SOFIE - Secure Open Federation for Internet Everywhere

779984

DELIVERABLE D6.10

Business planning

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Table of Contents

1. Introduction

A business plan is developed for the continuation of diffusion and expansion of the results of the project in the SOFIE specific industry verticals. The main objective of the D6.11 “Business planning” is to provide an overview how the assets that are created in the SOFIE project are involved in the business lines (value propositions, business concepts, products, services) of the SOFIE partners and the potential future activities with the economic and financial analysis. This document gives a preliminary understanding of how the results from SOFIE project could be moved towards financial success and enter company main business line.

1.1 SOFIE Value Proposition

SOFIE, Secure Open Federation for Internet Everywhere, is an innovation project that focuses on building and combining novel technologies, in order to provide practical solutions to business verticals and create sustainable solutions with revenue streams in the end. SOFIE applies distributed ledger technologies (DLTs) to securely and openly federate IoT platforms. It is based on the idea of using interconnected distributed ledgers as a cornerstone to build decentralised business solutions, that allow different types of IoT systems and data silos to be interconnected. With the delivery of governance, interconnection and distribution of data, SOFIE will contribute to different business cases and be essential part of creating value and revenue to relevant stakeholders.

We have been aspired to bring new business solutions to the market demonstrated through prototypes, and thus the aim of SOFIE project has been to reach this goal by establishing a solid framework, underlying components, and sector specific implementations.

The Figure 1 below presents a simplified hierarchic view on how we go to the market with SOFIE developments and create our value proposition 1) from SOFIE architecture, 2) to Components, 3) to Components implementation via Pilots, 4) to Business Products.

SOFIE VALUE PROPOSITION

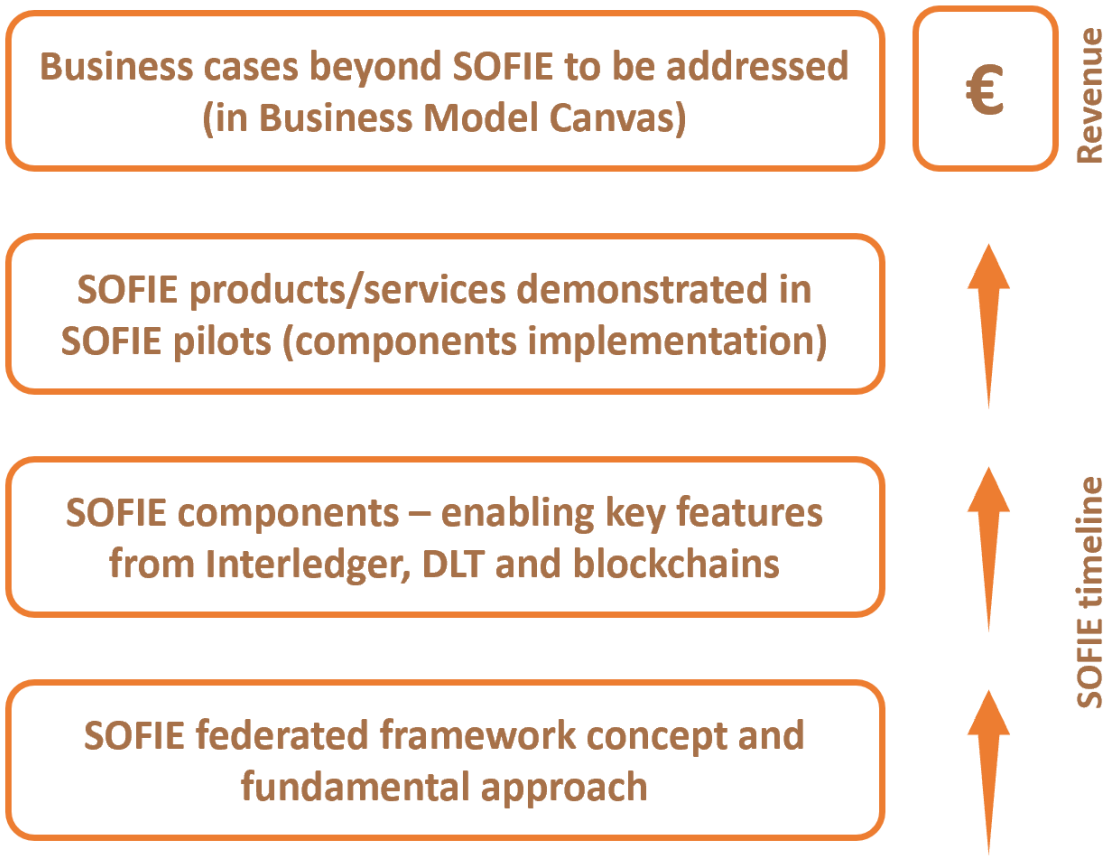

Figure 1. SOFIE value proposition

The bottom block “Framework and general approach” is closely related to the research conducted in the SOFIE. This has been the baseline to generate the SOFIE components considering a wider set of requirements, not just what each specific SOFIE pilot represents.

The second block “SOFIE components” are the materialisation of SOFIE solution. This means, that the components can be used separately from the pilots’ implementation. The business cases are not the key focus from the SOFIE components perspective. It is crucial that the functionality that components enable could be widely usable to many different challenges that are brought in from various business verticals. As a result, the means to combine different components from functional and non-functional requirements while keeping the general approach of SOFIE federated framework in the background, are enabled. The practical implementation has been demonstrated in the Secure Marketplace for Access to Ubiquitous Goods (SMAUG) example in SOFIE. Also, all the deliverables, GitHub repository and materials shared with community are focusing on wider user uptake to build business solutions using the SOFIE components.

“The SOFIE pilots”, as the third block, represent the examples how components can be used in specific business verticals. Energy, food supply chain and context aware gaming sector related prototypes demonstrate the added value to business and deliver minimal viable product that could be used to develop and offer a specific market ready product or service.

The top block “Business cases beyond SOFIE project”, represents a successful case, where a SOFIE partner and specific stakeholder reach a collaborative agreement that includes financing mechanism in order to continue the work beyond the SOFIE project. Actions for this level of

reaching the market started primarily during the final year (2020) of project SOFIE, when we also finalized our Business Model Canvases and conducted related market and financial analysis'. By the end of the project (2020) we confirmed that three SOFIE assets (DEDE owned by Guardtime, DEFM owned by Engineering and Synfield platform owned by Synelixis) have secured resources to move straight to further exploitation steps beyond the project. We also explore additional avenues to exploit other assets beyond the project. The latter is described in detail in D6.9.

2. SOFIE Business Plans

The aim of SOFIE is to launch the technological capabilities and investigate in which business verticals these could create new business opportunities. The basic setup for value creation and making profit has been set by the four SOFIE pilots. Our four pilots are the driving force behind other future business solutions. The overall goal is to reach at least 1-2 sustainable ecosystems using SOFIE assets after the project.

The steps that have been planned to reach this goal are:

a) Development of SOFIE assets (in multiple iterations together with pilot specific goals, SOFIE reference architecture and components development).
b) Creating and following the Business Model Canvas (for each pilot separately).
c) Defining the requirements from key stakeholders.
d) Implementing the SOFIE assets in pilot specific environments.
e) Demonstrating the minimal viable product to the stakeholders.
f) Creating follow up scenarios (requirements, cost analyse, financing mechanism) starting after SOFIE project.

