Systematic Steps Towards Concept Design of Pay–per-X Business Models: An Exploratory Research

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Abstract. During the last decade, equipment manufacturing companies (EMIs) have increasingly understood the unique competitive advantages offered by Pay-per-X (PPX) business models (BMs). Many such EMI companies seem ready for the transition towards PPX BMs. However, they are not aware of the needed systematic steps that will help them in the concept design of PPX models. There are currently no available systematic PPX concept design processes and related steps in literature that can support EMI companies in identifying their relevant PPX BM options. Therefore, we make use of qualitative case study research method and identify such overall process and major steps with the help of interviews and workshops with a company that has successfully designed and identified their PPX models. Additionally, these design steps are validated with the help of 3 companies that plan to shift towards offering PPX models.

Keywords: Pay-per-X · Pay-per-use · Pay-per-outcome · Pay-per-output · Business models · Design steps

1 Introduction

During the last decade, pay-per-x (PPX) services and related business models have established huge interest and importance in many fields, e.g., in equipment and capital-intensive product manufacturing industries, where they were earlier found to be difficult or even impossible to implement, due to inherent significant risks for their suppliers, as well as technological challenges [1, 2]. Due to the above type of challenges, many companies have struggled heavily with the design and implementation of novel pay-per-x services and related business models in equipment manufacturing industries (EMI) [1, 3]. Many companies also find it difficult to know what to do, in what order, and where to start when planning these new PPX business models.

Quite often, companies make use of free-form experimentation in designing business models (see e.g. [4]). For investment heavy equipment manufacturing companies, the preliminary conceptual design of PPX models is more critical to do before any sort

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of experimentation, prototyping or implementation because of the significant risks related to customer involvement and technological needed investments in EMI context (e.g. [5]).

Existing commonly used generic business model design and innovation approaches like Morphological box [6], Business model canvas [7], Cambridge business model innovation model [8], 4Is process [4] and PSS Conceptual design [9] provide a generic overview of how business models can be developed. They explain some generic design steps also at least from PPX context. However, they do not take into consideration some of the specific features of PPX model design, such as risk management, and further than that, they do not tell in more detail exactly where and how to start, and in which order to proceed in PPX model planning. Neither do they provide more instructions and examples on how to apply the generic models in PPX ad EMI context.

Existing major studies related to PPX business model design highlight the overall design related decisions and requirements. Lay et al. and Gleich et al. demonstrate the various design choices available for manufacturing companies, while designing various PPX business models using the morphological box [6, 10]. Morphological box does not go into the details of how to design various PPX business models in a systematic manner. Similarly, business model canvas also provides a framework where diverse options related to PPX business model design and implementation can be organized [11]. Business model canvas does not provide structured and detailed steps on how to design PPX business models. There are numerous studies that demonstrate the impact of technologies and data on PPX business models without going into a structured design for implementation [1, 5]. In the existing literature, numerous studies go into the depth of how different EMI's have implemented specific PPX business models and specific issues that they have faced, such as, financial issues, lack of resources technological as well as business model perspective and others [3, 11, 12]. These studies do not investigate detailed steps for designing the PPX business models.

To the best of authors' knowledge, having e.g., carried out a systematic literature review on PPX business models, there are no earlier studies that have described a more detailed process and related steps for designing a conceptual PPX business model in equipment manufacturing companies. There are studies, though, that make use of e.g., Business Model Canvas type of approaches in PPX model description or design.

Business Model Innovation or Business Model Design typically includes various phases: Initiation & Ideation (Concept Design), Prototyping & Experimentation, Detail design/re-design, Launch/Implementation/Integration. Our study focuses on particularly from the Concept Design perspective. We focus on creating an overall PPX Business Model Concept Design process and related description of systematic steps. Our research question therefore is: *"What is the overall process and what are the major systematic steps towards the preliminary concept design of pay-per-X business models for equipment manufacturing companies?"*.

