How to design revenue models for smart connected products

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Abstract

Manufacturing industry currently undergoes a transformation where digitalization through smart connected products enable new innovative service solutions. A key challenge for companies is capturing profits by designing appropriate revenue models for such service solutions. Through a case study of 11 companies, this study enhances knowledge about how to design revenue models for smart connected product-services. The paper provides novel insights about how to design new revenue models in a structured way by outlining a framework of key steps and activities. By doing so it bridges the emerging digitalization literature with literature on servitization, advanced services and service solutions.

Keywords: Revenue models, Smart connected products, Servitization

Introduction

'Finding new ways to capture value created by smart and connected product-services, is a key to long-term profitability within the manufacturing industry'
– Operations Director, Consulting Company in Product Development

Digitalization and industry 4.0 represents a technological radical revolution which is transforming manufacturing industry at its core. More specifically, we see emergence of smart connected product-services that is products and assets becoming embedded with processors, sensors, software and connectivity has enabled data to be exchanged between the product and its environment, manufacturer, operator/user, and other products and systems. This technological transformation has triggered servitization of the manufacturing industry to deliver advanced services closer to the customers' core processes, e.g. energy optimization, proactive maintenance, and fleet management systems. Servitization can be seen as "the strategic innovation of an organization's capabilities and processes to shift from selling products to selling an integrated product-service offering that delivers value-in-use" (Baines, et al., 2007; Martinez, et al., 2010).

The shift towards digitalization and service focus is typically a strategic response to intermitted revenue growth caused by reaching the maturity phase of the product lifecycle (Kowalkowski, et al., 2017). Thus, utilizing smart connected product-services has become a way to escape the product commodity trap, create offer differentiation, and nowadays represent an important source of revenue and profit to manufacturing companies.

Despite the known business benefits and opportunities related to smart connected product-services, many manufacturing companies struggle to realize monetary profits from their advanced service offerings, even though they are able to offer a higher value to their customers. The "service paradox" is an example of this phenomena, where firms heavily invest in becoming a service provider but fail to realize sufficient return (Kowalkowski, et al., 2017). One reason for this, is lack of understanding about how to adapt the business model's capture mechanisms i.e. the revenue model which describes "the revenue sources, their volume and distribution" (Amit & Zott, 2001).

Traditionally, manufacturing companies are mature in focusing on development and innovation for new technical solutions, however, knowledge about how to develop new revenue models to extract the value created by a smart connected product-service is limited. Moreover, opportunities associated with revenue models related to utilizing smart connected product-services are not mainstream within manufacturing industry, such as pay-per-use, or subscription based models. Thus, companies needs to significantly rethink and revise their approaches towards revenue models in servitization context. To this end, many questions remain unanswered, such as what are the key steps that manufacturing firms need to take when designing revenue models, what are the key activities related to new revenue models, and what are different guiding principles associated with capturing value from smart connected product-services.

Research insights about revenue models has remain scarce and focus has largely been dedicated towards developing business models where the revenue model represents one out of several dimensions and thus, is mentioned as passing but rarely is the key focus of research. Further, the research done particularly on revenue models can mainly be found in the pricing literature where focus is on different pricing strategies (Hinterhuber & Liozu, 2014; Rapaccini, 2015), pricing calculations (Kameshwaran, et al., 2007) or categorizations and comparisons between different revenue models, without consideration towards industry transformation. Focusing in the context of smart connected product-services provides a unique opportunity to understand how established manufacturing firms can innovatively utilize revenue models for generating value towards customers and secure long term competitiveness. Thus, the purpose of our study is to ***enhance knowledge about how to design revenue models of smart connected product-service for manufacturing companies.*** The paper provides novel insights about how to design new revenue models in a structured way by outlining a framework of key steps and activities. By doing so it bridges the emerging digitalization literature with literature on servitization, advanced services and service solutions.

Literature review

Smart connected product-services drive servitization

The manufacturing industry faces a technological transformation where digitalization and the emerge of smart connected products are enabling new service solutions to complement the traditional product offers (Iansiti & Lakhani, 2014; Frishammar, Dasselaar, & Parida, 2015). Digitalization is described as the third industrial revolution

(Lasi, et al., 2014) and have unleashed fundamental changes in almost all industries (Porter & Heppelmann, 2014) (Veit, et al., 2014). As sensors, processors and software makes products smart and connected, new possibilities to add value to offerings emerge, often in shape of more advanced services e.g. analytics and optimization, or offering integrated product-services delivering value-in-use. These technological development has further fueled the manufacturing industry's servitization journey (Boehm & Thomas, 2013), which can be defined as the journey towards a tightly coupled combination of product and services leading to higher value for customers (Martinez, et al., 2010).