From SOFIE perspective the sustainable ecosystem means, that we have at least one use-case to present where 3rd party investment is agreed in order to use the SOFIE assets to create new services/products for specific business verticals. Success in selling the service/product and revenue generation are additional metrics that should also be taken into account. The preliminary step for us is to continue commercial exploitation of SOFIE assets. The evidence for that is:

a) One or multiple stakeholders' confirmation about their interest to follow up with business plan.
b) There are some potential financing mechanisms targeted (POC paid by customer, National funding, RnD project etc.).
c) There is clear ownership of the product/service, approved budget for exploitation and Business Model Canvas - management tool that helps us approach customers.

The following SOFIE pilots' specific business plans and SMAUGs SOFIE reference concept contribute to the effort to reach the business goals of SOFIE project. The core elements of our business activities approach have been:

a) Close contact with customers/end-users/stakeholders.
b) Iterative approach to validate the ideas, business aspects and technological solutions.
c) Key focus on end-result and use of Fast fail approach.

The approach to iterative exploitation of the pilots' results is presented in the diagram here:

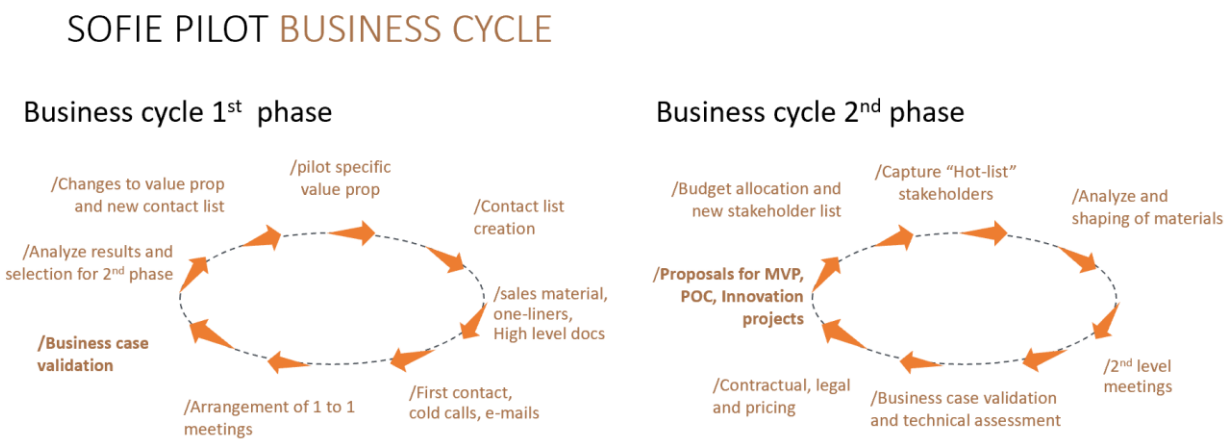

Figure 2. Pilots business cycles.

An entire business cycle is divided into two phases where 1st phase focuses in preliminary business case validation and 2nd phase heads towards making proposals for financing new initiatives. The business cycles of pilots, presented here, show the list of activities that are executed underneath the three SOFIE overall exploitation phases presented in the exploitation strategy roadmap (D6.9). This means that during each year's exploitation (2018, 2019 and 2020) there were multiple iterations of business cycles executed. Depending on the progress with stakeholders, the timeline of these cycles is different for each pilot.

In the 1st phase, additional outcome is a more consolidated list of stakeholders, that could be potential parties to finance next steps of activities. The metrics to move forward with the second phase is directly connected to how many committed stakeholders were found during the first phase. During the pilots' lifespans several 1st and 2nd phase iterations were made to get the minimal amount of "hot-list" stakeholders and potential follow up proposals.

List of activities that have been conducted during the 3-year period of SOFIE pilots are:

- Creation of value proposals - This has been conducted as an iterative process throughout the pilots. Based on the input gathered from the 1st phase and constantly updating the stakeholders list, the value proposition has been updated to match the problem/solution fit.
- Creation and upholding of contact lists of stakeholders and "Hot list" stakeholders – These activities included the creation and contacting the potential customers. The information was received from direct SOFIE dissemination, communication activities as well as the personal contacts, through partners, other busines verticals contacts and from stakeholders own internal promotions.
- Creation of sales materials – Under this section all the informational materials from one-liners, one-pagers to articles and technical documentation was created to help explain the messages and our solution to stakeholders.
- Carrying out meetings, interviews, workshops with stakeholders – Validation of the ideas, gathering input and moving forward with the business case was done all throughout the project. This was the key component used to evaluate the traction and benefit to the market.
- Analysing existing solutions – Technical analysis and details gathering in order to make the proposal for target groups.
- Proposals to end users – proposal creation to include the idea, basic business model, architecture & integration details, legal and pricing of the solution.

It should be noted that each pilot has small deviations from the general pilot exploitation cycle. Depending on the targeted stakeholder group, onboarded users and ambition/goal of the pilot some steps in the cycle could be skipped. For example, in the Energy flexibility marketplace

pilot the initial stakeholder, ASM Terni, is already part of SOFIE consortia. This means that one of "hot-list" stakeholder and actions taken with it are already in motion during the start of the project. From the mobile gaming pilot, the difference comes from Rovio not selling pilots results as a product, service or as a platform to end users. Instead, their approach was to confirm more of a technical feasibility and asses the business case internally. As a large corporation in gaming industry, the in-house validation was deemed sufficient to have pilot exploitation.

2.1 Decentralised Energy Data Exchange Pilot's (DEDE) Business Plans

2.1.1 Pilot's Business Model Canvas

With the SOFIE DEDE pilot we offer to the Distribution System Operator (DSO) and Transmission System Operator (TSO) the smart meter data access platform enabling the data gatekeeper service. We provide governance and control mechanism for energy metering data. When installed SOFIE adapters create the link between the user's energy database and the service provider, allowing one to see one's energy data, select service providers and grant/revoke access to your data. This enables a cheaper energy contract or better selling price for one's solar/wind power to the grid.

The key customers for this offer are the DSO/TSO that are operating the access control of energy consumption data. They will get:

- Means to manage datahub access to data with the data owners' consent and GDPR compliant evidence/audit trail.
- Secure authentication and control in between the data owner and the datahub owner.
- Visual representation of the data accessibility, evidence for future auditing and compliance.

The DEDE pilot is based heavily on two SOFIE components: Identity, Authentication and Authorisation (IAA) and Privacy and Data Sovereignty. The key functionality that the use of these components will deliver includes:

- Features from Hyperledger Indy-based decentralised identifiers provide a mechanism to link the data owners and service providers together (automated matchmaking functionality) and create a novel trusted way to authorize the access of data between the parties.
- Interaction of Hyperledger Indy based solution with the Guardtime's KSI Blockchain® for massive scale integrity verification and immutable audit trail generation.
- Easy to deploy SOFIE adapters concept for third party energy datahubs

The use of these components and possible success in DEDE business case will pave the way to use these two SOFIE components in similar use-cases that require the same features. This is even more straight forward if the existing system setup is similar to DEDE energy data hubs.