The approach used in current article combines an empirical and literature-based approach. Current article made use of a pioneering (SME) equipment manufacturer company that has years of experience with pay-per-x business models. We derived the overall procedure and main steps from (several) interviews of this pioneering company, creating a preliminary PPX business model Conceptual Design process. Using existing literature on business model design and innovation, as well as existing PPX case

studies in Equipment Manufacturing Industry (EMI) context, we complemented and iterated the procedure and added missing steps from literature. Here we explained the iterations as well. Furthermore, we used the created model with three other EMI companies, thus preliminarily validating the structure, major steps, and the usefulness of the model.

The structure of this study is as follows: we first explain what PPX business models are and what is their role in equipment manufacturing context. We review existing research and the research gap in more detail. Second, we describe the methodology of this paper. Then we present the resulting model, discussing the major steps and the overall PPX Concept Design process. Finally, we discuss the conclusions and managerial implications.

2 Theoretical Background

While reviewing literature our research team did not found any specific methodology that has been deployed for the concept design of the PPX models. Therefore, in this section we present and discuss the various popular methods that are used for business model innovation, and design of services and PPX models.

2.1 Business Model Innovation Methods

Cambridge Business Model Innovation Process is one of the popular methods that is used for leading business models towards innovation with a focus on sustainability [8]. This model consists of various phases like ideation, concept design, virtual prototyping, experimenting, detail design, piloting, launch, and adjustment and diversification. Cambridge Business Model Innovation Process is deployed for any innovation in business model, with concept design as one of its phases. For the concept design of PPX models, we need systematic steps that can help in identification and mitigation of risks as well and therefore, the Cambridge Business Model Innovation Process cannot be used. Similarly, 4I is used to develop and implement innovative business models [4]. Its four phases are initiation, ideation, integration, and implementation. This method is also a very generic method and does not consider the parameters of risk management.

2.2 Service and Pay-per-X Model Designs

Business Model Canvas (BMC) presents the building blocks that are to be considered while doing any business. These building blocks are customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. Although the building blocks in BMC have been used for the design of PPX business models (for e.g., [11]) however, BMC is a very generic method, and it does not focus on the challenges and the risks involved in the concept design of the PPX models. Morphological Box (MBox) is a valuable tool that has been employed for the design of PPX models in literature [6, 10]. It considers important characteristic features like who owns the assets, where manufacturing will

take place, who will look for the operations and maintenance; such characteristic features and their options support the design of PPX models. However, MBox and BMC approaches cannot be deployed in the concept design of PPX models because they do not include information e.g., regarding the risk mitigation and the contract preparation, and secondly, they do not provide a clear process and steps for the design. There are also specific methods for designing new service models [13, 14]. The phases included in such models can be generalized as opportunity identification, customer understanding, concept development, process design, and process refinement and implementation. Although the service development methods help in the development of services, such methods are applicable to all kinds of service models that can include renting, leasing, and product-oriented business models. Such services are of very elementary nature and here the risks do not play a vital role and therefore, the service development methods cannot be employed for the concept design of PPX models. The PSS concept design method is also available in the literature [9]. This method is specific to the concept design of PSS models. Although, it considers the data generated and based on that identifies and measures the capability parameters and sub-parameters for the design of PSS, here also the risk mitigation aspect has been missing. Additionally, the PSS concept design has been proposed for all PSS models, including product-oriented business models, but PPX models include the advanced PPS business models only.

2.3 Risk Mitigation in Pay-per-X Business Models for Equipment Manufacturing Industries

EMI need to overcome their own set of challenges while designing their PPX business models [1, 3]. Since the capital involved in EMIs is also exceptionally large, therefore, the risks involved with EMIs are greater as well. Importantly, e.g., compared to selling software through similar business models, software related costs (and thus, also the risks) are not similarly dependent on e.g., the manufacturing, development, logistics and installation costs, or the number of software deployed for customers, like EMI companies' products strongly are, so the earnings and business models of EMI are not at all scalable in the same manner than software business models. Furthermore, when it comes to a software industry, the risks associated with business models are relatively small, as the functionality, design, and the business model around the software may be modified if required. However, once capital equipment has been designed, it becomes difficult to change or modify the equipment or its business model. As a result, the success of the concept design phase for capital equipment manufacturing industries plays an extremely critical role, and there is a strong need to develop concept design steps specific to PPX models of EMI, and their risk management.

