Product + Service + Digital Systems Integration

Configuring Offerings for Business Model Innovation

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PRODUCT INTEGRATION
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JULIANA HSUAN

PRODUCT + SERVICE + DIGITAL SYSTEMS INTEGRATION:

CONFIGURING OFFERINGS FOR BUSINESS MODEL INNOVATION

JANUARY 2021

PRODUCT + SERVICE + DATA INTEGRATION PROJECT

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INDUSTRIENS FOND FREMMER DANSK KONKURRENCEEVNE
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ABSTRACT

This booklet provides a brief overview of the complexity behind business model innovation and the integration of product, service, and digital (PSD) systems. It illustrates and introduces modularity as a concept for managing such complexity in each of these systems. In the PSD system, eight distinct configurable offerings are introduced. There are many trajectories a manufacturer can follow in its PSD integration journeys. The various journeys are dependent on the manufacturer's standardization and innovation efforts as well as on the extent to which it has the capabilities and resources (including physical assets, operational and human resources) required for the desired journey.

INTRODUCTION

The integration of products and services is known as servitization. Specifically, servitization is about competing through value propositions that integrate service with product offerings (Avlonitis et al., 2014).

The Covid-19 pandemic placed almost anything digital (e.g., digitalization, digital technologies, apps, software, industrial internet of things, industry 4.0, data systems, etc.) at the centre of many companies. Manufacturers that have embarked on servitization have to embrace the new benefits and challenges imposed by data and its management.

A handful of Danish companies have advanced in integrating product, service, and digital (PSD) systems into their strategies. A survey of the Danish servitization landscape (Hsuan et al., 2018) found that 55% of the respondents (out of a sample of 143 companies) have started to offer "smart services" (i.e. services related to the utilization of technology), such as licensing services, remote monitoring, data analytics / diagnostics, system upgrades, and software upgrades. The survey also shows that a majority of Danish firms are investing significant resources on the development of services.

One of the barriers to achieving PSD integration is the lack of a business model and operations direction. Based on the development of innovative solutions and strategy, firms need to configure (and/or re-configure) their business models to enable competitive operational excellence in delivering PSD solutions. Whatever PSD integration strategy a manufacturer plans on adopting, the decisions must be made and the subsequent implementation strategy established in the light of the company's capabilities and willingness to innovate its business model for PSD integration, in the short and long term. Hence, manufacturers should be asking the following questions:

- How do we operationalize our business model innovation in terms of Product + Service + Digital (PSD) systems strategy?
- What trajectories should we pursue to implement the desired strategy?

This booklet addresses these questions through the following perspectives, organized as follows:

What is Business Model Innovation? (p. 6)
This section highlights how companies do business and renew existing business models to create business around product, service and digital systems.

Modularity: An Approach to Managing Complexity (p. 7)
The concept of modularity is introduced as an approach to managing complexity in PSD business model configurations in terms of: 1) integral and modular product systems, 2) basic and advanced service systems, and 3) standardized and proprietary digital systems.

Configuration Options for PSD Integration (p. 13)
There is a wide range of configuration options for creating PSD offerings. One key decision is about achieving a balance between standardization and innovation of the possible configurations, in the short and long term.

PSD Strategic Pathways and Trajectories (p. 14)
This section introduces eight distinct configurations that companies can adopt. There are endless pathways and trajectories companies can pursue to achieve the desired PSD configuration, depending on standardization and innovation efforts.

Resources for PSD Integration (p. 16)
To manage PSD configurations and related integration trajectories, companies should have a good overview of their capabilities and the resources required for the desired journey, including physical assets, operational, and human resources.

Conclusion (p. 17)
This section concludes the booklet with a set of questions manufacturers should consider for managing pathways and trajectories in order to achieve the desired strategy.

References and Further Reading (p. 18)
References used in the booklet are provided in addition to suggestions for further reading.

WHAT IS BUSINESS MODEL INNOVATION?

A business model explains how companies do business (Zott et al., 2011) and how companies' new ideas and technologies are commercialized, since a business model (Chesbrough, 2010, p. 355):

- articulates the value proposition
- identifies a market segment and specifies the revenue generation mechanism
- defines the structure of the value chain required to create and distribute the offering and complementary assets needed to support position in the chain
- details the revenue mechanism(s) by which the firm will be paid for the offering
- estimates the cost structure and profit potential
- describes the position of the firm within the value network linking suppliers and customers
- formulates the competitive strategy by which the innovating firm will gain and hold advantage over rivals

Business model innovation renews existing business models by paving the way for companies to achieve corporate transformation and renewal (Demil and Lecocq, 2010). At the heart of PSD integration, manufacturers are concerned with how to create business around product, service and digital systems, because configuration of business model innovation is not trivial. Configuration entails possibilities for mixing and matching product, service, and digital systems, in each case with a whole range of additional options. This means that configuration of offerings can have endless options, which are dependent on various decisions related to the allocation of resources for development and organization. Such decisions are made in the light of the competitive advantage of the company, for survival or growth.

