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Visualising the route of value-creation: Stakeholder engagement needs in early-stage system development

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VISUALISING THE ROUTE OF VALUE-CREATION - IDENTIFY STAKEHOLDER ENGAGEMENT NEEDS IN EARLY-STAGE SYSTEM DEVELOPMENT

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ABSTRACT

Companies and organisations design, develop, and market new systems of products and services, also known as product service-system (PSS), through the process of translating beneficiaries' needs into design specifications, and managing stakeholders in the PSS development process. Companies and organisations that manage the early-stage development process well could potentially reduce cost and time to market. One way to determine if a new PSS is successful is how attractive it is to its intended beneficiaries, where beneficiaries are those who generate value when using the new product or experiencing the new service.

This study explores how to combine concepts from new PSS development, value-in-use, and stakeholder engagement, to identify the engagement requirement of stakeholders of a PSS at its early stage of development. The intention is to contribute to midrange theories that bridge the general theory of service-dominant logic and evidence-based research about value co-creation. For practitioners, a workshop approach – stakeholder-value mapping - to identify stakeholder engagement needs that generates multiple visual representations is emerged. The final output of this workshop approach is a visual representation called the stakeholder-value map. The stakeholder-value map facilitates development teams to visualise the PSS' route(s) of value-creation, and then to discuss the opportunities to engage stakeholders differently from the teams' original plan to increase the new PSS's market success.

KEYWORDS

Product-service system (PSS), System design, Stakeholder, Value-in-use, Service-Dominant logic, Visualisation

INTRODUCTION

To stay competitive or to strive for a circular economy, many companies have adopted the concept of total care products (Alonso-Rasgado et al., 2004; Tukker, 2015), caring beyond the exchange of product ownership to the utility of system comprising product and service elements (Sakao & McAloone, 2011) - or product-service system (PSS) (Goedkoop et al., 1999). PSS development process has many components, interdependencies, diversity, and variabilities (Zou et al., 2018), making this risky business activity complex to manage (Calantone & di Benedetto, 1988). There are many tools for designers in new PSS development, which are means to apply designers' skills in examining solutions for a specific aim in the context of a design approach (Lutters et al., 2014).

This research study focuses on PSS' early-stage development, because it is a stage before most of the PSS lifecycle cost is committed (Yip et al., 2015). It aims to propose a tool for practitioners to employ, in the early stage of PSS development, for identifying stakeholder engagement needs throughout the development. Stakeholder engagement refers to one/two-way activities aim to impact stakeholder relations in a moral, strategic, and/or pragmatic manner (Kujala et al., 2022).

The proposed tool is a workshop approach called stakeholder-value mapping. It utilises a standard procedure to generate multiple visual representations, with the end result - the stakeholder-value map - highlighting the route(s) of value-creation of a PSS. The proposed approach intends to help practitioners identify key stakeholders, the how and when to interact with whom, to increase market adoption of the new PSS when it is launched. Increase in market adoption can be viewed as increase in value-creation for users and beneficiaries, as value is created when PSS is in-use (Vargo & Lusch, 2004, 2016). The attractiveness of using visual representations for the stakeholder-value mapping approach is that visual representation makes invisible relationships apparent (Kazmierczak, 2001) and mobilises actions (Kerr & Phaal, 2017). For academia, this study intends to contribute to midrange theories that bridge the general theory of service-dominant logic and evidence-based research about value co-creation (Vargo & Lusch, 2017).

Four cases were completed at the time of writing. Though the stakeholder-value mapping approach is emerged, it is complex and cannot be used without the researcher's guidance. The researcher reflected on the usefulness of each step in the approach with the intent of simplifying it. In the following sections, a literature review of the relevant concepts of this study is first presented followed by the presentation of the methodology. The original workshop approach that the first stakeholder-value mapping approach (SVM) is based on is then presented. The results and learning of the application of SVM on the four cases is then presented, followed by the simplified approach of stakeholder-value mapping approach (SVM-II). The retro-application of the simplified approach on the four cases is then discussed and the next steps presented. As a conclusion, the potential contributions of the study to academia and practitioners are presented.

LITERATURE REVIEW

This literature review covers the key concepts behind this study: PSS, how PSS creates value through the lens of Service-Dominant (SD) logic, stakeholder engagement in PSS development, and the benefits of using visual representations.

