, i.e. whether it can be used without correction.
Punctuality	Evaluates whether the information is delivered respecting the pre-defined deadlines and frequency.
Freshness	Questions whether the information that has been exchanged is up to date with the most recent results and situation.
Relevance	Assesses whether the information that has been exchanged is informative, meaningful, important, helpful, or significant for entities' decision-making.
Reliability	Addresses whether the information that has been exchanged is regarded as true, real and believable.
Understandability	Considers whether the information that has been exchanged is easy to use, understand, manipulate, aggregate and combine with other information.
Usability	Assesses whether the information that has been exchanged is presented in a format that is readable, interpretable and editable.

Information Systems and Communication Channels tries to evaluate the overall performance of entities' information systems and what requirements would need to be respected if a common Information system should be created for the Portuguese Node. Also, alternative and/or complementary communication channels should be defined and controlled. Defined as a set of interrelated components working together to collect, process, store and disseminate information (Cabral 2015), they will allow the efficient flow and utilization of information between and within entities with the objective to create added-value to METROFOOD-RI. The inherent sub-requirements are the ones figured in Table 4.9.

Table 4.9 - Sub-requirements of Information Systems and Communication Channels

(adapted from Cabral, 2015)

Sub-requirements of Employees and Work Culture	Description
Security	Questions whether users have the confidence to securely transmit confidential information and perform secure operations across the cooperating partners.
Privacy (partners' and project's)	Addresses whether the business partner's privacy, as well as existing e-business legislations are respected.
Speed and synchronicity	Addresses whether the information systems are fast enough for quick communication and whether information is synchronous or asynchronous.
Type of interaction	Addresses the type of technical process integration among applications and devices (human-human, human-machine or machine-machine).
Connectivity	Focuses on evaluating the type of connections established among applications and devices (1:1, 1:m, or m:n connections).
User interface	Concerned with whether the systems use modern technology and provides user-friendly interfaces (such as GUI – Graphical User Interface) that can present information to users in an easy-to-understand format, enabling them to use information systems effectively.
Data exchange and accessibility platforms	Considers whether there is a suitable IT infrastructure for easy exchange of data and files. Questions whether there are specific/standard translators or conversion applications that can be used to access data among the cooperating partners.
Information system's adaptability	Considers whether the information that has been exchanged is easy to use, understand, manipulate, aggregate and combine with other information.
Preventive and reactive maintenance	Assesses whether the information that has been exchanged is presented in a format that is readable, interpretable and editable.
Information Systems' Integration	Considers whether there is a suitable IT infrastructure for easy exchange of data and files.

After analysing the literature and adapting the existing Interoperability requirements and sub-requirements to the reality and context of METROFOOD-RI's Portuguese Node, a study of all the available informative materials about the METROFOOD-RI project was conducted with the objective of clearly understanding the specific requirements, aspects and characteristics of the project, as communicated by the project's leaders at European level.

These materials were obtained both from the project's public website available online, as well as provided by FCT-UNL's METROFOOD leader. A total of eight documents and four hundred and nine pages were analysed to identify the project's interoperability requirements.

After gathering all the project-specific requirements and listing them down on a draft document (in Appendix G), they were then filtered considering their relevance or not for Interoperability purposes. Only the ones considered to be relevant were kept and continued to be worked on.

They were then associated by affinity level to the previously defined Interoperability sub-requirements and, consequently, grouped under the Interoperability requirements. This association and all the initial Customer requirements can be found on the rightmost column of Table 4.10.

Table 4.10 – Initial Interoperability requirements, sub-requirements and associated Customer requirements

Interoperability requirements	Interoperability sub-requirements	Customer requirements
Business and project strategy	Objectivity; Transparency; Alignment and coordination among partners; Compliance with Project's requirements;	METROFOOD related annual costs coverage (financial model); Pricing policy for services; No. of staff involved; % of time allocated to METROFOOD; Staff recruitment and employment policies; Professional capacity; Appropriate scientific background; Procurement transparency; Common acknowledgement form and publicity form; Node's activities alignment with European level; Flowchart of Governance Model; Costs and reporting;
Management of external relationships	New partners' selection; Partner continuous assessment; Cooperation agreements; Inter-organisational communication; Conflict management; Mutual trust	Regular meetings within and with partners; Partners evaluation and communication to Project Leader; User mapping, engagement and communication strategies;
Collaborative business processes	Roles, responsibilities and authorisations; Clarity in business processes; Accessibility and visibility of business processes; Harmony of business processes; Integration of business processes; Flexibility of business processes	Access to samples from other researchers; Training and assistance of external researchers; Risk analysis and mitigation strategies;
Organisational structures	Cross-Organisational Role Mapping; Points of contact	Role mapping; Points of contact listing and definition;
Employees and work culture	Interpersonal trust; Interpersonal conflicts; Cultural differences; Work methods; Motivation; Responsibility; Honesty; Respect; Efficiency	Professional capacity (skills and training); Diversity of employees; Proficiency testing; Rules for personnel costs; Gender equality
Knowledge and data management	Protection of existing IPR; Protection of Cooperation-originated IPR; IPR conflicts; Encouragement for knowledge and data sharing; Knowledge and data vulnerability	EC recommended management of IP; Rules for knowledge ownership, individual and joint results, patens application and management; Plans to encourage the usage of project's outputs by relevant users;
Business and project semantics	Conflicting terminologies; Semantic conversion and standardisation; Linguistic barriers	Working languages

Table 4.10 – Initial Interoperability requirements, sub-requirements and associated Customer requirements (continuity)

Interoperability requirements	Interoperability sub-requirements	Customer requirements
Information systems and communication channels	Security; Privacy (partners' and project's); Speed and synchronicity; Type of interaction; Connectivity; User interface; Data exchange and accessibility platforms; Information system's adaptability; Preventive and reactive maintenance; Information Systems' Integration	Dissemination channels; Dissemination periodicity; Preservation of data; Access (authentication, authorisation and standardisation); Security (encryption, restriction to server rooms, hard and software); Maintenance software; Integration and connectivity with other e-RI; Quality and security management requirements, procedures and protocols;
Information quality and standards	Completeness; Cleanness; Accuracy; Punctuality; Freshness; Relevance; Reliability; Understandability; Usability	Data quality system; Standard Operation Procedure (SOP), procedures for periodic revision and training; KPIs and measurement methods; Traceability;

The Customer requirements defined in Table 4.10 were the first proposed version, with their designation undergoing multiple changes after further analyses and feedbacks from specialists in Interoperability and questionnaire design, namely Professors Izunildo Cabral and Rogério Puga-Leal respectively. Such changes were made with the common objective of rendering interoperability requirements as accurate, correct, clear and suited to the Portuguese Node as possible, never losing their original significance.

As these requirements were obtained directly from METROFOOD-RI's materials and sources, the designation of Customer requirements becomes increasingly meaningful and suitable.

The final version of the Customer requirements is presented in Table 4.11, and are only associated to the Interoperability requirements. These Customer requirements already represent a fully comprehensive designation of the requirements, allowing the Interoperability sub-requirements to not be needed to be displayed.

Table 4.11 - Customer requirements' final version

Interoperability Requirements	Customer Requirements
Business and project strategy	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI
	Alignment of prices for services provided under the scope of METROFOOD
	Transparency regarding the resources allocated to the National Node
	Similarity of criteria for recruiting new employees for each entity of the National Node
	Similarity of work standards between entities of the National Node
	Transparency in the purchasing and procurement policies of the National Node's entities
	Standardization of recognition and advertising methods
	Alignment of the objectives of the National Node with those of the METROFOOD network
Management of external relationships	Continuous communication between all entities of the National Node
	Alignment in the definition of selection / inclusion criteria for new partner entities
	Alignment in the definition of exclusion criteria for the entities involved
	Assurance of decision impartiality in the selection of new partner entities
	Clarity in the definition of new partner entities' enticement and allegiance strategies
	Clarity in the definition of end-user enticement and loyalty strategies
	Clairvoyance on the workflows followed by each entity
Collaborative business processes	Ease of integration of collaborative work processes
	Transparency of the results obtained under the scope of METROFOOD
	Flexibility of collaborative work processes in the event of unforeseen circumstances
	Alignment of the National Node's collaborative processes with those of the METROFOOD network
	Visibility of collaborative processes between entities of the National Node
	Coordination of collaborative processes between entities of the National Node
Organisational structures	Clear understanding of the hierarchical structure of each entity
	Clarity in mapping the functions of entities within the National Node
	Clarity in the definition of responsibilities between entities
	Clarity in the definition of contact points within entities
Employees and work culture	Assurance of professional competence of the employees of each entity
	Minimizing cultural differences and barriers
	Ensuring equal gender equality policies between entities
Knowledge and data management	Adoption of equal intellectual property management policies
	Regulation for the possession of knowledge between entities
	Clarity in defining rules for the dissemination of the produced scientific knowledge
	Ensuring the use and application of project outputs
Information systems and communication channels	Definition of communication channels
	Definition of the periodicity of communication
	Ensuring the privacy of computerized data
	Assurance of control of accesses to information systems and platforms

Table 4.11 - Customer requirements' final version (continuity)

Interoperability Requirements	Customer Requirements
	Ensuring the security of information systems
	Ensuring the security of restricted-access locations
	Certification of the correct and normal functioning of systems and platforms
	Assurance of versatility of systems and platforms
	Assurance of connectivity of systems and platforms
	Definition and alignment of quality management and data security policies
Information quality and standards	Assurance of equal levels of information quality between entities
	Certification of compliance with information sharing deadlines
	Use of the right and previously defined means of communication for information sharing
	Assurance of inform ation confidentiality
	Assurance of information integrity
	Assurance of information usability
	Assurance of information accuracy
	Assurance of information relevance
	Assurance of information reliability
	Assurance of information freshness
Business and project semantics	Agreement in the language used in the project and in a professional context
	Assurance of full and transversal understanding of the specific terms of the METROFOOD project
	Assurance of full and transversal understanding of technical-scientific concepts

4.2.2. Validation and classification of the Customer requirements

The validation and classification of the Customer requirements were both done in the form of virtual interviews, during which a questionnaire on the Interoperability requirements for the Portuguese Node was presented (the questionnaire is in Appendices A, B and C). Initially, these interviews were planned to be done in person but, due to reasons further explained in Sections 5.2 and 5.3, they had to be done virtually.

Three interviews were initially planned to happen, as the three entities composing the Portuguese Node were meant to be interviewed, but due to schedule incompatibilities and difficulties, such did not happen in the case of IPMA. Nevertheless, both FCT-NOVA and INSA were able to attend the interviews and answer the questionnaire.

For both interviews, *Google Meet* was used as the communication tool, having allowed to make video calls and to share the interviewer's screen with the interviewees with no problems encountered. Throughout the entire length of the interviews, the interviewer was presenting his screen for the interviewee to see and follow all steps.

Since both respondents (Ana Sofia Matos, from FCT-NOVA, and Isabel Castanheira, from INSA) were native Portuguese speakers, the questionnaire was designed in Portuguese and, consequently, the proposed Customer requirements had to be translated from English to Portuguese. Therefore, two different versions exist – one in Portuguese, one in English. For its analysis in this dissertation, the English version is the one used.

Microsoft® Excel® for Microsoft Office 365 was used to elaborate the questionnaire, as it was considered the most suited and versatile tool to build it and to have it answered by the interviewees in a quick and user-friendly manner.

At the end of each interview, and after all questions answered, the questionnaire was saved in .pdf format and sent by e-mail to the interviewees for them to check and confirm if all answers were correct and according to their inputs.

The developed questionnaire has a first page that explains the context under which it was being done, providing a brief explanation on its objectives, a clarification on the scope being only the National Node, the identification of the interviewer and highlighting the importance of answering it. A screenshot of the entire first page is provided in Figure 4.9.

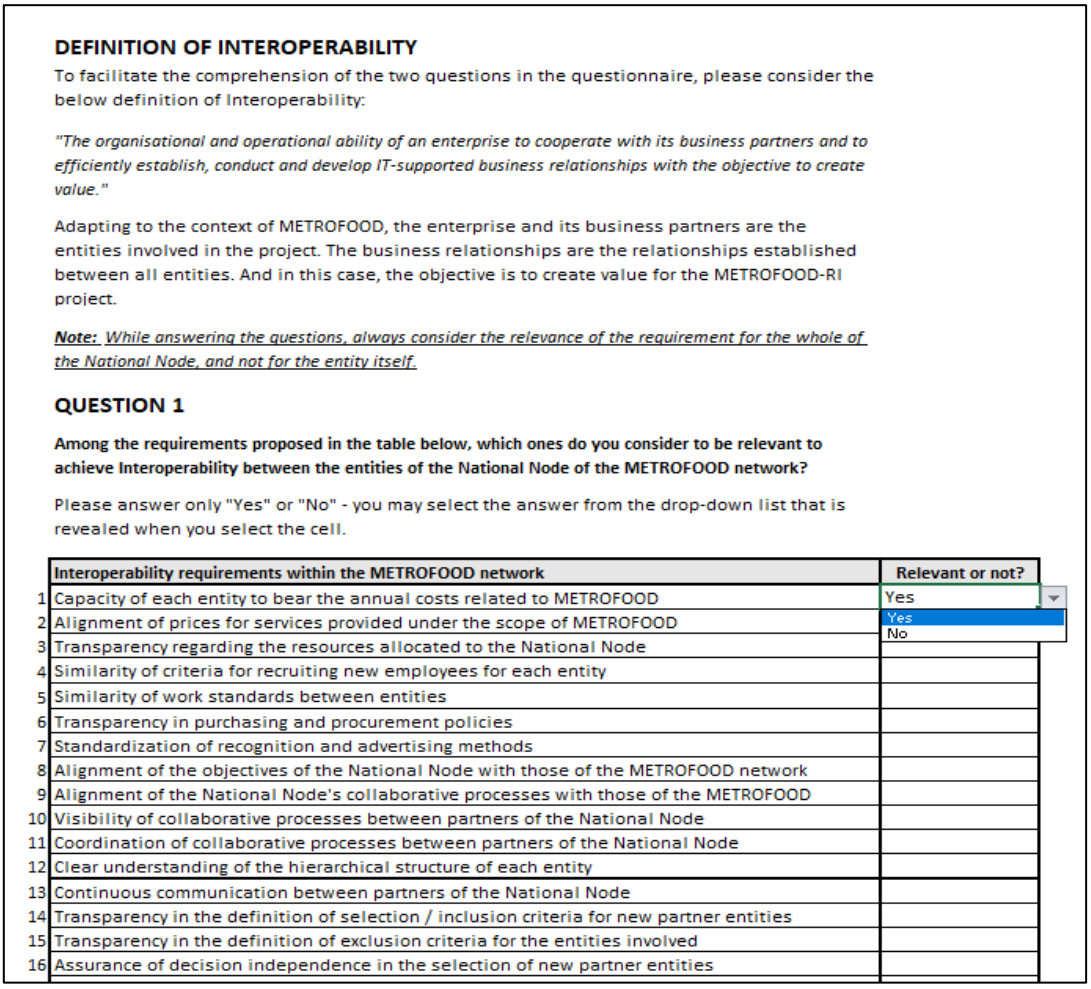
Figure 4.9 - First page of the questionnaire

To facilitate the interpretation of the questions and the requirements, the **second page** presented a short Definition of Interoperability, with a clarification on its meaning under the scope of METROFOOD-RI. A second note was added clarifying that the answers should take into consideration the relevance of the requirements for the National Node as a whole, and not for the entities as individuals.

“Question 1” was presented in this page and asked “Among the requirements proposed in the table below, which ones do you consider to be relevant to achieve Interoperability between the entities of the National Node of the METROFOOD network?”. As noticeable in Figure 4.10, the column under “Interoperability requirements within the METROFOOD network” listed all the Customer requirements exposed in section 4.2.1. When cells under “Relevant or not?” were selected, a drop-down list was revealed with the options “Yes” or “No”. The objective of this

question was to identify, among all proposed requirements, which ones were not relevant at all for the National Node, according to the respondents. Also, explanations about the proposed requirements were given when doubts arose.

Important to note that the proposed Customer requirements were listed in bulk, i.e. not organizing them by Interoperability requirement, so that the respondents interpreted each one of the them individually. Grouping them by Interoperability requirements could result in a bulk interpretation of the groups, instead of paying attention to the detailed description of each Customer requirement. Also, the term “Customer requirement” was not used in the questionnaire on purpose – the idea was for the respondents to understand these were the proposed requirements to achieve interoperability within the Portuguese Node, the term ”Customer” could have resulted in confusion.



DEFINITION OF INTEROPERABILITY

To facilitate the comprehension of the two questions in the questionnaire, please consider the below definition of Interoperability:

"The organisational and operational ability of an enterprise to cooperate with its business partners and to efficiently establish, conduct and develop IT-supported business relationships with the objective to create value."

Adapting to the context of METROFOOD, the enterprise and its business partners are the entities involved in the project. The business relationships are the relationships established between all entities. And in this case, the objective is to create value for the METROFOOD-RI project.

