Economic assessment of smart PSS multi-actor delivery networks: case study in the heating appliance sector

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Abstract. The comparative assessment of alternative Product-Service-Systems (PSS) economic models is an important objective to be integrated along the design process of smart PSS. Economic assessment of smart PSS delivery networks can support economic risk mitigation and help decision-makers in establishing collaborative mechanisms for financial risk sharing, within the enterprise networks. The paper proposes a generic and replicable approach for the development of smart PSS simulator for Economic assessment & risk analysis. A feasibility application is developed in an industrial case study (heating appliance sector).

Keywords: smart PSS, Economic assessment, Service delivery networks, Economic simulation

1 General Introduction

The current strategical trend on digital servitization (Pirola et al., 2020), has launched a set of various research work in the field of smart PSS design (Zheng et al., 2019; Liu et al., 2018). One of the specificity for the integration of smartness and PSS within an integrated design frame, is the increased diversity of economic models (interacting with other value creation parameters) which have to be a priori configured, estimated, then selected by industrial decision-makers at design time. Design time covers the period going from the start of the PSS innovation project, till the operational launch of the solution on the market. The design process of smart PSS should fully integrates the configuration and selection of the PSS delivery network's economic model, through a decision-making process starting in early design phases. Decision aid should notably take into consideration the multi-actor dimension of smart PSS delivery networks: both smartness and service orientations bring a high level of economic and financial risks, for the collaborative value actors (for instance the so called 'servitization paradox' (Kohtamäki et al., 2020), emphasizing the importance to assess and analyze risks by anticipation.

This paper intends to address the economical assessment challenge of smart PSS, to answer to weaknesses of the scientific literature in this area, notably (i) the reliability of economic assessment in each specific industrial case study of smart PSS design; (ii) the multi-actor perspective, required to support a regulation of economic value sharing. The paper presents a case-study oriented research. Its added-value is to propose a generic and replicable procedure to manage the development of economic simulators dedicated to industrial context of smart PSS design, supporting a multi-actor comparative analysis of alternative economic models for the deployment of smart PSS. After a state of the art (Section 2), the paper presents the structured and generic approach for smart PSS economic simulator development (section 3), then applies the approach in an industrial case study in the field of heating appliances (section 4). Section 5 brings conclusions & perspectives.

2 Literature review: smart PSS economic assessment

The configuration of smart PSS networks during the design and engineering process is submitted to a high level of economic uncertainty and risks (Dahmani et al., 2020, Boucher et al, 2019). In fact, the association of smartness and service orientations opens a large potential of diversity in the way to configure the economic model of a smart PSS offer. First, the basic and usual typology of product-service-systems (Product-, Use- or Performance- oriented PSS) available for any new design, induces alternative configurations of the delivery networks, the stakeholders concerned, their economic models and the way to share economical risks. But, second, both digital and service opportunities also increase the flexibility and variability of the value offer to be delivered on the market: depending on the precise configuration of the value offer, the cost and revenue factors of all actors are not the same, nor the risk-sharing balances.

In this perspective, several approaches have been developed in the recent years by the scientific literature (see key examples in table 1), to cope with economic assessment (Medini et al. 2021; Anke 2019; Alix and Zacharewicz, 2012). Economical risk management has been addressed for PSS networks (Boucher et al., 2019) and more recently for smart PSS (Murillo-Coba, 2022 ; Murillo-Coba et al. 2020). Among these approaches, simulation is the most common calculation method implemented, notably because it makes possible to model the dynamic behaviour of economic actors and markets and to include stochastic variables to represent uncertainty affecting several economical parameters. Simulation supports 'what-if' scenario analysis to evaluate the performance of future or existing systems, with or without disturbances (Pritsker et al., 1999). First applied to the industrial performance of Product-Service Systems (Chalal et al., 2015; Garetti et al., 2012) it has also been used to assess PSS economic behaviours and estimate risks at its design stage (Kambanou & Sakao, 2020; Goh et al., 2015). In spite of interesting advances (see table 1), the economic evaluation of smart PSS delivery networks still poses several challenges:

1. Despite a strong multi-actor dimension of smart PSS networks, most economic assessments presented in the literature report their evaluations from a single actor or a dyadic perspective. Smart PSS's successful implementation relies on the profitability obtained for each actor of the network, expecting win-win opportunities, and considering the cost and revenue factors along all the value chain, while managing risk sharing for the whole network. This generates the necessity to assess,

quite early, at design time, the best economic model options to ensure a good share of profit. Such economical evaluation should be based on a multi-actor view, including the customer and critical business partners and should make possible to ensure the viability of the offering under development.