3 Methodology

The methodological approach deployed in the current article combines an empirical qualitative case study research to design and validate the concept design methodology [15, 16] and we also complement it with steps recognized from literature. Since PPX

and related business models are a contemporary topic, we share in-depth experiences of companies who have implemented or are in a process of implementing PPX models. We found qualitative case study research as the best method for the current research [15, 16].

Company A is a pioneering equipment manufacturing a small-medium enterprise (SME) located in Finland. They manufacture compressors. They have implemented pay-per-output and pay-per-outcome business models with their customers and have an experience of 4–5 years in PPX business models. To understand the systematic process of PPX concept design we interviewed Company A from their own PPX business models' perspective. This process resulted in preliminary design steps which are presented in the findings and analysis section.

Using existing literature on business model design and innovation, as well as PPX case studies in Equipment Manufacturing Industry (EMI) context, we complemented and iterated the procedure and added missing steps from literature. Here we explained the iterations as well. This resulted into the PPX business model concept design model as presented in the findings and analysis section.

Furthermore, we used the created model with three other EMI companies (Company B – Precast element (for building construction) manufacturing machine builder, Company C – welding automation machine builder and Company D – medical equipment related machine builder), thus preliminarily validating the structure, major steps, and the usefulness of the model. All the three companies (B, C and D) are equipment manufacturing companies located in Finland and have clear drivers towards designing and implementing PPX business models.

4 Findings and Analysis

In this section we present the steps followed by the company A in their successful PPX concept design. The steps were selected to represent not all but the critical few steps for PPX concept design. We deduced the steps 2–9 first from company A workshop and interviews, dividing the concept design process of the company into separate logical steps (as presented in Sect. 4.1). The steps were tested with the three other companies in further separate workshops, and we thus also reviewed and validated their logical order (indicated by downward arrows), as well as their potential iterations back to earlier steps (shown as upward leading arrows) in Fig. 1, during these workshops. Finally, we also complemented these steps with the help of scientific literature and validated all the steps with the help of companies B, C and D (as presented in Sect. 4.2). Companies B, C and D found these steps extremely useful. However, all the three companies B, C and D have not implemented data collection systems yet, so they are not able to provide exact options towards some of the steps. We demonstrate all the steps in Fig. 1.

4.1 Systematic Steps for Concept Design of Pay-per-X Business Models

Step 1: Identify drivers, barriers, and challenges of PPX business models.