Hence there is a wide range of both opportunities and barriers to consider that are specific to the manufacturer's industry and competitive landscape. To achieve competitiveness and growth through business model excellence, companies need to address the following questions (Ritter, 2014, p. 13):

- What do we want to achieve in and through our organizations?
- For whom are we a valuable partner?
- What do we offer?
- What is our value proposition and do our customers understand it?
- Which capabilities do our organization need?

As we can see, business model innovation and achieving business model excellence can be complex. How do we make sense of such complexity? What approaches can we apply to make such complexity manageable? In the next sections, we apply modularity thinking as a tool for dealing with this.

MODULARITY: AN APPROACH TO MANAGING COMPLEXITY

How would you tackle and manage complex products, services, or data systems? One approach is to divide the complex system into smaller segments (such as modules or components), so that each segment can be managed independently. This approach is known as modularity (Baldwin and Clark, 1997). Once the product, service or digital system components are separated, they can be mixed and matched to create endless configurations, from which customization for variety is realized (Voss and Hsuan, 2009).

In designs, modularity is generally conceptualized in terms of architectures that can range from modular to integral (Mikkola, 2006), as shown in Figure 1. Integral architectures are designed with performance and craftsmanship in mind and are typically composed of specialized components that are tightly linked together. This means that components cannot be changed easily without affecting the functionality of the entire system. For example, Formula One cars (i.e. the product system) are designed for high-end performance involving the simultaneous performance of the team (i.e. the service system) and a high-tech information technology (IT) system (i.e. the digital system) linking the car and the team.

By contrast, modular architectures are designed with economies of scale in mind and typically involve standard components which can easily be shared, substituted or replaced. For example, personal computers (the product system) have modular components (i.e. mouse, keyboard, operating system, screen, etc.). There are plenty of options on the market if any component needs to be replaced or serviced (i.e. the service system), including online purchasing and tracking (i.e. the digital system).

Figure 1. Modularity Continuum.

Modularity is a powerful concept for managing complexity when a system can be conceptualized in terms of architectures and how components are put together to configure the system. With this perspective in mind, the business model and product, service, and digital systems can all be modularized into smaller segments.

PSD BUSINESS MODEL CONFIGURATION

If we treat any PSD business model as a complex system, then it can be modularized into an independent product system, service system, and digital system; each of these systems can be further separated into components and related resources. This also means that each system can be integrated into new configurations. For instance, servitization strategies consider the integration of product and service systems, with or without a digital system. A digital system can be combined with a product system to create superior technology or it can be combined with a service system to enable efficient service provision. A fully integrated PSD configuration would involve product, service, and digital systems as a whole. Figure 2 shows the different configurations of product, service and digital systems for new business models.