2. Secondly, uncertainty issues have been only partially considered in PSS economic assessment (Boucher et al., 2019) and not specifically considered for smart PSS. Uncertainty has been mainly addressed concerning cost factors, but hardly mentioned in the literature concerning revenue flows. Revenue uncertainty strongly depends on customer behaviors which are difficult to anticipate in the context of smart PSS, affected by many factors of personalization which can affects the behaviors. Such uncertainty sources directly affect the desirability which contributes to create viability risks for the deployment of smart PSS offers, thus requiring further research works to help industrialists anticipating financial risks, at design time.

3. Third, there is a remaining challenge in PSS economic model evaluations, to cope with a sufficiently detailed analysis of the cost and revenue factors. Most of the economic assessment proposed are situated at a rather aggregated level (e.g. table1). To be able providing a quite reliable cost/revenue estimation for the various actors of the whole value network, it appears crucial to build economic models which would be based on (i) a detailed identification of all activities (product- digital- or service-oriented activities) triggered along the life cycle of smart PSS; (ii) a characterization of these activities by their local economic factors (cost/revenue parameters); (iii) a consistent allocation of cost/revenue models to each of the actors of the value chain. The contribution of (Medini et al., 2021) with PS3A assessment tool was built in this perspective in the field of traditional PSS. Further research remains necessary to extend such work and, notably, to consider the context of smart PSS.

Complementary to these 3 challenges, the literature does not report generic method to develop such PSS-oriented economic simulators. Developing a generic approach appears as an important issue, in order to make easily replicable the configuration of simulators diectly aligned on specific industrial cases. The following sections propose a path forward in this direction.

Table 1. Key examples of economic assessment approaches.

Economic assessment tool in design field	Actors' perspec-tive	Economic models	Life-cycle stages included	Inputs	Uncertainty analysis application
PSS field Alix and Zacharewicz (2012).	- Clients - Producers - Sellers	Product-, and use-oriented	- Manufacturing - Sale/rent - Warranty -Test/clean/repair - Dispose/recycle	- Demand forecast - Playtime, pause time - End-of-interest - Broken toy incidents	Not mentioned
Smart service: Anke (2019).	- Service provider	Not reported	Not reported	- Service variable costs	Not mentioned
PSS field Medini et al. (2021).	- Solution provider - Battery provider - Customer	Product-, result-, and use-oriented	- Customer design - Manufacturing - Installation - Equipment cleaning - Maintenance	- Unit cost of activities - Service frequency - Margin rate of product and services - Yearly demand - Contract length	No

3 Structured approach for the development of a smart PSS simulator for Economic assessment and risk analysis

The objective of the paper is to present a structured approach supporting the development of economic simulators, dedicated to smart PSS assessment in a design context. The approach detailed below answers the following characteristics:

1. The approach intends to be replicable, to structure and guide the developement of a family of smart PSS simulators. Each simulator is developed to be dedicated on a specific smart PSS case study, with a particular economic model. We consider that, due to the complexity of economic parameters and their specificity for each case-study, it is highly difficult to ambition a fully generic simulator, adaptable to all smart PSS contexts. Consequently, the approach proposes a way to manage the context-oriented personalisation of the simulator.
2. Consistently with the conclusions of the state of the art, the simulation approach is multiactor-oriented, making possible to assess the economic models of all main actors of a smart PSS value network.
3. The approach includes the capacity to model uncertainties, with the ambition to be used as part of a risk assessment and mitigation method, to the various actors concerned.

In a context of smart PSS design, there is a rather high complexity in estimating by anticipation the economic models, notably due to the strong diversity of options and associated delivery networks to be analyzed and compared. This re-inforces the importance of a structured and generic approach. The next subsections explain the structured approach proposed as a generic procedure to develop a specific economic simulator dedicated to smart PSS. This approach is synthetized in figure 1. The seven steps of the procedure cover the understanding of the smart PSS value network to be simulated, the capture of all cost and revenue data necessary to simulate the economic behaviours for each actor concerned, the developement of the simulation tool and its validation. The usage of the simulator itself (after development), in order to analyze the economic balances of the smart PSS network under analysis will be illustrated in section 4. The seven steps of the procedure, expected to be replicable for any kind of smart PSS, are described below (further information in Murillo-Coba, 2022)).

