The Food Safety Market: An SME-powered industrial data platform to boost the competitiveness of European food certification

D7.1.1 – Market Research and Strategy Report

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PROJECT WEBSITE	www.foodsafetymarket.eu
COORDINATOR	Nikos Manouselis
ADDRESS	110 Pentelis Str., Marousi, GR15126, Greece
REPLY TO	nikosm@agroknow.com
PHONE	+30 210 6897 905
EU PROJECT OFFICER	Stefano Bertolo
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RESPONSIBLE AUTHOR	Dimitris Fotakidis (Agroknow)
REPLY TO	dimitris.fotakidis@agroknow.com
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AUTHORS (PARTNER)	Dimitris Fotakidis, Nikos Manouselis, Kouriantaki Eirini, Petri Alina, Mpokogiani Ifigeneia (Agroknow)
CONTRIBUTORS	VALORITALIA, TUV AU HELLAS, SAI, UBITECH, Agrivi d.o.o., PROSPEH DOO, WFSR
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PARTNERS		CONTACT
Agroknow IKE (Agroknow, Greece)	Agroknow	Nikos Manouselis (Agroknow) nikosm@agroknow.com
SIRMA AI EAD (SAI, Bulgaria)	ontotext	Svetla Boytcheva (SAI) svetla.boytcheva@ontotext.com
GIOUMPITEK MELETI SCHEDIASMOS YLOPOIISI KAI POLISI ERGON PLIROFORIKIS ETAIREIA PERIORISMENIS EFTHYNIS (UBITECH, Greece)	UBITECH ubiquitous solutions	Danai Vergeti (UBITECH) vergetid@ubitech.eu
AGRIVI DOO ZA PROIZVODNJU, TRGOVINU I USLUGE (Agrivi d.o.o., Croatia)	agrivi	Tanja Matosevic (Agrivi d.o.o.) tanja.matosevic@agrivi.com
PROSPEH, POSLOVNE STORITVE IN DIGITALNE RESITVE DOO (PROSPEH DOO, Slovenia)	tracelabs origintrail Core Developers	Ana Bevc (PROSPEH DOO) ana@origin-trail.com
UNIVERSITAT WIEN (UNIVIE, Austria)	universität wien	Elizabeth Steindl (UNIVIE) elisabeth.steindl@univie.ac.at
STICHTING WAGENINGEN RESEARCH (WFSR, Netherlands)	WAGENINGEN UNIVERSITY & RESEARCH	Yamine Bouzembrak (WFSR) yamine.bouzembrak@wur.nl
TUV- AUSTRIA ELLAS MONOPROSOPI ETAIREIA PERIORISMENIS EUTHYNIS (TUV AU HELLAS, Greece)	TÜV AUSTRIA HELLAS	Kostas Mavropoulos (TUV AU HELLAS) konstantinos.mavropoulos@tuv.at
TUV AUSTRIA ROMANIA SRL (TUV AU ROMANIA, Romania)	TÜV AUSTRIA ROMANIA	George Gheorghiou (TUV AU Romania) george.gheorghiu@tuv.at
VALORITALIA SOCIETA PER LA CERTIFICAZIONE DELLE QUALITA'E DELLE PRODUZIONI VITIVINICOLE ITALIANE SRL (VALORITALIA, Italy)	VALORITALIA	Francesca Romero (Valoritalia) francesca.romero@valoritalia.it
TUV AUSTRIA CERT GMBH (TUV AU CERT, Austria)	TÜV AUSTRIA	Stefan Hackel (TUV AU CERT) stefan.hackel@tuv.at

ACRONYMS LIST

TheFSM	The Food Safety Market
DoA	Description of Action
WP	Work Package
EU	European Union
EC	European Commission
BR(s)	Business Requirement(s)
BSC(s)	Business Scenario(s)
rBRc	Reference business requirement category
CB	Certification Body
FSMS	Food Safety Management System
T	Task
D	Deliverable
SME	Small and medium-sized enterprises
GFSI	Global Food Safety Initiative
CAGR	Compound annual growth rate
USA	United States of America
WHO	World Health Organisation
ISO	International Organization for Standardization
BRC	British Retail Consortium
SQF	Safe Quality Food
IFS	International Featured Standards
FSSC	Food Safety System Certification
ISTA	International Seed Testing Association
DALY	Disability-Adjusted Life Year
IT	Information Technology

HACCP	Hazard Analysis and Critical Control Points
PRAC	Pharmacovigilance Risk Assessment Committee
AgTech	Agricultural technology
FoodTech	Food technology
PLG	Product led growth

EXECUTIVE SUMMARY

This document is the first version of the Market Research and Strategy Report (D7.1 due in M6) for the Food Safety Market Project (TheFSM), an Innovation Action supported by the Horizon 2020 programme of the European Commission (Grant agreement ID: 871703). General information on the project, including its objectives and partners, facts and results, can be found on foodsafetymarket.eu.

The document offers a preliminary market assessment report, starting with the identification of stakeholders in a broader context, and an analysis of the competitive Food Safety landscape. Second, value propositions for key customer segments have been identified, along with opportunities and challenges for market entry and growth. A methodology for risk analysis for the TheFSM adoption has been developed. Together, these pieces lay out the groundwork for business planning and business growth in the subsequent stages of the project.

This deliverable builds on the critical findings from the D1.1 Report on Requirements for TheFSM. It is conceived as a living document that will be continually enriched with new insights and perspectives. The Report is centered around the following underlying objectives:

- Formulate a business model and a growth strategy, supported by risk assessment and practical advice for the adoption of the TheFSM in key customer segments;
- Deliver the exploitation strategy, for the benefit of the partners and the European Food Safety industry, while protecting intellectual property created by the project.

Further work on the market analysis will be carried out in M12 of the TheFSM project, as part of the deliverable D7.2 Ongoing Documentation of Governance and Business Models. In M12, we will publish our Annual Report of Marketing, Sales & Partnership Activities (D7.3), whereas in M36 we will release D7.4 Future Sustainability Roadmap for TheFSM.

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The vision statement describes where the TheFSM platform wants to be in the future; the mission statement describes what the TheFSM platform needs to do now to achieve the vision.

The vision and mission statements must support each other, but the mission statement is more specific. It defines how the platform will be different from other products with similar characteristics in its industry.

TheFSM Mission is to develop a transparent data-powered certification ecosystem for a safe food supply chain.

A **food supply chain** refers to the processes that describe how **food** from a farm ends up on consumers' tables. The processes include production, processing, distribution, consumption and disposal. (Center for Health and the Global Environment of Harvard)

The food is reaching the consumers via food supply chains through which food moves consistently in domino-like motion from producers to consumers whereas the money consumers pay for food goes to various steps of the food supply chain vice versa

Every single stage of the supply chain needs human and/or natural resources.

The two-sided flow which connects farmers and consumers is influenced by these two sets of domino flows (see Figure 1).

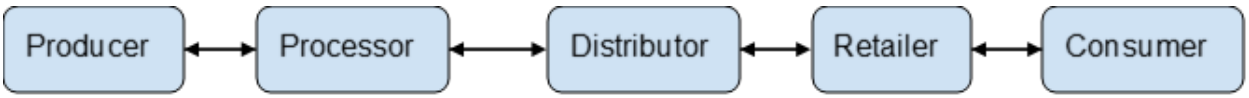

Figure 1. Movements of food and data in a simple food supply chain

For example, a food supply chain featuring pork products might include feed suppliers or veterinarians, a cooperative of farmers, meat packing and fabrication plants, food distributors, marketers, supermarkets and consumers.

TheFSM aims to deliver an industrial data platform that will significantly boost the way that food certification takes place in Europe and globally. The food certification market is a quite traditional but very data intensive business ecosystem and this led us in formulating the following vision statement.

TheFSM Vision is to catalyse the digital evolution of the business ecosystem that the global food certification market involves.

The values statement, also called the code of ethics, differs from both the vision and mission statements. The vision and mission state where the TheFSM project is going (vision) and what it will do to get there (mission). They direct the efforts of people in the project toward common goals. The values statement defines what the consortium believes in and how people in it are expected to behave—with each other, with project actors and with other stakeholders.

TheFSM values statement is: Make data sharing very easy and extremely affordable for the majority of food sector SMEs but simultaneously take all necessary steps to ensure that Personal Data are protected.

The way that TheFSM is envisaged, as a platform that may talk to users in their own languages and serve their custom, localised needs, will also help very small, small and medium enterprises of the European food sector respond to the digitisation challenge of the food industry. Data platforms should not only target the industry giants that can afford to invest into expensive and specialized technologies. In this way, the project will contribute to increasing the competitiveness & innovation capacity off all small and medium agriculture and food companies in Europe.

TheFSM consortium has analysed the potential ethical considerations to be taken into account. TheFSM does not include any aspect related to Ethics. Moreover, the consortium partners agree that any Background, Results, Confidential Information and/or any and all data and/or information that is provided, disclosed or otherwise made available between the partners during the implementation of the project and/or for any Exploitation activities ("Shared Information"), shall not include personal data as defined by Article 2, Section (a) of the Data Protection Directive (95/46/EEC) - hereinafter referred to as "Personal Data".

Accordingly, each partner agrees that it will take all necessary steps to ensure that all Personal Data is removed from Shared Information, made illegible, or otherwise made inaccessible (i.e. de-identify) to the other partners prior to providing the Shared Information to such other partners.

Each partner who provides or otherwise make available to any other partner Shared Information represents that:

(i) it has the authority to disclose the Shared Information, if any, which it provides to the other consortium partner;
(ii) where legally required and relevant, it has obtained appropriate informed consents from all the individuals involved, or from any other applicable institution, all in compliance with applicable regulations;
(iii) there is no restriction in place that would prevent any such other partner from using the Shared Information for the purpose of the project and the exploitation thereof.

Figure 2. TheFSM Vision, Mission, Values

1.2 Relations to other activities in the project

D7.1 documents the outcomes of T7.1 Market Research, Positioning & Uptake Strategy. Is the first deliverable of the Work Package 7 – Impact and is considered to be the roadmap for the marketing strategy of the project.

Deliverable	Nature of the relationship
D1.1 | Report on Requirements for TheFSM	Input: Business scenarios, actors, challenges and obstacles.
D7.2 | Ongoing Documentation of Governance & Business Models	Output: The personas analysis for the business model and the business canvas for the Business Model Evolution.
D7.4 | Future Sustainability Roadmap for TheFSM	Output: The positioning and uptake strategy to better plan for the way in which the data platform will continue to operate and evolve

Table 1: Link to other deliverables

1.3 Next steps

The first release of the Market Research and Strategy Report of TheFSM Platform aims to record all the critical data of the food safety market in order to develop a positioning and uptake strategy that will aim for maximum buy in from industrial data providers and consumers, by supporting critical food safety data sharing scenarios that inspection and certification require.

In the second version of this deliverable we will examine thoroughly the markets that the TÜV AUSTRIA GROUP is currently serving, with a particular emphasis to the ones participating in the consortium (Austria, Greece, Romania) but also others of high commercial importance to the group. Moreover, a market analysis for countries outside Europe will be conducted, such as the United States, Canada, the Middle East and Southeast Asia. The outcome of tbe second version will be revisiting the market positioning of both TheFSM and the other software products of the project, identifying how their new offerings should be communicated and promoted, and developing a plan for the implementation of this strategy during the project lifetime.

1.4 Report structure

The structure of the deliverable is as follows:

Section 1 – Introduction: Describes the mission, vision and values of the project, the next steps, the structure and the relation of the deliverable D7.1. with the other WPs of the project

Section 2 - Market Overview: Analyses the growth prospects and industry trends of the food industry and the food safety market (EU and outside EU) but also points to the relevant key market drivers, challenges, opportunities and legal framework.

Section 3 - Competitive Landscape: This section is about the comparison of TheFSM platform with similar products.

Section 4 - Business Proposition Describes TheFSM value proposition giving additional insights collected from the real-life environment

Section 5 - Barriers to adoption: Analyses the major barriers related to the deployment of the data platform.

Section 6 - Risk analysis: Analyses the economic and non-economic risks of the platform.

Section 7 - Value chain analysis: Analyses TheFSM Stakeholders and describes the goals, incentives and interests.

Section 8 - TheFSM Business Canvas: Describes the Business Canvas of TheFSM.

Section 9 - Roadmap for implementation and exploitation: Presents the Customer integration roadmap

Section 10 - TheFSM GO-TO-MARKET: Presents the disciplined process encompassing TheFSM's image, values, and driving its interactions with potential customers and other stakeholders.

Section 11 – Conclusion: Concludes the deliverable.

Section 12 – References: Contains all the citations used in this deliverable.

2. MARKET OVERVIEW

2.1 Growth prospects and industry trends

The food industry occupies a unique and privileged place inside every single household. Food and beverages play a central role in our lives, for sustenance, health and pleasure. Collectively, Europeans assign 14 percent of their expenditure to feeding themselves and their families. Every day of the year, households are buying, storing, preparing and consuming an enormous range of food products – from basic ingredients to readymade meals – which are produced and delivered by the largest manufacturing sector in the EU.

Following the above statistics and the growing consumer awareness about certified food products, the **demand for food certification** has significantly increased. This has led to the voluntary adoption of certification programs by food manufacturers to gain consumer trust. Another important factor that drives the growth of the market is the increasing demand for processed meat products certification.

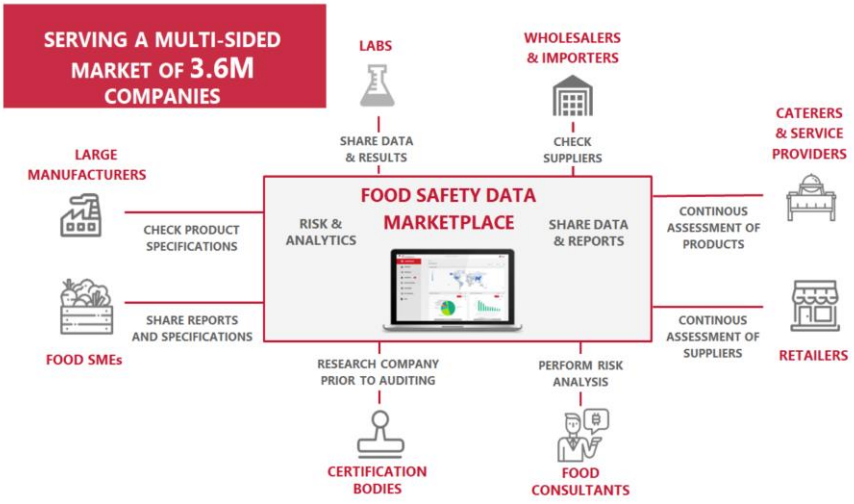

Figure 3. Position of TheFSM within the global food certification market

The **global food certification market** is a vertical, multi-sided one that shares a common need: all involved stakeholders need to share food safety data in well-defined, automated, and robust ways, using secured and controlled mechanisms that may enhance trust and collaboration. It has grown remarkably in the last few years. The market size is projected to grow from USD 17.0 billion in 2018 to USD 24.6 billion by 2023, at a CAGR of 7.7% during the forecast period[1].

Emerging economies such as India, China, and Brazil are the potential primary markets of the industry. Growing international trade, coupled with increasing food safety regulations, has been fueling the demand for food certifications. Rising prevalence of foodborne illness is expected to drive the growth of the market during the next decade. The food certification market, based on

[1] https://www.marketsandmarkets.com/Market-Reports/food-certification-market-82063283.html

type, is segmented into ISO 22000, BRC, SQF, IFS, halal, kosher, free-from certification, and others such as FSSC 22000, ISTA, other GFSI certifications. The free-from certifications segment is projected to grow at the highest CAGR among all food certification types from 2018 to 2023.

Regulatory bodies in various countries are asserting that food producers have appropriate allergen or gluten free labeling on their products, owing to the growing concerns among consumers about food allergies; this is expected to drive the demand for free-from certification during the forecast period.

Based on application, the market is segmented into meat, poultry, and seafood products, dairy products, infant food, beverages, bakery & confectionery products, free-from foods, and others. The meat, poultry, and seafood products segment is projected to lead the market during the forecast period. A certification system is required for the entire value chain of meat, poultry, and seafood products-from processors to importers, exporters, and distributors. Increasing meat product recalls across several countries are fueling the demand for food certifications for meat, poultry, and seafood products.

Based on risk category, the food certification market is segmented into high-risk foods and low-risk foods. The high-risk foods segment is projected to grow at a relatively higher CAGR from 2018 to 2023 as these foods are more prone to bacterial contamination due to high moisture and protein content, and therefore stringent quality standards are maintained while manufacturing, storing, and transporting these products.

Figure 4. The food safety market top facts

2.1.1 Key Market Drivers

To better analyze the key market drivers, we conducted a PESTEL analysis. A PESTEL analysis or PESTLE analysis (formerly known as PEST analysis) is a framework or tool used to analyse and monitor the macro-environmental factors that may have a profound impact on the project performance. This tool is especially useful when starting a new business or entering a foreign market and it is considered to be absolutely fit for the TheFSM platform market overview.

PESTEL is an acronym that stands for Political, Economic, Social, Technological, Environmental and Legal factors. Each factor will be elaborated on below.

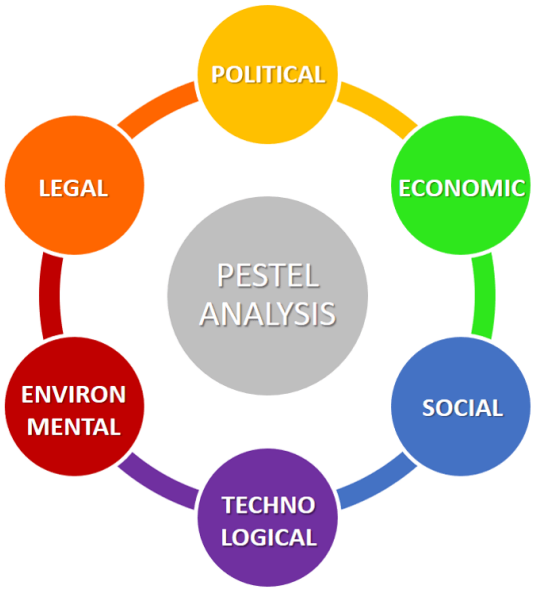

Figure 5. PESTEL Diagram

1. Political Drivers

These factors are all about how and to what degree a government intervenes in the economy or a certain industry. Basically, this can include national or union (eg. European Union) policy, political stability or instability, corruption, foreign trade policy, tax policy, labour law, environmental law and trade restrictions.

EU agriculture policy

EU agriculture policy is pushing towards more sustainable, more secure, safe and transparent food systems. It applies for wine as well and to organic certification. There are also a number of EU grant schemes for innovation.

National support for companies that develop innovative products

The governments of European Countries support startups and established companies that develop innovative products through tax benefits, innovation credit and grants.

For example, in Greece, the Partnership Agreement 2014-2020 has two sectoral programs (Competitiveness, Entrepreneurship & Innovation and Rural Development) which fund companies for developing innovative products with an aim in the food market. Additionally, the Dutch government Through its Future Fund is making additional money available for innovative SMEs and vital research for the future but also through funding PPP schemes, industry is supported financially (50% of the costs of PPP projects is funded) to develop technologies to innovate and to improve their competitiveness and business.