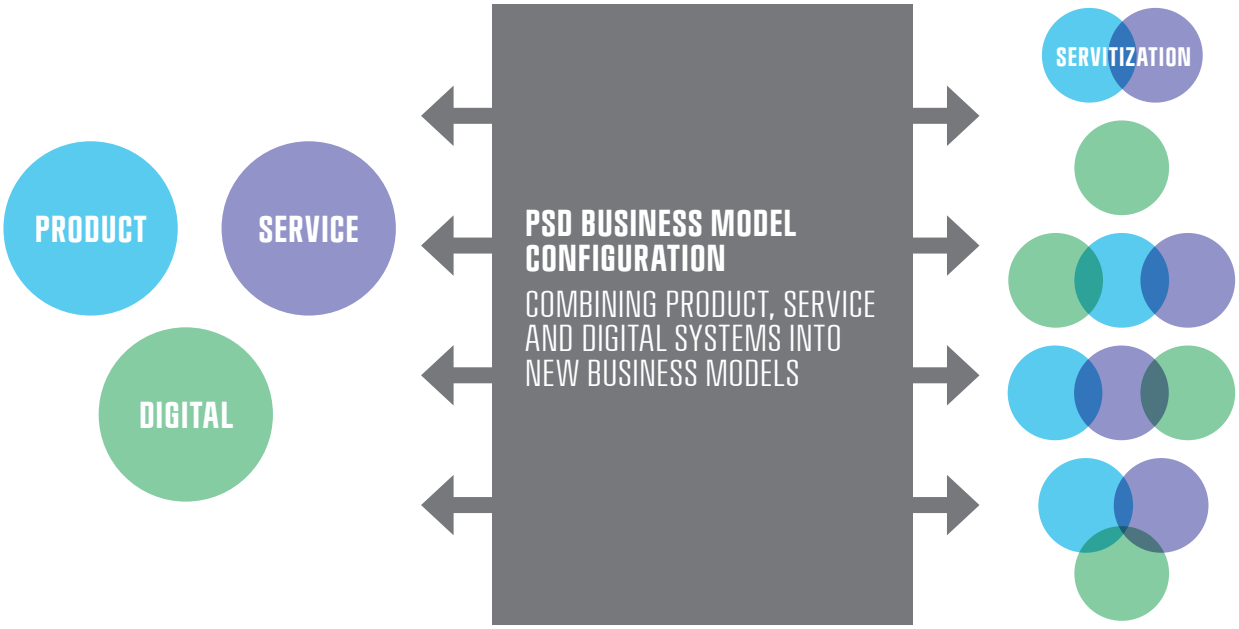


Figure 2. PSD Business Model Configuration.

Implementing the (re)configuration of business model innovation for PSD integration takes time and resources. As companies become more resilient and proactive in linking their value propositions to their customers, they may consider various configurations. In any case, with P, S, and D as separate systems and components, companies become flexible in mixing and matching different PSD combinations.

The next section looks at how we manage product systems.

MODULAR AND INTEGRAL PRODUCT SYSTEMS

Product systems can be broken down into smaller segments, with architectures ranging from modular to integral. There are many reasons why companies pursue either modular or integral product design strategies. Modular product systems usually have a large number of standard components, high component-sharing, high product variety and a high degree of customization. Platform strategies such as Dell computers, LEGO toys, etc., for instance, have modular product architectures. Integral product systems exhibit the opposite traits as such systems seek to focus on performance and craftsmanship, often with extensive use of proprietary technologies. Formula One cars are examples of integral product systems. Table 1 shows the trade-offs between modular and integral product systems.

Table 1. Benefits of modular and integral product systems (adapted from Mikkola and Gassmann, 2003).

Benefits of modular product systems	Benefits of integral product systems
• Task specialization • Platform flexibility • Increased number of product variants • Economies of scale in component commonality • Costs savings in inventory and logistics • Lower life cycle costs through incremental improvements such as upgrades, add-ons and adaptations • Flexibility in component reuse • Independent product development • Outsourcing • System reliability due to high production volume and experience curve	• Interactive learning • High levels of performance through proprietary technologies • Systemic innovations • Faster access to information • Protection of innovation from imitation • High entry barrier for component suppliers • Craftsmanship
Examples: elevators, mobile phones, personal computers, LEGO toys	Examples: Formula One cars, space satellites, designer tailored-made furniture

Many product systems involve a combination of modular and integral characteristics. The important take- away for any manager is to understand the company's product development capabilities and resources and its competitive position in the industry. While some companies and organizations continue to push the technological performance of their products (e.g., Tesla, Ferrari, NASA), others continue to improve the operational efficiency of their products through economies of scale (e.g., LEGO, Dell).

The next section looks at how we manage service systems.

BASIC AND ADVANCED SERVICE SYSTEMS

Services are different from products in many ways. For instance, services are intangible and perishable. The production, delivery and consumption of services all take place simultaneously. Services usually include people and information flow, making communication with customers a key interface.

Service systems can be conceptualized in terms of service architectures (Voss and Hsuan, 2009), ranging from basic services to advanced services. Table 2 shows the characteristics of basic and advanced service systems.

Basic service systems have many standard components (e.g., generic mass services), high levels of replicability (i.e. easily copied and replicated), low value-adding contribution (i.e. customers cannot change the services offered to fit their needs), and low differentiation (i.e. the same services are offered to all customers). Consequently, basic services are more affordable for the customers (Brax et al., 2017). Examples of basic services include service instruction books, help desks, call centres, basic repair and maintenance services.

Advanced service systems, by contrast, have few standard components (i.e. there is a high level of uniqueness), low levels of replicability (i.e. imitation by competitors can be difficult in the short term), high levels of value-adding contribution (i.e. the services are an integral part of the customer's processes), and a high level of customization and personalization (i.e. the delivered services are tailored to customers' individual needs). Consequently, advanced services may be expensive for customers (Bigdeli et al., 2018). Examples of advanced service systems include R&D-oriented services and professional consulting.