When mapping relevant stakeholders to DEDE business case, the interested parties were categorised into two levels, based on company type. The TSOs and DSOs are the Tier1 stakeholders, as they were the first to benefit from DEDE business case and control the relevant infrastructure where DEDE assets must be used. The Tier 2 stakeholders are companies that use the infrastructure and data that TSOs and DSOs provide for their business. They benefit directly from DEDE business case (easier data access and governance to the systems they oprate) when TSOs and DSOs use SOFIE DEDE solution.

During the 3rd year of the project the interaction with stakeholders revealed the urgency to have access control and free data available. It was strongly presented in the Tier 2 of stakeholders. The bottleneck was the fragmentation of these stakeholders and lack of possible resources to invest to data access solutions. This led to the decision to put more effort to finding ways how

the network operators (both TSO and DSO level) would invest into data sharing and security solutions.

The main change of the BMC for the DEDE pilot in the final phase of SOFIE has been focusing only on Tier 1 stakeholders, as they need to be onboard for further business models that are related to energy flexibility services. Based on the interviews with the DSO/TSO there were several challenges that prevented the straightforward business case to implement the DEDE adapters and focus on the market.

The energy market is in a stage where a lot of changes are taking place, some forced from regulations (Green energy deal) but also from rapid uptake of renewable energy sources. The challenge to share the responsibility in this changing environment was preventing the DEDE adapters business model to be evaluated. It had to be considered that countries (Finland, Germany, Netherlands, Estonia), where Guardtime focused, had already made investments to the datahubs and data access, prior to our value proposition.

For example, in Finland the business case is, that TSO has made the initial investment into Finnish Datahub and the market participants should pay for the receiving the metering data. The Datahub covers all main aspects from data processing, data protection, data security, support and maintenance, and the synchronization of electricity retail market processes. This leaves little room for any third-party solution (DEDE adapters) to play the role, as the company responsible for the Datahub development is interested to get the revenues and upgrade the Datahub further. For Tier 2 stakeholders, the requirement of free access to data is not granted, creating the first noticeable problem. The overhead and cost of data is preventing the services to be sustainable in the market. Second problem is the coverage and flexibility of data access. Not all the regional grids (and new smart grids) are connected to National data hub. The opt in cost for these smaller networks is high so alternatives are to build a stand-alone solution and business model. As a result, instead of getting data for free based on the region you have to pay for data, based on the tariffs of the datahub owner.

From the DEDE adapter business case perspective, there will be two different approaches (and value proposition) based if metering data is free for Tier 2 users or already only accessible through existing “marketplace”. Data access from one central Datahub means that the DEDE adapters business model is to provide that additional flexibility when adding new data sources and also reduction of cost for integrating Tier 2 parties to the datahub. The revenue generation will be form data access costs.

In the case, where data is free to access (Estonia, Germany, Netherlands), the DEDE adapters could be more embedded to the new business model, where data access and security is provided by 3rd party that is not owner of the datahub. The example of this type of model is in UK and in several states in US.

The discussion with TSO/DSO level has indicated, that there needs to be advanced services, toolkits to solve the privacy/security issue of accessing data in both fronts: The more national level data access and sharing (Finland, Estonia, Poland, Netherlands) and in the more distributed solutions (Germany, Austria, Switzerland). Based on these inputs, the Business Model Canvas has reached to current state in SOFIE and will be used to beyond project activities.

Energy data exchange Pilot's Business Model Canvas:

The Problem

For the Datahub operators, the risk to grant access to data owner and service providers is too high. These risks are handed over to service providers to comply and creates unexpectedly high cost to access the data. This applies especially in the case where there is National Datahub approach. The **cost reduction is key busines problem** for Central datahub in order to survive in free and open energy market. For decentralised and regional data access the key problem to be solved is **prevent the duplication** of solutions that connect different parties that are involved in energy data sharing.

The Energy Data Exchange Pilot

We offer to the DSO/TSO the smart meter data access platform that enables the data gatekeeper service. We provide governance and control mechanism four your energy data. The DEDE adapters will be an effective bridge between service providers system (Tier2 stakeholders) and data access platform operators fulfilling part of the requirements that come from GDPR, Green energy deal and open data access regulations side.

The pilot and the following exploitation activities are directed towards smart meter data operators (TSOs/DSOs). We will create a novel digital infrastructure available that will allow the targeted TSO-s/DSOs to grant access to data, track the process of who gives/receives data through their platform and creates immutable evidence for auditing and security purposes. The pilot is taking advantage of the recent cutting-edge breakthroughs in blockchain technologies, which enable to increase trust among companies and transparency in data management.

The Pilot Objective

The Energy Data Exchange Pilot will deliver:

- Means to manage DSO/TSO datahub access to data with the data owners' consent and GDPR compliant evidence/audit trail;
- SOFIE adapters placement in data input and on each participant side;
- Secure authentication and control in a mobile device for each data owner;
- Visual overview of access/revocation and "whitelist" between parties involved in data access
- GDPR compliant data access to pilot specific test sites.

The Exploitation Strategy

We plan to execute a two-tiered exploitation strategy:

- **Tier 1** - we approach the DSO/TSO's operating the access control of energy consumption data. We provide them with the digital infrastructure based on SOFIE adapters on an annual license fee. The solution adds value to the existing and running platforms, so DSO/TSO can make a shortcut into sharing data and skip the planning/development phase on their existing platform.
- **Tier 2** - we aim to get service providers to start using the SOFIE solution to be able to get data and sell flexibility services. **This tier will be postponed until we have successfully integrated with 4-6 DSO datahubs to make data available.**

Key markets to be targeted – The goal is to approach Austria, Switzerland, Netherlands, Poland and Finland as main markets.
Potential customer segment - smart meter datahub managers, the industry responsible for energy data consumption/production distribution, energy flexibility service providers.
Strategic exploitation stakeholders - energy sector regulators, GDPR related data protection agencies.

Benefits for targeted end-users	Enabling technologies
• Reduction of integration costs for governance mechanism for data access and controlling the risks involved to data sharing • Traceability of products and ensuring the integrity of critical data without the need for centralized authority; • Reducing the chances of fraud and data manipulation, cutting out corresponding mediation expenses and transaction costs; • Immutable blockchain-backed energy consumption readings which are correct beyond dispute.	• Guardtime's KSI Blockchain® API provides technology for massive scale integrity verification and immutable audit trail generation; • Hyperledger Indy-based decentralised identifiers provide a mechanism to link the data owners and service providers together (automated matchmaking functionality) and create a novel trusted way to authorize the access of data between the parties; • SOFIE adapters to collect energy consumption data.

2.1.2 Market Analysis

The DEDE pilot is mainly targeting the governance of Energy metering data together with solving the auditing and security aspects when sharing data between different parties in the energy sector. This means, that from the energy sector perspective the focus is related to providing infrastructure for any kind of energy trading, flexibility service provision and prosumer interaction with the markets. Generally approved approach in energy sector is that energy price consists of electricity price (35%) (cost to produce energy), utility price (35%) (cost to use infrastructure) and tax (30%) (tax instruments and subsidies)[1]. From the DEDE pilot's perspective, the value proposition is related to cost for the utility. Based on the recent EU reports[2] the trend of the cost for energy production is lowering and the cost for the utility and using the grid is raising, changing the current rate of 35% for both to have 20% of cost to energy production and 50% cost to utility. The reason for this change is focusing heavily on energy production from renewable energy sources (RES) (50% RES by 2050 in Europa). It reduces the cost of energy production but raises the complexity of future energy grids and cost for Utility.