2. Environmental Drivers

Environmental factors have come to the forefront only relatively recently. They have become important due to the increasing scarcity of raw materials, pollution targets and carbon footprint targets set by governments. These factors include ecological and environmental aspects such as weather, climate, environmental offsets and climate change which may especially affect the food industry. Furthermore, growing awareness of the potential impacts of climate change is affecting how companies in the food and agriculture markets operate and the products they offer. This has led to many companies getting more and more involved in practices such as Corporate Social Responsibility (CSR) and sustainability.

Countries with limited land size and high population density

For countries with limited land size, high population density and high economic activity (among others food producing industry), like the Netherlands, the environment is a crucial factor impacting the balance of environmental safety (ecosystems), human health (clean air etc) and economic activities.

Climate change will have an impact on this balance and much emphasis is now on this topic, either in national programs as international. Currently, nitrate emission is a huge political dispute since the limitations have been enforced by legal trials, which inhibits the further growth and activities of many sectors such as the construction industry and farmers.

Environmental impact

Conventional viticulture has a heavy impact on the environment due to pesticide use, soil and landscape modification. We decided to focus on organic viticulture as in Europe there is a growing trend towards more sustainable viticulture management (also supported by the market demand). To empower organic wine producers with an additional tool for traceability can make even stronger their position and increase the conversion to organic farming.

3. Social Drivers

This dimension of the general environment represents the demographic characteristics, norms, customs and values of the population within which the TheFSM platform operates.

The consumer education on food safety and mass awareness programs conducted by various bodies are also propelling the market for food safety testing.

The rising number of foodborne disease outbreaks, adulteration cases, and toxicity have increasingly manifested the threat to food safety. The Centre for Disease Control and Prevention (CDCP) has reported that every year, one in 10 people fall sick due to foodborne illness; most importantly, children under five years of age are at high risk.

According to WHO estimates, global burden of foodborne diseases, around 125,000 children are dying, every year, because of foodborne illnesses. This highlights the urgency and attention with which food safety issues should be addressed.

For example, The Netherlands Nutrition Centre provides practical tips on what consumers can do to avoid food safety risks associated with the storage and preparation of food and gives consumers advice to select healthy, nutritional food stuff for a balanced diet.

In the Dutch primary schools, much attention is given to healthy food choices. The Dutch food safety authority (NVWA), is focused on food safety risks related to non-compliance of a food producer. Consumers may contact NVWA with personal questions related to food safety concerns.

Consumers require more information about the food they consume, not only its nutritional and safety characteristics but also the places where it comes from, who produces it and in which way.

For example, in Italy it is becoming a relevant request also among wine consumers, where, besides the motivations that support such requests for food, the element of "wine culture" adds relevance to background information such as area of production, farming practices and wine-making practices.

A transparent value chain can assure fear product presentation to consumers, avoid frauds and protect producers.

The safety certifications and compliance undertaken by food processing companies and food service organizations are infusing consumer's trust in these establishments. So, these companies aim to get the appropriate certificates with Corporate Social Responsibility also in mind.

4. Technology Drivers

These factors pertain to innovations in technology that may affect the operations of the industry and the market favorably or unfavorably. This refers to technology incentives, the level of innovation, automation, research and development (R&D) activity, technological change and the amount of technological awareness that a market possesses.

Growing consumer interest for food quality has propelled high technological advancements in the market.

Growing consumer interest for food quality has propelled high technological advancements, which are, thereby, driving the food safety testing market in developed countries. Enhanced surveillance and detection methods have contributed to the growth of the food safety testing scenario, specifically in the developed countries, such as the United States.

Wine production is the agriculture sector with more investment potential and the highest level of applied technology (in the vineyard and in the cellar).

It is the first agricultural sector where the EU applied compulsory digital book-keeping (for AOP wines). As a consequence, wine-makers are the most prepared farmers to implement digital innovations and have the proper ecosystem into place to make it feasible.

The technological development of Europe is high and the food industry consists of a large number of innovative SME's.

For example, the Netherlands has a number of world leading food companies such as Unilever & Friesland Campina. In particular, the primary production (farmers (animals and crops)) are world leading in regard to production efficiency and quality in which the newest technologies are implemented. The food producing industry (farmers and companies) are supported by state-of-the-art science of TheFSM project partner Wageningen University and Research, ranking the 1st in the world in this domain for more than a decade.

5. Economic Drivers

Economic factors are determinants of the economy's performance. Factors include economic growth, exchange rates, inflation rates, interest rates, disposable income of consumers and unemployment rates. These factors may have a direct or indirect long-term impact on the platform positioning to the market, since it affects the purchasing power of consumers and could possibly change demand/supply models in the economy. Consequently, it also affects the future price model of the platform.

The economic data of Europe generally shows a steady increase of economic wealth.

The data is detailed in section 2.2 The food safety market – The European Perspective

High quality and often expensive products need strong traceability tools to be competitive for global markets.

Full and thorough traceability and reliability of the production chain are an asset for high quality products like European wines. Wine makers and can offer a competitive advantage on the market, especially for high quality products looking for global markets (i.e. USA, China etc). As European wines have a high reputation at world-wide level, so supporting and protecting it with strong traceability tools has a relevant economic impact.

6. Legal Drivers

Although these factors may have some overlap with the political factors, they include more specific laws such as discrimination laws, antitrust laws, employment laws, consumer protection laws, copyright and patent laws, and health and safety laws. It is clear that companies need to know what is and what is not legal in order to trade successfully and ethically.

Food processing companies in Europe are obliged to be certified.

The regulatory framework for food & beverage for most of the European Countries is based on EU regulations and directives that are implemented through national by-laws, Country specific regulations apply in cases for which the EU law is incomplete or absent or allows the member states to make exceptions.

Digitalization is compulsory for some certification schemes.

A strong traceability system is at the basis of certification systems, that in wine are AOP, organic and also integrated production, for example in Italy. In all the certification schemes digitalization is already into place (compulsory for some).

P	E	S	T	E	L
EU agriculture policy. National support for companies that develop innovative products.	Countries with limited land size and high population density. Environmental impact.	Consumer education is propelling for food safety testing. Consumers require more information about the food. A transparent value chain can protect producers.	Growing consumer interest for food quality. Great investment potential. The food industry consists of a large number of innovative SMEs	European economic data shows an increase of economic wealth. High quality products need strong traceability tools to be competitive.	Food processing companies in Europe are obliged to be certified. Digitalization is compulsory for some certification schemes.

Table 2: PESTEL Analysis

2.1.2 Needs and Challenges

In this chapter the needs and challenges of the food safety market is analysed. We started by giving the obstacles in a three-dimensional analysis, Europe; USA; Globally.

The safety of food supplies is a matter of global concern today. In today's modern era, despite the latest technology, novel product forms, detection tools, safety certifications, regulations, compliance, monitoring, and consumer education on food safety, reports about outbreaks of foodborne illnesses have been on the rise. Safe food supplies support national economies, trade and tourism, contribute to food and nutrition security, and reinforce sustainable development.

Due to growing urbanisation, and altering consumer habits, there is an increase in the number of people preferring to buy and eat food prepared in public places. Another challenge faced by the world today is food wastage. Better food safety and quality standards can be used to reduce wastage, in ways that are still safe for human consumption from the food supply chain. On the other hand, at a consumer level, inadequate planning of food purchases and inability to use it before it expires, can also lead to avoidable food waste.

Europe (EU)

In the EU, the food industry sector is one of the largest and most important manufacturing sectors. It is the second largest (after metal) in the manufacturing industry. More than 70 percent of the agricultural goods produced in the EU are later transformed into food industry products.

Over the past 20-to 30 years, food safety issues have become prominent across Europe and have led to the establishment of many "National Food Safety Agencies" in the 1990s, followed by European Food Safety Authority (EFSA) in 2002. The EFSA is the keystone of EU risk assessment regarding food and feed safety. It has resulted in a safer food supply and has greatly enhanced the science underlying food safety[2].

The EU Food policy and legislative framework enforces or proposes respective standards and requirements that not only ensure a high level of food quality but also position the EU in the competitive global market.

A series of evolving "challenges and risks" could put the currently successful European food system under severe stress. Some of these challenges include:

- Increasing concentration of the supply chain: Food safety challenges exist along each step of the supply chain from concept to commercialisation. An increase in population is important in terms of future food demand, as it relates to sufficient food production as well as food security. Depending upon how global trade develops, the ability of the EU to set food-related standards will accordingly be influenced.

[2] https://www.newfoodmagazine.com/article/64715/food-safety-2018/

- Changing diet trends: Increased consumer dependency on digital services or dietary choices
- Price volatility: Food choice is driven by price, taste and convenience
- Climate change: The food system is dynamic, constantly influenced and shaped by several factors such as environment, climatic conditions, global political and socio-economic situation, scientific and technological developments and consumers' demands and preferences.
- Demographic imbalances: Demographic characteristics of the EU population such as household size and ageing levels can affect eating habits and dietary needs.
- Decrease in agricultural productivity: The extent to which modern technologies are taken up and applied by food chain also influences food production, in addition to the environmental and economic performance of the food chain.
- Anti-microbial resistant emergence: Animal and plant production systems develop microbial resistance to disease-transmitting pathogens, resulting in a decrease in food production and food quality.
- Scarcity of energy and resources/ Depletion of natural resources: The future extent of global trade liberalisation, including agriculture and food products, will affect the availability of resources and food products in the EU market and might impact the structure of the agro-food industry. quantity and quality of future food supply will be constrained by limits of its main inputs, including land, water, energy, and fertilisers.

Technological innovation can aim at various food and food-related aspects, including increasing productivity, increasing shelf life as well as reducing cost and optimisation. Consequently, modern technologies may provide answers for existing and emerging challenges in food safety. However, modern technologies may also include new risks for food production.

Increased control and regulation have resulted in slower or inhibited innovation, but these are far outweighed by increased safety for consumers. All creativity, knowledge, entrepreneurial spirit and sustainable innovation pathways should be mobilised to guarantee availability and access to food for the coming generations.

United States of America (USA)

All the food facilities regulated by the U.S. Food and Drug Administration (USFDA) must follow minimum standards, which are provided by the Food Safety Modernization Act (FSMA) that recognises the vulnerability of suppliers.

Food safety challenges in the US:

- Improve agricultural productivity, to meet the increasing demand for a long-term
- Certification for high-risk foods: The U.S. FDA can request for third-party certification or another form of assurance in case of importing high-risk foods into the US
- Importer accountability: Contrary to the usual norm, now it is the importer's responsibility to verify that their foreign suppliers have sufficient preventive controls in place to ensure that the food imported is safe

- Authority to deny entry: FDA can restrain imports from a foreign facility, if they deny providing access to their facility
- Climatic changes, natural calamities and an increase in natural hazards
- Malnutrition
- Food systems need to be made more comprehensive and robust

Food safety challenges identified globally:

- Food related systems, certifications, and compliance should be adequate to have food product controls
- Umpteen sources of voluntary food information and increased opportunity for false information
- Lifestyle changes causes a rise in sedentary behaviour
- Food safety standards being not harmonised in the third countries, there is a lot of variation in food handling and compliance with food standards.
- Evolving biological risks and increased occurrence of antimicrobial resistance with appearance of new strains
- Safety challenges associated with processed and pre-packaged food
- Inadequate food safety and nutrition literacy, loss of food traditions and increased exposure to unreliable sources of information
- Risk of overconsumption of nutrients or other food ingredients
- Increased consumer dependency on digital services or dietary choices

World Health Organization (WHO) key facts sheet on Food Safety (WHO, 2020)

- Access to adequate quantities of safe and nutritious food is key to sustaining life and promoting good health
- Unhygienic food containing harmful bacteria, viruses, parasites or chemical substances, causes more than 200 diseases – ranging from diarrhoea to cancers
- An estimated 600 million – almost 1 in 10 people in the world – fall sick from consumption of contaminated food and 4,20,000 people die per year, resulting in the loss of 33 million healthy life years (DALYs)
- With 1,25,000 deaths every year, children under 5 are highly prone to foodborne diseases acting as vehicles for 40 per cent of those diseases
- Leading to sickness in 550 million people and 2,30,000 deaths every year, diarrhoeal diseases are most common, which result from consumption of contaminated food
- Food safety, nutrition, and food security are inseparably dependent. Unhygienic food forms a serious cycle of disease and malnutrition, especially in infants, young children, the elderly and the sick
- Socioeconomic development is delayed due to foodborne diseases, by straining health care systems, and harming national economies, tourism, and trade
- Food supply chains are now spread across the globe. Good collaboration between governments, manufacturers, and consumers helps, ensure food safety

WHO aims to facilitate global prevention, detection, and response to public health threats associated with unsafe food. Through this, it aims to achieve consumer trust in their authorities,

and confidence in safe food supply. To do this, WHO helps the Member States build the capacity to prevent, detect and manage foodborne risks by:

- providing independent scientific assessments on microbiological and chemical hazards that form the basis for international food standards, guidelines, and recommendations, known as the Codex Alimentarius, to ensure food is safe wherever it originates
- assessing the safety of modern technologies used in food production, such as genetic modification and nanotechnology
- helping improve national food systems and legal frameworks and implement adequate infrastructure to manage food safety risks. The International Food Safety Authorities Network (INFOSAN) was developed by WHO and the UN Food and Agriculture Organization (FAO) to rapidly share information during food safety emergencies
- promoting safe food handling through systematic disease prevention and awareness programmes, through the WHO Five Keys to Safer Food message and training materials,
- advocating for food safety as an important component of health security and for integrating food safety into national policies and programmes in line with the International Health Regulations (IHR – 2005)

WHO works closely with FAO, the World Organization for Animal Health and other international organisations to ensure food safety along the entire food chain from production to consumption.

Furthermore, to better understand the needs and challenges of the market, we segmentize it to three main categories based on the stakeholders of TheFSM project:

- Certification bodies
- Food processors, packagers, distributors and retailers
- Food producers and farmers

Certification bodies

- To address all restrictions and requirements regarding the handling of control information, placed on Certification Bodies by accreditation standard (ISO 17065:2012, ISO 17021:2105) and scheme holders, when using "TheFSM".
- Functionality of existing certification management solutions with TheFSM when sharing data – Harmonization with corporate policies and procedures.
- All certified customers must customize their data format based on TheFSM's technical specifications to facilitate their notification and disclosure.
- Participation of all those involved (main and secondary bodies) with whom there is cooperation in the certification process.
- Protection of all the sensitive business and commercial data of all the involved parties in the food supply chain (e.g. Certification Body)
- To keep the cost of certification unaffected by a possible simultaneous increase in the profit margin.
- There should be no additional maintenance costs for users.

Food processors, packagers, distributors and retailers

- Interoperability of existing processing management solutions (e.g. data logger) with TheFSM platform.
- Ease of data handling (data entry - upload, data processing - download etc.) through a user-friendly environment even for users who are not very familiar with relevant tools.
- No specialized (IT) experience or specialized involvement will be essential for using the platform.
- Participation in the platform of all the key end users (main and sub-actors) with whom a processor cooperates.
- The registration and maintenance cost of the platform and how this will possibly affect the cost of the final product in terms of its competitiveness.
- The participation of sub actors which are appointed by the company, such as business consultants, by having limited access only at company's profile, with an add-on cost for the company.
- Protected environment for private information and personal data.
- Data exchange of individual business processes is a cultural obstacle. Providing business sensitive data to other organizations in the food supply chain is felt as a loss on competitively.
- Sympathy and confidence in new digital data systems is low. The understanding of how data systems work is not available.
- Employees are partly not willing to learn new tasks and have no basic knowledge.
- Implementation of an integrated data system is costly. Existing systems are partly old and incompatible and must be renewed.

Food producers and farmers

- Need for ease of data entry through a user-friendly environment and specifically for users who are not very familiar with the technology
- The cost of registering and maintaining the platform, how this may affect the cost of production and therefore the cost of the final product and whether this will ultimately be competitive.
- The participation of sub actors is free since they are not directly involved in the production chain
- Protection against access to personal data
- No need for a specialized IT department in order to use the platform effectively
- Extensive use of IoT for data collection purposes
- To what extent can there be high added value and benefit of reciprocity
- Data exchange of individual business processes is a cultural obstacle. Providing business sensitive data to other organizations in the food supply chain is felt as a loss on competitiveness.
- Sympathy and confidence in new digital data systems is low. The understanding of how data systems work is not available.
- Employees are partly not willing to learn new tasks and have no basic knowledge.
- Implementation of an integrated data system is costly. Existing systems are partly old and incompatible and must be renewed.

- Historical grown data systems are often not efficient but work in compliance with operative processes.
- Transparency of operative processes is low and analysis and necessary adoptions of existing processes is not done during digitization projects. New data systems are risky.
- Data security: Loss of data through hack attacks or insufficient secured data cause an irreversible lack of ability to deliver and compromise the organization.

2.1.3 Opportunities

As stated in the 2016 Communication on Digitising European Industry[3], progress in digital technologies in combination with other key enabling technologies is changing the way we design, produce, commercialise and generate value from products and related services. The challenge ahead is for the European industry to seize fully and swiftly these digital opportunities. While bringing new opportunities, digital innovations also open the door for new competitors in key parts of the value chain. European businesses face the threat of vendor lock in with a few ICT suppliers or platform owners from other countries (especially the United States), which will shift a major part of value creation outside their business sphere.

The rising number of foodborne disease outbreaks, adulteration cases, and toxicity have increasingly followed the threat to food safety. The Center for Disease Control and Prevention (CDCP) in the USA has reported that every year, one in six people fall sick due to foodborne illness[4]; This data is expected to drive even more companies in acquiring certifications but also Governments to strict the relevant policies.

Food Fraud and Species Authentication Gain Prominence amidst Risk of Counterfeit Products: The developed markets are increasingly importing agricultural and horticultural commodities, due to increase in the number of trade agreements and the development of different trade partnerships.

The globalization of food trade has been unprecedented, and the supply chain of various food products spans across different geographies. In the wake of recent alerts reported in the media regarding the sub-standard food imports from specific countries, consumers are increasingly interested in the safety, quality, and importantly, the authenticity of food purchased. The trend has augmented the testing scenario for species identification in the food testing industry.

We have already presented the key market opportunities in the analysis of the market drivers:

- National support for companies that develop innovative products.
- Consumer education is propelling food safety testing.
- Consumers require more information about the food.
- A transparent value chain can protect producers.

[3] Communication on Digitising European Industry - Reaping the full benefits of a Digital Single Market (https://ec.europa.eu/digital-singlemarket/en/policies/digitising-european-industry)

[4] https://www.cdc.gov/features/solvingoutbreaks/index.html

- The food industry consists of a large number of innovative SME's
- European economic data shows an increase of economic wealth.
- High quality products need strong traceability tools to be competitive.
- Digitalization is compulsory for some certification schemes.

2.1.4 Regulation and Policy

The EU Rules regarding Food Hygiene cover all stages of the production, processing, distribution and placing on the market of food intended for human consumption.

General regulatory requirements are laid down in Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (General Food Law Regulation) and Regulation (EC) 852/2004 on the hygiene of foodstuffs. They set out an overarching framework for the development of food and food safety legislation, standards and authorities.