Table 2. Characteristics of basic and advanced service systems.

	BASIC SERVICES	ADVANCED SERVICES
Generic elements	High	Low
Replicability	High	Low
Value adding portion	Low	High
Customization & personalization	Low	High
Service cost	Low	High
Examples	Service instruction books, help desks, call centers, basic repair and maintenance	R&D-oriented services and professional consulting

When deciding on which service system to adopt, companies should consider the trade-offs between basic services and advanced services. This is particularly crucial for traditional manufacturing companies that have just embarked on servitization, as they typically don't have expertise in service development (at least, not to the same extent as their expertise and capability in their product systems). To tackle this, it is useful for companies to have an overview of the services they can offer, and to decide on how to incorporate the desired services into their product offerings in an efficient and cost-effective way. For a list of 57 services grouped into 16 service categories, see *Servitization of industrial firms: Mapping and analyzing the Danish service landscape* (Hsuan et al., 2017).

The next section looks at how we manage digital systems.

STANDARDIZED AND PROPRIETARY DIGITAL SYSTEMS

The Covid-19 pandemic has accelerated the incorporation of digitalization applications and development into manufacturers' servitization strategies. Digital systems can range from standardized to proprietary (as shown in Table 3), and can be standalone or coupled with service and/or product systems. Standardized digital systems typically involve standard components that are homogenous and easily accessed. Open systems such as blockchain platforms are examples of standardized digital systems. Proprietary digital systems, on the other hand, tend to have specialized components that are developed for particular applications, which means that the digital components (such as data or software) are non-homogenous and access by third parties is prevented. Examples of proprietary systems include the data system management of sensors and artificial intelligence development for specific applications in the manufacturer's organization. Such systems are typically closed systems.

Table 3. Characteristics of standardized and proprietary digital systems.

	STANDARDIZED	PROPRIETARY
Standard components	High	Low
Accessibility	High	Low
Data homogeneity	High	Low
System type	Open	Closed
Examples	Blockchain platforms	Management system of sensors, artificial intelligence

In deciding whether to adopt a standardized or a proprietary system, companies need to undertake a detailed evaluation of their IT capabilities and resources. While some manufacturers already have digital system expertise in-house (e.g. due to the high-tech nature of their product systems), others have to depend on third parties (e.g. development of apps for better communication with customers). The management of data security and privacy through digital systems is of crucial importance. It is not unusual for manufacturers to acquire or collaborate closely with a specialized IT company.

Now that we have a better understanding of product, service and digital systems and their respective characteristics, we can discuss how P, S, and D can be configured for an optimal combination of offerings.

CONFIGURATION OPTIONS FOR PSD INTEGRATION

What is the optimal PSD offering that is both efficient, cost-effective, and adaptable in the face of change? How does business model innovation shape such decisions? One key decision involves the balance between standardization and innovation of the possible configurations, in the short and long term. While standardization provides efficiency (through economies of scale), innovation provides competitive advantage through performance and prevents imitation. In reality, the majority of systems are hybrid configurations, involving a combination of standardization and innovation, as shown in Figure 3.

There is a wide range of configuration options for creating PSD offerings from products (modular or integral), services (basic or advanced), and digital systems (standardized or proprietary). At one extreme, there is the simplest offering (modular product, basic service, and standardized digital system). At the other extreme, there is the innovative offering (integral product, advanced service, and proprietary digital system). In between there are the hybrid configurations involving a combination of standardized and innovative offerings.