This means that in 5-year perspective the utility cost would reach 50% for 1MW/h that is charged from end-user side.. New products, including DEDE adapters, that offer functionality to utility management and infrastructure, have a significantly larger market share, when this happens.

From regional perspective the first target area is Europe due to fact that the Clean energy package, GDPR and general fragmentation of energy market in Europe all create even more demand for the use DEDE adapters and its functionality in each EU country energy grids.

Thus, succeeding in EU market will open the possibility to target also Asia, U.S. and Pacific regions as the compliance with regulations, and energy grid upgrades are an emerging and important topic to be covered.

From the discussion with TSOs and DSOs the rising cost for security and privacy for energy networks is also important to bring out. The automation of energy grids and higher number of smart grid participants will require larger share from that 1 MW/h price to this section. This is also, where DEDE adapters create value and solve the challenges.

[1] https://ec.europa.eu/info/live-work-travel-eu/consumers/energy/energy-supply-policy-information_en
[2] https://ec.europa.eu/energy/data-analysis/market-analysis_en

As the key responsible parties that make the open and shared energy market possible are the TSOs and DSOs, these are also the key end user segment that DEDE energy pilot is targeting. Of course, there are multiple excising system integrators, Datahub and cloud infrastructure service providers in the game, that are providing competition to SOFIE solution. The opportunity for us comes from the cost efficiency side but also from the regulatory and legislation point of view. The open energy market, more automation, granting access control to data owner and raising the security level are contradicting. Solving one part of the puzzle with SOFIE DEDE adapters is a possibility that Guardtime can use to partner up with existing solution providers to mutual benefit and build an end-to-end solution for DSO/TSO level.

2.1.3 Financial Analysis

In the DEDE adapters use case, a potential pricing model would be to take offer a regional, country level or cross-country license fee for each of the MW/h that is sold using the smart grid and the security features provided by DEDE adapters.

The period for charging for the network access control and security will be bundled together with Smart meter infrastructure, datahub infra, customer portals, communication services for a period of 2-5 years. Depending on the size of the energy consumption/production market per country the concurrent revenue stream for DEDE adapter will be from 0,5 million euro/year to 20 million euro/year. The CAPEX for starting the service in the country will vary from 0,2 mil – 2 mil euro. This is an extremely low investment cost to overall grid CAPEX. To bring an example the Low to medium voltage grid price for km is 20keur/km – 80keur/k. For example, with the investment cost to DEDE adapters network operators could build/renew 4km to 400km of grid (that's under 1% to 0.01% of whole network).

2.1.4 Conclusions and highlights

SOFIE DEDE pilot is having strong traction with the Energy sector data exchange platform operators. The Data access control solutions currently in use are not delivering the required functionality and upgrading these is main goal of our adapters.

The addressable market is growing, and the regulatory aspects are getting in the stage that Country level grid operators have to comply with them in coming 2-3 years.

To sum up, here are DEDE list of highlights:

- SOFIE assets will be reused after the project in EU-SysFlex project.
- SOFIE assets are agreed (consortia level) to be used in AKKA (France) Datahub, SACCESS H2020 proposal.
- Negotiations to have a PoC with a) TSO and DSO and b) 2 service providers.
- Letter of intent from a) Elektrilevi OÜ (DSO), b) Spotty energy (Flexibility service provider).

2.2 Decentralised Energy Flexibility Marketplace (DEFM) Pilot's Business Plans

2.2.1 Pilot's Business Model Canvas

The SOFIE DEFM (Decentralized Energy Flexibility Marketplace) pilot offers a rapid and user-friendly mechanism to negotiate energy flexibility requests and offers using decentralized smart contracts. We offer to the DSO a platform from which create flexibility requests on the marketplace to balance the local energy network, according to the forecasts calculated using the data provided by the IoT smart meters, and to the Fleet Managers a reliable way to reduce the maintenance costs thanks to the incentives provided by the DSO and to the opportunity to select the most convenient energy retailer any time is needed.

The actors involved will benefit from the transparency, auditability and security of the marketplace granted by the usage of decentralized smart contracts.

The DEFM pilot is based on the SOFIE Marketplace component as its core component, together with the Semantic Representation (SR) and Interledger components.

The Marketplace component manages the operation of the flexibility marketplace, defining the format of the requests and offers, the rules for the matchmaking, the actors able to interact with each of the functionalities and the finalization of the payments. The Interledger component is used to strengthen the security of the two main events for each market request: *i)* the selection of the winning offer and *ii)* the payment for a finalized request. Every time such events are registered in the marketplace, they are also propagated on an additional public ledger used as a public trust anchor. Finally, the SR component is used to provide an *on-the-fly* validation for the data represented in a graphical way to the DSO operator.

To draw the previous version of the BMC, some considerations about the key markets, potential customers, and stakeholders were made considering a potential overlap with the DEDE pilot. In the current version, those considerations were slightly refined, making the overall BMC more adherent with the DEFM pilot specifications.

Decentralized Energy Flexibility Marketplace Pilot's Business Model Canvas

The Problem

Following the advent of distributed electricity generation, the electric grid underwent an impressive change in power flows. The grid was designed with an assumption that energy had a unidirectional power flow, but today we have many renewable generation sources (solar and wind), distributed in the network and, sometimes the energy produced is higher than the energy consumed by the end users present in the same local network. The reversed power flow causes stability and safety problems in the electricity grid, which the DSO (medium/low voltage grid owner) has to solve to guarantee the continuity of the energy service. To understand the complexity of this phenomenon, we must consider that it is generated mainly by intermittent and non-programmable generation plants, strongly influenced by atmospheric conditions, making it very difficult to predict its progression.

The Energy Flexibility Marketplace Pilot

Thanks to the network equipped with devices that allow remote monitoring and management in real time, is possible to obtain useful information to receive accurate forecasts and avoid the emerging of reverse power flow. Thanks to the SOFIE project, we want to use blockchain technology and smart contracts to enable a secure and transparent mechanism to time-shift the end users' consumption according to the needs of the network (Demand-Response) involving the DSO, which needs energy flexibility, the EV Fleet Managers, which provides

energy flexibility by directing the electric vehicles in the areas of interest to charge and, finally, the Energy Retailers, which manages electricity trading.

The Pilot Objective

The goal is to build a new decentralized, fair, transparent and secure marketplace, powered by the blockchain in which market operators can be sure that the best offers will be selected without any kind of bias, and, by interfacing directly with the smart meters on the grid, the payments can be settled in near real time without the need for longer verification times. In this way, electric mobility can act as a catalyst to improve the usage of renewable energy sources, acting not only as an "on-demand" energy storage but also as a novel "on-the-move" storage solution able to operate in a specific area and at a specific time contributing to the balancing of the entire network.