Outlines general principles, requirements and procedures the underpin decision making in food safety matters at all stages of production and distribution. The Regulation will set the overarching framework for the applicable food safety standards in the scenario once these standards are identified.

An overview of EU Rules regarding Food Hygiene follows:

The rules adopted in April 2004 and that came into force on 1 January 2006 are provided for in the following key acts:

- 29 April 2004 - **Regulation (EC) 852/2004** on the hygiene of foodstuffs
- 29 April 2004 - **Regulation (EC) 853/2004** laying down specific hygiene rules for food of animal origin
- 29 April 2004 - **Regulation (EC) 854/2004** laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption
- NEW: Revision of official controls on products of animal origin intended for human consumption: from 14 December 2019 on, **Regulation (EC) 854/2004** will be replaced by the requirements in **Regulation (EU) 2017/625, Commission Delegated Regulation (EU) 2019/624, Commission Delegated Regulation (EU) 2019/625, Commission Implementing Regulation (EU) 2019/626, Commission Implementing Regulation (EU) 2019/627** and **Commission Implementing Regulation (EU) 2019/628.**

The new hygiene rules take particular account of the following principles:

- Primary responsibility for food safety borne by the food business operator
- Food safety ensured throughout the food chain, starting with primary production
- General implementation of procedures based on the Hazard Analysis and Critical Control Points principles (HACCP)
- Application of basic common hygiene requirements, possibly further specified for certain categories of food

- Registration or approval for certain food establishments
- Development of guides to good practice for hygiene or for the application of HACCP principles as a valuable instrument to aid food business operators at all levels of the food chain to comply with the new rules
- Flexibility provided for food produced in remote areas (high mountains, remote islands) and for traditional production and methods

Note: Primary production for domestic use and domestic preparation of food for private consumption are not regulated by Community rules.

Implementing and delegated acts (former PRAC) of the hygiene package

- **Regulation (EC) No 2073/2005** on microbiological criteria for foodstuffs
- **Regulation (EC) No 2074/2005** laying down implementing measures for certain products under Regulation (EC) No 853/2004 of the European Parliament and of the Council and for the organisation of official controls under Regulation (EC) No 854/2004 of the European Parliament and of the Council and Regulation (EC) No 882/2004 of the European Parliament and of the Council, derogating from Regulation (EC) No 852/2004 of the European Parliament and of the Council and amending Regulations (EC) No 853/2004 and (EC) No 854/2004
- Commission Implementing **Regulation (EU) 2015/1375** laying down specific rules on official controls for Trichinella in meat

Related key rules

- **Regulation (EC) No 178/2002 laying** down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety
- **Regulation (EC) No 882/2004** on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules, replaced by 14 December 2019 on by **Regulation (EU) 2017/625.**
- **Directive 2002/99/EC** laying down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption, 16 December 2002

2.2 The food safety market – The European Perspective

In the wake of a series of human food and animal feed crises (e.g. the Bovine spongiform encephalopathy outbreak and the dioxin scare), EU food safety policy underwent substantial reform in the early 2000s. The 'Farm to Fork' approach was defined, guaranteeing a high level of safety at all stages of the production and distribution process for all food products marketed within the EU, whether produced within the EU or imported from third countries. This body of legislation forms a complex and integrated system of rules covering the entire food chain, from animal feed and health, through plant protection and food production, to processing, storage, transport, import and export and retail sales.

The European Commission aims to assure a high level of food safety and animal & plant health within the EU through coherent Farm to Fork measures and adequate monitoring, while ensuring an effective internal market.

The implementation of this **integrated Food Safety policy** in the EU involves various actions, namely:

- to assure effective control systems and evaluate compliance with EU standards in the food safety and quality, animal health, animal welfare, animal nutrition and plant health sectors within the EU and in non-EU countries in relation to their exports to the EU;
- to manage international relations with non-EU countries and international organisations concerning food safety, animal health, animal welfare, animal nutrition and plant health;
- to manage relations with the European Food Safety Authority (EFSA) and ensure science-based risk management.

The integrated approach to food safety is covered by the following web sections:

Food

- Every European citizen has the right to know how the food he eats is produced, processed, packaged, labelled and sold.
- The central goal of the European Commission's Food Safety policy is to ensure a high level of protection of human health regarding the food industry — Europe's largest manufacturing and employment sector.
- The Commission's guiding principle, primarily set out in its White Paper on Food Safety, is to apply an integrated approach from farm to fork covering all sectors of the food chain.

Animals

- The objective of the Animal Health policy is to raise the health status and improve the conditions of the animals in the EU, in particular food-producing animals, whilst permitting intra-Community trade and imports of animals and animal products in accordance with the appropriate health standards and international obligations.
- The general aim of the Animal Welfare policy is to ensure that animals don't need to endure avoidable pain or suffering and obliges the owner/keeper of animals to respect minimum welfare requirements.
- The EU zootechnical legislation aims at the promotion of free trade in breeding animals and their genetic material considering the sustainability of breeding programs and preservation of genetic resources.

Plants

- The European Commission takes actively part in the setting of international phytosanitary and quality standards for plants and plant products.
- EU legislation has, over the years, provided for the harmonised protection of our 'green resources'. Issues like pesticides, plant variety rights or Genetically Modified Organisms are some of the topics you will find in this section.

In the business perspective, European companies will tackle food safety and supply chain quality even more in the future through cross functional teams that use specialist knowledge and integrate risk identification and management across operations.

A great role on this perspective is anticipated to play the **EU single market**. The single market refers to the EU as one territory without any internal borders or other regulatory obstacles to the free movement of goods and services. A functioning single market stimulates competition and trade, improves efficiency, raises quality, and helps cut prices. The European single market is one of the EU's greatest achievements. It has fuelled economic growth and made the everyday life of European businesses and consumers easier.

The single market strategy

The single market strategy is the European Commission's plan to unlock the full potential of the single market. The single market is at the heart of the European project, but its benefits do not always materialise because single market rules are not known or implemented, or they are undermined by other barriers. So, the Commission has decided to give the single market a boost by improving mobility for service providers, ensuring that innovative business models can flourish, making it easier for retailers to do business across borders, and enhancing access to goods and services throughout the EU.

The strategy to boost the single market

Single digital gateway

The single digital gateway will facilitate online access to the information, administrative procedures and assistance services that citizens and businesses need to get active in another EU country. As of 2020, citizens and companies moving across EU borders will easily be able to find out what rules and assistance services apply in their new residency. By 2023 at the latest, they will be able to perform a number of procedures in all EU member states without any physical paperwork, like registering a car or claiming pension benefits.

Single market for goods

The EU Single Market accounts for 450 million consumers and 22.5 million small and medium-sized enterprises (SMEs). The Commission's main goal is to ensure the free movement of goods within the market, and to set high safety standards for consumers and the protection of the environment. Learn more about conformity assessment, market surveillance, legal metrology, the 'new approach' legislation, harmonised and non-harmonised sectors, and the international dimension in the single market for goods section.

Single market for services

Services are crucial to the Single Market. They account for around 70% of all economic activity in the EU and a similar proportion of its employment. EU companies have the freedom to establish

themselves in other EU countries and the freedom to provide services in countries other than the one in which they are established. Learn more about the Services Directive, the free movement of professionals, retail, business and construction services, and service standards in the Single Market for services section.

Standardisation

Standards are voluntary technical specifications that apply to various products, materials, services and processes. They can help reduce costs, improve safety, enhance competition and facilitate the acceptance of innovations. Learn about the Joint Initiative on Standardisation, standardisation policy, harmonised standards, service standards, the notification system, standardisation requests and key guidance in the standardisation section.

Barriers to trade

The Commission works to remove or reduce barriers to intra-EU trade and prevent the creation of new ones so enterprises can trade freely in the EU and beyond. It applies Treaty rules prohibiting quantitative restrictions on imports and exports (Articles 34 to 36 TFEU) and manages the notification procedures on technical regulations (2015/1535) and technical barriers to trade.

CE marking

The Commission introduced the CE mark to indicate that a product meets high safety, health and environmental protection requirements and can be sold throughout the European Economic Area. See the guides for manufacturers, and importers and distributors, and read about CE marking in your country in the CE marking section.

Public procurement

Public procurement is the acquisition of goods and services by public authorities such as national, regional, or municipal governments. The EU works to ensure that public procurement is fair, competitive and conducive to the Single Market. Learn more about EU rules for contracting authorities and other aspects in the public procurement section.

Governance and monitoring of the single market

The Commission monitors the application of EU law and can launch infringement proceedings against EU countries that do not comply. It monitors the functioning of the single market, producing evaluations and key economic reports. The Single Market Forum gathers stakeholders to examine the state of the single market and contributes to policy evaluation. The forum monitors the implementation of the single market act.

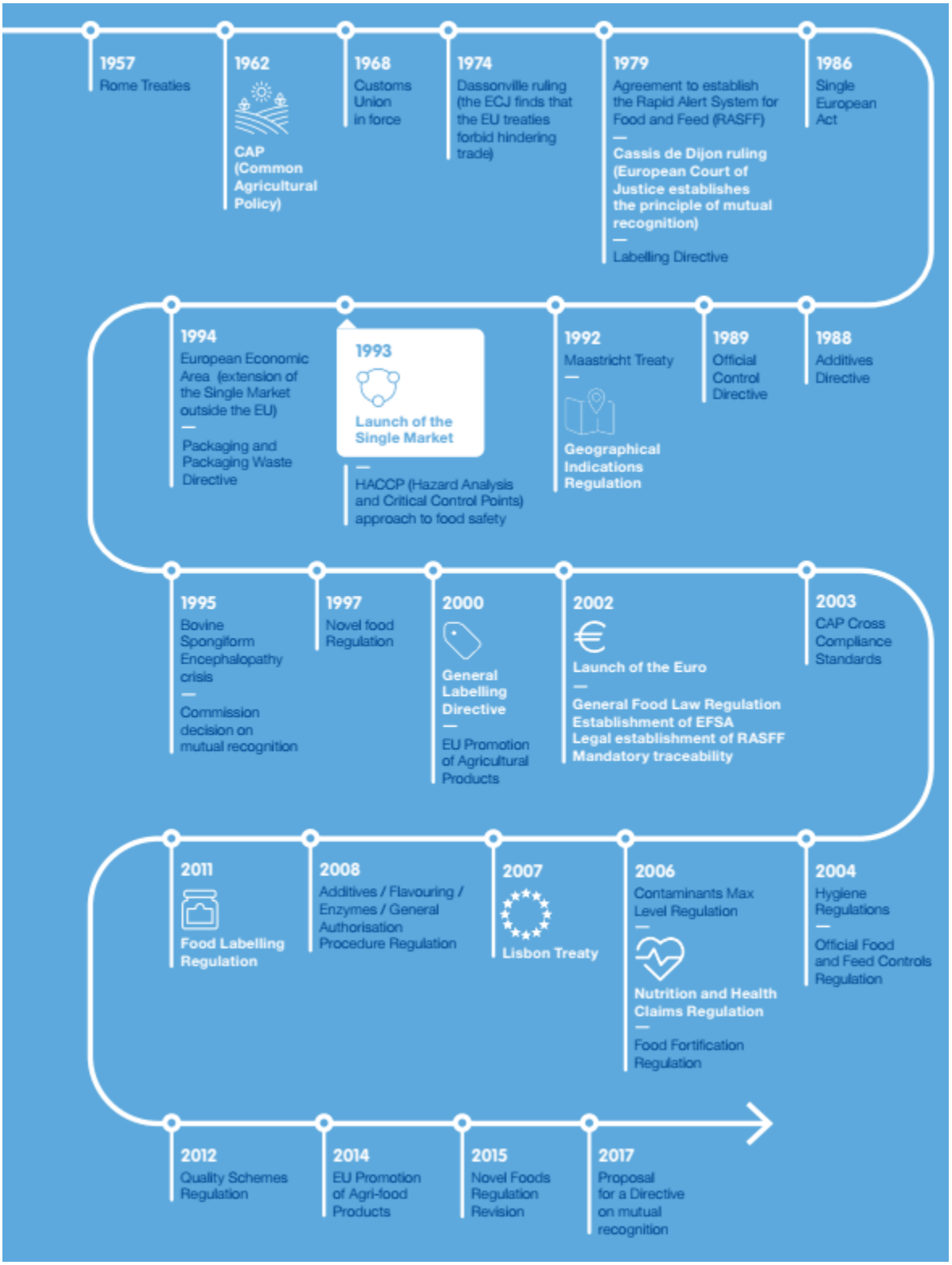

Figure 6. The EU single market timeline

Figure 7. The Single Market for the food and drink industry in figures

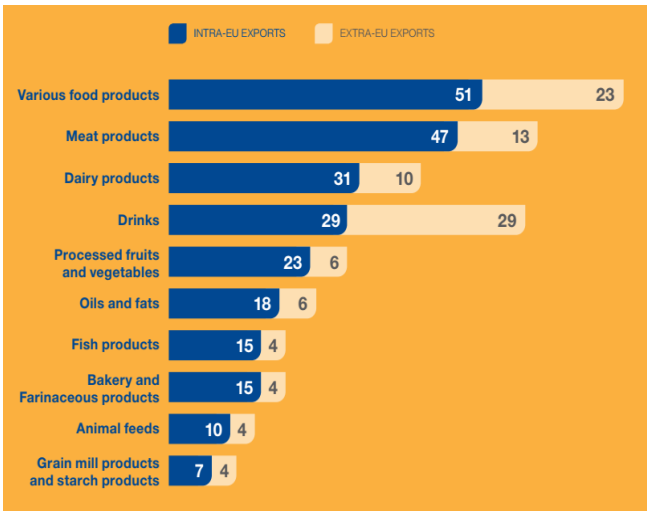

Figure 8. Intra- and extra-EU exports of sectors (2016, € billion)

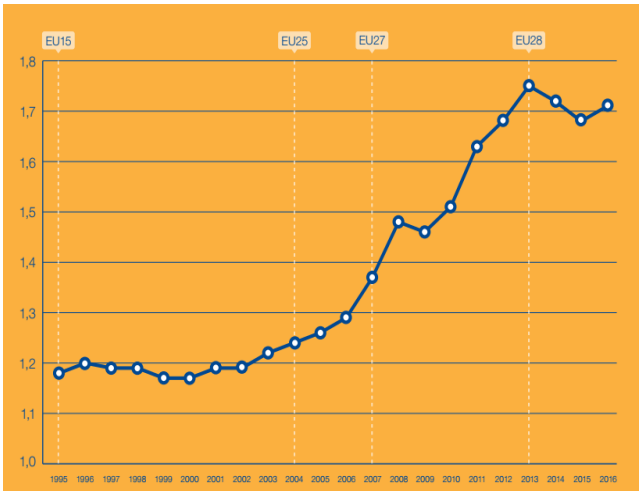

Figure 9. Intra-EU food and drink exports as share of GDP (%)

2.2.1 TheFSM Pilot Countries

Extensive piloting is going to take place in the implementation of the project. The pilot countries will be:

- Greece
- Austria
- Romania
- Italy
- Netherlands
- Croatia
- Hungary
- Poland
- Cyprus
- Egypt
- Jordan

The majority of the selected countries are in the European Union. There are, however, countries outside the EU. In this way the TheFSM project will gain extra experience and extended perspective in order to develop a scalable platform.

2.3 The food safety market outside the EU

This chapter provides a brief presentation for markets outside the EU and especially North America, Canada, Asia-Pacific (and especially the largest food producer in the world, China).

The largest share of the food safety testing market is in the European market. Over the last few years, European countries have noted many issues related to food safety testing. As a result, the introduction of complete food protection for the public has been governed with strict policies (ECSIP, 2016). During the next years, Asia-Pacific region is expected to be the fastest growing food safety testing market. Food safety testing Market growth is attributed to the growing international trade that has mandated testing of food safety to comply with the regulatory standards.

North America Food Safety Market[5]

Food safety testing market is expected to reach USD 8.26 billion by 2027 growing at a growth rate of 7.75% in the period of 2020 to 2027.

Food safety testing market is segmented on the basis of testing type, technology, and food tested.

On the basis of testing type, the food safety testing market is segmented into pathogens, GMO, toxins, pesticides, and others. Pathogens segment is further segmented into salmonella, listeria, e.coli, campylobacter and other pathogens.

[5] https://www.databridgemarketresearch.com/reports/north-america-food-safety-testing-market

On the basis of technology, the food safety testing market is segmented into polymerase chain reaction, immunoassay, enzyme linked immunosorbent assay, chromatography, biochip/biosensor, microarrays, rapid assay, flow cytometry, and others.

On the basis of food tested, the food safety testing market is segmented into meat & poultry products, dairy products, processed foods, fruits & vegetables, and other food products.

The countries playing the main role in the North America region are the U.S., Canada, and Mexico. The North American food safety testing market was dominated by the U.S. Food safety testing. The U.S. Food safety testing is a method by which food and food products are manufactured, handled and stored to prevent foodborne illness and poisoning owing to the rising number of foodborne disease outbreaks and food contamination caused by pathogens such as Salmonella, E, coli in the North American food safety testing market has grown.

The major players covered in the food safety testing market report are Eurofins Scientific, Bureau Veritas, Bio-Rad Laboratories, Inc., LabCorp., Intertek Group plc, TÜV SÜD, TÜV NORD GROUP, AsureQuality, Mérieux NutriSciences, ALS Limited, Microbac Laboratories, Inc., Accugen Laboratories, Inc., ADPEN Laboratories Inc., Genetic ID NA, Inc. among other domestic players.

Canada Food Safety Testing Market[6]

Canada food safety testing market is segmented based testing type, technology, food categories and contaminants.

On the basis of testing type, the market is segmented into pathogens, pesticides, GMO, toxins and others. Pathogens are sub segmented into E.coli, salmonella, campylobacter, listeria and others. GMO segment are growing at the highest CAGR of 7.8% in the forecast period of 2018 to 2025.

In August 2016, Bureau Veritas launched SAFEOPS. The digital service is to help the retailers and restauranteurs to manage food safety and operations. The SAFEOPS is powered by Eezytrace which carries out daily checks of food to deliver high quality, safe products to the customers. This service has strengthened company's position in the global market.

On the basis of technology, the market is segmented into polymerase chain reaction, immunoassay, chromatography, enzyme linked immunosorbent assay, biochip or biosensor, flow cytometry, microarrays, rapid assay and others. Chromatography is sub segmented into liquid chromatography, gas chromatography, thin layer chromatography, paper chromatography and column chromatography. Polymerase chain reaction segment is growing at the highest CAGR of 8.4% in the period of 2018 to 2025.

[6] https://www.databridgemarketresearch.com/reports/canada-food-safety-testing-market

On the basis of food categories, the market is segmented into processed foods, meat and poultry, dairy products, fruits and vegetables, grains and cereals, seafood and others. Fruits and vegetables segment is growing at the highest CAGR of 8.4% in the period of 2018 to 2025.

In February 2013, Bio-Rad Laboratories, Inc. (U.S.) launched New iQ-Check Prep System for automated real-time PCR detection of food pathogens. This helped the company in maximizing its product portfolio.

On the basis of contaminants, the market is segmented into Salmonella, Escherichia coli, Pseudomonas, Bacillus, moulds and others. Each contaminant is sub segmented into different food category such as processed foods, meat and poultry, dairy products, fruits and vegetables, grains and cereals, seafood and others. Salmonella segment is growing at the highest CAGR of 8.0% in the period of 2018 to 2025.