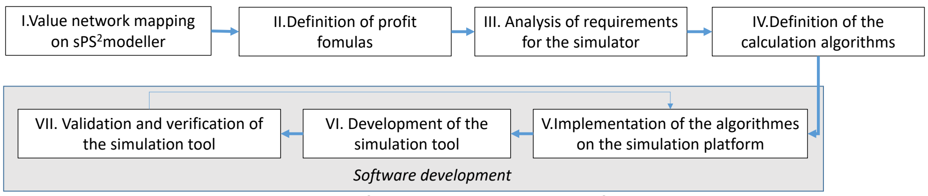

Figure 1. Generic procedure for the development of a smart PSS simulator.

3.1 Step I - Modeling the smart PSS value network

The procedure starts with a step of capture of the basic pieces of information on monetary exchanges among actors. All the actors of the value network are identified, together with the flow of value among each of them, constituting a so-called 'value-network' model. These elements are modelled graphically in a modelling tool supporting the capture and display of this pieces of knowledge. Several points can be underlined:

1. When designing a smart PSS solution, several alternative delivery networks, each associated with specific value exchanges and thus economic model are generally analyzed and compared. This means that this modeling step and subsequent developments are executed iteratively for each alternative.
2. In a smart PSS value network, the exchanges of value are not limited to monetary exchanges. The value network model can capture any kind of value exchanges. By restriction, in the following sections, we focus only on the monetary flows, that will be re-used for later economic assessment.
3. To execute this first task, in the context of our research, we used a specific modeling tools, call SPS²Modeller (Murillo-Coba et al., 2023) which is out of the scope of the current paper. However, any kind of modelling support for value network mapping can be used, including ad-hoc solutions.

The value-network model resulting for this task clearly identifies all actors concerned by the economic model of the PSS delivery and their monetary interrelations: it provides the starting point for next steps.

3.2 Step II - Defining profit formulas for the actors of the network

The economic model approach proposed in this paper answers to a multi-actor perspective. The economic point of view on any actor of the network can be taken into account, with calculation of cost, revenue and profit indicators (and complementary aggregated decision indicators, if required) for all concerned actor.

The profit formulas aim at simulating the profitability stemming from the delivery of the Smart PSS offering. The incoming value exchanges depicted in the 'value-network' model represent the revenue streams for the actors, while the outgoing value exchanges represent their cost objects. In step II, more detail economic information is captured for all actors, in order to formulate these revenue streams and cost structures in terms of input parameters and calculation formulas, expected to be implemented on a simulation platform. This will be illustrated in the case study.

3.3 Step III – Specifying the requirements for the simulation tool

The simulator to be developed is dedicated to support collaborative decision-making on the economic model configuration and regulation, to help building common mechanisms for economic value sharing. Step III aims at capturing the expectations of the various actors in terms of economic indicators to be calculated and displayed by the simulator, and in terms of potential analyses supported by the computer tool. To specify these requirements, collaborative workshops are organized with the actors, to define the following elements:

i. Variability parameters. This economic assessment approach is developed to help decision-making in a context of smart PSS design. This induces the need to be able analysing economically variable configurations of the smart PSS offer, with flexible definition of these configurations by the decision-makers. The variability parameters, are these input parameters (concerning for instance the market-share, some cost or revenue factors, or the definition of the offer) which are let for a flexible configuration by the user. There are defined contextually for the case study, in collaboration with the users.

ii. Uncertainty parameters. In this design context, by lack of definitive and full design information, there are important remaining uncertainties affecting several technical parameters of the economic model. The simulators aims at implementing a mathematical representation of this uncertainty, to help subsequent risk analysis. At this stage, key information is captured with the decision-makers to fix the more pertinent mathematical representation of these uncertain parameters.

iii. Data output display in the user interface. We capture also the user requirements concerning the graphical display of economic indicators expected for the simulator.

3.4 Step IV - Defining economic calculation algorithms.

After gathering specifications in the 3 previous steps, the last preparatory step, before software development, is to define and validate with the decision-makers, consistent economic calculation algorithms for cost, revenue and profit formulas. Before software development all calculations are specified using flowchart diagrams, providing a detailed specification for the developers.