The Exploitation Strategy

Different paths will be followed for the exploitation strategy. As for the DSO point of view, flexibility can be used for obtaining technical data. As for the Fleet Manager point of view, SOFIE outcomes could be exploited to improve electric mobility services, achieving money savings and reduced environmental impact: the use of energy produced from renewable sources for electric mobility entails a double benefit, on the one hand harmful emissions are removed from the places where vehicles circulate, making the streets healthier, on the other hand, avoiding to produce such energy from fossil fuel power plants, dangerous emissions that contribute to sickening our planet are not released. We aim to get service providers to start using SOFIE platform to be able to get data and sell flexibility services. Also providing evidence to DSO/TSO as well as regulators and other supervisory boards in the energy network is delivered to the service providers. The business model with service providers is sharing a revenue stream based on the new customer base that they get by new data access through the digital infrastructure.

Key markets to be targeted - the key market segment is coincided with the storage and flexibility market instruments for grid operators.

Potential customer segment – Distribution System Operators, EV Fleet Managers, EV users, Energy Prosumers.

Strategic exploitation stakeholders – Local communities, stakeholders in the energy production/distribution/consumption pipeline.

Benefits for targeted end-users

- Use real time and historical data to forecast the occurrence of reverse power flow
- Create flexibility requests on the marketplace to balance the local energy supply
- Help to charge the batteries of its fleet of electric vehicles at advantageous price.
- The incentive provided by the DSO can cover part of the electrical supply
- Thanks to the marketplace, the most convenient energy retailer can be selected any time a charge is needed
- Provides a rapid user-friendly mechanism to negotiate micro-contracts
- Grants security, transparency and auditability of the operations.

Enabling technologies

- SOFIE decentralized blockchain-based marketplace
- SOFIE adapters to collect data from DSO's smart meters and fleet managers' EVs and EVSEs

• Enable the interoperability among different siloed IoT systems.	
Market Trends • There is an industry-wide agreement to make the energy consumption as well as production data available and more usable. This has been also agreed in the Clean energy package. There is an organic demand and expanding the market need for technical solutions which make this industry disruptive trend possible. • Increase of distributed generation from renewable sources (solar and wind)	**Pilot Outputs** • The solution designed and validated with key stakeholders; • The solution deployed in an operational environment (TRL-6); • The solution replicable and scalable in any microgrid.

2.2.2 Market Analysis

The European Quarterly Report on European Electricity Markets (2020 Q2)[3] reports:

- The share of renewables (hydro, biomass, wind and solar) increased from 37% to 43% year-on-year during Q2 2020.
- Average retail prices continued to decrease across all consumer groups in Q2 2020. Falling European wholesale prices witnessed over the last 18 months have started to passthrough to retail markets. Retail prices for households moved increasingly in the same direction, reaching their highest level of convergence on record in June.
- In spite of the restrictions related to tackling the pandemic, demand for electrically chargeable passenger vehicles (ECVs) stayed strong between April and June. **More than 129,000 new ECVs were registered in the EU27 in Q2 2020**, a 53% increase compared to the same period last year. Rising interest in cleaner mobility coincided with sharply reduced sales of diesel and petrol cars and drove the market share of ECVs to record 7.2% in Q2 2020 (up from 2.4% in Q2 2019). This compares to a 4.3% ECV share in China and to 1.4%observed in the United States during the same period.
- **The pandemic challenged grid operators who had to manage increased volumes of intermittent renewable energy in a low-demand environment with fewer thermal power plants online to call upon for grid stability tasks**. Overall, networks coped with the situation well and proved their ability to handle high levels of renewable penetration, which at times crossed 60% in Italy, 70% in Spain, and approached 80% in Germany. However, high occurrence of negative prices, which tripled compared to Q2 2019, has accentuated the need for more storage and flexibility in the European power system in both directions. It has also **intensified the search for market instruments that would put a proper value on storage and flexibility.**

2.2.3 Financial Analysis

In order to have an effective penetration of the energy flexibility marketplace, it should represent an attractive solution for the Distribution System Operator, that would actually pay for those resources. In a nutshell, using flexibility resources needs to be economically sustainable as well as it has to be compliant with the National regulatory framework. This subsection is focused on the first item (i.e., financial sustainability of DSO participation into the marketplace) that could be addressed by two complementary approach, notably:

- Implicit attractiveness, namely the marketplace is financially sustainable in the current regulatory framework.

[3] https://ec.europa.eu/energy/sites/ener/files/documents/quarterly_report_on_european_electricity_markets_q_2_2020.pdf

- Explicit attractiveness, the regulatory framework would explicitly involve DSO in a marketplace (e.g., it has to guarantee a certain power profile at the interconnection with the Transmission System Operator).

Given that, the second bullet is not applicable in the Italian context (i.e., where the demonstrator has taken place), this analysis concerns the implicit attractiveness for a DSO given the current regulatory framework. In this respect, participation into market would support DSO on postponing intervention on the infrastructure when a higher demand of electric charging station and distributed generators will occur.

ASM estimates that the usage of flexibility resources would be in interesting in a scenario where a moderate penetration of PV occurs; as well as 15% of vehicles will be electric by the next 20 years, a detailed description of this study, related assumption and simulation outcomes are included in paper and deliverables recently submitted[45].

In those conditions, cable replacement is not sustainable and therefore DSO would ask for energy flexibility from EV; it can be assumed that that 1 kWh of flexibility would cost 0.1€ to DSO, the whole amount of flexibility can be estimated equal to 5.4 GWh, that would mean a total operational expenditure of 540 k€ in 20 years,

2.2.4 Conclusions and highlights

The conclusion that we can draw from the analysis is that, in similar conditions, a DSO is able to pay on average 27000 € per year to run the marketplace in a profitable way.

The total yearly amount needs to cover both the platform setup and the incentives to be awarded to the EV users for their flexibility. The platform setup on a new environment includes the interface with the existing platforms, the configuration of the software modules, the deploy and validation of the platform operativity and the final release. Assuming no extra maintenance is needed during the setup phases, the whole process can be concluded in 3-to-4 weeks, for an estimated flat-rate cost of 50 k€.

Considering paying the 60% of the amount indicated above for the incentives, the maximum cost of 1 kWh of flexibility paid to the EV users will be 0.06 €, resulting in about 2.6 € for a full recharge (considering a full recharge with a capacity of 44 kWh). Considering that the average cost per kWh for charging an electric vehicle in Italy is 0.45 €, this means that the incentive is equal to a 15% discount on the electric vehicle charge.

After considering the costs for the incentives and the platform setup, the remaining 40% would represent the net savings for the DSO, if it used the Demand Response schema enabled by the Flexibility Marketplace developed during SOFIE project, accounting for about 8 k€/y or 160 k€ in the whole 20-years window.

SOFIE DEFM pilot validation has demonstrated the viability of the solution, and the search by network operators for market solutions putting value on storage and flexibility has intensified. The current trend in RES and EV penetration is forcing traditional operators to adapt their infrastructure: flexibility can reduce capital expenditures of DSO by shaving peaks of PV and EVSE, increasing hosting capacity without higher costs on infrastructure.

The highlights of DEFM are listed below:

- Requirements defined from the initial phases of the project considering the needs of DSO (ASM) and service providers (EMOT)
- Technology transfer to ENG telco & utilities business unit started. Main customers, as an example, include Eni, Enel, E-On, Terna, Iren, and Hera.