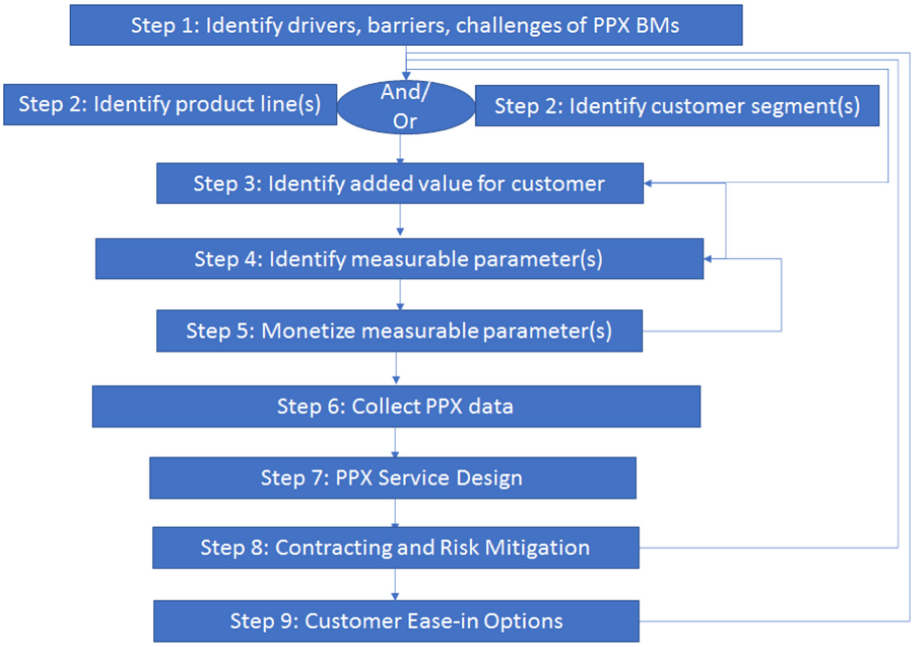

Fig. 1. Systematic steps for concept design of Pay-per-X business models

The very first step towards the concept design of PPX business models was recognized from business model innovation literature and it involves identifying the various drivers, barriers and challenges that will motivate a company, or that a company must face. The drivers, barriers and challenges are an important starting point for the whole PPX concept design process, because they also help to make right decisions in later process phases. Besides, the awareness of PPX drivers, barriers, and challenges also motivates and informs companies regarding their PPX transition. Thus, we felt we must add this step from business model innovation models in literature.

Step 2: Identify product line(s) and/or customer segment(s).

Companies must be aware of the product line(s) and/or customer segments they target to implement their PPX business models. The company A in its pay-per-output model targeted to implement PPX business models in all its customer segments, whereas, in its pay-per-outcome model it opted the product line where they were confident that the customer needs can be fulfilled.

Step 3: Identify added value.

The objective of this step is to focus on delivering the value added by the equipment to their customers. The company A in its pay-per-output model identified that the value they add for the customers is the certain standard of compressed air, whereas, in their pay-per-outcome model their value addition was certain quality and quantity of compressed air and saving on the power consumption offered to the consumer.

Step 4: Identify measurable parameter(s).

The added value is complemented with the help of a measurable parameter(s). If measurable parameter(s) cannot be identified, then the organization go back to previous step 3 and identify a new value that it can offer. In the pay-per-output model of the company A their measurable parameters were related to the quality and the quantity of the compressed air, whereas, in the pay-per-outcome model of the case company, their measurable parameters were the quality and quantity of compressed air and the electric energy saved.

Step 5: Monetize measurable parameter.

Here, the payment related to the measurable parameter(s) shall be identified. If the parameter(s) cannot be measured, then the organization shall go back to step 4. In the pay-per-output model of the company A, their measurable parameters were related with the quality and the quantity of the compressed air, whereas, in their pay-per-outcome model their measurable parameters were related to the quality and the quantity of the compressed air, and the energy saved.

Step 6: Collect data.

During this step, the required sensors and IT software for data collection, storage, and analysis are installed. This step is more relevant to the capital heavy equipment/machine as they generate data in bulk. In the pay-per-output model of company A, they collected data related to the consumption of compressed air, on the other hand, in their pay-per-outcome model they collected data related to the quality of air, surrounding environmental conditions, and amount of air and electricity consumed by the equipment.

Step 7: Service Design.

In this step, the company defines the PPX service it offers to its customers. Besides, it also includes information about ownership of equipment, operation of machines, deployment of people, therefore one may refer to MBox during this step [6]. In both the pay-per-output and pay-per-outcome models offered by company A the agreement on consumption of compressed air and corresponding payment were made. Additionally, a minimum consumption level of compressed air was also agreed.

Step 8: Contracting and Risk Mitigation.

During this step, a contract is prepared for the consumer. The contract also has terms where the equipment provider is penalized or given a bonus based on the performance of the equipment. If the terms do not suit the consumer, then one may again go to step 2, to identify new product line(s) and customer segment(s). In both the models offered by company A the bonus and penalty terms were agreed. For instance, in the second model, it was agreed that if the customer can save electricity consumption with the help of equipment, then they pay a percentage of savings from electricity to company A, on the other hand, if the equipment consumes comparatively more electricity than before then the company A pays the difference.

Step 9: Customer ease-in options.

Customer uses the contract for a fixed small duration, and during this duration the customer experience how it has been benefitted with the help of offered PPX business model. Besides, contract amendment also takes place. If either the provider or the customer do not like the contract, then we can go back to step 2 of the proposed (iterative). For instance, in both the models offered by company A, the customer was asked to use the machine for 6 months, and the collected data demonstrated that the

variable pricing is more beneficial for customers as compared to the fixed pricing. Besides, if a customer wanted to buy the compressor during the pilot phase than, that option was also available.

4.2 Validation of Systematic Steps for Concept Design of Pay-per-X Business Models

Step 1: Identify drivers, barriers, and challenges of PPX business models.