Note: *While answering the questions, always consider the relevance of the requirement for the whole of the National Node, and not for the entity itself.*

QUESTION 1

Among the requirements proposed in the table below, which ones do you consider to be relevant to achieve Interoperability between the entities of the National Node of the METROFOOD network?

Please answer only "Yes" or "No" - you may select the answer from the drop-down list that is revealed when you select the cell.

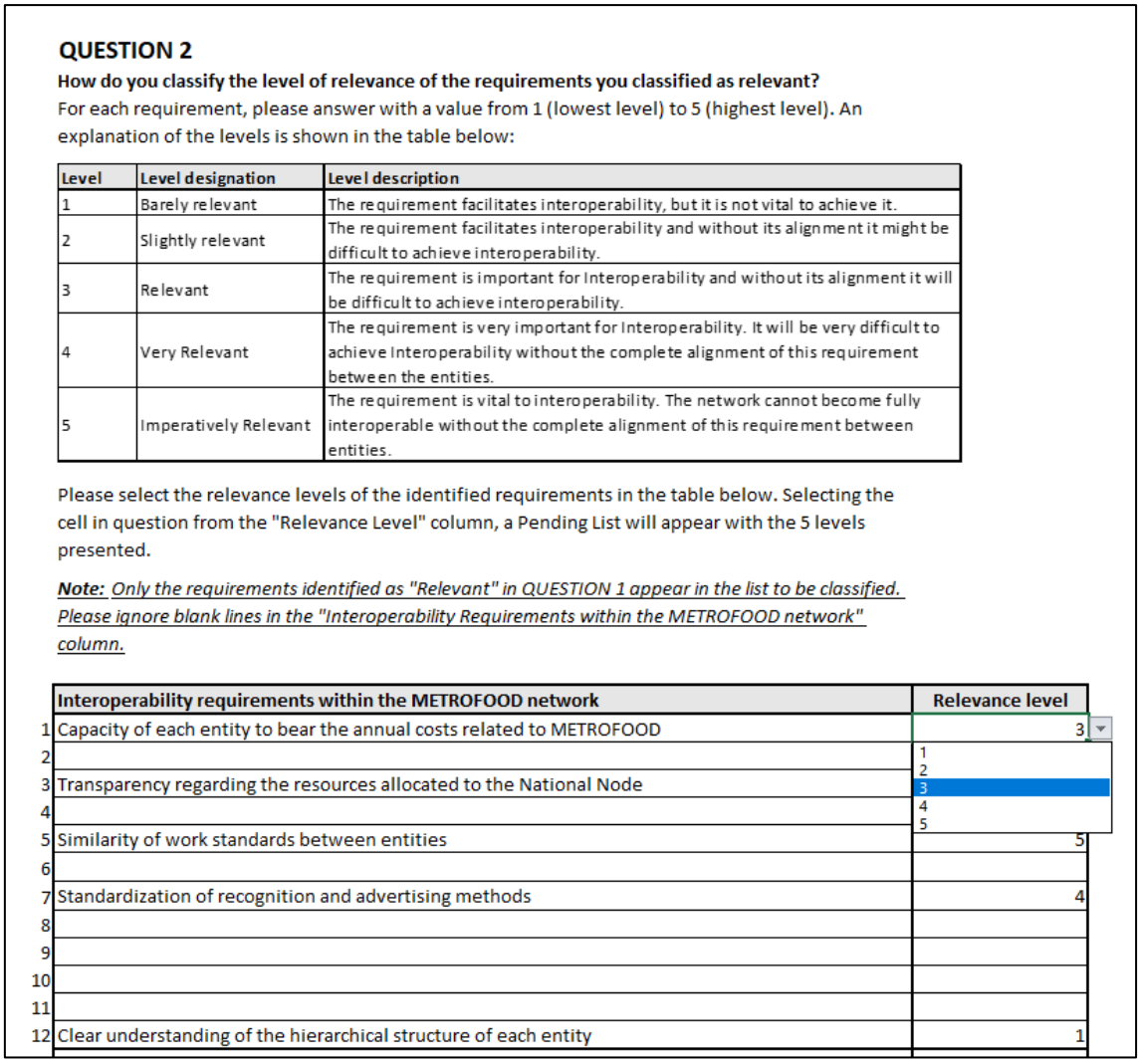
	Interoperability requirements within the METROFOOD network	Relevant or not?
1	Capacity of each entity to bear the annual costs related to METROFOOD	Yes
2	Alignment of prices for services provided under the scope of METROFOOD	
3	Transparency regarding the resources allocated to the National Node	
4	Similarity of criteria for recruiting new employees for each entity	
5	Similarity of work standards between entities	
6	Transparency in purchasing and procurement policies	
7	Standardization of recognition and advertising methods	
8	Alignment of the objectives of the National Node with those of the METROFOOD network	
9	Alignment of the National Node's collaborative processes with those of the METROFOOD	
10	Visibility of collaborative processes between partners of the National Node	
11	Coordination of collaborative processes between partners of the National Node	
12	Clear understanding of the hierarchical structure of each entity	
13	Continuous communication between partners of the National Node	
14	Transparency in the definition of selection / inclusion criteria for new partner entities	
15	Transparency in the definition of exclusion criteria for the entities involved	
16	Assurance of decision independence in the selection of new partner entities	

Yes
No

Figure 4.10 - Second page of the questionnaire (not interviewees’ answers)

On the third and last page of the questionnaire, “Question 2” was posed asking “How do you classify the level of relevance of the requirements you classified as relevant?”. The respondent was then asked to classify the level of relevance of each requirement between 1 and 5, considering the level-explanatory table visible in Figure 4.11. Under “Interoperability requirements within the METROFOOD network”, only the requirements considered to be “Relevant” in Question

1 would appear in order to be classified between 1 and 5. The blank lines visible in Figure 4.11 represented requirements considered “Not relevant” in Question 1. To classify each requirement, when the corresponding cell under “Relevance level” was selected, a drop-down list with the levels 1 to 5 would appear to select one of them.



QUESTION 2

How do you classify the level of relevance of the requirements you classified as relevant?

For each requirement, please answer with a value from 1 (lowest level) to 5 (highest level). An explanation of the levels is shown in the table below:

Level	Level designation	Level description
1	Barely relevant	The requirement facilitates interoperability, but it is not vital to achieve it.
2	Slightly relevant	The requirement facilitates interoperability and without its alignment it might be difficult to achieve interoperability.
3	Relevant	The requirement is important for Interoperability and without its alignment it will be difficult to achieve interoperability.
4	Very Relevant	The requirement is very important for Interoperability. It will be very difficult to achieve Interoperability without the complete alignment of this requirement between the entities.
5	Imperatively Relevant	The requirement is vital to interoperability. The network cannot become fully interoperable without the complete alignment of this requirement between entities.

Please select the relevance levels of the identified requirements in the table below. Selecting the cell in question from the "Relevance Level" column, a Pending List will appear with the 5 levels presented.

Note: *Only the requirements identified as "Relevant" in QUESTION 1 appear in the list to be classified. Please ignore blank lines in the "Interoperability Requirements within the METROFOOD network" column.*

	Interoperability requirements within the METROFOOD network	Relevance level
1	Capacity of each entity to bear the annual costs related to METROFOOD	3
2		
3	Transparency regarding the resources allocated to the National Node	
4		
5	Similarity of work standards between entities	5
6		
7	Standardization of recognition and advertising methods	4
8		
9		
10		
11		
12	Clear understanding of the hierarchical structure of each entity	1

1
2
3
4
5

Figure 4.11 - Third page of the questionnaire (not interviewees’ answers)

With the answers obtained from both entities (FCT-UNL and INSA) on the relevance of all requirements, it was possible to classify all relevant requirements calculating a weighted average of classifications. To define the weight of each entity’s answers, the current involvement and influence of each entity and its METROFOOD leader in the project were considered. Hence, considering INSA’s leadership role in the Portuguese Node and Isabel Castanheira’s deep involvement in the development of METROFOOD-RI, plus Ana Sofia Mato’s advice about allocating a greater weight to INSA’s answers, the weight stated in Table 4.12 was allocated.

Table 4.12 - Weights of entities' answers

Entity	Questionnaire answers' weight
INSA	70%
FCT-UNL	30%

With the weighted averages calculated for all requirements and the results rounded to the nearest whole number, a final classification for all of them was achieved. The requirements which final classification equalled 0 or 1, were excluded from the final list of Customer requirements, as for that to happen it would mean one of six scenarios, all shown in Table 4.13.

Table 4.13 - Scenarios for requirements classified with 0 or 1

Scenario #	Answers		Final Classification (not rounded)
	FCT-UNL (30%)	INSA (70%)	
1	0	0	0.0
2	0	1	0.7
3	0	2	1.4
4	1	0	0.3
5	1	1	1.0
6	2	0	0.6
7	3	0	0.9

Quickly analysing the answers from both entities, it was concluded that only scenarios 1 and 7 were verified. Scenario 1 (only one requirement in this situation) meant that the requirement is not relevant at all, as both entities classified it as “Not-relevant”. In scenario 7 (two requirements in this situation), FCT-UNL classified the requirement as “Relevant”, while INSA classified it as “Not-relevant” – considering INSA’s positioning as the Portuguese Node leader and greater knowledge about the project, the requirements in this situation were excluded.

With all calculations made and the analysis of results finished, a final classification of all requirements was achieved, which can be found in Appendix E.

4.2.3. Technical requirements definition and direction of improvement

The Technical requirements were defined by trying to answer each one of the Customer requirements. In practical terms, they represent the actions that the Portuguese Node and its entities need to put in place to fulfil the defined Interoperability requirements and, ultimately, to achieve Interoperability.

For these requirements to be effective in helping the Node achieve Interoperability, they need to be measurable, otherwise it would not be possible to keep track of the current level of

interoperability and generate proper actions according to the situation. Thus, all the defined Technical requirements for the Portuguese Node are measurable.

All technical requirements were created in a way that they can be improved, be it by increasing their value, decreasing or aiming at a certain Nominal value. The defined direction of improvement shows the entities how to work on each requirement to improve Interoperability.

Depending on the scope of each Customer requirement and the extent to which the defined Technical requirement covers it, there might be the need for multiple technical requirements to fulfil one single customer requirement. The same goes the other way around, as multiple customer requirements might be covered by one single technical requirement.

The full process behind the definition of a Technical requirement is explained in Figure 4.12.

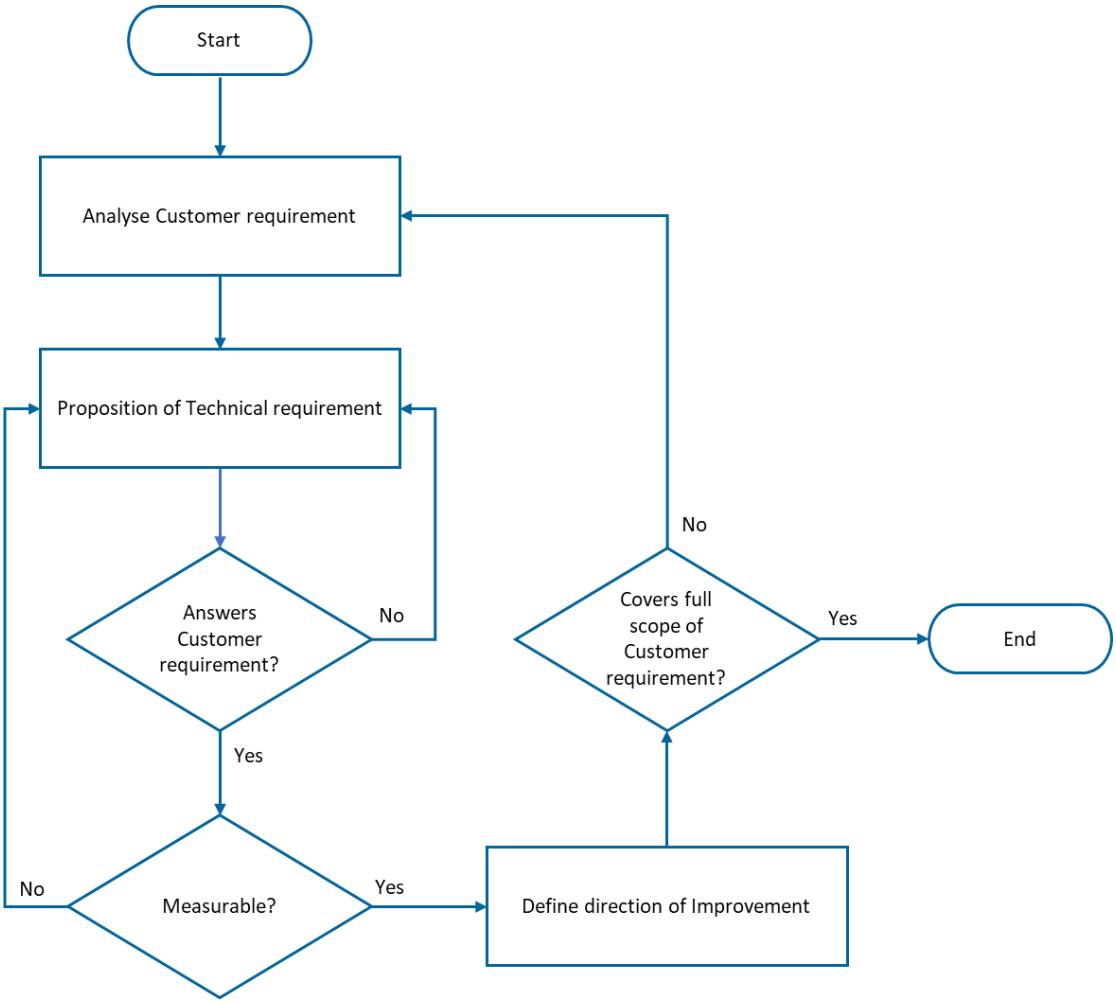


Figure 4.12 - Flowchart of the definition of Technical requirements

The example of the Technical requirements created to fulfil the Customer requirements associated with Information Quality and Standards, is showed in Table 4.14. In this case, we have

two different scenarios: Customer requirements which are fulfilled by one Technical requirement; and Customer requirements which are fulfilled by two different Technical requirements.

Regarding the direction of improvement, in this case all the requirements are of the type "Maximize" (↑), meaning that to optimise these Technical requirements and to get closer to Interoperability, they all need to be maximized.

Table 4.14 - Technical requirements associated with the Customer and Interoperability requirements (example for Information and Quality Standards)

Interoperability Requirements	Customer Requirements	Technical Requirements	Direction of Improvement
Information quality and standards	Assurance of equal levels of information quality between entities	Frequency of relevant trainings	↑
		Frequency of information quality revisions	↑
	Certification of compliance with information sharing deadlines	Level of compliance of information sharing deadlines	↑
		Frequency of alerts on deadline's proximity	↑
	Use of the right and previously defined means of communication for information sharing	Level of clarity on the listing of the proper means of communication	↑
	Assurance of information confidentiality	Degree of confidentiality of shared information	↑
	Assurance of information integrity	Degree of shared information's integrity	↑
	Assurance of information usability	Quantity of formats used to share each type of information	↑
	Assurance of information accuracy	Degree of accuracy of all shared information	↑
	Assurance of information relevance	Degree of relevance of all shared information	↑
	Assurance of information reliability	Amplitude of traceability of documents and communications	↑
		Quantity of certified references used	↑
	Assurance of information freshness	Level of freshness of information upon delivery	↑

In the case of the Technical requirements associated with Management of External Relationships, shown in Table 4.15, we have one case of a Customer requirement which is associated to four different technical requirements.

Concerning the direction of improvement of these requirements, the three possible scenarios were identified: "Maximize", which case was explained for the example of Table 4.14; "Minimize" (↓), where to optimize the requirement and approach Interoperability, it should be minimized; and "Target" (**X**), where to optimize the requirement a target value should be achieved.

Table 4.15 - Technical requirements associated with the Customer and Interoperability requirements (example for Management of External Relationships)

Interoperability Requirements	Customer Requirements	Technical Requirements	Direction of Improvement
Management of external relationships	Continuous communication between all entities of the National Node	Frequency of internal and external meetings	↑
		Frequency of digital/virtual communication	↑
	Alignment in the definition of selection / inclusion criteria for new partner entities	Level of clarity of the selection criteria for new partner entities to join the PT node	↑
		Frequency of revision of the criteria for new partner entities to join the PT node	X
	Alignment in the definition of exclusion criteria for the entities involved	Level of clarity of the evaluation/exclusion criteria for current National Node's entities	↑
		Frequency of performance reviews	X
		Level of performance during reviews	↑
		Extent of Lead time to communicate evaluations, reviews and exclusion decisions to METROFOOD project's leaders	↓
	Assurance of decision impartiality in the selection of new partner entities	Frequency of reviews of entities' contacts network	X
		Frequency of requests for approvals to METROFOOD project's leaders	↑
	Clarity in the definition of new partner entities' enticement and allegiance strategies	Degree of efficiency of communication and engagement strategies towards new entities	↑
	Clarity in the definition of end-user enticement and loyalty strategies	Degree of efficiency of end-user engagement and communication strategies	↑
		Level of clarity in end-user mapping	↑
	Clairvoyance on the workflows followed by each entity	Degree of complexity of each entity's METROFOOD-related workflows	↓

All the remaining Technical requirements can be found in Appendix F.