Some of the major players operating in this market are SGS SA, Bureau Veritas, Intertek Group plc, AsureQuality Ltd, LabCorp, Eurofins Scientific, TUV SUD, ALS Limited, TÜV NORD GROUP, Mérieux NutriSciences, Genetic ID NA, Inc and Bio-Rad Laboratories, Inc. among others.

Asia-Pacific Food Safety Testing Market[7]

Food safety testing market in the Asia-Pacific region is expected to grow at a growth rate of 8.93% in the period of 2020 to 2027.

The main factors contributing to the market growth include factors such as rising foodborne disease outbreaks, stringent food industry regulations, increased food trade globalization, advances in technology, increased demand for convenience and packaged food products, and increased incidence of chemical contamination outbreaks in food processing. On the other hand, lack of infrastructure for food control may hinder the growth of the food safety testing market. Whereas, the complexity of testing methods and lack of coordination of regulations were the major challenges for food safety testing market in the period of 2020 to 2027.

Food safety testing market is segmented on the basis of testing type, technology, and food tested. The growth among segments helps you analyse niche pockets of growth and strategies to approach the market and determine your core application areas and the difference in your target markets.

On the basis of testing type, the food safety testing market is segmented into pathogens, GMO, toxins, pesticides, and others. Pathogens segment is further segmented into salmonella, listeria, e.coli, campylobacter and other pathogens.

[7] https://www.databridgemarketresearch.com/reports/asia-pacific-food-safety-testing-market

On the basis of technology, the food safety testing market is segmented into polymerase chain reaction, immunoassay, enzyme linked immunosorbent assay, chromatography, biochip/biosensor, microarrays, rapid assay, flow cytometry, and others.

On the basis of food tested, the food safety testing market is segmented into meat & poultry products, dairy products, processed foods, fruits & vegetables, and other food products.

The China Market[8]

China is the largest food producer in the world, with 1.4 billion consumers. Food safety incidents have received significant media attention and damaged consumer confidence, brand value and profitability for both local and foreign companies.

The **Chinese government has made food safety** a top priority. Reforms are underway on food safety governance. The 2015 food safety law is the strictest in Chinese history, while enforcement, supervision and penalties are being strengthened. These developments are increasing the pressure on companies operating in China's food sector.

China's food safety management, on average, is behind international best practices. While the dairy sector is more advanced than other sectors, it is mostly not up to EU standards. Food safety management relies more on passive testing of final products than proactive upstream prevention.

China's highly fragmented production and supply chain, soil and water pollution, inadequate food safety culture, and widespread lack of technical expertise presents both opportunities and challenges for food safety related service and product providers.

Market Characteristics

Policy and consumer driven. The government has made food safety a KPI for regional governors. Food safety is a key provision of the 13th Five-Year-Plan, a historic first.

The Chinese food market is a buyer's market. Hard price competition for food products, but consumers' disposable income and their willingness to pay a premium for safe food is increasing.

Billions of RMB in investment have been poured into China's food sector, especially, farm and food testing.

Agricultural production is highly fragmented. Soil and water contamination are severe in some locations, antibiotics and pesticide use is high and the level of technical expertise and skills of food workers is generally low.

60% of food safety incidents occur in food production and processing. 75% of food safety incidents are caused by human practice. Common issues relate to additives, food fraud, poor hygiene, expired material or sale of expired food, unlicensed production, disease management

[8] https://www.eu-gateway.eu/sites/default/files/collections/document/file/food-safety-technologies-and-services-china_0.pdf

information asymmetry between producers and consumers, and abuse of fertilizer, antibiotics and pesticides.

Chinese food companies are selective and cautious in purchasing products or services for food safety because the immediate impact on profits is not guaranteed. Food safety improvements may not be noticed by consumers or could fail to command premium pricing.

Top Business Opportunities for EU Companies

1. **Food safety testing sector** - Advanced testing equipment, technology, methods, training and management systems are in high demand. Examples include cost effective or new rapid testing for chemical and antibiotics residue in milk and for animal diseases such as brucellosis. The food safety testing market is forecasted to reach €713 million in 2020 with a CAGR of 9.9% from 2016 to 2020.

2. **Food traceability market size** is estimated to be over €10 billion. The 2015 food safety law requires the government to develop an integrated food traceability system. Companies require food traceability systems to build consumer trust. There is demand for traceability equipment, technology, software and know-how.

3. **Food storage and transport** is moving from a basic to a value-added service. The cold chain is still developing and has strong potential; the market was worth €21.4 billion in 2015 and is projected to reach between €47 billion to €63 billion by 2020. Key demands are advanced technology, operating standards, equipment, techniques, and information systems, (including traceability).

4. **Farming practices/systems** are the weak link in China's upper food supply chain. In the Chinese dairy sector, leading players have built or imported modern equipment and facilities, but may be lacking in the areas of farm design, farm management systems, input management, tailor made standard or operating procedures, animal welfare, biosecurity and disease control, farm information systems, effluent disposal, and training to fully utilise advanced hardware. Both governments and corporations are interested in solutions to recover polluted farm land and water.

5. Chinese **food producers** are looking for any food supply chain safety technologies and systems (including tailor made programmes/standards) that can increase production efficiency, decrease waste, reduce human error, prevent food fraud or enhance food safety & quality. An example of such needs is the China's meat industry, where general production and supply chain practice can only produce chilled lamb with a shelf life of 7 days, compared to 70 days in more advanced markets such as New Zealand. There is also a need for technologies or systems for supplier management and crisis management and product recall are also in demand, although it can be challenging to convince companies of their economic value.

6. **Food safety technologies**, systems and standards for organic food are in high demand in China. The organic food market size in China has been estimated at €3.4 billion to €8.0 billion and

has been growing at a CAGR of 15%. The shortage of organic food has been around 30% for several years.

7. **Certification services** for common standards such as ISO or Global GAP are highly competitive. All major international certification providers are present in China.

8. **Smart food labelling** technology that can tell consumers the authentication, status or temperature history of food may become the future of the food market of China.

DRIVERS
• Social and political pressure to improve food safety • More stringent food safety regulations • Food scandals and rising awareness of food safety • Increasing and changing food demand, particularly for safe food • Growing consumption of animal products • Globalisation of food supply chains • Investment in new, large-scale farms and factories ν Increasing importance of domestic food brands

CHALLENGES
• Heavy soil and water pollution in some areas • Generally low skills and competency of workforce in the food sector • Overseas providers lack understanding on local production practices, culture and commercial environment, while Chinese food companies are selective and cautious in purchasing products or services for food safety • Advanced products or services from overseas must be tailored for China's market environment • Food companies are cautious about investing in food safety enhancement

3. COMPETITIVE LANDSCAPE

3.1 TheFSM platform architecture

The architecture of our platform is going to be open, distributed and federated. Independent components and systems will serve different parts of food data indexing, brokerage and exchange. The interaction and secure communication between the different components of the platform will be based on web APIs and secure data storage, so that we can connect to other software systems that the food supply stakeholders already use. As the diagram illustrates, the starting point will be a reference architecture that combines a number of innovative components that the technology partners bring in the project:

Advanced data interoperability and semantics, based on the expertise, technology stack and products of SAI (such as GraphDB and Ontotext Platform): we will use them to address the challenge of semantic interoperability of the data measured for different certificates, easily transforming one format of measurements to another, allowing data measured for one certificate to be transformed into a format needed for another certification scheme. These technologies will be used as part of the Data and Semantics Layer. More specifically, within this layer different data sources are semantically annotated and integrated as parts of a common data pool comprising disparate yet interconnected data assets, which are then securely stored within the platform.

Advanced multilinguality for both textual information and data ontologies, based on the expertise, technology stack and products of both SAI and AGROKNOW: we will use them to offer harmonized data labels and cross-lingual data discovery powered by multilingual backbone ontologies, as well as applications in many European languages powered by machine translation algorithms.

Automated and blockchain smart contracting, based on the expertise, technology stack and products of both PROSPEH and UBITECH: we will use them to implement automated contracting workflows for data exchange that already include all necessary terms, liabilities and provisions in machine readable and executable formats.

Secure and reliable identity and data management, storage and access, based on the expertise, technology stack and products of both PROSPEH and UBITECH: we will use them to implement blockchain-powered protocols to ensure that the data is seen only by the designated parties and that nobody has hampered with the data.

Real-time processing and big data storage & visualisation capabilities, based on the expertise, technology stack and products of both UBITECH and AGROKNOW: we will use them to allow for realtime data processing and model execution, such as collecting time-series with sensor measurements, combining them, and using them as input to real-time risk assessment estimation according the model that each certificate is using.Data marketplace, for sharing and trading large and heterogeneous food certification-related data assets: we will be based on AGROKNOW's Data Processing Platform developed through H2020 BigDataGrapes.

This architecture also shows the way that 3rd party applications and services can be connected via dataconnectors and an API gateway. More specifically, in the context of the project we will test the connection with Farm and livestock management applications that are typically used by agricultural producers to manage information about their farming and agricultural practices. Reading critical certification data such as data about spraying, critical control parameters estimated from sensor data will be foreseen. We will pilot the connection using data stored within AGRIVI.

The connection of Laboratory Information Management Systems (LIMS) that are used to store the laboratory analysis results for the agricultural and food products that are necessary to get a certificate. We will select one and pilot the connection with the software used by one of the labs that will participate in the local pilots.

The connection of Customer Management/ERP systems already used by the certification bodies and food manufacturers to store information about the producers and audit results. In the project, we will develop the data connectors for exchanging data with the ERP systems that TÜV AUSTRIA partners are using.

The connection of third-party databases that provide information about certificates and producers, from certification scheme owners like GlobalG.A.P.16, BRC17 and others. In the project, we will develop the data connector for exchanging data with the database of GlobalG.A.P..

The connection with other agriculture and food data platforms, such as IBM's Food Trust18, AgriPlace19, Microsoft's FarmBeats20, and other blockchain platforms such as the SAP solution21.

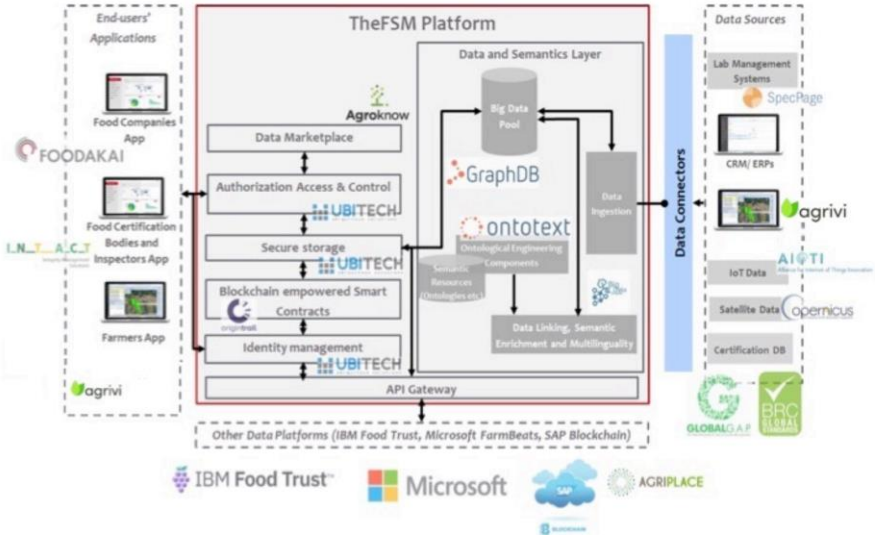

Figure 10. TheFSM platform architecture

3.2 Feature comparison

TheFSM platform will not be the first solution of its kind. There are several competitors in the market, trying to deliver the promise of secured and controlled exchange of commercially sensitive data for food certification purposes.

From this competition, we highlight two (2) specific platforms that we consider as direct and relevant competitors to the TheFSM data platform. We have also developed a table with the assessment of 13 platforms regarding the key features that TheFSM platform is planned to have. These are:

1. IBM's Food Trust Platform (US/global)[9]

An industrial data platform that uses blockchain technology to create visibility and accountability in the food supply. It has been the pioneer in large-scale traceability pilots with large food retailers, such as Walmart. It aims to connect growers, processors, distributors, and retailers through a permissioned, permanent and shared record of food system data.

2. AgriPlace[10] (The Netherlands)

A data platform for farmers, producer groups, auditors, standard setting organisations and food companies. All parties benefit by linking into a centralized platform that makes food certification compliance easy, by smart data management from field to fork, re-using and reducing efforts for multiple certificates.

There are also plenty of other systems that are implementing secure and controlled ways for food safety data traceability, usually through a blockchain-powered solution. These are not industrial data platforms in the way that the IDC study report on "Industrial Data Platforms"[11] defines them ("environments that facilitate the exchange and connection of data between different organisations through a shared reference architecture and common governance rules").

Neither do they enable and facilitate sharing and trading of data assets, directly aiming at creating data markets in the food certification space. An overview of these systems is provided in the following table.

[9] https://www.ibm.com/blockchain/solutions/food-trust

[10] https://www.agriplace.com/

[11] http://datalandscape.eu/data-driven-stories/facilitating-industry-40-whats-role-industrial-data-platforms

Competitor name	Blockchain	Traceability	Food safety data interoperability	Big data processing	Multilingual	Data trading marketplace
FoodLogiQ[12] **(US)**	Yes	Yes	**Partially**	**No**	**No**	**No**
Greenfence[13] **(US)**	**No**	**No**	**Partially**	**Partially**	**No**	**No**
Provenance[14] **(UK)**	Yes	Yes	**No**	**No**	**No**	**No**
arc-net[15] **(Scotland)**	Yes	Yes	**No**	**No**	**No**	**No**
Ambrosus[16] **(Switzerland)**	Yes	Yes	**No**	**No**	Yes	**No**
BeefLedger[17] **(AU, China)**	Yes	Yes	**No**	**No**	**Partially**	**No**
BeefChain[18] **(USA)**	Yes	Yes	**No**	**No**	**No**	**No**
Owl Ting[19] **(Taiwan)**	Yes	Yes	**No**	**No**	**Partially**	**No**
TE-FOOD[20] **(DE, HUN, Vietnam)**	Yes	Yes	**No**	**No**	Yes	**No**
Tech Rock[21] **(China)**	Yes	Yes	**No**	**No**	**No**	**No**
Bubuji[22] **(China)**	Yes	Yes	**No**	**No**	**No**	**No**
TraSeable[23] **(Fiji)**	Yes	Yes	**No**	**No**	**No**	**No**
Zest Fresh[24] **(US)**	Yes	Yes	**No**	**No**	**No**	**No**

Table 3: TheFSM platform competition

[12] https://www.foodlogiq.com/
[13] http://greenfence.com/
[14] https://www.provenance.org/
[15] https://arc-net.io/
[16] https://ambrosus.com/
[17] https://beefledger.io/
[18] https://beefchain.com/
[19] https://www.owlting.com
[20] https://www.te-food.com
[21] https://rock.tech/
[22] https://ibubuji.com/
[23] https://www.traseable.com/
[24] https://www.zestlabs.com/zest-fresh-for-produce/

There are also the generic industrial data platforms that have been deployed in specific demonstration use cases to support traceability and compliance in food supply chains.

These include initiatives like the SAP Industry Blockchain Consortium[25] where food companies and agribusinesses participate. We consider those as custom solution implementations that try to solve similar challenges but are not positioned as operational data platforms with well-defined architecture and governance principles.

In this light, our ambition is to deliver an industrial data platform that (a) aims to specifically boost European certification stakeholders and (b) has a uniquely open and collaborative architecture that combines technology contributions from highly innovative European SMEs.

Competition in partner's countries

To get the best results about the competition, the software partners (AGRIVI, SAI, PROSPEH) of the consortium were asked to contribute their opinion about the proposition in their respective countries.

Bulgaria

In order to outline the competition that the TheFSM platform would have in the Bulgarian market, Sirma AI performed an initial market research. Our research produced the following list of potential competitors to the TheFSM platform. As an initial list, it is not exhaustive and represents the competition to the TheFSM at the local market to the best of our knowledge. Certification and control of food products:

  - SGS Bulgaria[26] - offers solutions including strategic data gathering, collateral management, audits and certification, testing and analytical services, inspection, verification technical solutions, advisory and training.
- Companies providing BIO product certifications:
  - Biocert[27]- offers certification and control for BIO products in agriculture.
  - Bulgarkontrola[28] - offers certification and control for BIO products in agriculture.
- Portal for BIO certification companies:
  - BGBio.org[29] - lists companies offering BIO product certification.
- Bulgarian Food Safety Agency

[25] https://discover.sap.com/sap-blockchain-consortium/en-us/index.html

26 https://www.sgs.bg/bg-bg/agriculture-food

27 http://biocert.nutramedbg.com/

28 http://www.bulgarkontrola.bg/services/la

29https://bgbio.org/%D0%B1%D0%B8%D0%BE-%D1%81%D0%B5%D1%80%D1%82%D0%B8%D1%84%D0%B8%D1%86%D0%B8%D1%80%D0%B0%D1%89%D0%B8-%D1%84%D0%B8%D1%80%D0%BC%D0%B8/

  - Food control[30] – Bulgarian government agency responsible for food control.
  - Food standard[31] – Bulgarian government body responsible for food standards and control.
- Halal certification
  - Halal Bulgaria[32] - offers Halal certification for food products

As the above list suggests, there are several private and government organisations operating in the food safety and certification market. We believe the TheFSM would stand out as it would offer an integrated solution to cover all aspects of food safety and certification whereas existing solutions dive deep into specific aspects of the area. Our initial research has indicated that the TheFSM platform would be distinguishable from other market offerings and would cover a variety of use cases, which current solutions don't cover.

Croatia

There is currently no competition on TheFSM platform in Croatia.

The Netherlands

As it was identified in the previous section, AgriPlace is a competitor of TheFSM platform. AgriPlace is a data platform for farmers, producer groups, auditors, standard setting organisations and food companies. All parties benefit by linking into a centralized platform that makes food certification compliance easy, by smart data management from field to fork, re-using and reducing efforts for multiple certificates.

Slovenia

Currently there is no clear market leader that would provide an IT system for easing food certification in Slovenia. However, there are national and international certification bodies (Bureau Veritas, IKC, KonCert…) engaging in ensuring compliance with safety of food products and providing agri-food and food division certifications. Some of them also offer digital platforms for larger clients that display quality and security through the whole supply chain.

The main difference between such agencies and the TheFSM is that TheFSM acts on a broader scale. It goes beyond providing certificates for one certain entity only. FSM will enable data exchange between different food safety actors along the supply chain interested in sharing info critical to the wished certification. Data exchange will be automated, predictable and, most importantly, secure and will run on an open-source infrastructure.

30http://www.babh.government.bg/en/Page/Food_Controls/index/Food_Controls/%D0%9A%D0%BE%D0%BD%D1%82%D1%80%D0%BE%D0%BB%20%D0%BD%D0%B0

31http://www.babh.government.bg/bg/Page/standards/index/standards/%D0%A1%D1%82%D0%B0%D0%BD%D0%B4%D0%B0%D1%80%D1%82%D0%B8%20%EF%BF%BD

32 http://www.halalbulgaria.com/

3.3 TheFSM differentiation

In the following sections, we will describe how TheFSM is going to provide services that are beyond the current state-of-art that direct competition is offering.