The general principle of the smart PSS economic model simulator is to virtualize, with event-driven simulation, the economic exchanges of a set of active contracts (extended from a subscription date till an end date), representing the commercial behavior of the simulated market. Each contract is simulated, by launching some cost/revenue calculation depending on the temporal events of the contract and corresponding to the execution of the PSS delivery activities. To enhance reusability and later capacity to transform the simulator for new case studies, a set of rather generic ‘calculation blocks’ have been defined, for instance: (i) the subscription billing (i.e., the contract between the customer and the Smart PSS provider), (ii) the appliance installation, (iii) the mandatory routine maintenance, (iv) the repairs and the supply of spare parts, and (v) the management of the subscription's end.

For example, the following figure 2 displays the activity flow associated with a mandatory maintenance routine, linked to the case study further developed in section 4. In this flowchart, the algorithm verifies whether a routine maintenance operation must be planned for each active subscription (i.e Smart PSS contract). This decision is based on the subscription's start date and the maintenance frequency. If a maintenance operation is required, then an update of maintenance operation costs (MPC) is triggered, as part of the overall cost/revenue calculations.

When assessing a smart PSS delivery network, several alternative delivery networks are to be evaluated and compared, each with a distinct economic model. But even with some differences, these alternative economic models do share common elements, like the generic ‘calculation blocks’ mentioned above. In order to enable the economic performance assessment of each alternative value delivery network, these calculation blocks are aimed to be reused on the simulation platform. These flowcharts also display the parameters that must be entered by the user and the calculations made to obtain the assigned costs and revenues. For example, it can be identified from this flowchart that the maintenance frequency is a variable parameter, to be adapted to the context. Therefore, the simulation tool must enable the user to enter a differentiated value for this input parameter depending on the type of maintenance operation.

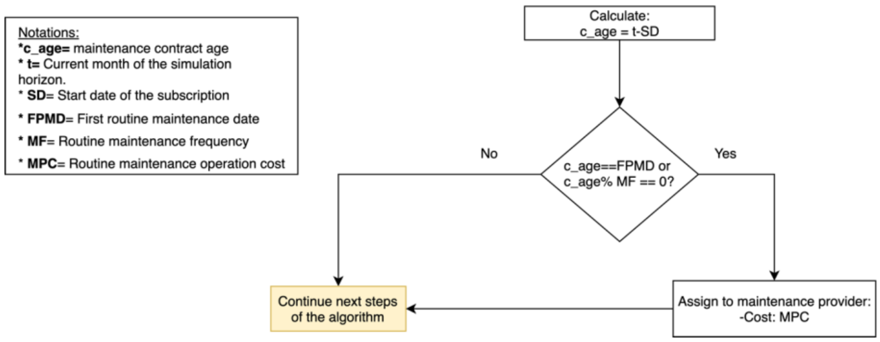

Figure 2. Flowchart, example of maintenance activities, affecting cost calculations.

3.4 Step V / VI / VII - Technical development of the simulator

The last steps are usual computer development steps, including the selection of an implementation language and environment, the iterative development of the calculation algorithms and of the user interfaces, together with the necessary test and validation tasks (for limited algorithms and for the integrated simulator). In the case study illustrated in section 4, the computer environment of excel and VBA was selected for the development because of contextual reasons, however other technical environments able to support temporal simulation could be alternatively used.

4 Industrial case study in the heating appliance sector

4.1 The case study

'Heat-as-a-Service' (HaaS) has emerged as a prospective business trend aiming to cope with the challenges raised by the energy transition. Given the French market regulations, the variant of the ‘HaaS’ offering known as 'heating-appliance-as-a-service' has been selected for the current case study, developed in collaboration with the company elm.leblanc (Group Bosch France). This HaaS variant implies that the customer does not pay once for acquiring the heating device and its installation, but a recurring fee to a service provider for the use of the heating appliance instead. Due to the increasing number of connected home appliances, such specific devices are likely to be included in HaaS offerings. Unlike conventional products, a connected heating appliance may allow the user to control the heat of water using their phone or other devices. This feature also makes easier the delivery of digital services, such as the remote monitoring of the appliance that could prevent breakdowns. This is enabled by the implementation of several sensors installed within the appliance. When the data originating from the sensors anticipate a potential upcoming failure, warnings are sent to a maintenance stakeholder in charge of managing the potential incident and spare parts that could need to be replaced. The information about the breakdown also flows to the homeowner, who is notified with the time necessary for the maintenance operator to travel to his home and repair the heating appliance. Consequently, Smart PSS offerings in the residential heating business include a bundle of connected appliances together with both classical and digital services aimed to satisfy customers' needs.