Even though the Technical requirements were defined trying to fulfil each one of the Customer requirements, these relationships are not exclusive, as a Technical requirement initially created to answer a specific Customer requirement might also fulfil other Customer requirements. This will become clear in section 4.2.4.

4.2.4. Relationships between Technical and Customer requirements

The Relationships Matrix evaluates the impact that Technical requirements have on the Customer requirements by classifying these relationships according to a pre-defined scale. This scale measures the strength of the relationships and can be divided in three levels (four, if we consider “No relationship” as a level of relationship). This scale can be seen in Table 4.16.

Table 4.16 - Strength levels of Relationships between Technical and Customer Requirements

Relationship description	Level of strength
Strong relationship	9
Medium relationship	3
Light Relationship	1
No relationship	0

The attribution of these relationships' levels of strength is usually based on expertise resultant of past experiences, or on data from statistical studies or controlled experiments. When none of these cases is verified, like for METROFOOD'S Portuguese Node, the attribution of the levels of strength is based on logic and critical judgement. Thereby, Figure 4.13 shows the inherent rationale.

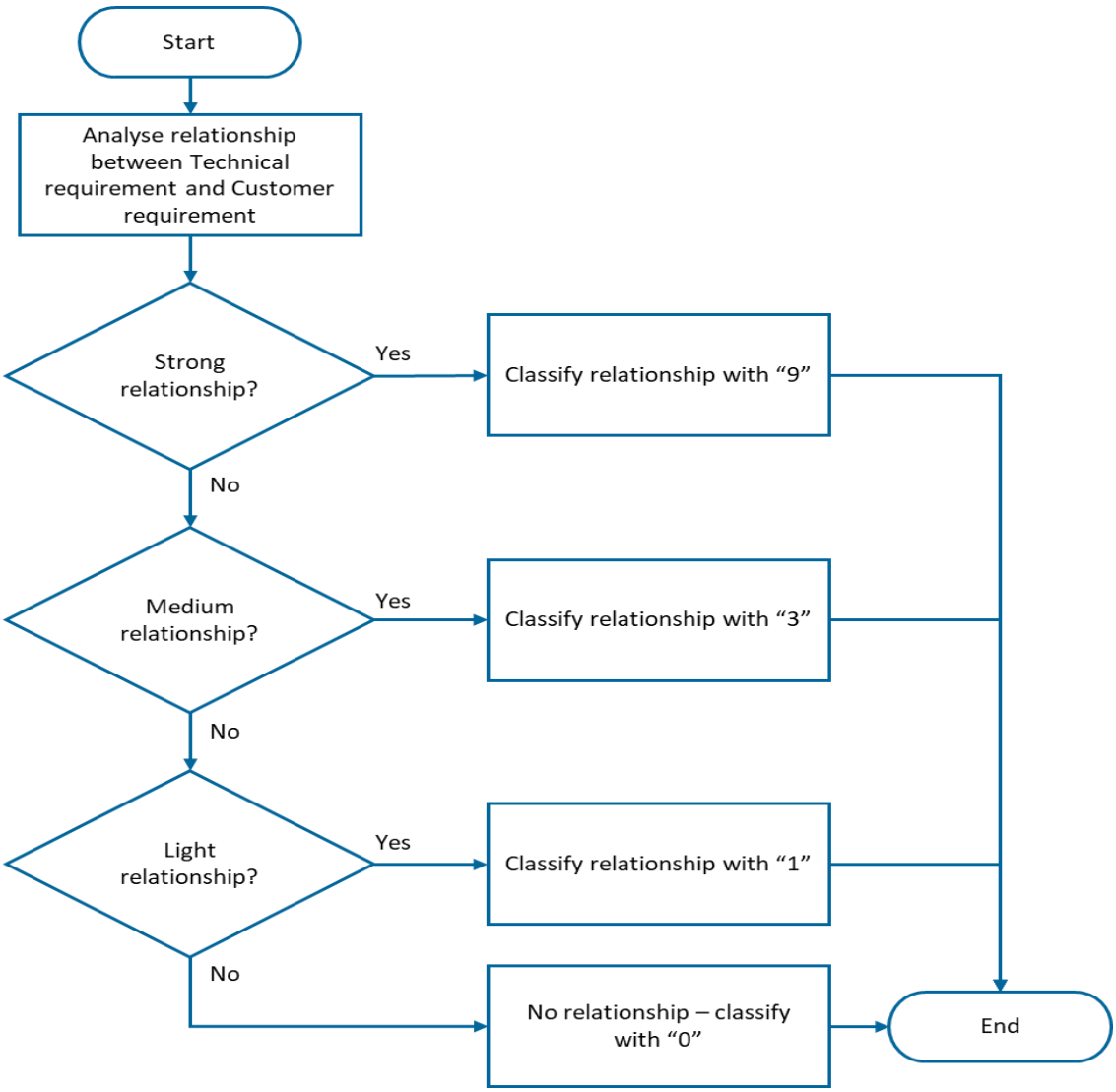


Figure 4.13 - Flowchart of the classification of Relationships between Technical and Customer requirements

To complete the entire Relationships Matrix, the rationale in Figure 4.13 was applied for every Technical requirement/Customer requirement pair. The sequence followed was checking, one at a time, each Technical requirement's relationships with all Customer requirements. This totalled 3848 relationships, with 331 of that total being different from zero.

Considering that the final Customer requirements were the ones validated by Node's entities and then filtered to exclude the ones with Relevance levels lower than 2, and that the Technical requirements were created with the objective of fulfilling those Customer requirements, it is expected that no Customer requirements are left unfulfilled, i.e., no blank lines are expected to exist. Moreover, no blank column should also be encountered, as every Technical requirement has at least a corresponding Customer requirement.

Each Technical requirement was initially defined to respond to a specific Customer requirement, which means that for all those cases, the attributed Relationship level was "9". Nonetheless, when applying the rationale, it becomes clear that for many cases, one Technical requirement will respond (even if with lower levels of relationship) to multiple Customer requirements. Taking the example of Table 4.17, initially the three displayed Technical requirements were defined to fulfil the Customer requirements on row numbers 50 to 52, thus the Relationship strength levels of 9 in those rows. However, applying the rationale to all the other Customer requirements, it was possible to conclude that several other relationships also existed, even though they were lower than the initially planned ones. The complete Relationships Matrix is in Appendix H

Table 4.17 - Partial Relationships Matrix (example of three Technical requirements)

ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	Level of difficulty to use the agreed language(s) by all entities	Degree of accessibility to all METROFOOD related terms, concepts and definitions	Degree of accessibility to relevant materials for all areas and domains within the scope of the project
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network		1	1
8	2.3%	5	Continuous communication between all entities of the National Node	3	3	3
15	1.8%	4	Ease of integration of collaborative work processes	3	3	1
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD			
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances			
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network			
19	2.3%	5	Visibility of collaborative processes between entities of the National Node			
20	2.3%	5	Coordination of collaborative processes between entities of the National Node	3	1	1
21	1.8%	4	Clear understanding of the hierarchical structure of each entity			
22	1.8%	4	Clarity in mapping the functions of entities within the National Node			
23	2.3%	5	Clarity in the definition of responsibilities between entities			1
24	1.8%	4	Clarity in the definition of contact points within entities			
30	1.8%	4	Definition of communication channels	1		
31	1.4%	3	Definition of the frequency of communication			
32	1.8%	4	Ensuring the privacy of computerized data			
33	2.3%	5	Assurance of control of accesses to information systems and platforms			
34	2.3%	5	Ensuring the security of information systems			
35	1.4%	3	Ensuring the security of restricted-access locations			
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms			
37	1.4%	3	Assurance of versatility of systems and platforms	3		
38	2.3%	5	Assurance of connectivity of systems and platforms			
39	1.8%	4	Definition and alignment of quality management and data security policies			
40	1.8%	4	Assurance of equal levels of information quality between entities		3	3
41	2.3%	5	Certification of compliance with information sharing deadlines			
42	1.4%	3	Use of the right and previously defined means of communication for information sharing			
43	1.8%	4	Assurance of information confidentiality			
44	2.3%	5	Assurance of information integrity			
45	1.8%	4	Assurance of information usability	3		
46	2.3%	5	Assurance of information accuracy			
47	2.3%	5	Assurance of information relevance		3	3
48	2.3%	5	Assurance of information reliability			
49	2.3%	5	Assurance of information freshness			
50	1.8%	4	Agreement in the language used in the project	**9**		
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project		**9**	
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts			**9**

4.2.5. Prioritization of the Technical Requirements

With the Relationships defined, we can conclude on the most important Technical requirements to help the Portuguese Node achieving Interoperability. These should be the ones being prioritized by the Node's entities, with the most effort being put into them, as they will be the ones with the greatest overall impact on the Node's Interoperability.

For that purpose, the Technical Relevance and Relative Technical Relevance needed to be calculated. Considering the Customer requirements' previously attributed relevance and the Relationships defined between the Technical requirements and Customer requirements, the below formulas were applied for each column of the House of Quality:

$$\textit{Technical relevance} = \sum \textit{(Customer Requirement's Relevance x Relationship Strength Level)}$$

$$\textit{Relative Technical Relevance} = \textit{Technical Relevance} \ / \ \sum \textit{Technical Relevance}$$

With all the calculations performed, it was possible to identify the most relevant Technical requirements for the Portuguese Node to invest in with the objective of achieving Interoperability within the Node.

In an initial phase, it is proposed to apply Pareto's principle and give priority to 20% of the Technical Requirements, meaning in this case, to give priority to the fifteen Technical Requirements with the highest Technical Relevance.

As already well known, the 80/20 rule of Pareto's principle is hard to find in practical examples of real situations. In this case, and considering the requirements' Relative Technical Relevance, these fifteen Technical Requirements should represent a total progress towards Interoperability within the Portuguese Node of around 32%. In Table 4.18, are listed the fifteen requirements.

Table 4.18 - First Technical Requirements to prioritize towards achieving Interoperability

Technical Requirement	Technical Relevance	Relative Technical Relevance (%)
Frequency of trainings on information and data quality	140	2.72
Frequency of information and data quality revisions	131	2.54
Degree of relevance of all shared information	117	2.27
Frequency of meetings to discuss and update status of on-going and planned business processes	109	2.12
Level of compliance with information sharing deadlines	109	2.12
Frequency of performance reviews	106	2.06
Frequency of alerts on the proximity of deadlines for information sharing	105	2.04
Level of clarity on the listing of the proper means of communication	104	2.02
Level of difficulty to use the agreed language(s) by all entities	103	2.00
Degree of accessibility to all METROFOOD related terms, concepts and definitions	100	1.94
Level of clarity of quality management and data security policies	99	1.92
Amplitude of traceability of documents and communications	98	1.90
Degree of shared information's integrity	97	1.88
Level of complexity of the encryption of all project-related data	93	1.81
Quantity of firewalls to protect all systems	93	1.81

Afterwards, and with their expertise and knowledge on the project itself and in their specific areas of knowledge, the Node's entities, namely INSA, IPMA and FCT-NOVA should define realistic KPIs to measure and evaluate their status and evolution on those Technical requirements. This will render the Technical Requirements actionable and controllable over time, thus allowing continuous control and improvement of Interoperability within the Node.

Should the Node be successful implementing this Interoperability Framework, the utilization of the Framework could be extended to all National Nodes and the whole METROFOOD-RI itself. The fully developed House of Quality is in Appendix I.

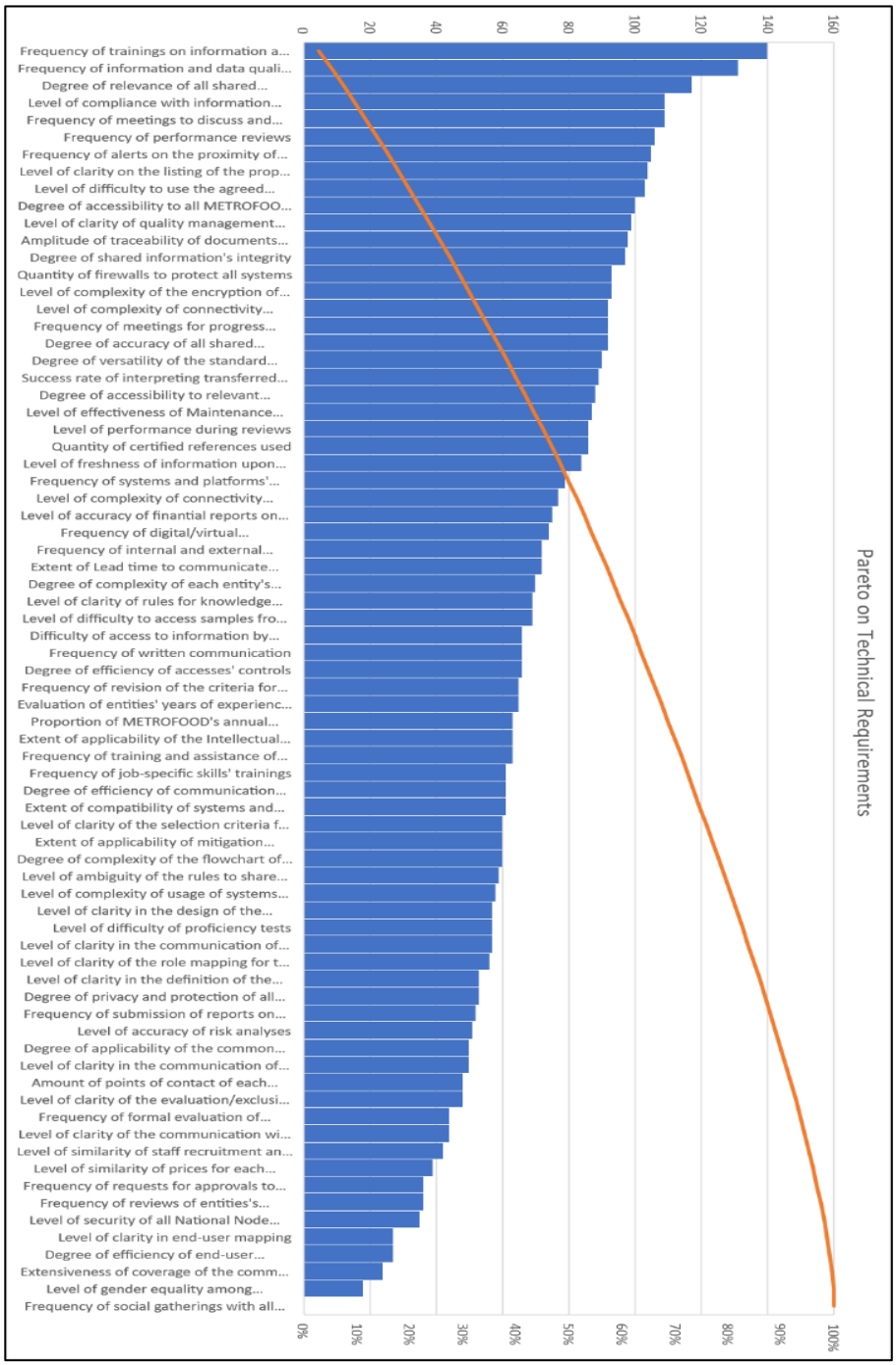


Figure 4.14 - Pareto chart of the Technical Requirements (also in Appendix)

5. CONCLUSIONS

5.1. Conclusions on the research purposes and assumption

This dissertation's main purpose and its corresponding hypothesis were the following:

Main purpose: *To propose a viable methodology to develop design Interoperable METROFOOD Research Infrastructures.*

Assumption: *It is possible to apply the Quality Function Deployment (QFD) methodology to design an Interoperability configuration suited to the METROFOOD network's requirements.*

Throughout this dissertation, all the work developed aimed at fulfilling the main purpose and to assess the made assumptions. From the Literature Review on Interoperability, to the Framework Development, both objectives were always kept in mind.

In short, it is possible to say that the main purpose was fulfilled and the assumption was assessed and verified to be correct.

To look into further detail, conclusions on the secondary purposes are drawn below:

- *To understand and identify each Portuguese entity's role in the project and how they each other;*

The Portuguese Node is currently composed by INSA, IPMA and FCT-NOVA. INSA, being the Node leader, is the most involved entity in the project at this moment, with very-well defined roles that encompass almost all functions under the P-RI Metro part of METROFOOD-RI, as well as Data collection under the e-RI part. On the other hand, FCT-NOVA's and IPMA's scopes are still evolving. The initial role of FCT-NOVA, essentially consists of providing the National Node with tools to render the network fully interoperable.

In any case, it should be highlighted that all entities directly impact the others' performance and, most importantly, the Node's performance. In this sense, the importance of rendering the Portuguese Node fully Interoperable became more obvious.