Product-Service System

In this study, the ‘product’, ‘service’, or ‘solution’ analysed in the case studies are referred to as product-service system (PSS) or simply as system. One of the earliest definitions of PSS is “a marketable set of products and services capable of jointly fulfilling a user’s need” (Goedkoop et al., 1999, p. 18). A system carries the meaning of “the whole is more than the sum of its parts” and that it is complex and involved interacting elements (von Bertalanffy, 1950, pp. 142–143). This definition of system does not contradict that of Goedkoop et al. (1999). The definition of PSS has then evolved, and the description of PSS is numerous, diverse and at times conflicting (Rizvi & Chew, 2018). The researcher has adopted the view that products do not have to be tangible, which is a traditional demarcation of products and services (Yip et al., 2019), as the tangibility view would have excluded digital products. In this study, the definition of PSS is a marketable system comprises of interacting product and service elements (Goedkoop et al., 1999; von Bertalanffy, 1950), where the product elements do not lose their identity over time and can be stocked-up, while the service elements cannot be stocked-up and require the presence of both producer and consumer (P. Hill, 1999).

Service-Dominant Logic and Value in-use

The Service-Dominant (S-D) logic challenges the goods-dominant view of value embedded in products and exchanged through transactions. Instead, it highlights the dynamic, service-oriented nature of value creation, where resources and competences are applied through service ecosystems to co-create value with various actors (Vargo & Lusch, 2017). Here, service ecosystem is defined as system of resource-integration actors that are connected by shared institutional arrangement within economic and social networks and participate in mutual value creation through service exchange (Vargo & Lusch, 2016). Vargo & Lusch (2017) traced the evolution of S-D logic, highlighting its foundational role in service science and its widespread diffusion across marketing, business education, management, healthcare, arts, design science, and information systems research. This broad adoption underscores S-D logic's unifying framework, offering a systemic perspective for understanding complex value creation processes within service ecosystems.

The concept of value-in-use stems from S-D logic (Vargo & Lusch, 2004) and is closely related to the concept of manufacturers’ role in co-creating value with customers (Kowalkowski, 2011). In S-D logic, the proposition is that value is always co-created with the beneficiary coordinated through institutional arrangements. Value is uniquely determined by its beneficiary (axiom 2, 4 and 5 of the S-D logic) (Vargo & Lusch, 2016) and is context dependent (Vargo & Lusch, 2008).

Stakeholder identification in PSS development

This sub-section covers the definition of stakeholders, stakeholder identification methods for PSS development, the definition of stakeholder engagement, and methods to incorporate stakeholders' interests in the PSS development process.

The definition of stakeholders in this study is adapted from Freeman's (1984): stakeholders are groups or individuals who can affect or are affected by the new PSS. There are several stakeholder theories that could help companies and organisations to better manage their stakeholders. For example, agency theory has been extended to explain the relationships among a company's stakeholders and the behaviours of its managers (C. W. L. Hill & Jones, 1992; Quinn & Jones, 1995). For PSS development, there are proposals to identify stakeholders using the concept of direct and indirect product and service stakeholders (Rondini et al., 2015) and along the lifecycle of a product (Bertoni et al., 2016; Pigosso & Mcaloone, 2016).

In this study, a four-level stakeholder identification framework for new system development that contains 32 internal and external stakeholder groups (Yip & Juhola, 2015) is adopted. This framework has been found useful by companies to systemically identify stakeholders of the new PSS they are developing (Yip et al., 2019). The four different levels of stakeholders are: (1) those who are in the environment where the new PSS is to be used in; (2) those who are involved in the development and operations of the new PSS; (3) those who are to manage and operate the product portion of the new PSS; and (4) those who are delivering or receiving the services enabled by the products of the new PSS. In this framework, internal stakeholders are defined as employees of the company developing the PSS, and external stakeholders are groups, including institutions, that are external to the company.

Once stakeholders are identified, companies and organisations developing new PSS would consider engaging them. Stakeholder engagement, a theoretical construct that gained more attention in 2000s, proposes the idea of engaging stakeholders for long-term value creation (Kujala et al., 2022). Stakeholder engagement can be defined as "the aims, activities, and impacts of stakeholder relations in a moral, strategic, and/or pragmatic manner" (Kujala et al., 2022, p. 60). The engagement activities for PSS development could involve one-way information flows, two-way communications, supportive structures, and top management commitment (Kujala et al., 2022). Specifically for new PSS development, there are tools proposed in literature that assist companies and organisations to translate and prioritise stakeholders' needs into the design specifications. These proposals include Kansei engineering (Nagamachi, 1995), quality function deployment (QFD) (Akao, 1990), Analytic Hierarchy Process (AHP) and its generalised form called the Analytic Network Process (ANP) (Saaty, 1983, 2008), the Kano model (Sauerwein et al., 1996), and their hybrids (e.g., Geng et al., 2011; Hartono et al., 2013; Lee et al., 2011; Raharjo et al., 2008; Tontini, 2007). Among the reviewed models and tools, QFD-based tools appear to be the most robust towards supporting the incorporation of multiple stakeholder interests into the design. It correlates customer needs with technical requirements and can be extended to correlate environmental needs with quality requirements (Ramani et al., 2010). In fact, the SDC approach that was the method initially used in this study, to be described later in the Methodology section, has been inspired by QFD.