Food safety data interoperability and semantics

In a typical food certification scenario, extensive data logging and documentation takes place. It measures, ensures and verifies the way that every food supplier controls each type of potential risk (e.g. chemical, biological, fraud) in their production or processing facilities. This is a hard and quite demanding requirement, as different versions and formats of sensitive and proprietary data need to be submitted to third parties like inspectors (to acquire or renew a certificate) or buyers (to start or continue doing business with them).

Such data ranges from toxicology lab testing results over agricultural product lots to real-time measurements of critical parameters in the processing, production and storage facilities of suppliers, processors and distributors.

All this information is being collected, documented and stored in different formats, using various software or other systems, in metric systems that differ across geographies.

This picture becomes even more complex, when one looks at the different food safety standards and the schemes that are being used to certify or verify their appropriate implementation. One of the main activities that the GFSI has undertaken since 2001, is a benchmarking process that determines equivalency between existing food safety certification programmes, to allow for flexibility and choice in the market. Each standard has its own philosophy and requirements, but they are typically looking at very similar criteria, checklists, and critical control points.

When a food company has to implement several food standards (e.g. because two suppliers require different certificates for the same process or product), they have to collect, document and share the same or very similar data in different formats.

The GFSI benchmarking model[33] follows a set of industry wide accepted rules that allow food safety standards to be mapped and harmonised, thus reducing the need to run duplicate audits throughout the supply chain. This practically means that one measurement can be used to justify more than one certificate, if it concerns a dimension that is considered as equivalent.

Challenge:

This is one of the most important pain points of food companies and their suppliers, as very often they have to document the same things in parallel or transform measurements from one format to another. There is a need to represent all food safety standards and their specifications for data

[33] https://www.mygfsi.com/certification/benchmarking/benchmarking-overview.html

monitoring and collection as commonly referenced and interoperable information models that can link, map, translate and transform different data formats in equivalent versions and formats.

Our competition:

- IBM Food Trust: includes a Certificates Module that allows users to upload and manage certification documents digitally. The specifications of the data types that the Food Trust can handle[34] indicate that in terms of certification information, only descriptive metadata for the auditing body, audit dates and scores, expiration dates and location GLNs are included. This data platform is not supporting actual data asset management, processing, transformation and delivery.
- AgriPlace: has been built with multiple certification schemes in mind and is supporting almost a dozen of certificates[35]. It foresees self-assessment checklists and document uploads that help users prepare for an audit. It tries to make data exchange easy with other systems, for example with farm management systems, working with standardized data definitions such as Farm Digital[36] and UN/CEFACT[37]. This platform is not supporting automatic re-use scenarios between different certificates, although re-use is possible by re-using uploaded evidence from one assessment to another as all information is stored centrally. It is also not supporting actual data asset management, processing, transformation and delivery.

Our differentiation:

TheFSM will incorporate advanced semantic technologies that can enable highly sophisticated data interoperability and integration capabilities. We want to significantly facilitate the data sharing process through the platform, by offering a very powerful data modelling, interoperability and semantics backbone that will easily support data transformations from one scheme to another.

To achieve this, we will work with the domain experts from TÜV AUSTRIA to carry out an extensive, domain-specific data modelling effort and create a common food certification semantics backbone that can be made available in the different languages and metric systems that food supply chain stakeholders use. We will pilot such cross-certificate interoperability services for a selection of the most widespread certificates that TÜV AUSTRIA is offering to its clients (i.e. ISO

[34] https://www.agriplace.com/en-certificates

[35] https://www.youtube.com/watch?v=iOis05rFMvM

[36] http://www.unece.org/cefact

[37] https://www.iso.org/iso-22000-food-safety-management.html

22000[38], BRC[39], IFS Food[40], GlobalG.A.P.[41], and EU's Organic Regulation[42]). This is going to be particularly useful for the food companies and producers, as it will help them transform certificate-related data from one format to another, when a buyer or inspector asks for it.

Multilinguality support for localised food safety applications

One of the fierce realities in today's agri-food systems is globalization. Food supply chains have changed the way they function. If they were fully autonomous and independent of outside actors in the past, today they are moving towards globally interconnected systems with complex relationships. This radical change is not only technical but practical as well.

The ways in which food is produced, processed or delivered are changing in a state where perishable food products can be shipped halfway across the world in a very short timeframe at fairly competitive prices.

Producers concentrate more on the international demand, instead of the local regions. Nevertheless, this brings localisation as a huge issue in the food sector[43]. This is also valid as far as information localisation is concerned. Especially in the case of small and medium enterprises of the food sector, both employees and customers are primarily communicating using their own languages.

Professional communication about the application of food standards in their local supply chains, as well as certificate inspections from local certification bodies, usually take place in their own language. This is creating a huge burden for certification bodies operating in multiple geographies, as they need to devote effort in scientifically accurate localisation of each food certificate that they are offering.

Challenge:

Making information available in multiple languages usually needs a human translation process that is error prone and very time consuming. Existing software systems in the food sector relies completely on human effort in translating and do not use existing linguistic resources and tools to help make resources and descriptions available in different languages or to enable cross-lingual search.

Language support is currently provided via an extremely demanding multi-configuration process in which the different parts of the solution (portal, metadata, ontologies, etc.) can be provided

[38] https://www.iso.org/iso-22000-food-safety-management.html

[39] https://www.brcgs.com/brcgs/food-safety/

[40] https://www.ifs-certification.com

[41] https://www.globalgap.org

[42] http://data.europa.eu/eli/reg/2007/834/oj

[43] https://www.k-international.com/blog/a-primer-on-food-localisation-strategy/

with translations to several languages using simple form-based applications which provide little support to translation.

Our competition:

- IBM Food Trust: it is only available in English and does not provide automatic support of data and service localisation.
- AgriPlace: it is available in 3 languages, i.e. English, Spanish and Dutch. It has been manually translated and does not provide automatic support of data and service localisation.

Our differentiation:

TheFSM platform will offer advanced multilinguality for both textual information and data ontologies, based on the expertise and technology stack of the partners. Textual data and ontologies, as well as the interfaces of the user applications, will be powered with a machine translation component in order to be offered in the languages of the countries that the project will run pilots in (i.e. English, German, Italian, Polish, Greek, Croatian – and if possible also Hungarian and Arabic).

The content will be annotated with the identifiers of each ontology term, which will be language independent. Each identifier will have multilingual labels that will be developed by local experts covering all the languages of the project pilots.

For the automatic annotation, the content will be first scanned for identifying the specific terminologies in the target language and then automatic translation methods will be applied. This approach will be followed to ensure that the critical terms for the food safety are correctly translated. The multilingual labels for each identifier will be created by the local experts participating in the project.

Automated and smart contracts for food safety data transactions

The 2016 GODAN publication "A Global Data Ecosystem for Agriculture and Food"[44] indicates that a large part of the motivation for data sharing has to do with how widely it will be shared, with whom and under what conditions. Similarly, in the 2017 EIP-AGRI Workshop report on "Data

Sharing: Ensuring Fair Sharing of Digitisation Benefits in Agriculture"[45] a number of legal and ownership concerns that participants have shared were listed:

- Is there a license about who may (re)use the data, and how they may use it? Is there a specific license about who may access and use the data? Is there a license about the conditions of use? Are the terms of use easy to identify, read and understand?

[44] https://www.godan.info/documents/global-data-ecosystem-agriculture-and-food

[45] https://ec.europa.eu/eip/agriculture/en/publications/eip-agri-workshop-data-sharing-final-report

- Is commercial use of this data allowed? Can an individual or organisation reuse this data to make money?
- Which are the allowed commercial uses? Does this require an official permission from the data owner? Are data sharing terms explained to all parties? Is the data sharing model clearly explained to all parties and partners involved? Does everyone understand who and how is going to have access to their data? Are the licensing and usage terms clearly described and articulated?
- Is the license agreement monitored or audited by a third party? Who is responsible for ensuring that the terms agreed are being kept? How is the agreement regulated and by whom? What can the parties do in case of a violation of the agreement to protect its interests?

Challenge:

Providing data sharing environments that can address such concerns in a way that respects clear and mutually agreed ownership rights and terms of use. This calls for clear data governance rules that safeguard the principle of data sovereignty by granting the data owners the exclusive right of determining the terms and conditions of the use of the data provided. As well as "brokerage" services between data providers offering data and data users requesting data that facilitate ad-hoc agreements the provision and use of the data.

Our competition:

- IBM Food Trust: does not provide automated support of data transactions and contracting.
- AgriPlace: serves as an independent tool to prepare and audit for several certifications. It does not provide automated support of data transactions and contracting.

Our differentiation:

TheFSM will offer a multi-sided data brokerage service, where actors like the farmer acts as a "trader" of his data, that can be used for purposes of certification, product risk assessment and verification. We will implement automated contracting workflows for data exchange that already include all necessary terms, liabilities and provisions in machine readable and executable formats.

The Smart Contracting Layer of the TheFSM will constitute a blockchain-based solution with a two-fold focus: one the one hand to undertake all authentication related aspects (complementing the authorization and access control), and on the other hand to undertake all data brokerage aspects.

With regards to data brokerage, the Smart Contracting Layer will enable the (semi) automatic execution of contracts signed between two parties in a transparent and conflict-free way. It will facilitate the exchange of the data assets, and will not only define the rules (and probably the penalties) associated with the agreement, but also automatically enforce these agreements if and when the pre-defined rules are met.

Through the design and implementation of these smart contracts, the data platform will facilitate: turning well-defined legal obligations into automated processes; guaranteeing a greater degree of security; reducing reliance on trusted intermediaries; and lowering transaction costs. Towards this end, the Smart Contracting Layer will formalise all data attributes and qualities that affect, or are in any way relevant to, the ways in which the data assets can be shared / traded and handled subsequently to their acquisition, and also enable the creation of structured, machine-processable data contracts. This entails the expression of contractual terms pertaining to data trading agreements into an appropriate machine-processable language.

Furthermore, it will foresee all possible interactions of stakeholders in data sharing scenarios and will define the system's expected behavior in this context.

Real-time processing and big data storage & visualization

In food processing, a hazard is a biological, chemical, allergenic or physical substance that has the potential to harm. It may also be a condition (e.g. high humidity) that could cause harm. Not all hazards are as serious, or as immediate a threat, as others.

Some situations can be more 'hazardous' depending on the levels, sizes, quantities, or doses of unwanted substance or conditions. When it comes to food and food processing, just how hazardous a substance or condition is may vary greatly. The level of danger can depend not only on the type hazard, but also on who might consume a food product. There usually is a threshold level below or above which the presence of a hazard is considered tolerable, or acceptable. Risk is a measure of the likelihood of a hazard doing harm and how much harm the hazard could do. Or, another way of looking at it is to consider risk an estimate of the probability of a hazard being present.

Challenge:

At the core of food safety certification is the notion of risk analysis and assessment. This is an extremely data intensive process that involves collecting information about many critical factors that are different for each food product and process. Recent legislation puts forward very detailed guidelines about expected risks and how food companies should analyse, assess and prevent them.

This is also what a food inspector typically does when performing an audit: they collect as much data as possible, analyse possible risks, and try to estimate which risk factors have a higher probability - and therefore some extra preventive measure needs to be taken.

This brings forward the need for software solutions that will integrate data from multiple, heterogeneous and distributed sources, process the data in almost real-time, and use the results to support the critical risk analysis and assessment decisions of actors like the food inspectors.

Our competition:

- IBM Food Trust: does not provide any data processing services that are able to translate food safety data measurements into meaningful predictions and support such critical decisions.
- AgriPlace: does not provide any data processing services that are able to translate food safety data assessments into meaningful predictions and support such critical decisions.

Our differentiation:

TheFSM will incorporate big data indexing, processing and visualisation capabilities. They will be used to support real-time data processing and food risk model execution, such as collecting time-series with sensor measurements, combining them, and using them as input to real-time risk assessment estimation according to the requirements of each certificate.

We will incorporate and deliver as a service prediction models for audit nonconformities, the risk of a potential new certification client and supplier, respectively, or to assess the expected risk class for already certified customers and suppliers.

We can also incorporate prediction models for future audit results and key risk factors based on the data from previous audits and client self-assessments.

Results of patent search

We have carried out a search at the United States Patent and Trademark Office (USPTO) Patent Full-Text and Image Database[46], to see if a patent has already been filed or granted that is similar to the innovations that we are putting together.

We have discovered an IBM patent on supply chain management using mobile devices[47] that also refers to product recall data, as well as a patent referring to a method for the management of product provenance using blockchain[48].

Nevertheless, we have not identified anything specific to food safety or certification data management and exchange methods or systems. Neither concepts or applications combining the technologies listed above to address the particular challenges.

We believe that our approach is unique and will consider filing our own patent application describing the overall concept and its components.

[46] https://www.uspto.gov/patents-application-process/search-patents

[47] http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearchbool.html&r=22&f=G&l=50&co1=AND&d=PTXT&s1=IBM&s2=%22food+safety%22&OS=IBM+AND+%22food+safety%22&RS=IBM+AND+%22food+safety%22

[48] http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearchadv.htm&r=11&f=G&l=50&d=PTXT&p=1&S1=(%22food%22+AND+%22blockchain%22)&OS=%22food%22+AND+%22blockchain%22&RS=(%22food%22+AND+%22blockchain%22)

4. BUSINESS PROPOSITION

4.1 TheFSM value proposition

The proposal is putting forward the organisational model of an open and distributed marketplace of data and services for food certification. Our experience shows that the one-platform-fits-all approach that the IBM's Food Trust is following has serious limitations. It is proposing a generic solution that tries to address all types of challenges for practically all stakeholders in the food supply chain - and therefore cannot address the specific complexities and particularities of the food certification market.

On the other hand, our European competitor AgriPlace is following such a laser focused approach, providing farmers with certification document management capabilities that may be reused across certification schemes. Nevertheless, it has a closed architecture and its technological features are not state-of-art.

We believe that our innovation potential is significant, as the technologies that we have selected to combine will give us the ability to create a proposition of unique value to our targeted clients.

We propose an open, shared, collaboratively developed and evolved platform that is developed according to a reference architecture that all involved parties adopt.

Our key service innovation lies to the offering of a novel food safety data marketplace. There are various emerging data marketplaces, directed on marketing[49], consumer[50], financial[51] or science[52] data.

The different data marketplaces can be differentiated based on various characteristics such as: domain of the hosted data sets, pricing and monetization models, data exchange services or tools, Service Level Agreement (SLA) guarantees, data query languages supported, data model, etc.

TheFSM will open new directions for the management and operation of a marketplace via innovative services that combine, enrich and serve heterogeneous data sources, types and formats. This will bring competitive advantages to all food sector businesses that demand easy, fast, and actionable access to variegating food safety data from multiple devices and in various settings (on-site access and recommendations, responsiveness and adaptability in changes, etc.).

[49] https://www.factual.com/

[50] http://www.bigdataexchange.com/

[51] https://www.quandl.com/

[52] https://www.opensciencedatacloud.org

4.2 Value proposition – additional insights collected from the real-life environment

To get the best results about the value proposition the partners of the consortium were asked to contribute their opinion about the proposition in their respective countries with insights collected from the real-life environment.

Bulgaria

In order to determine the market readiness for the TheFSM platform we can use the below assessment of the data market in Bulgaria, as well as a forecast for market growth until 2025, performed by Datalandscape[53].

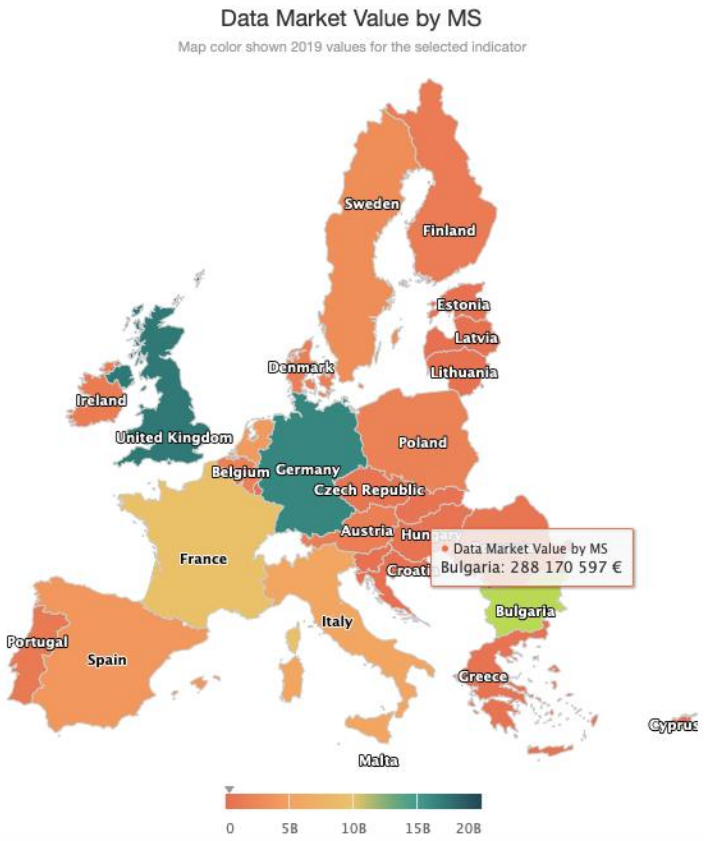

Figure 11. Data market assessment in Bulgaria

The data market in Bulgaria was valued at more than 288 M euro in 2019. By 2025 the market is expected to grow to 477 M, which can be seen in the below forecast. The number of data suppliers is also expected to grow from 1250 in 2019 to over 1500 in 2025. The forecast for data users is also encouraging as they are expected to increase from 3100 in 2019 to 3400 in 2025.