- *To define the interoperability requirements that all entities of the Portuguese Node will need to fulfil in order to make the node interoperable;*

The first phase undergone to comply with this secondary purpose was the Literature Review. Having in mind the objective of understanding which requirements proposed in previous works would be suitable to be applied in the Portuguese Node's scope, a thorough research on the available literature was carried out. From this review, a set of general Interoperability requirements, with respective multiple sub-requirements, were defined for the network.

Nonetheless, considering the specific nature of METROFOOD-RI, being a Pan-European project whose main scope is not generating profit, but to promote scientific excellence in the field of food quality and safety, further investigation needed to be done to propose suited Interoperability

requirements. In that interest, all available materials on METROFOOD-RI were carefully analysed to withdraw the project-specific requirements which needed to be fulfilled.

By associating those specific requirements to the ones from the literature by affinity, and adapting terminologies and designations, the final and most accurate Interoperability requirements for the Portuguese Node to try and comply with, were successfully defined.

- *To validate the defined Interoperability requirements with the entities comprising the Portuguese Node;*

AND

- *To evaluate these Interoperability requirements' relevance in the scope of the METROFOOD-RI project;*

For these two purposes, two separate interviews were made, where the interviewees were Dr. Isabel Castanheira, from INSA, and Professor Dr. Ana Sofia Matos, from FCT-NOVA. Both of them answered a questionnaire which was presented during the interviews. Two questions composed the questionnaire: "Are the below requirements relevant for the Portuguese Node?" and "What is the level of relevance?".

With both respondents answering these questions, it was possible to validate the proposed Interoperability requirements.

- *To assess how the Interoperability requirements can be fulfilled by the entities and propose realistic and general guidelines on how to do it.*

HoQ was the tool chosen to try and fulfil this purpose. The first step was defining the Technical requirements which would answer the Interoperability requirements. This was done by creating measurable Technical requirements specifically for each Interoperability requirement. The respective direction of improvement was then defined and, finally, a verification on whether the technical requirement would cover the full scope of the interoperability requirement – if not, additional technical requirements were defined.

Next, the relationships between the technical requirements and the interoperability requirements (or Customer requirements) were classified, allowing to understand the impact of those relationships on the Portuguese Node's interoperability.

Conclusions were made on the technical requirements that should be prioritized to achieve Interoperability within the Portuguese Node, thus providing the necessary guidelines for the entities to follow to achieve Interoperability among each other.

The results of the investigation suggest that the QFD is a methodology that can help achieve Interoperability within the Portuguese National Node. It is expected that the methodology can be successfully applied in other national nodes to achieve the same purpose. To confirm this, further testing of the proposed methodology in additional national nodes needs to be conducted. Also,

the steps which were not possible to follow in this Case Study, need to be tested in the future to conclude on the viability of the whole methodology.

5.2. Future research and next steps

Even though the conclusions of this dissertation suggest that the HoQ is a viable methodology to design an Interoperability Framework, several assumptions were made which might affect the reliability of the conclusions.

Due to lack of prior investigations on this theme, and lack of quantitative and qualitative data concerning METROFOOD-RI, assumptions were made during the construction of HoQ and construction steps were not followed, which might render the results bias. Below is a list of topics that should be further investigated to increase the reliability of HoQ as a tool to design an Interoperability Framework:

- How can the proposed technical requirements be measured? I.e., what KPIs can be put in place to control these requirements?
- How do the Technical requirements relate to each other? Are there trade-offs to be analysed?
- What METROFOOD-RI's data can be used to quantify more thoroughly the level of relationships between Technical requirements and Customer requirements?
- Are there other Interoperability Frameworks put in place in the scope of METROFOOD-RI with which the proposed framework can be compared?
- How to use this methodology to perform benchmarking in the scope of the METROFOOD-RI? Who should be consulted to perform such benchmarking?

5.3. Challenges and constraints faced

This dissertation's development started approximately one year ago and, initially, it was meant to be submitted by June 2020. Unfortunately, COVID-19's pandemic started shortly after and compromised all plans and deadlines.

Presential interviews with the three entities composing METROFOOD-RI's Portuguese Node were planned to have happened in March, which did not happen due to the Emergency State the country was under. Furthermore, the entities composing the National Node, being public and directly involved in National Health services, temporarily ceased their activities related to METROFOOD, delaying even further the possibility to collect data and attend the planned interviews. Out of three entities, only two were able to attend the interview which took place 7

months later than initially planned. All these factors might have diminished the amount of data and information possible to gather and analyse for the development of the dissertation.

Additionally, this was the first time that Interoperability was studied in the context of METROFOOD-RI and the first time that QFD was used as methodology to design an Interoperable network. Although both facts mean that this dissertation is the first formal first step in both fields, it also means that certain steps of the QFD were not executed and possible characteristics of the METROFOOD project were not captured.

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APPENDICES

APPENDIX A – Interoperability Questionnaire (Portuguese Version) - INSA’s answers

METROFOOOD-RI PT NODE - Questionário sobre os requisitos de Interoperabilidade

Realizado no âmbito do projeto METROFOOD-RI, este questionário tem como objectivo obter a opinião das entidades envolvidas no Nó Nacional sobre os requisitos de interoperabilidade propostos no questionário. Os requisitos que forem validados, serão utilizados na construção da Framework de Interoperabilidade que servirá como referência para a cooperação e Interoperabilidade entre as entidades envolvidas no Nó Nacional.

Assim, todas as questões que mencionam o projeto ou a rede METROFOOD, referem-se sempre ao contexto do Nó Nacional.

O questionário foi desenvolvido pelo aluno do Mestrado em Engenharia e Gestão Industrial, Tiago Abrantes, em nome da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa (FCT-UNL). As respostas obtidas serão apenas utilizadas e interpretadas no âmbito do projeto METROFOOD-RI.

O preenchimento deste questionário deverá demorar entre 15 a 20 minutos.

O seu tempo e a sua contribuição são indispensáveis para a continuidade do projeto METROFOOD-RI, agradecendo, assim e desde já, as suas respostas e a sua colaboração.

Antecipadamente grato pela atenção,
Tiago Abrantes

DEFINIÇÃO DE INTEROPERABILIDADE

Para facilitar a compreensão das duas questões do questionário, por favor, tenha em conta a seguinte definição de Interoperabilidade:

"A capacidade organizacional e operacional de uma empresa para cooperar com os seus parceiros de negócios e estabelecer, conduzir e desenvolver com eficiência relacões comerciais suportadas pelas Tecnologias de Informação, com o objetivo de criar valor"

Adaptando-se esta definição ao contexto METROFOOD, "a empresa e os seus parceiros de negócios" serão as entidades envolvidas no projeto. "As relações comerciais" serão todas as relações estabelecidas entre as entidades. E, neste caso, o objetivo é criar valor para o projeto METROFOOD.

Notas:
1. Na resposta às questões, considere sempre a relevância do requisito para o conjunto do Nó Nacional, e não para a própria entidade.
2. O "Nó Nacional" é constituído pelas 3 entidades portuguesas atualmente envolvidas no projeto METROFOOD (INSA, IPMA e FCT-UNL).
3. As "entidades parceiras" ou "novas entidades parceiras", são eventuais entidades que venham a juntar-se ao Nó Nacional.
4. Por "METROFOOD-RI" ou "rede METROFOOD-RI" entende-se toda a rede europeia que constitui o projeto METROFOOD.

QUESTÃO 1

De entre os requisitos propostos na tabela abaixo, quais considera serem relevantes para alcançar a Interoperabilidade entre as entidades do Nó Nacional?
Por favor, responder apenas "Sim" ou "Não" - poderá selecionar a resposta na Lista Pendente que se revela quando seleciona a célula.

	Requisitos de Interoperabildade dentro da rede METROFOOD	Relevante ou não?
1	Capacidade de cada entidade para respeitar o orçamento anual cedido pela METROFOOD-RI	Sim
2	Alinhamento de preços de serviços prestados no âmbito do projeto METROFOOD	Sim
3	Transparência relativamente aos recursos alocados ao Nó Nacional	Sim
4	Semelhança de critérios de recrutamento de colaboradores para as entidades do Nó Nacional	Sim
5	Semelhança de standards de trabalho entre as entidades do Nó Nacional	Sim
6	Transparência na política de compras e aquisições entre as entidades do Nó Nacional	Sim
7	Harmonização dos métodos de reconhecimento e de publicidade	Não
8	Alinhamento de objetivos do Nó Nacional com os da rede METROFOOD-RI	Sim
9	Alinhamento dos processos colaborativos do Nó Nacional com os da rede METROFOOD-RI	Sim
10	Visibilidade dos processos colaborativos entre as entidades do Nó Nacional	Sim
11	Coordenação dos processos colaborativos entre as entidades do Nó Nacional	Sim
12	Compreensão da estrutura hierárquica de cada entidade	Sim
13	Comunicação contínua entre as entidades do Nó Nacional	Sim
14	Alinhamento na definição de critérios de seleção/inclusão de novas entidades parceiras	Sim
15	Alinhamento na definição de critérios de exclusão das entidades envolvidas	Sim
16	Garantia de imparcialidade de decisão na seleção de novas entidades parceiras	Sim
17	Clareza na elaboração de estratégias de angariação e fidelização de novas entidades parceiras	Sim
18	Clareza na elaboração de estratégias de angariação e fidelização de utilizadores finais	Sim
19	Transparência dos fluxos de trabalho seguidos por cada entidade	Sim
20	Facilidade de integração dos processos colaborativos de trabalho entre as entidades do Nó Naci	Sim
21	Transparência dos resultados obtidos no âmbito do METROFOOD	Sim
22	Flexibilidade dos processos colaborativos de trabalho perante imprevistos	Sim
23	Clareza no definição de funções das entidades do Nó Nacional	Sim
24	Clareza na definição de responsabilidades entre entidades	Sim

25	Clareza na definição dos pontos de contacto dentro das entidades	Sim
26	Garantia de competência profissional dos colaboradores de cada entidade	Não
27	Minimização de barreiras e diferenças culturais	Não
28	Garantia de iguais políticas de igualdade de género entre as entidades	Sim
29	Adoção de iguais políticas de gestão da propriedade intelectual	Sim
30	Acordos para a posse de conhecimento entre as entidades	Sim
31	Transparência na definição de regras para disseminação do conhecimento científico produzido	Sim
32	Garantia da utilização e aplicação dos outputs do projeto	Sim
33	Definição de canais de comunicação	Sim
34	Definição da periodicidade de comunicação	Sim
35	Garantia da privacidade de dados informatizados	Sim
36	Controlo de acessos aos sistemas de informação e plataformas	Sim
37	Garantia da segurança dos sistemas informáticos	Sim
38	Garantia da segurança dos locais de acesso restrito	Sim
39	Certificação do correto e normal funcionamento dos sistemas e plataformas	Sim
40	Garantia de versatilidade dos sistemas e plataformas	Sim
41	Garantia de conectividade dos sistemas e plataformas	Sim
42	Definição e alinhamento de políticas de gestão da qualidade e segurança de dados	Sim
43	Garantia de iguais níveis de qualidade da informação entre as entidades	Sim
44	Garantia do cumprimento de prazos de partilha de informação	Sim
45	Utilização dos meios de comunicação previamente definidos para partilha de informação	Sim
46	Garantia da confidencialidade da informação	Sim
47	Garantia da integridade da informação	Sim
48	Garantia da usabilidade da informação	Sim
49	Garantia da precisão da informação	Sim
50	Garantia da relevância da informação	Sim
51	Garantia da fidedignidade da informação	Sim
52	Garantia da atualidade da informação	Sim
53	Concordância dos idiomas utilizados no projeto	Sim
54	Garantia da adopção de toda a terminologia METROFOOD	Sim
55	Garantia da assimilação total e transversal dos conceitos técnico-científicos	Sim

QUESTÃO 2

Como classifica o nível de relevância dos requisitos que considerou serem relevantes?

Para cada requisito, por favor responder com um valor de 1 (Nível mais baixo) a 5 (Nível mais alto). Na tabela abaixo, encontra-se uma explicação dos níveis:

Nível	Designação do nível	Descrição do nível
1	Muito pouco relevante	O requisito facilita a interoperabilidade, mas não é vital para alcançá-la.
2	Pouco relevante	O requisito facilita a interoperabilidade e sem o seu alinhamento pode ser difícil atingir a mesma.
3	Relevante	O requisito é importante para a Interoperabilidade e sem o seu alinhamento será difícil atingir a mesma.
4	Muito Relevante	O requisito é muito importante para a Interoperabilidade. Muito dificilmente será possível atingir a Interoperabilidade sem o alinhamento completo deste requisito entre as entidades.
5	Indispensável	O requisito é vital para a Interoperabilidade. A rede não pode tornar-se totalmente Interoperável sem o alinhamento completo deste requisito entre as entidades.

Por favor, selecionar, na tabela abaixo, os níveis de relevância dos requisitos identificados. Selecionando a célula em questão da coluna "Nível de Relevância", aparecerá uma Lista Pendente com os 5 níveis apresentados.

Nota: Apenas os requisitos identificados como "Relevantes" na QUESTÃO 1 aparecem na lista para serem classificados. Por favor, ignorar linhas em branco na coluna "Requisitos de Interoperabildade dentro da rede METROFOOD".

	Requisitos de Interoperabildade dentro da rede METROFOOD	Nível de Relevância
1	Capacidade de cada entidade para respeitar o orçamento anual cedido pela METROFOOD-RI	5
2	Alinhamento de preços de serviços prestados no âmbito do projeto METROFOOD	4
3	Transparência relativamente aos recursos alocados ao Nó Nacional	5
4	Semelhança de critérios de recrutamento de colaboradores para as entidades do Nó Nacional	4
5	Semelhança de standards de trabalho entre as entidades do Nó Nacional	5
6	Transparência na política de compras e aquisições entre as entidades do Nó Nacional	5
7		
8	Alinhamento de objetivos do Nó Nacional com os da rede METROFOOD-RI	5
9	Alinhamento dos processos colaborativos do Nó Nacional com os da rede METROFOOD-RI	5
10	Visibilidade dos processos colaborativos entre as entidades do Nó Nacional	5
11	Coordenação dos processos colaborativos entre as entidades do Nó Nacional	5
12	Compreensão da estrutura hierárquica de cada entidade	5
13	Comunicação contínua entre as entidades do Nó Nacional	5
14	Alinhamento na definição de critérios de seleção/inclusão de novas entidades parceiras	4
15	Alinhamento na definição de critérios de exclusão das entidades envolvidas	4
16	Garantia de imparcialidade de decisão na seleção de novas entidades parceiras	4
17	Clareza na elaboração de estratégias de angariação e fidelização de novas entidades parceiras	5
18	Clareza na elaboração de estratégias de angariação e fidelização de utilizadores finais	4
19	Transparência dos fluxos de trabalho seguidos por cada entidade	5
20	Facilidade de integração dos processos colaborativos de trabalho entre as entidades do Nó Nacional	4
21	Transparência dos resultados obtidos no âmbito do METROFOOD	5
22	Flexibilidade dos processos colaborativos de trabalho perante imprevistos	4
23	Clareza no definição de funções das entidades do Nó Nacional	4
24	Clareza na definição de responsabilidades entre entidades	5
25	Clareza na definição dos pontos de contacto dentro das entidades	5
26		

27		
28	Garantia de iguais políticas de igualdade de género entre as entidades	3
29	Adoção de iguais políticas de gestão da propriedade intelectual	4
30	Acordos para a posse de conhecimento entre as entidades	5
31	Transparência na definição de regras para disseminação do conhecimento científico produzido	4
32	Garantia da utilização e aplicação dos outputs do projeto	4
33	Definição de canais de comunicação	5
34	Definição da periodicidade de comunicação	4
35	Garantia da privacidade de dados informatizados	5
36	Controlo de acessos aos sistemas de informação e plataformas	5
37	Garantia da segurança dos sistemas informáticos	5
38	Garantia da segurança dos locais de acesso restrito	4
39	Certificação do correto e normal funcionamento dos sistemas e plataformas	4
40	Garantia de versatilidade dos sistemas e plataformas	3
41	Garantia de conectividade dos sistemas e plataformas	5
42	Definição e alinhamento de políticas de gestão da qualidade e segurança de dados	4
43	Garantia de iguais níveis de qualidade da informação entre as entidades	4
44	Garantia do cumprimento de prazos de partilha de informação	5
45	Utilização dos meios de comunicação previamente definidos para partilha de informação	3
46	Garantia da confidencialidade da informação	5
47	Garantia da integridade da informação	5
48	Garantia da usabilidade da informação	5
49	Garantia da precisão da informação	5
50	Garantia da relevância da informação	5
51	Garantia da fidedignidade da informação	5
52	Garantia da atualidade da informação	5
53	Concordância dos idiomas utilizados no projeto	4
54	Garantia da adopção de toda a terminologia METROFOOD	5
55	Garantia da assimilação total e transversal dos conceitos técnico-científicos	3

APPENDIX B - Interoperability Questionnaire (Portuguese Version) –

FCT-UNL's answers

Page 1

METROFOOOD-RI PT NODE - Questionário sobre os requisitos de Interoperabilidade

Realizado no âmbito do projeto METROFOOD-RI, este questionário tem como objectivo obter a opinião das entidades envolvidas no Nó Nacional sobre os requisitos de interoperabilidade propostos no questionário. Os requisitos que forem validados, serão utilizados na construção da Framework de Interoperabilidade que servirá como referência para a cooperação e Interoperabilidade entre as entidades envolvidas no Nó Nacional.