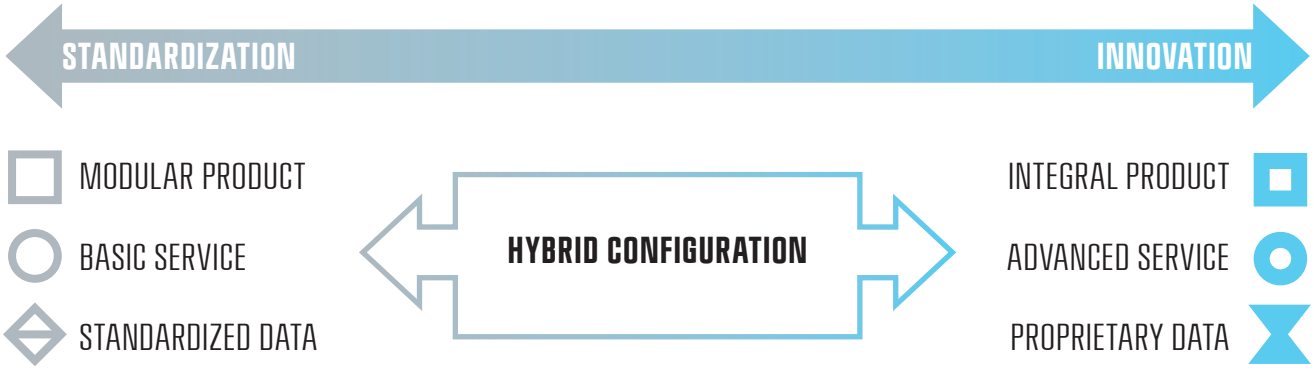


Figure 3. Configuration options for PSD integration.

Now that you have a good grasp of your company's capabilities and expertise in relation to its product, service, and digital systems and are also aware that there are six possible modules that can be mixed and matched, you can play with various possible combinations and scenarios.

Configuring for innovation or standardization of offerings involves dynamic processes that establish the trajectories and pathways for achieving the business model innovation. This procedure is presented in the next section.

PSD STRATEGIC PATHWAYS AND TRAJECTORIES

Configurations can change due to standardization or innovation in the product, service or digital systems. This change captures the strategic pathways and trajectories of the transformation, as shown in Figure 4.