In the reviewed literature, the engagement of the identified stakeholders in the new system development process is often discussed in two ways. First, stakeholders are implied to be engaged in the step to generate design specification, when companies elicit, capture and translate stakeholder needs as technical and quality requirements. Second, design methodology literature has proposed various degrees of involving users, such as lead-user involvement (von Hippel, 1976) and Living Lab (Dell’Era & Landoni, 2014). In this study, the timing and how to engage with stakeholders according to their interests and impact on the different configuration parts of a new PSS is explored, to improve the PSS’ success in generating value-in-use.

Semiotics and Visual Representations

Visual representations can be defined as knowledge and structures in the environment that allow human-being to interact with, and can be two-dimensional or three-dimensional (de Vries, 2012; Zhang, 1997). The theories underpinning the usage of visual representations to support design process appeared to be mainly from social and cognitive sciences. For example, the usage of diagrams to help people solving problems has been investigated in cognitive psychology (Zhang, 1997). The attractiveness of exploring the usage of a standard set of visual representations for PSS development is that using visual diagrams has the advantage of making the invisible relationships apparent (Kazmierczak, 2001), improving perception of system relationships (Logan et al., 2018), preventing cognitive inertia, and mobilising actions (Kerr & Phaal, 2017). The visual representations generated from the stakeholder-value mapping approach proposed in this study aims to enhance practitioners’ ability to recognise relationships between product and service elements in a PSS under development, as well as identify upfront at the early stage of development the gaps and opportunities in engaging stakeholders in the PSS development process.

METHODOLOGY

The philosophical position of this study is that a prescriptive approach to PSS development will result in better chance of value-creation. To develop a tool useful for practitioners, knowledge needs to be created jointly between researchers and practitioners. Given its epistemology, action research (Lewin, 1946), in particular Procedural Action Research (Maslen & Lewis, 1994) is selected as the method for this study.

Action research has been found to be appropriate to develop new process to support organisation’s strategy formulation (e.g., Platts et al., 1998). In a cyclical manner, action researchers diagnose specific situations, plan actions, take actions, evaluate effectiveness of the actions and specify learning (Lewin, 1946; Susman & Evered, 1978). By using similar cyclical action research steps, Platts et al. (1998) developed and tested their new manufacturing strategy process in workshops. They applied this new process in different situations and assessed its effectiveness using the criteria of *feasibility*, *usability*, and *utility* of the process (Platts, 1993; Platts et al., 1998). Feasibility assesses how well the process can be followed as laid down. Usability examines how easy it is to follow the process. Utility evaluates whether the process has resulted in the desired outcomes, and whether the participants found it useful (Platts et al., 1998). Maslen & Lewis (1994) formalised the work of Platts (1993) as Procedural Action

Research (PAR). In PAR, different case studies are to be identified to apply the procedure being developed, and the success of each application is to be tracked. The number of cases is not fixed as the objective is to reach procedural stability (Maslen & Lewis, 1994).

In this study, each case is a commercialised or halted new development project. To analyse the case, a procedure that was emerged and still in development, called the stakeholder-value mapping (SVM) approach (to be presented later in this section), was applied to understand where and which stakeholders could have been engaged differently. Four case studies were completed at the time of writing this paper.

The SVM approach (Yip, 2023) was developed on top of a research-based business improvement tool called System Design Characterisation (SDC) (Yip et al., 2016). In the following sub-sections, the SDC approach is first presented, and then where SVM differs from SDC is highlighted. Then, how the SVM approach needs to be simplified for better usability and utility is described.