Assim, todas as questões que mencionam o projeto ou a rede METROFOOD, referem-se sempre ao contexto do Nó Nacional.

O questionário foi desenvolvido pelo aluno do Mestrado em Engenharia e Gestão Industrial, Tiago Abrantes, em nome da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa (FCT-UNL). As respostas obtidas serão apenas utilizadas e interpretadas no âmbito do projeto METROFOOD-RI.

O preenchimento deste questionário deverá demorar entre 15 a 20 minutos.

O seu tempo e a sua contribuição são indispensáveis para a continuidade do projeto METROFOOD-RI, agradecendo, assim e desde já, as suas respostas e a sua colaboração.

Antecipadamente grato pela atenção,
Tiago Abrantes

Page 2 (part A)

DEFINIÇÃO DE INTEROPERABILIDADE

Para facilitar a compreensão das duas questões do questionário, por favor, tenha em conta a seguinte definição de Interoperabilidade:

"A capacidade organizacional e operacional de uma empresa para cooperar com os seus parceiros de negócios e estabelecer, conduzir e desenvolver com eficiência relacões comerciais suportadas pelas Tecnologias de Informação, com o objetivo de criar valor"

Adaptando-se esta definição ao contexto METROFOOD, "a empresa e os seus parceiros de negócios" serão as entidades envolvidas no projeto. "As relações comerciais" serão todas as relações estabelecidas entre as entidades. E, neste caso, o objetivo é criar valor para o projeto METROFOOD.

Notas:

1. Na resposta às questões, considere sempre a relevância do requisito para o conjunto do Nó Nacional, e não para a própria entidade.
2. O "Nó Nacional" é constituído pelas 3 entidades portuguesas atualmente envolvidas no projeto METROFOOD (INSA, IPMA e FCT-UNL).
3. As "entidades parceiras" ou "novas entidades parceiras", são eventuais entidades que venham a juntar-se ao Nó Nacional.
4. Por "METROFOOD-RI" ou "rede METROFOOD-RI" entende-se toda a rede europeia que constitui o projeto METROFOOD.

QUESTÃO 1

De entre os requisitos propostos na tabela abaixo, quais considera serem relevantes para alcançar a Interoperabilidade entre as entidades do Nó Nacional?

Por favor, responder apenas "Sim" ou "Não" - poderá selecionar a resposta na Lista Pendente que se revela quando seleciona a célula.

	Requisitos de Interoperabildade dentro da rede METROFOOD	Relevante ou não?
1	Capacidade de cada entidade para respeitar o orçamento anual cedido pela METROFOOD-RI	Sim
2	Alinhamento de preços de serviços prestados no âmbito do projeto METROFOOD	Sim
3	Transparência relativamente aos recursos alocados ao Nó Nacional	Sim
4	Semelhança de critérios de recrutamento de colaboradores para as entidades do Nó Nacional	Sim
5	Semelhança de standards de trabalho entre as entidades do Nó Nacional	Sim
6	Transparência na política de compras e aquisições entre as entidades do Nó Nacional	Sim
7	Harmonização dos métodos de reconhecimento e de publicidade	Sim
8	Alinhamento de objetivos do Nó Nacional com os da rede METROFOOD-RI	Sim
9	Alinhamento dos processos colaborativos do Nó Nacional com os da rede METROFOOD-RI	Sim
10	Visibilidade dos processos colaborativos entre as entidades do Nó Nacional	Sim
11	Coordenação dos processos colaborativos entre as entidades do Nó Nacional	Sim
12	Compreensão da estrutura hierárquica de cada entidade	Não
13	Comunicação contínua entre as entidades do Nó Nacional	Sim
14	Alinhamento na definição de critérios de seleção/inclusão de novas entidades parceiras	Sim
15	Alinhamento na definição de critérios de exclusão das entidades envolvidas	Sim
16	Garantia de imparcialidade de decisão na seleção de novas entidades parceiras	Sim
17	Clareza na elaboração de estratégias de angariação e fidelização de novas entidades parceiras	Sim
18	Clareza na elaboração de estratégias de angariação e fidelização de utilizadores finais	Não
19	Transparência dos fluxos de trabalho seguidos por cada entidade	Não
20	Facilidade de integração dos processos colaborativos de trabalho entre as entidades do Nó Naci	Sim
21	Transparência dos resultados obtidos no âmbito do METROFOOD	Sim
22	Flexibilidade dos processos colaborativos de trabalho perante imprevistos	Sim
23	Clareza no definição de funções das entidades do Nó Nacional	Sim
24	Clareza na definição de responsabilidades entre entidades	Sim

25	Clareza na definição dos pontos de contacto dentro das entidades	Sim
26	Garantia de competência profissional dos colaboradores de cada entidade	Sim
27	Minimização de barreiras e diferenças culturais	Não
28	Garantia de iguais políticas de igualdade de género entre as entidades	Não
29	Adoção de iguais políticas de gestão da propriedade intelectual	Sim
30	Acordos para a posse de conhecimento entre as entidades	Sim
31	Transparência na definição de regras para disseminação do conhecimento científico produzido	Sim
32	Garantia da utilização e aplicação dos outputs do projeto	Sim
33	Definição de canais de comunicação	Sim
34	Definição da periodicidade de comunicação	Sim
35	Garantia da privacidade de dados informatizados	Sim
36	Controlo de acessos aos sistemas de informação e plataformas	Sim
37	Garantia da segurança dos sistemas informáticos	Sim
38	Garantia da segurança dos locais de acesso restrito	Não
39	Certificação do correto e normal funcionamento dos sistemas e plataformas	Sim
40	Garantia de versatilidade dos sistemas e plataformas	Sim
41	Garantia de conectividade dos sistemas e plataformas	Sim
42	Definição e alinhamento de políticas de gestão da qualidade e segurança de dados	Sim
43	Garantia de iguais níveis de qualidade da informação entre as entidades	Sim
44	Garantia do cumprimento de prazos de partilha de informação	Sim
45	Utilização dos meios de comunicação previamente definidos para partilha de informação	Sim
46	Garantia da confidencialidade da informação	Sim
47	Garantia da integridade da informação	Sim
48	Garantia da usabilidade da informação	Sim
49	Garantia da precisão da informação	Sim
50	Garantia da relevância da informação	Sim
51	Garantia da fidedignidade da informação	Sim
52	Garantia da atualidade da informação	Sim
53	Concordância dos idiomas utilizados no projeto	Sim
54	Garantia da adopção de toda a terminologia METROFOOD	Sim
55	Garantia da assimilação total e transversal dos conceitos técnico-científicos	Sim

QUESTÃO 2

Como classifica o nível de relevância dos requisitos que considerou serem relevantes?

Para cada requisito, por favor responder com um valor de 1 (Nível mais baixo) a 5 (Nível mais alto). Na tabela abaixo, encontra-se uma explicação dos níveis:

Nível	Designação do nível	Descrição do nível
1	Muito pouco relevante	O requisito facilita a interoperabilidade, mas não é vital para alcançá-la.
2	Pouco relevante	O requisito facilita a interoperabilidade e sem o seu alinhamento pode ser difícil atingir a mesma.
3	Relevante	O requisito é importante para a Interoperabilidade e sem o seu alinhamento será difícil atingir a mesma.
4	Muito Relevante	O requisito é muito importante para a Interoperabilidade. Muito dificilmente será possível atingir a Interoperabilidade sem o alinhamento completo deste requisito entre as entidades.
5	Indispensável	O requisito é vital para a Interoperabilidade. A rede não pode tornar-se totalmente Interoperável sem o alinhamento completo deste requisito entre as entidades.

Por favor, selecionar, na tabela abaixo, os níveis de relevância dos requisitos identificados. Selecionando a célula em questão da coluna "Nível de Relevância", aparecerá uma Lista Pendente com os 5 níveis apresentados.

Nota: Apenas os requisitos identificados como "Relevantes" na QUESTÃO 1 aparecem na lista para serem classificados. Por favor, ignorar linhas em branco na coluna "Requisitos de Interoperabildade dentro da rede METROFOOD".

	Requisitos de Interoperabildade dentro da rede METROFOOD	Nível de Relevância
1	Capacidade de cada entidade para respeitar o orçamento anual cedido pela METROFOOD-RI	4
2	Alinhamento de preços de serviços prestados no âmbito do projeto METROFOOD	2
3	Transparência relativamente aos recursos alocados ao Nó Nacional	4
4	Semelhança de critérios de recrutamento de colaboradores para as entidades do Nó Nacional	2
5	Semelhança de standards de trabalho entre as entidades do Nó Nacional	3
6	Transparência na política de compras e aquisições entre as entidades do Nó Nacional	3
7	Harmonização dos métodos de reconhecimento e de publicidade	3
8	Alinhamento de objetivos do Nó Nacional com os da rede METROFOOD-RI	4
9	Alinhamento dos processos colaborativos do Nó Nacional com os da rede METROFOOD-RI	3
10	Visibilidade dos processos colaborativos entre as entidades do Nó Nacional	4
11	Coordenação dos processos colaborativos entre as entidades do Nó Nacional	4
12		
13	Comunicação contínua entre as entidades do Nó Nacional	5
14	Alinhamento na definição de critérios de seleção/inclusão de novas entidades parceiras	3
15	Alinhamento na definição de critérios de exclusão das entidades envolvidas	3
16	Garantia de imparcialidade de decisão na seleção de novas entidades parceiras	3
17	Clareza na elaboração de estratégias de angariação e fidelização de novas entidades parceiras	4
18		
19		
20	Facilidade de integração dos processos colaborativos de trabalho entre as entidades do Nó Nacional	3
21	Transparência dos resultados obtidos no âmbito do METROFOOD	5
22	Flexibilidade dos processos colaborativos de trabalho perante imprevistos	3
23	Clareza no definição de funções das entidades do Nó Nacional	4
24	Clareza na definição de responsabilidades entre entidades	4
25	Clareza na definição dos pontos de contacto dentro das entidades	3
26	Garantia de competência profissional dos colaboradores de cada entidade	3
27		
28		

29	Adoção de iguais políticas de gestão da propriedade intelectual	4
30	Acordos para a posse de conhecimento entre as entidades	4
31	Transparência na definição de regras para disseminação do conhecimento científico produzido	5
32	Garantia da utilização e aplicação dos outputs do projeto	3
33	Definição de canais de comunicação	3
34	Definição da periodicidade de comunicação	2
35	Garantia da privacidade de dados informatizados	3
36	Controlo de acessos aos sistemas de informação e plataformas	4
37	Garantia da segurança dos sistemas informáticos	4
38		
39	Certificação do correto e normal funcionamento dos sistemas e plataformas	3
40	Garantia de versatilidade dos sistemas e plataformas	3
41	Garantia de conectividade dos sistemas e plataformas	4
42	Definição e alinhamento de políticas de gestão da qualidade e segurança de dados	4
43	Garantia de iguais níveis de qualidade da informação entre as entidades	3
44	Garantia do cumprimento de prazos de partilha de informação	4
45	Utilização dos meios de comunicação previamente definidos para partilha de informação	3
46	Garantia da confidencialidade da informação	3
47	Garantia da integridade da informação	4
48	Garantia da usabilidade da informação	3
49	Garantia da precisão da informação	4
50	Garantia da relevância da informação	4
51	Garantia da fidedignidade da informação	4
52	Garantia da atualidade da informação	4
53	Concordância dos idiomas utilizados no projeto	4
54	Garantia da adopção de toda a terminologia METROFOOD	3
55	Garantia da assimilação total e transversal dos conceitos técnico-científicos	3

APPENDIX C – Interoperability Questionnaire (English Version)

METROFOOOD-RI PT NODE - Questionnaire on the Interoperability requirements

Developed in the scope of the METROFOOD-RI project, this questionnaire aims to obtain the opinion of the entities involved in the National Node on the interoperability requirements proposed in the questionnaire. The requirements that are validated will be used in the construction of the Interoperability Framework which will serve as a reference for cooperation and Interoperability between the entities involved in the National Node.

Thus, all questions that mention the project or the METROFOOD network, always refer to the context of the National Node.

The questionnaire was developed by Tiago Abrantes, student of the Master's in Industrial Engineering and Management at the Faculty of Sciences and Technology of Universidade Nova de Lisboa (FCT-UNL). The answers obtained will only be used and interpreted within the scope of the METROFOOD-RI project and on behalf of FCT-UNL.

The completion of this questionnaire should take around 20 minutes

Your time and contribution are indispensable for the continuity of the METROFOOD-RI project, thanking you, thus and in advance, for your answers and collaboration.

Cordially,
Tiago Abrantes

DEFINITION OF INTEROPERABILITY

To facilitate the comprehension of the two questions in the questionnaire, please consider the below definition of Interoperability:

"The organisational and operational ability of an enterprise to cooperate with its business partners and to efficiently establish, conduct and develop IT-supported business relationships with the objective to create value."

Adapting to the context of METROFOOD, the enterprise and its business partners are the entities involved in the project. The business relationships are the relationships established between all entities. And in this case, the objective is to create value for the METROFOOD-RI project.

Note: *While answering the questions, always consider the relevance of the requirement for the whole of the National Node, and not for the entity itself.*

QUESTION 1

Among the requirements proposed in the table below, which ones do you consider to be relevant to achieve Interoperability between the entities of the National Node of the METROFOOD network?

Please answer only "Yes" or "No" - you may select the answer from the drop-down list that is revealed when you select the cell.

	Interoperability requirements within the METROFOOD network	Relevant or not?
1	Capacity of each entity to bear the annual costs related to METROFOOD	
2	Alignment of prices for services provided under the scope of METROFOOD	
3	Transparency regarding the resources allocated to the National Node	
4	Similarity of criteria for recruiting new employees for each entity	
5	Similarity of work standards between entities	
6	Transparency in purchasing and procurement policies	
7	Standardization of recognition and advertising methods	
8	Alignment of the objectives of the National Node with those of the METROFOOD network	
9	Alignment of the National Node's collaborative processes with those of the METROFOOD network	
10	Visibility of collaborative processes between partners of the National Node	
11	Coordination of collaborative processes between partners of the National Node	
12	Clear understanding of the hierarchical structure of each entity	
13	Continuous communication between partners of the National Node	
14	Transparency in the definition of selection / inclusion criteria for new partner entities	
15	Transparency in the definition of exclusion criteria for the entities involved	
16	Assurance of decision independence in the selection of new partner entities	
17	Clarity in the definition of new entities' enticement and allegiance strategies	
18	Clarity in the definition of end-user enticement and loyalty strategies	
19	Clairvoyance on the workflows followed by each entity	
20	Ease of integration of collaborative work processes	
21	Transparency of the results obtained under the scope of METROFOOD	
22	Flexibility of collaborative work processes in the event of unforeseen circumstances	
23	Clarity in mapping the functions of entities within the network	
24	Clarity in the definition of responsibilities between entities	
25	Clarity in the definition of contact points within entities	
26	Assurance of professional competence of the employees of each entity	
27	Minimizing cultural differences and barriers	
28	Ensuring the competence and aptitude of employees to perform their respective functions	
29	Ensuring equal gender equality policies between entities	
30	Adoption of equal intellectual property management policies	
31	Regulation for the possession of knowledge between entities	
32	Clarity in defining rules for the dissemination of the produced scientific knowledge	
33	Ensuring the use and application of project outputs	
34	Definition of communication channels	
35	Definition of the periodicity of communication	
36	Ensuring the privacy of computerized data	
37	Assurance of control of accesses to information systems and platforms	
38	Ensuring the security of information systems	
39	Ensuring the security of restricted-access locations	
40	Certification of the correct and normal functioning of systems and platforms	
41	Assurance of versatility of systems and platforms	
42	Assurance of connectivity of systems and platforms	
43	Definition and alignment of quality management and data security policies	
44	Assurance of equal levels of information quality between entities	
45	Certification of compliance with information sharing deadlines	
46	Use of the right and previously defined means of communication for information sharing	
47	Assurance of information confidentiality	
48	Assurance of information integrity	
49	Assurance of information usability	
50	Assurance of information accuracy	
51	Assurance of information relevance	
52	Assurance of information reliability	
53	Assurance of information freshness	
54	Agreement in the language used in the project and in a professional context	
55	Assurance of full and transversal understanding of the specific terms of the METROFOOD project	
56	Assurance of full and transversal understanding of technical-scientific concepts	

QUESTION 2

How do you classify the level of relevance of the requirements you classified as relevant?