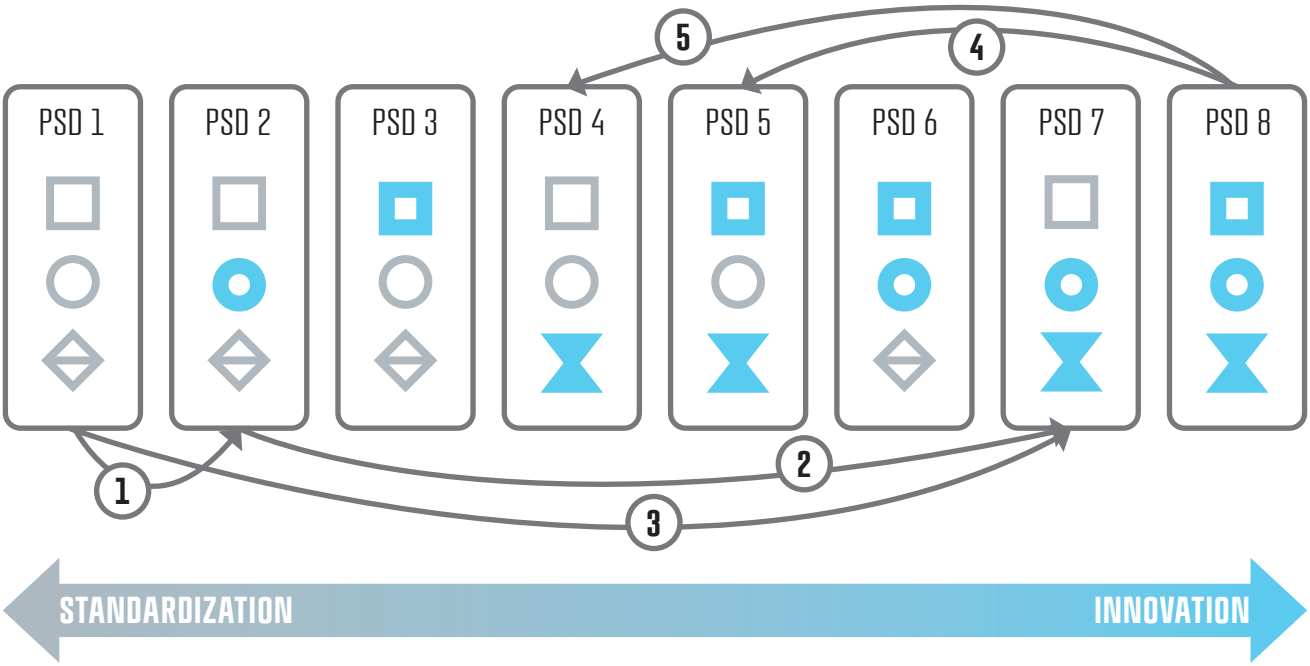


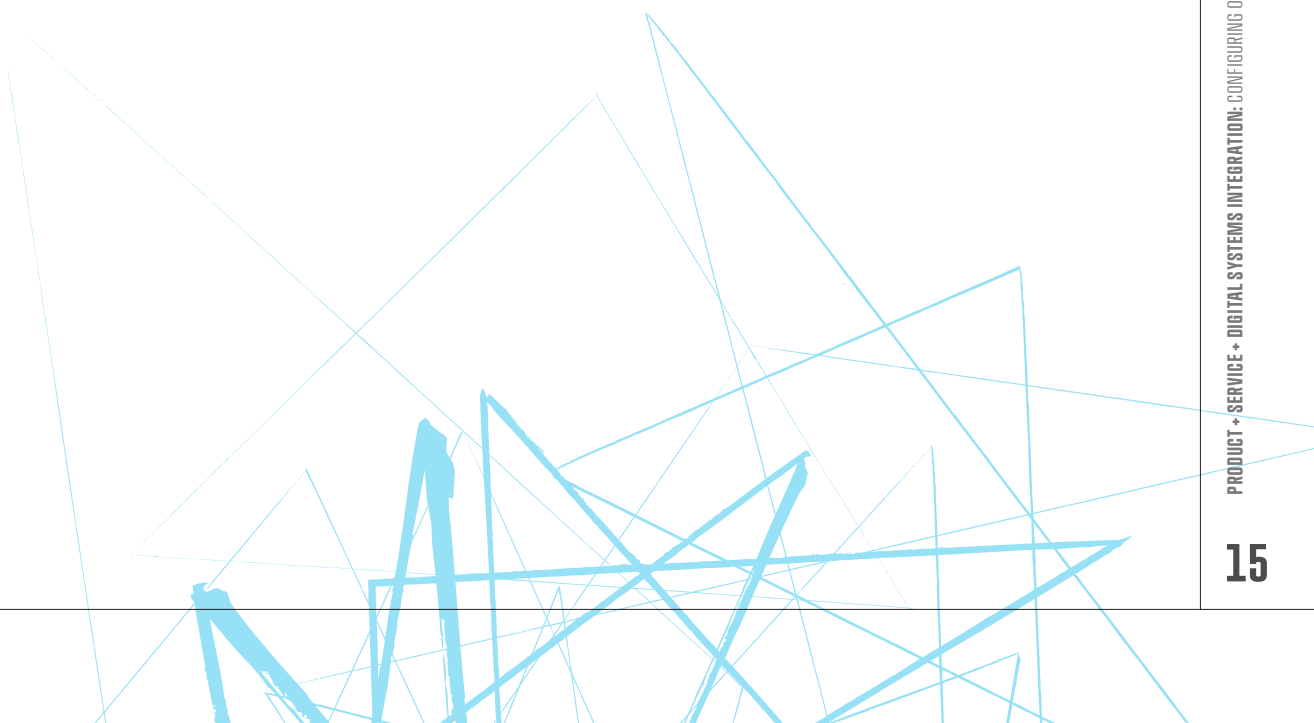
Figure 4. PSD Strategy Pathways and Trajectories.

There are eight configurations, with PSD1 as the simplest, PSD8 the most innovative, and six hybrid configurations. The starting point can take place at any of the PSD configurations (PSD1 to PSD8).

Depending on the industry and its competitive landscape, the desired level of innovation or standardization will vary. For example, any manufacturing company that is starting to consider servitization strategies obviously needs to consider how to incorporate service strategies into its product portfolio. The company might decide to start by advancing its basic services (path 1: moving from PSD1 to PSD2) or by coupling the advancement of services with new IT solutions (path 3: moving from PSD1 to PSD7). It might realize that path 3 is too risky due to the company's resource constraints or lack of knowledge in service development and data systems. Hence, it might approach the transition in an incremental fashion, by starting with service innovation, then digital system innovation (that is, taking path 1 then path 2 in order to arrive at PSD7).

PSD8 is the most innovative configuration with an integral product, advanced services and a proprietary digital system. For the future, any manufacturing company competing on the basis of this strategy might consider maintaining it by continuing to innovate in all three systems. However, market competition might force the company to consider other strategies. For instance, the company might consider expanding its business into other markets by replicating its domestic business model. In order to achieve efficiency in the replication process, some sort of standardization needs to take place. The company might retain its proprietary digital system and only standardize its service system (path 4) or make its product system more modular (path 5).

Any trajectory, whether based on a decision to innovate or to standardize the configuration of the PSD offerings, requires careful evaluation of the required resources.