Many researchers discuss smart connected products under diverse terminologies and concepts, such as advanced services (Baines, et al., 2017), service solutions (Parida, et al., 2015), smart services (Reinartz & Ulaga, 2008), and remote monitoring technology (Grubic, 2014). Clearly diversity of terminologies exist and we still lack a clear definition for smart connected products. However, Porter and Heppelmann (2014) identifies three elements that constitute a smart, connected product, 1) the physical component, which is the product's mechanical and electrical parts, 2) the 'smart' component, comprising the sensors, microprocessors, software, data storage, and often an embedded operating system and user interface, 3) the connectivity component, which comprise the antennae, ports and protocols that enables wired or wireless connection with the product. The smart and connectivity components are in many cases what enables a product manufacturer to be able to sell service solutions (Porter & Heppelmann, 2014). A classic example of this is Rolls Royce's business model 'power-by-the-hour', where the company, instead of selling gas turbine engines and transferring the ownership to the airlines, deliver a service where the customer is paying for number of hours the engine has run due to improved diagnostics data collection and analytics (Baines, et al., 2007). The advanced service business model was largely enabled by access to accurate data about the engines performance and increased ability to use this data to improve engine efficiency and plan maintenance and spare part services. Information on usage secures that the engines are run properly and makes it possible to leave guarantees or charge for careless usage. In this way, adding the smart and connectivity components enables firms to create new revenue streams from advanced services, either in addition or as a substitute to the traditional product deal.

Smart connected product completely change the business logic of firms as they take on risks and exploited new value capturing opportunities. The transformation to become a service provider is something that requires new processes and routines, especially related to calculating risks, costs and revenue streams (Reim, et al., 2016). As the manufacturing firm retains a larger extent of performance responsibility, it is necessary to account for costs related to product breakdown and opportunistic behavior during use of the products. If not handled properly e.g. though contractual limitations, these risks may lead to manufacturers not being able to realize financial return for the investments in becoming a provider of smart connected product-services. Furthermore, another aspect that have proved highly challenging for many firms are to create service offerings that address a true customer need i.e. not merely providing technology cool features which creates limited value to customers business bottom-line (Bonnemeier, et al., 2010). To ensure successful implementation new business models, like Rolls Royce's "Power by the hour" to become critical to reevaluate new revenue models. For example, questions like, what should be the price parameters? and how should the payment look like? are necessary to be address. Thus, there is need for advancing knowledge about revenue models connected to smart connected product, and more importantly investigate how manufacturing firms design revenue models for smart connected products.

Revenue models for smart connected products

The revenue model is usually considered as an important sub-component of an business model canvas (Osterwalder & Pigneur, 2010), and quite often studies used these two interrelated but diverse concepts interchangeably (Amit & Zott, 2001). A business model enables revenue generation however, a revenue model describes 'the revenue sources, their volume and distribution' or simply 'the means by which value is captured' (DaSilva & Trkman, 2014). As Amit and Zott (2001) points out, the business model and the revenue model is 'complementary yet distinct concepts', where the business model primarily refers to value creation whereas the revenue model mainly is concerned with value appropriation and how to capture value. The way a company creates and captures value is closely related, and equally important according to Amit and Zott (2001), who express this close relation as 'value is created by the way in which transactions are enabled'. This statement shows the close connection between revenue models and pricing, where pricing is a more established literature.

Building on pricing literature, certain terms such as pricing model, payment mechanisms (Rapaccini, 2015) and pricing approach (Bonnemeier, et al., 2010) are used almost equivalent to revenue model. Thus, the research on revenue models can be considered sparse and spread across numerous terminologies. However, some researchers have tried to characterize and classify different revenue models. For example, Bonnemeier, Burianek, and Reichwald (2010), identified seven commonly used revenue models. Four of these are considered "traditional" revenue models where the value proposition is based on conventional products or services. The other three so called "innovative" revenue models, focus on the customers' actual input or output which often is the case with smart connected product-services. These revenue models have either usage-, performance- or value-based price parameters, and imply a long-term relation with customers. Further, the same study conclude that these innovative models demand a much more iterative process with continuous adjustments of contractual parameters, and stress the importance of performing a customer value analysis to ensure that customers are willing to pay for a new value offering. In general, scholars seems to agree that the shift towards service-orientation demands much more customized revenue models, and that the increased risks needs to be accented for in the contracts (den Hertog, et al., 2010)

To summarize, the revenue model is often considered one component of the business model, and most research can be found within the pricing literature. Even though scholars have begun addressing the specific context of revenue models in servitization (Rapaccini, 2015) and digitalization (den Hertog, et al., 2010), limited focus has been on the industry transformation such as the case with smart connect products. Further, much knowledge is still needed to be able to guide established manufacturing firms with a deeply rooted product-orientation to redesign their revenue model. In ability to develop revenue model in conjunction with engaging with smart connected products which enable servitization can lead financial loss and unrealized investments. Thus, in the current study we address the call to provide an framework to systematically work with designing revenue model for smart connected products.