For each requirement, please answer with a value from 1 (lowest level) to 5 (highest level). An explanation of the levels is shown in the table below:

Level	Level designation	Level description
1	Barely relevant	The requirement facilitates interoperability, but it is not vital to achieve it.
2	Slightly relevant	The requirement facilitates interoperability and without its alignment it might be difficult to achieve interoperability.
3	Relevant	The requirement is important for Interoperability and without its alignment it will be difficult to achieve interoperability.
4	Very Relevant	The requirement is very important for Interoperability. It will be very difficult to achieve Interoperability without the complete alignment of this requirement between the entities.
5	Imperatively Relevant	The requirement is vital to interoperability. The network cannot become fully interoperable without the complete alignment of this requirement between entities.

Please select the relevance levels of the identified requirements in the table below. Selecting the cell in question from the "Relevance Level" column, a Pending List will appear with the 5 levels presented.

Note: *Only the requirements identified as "Relevant" in QUESTION 1 appear in the list to be classified. Please ignore blank lines in the "Interoperability Requirements within the METROFOOD network" column.*

	Interoperability requirements within the METROFOOD network	Relevance level
1		3
2		
3		2
4		
5		5
6		
7		4
8		
9		
10		
11		
12		1
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APPENDIX D – Customer Requirements classification (Portuguese version)

	Requisitos de Interoperabildade dentro da rede METROFOOD	Nível de Relevância - Média ponderada	Arredondamento
1	Capacidade de cada entidade para respeitar o orçamento anual cedido pela METROFOOD-RI	4.7	5
2	Alinhamento de preços de serviços prestados no âmbito do projeto METROFOOD	3.4	3
3	Transparência relativamente aos recursos alocados ao Nó Nacional	4.7	5
4	Semelhança de critérios de recrutamento de colaboradores para as entidades do Nó Nacional	3.4	3
5	Semelhança de standards de trabalho entre as entidades do Nó Nacional	4.4	4
6	Transparência na política de compras e aquisições entre as entidades do Nó Nacional	4.4	4
7	Harmonização dos métodos de reconhecimento e de publicidade	0.9	1
8	Alinhamento de objetivos do Nó Nacional com os da rede METROFOOD-RI	4.7	5
9	Alinhamento dos processos colaborativos do Nó Nacional com os da rede METROFOOD-RI	4.4	4
10	Visibilidade dos processos colaborativos entre as entidades do Nó Nacional	4.7	5
11	Coordenação dos processos colaborativos entre as entidades do Nó Nacional	4.7	5
12	Compreensão da estrutura hierárquica de cada entidade	3.5	4
13	Comunicação contínua entre as entidades do Nó Nacional	5	5
14	Alinhamento na definição de critérios de seleção/inclusão de novas entidades parceiras	3.7	4
15	Alinhamento na definição de critérios de exclusão das entidades envolvidas	3.7	4
16	Garantia de imparcialidade de decisão na seleção de novas entidades parceiras	3.7	4
17	Clareza na elaboração de estratégias de angariação e fidelização de novas entidades parceiras	4.7	5
18	Clareza na elaboração de estratégias de angariação e fidelização de utilizadores finais	2.8	3
19	Transparência dos fluxos de trabalho seguidos por cada entidade	3.5	4
20	Facilidade de integração dos processos colaborativos de trabalho entre as entidades do Nó Nacional	3.7	4
21	Transparência dos resultados obtidos no âmbito do METROFOOD	5	5
22	Flexibilidade dos processos colaborativos de trabalho perante imprevistos	3.7	4
23	Clareza no definição de funções das entidades do Nó Nacional	4	4
24	Clareza na definição de responsabilidades entre entidades	4.7	5
25	Clareza na definição dos pontos de contacto dentro das entidades	4.4	4
26	Garantia de competência profissional dos colaboradores de cada entidade	0.9	1
27	Minimização de barreiras e diferenças culturais	0	0
28	Garantia de iguais políticas de igualdade de género entre as entidades	2.1	2
29	Adoção de iguais políticas de gestão da propriedade intelectual	4	4
30	Acordos para a posse de conhecimento entre as entidades	4.7	5
31	Transparência na definição de regras para disseminação do conhecimento científico produzido	4.3	4
32	Garantia da utilização e aplicação dos outputs do projeto	3.7	4
33	Definição de canais de comunicação	4.4	4
34	Definição da periodicidade de comunicação	3.4	3
35	Garantia da privacidade de dados informatizados	4.4	4
36	Controlo de acessos aos sistemas de informação e plataformas	4.7	5
37	Garantia da segurança dos sistemas informáticos	4.7	5
38	Garantia da segurança dos locais de acesso restrito	2.8	3
39	Certificação do correto e normal funcionamento dos sistemas e plataformas	3.7	4
40	Garantia de versatilidade dos sistemas e plataformas	3	3
41	Garantia de conectividade dos sistemas e plataformas	4.7	5
42	Definição e alinhamento de políticas de gestão da qualidade e segurança de dados	4	4
43	Garantia de iguais níveis de qualidade da informação entre as entidades	3.7	4
44	Garantia do cumprimento de prazos de partilha de informação	4.7	5
45	Utilização dos meios de comunicação previamente definidos para partilha de informação	3	3
46	Garantia da confidencialidade da informação	4.4	4
47	Garantia da integridade da informação	4.7	5
48	Garantia da usabilidade da informação	4.4	4
49	Garantia da precisão da informação	4.7	5
50	Garantia da relevância da informação	4.7	5
51	Garantia da fidedignidade da informação	4.7	5
52	Garantia da atualidade da informação	4.7	5
53	Concordância dos idiomas utilizados no projeto	4	4
54	Garantia da adopção de toda a terminologia METROFOOD	4.4	4
55	Garantia da assimilação total e transversal dos conceitos técnico-científicos	3	3

APPENDIX E – Final Customer Requirements classification (in English)

English	Class
Capacity of each entity to respect the annual budget conceded by METROFOOD-RI	5
Alignment of prices for services provided under the scope of METROFOOD	3
Transparency regarding the resources allocated to the National Node	5
Similarity of criteria for recruiting new employees for each entity of the National Node	3
Similarity of work standards between entities of the National Node	4
Transparency in the purchasing and procurement policies of the National Node's entities	4
Alignment of the objectives of the National Node with those of the METROFOOD network	5
Continuous communication between all entities of the National Node	5
Alignment in the definition of selection / inclusion criteria for new partner entities	4
Alignment in the definition of exclusion criteria for the entities involved	4
Assurance of decision impartiality in the selection of new partner entities	4
Clarity in the definition of new partner entities' enticement and allegiance strategies	5
Clarity in the definition of end-user enticement and loyalty strategies	3
Clairvoyance on the workflows followed by each entity	4
Ease of integration of collaborative work processes	4
Transparency of the results obtained under the scope of METROFOOD	5
Flexibility of collaborative work processes in the event of unforeseen circumstances	4
Alignment of the National Node's collaborative processes with those of the METROFOOD network	4
Visibility of collaborative processes between entities of the National Node	5
Coordination of collaborative processes between entities of the National Node	5
Clear understanding of the hierarchical structure of each entity	4
Clarity in mapping the functions of entities within the National Node	4
Clarity in the definition of responsibilities between entities	5
Clarity in the definition of contact points within entities	4
Ensuring equal gender equality policies between entities	2
Adoption of equal intellectual property management policies	4
Regulation for the possession of knowledge between entities	5
Clarity in defining rules for the dissemination of the produced scientific knowledge	4
Ensuring the use and application of project outputs	4
Definition of communication channels	4
Definition of the periodicity of communication	3
Ensuring the privacy of computerized data	4
Assurance of control of accesses to information systems and platforms	5
Ensuring the security of information systems	5
Ensuring the security of restricted-access locations	3
Certification of the correct and normal functioning of systems and platforms	4
Assurance of versatility of systems and platforms	3
Assurance of connectivity of systems and platforms	5
Definition and alignment of quality management and data security policies	4
Assurance of equal levels of information quality between entities	4
Certification of compliance with information sharing deadlines	5
Use of the right and previously defined means of communication for information sharing	3
Assurance of information confidentiality	4
Assurance of information integrity	5
Assurance of information usability	4
Assurance of information accuracy	5
Assurance of information relevance	5
Assurance of information reliability	5
Assurance of information freshness	5
Agreement in the language used in the project and in a professional context	4
Assurance of full and transversal understanding of the specific terms of the METROFOOD project	4
Assurance of full and transversal understanding of technical-scientific concepts	3

APPENDIX F – Final Technical Requirements

INTEROPERABILITY REQUIREMENTS	CUSTOMER REQUIREMENTS	TECHNICAL REQUIREMENTS
Business and project strategy	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI	Proportion of METROFOOD's annual budget used
		Level of accuracy of finantial reports on the annual costs related to METROFOOD
	Alignment of prices for services provided under the scope of METROFOOD	Level of similarity of prices for each service under the scope of METROFOOD
	Transparency regarding the resources allocated to the National Node	Frequency of submission of reports on the workforce and workload allocated to METROFOOD
	Similarity of criteria for recruiting new employees for each entity of the National Node	Level of similarity of staff recruitment and employment policies
	Similarity of work standards between entities of the National Node	Frequency of formal evaluation of entities' employees
		Evaluation of entities' years of experience in their scientific area
	Transparency in the purchasing and procurement policies of the National Node's entities	Degree of applicability of the common procurement and purchasing policy
	Standardization of recognition and advertising methods	Extensiveness of coverage of the common acknowledgement and publicity form
	Alignment of the objectives of the National Node with those of the METROFOOD network	Level of clarity in the communication of the METROFOOD network's objectives to all nodes
Management of external relationships	Continuous communication between all entities of the National Node	Frequency of internal and external meetings
		Frequency of digital/virtual communication
	Alignment in the definition of selection / inclusion criteria for new partner entities	Level of clarity of the selection criteria for new partner entities to join the PT node
		Frequency of revision of the criteria for new partner entities to join the PT node
	Alignment in the definition of exclusion criteria for the entities involved	Level of clarity of the evaluation/exclusion criteria for current National Node's entities
		Frequency of performance reviews
		Level of performance during reviews
		Extent of Lead time to communicate evaluations, reviews and exclusion decisions to METROFOOD project's leaders
	Assurance of decision impartiality in the selection of new partner entities	Frequency of reviews of entities's contacts network
		Frequency of requests for approvals to METROFOOD project's leaders
	Clarity in the definition of new partner entities' enticement and allegiance strategies	Degree of efficiency of communication and engagement strategies towards new entities
	Clarity in the definition of end-user enticement and loyalty strategies	Degree of efficiency of end-user engagement and communication strategies
		Level of clarity in end-user mapping
	Clairvoyance on the workflows followed by each entity	Degree of complexity of each entity's METROFOOD-related workflows
Collaborative business processes	Ease of integration of collaborative work processes	Frequency of training and assistance of external researchers
	Transparency of the results obtained under the scope of METROFOOD	Level of difficulty to access samples from other researchers

INTEROPERABILITY REQUIREMENTS	CUSTOMER REQUIREMENTS	TECHNICAL REQUIREMENTS
	Flexibility of collaborative work processes in the event of unforeseen circumstances	Level of accuracy of risk analyses
		Extent of applicability of mitigation strategies
	Alignment of the National Node's collaborative processes with those of the METROFOOD network	Level of clarity in the communication of the METROFOOD network's collaborative processes to all nodes
	Visibility of collaborative processes between entities of the National Node	Frequency of meetings to discuss and update status of on-going and planned business processes
	Coordination of collaborative processes between entities of the National Node	
Organisational structures	Clear understanding of the hierarchical structure of each entity	Degree of complexity of the flowchart of each entity's Governance Model
	Clarity in mapping the functions of entities within the National Node	Level of clarity of the role mapping for the National Node
	Clarity in the definition of responsibilities between entities	Level of clarity in the design of the Hierarchical Structure of the National Node
	Clarity in the definition of contact points within entities	Amount of points of contact of each entity
Employees and work culture	Assurance of professional competence of the employees of each entity	Frequency of skills' trainings
		Level of difficulty of proficiency tests
	Minimizing cultural differences and barriers	Frequency of social gatherings with all employees from all entities
	Ensuring equal gender equality policies between entities	Level of gender equality among employees within the National Node
Knowledge and data management	Adoption of equal intellectual property management policies	Extent of applicability of the Intellectual Property management policy recommended by the European Commision
	Regulation for the possession of knowledge between entities	Level of Level of clarity of rules for knowledge ownership, individual and joint results, patents application and management
	Clarity in defining rules for the dissemination of the produced scientific knowledge	Level of ambiguity of the rules to share scientific knowledge
	Ensuring the use and application of project outputs	Level of clarity of the communication with end-users
Information systems and communication channels	Definition of communication channels	Level of clarity in the definition of the channels to publish and share the produced scientific knowledge
		Degree of versatility of the standard written communication channel between entities
	Definition of the periodicity of communication	Frequency of meetings for progress follow-up and strategies' alignment
		Frequency of written communication
	Ensuring the privacy of computerized data	Degree of privacy and protection of all project-related data
	Assurance of control of accesses to information systems and platforms	Degree of Degree of efficiency of accesses' controls
	Ensuring the security of information systems	Level of complexity of the encryption of all project-related data
		Quantity of firewalls to protect all systems
	Ensuring the security of restricted-access locations	Level of security of all National Node entities' sites
		Level of effectiveness of Maintenance software

INTEROPERABILITY REQUIREMENTS	CUSTOMER REQUIREMENTS	TECHNICAL REQUIREMENTS
	Certification of the correct and normal functioning of systems and platforms	Frequency of systems and platforms' performance tests
	Assurance of versatility of systems and platforms	Extent of compatibility of systems and platforms with multiple operating systems and devices
		Level of complexity of usage of systems and platforms
	Assurance of connectivity of systems and platforms	Level of complexity of connectivity between all systems and platforms within the National Node
		Level of complexity of connectivity between National Node's systems and plaforms with METROFOOD's e-RI
	Definition and alignment of quality management and data security policies	Level of clarity of quality management and data security policies
Information quality and standards	Assurance of equal levels of information quality between entities	Frequency of relevant trainings
		Frequency of information quality revisions
	Certification of compliance with information sharing deadlines	Level of compliance of information sharing deadlines
		Frequency of alerts on deadline's proximity
	Use of the right and previously defined means of communication for information sharing	Level of clarity on the listing of the proper means of communication
	Assurance of information confidentiality	Degree of confidentiality of shared information
	Assurance of information integrity	Degree of shared information's integrity
	Assurance of information usability	Quantity of formats used to share each type of information
	Assurance of information accuracy	Degree of accuracy of all shared information
	Assurance of information relevance	Degree of relevance of all shared information
	Assurance of information reliability	Amplitude of traceability of documents and communications
		Quantity of certified references used
	Assurance of information freshness	Level of freshness of information upon delivery
Business and project semantics	Agreement in the language used in the project and in a professional context	Level of difficulty to use the agreed language(s) by all entities
	Assurance of full and transversal understanding of the specific terms of the METROFOOD project	Degree of accessibility to all METROFOOD related terms, concepts and definitions
	Assurance of full and transversal understanding of technical-scientific concepts	Degree of accessibility to relevant materials for all areas and domains within the scope of the project

APPENDIX G – Draft Document with Project-specific requirements

POSSIBLE REQUIREMENTS OF THE FW FOR THE PORTUGUESE NODE

BLOCK1
ERIC STATUS

- Agreement between the members of the ERIC on the limits and conditions of the tax exemptions
- Recognition of the legal personality and the privileges of the ERIC by associat3ed and third countries
- Procurement
- IPR policy (Knowledge Management)
- Dissemination (Knowledge Management; Business Semantics)
- Human resources
- Access Cooperation dynamics; Business semantics
- Data management (Connectivity)
- Scientific evaluation (
- Financial plan
- Cost-book update
- Business plan
-

POSSIBLE REQUIREMENTS

- ✓ Obligation to make contributions to a balanced budget and voting rights (
- ✓ Working languages (Business semantics; Employees and work culture)
- ✓ Meetings with team members (Management of external relationships);
- ✓ Communication of relevant parties regular evaluation
- ✓ Coverage of annual cost related to METROFOOD-RI
- ✓ Average annual costs by category
- ✓ No. of staff involved
- ✓ % of time spent in METROFOOD
- ✓ HR needs and staff recruitment policies
- ✓ Employment/secondment policies
- ✓ Professional capacity
- ✓ Scientific background

POLICIES OF METROFOOD **(REQUIREMENTS ??)**

- ✓ Human resource policy **(D4.etc)**
  - Salaries policy
  - Equity and equal opportunities
  - Transparency, non-discrimination and competition
- ✓ Access policy
  - Principles and procedures to allow and regulate the admission to the RI and related services for users
  - Financial model and pricing policy for services

- Processes, interactions and support measures to facilitate the access

✓ Procurement policy
- Transparency
- Non-discrimination
- Competition

✓ Data management policy
- Data collection, storage, security, maintenance, dissemination and quality
- Data format, acquisition, processing, preservation, access, governance, quality, assurance, GDPR, ethical aspects

✓ IPR policy
- Implementation of the EC recommendation on the management of IP in knowledge transfer activities ??
- Frame for ownership knowledge, individual and joint results, patents application and management
- Plans to encourage and facilitate the uptake and usage of the project's outputs by relevant users

✓ Scientific evaluation policy
- Criteria, procedures, periodicity, tools and bodies in charge
- System to evaluate and monitor the scientific performance and impact of METROFOOD (SPI)

✓ Dissemination policy
- Channels
- Periodicity
- Implementation of a common acknowledgement form and obligatory publicity form

BLOCK2

✓ National nodes' **activities aligned** with European level planning
✓ Political support from Ministry
✓ Data and info sharing for ERIC status – no funds received
✓ Financial contribution
✓ Multi-lateral agreement
✓ Physical RI
✓ E-RI
✓ Fills gaps?
✓ Inclusion in National Roadmap
✓ Geopolitical frame
✓ Membership's sustainability
✓ Node/institute's sustainability
✓ Management capability (H2020 projects, National Projects, etc)

P-RI

✓ Staff size, staff skills, training, diversity
✓ Technical implementation plans (major and constant upgrades, new acquisitions and facility maintenance)
✓ Metro side needs identified by Science and Innovation

- Production of new RM (research methods?)
- Analytical methods to determine new parameters related to food profiling
- Contaminants' study

✓ Food side needs identified by Science and Innovation
- Food safety studies/food nutritional value studies
- Geographic origin, production/process/storage/preparation technologies
- Evaluation of exposure through diet
- New technologies' benefits and risks
- Development of best practices
- Post-retail studies and evaluation of consumer practices and domestic procedures

✓ Data, quality and security management protocols

✓ Service development and delivery – access procedures, service charts

E-RI

✓ Preservation of data (backups of data)

✓ Access (authentication and authorisation infrastructure needed; standardisation of data models)

✓ Security (encryption of communication, access restriction to server rooms, hardware and software)

✓ Data management (information systems, knowledge bases and wiki; datasets??)