RESOURCES FOR PSD INTEGRATION

There are many trajectories a manufacturer can pursue in its PSD integration journey. Whatever the chosen trajectory, (re) allocation of resources must be critically considered. There is no one-size-fits-all strategy and there is no guarantee of success. Even standardization of processes takes time and investment! In any case, companies should have a good overview of their capabilities and of the resources required for the desired journey vis-à-vis the competitive landscape of their business and the viability of their supply chain resilience. Table 4 lists examples of physical assets, operational, and human resources.

Table 4. Physical assets, operational and human resources for PSD integration.

PHYSICAL ASSETS RESOURCES	OPERATIONAL RESOURCES	HUMAN RESOURCES
• New products • Plants • production technology • Inventory • Data systems and process technology	• Supply chain risks • Supplier relationship • Customer relationship • Logistics and distribution • Pricing and contracts • Sustainability • Outsourcing vs. insourcing	• Service expertise (new service design, sales, pricing, etc.) • IT expertise (development or application of IT systems, either in-house or by third parties)

It might seem obvious that PSD integration requires physical assets, operational and human resources. The challenge is to have a comprehensive overview of the resources for all three systems: product, service and digital. This requires managers from different departments or functions to communicate with each other and share learnings. Because PSD integration also involves supplier and customer processes, transparency in the supply chain presents an added challenge.

CONCLUSION

This booklet provides a brief overview of PSD integration and how manufacturers can manage PSD complexity through modularization strategies. It takes into consideration the trade-offs between standardization and innovation, which have a major impact on a company's goal of striking a balance between efficiency and performance as well as on replication and imitation.

As manufacturers innovate their business models for PSD integration, the following questions about managing the pathways and trajectories in order to achieve the desired strategy should be considered:

- What are the PSD configuration options available for you to choose from?
- How do the PSD configurations impact your competitors, suppliers and customers?
- Which PSD configurations are feasible for your company in one year, five years or longer?
- How are you going to get there?
- Do you have the resources?
- What resources should you prioritize? Why?
- How do you monitor progress?
- Do you have a measurement system?

These questions provide a starting point for companies to understand the complexity behind managing resources for PSD integration. They should lead managers to reflect on the strategic decisions related to the combination of product, service and digital systems (together as one system or as separate systems) as well as on how such decisions shape business model innovation for excellence.

REFERENCES

Avlonitis, V., Frandsen. T., Hsuan, J., & Karlsson, C. (2014). Driving competitiveness through servitization: *A guide for practitioners*. Copenhagen Business School.

Baldwin, C.Y., & Clark, K.B. (1997). Managing in an age of modularity. *Harvard Business Review*, 75(5), 84–93.

Bigdeli, A.Z., Baines, T., Schroeder, A., Brown, S., Musson, E., Shi, G.V., & Calabrese, A. (2018). Measuring servitization progress and outcome: the case of 'advanced services'. *Production Planning & Control,* 29(4), 315–332.

Brax, S.A., Bask, A., Hsuan, J., & Voss, C. (2017). Service modularity and architecture: An overview and research agenda. *International Journal of Operations & Production Management,* 37(6), 686–702.

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning,* 43, 354-363.

Demil, B., & Lecocq, X. (2010). Business model evolution: In search of dynamic consistency. *Long Range Planning*, 43, 227-246.

Hsuan, J., Frandsen, T., Raja, J., & Basner, K. (2017). Servitization in industrial firms: *Mapping and analyzing the Danish service landscape.* Copenhagen Business School, CBS.

Hsuan, J., Frandsen, T. and Raja, J. (2018). Survey of the *Danish servitization landscape: Service performance and service strategies.* Copenhagen Business School, CBS.

Mikkola, J.H. (2006). Capturing the degree of modularity embedded in product architectures. J*ournal of Product Innovation Management,* 23(2), 128–146.

Mikkola, J.H., & Gassmann, O. (2003). Managing modularity of product architectures: Toward an integrated theory. *IEEE Transactions on Engineering Management,* 50(2), 1–15.

Ritter, T. (2014). *Alignment Squared.* CBS Competitiveness Platform, CBS.

Voss, C.A., & Hsuan, J. (2009). Service architecture and modularity. *Decision Sciences,* 40(3), 541–569.

Zott, C., Amit, R., & Massa, L. (2011). The business model: recent developments and future research. *Journal of Management,* 37(4), 1019-1042.