Method

Research approach

As prior literature on designing revenue models for smart connected products is scarce, we adopted an abductive case study approach (Dubois & Gadde, 2002; 2014). The

abductive approach combines inductive and deductive elements and enabled iteration between prior literature and empirical data, where prior research helped interpret and contextualize emergent findings as well as guiding the construct of interview protocols, while still allowing codes and themes to largely emerge inductively. The research was organized into three phases. First, we performed exploratory interviews, held an initial workshop and reviewed prior literature to better understand the context and practical problem. Second, we engaged in semi-structured interviews, complementary literature studies and another workshop to address the research purpose directly. Finally, the third phase of research centered on filling remaining gaps by means of confirmation interviews, and comparison of empirical results with prior literature, and a third workshop to obtain feedback on emergent versions of the revenue model design process.

Sample & data collection

Emerging revenue models for smart connected products in mature manufacturing companies constitute the key unit of analysis. We sampled six manufacturing companies engaged in revenue model design; all active on global markets and between 5000 and 25000 employees, along with two technology expert companies and three consulting companies specializing in digitalization, pricing strategies and product development for external clients in manufacturing industries. The manufacturing companies produce equipment for a number of different industries and applications, for example ports and cargo handling, the food processing and packaging industry, the process industry, and equipment for forest, park and garden handling. The main offers' composition were still highly product-oriented and most of the companies focused on extending the traditional service contracts by adding more high-end components such as proactive maintenance, machine monitoring and optimization. Thus, the revenue models use were still product or service oriented i.e. classified as "traditional revenue models" according to Bonnemeier, Burianek, and Reichwald (2010). Although, three companies had begun testing input- or output-based revenue models together with key customers.

Interviews constituted the primary source of data (Gioia, et al., 2013), and were performed in three waves, one for each phase of the research, and amounted to 25 in total, 14 with manufacturing companies and 11 with experts. Out of these 25 interviews, 19 were face-to-face and six were executed over phone or Skype. The first wave of interviews (7 in total) was exploratory and aimed to get an overall understanding of the situation and problem (Leech & Onwuegbuzie, 2008) and to set the direction for subsequent research. The first wave of interviews also validated some ideas in the existing literature, contradicted others, and guided the formulation of the research purpose. The second wave of interviews (13 in total) was semi-structured (Ghauri & Grønhaug, 2005) and followed a standardized interview protocol. The third wave was confirmation interviews (5 in total), with a purpose to fill remaining information gaps from previous interviews, and to clarify and confirm key statements (Leech & Onwuegbuzie, 2008).

Interviews were complemented with a total of three half-day-workshops, one for each phase of the research. For each workshop, notes were taken and subsequently analyzed together with other data for each research phase. The first workshop was exploratory and intended to create a deeper understanding of the practical side of the research problem. Participants came from one of the manufacturing companies, complemented with two consultants. The second workshop was more structured and focused on the process of moving from a pure product manufacturer to one of integrated product-services, and the required changes to revenue models. This time, three consultancy companies participated together with staff from the same manufacturing company as the first workshop. The third

workshop was conducted together with three consultancy companies and focused on the development of the design process for new revenue models, to ensure practical usability.

A final source of data was documented material, such as internal reports, information sheets and investor presentations, which contributed with general information about the interviewed companies. It also validated some insights that emerged in workshops and interviews.

Data analysis

Due to the study's abductive nature, data analysis was conduct in parallel with data collection and was continuously compared with prior literature. Data was analyzed by means of thematic analysis (Braun & Clarke, 2006). As prior research on revenue model design is scarce, we paid specific attention not to "squeezing" data into pre-defined theoretical categories, and hence we allowed initial codes, sub-themes and themes to emerge without requiring immediate fit with existing theories (Gioia, Corley, & Hamilton, 2013). This approach allowed us to create a thematic map by means of a four-step coding process:

The purpose with the first step - familiarize with the data - included reading through the interview materials and workshop notes several times to acquire an in-depth understanding of the content. Notes were taken on ideas for codes, themes and potential findings. For example, the importance of focusing on customers' needs was found in this phase and was later translated into a formal sub-theme. The second step – generate codes - was similar to (Corley & Gioia, 2004) idea of 1st-order concepts and thus used respondents' terms and phrases to identify those parts of the raw data that could explain the studied phenomenon in a meaningful way (Braun & Clarke, 2006). To stay true to the respondents' words and formulations, the terms and phrases were changed to a minimum (Corbin & Strauss, 2008).