[4] T. Bragatto, M. Paulucci, G. Thanos, M. Minou, C. Kalogiros "DSOs Using Demand-Side Management Techniques for Reducing Congestion Issues: The Case of ASM Terni" HAEE 2019, Athens, 2019
[5] SOFIE Consortium, "D5.3 End – to – end Platform Validation", 2020

- SOFIE assets will be reused after the project in H2020 BRIGHT project
- Scouting activities, resulting in the engagement of 2 DSO with targeted communication activities

2.3 Food Supply Chain Pilot's Business Plans

2.3.1 Pilot's Business Model Canvas

During the final year of the project, the interaction of the technical partners with the end users, and the feedback from them following the on-site deployment, confirmed that the following two types of services are of significant importance for targeted end-users and stakeholders; end-to-end product traceability and audit to verify integrity of the enforced business rules. Furthermore, the end-users have confirmed the two main scenarios of the pilot (as described in D5.2 and further validated in D5.3) and the technical design and implementation of the pilot software platform has been completed. With the SOFIE Food Chain pilot, we offer a decentralized, flexible, and secure business platform to transparently collect data from different administrative domains across the supply chain, to enable secure information sharing among them, to establish trust among them, and to open up opportunities for further analysis of their businesses and interactions. In the third year of the SOFIE project, emphasis will be given in demonstration activities and exploitation opportunities for which the business model canvas will be the main driver.

Food Chain pilot relies mainly on three SOFIE components: the Interledger component, the Semantic Representation component, and the Federation Adapter component. Their functionality within the pilot:

- The Interledger component provides the interoperability required between the different Blockchains utilized to enhance security and trust.
- The Semantic Representation component is utilized to achieve interoperability between the different IoT platforms of the participants.
- The Federation Adapters allow to federate heterogenous IoT platforms from various companies.

As mentioned above, no significant changes are to be reported in the BMC. In addition to what has been described in the previous version, extra emphasis will be given to the fact that the business platform being offered allows for rapid replacement of participants in a supply chain with a lower risk due to trust concerns.

Food Supply Chain pilot's Business Model Canvas

The Problem
Producers, distributors, logistics and retailers want to get their products to the market quickly, safely, and in the best possible condition. They also share a common trust issue among each other in the sense that there might be multiple participants in a supply chain and not every participant is aware of all other participants. Consumers want to buy high-quality products and know how these were produced, where they came from and what is their ingredients. They also have increased expectations about the environmental sustainability or health-related issues in the production cycle, not rarely preferring brands which promote the same social and environmental values as their own.
The Food Supply Chain Pilot
The food supply chain (FSC) pilot considers the field-to-fork grapes supply chain system covering the farming, storage, distribution (logistics), and retail subdomains, and serves as a proof-of-concept for the validation and demonstration of the capabilities of the SOFIE platform

to combine and interconnect, in a secure way, different IoT platforms that are involved in the food supply chain sector.

The pilot demonstrates a provenance chain Business Platform (BP) to ensure wide visibility of supply chain information, traceability of assets, and secure data exchange among heterogeneous, federated IoT environments, without forcing additional changes to their infrastructures, equipment and security policies. The pilot leverages a hierarchical topology of DLTs to improve transparency and traceability of assets and build a robust and secure data management framework that verifies integrity of exchanged data and ensures identity and authenticity control of involved entities.

The Pilot Objective

The objective is to demonstrate a provenance chain BP that secures information sharing and value exchange between organizations which participate in the food supply chain without the need of a third-party intermediary to establish trust, coordinate interaction and supervise products flow over the chain. The BP will provide end-to-end product traceability services to all involved companies as well as food consumers.

The Exploitation Strategy

FSC traceability services could be released as a mixed Platform as a Service (PaaS) and Software as a Service (SaaS) model. This model will maximize the scalability and flexibility of the platform allowing customers to access more or fewer services or features on-demand. Different releases of the platform and provided services could be possible:

- Open platform access with limited functionality and service provision on top of a basic schema to adapt existing IoT services and systems.
- Full platform access and customizable services with provision of federation adapters for existing IoT systems.

The commercial usage of the pilot platform and its services could combine a double revenue model: On the one hand, the companies which participate in the supply chain could pay a periodical fee (subscription model) to get federation adapters for their IoT platforms and share data through the SOFIE FSC platform. This is applicable to all identified chain segments (e.g. producers, logistics, etc.), under the appropriate adaptations tailored to the specific interests and activities per domain. On the other hand, retailers and/or customers which want secure traceability information and food safety assurance could directly pay a small amount per SOFIE-traceable product purchase.

Potential customer segments - suppliers in agri-food domain, logistics and transportation companies.

Strategic exploitation stakeholders - retailers, supermarkets, consumers associations.

Potential customers: Vivartia group, 7Grapes coop, Sklavenitis group

Benefits for targeted end-users and stakeholders

For suppliers:

- secure information sharing without the need of a centralized authority to supervise and control data exchange,

Enabling technologies

- DLT-based identity authentication and role-based control management.

- easy to use and non-disruptive solution to federate local IoT business environments,
- verify goods ownership and authenticity, as well as on-time and in-full transactions and deliveries,
- cut out mediation expenses, reduce transaction costs and improve quality management of products distribution
- enhance trust between participants of the supply chain and allow rapid replacement of participants

For retailers:

- increase visibility in goods transfer from the field to the market shelf,
- improve efficiency in audits and disputes resolution when quality conditions are not met,
- enable immediate identification and recall of potential contaminated goods in cases where product quality and/or safety events are detected

For food consumers:

- increase consumers' visibility about goods production, transportation and processing practices over the whole food supply chain.

Market Trends

- Immutable, real-time keeping of transactions among supply chain companies improves product and inventory mgmt., minimizes errors in their communication and increases trust among them.
- Companies want to protect their brands and product labels against negative publicity, potential frauds and counterfeits as well as to highlight their sustainable supply chain and market practices.
- Customers and customer associations push for extended visibility and traceability of products' history to ensure high standards for their quality and safety.

- SOFIE adapters to enable a common interface specification upon federation of heterogeneous IoT systems.
- SOFIE interledger protocol to bridge different DLTs.

Pilot outputs

- A validated platform with key stakeholders that offers two main services: i) secure product traceability for final customers, and ii) audit process allowing supply chain companies to detect product quality issues.
- The solution deployed in an operational environment (TRL-6).

2.3.2 Market Analysis

According to the European Commission portal[6]:

- There are about 11 million farms in the European Union (EU) and 44 million people are employed in the entire EU food supply chain. Farmers are important strategic and economic players in the food supply chain.
- The common agricultural policy (CAP) has over time become more market-oriented and less reliant on the management of markets. In addition, European agriculture and the agri-food sector are increasingly integrated in global markets.
- This has created important business opportunities, but also exposed farmers to greater market uncertainties and increased price volatility. Farmers often work independently of each other, and there is little in the way of collective bargaining power to help farmers defend their interests against other parts of the food chain, such as food processors and retailers.

Blockchains in agriculture market and food supply chain in specific, is projected to reach USD 363.38 million by 2023, at a Compound Annual Growth Rate (CAGR) of 47.8%. Blockchain technology is revolutionizing the food and agriculture sectors by enhancing the decision-making capabilities of organizations. It finds several potential applications in these sectors, some of which have already been explored. The major applications of blockchain technology in food and agriculture include traceability and tracking, payment and settlement, smart contract, and governance, risk, and compliance management. The growth of the blockchain in agriculture and food supply chain market is attributed to the increase in demand for supply chain transparency, the rise in cases of food fraud, and growth in concerns toward food wastage.