The smart PSS simulator dedicated to this specific case was developed as a support for design decision-makers. When developing this new market offer, the company needed to compare several alternative delivery networks, each associated with a specific economic model. The ambition was to make possible for decision-makers to simulate and compare the behaviors of the alternative models, with a prospective and anticipatory vision on several years.

The simulator was developed to support the comparative analysis of 3 distinct economic models (namely M_1 a product-oriented economic model, M_2 a use-oriented economic model based on heating system's leasing, M_3 a use-oriented economic model based on heating system's rental), leading to define 6 alternative scenarios of delivery networks (for each economic model M_i, there is a possibility to implement either a usual PSS offer, or a smart PSS offer which includes additional IT based smart services). The 6 scenarios to be simulated or displayed in the figure 3 below.

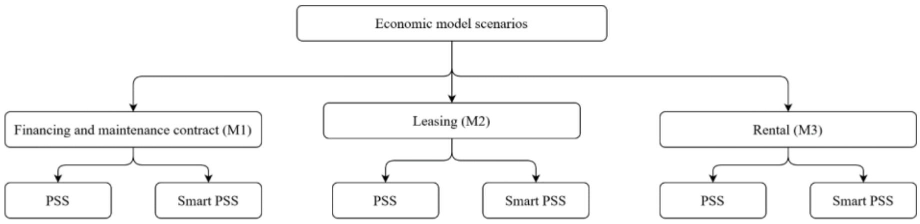

Figure 3. Three economic models, with 6 alternative delivery networks.

Step I of the procedure explained in section 3 consists in identifying and charactering the value network of the smart PSS under design. This step starts with modelling the Business Ecosystem, with identification of different types of actors and transactions or interactions among them. Figure 4 gives a representation of the Business Ecosystem for the case study.

The three economic models mentioned in figure 3 more precisely focus on the economic actors who directly contribute to the delivery networks of M1 to M3. In this case, for this economic assessment we focus on: (i) elm.leblanc as heating appliance manufacturer and maintenance provider; (ii) the installer network ; (iii) the service provider ; (iv) the customer.

4.2 Development of the simulator

As explained in section 3.4 the principles of the simulator consist in reproducing virtually the commercial behavior of a market, leading to launch PSS user contracts. Then the tool simulates the various steps and life-cycle economic events triggered along the contract for each customer (only life-cycle events concerning cost/revenue flows). These economic events are implemented by the calculation algorithms mentioned earlier. To cope with contextual constraints of elm.leblanc, the simulator of this case study was developed with VBA programming language, using excel as base interface for Inputs and Outputs data. The simulator aims at calculating the functioning of the three economic models M1, M2, M3 considering a simulated market, then at displaying consistent comparative indicators to help decision-making. The key functionalities of the simulator can be splitted into (1) the Input interfaces, offering the possibilities to configure basic data of the case study before simulation, (2) the Output interfaces which generates economic indicators for the four key partners of the smart PSS network, and finally (3) the calculation algorithms as defined in step IV of the procedure. Precise information is available in (Murillo-Coba, 2022).

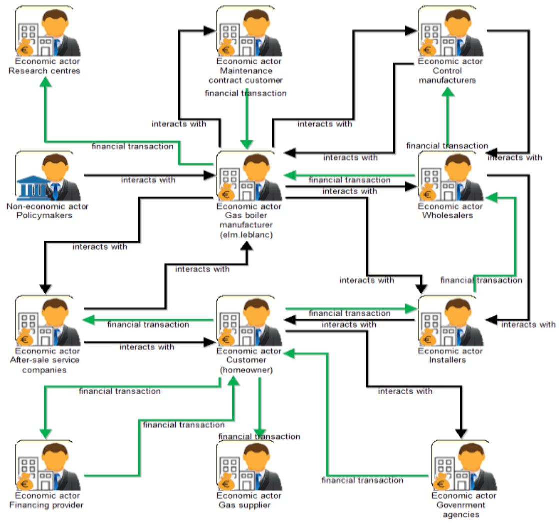

Figure 4. Representation of elm.leblanc's business ecosystem.