During the third step - search for sub-themes and themes - similarities and differences amongst codes were analyzed and then grouped into themes and sub-themes, which comprised an initial thematic map (Braun & Clarke, 2006). Here, the codes connection to existing literature was analyzed to guide the development of appropriate labeling of themes (Braun & Clarke, 2006). For example, the theme 'Sequence of activities' was chosen to represent the processual connection of the purpose, i.e. how something 'come about'. This step is thus similar to axial coding, were concepts are compered and relationships among the concepts are identified (Corbin & Strauss, 2008). Finally, in step four, we created a final version of the thematic map by further reviewing themes, sub-themes and codes, first individually and then in relation to each other (Braun & Clarke, 2006). This full set of codes, sub-themes and themes constitute the thematic map, which creates a visual representation of the process from raw data to the final data structure.

Analysis and findings

Due to the space limitations for the conference, this section presents only a brief summary of the findings. On an overall level, the analysis reveal that new revenue models come about through a highly iterative process, characterized by fast feedback loops and trial-and-error learning. Furthermore, most respondents state that the process of designing revenue models for smart connected product-services should be customer centric, meaning that the design process should start with a clear customer need and then design and test the revenue model together with a selected customer before further upscaling. In the words of one of our respondents:

'You must get feedback fast and then you make necessary changes to your revenue model, and then you test again until you have found the right model.' – Director Product Management, Information and Connectivity, Product Manufacturer

From the analysis emerges a framework for revenue model design which is more similar to Agile or Scrum approaches to innovation (Cockburns & Highsmith, 2001) than to the traditional innovation process models, like the stage-gate approach, which follows a more sequential and stepwise logic (Cooper, 2014). Our framework outlines a process for how to design revenue models for smart connected product-services, and thus constitute a visual representation of the empirical findings. The framework attempts to illustrate the most significant characteristics and main ideas. The framework can be used by manufacturing firms as a roadmap and may serve as a point of departure for further discussions on how to explore new business opportunities and create more viable revenue models for smart connected product-services. Furthermore, it may serve as a decision support tool on overall process outline and which key activities to be considered when designing new revenue models, and/or when to give a new revenue model a green light or a "go". The iterative process and its eight steps are divided into three phases; Insight, Development and Upscaling (see Figure 1).

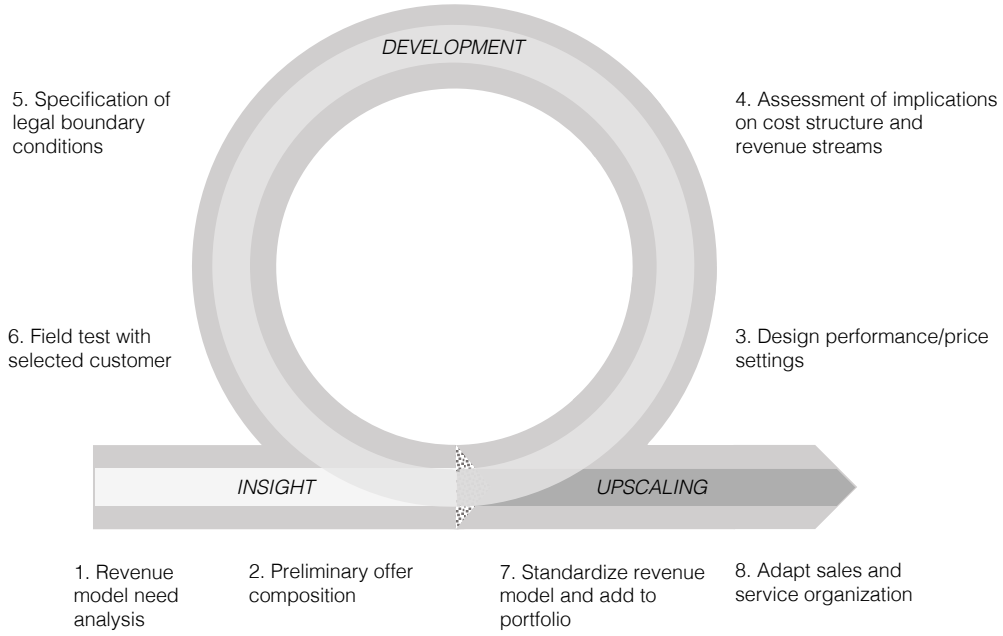

Figure 1 – Framework for designing revenue models for smart connected products.