The market is dominated by key players such as IBM (US), Microsoft (US), SAP-SE (Germany), Ambrosus (Switzerland), Arc-net (Ireland), OriginTrail (Slovenia), Ripe.io (US), VeChain (China), Provenance (UK), ChainVine (UK), AgriDigital (Australia), and BlockGrain (Australia).

2.3.3 Financial Analysis

The pricing model could be twofold, thus following:

- a subscription fee basis: Companies participating in the supply chain could pay a subscription fee for using the platform (which includes Federation Adapters for their IoT platforms and access to the platform) on an annual basis.
- a fee-per-purchase basis: the introduction of a Fee per SOFIE-traceable product purchase by end users (retailers and/or customers) could be another significant revenue stream.

2.3.4 Conclusions and highlights

During the project, several activities have been undertaken aiming to the future exploitation of the SOFIE-powered platform of the Food Supply Chain pilot. From the beginning of the project, we initiated a stakeholder identification and analysis process. This process was a live process throughout the project duration as more feedback (and experience) was collected. The idea of identifying key stakeholders was also adopted. Key stakeholders could be the drivers for the further development of the pilot platform and were one of the outcomes of the stakeholders' analysis process. Collecting feedback from the stakeholders is a very important task, hence, we performed several meetings with stakeholders. There have been more than three on-premise visits to our key stakeholder (7Grapes-Pegasus) and several other meetings (both physical and virtual) with various stakeholders (including people from several sectors, e.g., Logistics,

[6] https://ec.europa.eu/food/farm2fork_en

Supermarkets, Producers). During the last year of the project, the pandemic made on-site meetings difficult, however we switched to remote meetings. In this context we also had discussions with three stakeholders during the third SOFIE workshop (reported in Deliverable D6.11). Throughout the stakeholder and potential customers/adopters we have been presenting a consolidated value proposition that was in line with the approach strategy that has been defined early in the project. This strategy was adapting to the feedback received along the way. A particularly important asset towards the aim of highlighting the platform's benefits was the demonstration of the platform, especially in the case of on-site deployments. That was quite evident during the on-site deployment of the pilot platform at 7Grapes-Pegasus premises during the last months of the project, where the stakeholders were able to see the platform functioning in a real operation environment. In view of the future of the platform, the effort is put on pursuing collaboration with key players in the Food Supply Chain, aiming to gain confidence and reputation from the rest of the market via their participation.

In conclusion, the Food Supply Chain pilot resulted in a potential product which can be further explored for potential commercial exploitation. Given the EU Farm-To-Fork strategy, participants in this pilot are motivated to further pursue this potential. The on-site deployment on the premises of one of the potential customers for this platform highlights the ambition of the participants to continue with such activities in the future, demonstrating the functionality and benefits of the SOFIE-powered platform in various players along the Food Supply Chain.

2.4 Context-Aware Mobile Gaming Pilot's Business Plans

2.4.1 Pilot's Business Model Canvas

The gaming pilot produces three main prototypes that may be used as a foundation for future research work:

- Scavenger Hunt – a prototype of a BLE location-based game utilizing a hybrid server-DLT architecture.
- Blockmoji – a prototype of a management application of virtual items stored on the blockchain
- Decent ID – a prototype of a decentralized identity management framework

Within the SOFIE project, the gaming pilot is a set of explorative prototypes that aims to research and understand the potential use cases of DLT and IoT in the context of mobile gaming. The prototypes utilize the following SOFIE components:

- **Marketplace**: Trading virtual Blockmoji items.
- **Interledger**: Transferring assets between permissioned Hyperledger Fabric (performance) and Ethereum (trading).
- **Provision and Discovery:** We developed this component, which discovers suitable IoT devices for Scavenger Hunt.
- **Semantic Representation:** A standardized way of describing the capabilities and functionalities of IoT devices.

Based on reasons outlined in section 2.4.4, Rovio does not plan to pursue the pilot beyond the SOFIE project. However, in order to better understand how the pilot's prototypes would function in a realistic environment, a business model canvas can serve as a useful exercise. Compared to the previous version of the canvas in D6.8, the following changes have been made for the current version:

- discussed customers in the "Pilot Outputs" part of the BMC,
- benefits of BLE positioning accuracy indoors compared with GPS specifically,

- stating the potential benefit and demand of the sense of true ownership brought with DL.

Context Aware Mobile Gaming Pilot's Business Model Canvas

The Problem

If positioning players is done through ubiquitous IoT devices, new location-based mobile games require access to infrastructure in order to be attractive and to offer new ubiquitous gaming experiences. There is a high cost associated with investing into new sensors, thus making it more reasonable to use existing devices and sensors while developing new location-based games. In this process, involving the stakeholders of IoT devices is challenging. There is a hurdle of how to motivate them to be a part of the game and get the fair share of the money coming in from the game and to cover the costs of integration and implementation.

From a technical perspective we are addressing the following two problems:

- Could the existing base of fixed-location IoT devices also be used for location-based mobile gaming?
- Could DLT bring benefits to players or other stakeholders in mobile gaming?

The Context-aware Mobile Gaming Pilot

We identify and test use cases of DLT and IoT in mobile gaming in an iterative fashion. We are not working on a commercial product but experimenting with new technologies.

The Pilot Objective

Through iterative prototypes, tests and calculations, we evaluate the technical fit, performance, gameplay experience, and business potential of the use cases that we identify. The objective of the pilot is to experiment and understand whether DLT and IoT can provide new kinds of compelling player experiences.

The Exploitation Strategy

We have a working architecture (hybrid game server & DLT combination), and we receive feedback and insight from dissemination activities. We are keen on discovering whether these technologies do not stand in the way of sustaining a game with more than one million daily active users and the means of generating reasonable revenue, while bringing compelling benefits to consumers and/or other stakeholders.

Benefits for targeted end-users and stakeholders

- By using ephemeral identifiers, beacons can be harder to spoof than GPS. Player locations can be verified, reducing the number of cheaters in competitive games.
- Indoor positions, especially altitude information, can be more accurate when compared to GPS.
- Hypothesis: DLTs can bring transparency, automation and virtual item cross-game interoperability to companies participating in an ecosystem for location-based (and other) games.
- Hypothesis: DLTs can bring a sense of true ownership of virtual items to players.

Market Trends

- The global number of IoT devices is increasing - can location-based games utilize them?
- A potential demand for "true ownership" of virtual items

Enabling technologies

- In the prototype we're using Hyperledger Fabric for a permissioned blockchain, but we are not locking into it.
- Bluetooth low-energy beacons.

Pilot outputs

- Results from testing the technical fit and performance of DLT and IoT technologies in mobile gaming (academic paper). Learning which benefits of DLT outweigh the technology's shortcomings and identifying whether such benefits cannot be achieved on a traditional game server and a database.

- An open-sourced scavenger hunt game prototype: an example of a real location-based game that uses beacons for positioning and a server-DLT hybrid architecture, bundled with the Blockmoji virtual item management application

- In the imagined business environment described in this canvas the end users (the players) as well as points of interest (who would use a location-based game as a business platform) can be seen as customers. In practice, the global DLT & IoT research and development communities can be seen as customers of this pilot, who would be able to use the open-sourced prototypes as a base for their projects for free.