✓ Maintenance software (…)

✓ Collaboration/integration with other e-RI (MAIS PARA A E-RI EM SI EM PRINCIPIO)

✓ Usage of other e-RI

SERVICE DEVELOPMENT AND DELIVERY

✓ Physical access to Food pilot plants (technical-economic documentation; ; food quality and safety

✓ Remote operation of TEM (??) (access to samples supplied by other researchers; training and assistance to external researchers, provide remote access and operation of TEM)

✓ ????

QUALITY AND SECURITY MANAGEMENT

✓ Common language establishment and **framework to ensure common management procedures**

✓ Quality management requirements and procedures

✓ Security management procedures and protocols

✓ Strong linkage between quality and security management and assurance of the right utilisation of the RI

✓ QUALITY MANAGEMENT
- Standard Operation Procedure (SOP), procedures for periodic revision and for training
- Harmonisation of terms needed for the RI operation
- Conceptual Flowchart of Governance Model

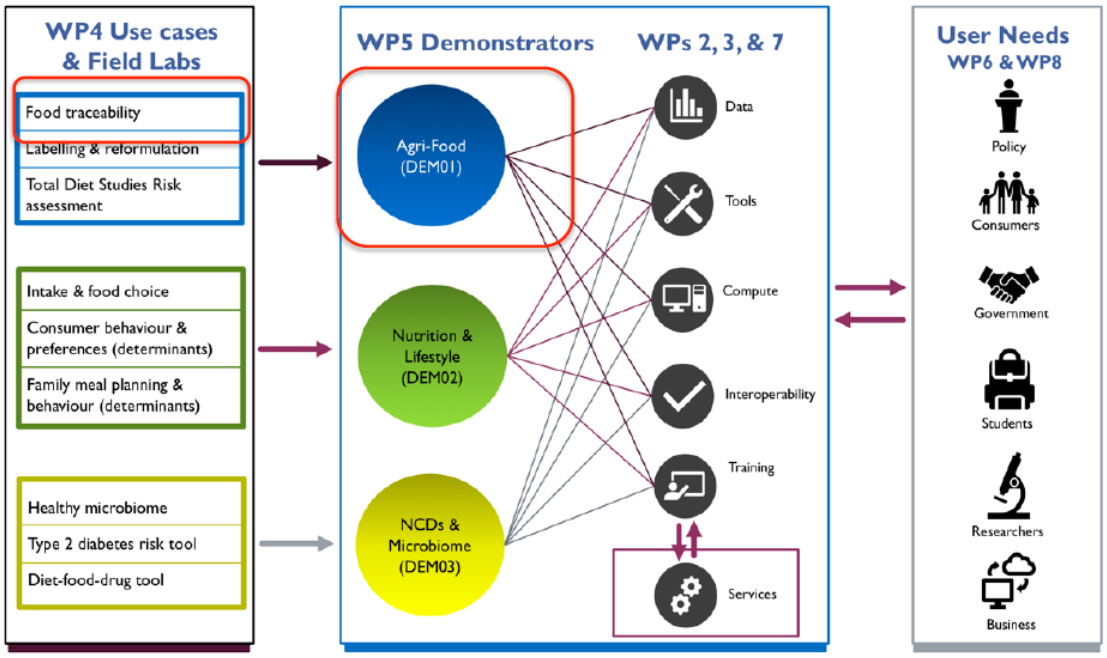
- Data quality system
- Good Practices; calibrated equipment; Matrix-RMs; standard solutions; lab register; instrument sheets
- Vocabulary system

✓ SECURITY MANAGEMENT (ISO 27001 compliant)
- Security management principles
- Risk analysis regarding Physical facilities and Electronic
- Security management procedures
- Official standard

BLOCK 3

✓ Interaction with partners
✓ Metrological tools used and methods
✓ Proficiency testing
✓ Methods validation?
✓ Methods for traceability
✓ Data collection and sharing
✓ KPIs and methods to measure them?
✓ Patents and IPR
✓ Harmonisation and standardisation
✓ Knowledge integration
✓ Accessibility to research data
✓ Risk analysis and mitigation strategies (TARA risk assessment tool?)
✓ User mapping, plans for user engagement, strategies and tools for comms with the user community
✓ User engagement strategy
✓ Standardised procedures for getting user inputs
✓ Online, secure, searchable and expandable IT database. Standard input fields for each category of the database structure
✓ Communication channels and setup of a decision matrix

① Define **initial communication tools** potentially suitable for each user category
② Create first version of **communication decision matrix**
③ Design a **study to measure the efficiency** of the communication
④ Define **procedures to avoid user input losses**



PROJECT MANAGEMENTY AND REPORTING, ETHICS AND GENDER ISSUES – **WP1 AND WP16**

- ✓ Dissemination of results, report and other documents and publications
- ✓ Costs and reporting
- ✓ Personnel costs (formula and rules)
- ✓ Budget transfers and re-allocation
- ✓ Payments (pre-financing, interim payments and payment of the Balance)
- ✓ Records and documents to prove proper implementation of actions and costs
- ✓ Gender equality
    - Number of women vs men in all activities and how they are involved
    - Gather gendered feedback to understand needs, implications and impacts
    - Gender balance in decision-making
    - Integrate gender in research and innovation
- ✓ Protection of Personal data

Dissemination on EU funding

GA Art.29

- Each beneficiary must - as soon as possible - **'disseminate' its results** by disclosing them to the public by appropriate means, including in scientific publications (stated the rules on result protection and prior notice)
- Each beneficiary must ensure **open access** (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results (stated the rules on result protection)

Any dissemination of results (in any form, including electronic) must:

(a) display the EU emblem and

(b) include the following text:

"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871083".

When displayed together with another logo, the EU emblem must have appropriate prominence.

APPENDIX H – Relationships matrix and HoQ

Columns #1 to #10

			COLUMN #	1	2	3	4	5	6	7	8	9	10
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↓	↑	↑	X	↑	X	↑	↑	↑	↑
ROW #	**RELATIVE WEIGHT**	**RELEVANCE**	**TECHNICAL REQUIREMENTS** / **CUSTOMER REQUIREMENTS**	Proportion of METROFOOD's annual budget used	Level of accuracy of finantial reports on the annual costs related to METROFOOD	Level of similarity of prices for each service under the scope of METROFOOD	Frequency of submission of reports on the workforce and workload allocated to METROFOOD	Level of similarity of staff recruitment and employment policies	Frequency of formal evaluation of entities' employees	Evaluation of entities' years of experience in their scientific area	Degree of applicability of the common procurement and purchasing policy	Extensiveness of coverage of the common acknowledgement and publicity form	Level of clarity in the communication of the METROFOOD network's objectives to all nodes
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI	9	9						1		
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD	3	1	9							
3	2.3%	5	Transparency regarding the resources allocated to the National Node	1	3		9	3					
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node				1	9	1				
5	1.8%	4	Similarity of work standards between entities of the National Node			3			9	9	1		1
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities	1	3		1				9		
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network						1	1	1		9
8	2.3%	5	Continuous communication between all entities of the National Node										
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities							3			
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved										
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities							3			
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies									3	1
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies									3	1
14	1.8%	4	Clairvoyance on the workflows followed by each entity										
15	1.8%	4	Ease of integration of collaborative work processes										
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD										
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances										
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network										
19	2.3%	5	Visibility of collaborative processes between entities of the National Node										
20	2.3%	5	Coordination of collaborative processes between entities of the National Node										
21	1.8%	4	Clear understanding of the hierarchical structure of each entity										
22	1.8%	4	Clarity in mapping the functions of entities within the National Node										
23	2.3%	5	Clarity in the definition of responsibilities between entities										
24	1.8%	4	Clarity in the definition of contact points within entities										
25	0.9%	2	Ensuring equal gender equality policies between entities										
26	1.8%	4	Adoption of equal intellectual property management policies										
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities										
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge										
29	1.8%	4	Ensuring the use and application of project outputs										
30	1.8%	4	Definition of communication channels										
31	1.4%	3	Definition of the frequency of communication										
32	1.8%	4	Ensuring the privacy of computerized data										
33	2.3%	5	Assurance of control of accesses to information systems and platforms										
34	2.3%	5	Ensuring the security of information systems										
35	1.4%	3	Ensuring the security of restricted-access locations										
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms										
37	1.4%	3	Assurance of versatility of systems and platforms										
38	2.3%	5	Assurance of connectivity of systems and platforms										
39	1.8%	4	Definition and alignment of quality management and data security policies										
40	1.8%	4	Assurance of equal levels of information quality between entities										
41	2.3%	5	Certification of compliance with information sharing deadlines										
42	1.4%	3	Use of the right and previously defined means of communication for information sharing										
43	1.8%	4	Assurance of information confidentiality										
44	2.3%	5	Assurance of information integrity										
45	1.8%	4	Assurance of information usability										
46	2.3%	5	Assurance of information accuracy										
47	2.3%	5	Assurance of information relevance										
48	2.3%	5	Assurance of information reliability										
49	2.3%	5	Assurance of information freshness										
50	1.8%	4	Agreement in the language used in the project										
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project										
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts										
			TECHNICAL RELEVANCE	63	75	39	52	42	44	65	50	24	57
			RELATIVE TECHNICAL RELEVANCE	1.2%	1.5%	0.8%	1.0%	0.8%	0.9%	1.3%	1.0%	0.5%	1.1%

Columns #11 to #21

ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	11	12	13	14	15	16	17	18	19	20	21
			COLUMN #	11	12	13	14	15	16	17	18	19	20	21
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↑	↑	↑	X	↑	X	↑	↓	X	↑	↑
				Frequency of internal and external meetings	Frequency of digital/virtual communication	Level of clarity of the selection criteria for new partner entities to join the PT node	Frequency of revision of the criteria for new partner entities to join the PT node	Level of clarity of the evaluation/exclusion criteria for current National Node's entities	Frequency of performance reviews	Level of performance during reviews	Extent of Lead time to communicate evaluations, reviews and exclusion decisions to METROFOOD project's leaders	Frequency of reviews of entities's contacts network	Frequency of requests for approvals to METROFOOD project's leaders	Degree of efficiency of communication and engagement strategies towards new entities
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI											
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD											
3	2.3%	5	Transparency regarding the resources allocated to the National Node											
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node											
5	1.8%	4	Similarity of work standards between entities of the National Node			3	3	3	3	3	1			
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities											
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network											
8	2.3%	5	Continuous communication between all entities of the National Node	9	9		1							
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities			9	9							1
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved					9	9	9	9			
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities			3	3				3	9	9	3
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies											9
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies											
14	1.8%	4	Clairvoyance on the workflows followed by each entity	3	1				3	1				
15	1.8%	4	Ease of integration of collaborative work processes											
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD	1	3				3	1	3			
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances											
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network											
19	2.3%	5	Visibility of collaborative processes between entities of the National Node	1	1				3	1	1			
20	2.3%	5	Coordination of collaborative processes between entities of the National Node	1	1									
21	1.8%	4	Clear understanding of the hierarchical structure of each entity											
22	1.8%	4	Clarity in mapping the functions of entities within the National Node											
23	2.3%	5	Clarity in the definition of responsibilities between entities											
24	1.8%	4	Clarity in the definition of contact points within entities											
25	0.9%	2	Ensuring equal gender equality policies between entities											
26	1.8%	4	Adoption of equal intellectual property management policies											
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities											
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge											
29	1.8%	4	Ensuring the use and application of project outputs											
30	1.8%	4	Definition of communication channels											
31	1.4%	3	Definition of the frequency of communication											
32	1.8%	4	Ensuring the privacy of computerized data											
33	2.3%	5	Assurance of control of accesses to information systems and platforms											
34	2.3%	5	Ensuring the security of information systems											
35	1.4%	3	Ensuring the security of restricted-access locations											
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms											
37	1.4%	3	Assurance of versatility of systems and platforms											
38	2.3%	5	Assurance of connectivity of systems and platforms											
39	1.8%	4	Definition and alignment of quality management and data security policies											
40	1.8%	4	Assurance of equal levels of information quality between entities						1	3				
41	2.3%	5	Certification of compliance with information sharing deadlines						1	1				
42	1.4%	3	Use of the right and previously defined means of communication for information sharing											
43	1.8%	4	Assurance of information confidentiality											
44	2.3%	5	Assurance of information integrity											
45	1.8%	4	Assurance of information usability											
46	2.3%	5	Assurance of information accuracy											
47	2.3%	5	Assurance of information relevance											
48	2.3%	5	Assurance of information reliability											
49	2.3%	5	Assurance of information freshness											
50	1.8%	4	Agreement in the language used in the project											
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project						1	1				
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts						1	1				
			TECHNICAL RELEVANCE	72	74	60	65	48	106	86	72	36	36	61
			RELATIVE TECHNICAL RELEVANCE	1.4%	1.4%	1.2%	1.3%	0.9%	2.1%	1.7%	1.4%	0.7%	0.7%	1.2%

Columns #22 to #32

ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	22	23	24	25	26	27	28	29	30	31	32
			COLUMN #	22	23	24	25	26	27	28	29	30	31	32
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↑	↑	↓	↑	↓	↑	↑	↑	↑	↓	↑
				Degree of efficiency of end-user engagement and communication strategies	Level of clarity in end-user mapping	Degree of complexity of each entity's METROFOOD-related workflows	Frequency of training and assistance of external researchers	Level of difficulty to access samples from other researchers	Level of accuracy of risk analyses	Extent of applicability of mitigation strategies for issues in collaborative processes	Level of clarity in the communication of the METROFOOD network's collaborative processes to all nodes	Frequency of meetings to discuss and update status of on-going and planned business processes	Degree of complexity of the flowchart of each entity's Governance Model	Level of clarity of the role mapping for the National Node
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI											
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD											
3	2.3%	5	Transparency regarding the resources allocated to the National Node											
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node											
5	1.8%	4	Similarity of work standards between entities of the National Node											
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities											
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network											
8	2.3%	5	Continuous communication between all entities of the National Node											
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities											
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved											
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities											
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies											
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies	9	9									
14	1.8%	4	Clairvoyance on the workflows followed by each entity			9							3	
15	1.8%	4	Ease of integration of collaborative work processes			3	9	1		1	1	1		
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD					9				3		
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances			3	1		9	9				
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network								9			
19	2.3%	5	Visibility of collaborative processes between entities of the National Node			1	1	3	1	1	1	9		1
20	2.3%	5	Coordination of collaborative processes between entities of the National Node			1	3	1	1	3	1	9		
21	1.8%	4	Clear understanding of the hierarchical structure of each entity										9	
22	1.8%	4	Clarity in mapping the functions of entities within the National Node											9
23	2.3%	5	Clarity in the definition of responsibilities between entities											3
24	1.8%	4	Clarity in the definition of contact points within entities										3	
25	0.9%	2	Ensuring equal gender equality policies between entities											
26	1.8%	4	Adoption of equal intellectual property management policies											
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities											
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge											
29	1.8%	4	Ensuring the use and application of project outputs											
30	1.8%	4	Definition of communication channels											
31	1.4%	3	Definition of the frequency of communication											
32	1.8%	4	Ensuring the privacy of computerized data											
33	2.3%	5	Assurance of control of accesses to information systems and platforms											
34	2.3%	5	Ensuring the security of information systems											
35	1.4%	3	Ensuring the security of restricted-access locations											
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms											
37	1.4%	3	Assurance of versatility of systems and platforms											
38	2.3%	5	Assurance of connectivity of systems and platforms											
39	1.8%	4	Definition and alignment of quality management and data security policies											
40	1.8%	4	Assurance of equal levels of information quality between entities											
41	2.3%	5	Certification of compliance with information sharing deadlines						1					
42	1.4%	3	Use of the right and previously defined means of communication for information sharing											
43	1.8%	4	Assurance of information confidentiality											
44	2.3%	5	Assurance of information integrity											
45	1.8%	4	Assurance of information usability											
46	2.3%	5	Assurance of information accuracy											
47	2.3%	5	Assurance of information relevance											
48	2.3%	5	Assurance of information reliability											
49	2.3%	5	Assurance of information freshness											
50	1.8%	4	Agreement in the language used in the project											
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project											
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts				1							
			TECHNICAL RELEVANCE	27	27	70	63	69	51	60	50	109	60	56
			RELATIVE TECHNICAL RELEVANCE	0.5%	0.5%	1.4%	1.2%	1.3%	1.0%	1.2%	1.0%	2.1%	1.2%	1.1%