The insight phase aim to set directions for the manufacturing company and create an in-depth understanding of customers' needs, e.g. payment intervals that relate to the customers' operations, business logic, cost structures and revenue streams. This phase will help in aligning customer and provider incentives.

1. *Revenue model need analysis*
   - Assess internal strengths and weaknesses to understand underlying capabilities and which resources (time, money, competences, etc.) that is needed to become a profitable provider of smart connected product-services.
   - Decide on internal strategy towards product-service integration, i.e. by analysing risks and rewards when moving towards a more service-oriented strategy.

- Perform observations and interviews with customers to understand their needs (not just wishes or "fun features") i.e. ensure willingness to pay for a new offering.

2. *Preliminary offer composition*
   - Evaluate how the smart and connected components can help to fulfil the customers' needs.
   - Decide on offer composition, i.e. what should be the product and/or service offer.

The development phase aims to further develop the emerging revenue model by making key decisions on its components and testing it with a selected customer. Further, this phase ensures informed decisions by testing the revenue model both theoretically and practically.

3. *Design performance/price settings*
   - Evaluate suitable performance/price parameters, i.e. product, service, input for the customer, or output for the customer. For example, a traditional product transaction where the price it based on product ownership, or the possession rights such as rent or leasing with a stronger focus on value-in-use. Traditionally, for service deals, the price is based either on costs to deliver a service, or the actual utilization of the service. An example of price parameters based on input is time or intensity of usage of the product. Finally, examples of output parameters are performance level such as quality or availability, or more value-oriented ones like optimization or cost savings.
4. *Assessment of implications on cost structure and revenue streams*
   - Assess and adapt effects on cost structure depending on chosen offer configuration and performance/price parameters. For example, if choosing a performance parameter like usage time, the income will typically vary with how much the product is used and, consequently, it might be relevant to move the cost structure towards variable cost rather than fixed.
   - Evaluate suitable revenue stream options, i.e. transactional (one-time) payments and/or recurring payments over time.
5. *Specification of legal boundary conditions*
   - Create what-if scenarios (e.g., one optimistic, one realistic and one pessimistic) by varying financial parameters such as price, cost and demand, to understand critical limits.
   - Decide on back-stops and boundary limitations that needs to be incorporated/controlled for in the contract. For example, this is a way to ensure a minimum limit for the number of usage time to charge the customers for, or to control price levels depending on the amount of usage hours.
6. *Field test with selected customer*
   - Run tests together with a selected customer to facilitate a learning period with fast feedback loops and iterations.
   - Evaluate test result continuously and adapt performance/price parameters accordingly.
   - Decide on a go-/no-go decision for the revenue model.

The Upscaling phase aim to "prepare" the emerging revenue model, as well as the manufacturing firm that developed it, for a large-scale rollout to additional customers. This rollout could be within the same customer segment, or additional one(s). A key challenge is to stay attuned to the idea of high levels of customization but at the same time reap scale benefits as new customers are added. Another objective is that the revenue model is firmly anchorage at all levels in the organization and not merely at top and middle management.

7. *Standardize revenue model and add to existing portfolio*
   - Evaluate suitable target customer segment(s) based on, for example, geographic area, size, or industry characteristics.
   - Standardize revenue model by deciding on a set of value proposition items and performance/price parameters available for customers to choose from.
8. *Adapt sales and service organization*
   - Educate the larger sales force on the new revenue model and its implications, and how to communicate the added value to customers.
   - Adapt the service organization's processes and routines to be able to handle e.g. proactive rather than reactive service intervals, and closer and longer customer relationships.

Conclusion

Smart and connected product-services imply major changes to manufacturing industries and manufacturing firms. While such products may be a source of future competitive advantage, they need to be accompanied by appropriate value capture mechanisms explicated in a revenue model. Otherwise, a focal manufacturing firm may create a lot of value for customers but without capturing this value. Our study shed light on how to better capture value by explicating the design process for revenue models for smart connected product-services. This design process is highly iterative, and is conceptually close to Agile or Scrum approaches to innovation. Moving the full cycle may be a lengthy process, and small-scale rollout and continuous learning is at the heart of the process. Collaborating with selected customers is a key, and a manufacturing firm will benefit from understanding latent customer needs on value creation in depth (rather than relying on expressed customer wants). Fundamentally, the framework we outline is a sense making devise. It provides novel insights about how to design revenue models in a structured way, by providing a framework on what steps and activities are most important to address. This process allow managers to make sense of current revenue models, and understand what is required to design new ones, which is a key to successful servitization in an ever more digitalized world.

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