[53] http://datalandscape.eu/european-data-market-monitoring-tool-2018

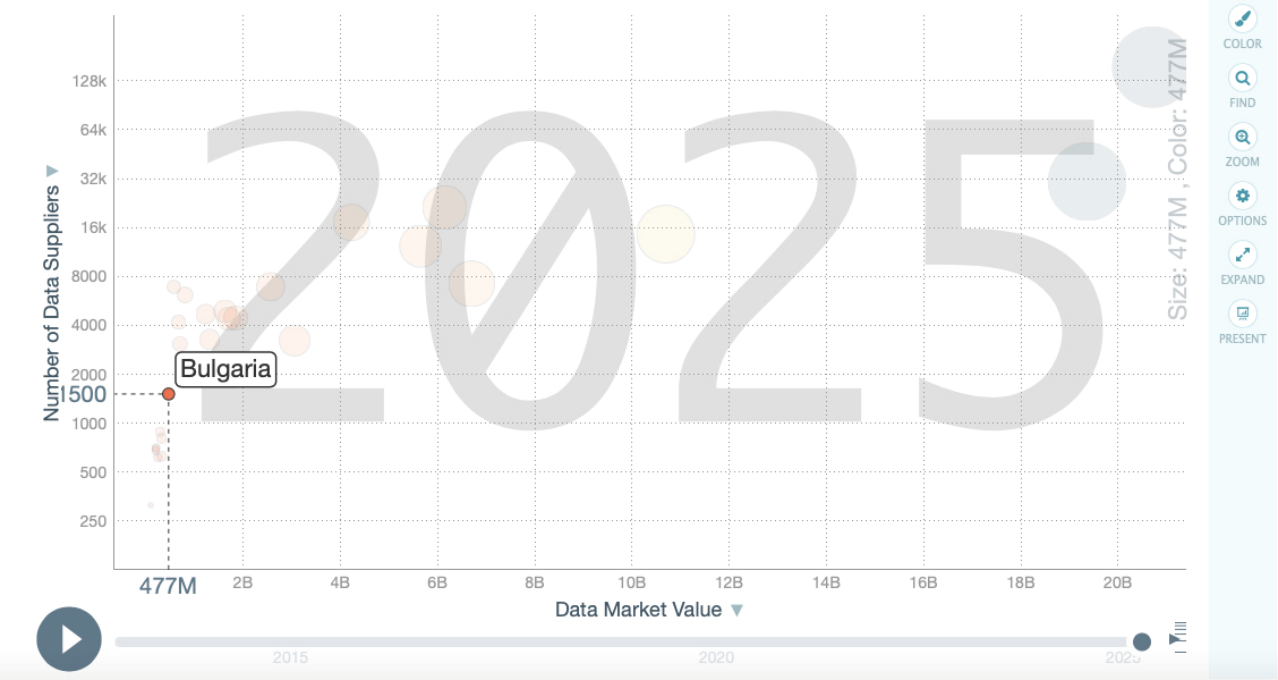

Figure 12. Data market value in Bulgaria

The above forecast shows a great potential for data marketplace platforms such as the TheFSM in the local market and can be seen as encouraging signs for the TheFSM's market readiness.

As potential clients of the TheFSM platforms we see the certification bodies listed in point 1 as the TheFSM platform would benefit them as a unified source of data related to certification, control, testing and audit.

Croatia

The market is at the phase of entering the early stage where companies are now educated about the benefits of agri-food technologies and forerunners are ready for implementation. At the moment penetration of agri-food technologies is low.

Netherlands

The estimation for the market readiness to use a platform like TheFSM is that the digitalization of the certification process is a high priority.

The digitalization of the flow of information along the food supply chain is very important.

Italy

In Italy the origin, authenticity and history of food has a relevant cultural role and also a market value. It applies as well to wine and is often a "side value" of Italian wines when exported all over the world.

AOP and organic wines are already traced (compulsory by EU regulatory framework) and progressively moving to the use of digital tools. As a consequence, the use of FSM platform can be appealing for at least a selected group of wine producers, especially for AOP and organic ones.

At present, in Italy there are nearly 13.000 AOP wines cellars, and already 105.000 hectares organic wine out of nearly 500.000 hectares AOP grapes. In the coming 2 years potentially at least 5% of them could be interested in using the TheFSM platform.

Slovenia

The market landscape with regards to technology readiness varies significantly between groups of stakeholders in Slovenia. Among the farmers, we can find advanced farms with typically younger owners that are technologically very well equipped and knowledgeable. However, the majority of farms will still require a lot of hand holding to get onboarded on any type of digital platform. Stakeholders downstream from farmers would generally have their processes digitalised (at least up to a certain point) already. The challenge with this group of stakeholders is focused on interoperability, not disrupting the current business processes and not creating vendor lock-in for the companies.

4.3 TheFSM team

The consortium implementing TheFSM has at its core a group of leading European SMEs that are implementing innovative ICT solutions. Some of them (i.e. AGROKNOW, PROSPEH, AGRIVI) have particular expertise and a proven track record in delivering solutions for agriculture and food supply chains.

Others (i.e. SAI and UBITECH) have very strong technology know-how with proven large-scale system implementations, ensuring that the data platform is robust, reliable and can scale. The partner coordinating the pilot activities is Wageningen Food Safety Research (WFSR), a world class institute in topics related to food safety that also serves as the Dutch national food inspection authority. They have the experience and expertise to coordinate the pilots, as well as implement a national food inspection pilot in the Netherlands.

The TÜV AUSTRIA GROUP is represented by a selection of its subsidiaries that are based in various geographical regions in Europe and that are covering also nearby regions of relevance (such as North Africa and Middle East). TÜV AU HELLAS is one of the group members most active in agriculture and food certification, supervising the implementation of a variety of GFSI-recognised certificates and supporting nearby subsidiaries (such as TÜV AUSTRIA Cyprus, TÜV AUSTRIA Jordan and TÜV AUSTRIA Egypt) in extending their activities in the food sector. The participation of TÜV AU ROMANIA and TÜV AU CERT will bring on board client cases and business scenarios covering different types of supply chains, different types of products (ranging from fruit crops to meat products), and localised needs that can inform and validate the platform services. To illustrate the way that TheFSM platform is suitable to serve the needs of other certification bodies as well, our pilot partners also include VALORITALIA, a certification body that has already tested

digital technologies in wine PDO certification within IoF2020[54]. They will work on other certification schemes and workflows within TheFSM. Finally, the participation of a specialised department of UNIVIE will ensure that we can work together with the legal teams of the TÜV AUSTRIA members and ensure compliance to both the regulations about data protection and privacy, as well as the regulations about food safety information records. The table below summarises the skills contributed by each organisation along with the primary roles that every partner will undertake in the project.

Partner	Country	Skills	Role in Project
1 – AGROKNOW	Greece	✓ Software applications for agriculture and food stakeholders ✓ Sector-specific data modelling and integration expertise ✓ Big data processing and indexing platform for sector specific applications ✓ Extensive experience in coordinating EU-funded projects ✓ Online SaaS data analytics platform FOODAKAI that serves food companies globally	• Project management & dissemination coordinator • Leading user application development, integration and testing • Coordinating marketing, sustainability and impact activities • Coordinate the development and testing of localized software tools • Contributing to data models and interoperability • Integrate, extend and pilot novel capabilities in FOODAKAI product • Implement and pilot a new product (Food Inspector) for food safety data inspection and digital auditing services
2 - SAI	Bulgaria	✓ ● Semantic data integration infrastructure & tools ● Data modelling & interoperability expertise ● Data processing and machine learning algorithms ● GraphDB Semantic	• Leading data modelling, interoperability, management, and integration services • Integrate, populate and extend multilingual food safety data ontologies and classifications in

[54] https://www.iof2020.eu/trials/vegetables/enhanced-quality-certification-system

		Graph Database	dedicated GraphDB instance • Integrate, customise and improve advanced data ingestion, curation and publication workflows • Integrate, customise and improve data combination, linking, transformation and delivery workflows • Contribute to big data and AI processing algorithms to generate derivative data (predictions, estimations etc) from primary data assets
3 - UBITECH	Greece	✓ ● Systems integrator and technology provider ● Robust, extensible and customizable security enhanced solutions for information sharing, data exchange, services invocation ✓ and communication ● Experience in implementation of workflow-based e-services to support specific business processes	• Leading TheFSM data platform roadmap, architecture, smart contracting • Integrate, customise and improve secure identity management, entity and data storage and exchange • Integrate, populate and extend smart and automated contract initiation, negotiation and execution for commercial data exchange • Integrate, customise and improve robust workflows that will enable automated sharing of food safety data across the supply chain stakeholders, especially in the context of the examined business scenarios.

			• Contribute and integrate smart contracting to OriginTrail blockchain software layer for encrypted and reliable sharing of proprietary, commercially sensitive data across the supply chain
4 - AGRIVI	Croatia	✓ Knowledge-based software solutions that help agricultural producers optimize their production ✓ Works with farmers of all scales in 150 countries worldwide ✓ Serves agricultural cooperatives, food processing companies, NGOs, governments ✓ AGRIVI SaaS farm management application	• Integrate, extend and pilot supplier data sharing capabilities in AGRIVI • Design, setup, involve and mobilise existing clients that will participate in innovation and piloting activities in Croatia, Hungary and Poland • Contribute to 3rd party software integration, data models and interoperability, data population & localisation of data in Croatian & Hungarian
5- PROSPEH D.O.O.	Slovenia	✓ Blockchain technology expertise and solutions ✓ OriginTrail open-source protocol and decentralized network for seamless and automatic data connection and interoperability of different supply chain software systems ✓ Trace Alliance non-profit association to connect stakeholders in the field of blockchain research	• Responsible for integrating OriginTrail blockchain software in data platform and establishing/linking secure nodes for all involved software systems • Coordinate integration of existing data sets • Coordinate integration of data from existing 3rd party systems • Coordinate integration with other data platforms, such as IBM's Food Trust, Microsoft's FarmBeans,
5.1- PROSPEH B.G.D. (Linked Third Party)	Serbia		

			and the SAP blockchain platform • Coordinate ecosystem development through Trace Alliance and other networks
6 - UNIVIE	Austria	✓ Innovation and digitalization in law ✓ Legal expertise on IT and Intellectual Property Rights ✓ Emphasis on data protection, copyright, e-commerce and consumer protection law	• Leading legal requirements, regulation analysis, and compliance activities of the project • Identify, document and specify data transaction workflows and legal terms that smart contracting should comply to and implement • Identify and specify appropriate licensing schemes for IPR and terms of data access/use • Develop appropriate terms of service, warranties and liabilities for the data platform services • Responsible for the development of the project's and the pilots' data management plans and activities
7 - WFSR	The Netherlands	✓ World leading food safety research institute, implementing & testing digital technologies for data exchange and risk prediction ✓ Dutch Food Safety Authority (NVWA) employing 2.000 food inspectors and performing a large number of sample	• Coordinating piloting work in all eight (8) covered countries • Contribute to the food safety data models design, population and localization • Design, setup, involve and mobilise food inspectors that will participate in innovation and piloting

		testing in its state-of art laboratories ✓ Dutch Food Safety Authority (NVWA) issues more than 50 certificates annually	activities in The Netherlands • Coordinate the sustainability activities in terms of on-boarding additional Dutch food inspectors
8 - TÜV AU HELLAS	Greece	✓ Subsidiary of TÜV AUSTRIA GROUP ✓ Inspection, certification and training provider ✓ Covering Sustainability, Food/Primary Production, Food Processing, and Organic Products ✓ Issues around 3.860 certificates in agri-food sector annually ✓ Contacts around 4.200 inspections in agri-food annually	• Leading requirements analysis and business scenarios design for all pilot partners • Contribute to the food safety data models design, population and localization • Design, setup, involve and mobilise existing clients that will participate in innovation and piloting activities in Greece, Cyprus, Egypt and Jordan • Channel at least 10% of its certification or inspection business activities through TheFSM platform • Coordinate the sustainability activities in terms of on-boarding additional TÜV AUSTRIA members that are providing agriculture and food certification services
9 - TÜV AU ROMANIA	Romania	✓ Subsidiary of TÜV AUSTRIA GROUP ✓ Inspection, certification and training provider ✓ Covering Food/Primary Production and Food Processing ✓ Issues around 550 certificates in agri-food sector annually	• Participate in requirements analysis and business scenarios design • Contribute to the food safety data models design, population and localization • Design, setup, involve and mobilise existing clients that will participate in

		✓ Contacts around 450 inspections in agri food annually	innovation and piloting activities in Romania • Channel at least 10% of its certification or inspection business activities through TheFSM platform
10 - TÜV AU CERT	Austria	✓ Subsidiary of TÜV AUSTRIA GROUP ✓ Inspection, certification and training provider ✓ Covering Food/Primary Production and Food Processing ✓ Issues around 2.000 certificates in agri-food sector annually ✓ Contacts around 700 inspections in agri food annually	• Participate in requirements analysis and business scenarios design • Contribute to the food safety data models design, population and localization • Design, setup, involve and mobilise existing clients that will participate in innovation and piloting activities in Austria • Channel at least 10% of its certification or inspection business activities through TheFSM platform
11 - VALORITALIA	Italy	✓ Inspection, certification and training provider ✓ Covering Food/Primary Production and Food Processing ✓ Issues around 1.750 certificates in organic and protected designation of origin (PDO) wine (including farms, cellars and bottlers)	• Participate in requirements analysis and business scenarios design • Contribute to the food safety data models design, population and localization • Design, setup, involve and mobilise existing clients that will participate in innovation and piloting activities in Italy • Channel at least 10% of its certification or inspection business activities through TheFSM platform

Table 4: TheFSM team

5. BARRIERS TO ADOPTION

The established stream of technology adoption research has primarily focused on the enablers of technology. Additionally, this stream of research has often been labeled as too parsimonious due to the prominence of two constructs only, namely "perceived usefulness" and "perceived ease of use" (Davis, 1989).

Thus, adoption research has often failed to provide specific and elaborate guidance to practitioners to encourage adoption of a technology. Moreover, the barriers to adoption are not always the opposites of the enablers (Cenfetelli, R. T. and Schwarz, A, 2011). Thus, understanding the adoption of a technology does not necessarily shed light on the probable barriers to adoption or even the total rejection of a technology. A distinction between the enablers and barriers is important because it might shed light on the probable antecedents of non-adoption and identify the negative perceptions of the prospective adopters as well which might aid in the recognition of the limitations of a novel technology.

Prior related studies have identified various factors like loss of control, distrust, website download delay, anxiety, resource barriers, lack of knowledge, website presentation flaws, and lack of support as inhibitors to adoption of different technologies (Cenfetelli, R. T. and Schwarz, A, 2011).

But to the best of our knowledge there is a lack of an established theoretical model for studying the barriers to the adoption of a technology. A barrier is understood as "anything that prevents progress or makes it difficult for someone to achieve something" (Soja, 2015). Thus, we define the barriers to adoption of a technology as those factors that constrain the probable adopters form employing the usefulness of the technology and also inhibit their intentions to use it.

One of the major barriers related to the deployment of an industrial data platform has to do with the issue of data and privacy protection, as well as the way that it is being addressed by different regulations, legislations but also ethical principles in both EU member states and the rest of the world. The large-scale production, collection, aggregation, and processing of information from various databases, platforms and applications have given the floor to major ethical and privacy concerns regarding potential harm to individuals and businesses. E.g. misuse of food product recall data or risk mitigation assessment data could result into consumer risk or brand damage.

The GDPR is a major transformation in the direction of protecting individual data ownership and privacy rights. Nevertheless, data exchange with supply chain stakeholders based in other parts of the world (like the United States and China) may become a barrier, if stricter national regulations come to place. It is also not clear which ones of the free data flow measures that the EC is proposing (EC, Free flow of non-personal data) will eventually become legislation and practice. The way that they will align with the food safety regulation and its data-related provisions is also not clear.

We intend to carefully investigate this area within our dedicated WP5 - Legal, nevertheless it may be that future legislation becomes a barrier for some of the envisaged data transactions.

Furthermore, there are a range of additional external factors at play which may affect TheFSM's impact:

Economic conditions

The worsening global financial situation may distract investments from the digital transformation of food SMEs at a European or national level, even if it initially seems that these are going to increase.

Political conditions

The changing political environment may change the focus and prioritisation from industrial data platforms and support of data-driven industries to other investments.

Market conditions

The AgTech and FoodTech markets seem to be very promising and are in the midst of tremendous transformation – still the market situation might change.

The Blockchain Adoption Barriers

We identified 16 barriers for the adoption of blockchain technology based on an extensive scrutiny of reputed archival data. Some of the barriers are purely technical limitations like energy consumption, storage concerns, transaction scalability while others are primarily perceptions of probable adopters. We do not categorize or comment on the relative significance of the barriers because of the variability of their distribution across the data set.

We present a detailed explanation of each of the barriers identified. Knowledge of Blockchain: Undoubtedly the most significant barrier identified across all the data sources and unanimously agreed upon by the researchers in the study, is the lack of a sound understanding of the technology.

This knowledge deficiency has resulted in inadequate realization of the relevance of the technology, the ensuing benefits of adopting it and also its feasible use cases. The technology has also been frequently designated as too complex to intrigue ample attention from the masses. There is a lack of awareness at the organizational level also, where executives have shown reluctance to adopt the novel technology. This is due to their failure to recognize a substantial return on investment and the lack of coherent use cases of the technology. The synonymity of blockchain with Bitcoin has significantly contributed to these misconceptions. The technology has to distinguish itself from the negative undertones of the cryptocurrency and a collaborative effort of the educated patrons is required to spread a mass awareness of blockchain and its benefits beyond just cryptocurrencies.

Labels / Headings Used	Barrier Category
Lack of education / knowledge / technical awareness / relevance / Public perception / Advantages of blockchain	Knowledge of Blockchain
Desire to apply the tech to every problem / Be a part of the hype / Ride the wave / Buzzword / Trend	Bandwagon Effect/Herd Behavior
Regulatory Issues / Lack of Government Support / Opposition by Regulators	Regulatory Issues
Data Security and Privacy / Securing data in transaction / Transparency Issues /Private data on blockchain	Privacy and Security
Switching Cost / Switching Decision / Parallel implementation / Integration with Legacy Systems / Replace Legacy Systems	Implementation Dilemma
Initial Cost of Implementation / High Cost for Resources	Initial Costs
Governmental / International standardization / Interoperability	Standards
Risk Avoidance / Low propensity to risk / Mental Barrier / Traditional Dependence on Authority / Lack of institutions	Risk Avoidance
Anonymity / Identity issues / Identity Theft / Exposing private data	Anonymity
Reputation of Bitcoin and lack of trust / Frauds / Illegal Activities / Silk Road	Lack of Trust
Transaction scalability / Low Transaction Speed	Transaction Scalability
Energy consumption / Huge power requirements / Waste of Energy	Energy Consumption
Human Error / Difficult to use / Loss of keys / Keys Stolen	Ease of Use
Storage constraints / Large Amounts / Redundancy / Storage wastage	Storage Concerns
Probability of a 51% attack / Attack at the initial stages	51% Attack
Lack of technological maturity / Varying or Limitations of Consensus Algorithms	Technical Maturity

Table 5: Blockchain barriers categories

Bandwagon Effect / Herd Behavior: The established notions of bandwagon (Avital, M; King,, J. L.; Beck, R.; Rossi, M.; Teigland, R., 2016) and herd behavior, common in the economic literature, are aptly relevant to the current state of adoption of the blockchain technology, especially among businesses. Herd behavior is a phenomenon when everyone imitates what everyone else is doing although their own conscious suggests doing something absolutely different (Banerjee, 1992). On the other hand, bandwagon effect refers to the extent to which the demand for a product is increased due to its use by others (Leibenstein, 1950). Organizations across industries are trying to affiliate themselves with the buzzword "blockchain" and to implement a blockchain solution irrespective of its relevance to its underlying setting. There is an overwhelming desire to apply the technology to every problem confronted or even change stable existing systems. But knowledgeable advocates of the technology propose that the need of the hour is to find the right application the technology solves which also leverages its unique attributes.

Regulatory Issues: The regulatory bodies have not yet caught up with the blockchain innovation and this adversely affects its adoption by businesses across industries. Digital currencies implementing blockchain have also struggled to gain widespread adoption due to the lack of governmental and regulatory support (Christopher, 2014). New business models conceived by the technology would require a framework of new regulations and active collaboration with the authorities. Moreover, blockchain technology has the potential to eliminate the need for trusted intermediaries (Risius, M., and Spohrer, K.) most of whom are elements of the present day's regulatory fabric. Also, these traditional institutions are often required to keep their information private but the transparency feature of the blockchain technology undermines this requisite. Hence the regulators are in a state of dilemma, but their support could encourage more experimentations from interested patrons revealing viable use cases of the technology. Additionally, regulating this decentralized technology will ensure that the consumers' rights are protected and stakeholders of the technology comply with the law (Abramova, S., and Böhme, R., 2016).