Columns #33 to #43

ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	33	34	35	36	37	38	39	40	41	42	43
			COLUMN #	33	34	35	36	37	38	39	40	41	42	43
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑
				Level of clarity in the design of the Hierarchical Structure of the National Node	Amount of points of contact of each entity	Frequency of job-specific skills' trainings	Level of difficulty of proficiency tests	Frequency of social gatherings with all employees from all entities	Level of gender equality among employees within the National Node	Extent of applicability of the Intellectual Property management policy recommended by the European Commision	Level of clarity of rules for knowledge ownership, individual and joint results, patents application and management	Level of ambiguity of the rules to share scientific knowledge	Level of clarity of the communication with end-users	Level of clarity in the definition of the channels to publish and share the produced scientific knowledge
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI											
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD											
3	2.3%	5	Transparency regarding the resources allocated to the National Node											
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node											
5	1.8%	4	Similarity of work standards between entities of the National Node			9	9							
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities											
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network											
8	2.3%	5	Continuous communication between all entities of the National Node											
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities											
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved											
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities											
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies											
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies											
14	1.8%	4	Clairvoyance on the workflows followed by each entity											
15	1.8%	4	Ease of integration of collaborative work processes			1								
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD											
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances											
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network											
19	2.3%	5	Visibility of collaborative processes between entities of the National Node											
20	2.3%	5	Coordination of collaborative processes between entities of the National Node											
21	1.8%	4	Clear understanding of the hierarchical structure of each entity		3									
22	1.8%	4	Clarity in mapping the functions of entities within the National Node	3										
23	2.3%	5	Clarity in the definition of responsibilities between entities	9										
24	1.8%	4	Clarity in the definition of contact points within entities		9									
25	0.9%	2	Ensuring equal gender equality policies between entities						9					
26	1.8%	4	Adoption of equal intellectual property management policies							9	3	1		
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities							3	9	3		1
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge							3	3	9	1	3
29	1.8%	4	Ensuring the use and application of project outputs										9	
30	1.8%	4	Definition of communication channels									1	1	9
31	1.4%	3	Definition of the frequency of communication											
32	1.8%	4	Ensuring the privacy of computerized data											
33	2.3%	5	Assurance of control of accesses to information systems and platforms											
34	2.3%	5	Ensuring the security of information systems											
35	1.4%	3	Ensuring the security of restricted-access locations											
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms											
37	1.4%	3	Assurance of versatility of systems and platforms											
38	2.3%	5	Assurance of connectivity of systems and platforms											
39	1.8%	4	Definition and alignment of quality management and data security policies											
40	1.8%	4	Assurance of equal levels of information quality between entities											
41	2.3%	5	Certification of compliance with information sharing deadlines											
42	1.4%	3	Use of the right and previously defined means of communication for information sharing											
43	1.8%	4	Assurance of information confidentiality											
44	2.3%	5	Assurance of information integrity											
45	1.8%	4	Assurance of information usability											
46	2.3%	5	Assurance of information accuracy											
47	2.3%	5	Assurance of information relevance											
48	2.3%	5	Assurance of information reliability											
49	2.3%	5	Assurance of information freshness											
50	1.8%	4	Agreement in the language used in the project											
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project			3	3							
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts			3	3							
			TECHNICAL RELEVANCE	57	48	61	57	0	18	63	69	59	44	53
			RELATIVE TECHNICAL RELEVANCE	1.1%	0.9%	1.2%	1.1%	0.0%	0.3%	1.2%	1.3%	1.1%	0.9%	1.0%

Columns #44 to #54

ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	44	45	46	47	48	49	50	51	52	53	54
			COLUMN #	44	45	46	47	48	49	50	51	52	53	54
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↑	X	↑	↑	↑	↑	↑	↑	↑	↑	↑
				Degree of versatility of the standard written and oral communication channels between entities	Frequency of meetings for progress follow-up and strategies' alignment	Frequency of written communication	Degree of privacy and protection of all project- related data	Degree of efficiency of accesses' controls	Level of complexity of the encryption of all project-related data	Quantity of firewalls to protect all systems	Level of security of all National Node entities' sites	Level of effectiveness of Maintenance software	Frequency of systems and platforms' performance tests	Extent of compatibility of systems and platforms with multiple operating systems and devices
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI											
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD											
3	2.3%	5	Transparency regarding the resources allocated to the National Node											
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node											
5	1.8%	4	Similarity of work standards between entities of the National Node											
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities											
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network											
8	2.3%	5	Continuous communication between all entities of the National Node	3	3	3								
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities											
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved											
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities											
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies											
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies											
14	1.8%	4	Clairvoyance on the workflows followed by each entity											
15	1.8%	4	Ease of integration of collaborative work processes											
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD											
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances											
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network											
19	2.3%	5	Visibility of collaborative processes between entities of the National Node											
20	2.3%	5	Coordination of collaborative processes between entities of the National Node											
21	1.8%	4	Clear understanding of the hierarchical structure of each entity											
22	1.8%	4	Clarity in mapping the functions of entities within the National Node											
23	2.3%	5	Clarity in the definition of responsibilities between entities											
24	1.8%	4	Clarity in the definition of contact points within entities											
25	0.9%	2	Ensuring equal gender equality policies between entities											
26	1.8%	4	Adoption of equal intellectual property management policies											
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities											
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge	1										
29	1.8%	4	Ensuring the use and application of project outputs											
30	1.8%	4	Definition of communication channels	9	9									
31	1.4%	3	Definition of the frequency of communication	1	9	9								
32	1.8%	4	Ensuring the privacy of computerized data				9	3	9	9	1	1	1	
33	2.3%	5	Assurance of control of accesses to information systems and platforms					9				1	1	
34	2.3%	5	Ensuring the security of information systems				1	1	9	9		3	3	
35	1.4%	3	Ensuring the security of restricted-access locations								9			
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms									9	9	
37	1.4%	3	Assurance of versatility of systems and platforms											9
38	2.3%	5	Assurance of connectivity of systems and platforms									3	3	3
39	1.8%	4	Definition and alignment of quality management and data security policies											
40	1.8%	4	Assurance of equal levels of information quality between entities											3
41	2.3%	5	Certification of compliance with information sharing deadlines	1	1	3								
42	1.4%	3	Use of the right and previously defined means of communication for information sharing	9	3	3								1
43	1.8%	4	Assurance of information confidentiality				3	1	3	3	1	3	1	
44	2.3%	5	Assurance of information integrity											
45	1.8%	4	Assurance of information usability											1
46	2.3%	5	Assurance of information accuracy											
47	2.3%	5	Assurance of information relevance											
48	2.3%	5	Assurance of information reliability											
49	2.3%	5	Assurance of information freshness											
50	1.8%	4	Agreement in the language used in the project											
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project											
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts											
			TECHNICAL RELEVANCE	90	92	66	53	66	93	93	35	87	79	61
			RELATIVE TECHNICAL RELEVANCE	1.7%	1.8%	1.3%	1.0%	1.3%	1.8%	1.8%	0.7%	1.7%	1.5%	1.2%

Columns #55 to #65

ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	55	56	57	58	59	60	61	62	63	64	65
			COLUMN #	55	56	57	58	59	60	61	62	63	64	65
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↓	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑
				Level of complexity of usage of systems and platforms	Level of complexity of connectivity between all systems and platforms within the National Node	Level of complexity of connectivity between National Node's systems and platforms with METROFOOD's e-RI	Level of clarity of quality management and data security policies	Frequency of trainings on information and data quality	Frequency of information and data quality revisions	Level of compliance with information sharing deadlines	Frequency of alerts on the proximity of deadlines for information sharing	Level of clarity on the listing of the proper means of communication	Difficulty of access to information by external parties	Degree of shared information's integrity
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI											
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD											
3	2.3%	5	Transparency regarding the resources allocated to the National Node											
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node											
5	1.8%	4	Similarity of work standards between entities of the National Node		1		1	1	1	1				
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities											
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network			1								
8	2.3%	5	Continuous communication between all entities of the National Node		3					1	1	1		
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities											
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved											
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities											
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies											
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies											
14	1.8%	4	Clairvoyance on the workflows followed by each entity											
15	1.8%	4	Ease of integration of collaborative work processes		1			1				1		3
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD											3
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances											
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network			1								
19	2.3%	5	Visibility of collaborative processes between entities of the National Node									1		1
20	2.3%	5	Coordination of collaborative processes between entities of the National Node					1		1	1	1		1
21	1.8%	4	Clear understanding of the hierarchical structure of each entity											
22	1.8%	4	Clarity in mapping the functions of entities within the National Node											
23	2.3%	5	Clarity in the definition of responsibilities between entities											
24	1.8%	4	Clarity in the definition of contact points within entities											
25	0.9%	2	Ensuring equal gender equality policies between entities											
26	1.8%	4	Adoption of equal intellectual property management policies											
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities											
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge											
29	1.8%	4	Ensuring the use and application of project outputs											
30	1.8%	4	Definition of communication channels			1						3		
31	1.4%	3	Definition of the frequency of communication											
32	1.8%	4	Ensuring the privacy of computerized data											
33	2.3%	5	Assurance of control of accesses to information systems and platforms										3	
34	2.3%	5	Ensuring the security of information systems				3						3	
35	1.4%	3	Ensuring the security of restricted-access locations											
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms				1							
37	1.4%	3	Assurance of versatility of systems and platforms	9	3	3								
38	2.3%	5	Assurance of connectivity of systems and platforms	3	9	9								
39	1.8%	4	Definition and alignment of quality management and data security policies				9	3	3					
40	1.8%	4	Assurance of equal levels of information quality between entities	1			9	9	9			3		
41	2.3%	5	Certification of compliance with information sharing deadlines							9	9			
42	1.4%	3	Use of the right and previously defined means of communication for information sharing			3						9		
43	1.8%	4	Assurance of information confidentiality				1	3	3			3	9	
44	2.3%	5	Assurance of information integrity					3	3					9
45	1.8%	4	Assurance of information usability	3		1		3	3			3		
46	2.3%	5	Assurance of information accuracy					3	3					
47	2.3%	5	Assurance of information relevance					1	1	1	1			3
48	2.3%	5	Assurance of information reliability					3	3			1		
49	2.3%	5	Assurance of information freshness					1	1	9	9	1		
50	1.8%	4	Agreement in the language used in the project			3								
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project											
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts											
			TECHNICAL RELEVANCE	58	77	92	99	140	131	109	105	104	66	97
			RELATIVE TECHNICAL RELEVANCE	1.1%	1.5%	1.8%	1.9%	2.7%	2.5%	2.1%	2.0%	2.0%	1.3%	1.9%

			COLUMN #	66	67	68	69	70	71	72	73	74
			DIRECTION OF IMPROVEMENT: Maximize (↑); Minimize (↓); Target (X)	↑	↑	↑	↑	↑	↑	↓	↑	↑
ROW #	RELATIVE WEIGHT	RELEVANCE	TECHNICAL REQUIREMENTS / CUSTOMER REQUIREMENTS	Success rate of interpreting transferred information and following the flow through	Degree of accuracy of all shared information	Degree of relevance of all shared information	Amplitude of traceability of documents and communications	Quantity of certified references used	Level of freshness of information upon delivery	Level of difficulty to use the agreed language(s) by all entities	Degree of accessibility to all METROFOOD related terms, concepts and definitions	Degree of accessibility to relevant materials for all areas and domains within the scope of the project
1	2.3%	5	Capacity of each entity to respect the annual budget conceded by METROFOOD-RI									
2	1.4%	3	Alignment of prices for services provided under the scope of METROFOOD									
3	2.3%	5	Transparency regarding the resources allocated to the National Node									
4	1.4%	3	Similarity of criteria for recruiting new employees for each entity of the National Node									
5	1.8%	4	Similarity of work standards between entities of the National Node			3						
6	1.8%	4	Transparency in the purchasing and procurement policies of the National Node's entities									
7	2.3%	5	Alignment of the objectives of the National Node with those of the METROFOOD network								1	1
8	2.3%	5	Continuous communication between all entities of the National Node							3	3	3
9	1.8%	4	Alignment in the definition of selection / inclusion criteria for new partner entities									
10	1.8%	4	Alignment in the definition of exclusion criteria for the entities involved									
11	1.8%	4	Assurance of decision impartiality in the selection of new partner entities									
12	2.3%	5	Clarity in the definition of new partner entities' enticement and allegiance strategies									
13	1.4%	3	Clarity in the definition of end-user enticement and loyalty strategies									
14	1.8%	4	Clairvoyance on the workflows followed by each entity									
15	1.8%	4	Ease of integration of collaborative work processes	1		1				3	3	1
16	2.3%	5	Transparency of the results obtained under the scope of METROFOOD				1	1				
17	1.8%	4	Flexibility of collaborative work processes in the event of unforeseen circumstances									
18	1.8%	4	Alignment of the National Node's collaborative processes with those of the METROFOOD network									
19	2.3%	5	Visibility of collaborative processes between entities of the National Node		1		1	1				
20	2.3%	5	Coordination of collaborative processes between entities of the National Node	1						3	1	1
21	1.8%	4	Clear understanding of the hierarchical structure of each entity									
22	1.8%	4	Clarity in mapping the functions of entities within the National Node									
23	2.3%	5	Clarity in the definition of responsibilities between entities									1
24	1.8%	4	Clarity in the definition of contact points within entities									
25	0.9%	2	Ensuring equal gender equality policies between entities									
26	1.8%	4	Adoption of equal intellectual property management policies									
27	2.3%	5	Clarity of agreements for the possession of knowledge between entities									
28	1.8%	4	Clarity in defining rules for the dissemination of the produced scientific knowledge									
29	1.8%	4	Ensuring the use and application of project outputs									
30	1.8%	4	Definition of communication channels							1		
31	1.4%	3	Definition of the frequency of communication						3			
32	1.8%	4	Ensuring the privacy of computerized data									
33	2.3%	5	Assurance of control of accesses to information systems and platforms									
34	2.3%	5	Ensuring the security of information systems									
35	1.4%	3	Ensuring the security of restricted-access locations									
36	1.8%	4	Certification of the correct and normal functioning of systems and platforms									
37	1.4%	3	Assurance of versatility of systems and platforms	1						3		
38	2.3%	5	Assurance of connectivity of systems and platforms	1								
39	1.8%	4	Definition and alignment of quality management and data security policies			1	3	1				
40	1.8%	4	Assurance of equal levels of information quality between entities	1	3	3	3	3			3	3
41	2.3%	5	Certification of compliance with information sharing deadlines			1			3			
42	1.4%	3	Use of the right and previously defined means of communication for information sharing									
43	1.8%	4	Assurance of information confidentiality									
44	2.3%	5	Assurance of information integrity	1		1						
45	1.8%	4	Assurance of information usability	9			1			3		
46	2.3%	5	Assurance of information accuracy		9							
47	2.3%	5	Assurance of information relevance	3	3	9	3	3	3		3	3
48	2.3%	5	Assurance of information reliability		3	3	9	9				
49	2.3%	5	Assurance of information freshness			3			9			
50	1.8%	4	Agreement in the language used in the project	3						**9**		
51	1.8%	4	Assurance of full and transversal understanding of the specific terms of the METROFOOD project								**9**	
52	1.4%	3	Assurance of full and transversal understanding of technical-scientific concepts									**9**
			TECHNICAL RELEVANCE	89	92	117	98	86	84	103	100	88
			RELATIVE TECHNICAL RELEVANCE	1.7%	1.8%	2.3%	1.9%	1.7%	1.6%	2.0%	1.9%	1.7%

APPENDIX I – Pareto's chart on Technical Requirements