To define Input Interfaces a set of Input parameters was defined corresponding to characteristics of the smart PSS offer and its market, which can be configured by the user. These Input parameters are thus quite important to ensure the flexibility of the tool for a good adaptation to industrial needs and contextual changes. Input parameters cover information related to customer smart PSS contract subscription (price, periodicity, etc…), product characteristics, product maintenance characteristics, market volumes, economic characteristics for digital- of human-service delivery. As an example, Figure 5, shows part of the interface to register the parameters related to the simulation run (e.g., the number of iterations), the references of the products included in the subscriptions, and the distribution of their sales. These input fields are also related to the distribution of PSS and Smart PSS subscriptions for the simulated economic model. Furthermore, we find parameters representing the dynamic factors described by Phumbua and Tjahjono (2012), such as the customer cancelation rate and the market volume of the all-inclusive subscriptions. Among the Input parameters, a set of stochastic variables were introduced. These stochastic variables more specifically concern the market volume and the product failure rate.

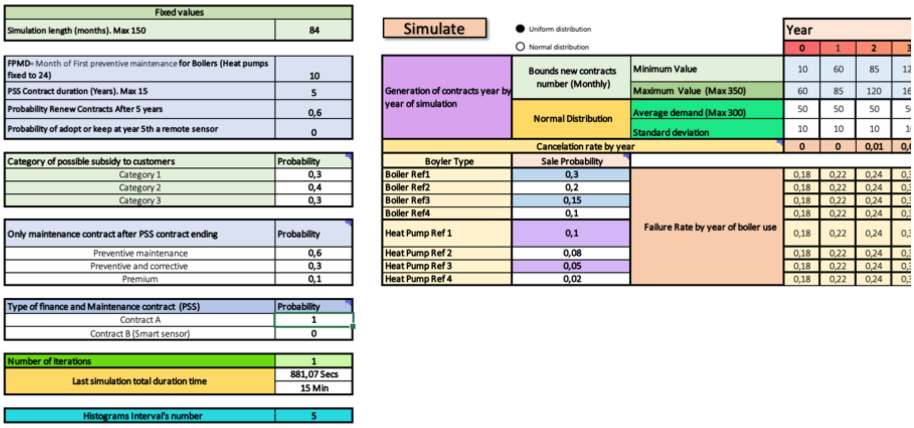

Figure 5. Input parameters Interface

Once the user enters the value of the required input parameters, the sPS²Simulator computes the KPIs and metrics (revenues, costs, and profits) for each key value delivery actor. The results of these metrics and KPIs are presented to the user in two different forms. First, they are displayed month by month over the simulation horizon set by the user. This allows the sPS2Simulator's users to track the monthly evolution of these figures. These figures are aggregated on an annual basis and presented to the user. Revenue and cost sources are differentiated for each actor.

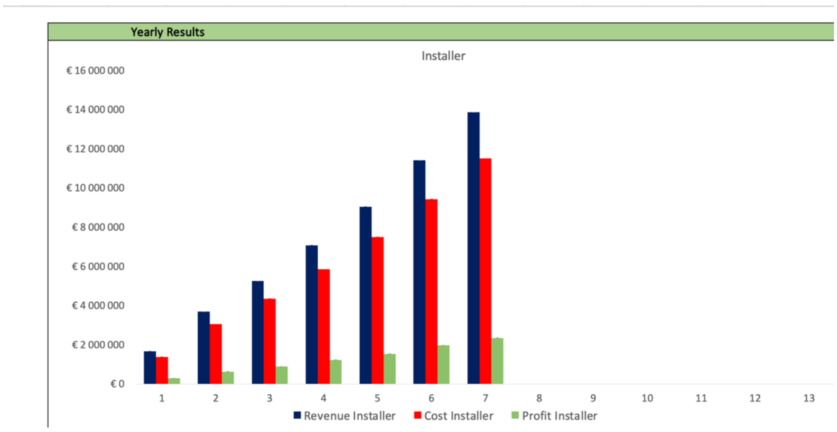

Figure 6. Dashboard with key KPIs for the installer network.

The Output Interfaces display dashboards (figure 6) to provide the decision-makers with insights into the economic performance of each simulated value delivery network, notably the actors' total costs, revenues, and profits. The annual values of these KPIs are plotted in graph bars and the month values are plotted in curve charts.