Privacy and Security: Blockchain is designed to be transparent (Beck, R., Czepluch, J. S., Lollike, N., and Malone S., 2016), that is to provide visibility of the transactions to all the adopters. This ensures auditability and immutability of the transaction records as well. This transparency is imperative to ensure the displacement of a central authoritative institution (Zohar, 2015). But this attribute is both a characterizing feature and also a reason for its repudiation by many prospective adopters. Certain legacy institutions like governments are compelled to protect access to sensitive data for variable reasons. The transparency feature of blockchain technology undermines this provision. Accordingly, Egelund-Müller et al. (Egelund-Müller, 2017) rightly advocate that the immutability, distributed consensus mechanisms and privacy features of the technology are orthogonal to the requirements of financial applications. Although the technology provides anonymity to its users by pseudonymous representations, consumers have expressed concerns about sharing their transaction data and pseudonymous identities openly (Egelund-Müller, 2017). The extent to which they are willing to share their information depends upon their values, culture and individual

interests which is greatly undermined by the design of the technology. Moreover, news regarding the illegal activities (Silk Road) (Dhillon, 2016), hacks (Ingram, C., Morisse, M., and Teigland, R., 2015), money laundering and frauds surrounding Bitcoin have developed misconceptions pertaining to the technology itself. Bitcoin and blockchain are often undistinguished which has led the less technically savvy consumers to misconstrue the technology. Fabian et al. (Fabian, B., Ermakova, T., and Sander, U., 2016) showed that Bitcoin users are concerned about the anonymity of the technology and have also considered abandoning the network although they are only vaguely aware of the prevalent deanonymizing techniques.

Implementation Dilemma: Businesses have to either procure or develop blockchain based solutions that interoperate with their present legacy systems or transform their existing systems to be blockchain compatible. Moreover, blockchain solutions may not initially provide all the functionalities presently offered by the existing systems and thus a parallel implementation might be more relevant. In some instances, such a parallel arrangement may not be feasible and would require novel systems integratable with blockchain solutions. All of these solutions require substantial financial resources, human expertise and time and a clear guarantee of an appreciable return on investment.

Initial Costs: The initial costs for adoption of the blockchain technology are substantially higher due to its novelty and complexity. Adopting the technology currently requires either developing a proprietary solution or soliciting the resources of a blockchain technology service provider which are very scarce. Due to the infancy of the technology there is a dearth of skilled professionals in this domain. Moreover, a new system might require more resourceful hardware due to the computation intensive nature of the technology. Thus, the adoption of a blockchain based solution currently is beyond the limited financial and workforce reserves of small and medium sized businesses and only viable for a privileged few.

Standards: The lack of standards recognized by regulators is also a commonly cited barrier inhibiting the large-scale adoption of the technology. Ethereum and IBM's Hyperledger are probably the only wellknown blockchain infrastructures that have received acclamation as standards across industries. But these and many others also are still under active development with frequent version changes as new functionalities are being added incrementally.

Active collaboration among regulators and prominent technology providers is required for establishing more industry wide standards to encourage adoption. Blockchain technology enables a network for transactions among participants without mutual trust and network effects (Metcalfe, 1995) is often cited as the rationale for the growth of such networks. Industry wide standards can expedite network effects and support blockchain adoption across industries.

Risk Avoidance: Traditionally consumers have relied on trust to overcome highly risky and uncertain situations which are laden with the possibility of undesirable outcomes as well. Also trust plays a significant role in helping consumers overcome the perceptions of risks and uncertainties while adopting a new technology (Pavlou, P. A., and Gefen, D., 2004). Moreover,

consumers have expressed trust in institutions and trust grows over time varying from initial calculative trust based on cost and benefit assessment to knowledge based or experiential trust when a trustor becomes familiar with a trustee (Mcknight, D. H., Carter, M., Thatcher, J. B. and Clay, P. F. , 2011).

But the novelty and nature of the blockchain technology impairs these traditional notions of trust. A consumer's disposition to trust is the degree to which he/she is willing to depend on a technology irrespective of the risk and it varies greatly ((Mcknight, D. H., Carter, M., Thatcher, J. B. and Clay, P. F. , 2011). The disparate news about blockchain floating around in media coupled with the consumers varying tendencies to avoid risks have culminated in even diverse trends of adoption to avoid those risks.

Anonymity: The anonymous nature of blockchain transactions has received considerable attention from academic researchers and practitioners as well. Although transactions in a blockchain network are represented by pseudonyms which cannot be linked to real world identities unless intentionally disclosed, the anonymity of blockchain transactions is a delusion that can be exploited over a length of time (Meiklejohn, S., Pomarole, M., Jordan, G., Levchenko, K., McCoy, D., Voelker, G. M., and Savage, S., 2016).

Bitcoin users have expressed the awareness of a medium to high level of anonymity in the Bitcoin network and are relatively concerned about it; But a significant proportion of the users have acknowledged the cognizance of deanonymization techniques while some have contemplated abandoning the network perturbed by its anonymity (Fabian, B., Ermakova, T., and Sander, U., 2016). A mistaken transaction due to a human error might never be traceable due to a dishonest recipient and the irreversible nature of the technology only adds to the woes.

Lack of Trust: Contrary to the popular notion of blockchain being a trust free technology (Beck, R., Czepluch, J. S., Lollike, N., and Malone S., 2016), followers of the technology have expressed a lack of trust in it. This perception can be primarily attributed to a naive comprehension of the technology and the synonymity of blockchain with Bitcoin and its' use for criminal or illegal activities.

The blockchain technology characteristics like transparency, decentralization and unregulation imbibes trust in the technology. But the preponderance of Bitcoin related news in popular media and its association with illegal activities in the dark net has greatly impeded blockchain, the technology and even contributed to its negligence by many. Moreover, a new technology is inherently untrustworthy until it is proven to the potential consumers.

Transaction Scalability: The number of transactions verified per second and finally appended to the blockchain is the throughput of the Bitcoin network (Bitcoin 2018). It is determined by the block size and the block creation intervals and can be considerably diminished during high transaction loads. In its current form Bitcoin, the most notable application of the blockchain

technology, can only conduct 7 transactions per second at the maximum which is primarily due to its block size of 1 MB (Bitcoin 2017).

But, the widely recognized payment system VISA can handle 4000 transactions per second and has been stress tested to handle 47000 transactions per second too (Trillo 2013). Blockchain solutions on a global scale would require support for greater number of transactions with throughput alike or even higher than VISA (Beck, R., Czepluch, J. S., Lollike, N., and Malone S., 2016) which demands improvements in the technical architecture of blockchain.

Energy Consumption: The blockchain technology inherently requires exponential amounts of energy consumption to guarantee the honesty of the participants and the validation of transactions by a process called mining.

This energy requirement multiplies exponentially as the size of the network of adopters grows overtime. The energy consumption for Bitcoin mining is ever growing (Vranken, 2017); But the waste and expense of this energy makes the Bitcoin network secure and a malicious entity has to expend even more energy to attack the network. This energy expenditure is fundamental to the blockchain technology to ensure security though various alternatives have been proposed to alleviate it.

Climate change being a global issue, existing and emerging businesses have to comply with regulations to ensure that they adhere to the climate conservation policies. Accordingly, the requirement for large amounts of energy expenditure is viewed as a deterrent by many prospective adopters.

Ease of Use: The blockchain, the log of transactions, the core of the technology is immutable by design and thus any human error in a transaction is permanently recorded and cannot be restored.

Moreover, the transactions enabled by a blockchain technology are irreversible (Abramova, S., and Böhme, R., 2016). Cryptocurrencies, the prominent blockchain applications presently, are inherently complex for transactions. They require public and private keys which are strings of alphanumerics for completing a transaction and the security of these keys is a noted concern (Fabian, 2016).

Users of cryptocurrencies like Bitcoin have expressed their awareness of the benefits of the technology but have also voiced their concerns about the complexity of the technology for regular transactions which makes it prone to human errors (Abramova, S., and Böhme, R., 2016). Thus "ease of use" is a limitation of the current form of the blockchain applications, but due to its' significance for technology adoption, it demands attention (Davis, 1989). But this usage complexity is primarily a perception propelled by cryptocurrencies.

Storage Concerns: The blockchain technology maintains a log of all the transactions since its inception and the log only appends timestamped records in a chronological order. The log is replicated or stored locally by each individual full node and miner of the network to participate in the consensus mechanism (Zohar, 2015).

This results in redundancy of data in the network and as the network grows in size and with it the number of transactions conducted on the network, the log increases in size substantially and thus hefty storage resources are required to hold a copy of the blockchain. This replication of the log of transactions across the network has been widely referred to as a deterrent across the data sources employed in this study. It is a barrier for the probable full nodes as it calls for substantial storage resources to participate in the network.

51% Attack: A blockchain network is vulnerable to a 51% attack to a greater extent in the initial days of formation. The number of active miners in a nascent blockchain network is relatively small and the computational power needed to support the network transactions is also significantly lower. A miner possessing computational power in excess of 50% of the combined power of the rest of the miners in the network can create blocks faster than the rest of the miners combined and literally control the network; It allows that miner to double spent any transaction it initiates, change the blockchain, create an empty block while ignoring all the other legitimate transactions in the same time window (Zohar, 2015).

A malicious miner can exploit a blockchain network in the initial days to an irreparable extent. But as the size of the network grows, the computational power needed to maintain it grows rather exponentially and it virtually becomes impossible for a lone miner to acquire computational resources substantial enough to overhaul 50% of the combined power of the rest of the miners of the network. Theoretically the possibility of a group of dishonest miners collaborating to wage such an attack does exists, but it has not been encountered in any of the well-known blockchain implementations till date.

Technical Maturity: The lack of technical maturity in blockchain is an embodiment of all the technical limitations identified in the technology itself. The relative novelty of the technology can also be attributed partly.

Moreover, the discordant views about the technology broadcasted in the media, the lack of regulatory recognition and industry standards and the lack of mainstream applications that are justifiable use cases ensuing benefits over the existing ones, all undermine the technology's innovative potential and create the illusion of an immature technology.

Additionally, the frequent code forking in the Bitcoin community demonstrates the disagreement among the members of the open source community responsible for maintaining the digital infrastructure of Bitcoin (Andersen, J. V., and Bogusz, C. I., 2017) and only magnifies the sense of technical immaturity of the technology.

6. RISK ANALYSIS (ECONOMIC AND NON-ECONOMIC RISKS)

This chapter presents the process and methodology of identifying and analyzing risks arising from the business activities, assessing them and determining their significance.

The risk management process sets the methodological framework for identifying potential problems that may arise and will result in the preparation of an appropriate plan to address them, with a view to enhancing the efficiency and effectiveness of project management. TheFSM organization requires that a specific plan will be drawn up for milestones, activities and the allocation of resources for their execution. It will also examine which factors can potentially threaten planned activities and eventually achieve milestones.

TheFSM risk management seeks to timely detect problems and to review the plan whenever necessary and feasible in order to reduce the likelihood of the risk and / or mitigate the impact of the risk, if it is realized.

In the context of the implementation of the plan, the risk management mechanism must be in place throughout it. In particular, it should be supported by actions such as regular and periodic review and redefinition of risks before the start of each stage of the process. This process requires a periodic careful monitoring of the organizational environment in order to identify the risks in a timely manner and to eliminate the risks that no longer exist. Risk Analysis can be schematically depicted with the risk consequence and probability charts that provide a concise graphical representation of the total and type of risks for the organisation.

Risk assessment is required to deal with the uncertainty that always permeates entrepreneurial projects. The assessment is based on a sensitivity analysis that enables the identification of the 'critical' variables, a qualitative and probabilistic risk analysis, as well as measures on risk prevention and mitigation. Risk assessment methodology is based on assessing the following:

- Factors that may create risks
- Risks identified
- Risk impact and evaluation
- Measures with which risks are controlled
- Proposed actions and planning to further restrict risks

Key steps in risk analysis include:

- Defining the processes under evaluation.
- Development of a list of risks related to processes.
- Evaluating the impact and likelihood of their occurrence.
- Assessing the risk management capability.

In order to make risk measurable it is important to specify values for the consequence and probability of risk occurrence.

The table below is used to match these values:

Consequence				
	High	3	6	9
	Medium	2	4	6
	Low	1	2	3
		Probability		
		Low	Medium	High

Table 6: **Values for the consequence and probability of risk occurrence**

The risk is determined by multiplying the consequence of the impact with the probability of its occurrence. Overall risk is determined by multiplying the risk with the risk manageability using the following table.

Overall Risk			
9	9	18	27
6	6	12	18
4	4	8	12
3	3	6	9
2	2	4	6
1	1	2	3
	High	Medium	Low
	Manageability		

Table 7: **Overall risk determination**

Potential risks

- Inability to create a sufficiently strong leadership team to inspire, guide and support. Any big or small success requires active support from the management team.
- Early celebrations of success. Beyond the first major success follows a possible risk of restlessness. High performance requires time and persistence.
- Inertia and complacency. The false impression that there is time available is likely to lead to low intensity of work and alertness.
- Affliction and fear. Hesitation in assuming a reasonable risk and necessary initiatives practically invalidates planning, which by definition contains a reasonable risk.
- Self-indulgence and introversion. The belief that everything evolves positively and all major issues have been properly routed may provoke dangerous "narcissism" and cause introversion. Excessive self-indulgence may mean going on without preparation.
- Incomplete motivation of executives. Every business requires the involvement of human resources, whose limited motivation is an obstacle. Improper transmission of the vision and goals means that the people will not accept short-term overwork and personal sacrifices.
- Non-recognition of short-term achievements. Sustainable growth takes time. But to acknowledge short-term achievements and praise people for their contribution is necessary at all times.
- Adoption of low performance standards. High performance and business excellence require high performance standards and continuous effort, otherwise results are below the original goals.
- Limited resources. The best ideas, despite possible volition, remain inapplicable when the required resources are not available.
- Priority errors. Incorrect definition of priorities is likely to lead to failures, which in turn may discourage the continuation of the implementation of the strategy.
- Insufficient continuity and consistency. For every activity and initiative, it is necessary to have objectives, structured views, continuity, consistency and commitment to the vision. The obstacles should not shade the organisation’s vision.

7. VALUE CHAIN ANALYSIS

7.1 TheFSM Stakeholder analysis

The stakeholder analysis identifies customers, groups, and institutions that have an interest in the results of TheFSM. A clear overview of stakeholders and their goals, interest and influence is an important precondition for analyzing the context and market for TheFSM, for formulating value propositions and identifying optimal communication channels. The stakeholder analysis also provides valuable input for developing dissemination material tailored for the different groups.

The identified stakeholder groups have been classified into three types to better distinguish their incentives and interest in TheFSM.

Type of stakeholder	*Description*
Potential adopter/ end-user	End user of TheFSM Platform and tools
Significant Promoter	Promoter and/or significant supporter of TheFSM Platform. Has considerable influence towards other stakeholders
Interested party	Interested in following TheFSM and its developments (typically a provider/vendor of competing and/or adjacent solutions).

Table 8: **Types of stakeholders**

For each stakeholder group identified, segmentation into sub-groups is done according to the characteristics deemed most relevant for that group, e.g. for enterprises, organizational maturity is chosen as differentiating parameter while for public bodies and authorities, differentiation is made based on the level of fragmentation.

The concept of organizational maturity is important for approaching different end-user enterprises with suitable value propositions.

The stakeholder groups and their goals, incentives and interests are presented in below. In the next sub-chapter, we also discuss the relative interest and influence of stakeholder groups, and the recommended communication channels for each group.

7.2 Goals, Incentives, Interest

The table below shows the stakeholder groups, their classification into stakeholder type and typical goals for such a company.

Group	Sub-group	Examples	Type	Maturity
Food sector users	Certification bodies	TÜV SÜD, TÜV AUSTRIA GROUP, OF&G	Potential adopter	Sophisticated
	Certification scheme owners	GFSI, BRC, IFS Food, GlobalG.A.P., The European Organic Certifiers Council	Potential adopter	Sophisticated
	Food distributors & retailers	Euro Coop, Food Drink Europe, Grocery Manufacturer Association	Potential adopter/ Significant promoter	High fragmentation/ Transitional change
	Primary producers and farmers	Copa Cogeca, WFO-OMA, Organic Farmers Association, Farm Retail Association, OStevia Hellas	Significant promoter	High fragmentation/ Undisciplined
Technology providers	ICT contributors to TheFSM technology stack	Trail Alliance, Big Data Value Association, other innovative ICT companies in Europe	Interested party	n/a
	Providers of ICT services to the food sector	Ag/FoodTech startups, Farm Management System & Lab Management System providers, ERP providers	Interested party	n/a

Table 9: Stakeholders groups

7.3 Recommended communication channels

TheFSM Partner (Lighthouse Customers) Program is an important part of the overall communication and dissemination strategy of TheFSM, and provides a context for interacting with key stakeholders. Effective dissemination and stakeholder communication is however dependent on selecting the appropriate communication channels. The most relevant communication channels for each stakeholder group are presented below.

Sub-group	Type	Lighthouse Customer Programme	C-level brochures, white papers, videos, webinars	Academic journals, research public.	Industry seminars, conferences	Public showcase/ demo	Training courses
Certification bodies	Potential adopter	X	X		X	X	X
Certification scheme owners	Potential adopter	X	X		X	X	X
Food distributors & retailers	Potential adopter/ Significant promoter	X	X	X	X	X	X
Primary producers and farmers	Significant promoter					X	X
ICT contributors to TheFSM technology stack	Interested party		X	X		X	X
Providers of ICT services to the food sector	Interested party		X			X	X

Table 10: Recommended communication channels

8. THEFSM BUSINESS CANVAS

Lean Start-up method is used for developing businesses and products based on the principle that product development cycles can be enhanced by adopting a combination of business-hypothesis-driven experimentation with user feedback and iterative product releases, which is known as validated learning.

In TheFSM, business canvas methodology is included into the initial phase of the TheFSM Platform development to support the Lean Start-up methodology principles. Moreover, starting point for determining exploitation opportunities is the development of a TheFSM Business Canvas Model (see below).

Throughout the process of TheFSM co-creation, TheFSM Business Model Canvas will be updated based on feedback of relevant food safety players / TheFSM Lighthouse Customers for the further development of TheFSM Platform, aligned with their requirements. Here, canvas represents a living scheme and as the project goes and will be constantly updated to the end of the project lifetime.

The active participation of end-users in the validated learning process is of key importance for obtaining meaningful feedback that will allow matching their needs with value proposition in order to be capable of entering the market.

As a critical measure of progress towards converging from initial hypotheses to a 'business opportunity', actionable metrics will evaluate the speed and effectiveness of validated learning by stakeholders (LHCs), e.g. a basic metric would be to quantify willingness of the food safety industry to use TheFSM Platform. It will also illustrate their level of satisfaction with this engagement and their intention to pay or not to pay for the TheFSM Platform.