The companies B, C, and D were already aware of the drivers, barriers and challenges of PPX business models. Some of the drivers, barriers, and challenges can be identified from literature [2], however, each company may have their unique sets of drivers, barriers, and challenges.

Analysis: Thus, it was validated that identifying, barriers, enablers and challenges is the first step towards concept design of PPX BMs.

Step 2: Identify product line(s) and/or customer segment(s).

When providing the PPX business models, the company C wanted to restrict themselves to columns and booms only, whereas company D wanted to offer PPX business models for their lateral flow device assembly machines only.

Analysis: Therefore, it can be said that identifying product line(s) and/or customer segment(s) plays an important role in the concept design of the PPX BMs.

Step 3: Identify added value.

For company B's first model the added value was machine being up and running when required, whereas in their second and third model the value is long lasting and real-time monitoring of the spare parts, and the savings that were for per meter square of space due to spare parts. For company C, the value was regarding how much time they were able to save as compared to welding manually or by automation. Finally, for company D the value added was in terms of the improved quality, and increased production outputs and availability time of the machine. The companies B, C, and D also agreed that if they will not be able to identify the added value, then, they will go back to step 2 identify another product line(s) and/or customer segment(s).

Analysis: As a result, we can conclude that identifying the value offered to the customer is a vital part in the concept design of the PPX BMs. It was also confirmed that this step is an iterative step.

Step 4: Identify measurable parameter(s).

Company B, in its first model, identified that measurable parameters are machine uptime, waiting time, alarm time and casting information of the equipment. In the second and the third model of company B, the measurable parameters were the wear and tear of the critical parts. For company C, the measurable parameters were welding speed of machine, deposition rate of weld and the availability of welding equipment. For company D, the measurable parameters for quality were amount of scrap produced, material saved, environmental parameters, and incoming material quality. Here, also the companies B, C, and D confirmed that if they were not able to identify the measurable parameter(s) related to the added value to the customer, then, they need to identify another value added.

Analysis: Thus, it was validated that identifying measurable parameter(s) related to the value added is critical to the concept design of PPX BM. It was also confirmed that identifying measurable parameter(s) is an iterative step.

Step 5: Monetize measurable parameter.

Company B in its first model related its measurable parameters related to the report that the customers may access on an interface. In the second model company B planned to have measurable parameter(s) related to the wear and tear information of the spare parts on interface, whereas in its third model the parameters were regarding the production of pre-cast and their savings on per meter square pre-cast produced by the parts that may have wear. Company C is considering different parameters like availability and access to the diagnostic packages, amount of weld used by customers, rate of welding deposition and the availability of their equipment. Finally, company C's parameters were regarding yield, the overall output generated and the availability of the equipment. Companies B, C, and D during validation agreed that if they were not able to monetize the measurable parameter(s), then, they will try to identify newer measurable parameter(s).

Analysis: Hence, it can be said that monetizing the measurable parameter(s) is also important for the concept design of PPX BM. It was also confirmed that, monetizing the measurable parameter(s) is an iterative process.

Step 6: Collect data.

The companies B, C and D strongly agreed to the usefulness of this step. However, since the companies B, C and D were in the initial stages of PPX concept design, therefore, they were not able to share anything specific related to the collected data.

Analysis: Therefore, it can be concluded that collected data after monetizing the parameters is also important for the concept design of PPX BM.

Step 7: Service Design.

The companies B, C and D also strongly agreed to the usefulness of designing the service. However, since the companies B, C and D were in the initial stages of PPX concept design, therefore, they have not designed their services yet and were not able to share any data.

Analysis: Thus, it can be concluded that service design is also especially important for the concept design of PPX BM.

Step 8: Contracting and Risk Mitigation.

The companies B, C and D found this step to be extremely useful, because of the risk management policies that have been included here. However, since the companies B, C and D have not designed PPX services, therefore, they were not able to prepare the service contract. Additionally, companies B, C, and D agreed that if the customer is not satisfied with the contract, then they will go back and identify newer customer segment(s) and/ or product line(s).

Analysis: As a result, it can be concluded that contracting and risk mitigation plays a significant role in the concept design of PPX BM. It was also confirmed that, contracting and risk mitigation is an iterative step.