Other metrics calculated over the simulation were also included in the dashboard. Among these metrics, we find the number of active subscriptions, the number of routine maintenance operations performed, and the number of spare parts sold. The dashboard also displays histograms that trace out the structure of the distribution of the cumulative profit for each key value network actor. These histograms are plotted based on the simulation outputs of each iteration of the simulation run. Decision-makers can use these histograms to quantify the aggregated uncertainty of the profitability of each value delivery scenario over the simulation horizon.

4.3 Economic assessment of smart PSS delivery scenarios

Several insights can be given on the simulator's outputs. At first, it is obviously possible to assess the viability of the different economic models from a given actor's perspective. For instance, it is possible to evaluate the cumulative expected profit for the manufacturing company depending on different scenarios (denoted as Pessimistic, Optimistic, Realistic), in which parameters have been tailored to avoid sharing sensitive data. In Fig. 7, it can be observed that the product-oriented PSS economic model M1 (Financing and maintenance contract), in its smart PSS form, seems better than any other economic model in the different scenarios regarding the 'cumulative profit indicator'. However, if other indicators are preferred, the best economic model could be different, as is the case while observing the operating margin (see fig.7), which is better with model M3 (i.e. rental). Please note that this specific model relies on renting one type of product, due to physical constraints at the time of this research project, whereas others give access to two different types of heating appliances.

However, if the simulator can be used to focus on KPIs of one specific actor of the network at a time, it also allows to visualize several indicators for other stakeholders, providing a more global vision of the whole network. For instance, it is possible to compare cumulative profits from different actor's perspectives, such as the Installer or the Service Provider as stressed in Fig. 8. In this figure, we focus on the realistic configuration (that is also listed in Fig. 7), where it can be observed that economic model M2-Smart PSS is more profitable to the Service provider, while M2-PSS seems slightly better to the Installer. Yet, these two economic models are making sense to these actors. This result comes in opposition to what was observed for the manufacturer, who would be more inclined to focus on model M1. However, in search of win/win situations, the economic model M2-Smart PSS would still be profitable to the company. As the company cannot handle all the tasks supported by the other actors, it is important to rely on their strengths to make the economic model viable, and hence some tradeoffs could be achieved that could still benefit all stakeholders if some are reluctant to compromise. In the meantime, observed results for Service provider and Installer are larger than the Manufacturer's, which can be explained by markup effects. Based on these results, several possibilities could then be discussed between the actors to change their practices, or by simulating the impact of changing some of the partners of the consortium. In addition, another possible alternatives could also be to search for a ratio of different contract types and have two different economic models (i.e. M1 and M2) coexist. In this perspective the simulator helps collaborative decision-making. To sum up, the economic analysis based on realistic data showed no evidence of financial losses for the key value network actors under the three simulated economic models. Nonetheless, it was noted that the achievement of the financial targets mainly relies on input parameters associated with the subscription demand.