FURTHER READING

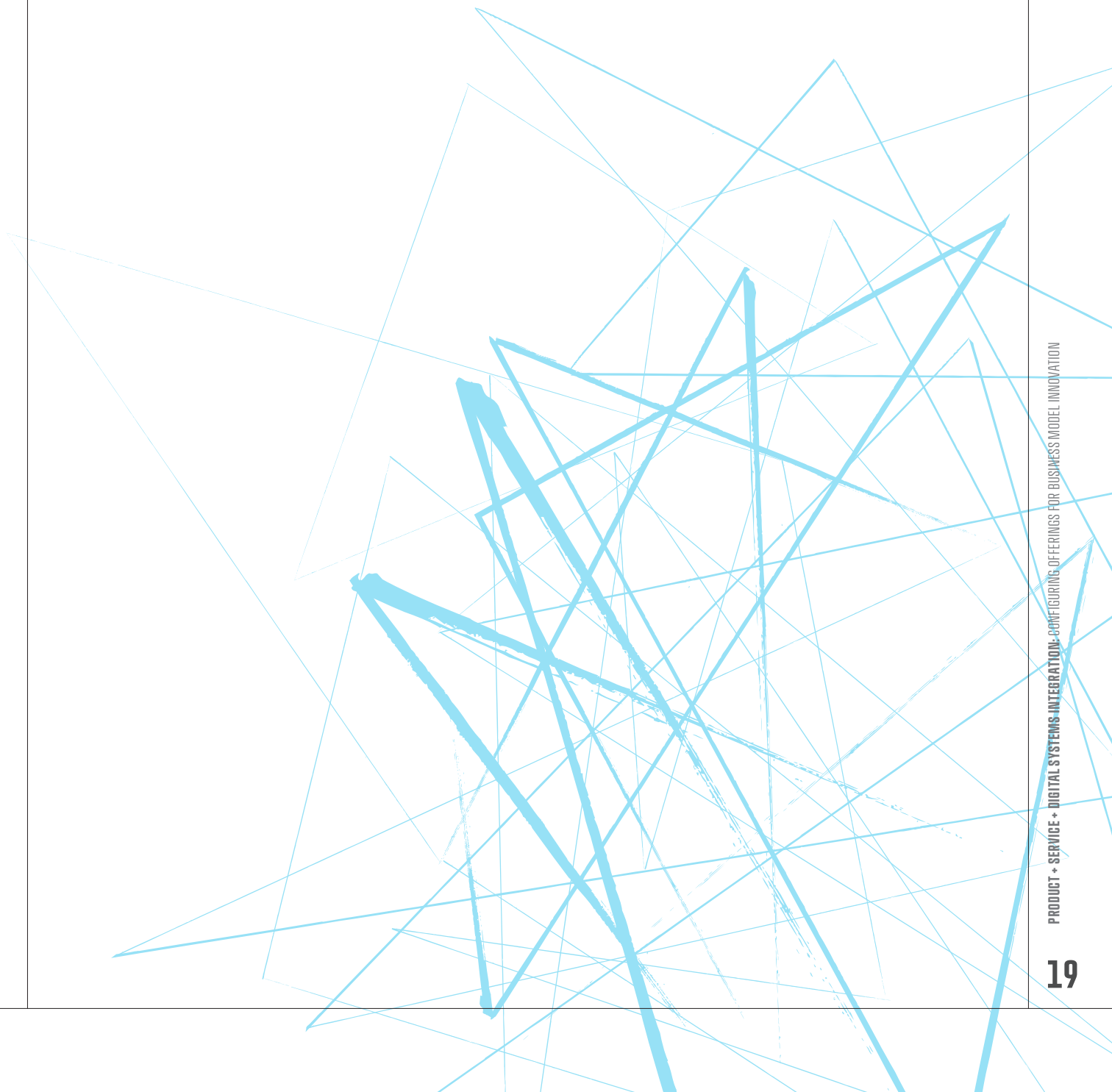
Aversa, P., Haefliger, S., Rossi, A., & Baden-Fuller, C. (2015). From business model to business modelling: Modularity and manipulation. *Business Models and Modelling,* 33, 151–185.

Foss, N.J., & Saebi, T. (2017). Fifteen years of research on business model innovation. *Journal of Management,* 43(1), 200–227.

Kastalli, I.V., Van Looy, B., & Neely, A. (2013). Steering manufacturing firms towards service business model innovation. *California Management Review,* 56(1), 100–123.

Sjödin, D., Parida, V., Jovanovic, M., & Visnjic, I. (2020). Value creation and value capture alignment in business model innovation: a process view on outcome-based business models. *Journal of Product Innovation Management,* 37(2), 158–183.

Sousa, R., & da Silveira, G.J.C. (2017). Capability antecedents and performance outcomes of servitization: differences between basic and advanced services. *International Journal of Operations & Production Management,* 37(4), 444–467.



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