<table>
<tr>
<td rowspan="2">Key partners
- Establish strategic partnership with key food safety actors;
Establish synergies for indirect sales;
- Establish strategic business relationships to communicate the e-services platform;
- Showcase “Success stories”;</td>
<td>Key activities
- secure, efficient interoperable systems
- automated legal controls
- combined data sources</td>
<td rowspan="2">Value proposition
- Data as a service
- Make better Decisions;
- Decrease O&A costs;
- Increase Profitability and customer satisfaction;
- Enable new food safety. solutions
- Trusted data.
- Covering the whole food safety chain.
-Hassle-free Integration</td>
<td>Customer relationship
- Direct contact
- Timely and Consistent
- Quality and affordable Services</td>
<td rowspan="2">Customer segments
- retailers
- Food processing bodies
- private certification bodies
- organic certification controllers
- safety/ inspection authorities</td>
</tr>
<tr>
<td>Key resources
- Data modelling and Semantics Layer
- Core backend platform layer
- Application layer
- Interconn. layer</td>
<td>Channels
- Sales Generating
- Direct Sales
- Indirect sales
- Marketin Channels
- Offline activities(B2B)</td>
</tr>
<tr>
<td colspan="3">Costs Structure
- Platform development and maintenance
- Piloting and validation of services costs
- Sales and marketing
- General and administrative costs
- Customer support</td>
<td colspan="2">Revenue Stream
Platform as a service (Paas)
Data as a service (Daas)
- Direct selling
- Reselling affiliations model
- Industry sector partnerships</td>
</tr>
</table>

Table 11: TheFSM Business Canvas

9. ROADMAP FOR IMPLEMENTATION AND EXPLOITATION

To generate real business and commercial value of the TheFSM Platform, TheFSM placed the co-creation process with future customers into the core of the development process of the solution. By combining the approach of user-centred Design, the Lean Start-Up Methodology and Product-led growth, TheFSM allows the development of the solution in iterative cycles, with end-users and other stakeholders providing feedback, within each cycle. In this way, the implementation of such a dynamic co-creation process ensures the best market fit, applicability and sustainability of TheFSM Platform.

Moreover, such collaboration with future customers represents an excellent way to discover all food safety market opportunities, push product branding in all possible directions, and establish a presence in the whole sector.

Taking into consideration the importance of the role of TheFSM end-users, as a future TheFSM Platform customer, in the co-development of the platform and its services, the Business team created the TheFSM Customer Integration Roadmap (see below). Namely, TheFSM Customer Integration Roadmap is designed to provide clarity in all development phases and to simplify the process of attracting and on-boarding of as many as possible food safety related players into end-users Group.

Moreover, TheFSM Roadmap guarantees that the service integration process will be a positive experience for new end-users and a transparent process. Thus, with this roadmap, they will be provided with complete information during each phase of the TheFSM integration.

In addition, as the complexity of project implementation increases and (Lighthouse) customer's demands in terms of time and quality grow, project management becomes imperative in ensuring a project's final success – commercialization of TheFSM Platform.

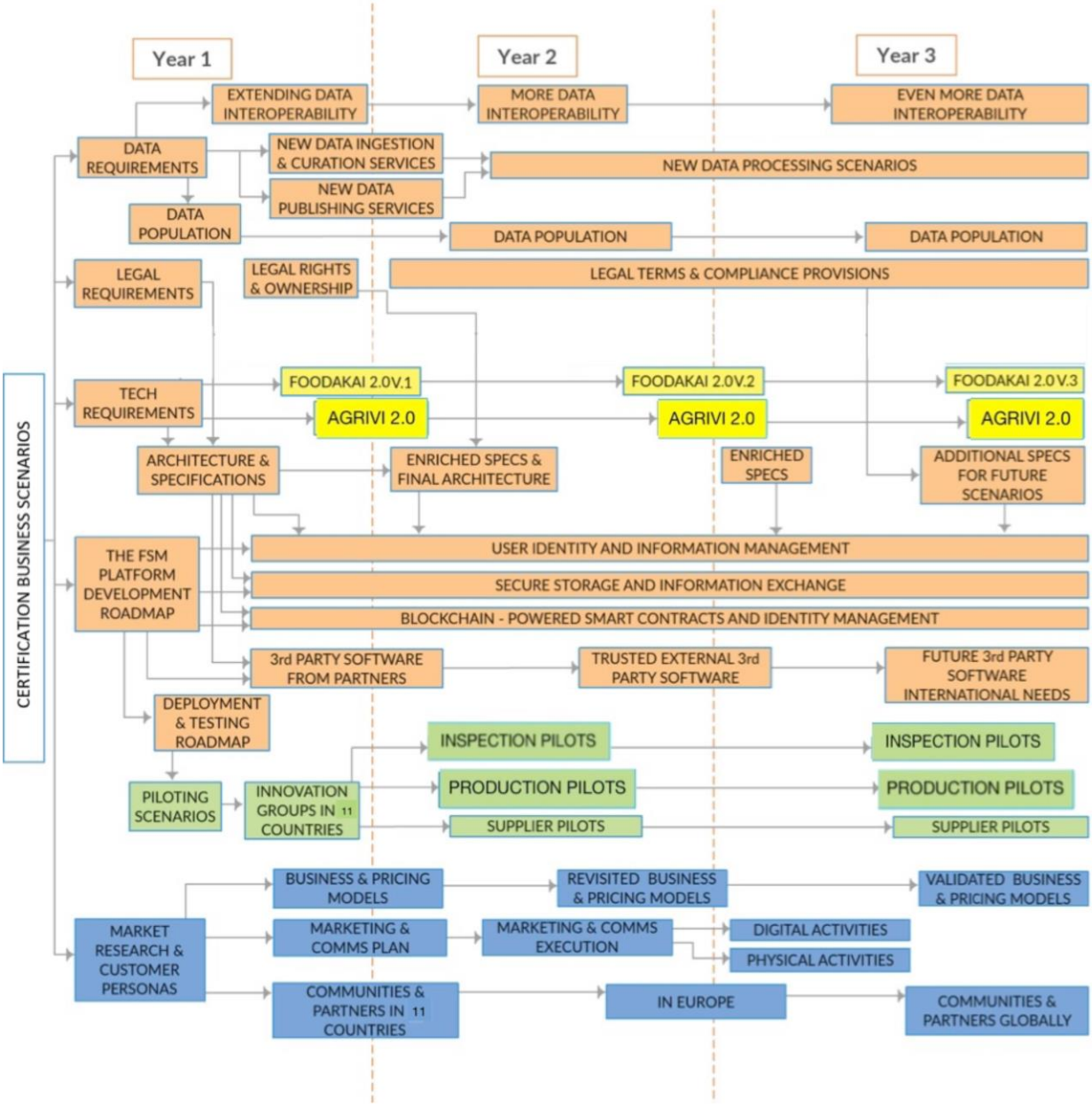

Figure 13. TheFSM Customer Integration Roadmap

10. THEFSM GO-TO-MARKET: PRODUCT-LED GROWTH

Branding is a complex marketing strategy that requires careful planning and calculated approach. There are many areas that are used to develop a brand including advertising, customer service, promotional merchandise, reputation, and logo. It is a disciplined process encompassing TheFSM's image, values, and driving its interactions with potential customers and other stakeholders.

TheFSM will seek to aggressively and proactively promote itself as a differentiated platform allowing its customers but also other key players along the food certification value chain to innovate and grow.

10.1 Marketing and dissemination

In a nutshell, following the project completion, TheFSM marketing activities will adhere to the principles and objectives established while the project is still ongoing; however, the strategy will be slightly revised to give it a clearer commercial focus, improving the platform, marketing and customer service.

In our marketing and dissemination strategy, we adopt the principles of Product-led growth (PLG) - see figure below. This is an end user-focused growth model that relies on the product itself as the primary driver of customer acquisition, conversion and expansion. TheFSM will empower its end-users to find, evaluate and adopt the platform on their own. Namely, we live in the end-user era. The decision-making criteria are now personal productivity—will this platform actually help me day-to-day?

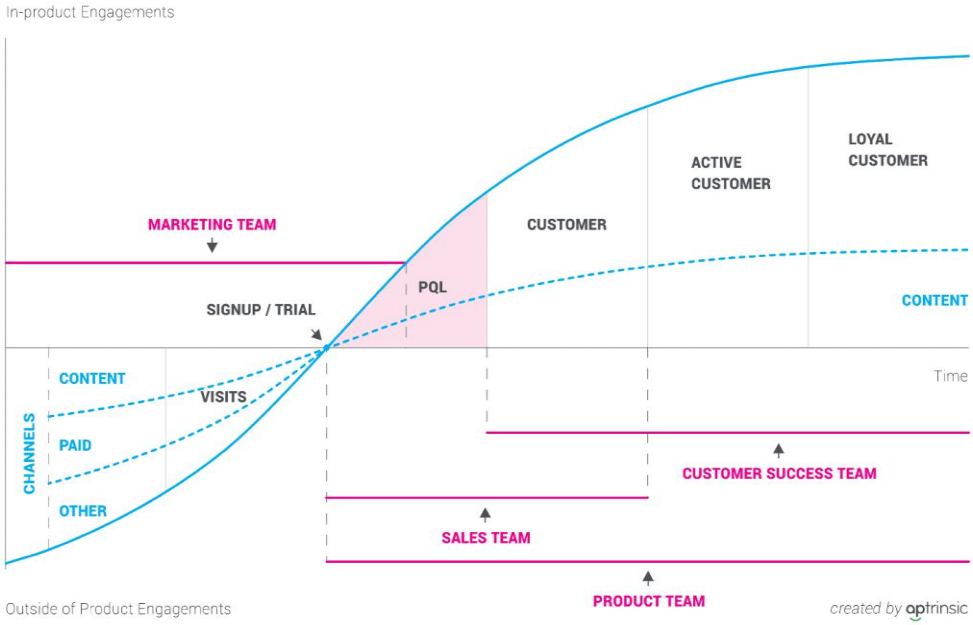

Figure 14. Product-led growth principles

The following pillars of the PLG model will accelerate TheFSM growth:

- Aligned with how customers want to buy;
- Able to personalize experience early in the buying cycle;
- Platform usage is correlated with buying intent;
- Focuses sales, platform and successes around solving customer problems;
- Build innovative products and services that people want to use.

The starting point will be to inform, engage, and delight key players involved in inspecting, auditing and certifying supply chain management systems. These activities (top of the funnel) will take place during all along the project. As we get closer to the end of the project, TheFSM team will seek to convert these 'light house' customers and qualified leads into customers.

TheFSM marketing and dissemination team will share success stories, on the basis of pilot activities and Lighthouse Customers project results. Such an approach will translate the project activities into tangible benefits for key industry players.

10.2 TheFSM Brand positioning statement

As marketing is closely related to business, sales and commercialization of the product, the value proposition of the TheFSM Platform will support the creation of the TheFSM brand as well. Namely, the Brand positioning statement is a declaration of a brand's unique value proposition and how it can fulfil all customer's need. It is a showing of how the developed product, service or brand fills a specific consumer need in a way that its competitors don't. Moreover, it serves as a tool to control what the customer hears about the brand.

Major factors included in building a successful TheFSM brand are:

- The value - If future customers knew that through TheFSM will consistently deliver benefits and valuable services, they woujld respond to that positive reputation;
- Positioning will be achieved a combination of value proposition, name, image, delivering of services, clear benefits;
- Communication - As an aspect of marketing refers to the tailoring of all aspects of TheFSM promotional mix toward creating a sustainable customer base;
- Long term perspective - TheFSM will be loyal to its brand as it would wish from its customers and clients to be.

TheFSM operation should first define its brand. In order to do so, it will answer simple questions: Who? What? etc. It has to focus on its business and target the exact challenges defined in the food safety market. It matches the needs of future customers and brings them into its strategy. As the potential of the Brand positioning statement is paramount, TheFSM will apply all solid elements of this declaration into the commercialization of the TheFSM Platform. More precisely is presented below:

WHO? TheFSM Customers - food certification stakeholders (main actors and sub-actors)

WHAT? Food safety value chain

WHY? A trusted and secure data sharing Platform - certification and verification; monitoring, tracing and predicting risks in food production lines, real time and intelligent data sharing for suppliers;

HOW? TheFSM Platform enables the food safety sector to elevate the risks and challenges in terms of data sharing and enable innovative solutions for the food safety issues in the supply chain.

Finally, the TheFSM Platform position itself as a brand: The Ultimate Solution for Growing Food Certification Businesses.

10.3 TheFSM Marketing Mix

TheFSM targets the food safety market, especially the retailer, food processing bodies, private food safety standards certification agencies, organic certifiers, food safety authorities.

All marketing campaigns will be carefully designed and executed to effectively target high-level individuals and companies that are looking to improve their current business workflows. Direct marketing will be used to establish a nurturing and enabling relationship with our potential customers and other key players in the food safety industry. Once an initial word is created within the food safety community, word of mouth will help upscale the traction of the platform.

In marketing, the promotional mix describes a blend of promotional variables chosen to help to reach the goals. Activities identified as elements of TheFSM promotional mix vary, but definitely will include the following:

- Advertising as a paid presentation and promotion of services is a massively used tool. Examples include direct mail, brochures, posters, mobile apps, web pages, banner ads. TheFSM will scale all services and choose the appropriate activity(s) which show more success.
- Direct marketing allows businesses to communicate directly to the customer, with methods such as messaging with consent, email, interactive websites, ads, promotional letters.
- Sponsorship of an event is a way to generate positive publicity. This might be sometimes a high-cost activity; however, it will be examined.
- Participation in the events that gathers the target audience of customers (conferences, meetings, fairs, etc.).
- Social media use is considered to be a supporting promotional tool for TheFSM in order to engage and inform the food safety target audience. The exploitation of websites and

social media (i.e. Linkedin, Twitter, YouTube, etc) must be consistent. TheFSM will make optimum use of social media to get its message and services to its future direct and indirect customers.

- The main efforts will be pointed into direct marketing and organization of in-person meetings with potential customers – B2B Marketing. Finally, such personal selling as a process of persuading potential customers to purchase the services is often a face-to-face manner. Examples include presentations, meetings etc. B2B marketing is the main and up to the point activity, the TheFSm will undertake in order to promote and sell its services. TheFSM Business Team will strongly rely on an already built network of customers and their recommendations

Based on the all abovementioned, TheFSM Platform operates as a set of services that are tailored-made for food safety actors and therefore a focused strategic marketing plan is required to target those companies and high-level representatives. For example, outbound marketing will be used in targeting certification bodies. Here, attendance at events of interest per targeted country is planned to further disseminate the TheFSM Platform. Food fairs, conventions, sectoral events, conferences, business fairs and other industry gatherings will be attended by TheFSM Sales and Marketing specialists, promoting and exhibiting the TheFSM Platform. Moreover, TheFSM will keep on establishing a connection with food related initiatives and continuing to search for more. Here, it will have only the business focus, aiming at further connecting TheFSM with the target audience.

10.4 B2B Marketing

As previously mentioned, the organization of meetings is perceived as the main channel for successful commercialization and as such it will be applied for marketing during the post-project period. For such occasions, the B2B approach is applied (taking into consideration some principles of B2G, when it comes to public bodies).

The initial contact is mainly established via mail or phone call. Specially made TheFSM promo mail (will be sent to the relevant person within the company, followed by the call or Skype meeting, and at the end, the organization of face-to-face meetings, mostly in the premises of their companies. For this purpose, the TheFSM Platform pitch deck will be prepared to highlight the main benefits of the TheFSM Platform. After the meeting, if a company shows any interest and willingness to join the TheFSM end-user pool, the process will be finalized.

10.5 Exploitation

The following elements will be investigated by M12 to provide a firm basis for exploitation:

- Key elements of TheFSM platform;
- Main contributors to their development;
- Intended users and other stakeholders;
- Expected benefits and the context of use;

- Main form of Exploitation.

TheFSM seeks collaboration as a competitive advantage; therefore, we will analyze the framework conditions for collaborative business models and operational structures which allow and promote cross-industry partnerships and value co-creation (D7.2: Ongoing Documentation of Governance and Business Models). The following items will be taken into consideration:

- Purpose, specific conditions (e.g. data, legal aspects, timeframe),
- Persons/ organizations involved and cooperation readiness,
- Bilateral contracts – Confidentiality Agreements,
- Piloting – exploitation.

When it comes to validation of TheFSM platform, one of the key activities will be piloting. We will validate various requirements (business, technical, legal, data) in high-level inspection and certification scenarios. To this end, TheFSM heavily relies on lean principles and practices. The goal is to refine business cases and validate business models while focusing all activities towards growth. To this end, TheFSM has already established a heterogeneous pool of end-users and other key stakeholders. We will leverage their market presence and experience to create a network effect. The underlying aim is to create a synergistic alliance with key stakeholders that have resources or strategies that sync well with ours.

These activities will be reported in M12, when we will publish our Annual Report of Marketing, Sales & Partnership Activities (D7.3),

11. CONCLUSION

This deliverable aims to shed light on proven strategies and tactical methods to accelerate product innovation, go-to-market planning and commercialization, and building an open and favourable ecosystem for the adoption of TheFSM. To put it simply, this report has been designed to serve as a basis for the definition of a realistic go-to-market plan. The crucial step is the identification of the exploitable assets of TheFSM, technical features, competitors, ideal customer profile, etc. (i.e. all the aspects needed to position TheFSM in the market context).

The report itself represents the initial version of TheFSM market research and go-to-market planning. To facilitate this process, we have put end-users and potential customers at the heart of an iterative development process. By applying lean principles and practices, we aim to ensure that TheFSM will not only trigger interest in end-users but will create lucrative growth opportunities. Furthermore, we have established a heterogeneous pool of end-users that will engage themselves in the design, development and validation of TheFSM, ensuring that the developed platform meets the needs of the market and fulfils our potential customers' business objectives. The market roll-out follows an iterative development and validation process, allowing us to make adjustments and optimizations quickly based on what the market needs. Our interactions with end-users will be augmented with desk research and expert analysis. Last but not least, we will be combining both inbound and outbound B2B marketing to grow brand awareness and nurture a highly-targeted list of potential prospects in our target markets.

This document has been prepared in two phases. In the first phase, we have built upon the work conducted in WP1 - Requirements, making the most of the five high-level inspection and certification business scenarios in the food sector (D1.1 Report on Requirements for TheFSM). The work in the second phase heavily relied on the TheFSM end-users pool to gather inputs concerning positioning and value differentiators (mostly, but not only). The result is an operational roadmap and a 'living document' that evolves as TheFSM platform develops. We have a number of activities planned and upcoming — deliberately geared towards securing sensible, sustainable commercialization.

The chapters presented here gather, for the first time, comprehensive and cutting-edge insights brought by our core partners. We have provided an overview of the market and industry basics, highlighting the general interest in use and potential use cases. The scenario offered in this report presumes normal (not more or less probable) developments, proposing a strategic, operational and financial trajectory. In no way, should this strategy and projections be viewed as optimal and "must follow" for TheFSM. To put it simply, TheFSM is being developed in a supportive and enabling environment, allowing us to capture market changes and opportunities, be more competitive and increase our growth potential - by most immediate market data and updates from key stakeholders.

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