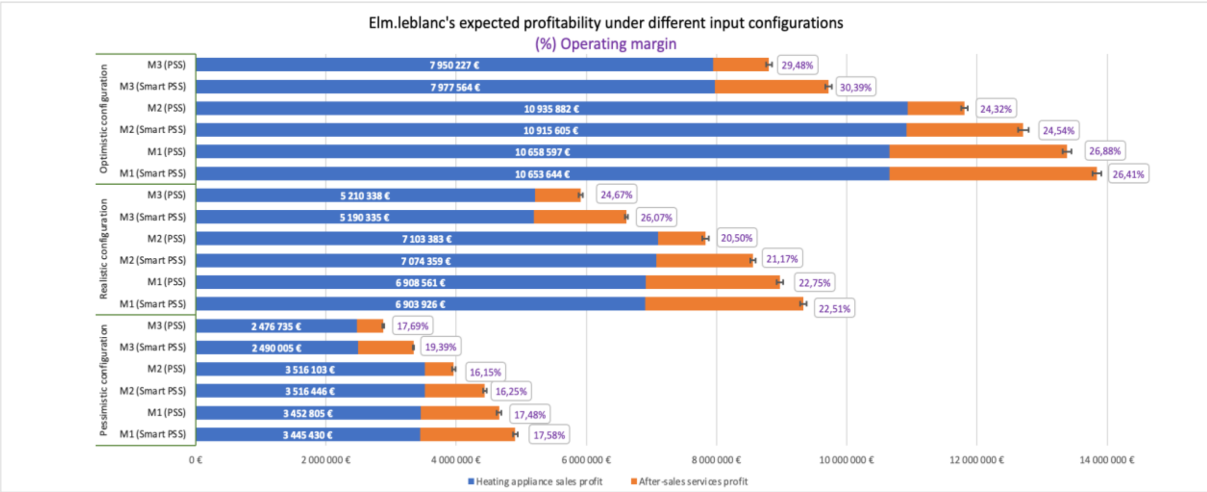

Figure 7. Simulation results of profits derived from maintenance operations and heating appliance sales

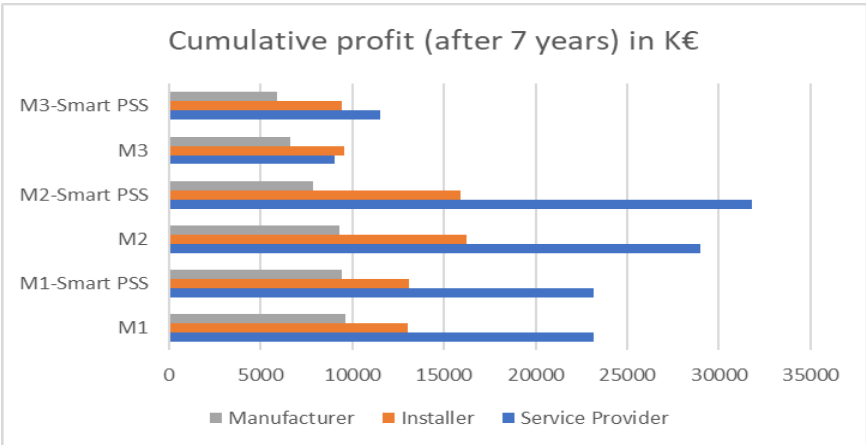

Figure 8. Cumulative profit for Manufacturer, Installer and Service Provider when considering realistic parameters.

However, it is important to mention that all the expected results are directly related to the customer's willingness to pay for the provided offers. Hence, another view of the simulator allows to display the monthly cost that could be charged to the final user. This information can then be used to question potential clients through specific surveys, which could help mitigating desirability risk. Finally, the simulator allows to run very specific scenarios such as a dramatic loss in market share at a given moment, due to external factors (i.e. impact of a conflict on gas distribution, removal of governmental aids, etc.). To support collaborative decision-making, it becomes possible to simulate the behavior of the whole network and the impacts on each of its actors, to assess if it can sustain such events.

5 Discussion, conclusion and perspectives

This paper investigates a generic approach for the development of smart PSS economic simulators. The case study demonstrates an instantiation of the approach to develop a specific case-study simulator, named sPS^{2}Simulator, allowing the computation of several performance indicators, from a multi-actor perspective. It evaluates different kinds of scenarios, depending on input parameters, which could represent pessimistic to optimistic economical situations. Results show that, depending of the economic model, profits range can be very different from one actor to another. This can be used to find tradeoffs between stakeholders' expectations and search for win/win solutions. It could also be used to survey the market, ensuring that the launched solution will reach its target (i.e. desirability risk). Furthermore, if its purpose is to provide an estimate of profitability over several years, it could be used regularly to compare real outcomes to what was forecasted, and make corresponding adjustments along the way by answering "What-if" up-to-date scenarios.

Beyond the current case study which applies the proposed procedure of economic simulator development, a first perspective would be to re-inforce the genericity of the overall approval. As the simulator relies on generic components modelling financial flows between actors, it can easily be extended to add other stakeholders if required. However, in the current status, to apply the same approach of simulator development in other industrial case study, would require a deep reconfiguration of the data and economic scenarios simulated, thus requiring starting with the first steps of the method proposed. Of course, the whole process could take advantage of re-using some rather generic bricks for the calculation algorithms already developed. However, a dedicated research could be now launched to increase the genericity of the procedure and build a fully generic PSS economic model simulator able to support a quick and low-effort customization for any new case study.

Another perspective of this case-study oriented paper consists in deeper contributing to the academic literature on 'PSS cost engineering and pricing'. Based on a stronger analysis of scientific approaches in this field, a more generic and methodological contribution to improve PSS economic management could be developed.

Acknowledgement

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