2.4.2 Market Analysis

The gaming pilot is not attempting to enter any market commercially but tries to explore the potential use cases of DLT and IoT in gaming. Hence, it is worthwhile to stay educated on the landscape of our prototypes, had they been real products.

According to SensorTower, the size of the location-based gaming market in 2019 was over 1.2 billion dollars in revenue. This market is driven by a handful of games, of which the top-grossing one (Pokémon GO) accounts for the overwhelming majority of total revenue and players. In 2017, the game's daily active player count peaked at 28.5 million.

Location-based games can see virality and success, but so far this genre has been dominated only by a handful of games. A small number of viable games in a genre means that the success cannot be attributed to the genre itself with certainty. Certainty of replicability is low, when there isn't necessarily a "location-based games" audience, but, rather, each individual game has its

own audience. Thus, the apparent lucrativeness of the market as a whole is skewed. It can only be said that millions of daily active users can enjoy a location-based game, if they find the game's experience compelling enough.

There is room for innovation when it comes to indoor location-based experiences, where GPS fails to achieve a satisfactory level of accuracy. IoT devices can be used to aid in positioning, whose number globally is increasing exponentially by the year. However, there is a high cost and inconvenience of installing the infrastructure, posing as a barrier for entry. Hence, the most attractive positioning methods are as passive as possible. Non-IoT indoor positioning methods also exist, such as computer vision. As for DLT, one use case is providing users with a sense of true ownership of virtual items. However, as our performance tests have shown, even a permissioned DLT caps the supported number of players way below what is achievable with a traditional game server and a database.

2.4.3 Financial Analysis

In the Blockmoji use case, a potential pricing model would be to take a cut from every trading transaction of a Blockmoji item. In a game such as the Scavenger Hunt use case, the revenue would be generated through in-app-purchases of items that help players on their hunts, Blockmoji items, advertisements, and possibly a cut from the revenue of third-party businesses who use the game as a business platform to attract player into their physical stores. In addition, the BLE beacon device owners could get a share of the revenue the game is generating through smart contracts on the permissioned blockchain.

2.4.4 Conclusions and highlights

The objective of the pilot is to experiment with and understand DLT and IoT use cases in the context of gaming. Through iterative prototypes, tests and calculations, we evaluate the technical fit, performance, gameplay experience, and business potential of the use cases that we identify. The pilot yields three main prototypes – Scavenger Hunt, Blockmoji and Decent ID, out of which we open source two to the wider research and development community so that our work may be used as a basis for future research.

The pilot's output that highlights our evaluation of DLT and IoT use cases is a paper that we published on IEEE Xplore during Fall 2020: "Scavenger Hunt: Utilization of Blockchain and IoT for a Location-Based Game". Based on the technical evaluation done during for research, our hybrid server-DLT architecture could support no more than 76,800 concurrent users for a game like Scavenger Hunt, which is a major blocker for scalability. In addition, BLE beacon's detection latency was rather long and irregular, which can negatively impact the gaming experience. Another business activity was conducting internal expert interviews on the views on the SOFIE framework. Based on all this input, Rovio does not currently plan to pursue the pilot beyond the SOFIE project. However, Rovio has open sourced Scavenger Hunt Game and Blockmoji prototypes to the wider developer community. The prototypes may serve as foundations for new use cases of DLT and IoT in gaming that future developers and designers may devise.

3. SOFIE's Cross-Sectoral Value

The SOFIE project is built on demonstrations of SOFIE components in energy, food supply chain and mobile gaming sector. The wide coverage of different sectors is set to accomplish two important goals that would contribute to the cross-sectoral value.

Firstly, it is the use of SOFIE components in totally different business cases and to prove that the general SOFIE high level reference architecture, supported by 6 components can be "put to work" in very different situations. To take this even one step further, the SOFIE project has made additional demonstration by presenting the SMAUG, the practical realization of the developed architecture.

Secondly the cross-sectoral value is created via interoperability of SOFIE components that are in use in different sectors. The business cases for opening data between business sectors in SOFIE needs more research but the technical capabilities demonstration is provided in both, the description of SOFIE components as well as cross pilot interaction. Addition to the components interaction, from the developers' point of view, building your energy data governance or IoT beacon access control solution is showcasing, that it is possible to cross these different sectors boundaries.

3.1 Secure Marketplace for Access to Ubiquitous Goods (SMAUG)

Secure Marketplace for Access to Ubiquitous Goods (SMAUG), developed by Ericsson, is a practical realization of the SOFIE architecture and framework. As the name suggests, SMAUG provides a secure and decentralized marketplace for to rent access to smart lockers for short periods.

SMAUG is not to be seen as a SOFIE pilot with direct business plans. Instead, the purpose of SMAUG is to strengthen the reference implementation in the project by demonstrating a use case that natively integrates all six SOFIE framework components. The indirect business value of SMAUG comes from applying the reference implementation for business goal-driven use case development. Ericsson is developing a proof of concept for 5G Spectrum Exchange that builds further on SMAUG.

In the SMAUG business case perspective, lockers are controlled, shared and monetized with the same SOFIE components as for the SOFIE pilots. That builds confidence that if the business problem matches with the one SOFIE has, the existing legacy systems characteristics are comparable, meeting the minimal setup, then the use of SOFIE is not limited to 3 sectors presented. Instead, the exploitation and value generation can be much wider. The SMAUG is a quick demonstration to prove it. Eventually the functionality list through SOFIE components can play a key role in other sectors, where data is "locked in" and market demands require change from participants point of view.

The Cross sectorial value aspects can be divided in two:

- the benefits for workload reduction in the system development and implementation phase.
- the actual revenue creation by enabling the cross sectoral business cases.

The resource reduction by avoiding duplication, seamless integration and same framework is proved already during SOFIE project. The problem is that the value, that is generated, is not that high. The trade of using new, innovative technology instead of existing legacy solution will raise the overall development time. So, there is possibility that these two even each other out.

The revenue generation will have a much larger impact when materialised. The challenge here lies in the business concept itself. As the cross sectoral data sharing, accessing is to current time quite a new area, the effort to create these new business verticals is challenging.

Overall, the SOFIE project has shown that technically it is feasible and required to use SOFIE as a bridge between systems where entities are interested to collaborate.

4. Conclusion

Throughout the SOFIE project the business activities have been ongoing in pilots covering energy, food supply chain and mobile gaming sector. We have been successful in making contact with sufficient number of stakeholders and gathered the input for business activities beyond the SOFIE project.

Four Business Model Canvas' are ready to be used in order to continue financing the business efforts in next 6 months beyond the project. We have proved that the assets we have created in the project can be demonstrated in the end-user's environment. Nevertheless, we recognize that investments into more specific business processes are needed to generate even greater value based on our prototypes' functionality.

The result of business activities in SOFIE is that three pilots out of four will continue their exploitation of results beyond the project. The current Business Model Canvas' for each of pilot will be used to reach primary goal of getting at least one stakeholder to invest into a commercial project. The two SOFIE pilots in energy sector and one in the Food Supply Chain sector have delivered and demonstrated the three assets to stakeholders:

- Decentralised Data Exchange adapter
- DEFM Federation adapter
- SynField platform for traceability and audit services

These three assets will be the main focus point to propose the PoCs to the stakeholders and potentially sign a commercial contract.