Step 9: Customer ease-in options.

The companies B, C and D found this step to be extremely useful as well, because this step allows customers to use the step for a small duration, and both the provider and customer may get to know the advantages and issues they might face in the PPX

model. However, since the companies B, C and D have not designed PPX services and offer PPX contract, therefore, they were not able to share data regarding customer ease-in option. Additionally, companies B, C, and D agreed that if the customer has any issue while using the model, then they will go back and identify newer customer segment(s) and/ or product line(s).

Analysis: Therefore, it can be concluded that customer-ease in option is also necessary for the concept design of PPX BM. Besides, it was also confirmed that customer ease-in option is an iterative step.

5 Discussion and Conclusions

The current article develops a novel systematic process and steps towards PPX business model concept design for particularly EMI companies. The process and steps were designed and preliminarily validated with one experienced PPX company (that has successfully offered two PPX models) and three EMI companies planning to adopt PPX models in their business. The study also shows and discusses examples on what was learned regarding the design of PPX models in each of the steps from validating EMI companies, for instance on important PPX-related topics such as PPX risk management and mitigation. As for the academic novelty of our study, we have not been able to find any other PPX concept design processes reported in literature. Regarding the existing PPX research, some earlier studies have reported e.g. BMC analyses of existing PPX models (e.g., [11], but these were more used to analyse the PPX components of already existing PPX models, and they do not provide a systematic processual and stepwise picture of the PPX concept design phase, but only its main outcomes. Regarding the existing business model innovation research, EMI business model -related Morphological Box studies [6, 10] have shown main design options of overall PSS design options, but again, they do not provide a systematic processual and stepwise picture of the PPX concept design phase. In overall business model innovation studies, many steps that are like our PPX concept design process can be found, e.g., identifying drivers, barriers and challenges is ideation and identification in other popular business model innovation methods, but simultaneously, there were PPX-related steps which were entirely different as compared to the popular existing methodologies, e.g., monetization, data analysis, and risks mitigation.

While validating the proposed model in three EMI companies, the model was found to significantly support the systematic design of PPX business models e.g., by asking the right questions in a right order, and helping to concentrate into the critical few tasks to provide preliminary concept models and related options for new PPX business models. Concerning the usefulness, one of the case company shared that they agreed with the customer that if their equipment saved power for the consumer then they would get a specific percentage of power savings and on the other hand if the equipment utilizes more power than the case company pays for the difference. Such schemes included in the PPX business models demonstrate why considering e.g., the risk factors are so important for equipment manufacturing companies. Also, by deploying the systematic steps company A was able to offer two different service models to its customers, similarly company B was able to offer three different

incremental service models. This shows that the proposed model is dynamic in nature and considers offering hybrid models as well.

Since the domain of PPX concept design has been little studied from the perspective of EMIs, the proposed PPX concept design model will also be helpful to the managers of the EMIs. Other existing business model innovation approaches can complement the various steps in the proposed model. For e.g., the ideation phase of 4I can be used in step 1 to identify the risks, barriers and challenges, and morphological box can be used in step 6 to design the PPX service.

5.1 Limitations and Future Work

First, we validated only the first five steps of the proposed PPX concept design methodology in more depth. In future, we plan to further validate the remaining four steps when the three companies studied have performed all the steps. However, there is no reason to think that there would be bigger changes or additions in the steps and the overall process.

Second, the validation was done with SMEs and somewhat larger companies. Thus, the process can be said to be useful at least for similar-sized companies. In further research, we should further validate the process also for larger companies.

Third, we should further test how far this model can be used for the design of all diverse types of PPX models, including Pay-per-use models, which were not specifically tested by experienced PPX model users. So, thus we cannot currently generalize our model to apply fully to PPU concept design and will have to confirm that in future studies. Since, PPU models are more about the time units under which the equipment is for use, therefore, if it is not available for use then the customer is not paying for it and since PPU is the most elementary model among all the PPX business models therefore, risk mitigation in PPU model can be covered in the proposed concept design model. In future research, the systematic steps that will help in the experimentation and implementation of PPX models shall be proposed as well. When the concept design steps are complemented with the experimentation and implementation steps it will add more value for the customer.

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