The SDC approach

SDC is developed between 2016-2019 for application in business settings (Yip et al., 2016) from the research instrument PSS Characterisation Approach (PSSCA) that was stabilised in 2014. PSSCA is a workshop approach that uses visual representations to analyse a system for its four design characteristics. These four design characteristics have been found to be useful in clarifying design specifications (Yip, 2015). The first characteristic, the ‘customer perceived value-level’, is the value that the target beneficiaries perceive they can generate from the new system. The higher the value-level, the more desirable the system is. The second characteristic, connectivity number, is the number of interactions between the new and existing elements of a system or with its operating environment. This number shows the level of attention above routine design effort that the development team needs to give to the system design. The third characteristic, the type and degree of connectivity, is related to the connectivity number. The relationship can be ‘independent’ when there is no relationship between the new and existing elements; ‘linked’ when there is/are new elements depend(s) on the existing element(s) to function properly; and ‘incorporated’ when there is/are new elements impact(s) the functioning of existing element(s). The fourth characteristic, system configuration type, represents the structure of a system in terms of how the product and service portions interact. Eight molecular representations were emerged during the SDC approach development (Yip, 2022). The hypothesis was that any system configuration could be represented by a combination of the eight molecular representations.

The steps in the SDC approach are: (1) stakeholder identification; (2) element identification; (3) decomposition; and (4) representation. Step 1 is where the company/organisation participants identify the stakeholders of the new system using the stakeholder identification table from (Yip & Juhola, 2014). They are also to identify whether the stakeholders are viewed as important by the company/organisation to the new system being developed. Step 2 is where the researcher guides the company/organisation participants to think from a functional perspective to identify the key elements of the system. An element can be a component or a sub-system. All identified elements are marked whether they are existing or to be developed (new). The elements that are viewed as important by the

customers are also marked. Step 3 is the systematic layout of the identified elements, based on their interdependencies, from the highest to the lowest customer perceived value-level. The output is a water-fall-like decomposition diagram, with arrows showing the different types of interactions between the elements (an example can be seen in Figure 5.). Step 4 is to build mini-representations from the elements with 'incorporated' and 'linked' interactions in the decomposition diagram, and place them along the customer perceived value-level.

The Stakeholder-value mapping (SVM) approach

The SDC approach is extended to Step 5 – stakeholder-value mapping - to connect the stakeholders identified as important to the system with the customer perceived value-level, via the more complex element(s) that the stakeholders are associated with. The more complex elements here refer to those that have 'linked' or 'incorporated' interactions with other elements under the definition of the third characteristic in the four design characteristics. The value-level of each element is determined in the decomposition diagram produced in Step 3. The output of Step 5 is a stakeholder-value map, where the opportunities to better engage stakeholders in the development process are visualised, in particular, proposals of extending interest of some stakeholders to elements at adjacent value-levels are highlighted in orange dotted pattern (see Figure 2). The hypothesis is that stakeholders that form routes of value-creation, that is having one or more stakeholders that touch(es) all value-levels from the lowest to the highest, would be able to influence others in their perception of the value of the PSS being developed.

The next step of the SVM approach

Following PAR, the researcher reflected on the SVM approach developed so far. The researcher realised that while the participants of three of the four case studies agreed that the stakeholder-value map was useful, giving them insights of how to engage stakeholders differently, there were minimal interests to participate in Step 4, the building of the mini-representations, or to ask any questions about these mini-representations. In fact, to save time for the participants, in all four cases, the researcher completed Step 4 on her own, which took approximately two hours in each case. This would mean that if the participants were to complete Step 4 without the researcher's guidance, Step 4 would be too complex to follow – not feasible nor usable. To continue with the SVM approach development, using PAR's assessment criteria, the researcher must find ways to simplify the approach.

RESULTS

In this section, the four cases completed are presented and the learning from each case study is highlighted. The learning from the case studies has led the researcher to propose changes to the SVM approach. The new approach is called SVM-II.

Case A and Case B, conducted in 2020, belonged to the same company in the polymers industry. The commercialised PSS were for the medical market, with an embedded innovative polymer. The same participant participated in both case studies remotely due to COVID19 restrictions. The PSS in Case A was a new fraction fixation surgery that enabled patients to have faster fracture recovery. The PSS in

Case B was a dental prosthetics that improved dental patients' on-going experience. Case C was conducted in 2022, with an international manufacturer in the shoe and apparel industry. The PSS in Case C was called “confirmed release mechanics” (this is how the participant called it), which was developed to support hyped-market launch of selected products. This case was conducted remotely as the researcher and the participant were located in different countries and the participant had a very busy schedule. Case D was conducted between 2022-2024, with the long delays in between due to the limited common availability between the participants and the researcher. The case study was carried out remotely as the participants and the researcher are were located in different countries. The PSS in Case D was a special short course that was developed by institutions in the USA and delivered to government officials in Vietnam, with the aim to transfer the capability of developing this type of courses to a selected university in Vietnam.

Results and learnings from applying SVM approach in the four cases

In Case A, SDC was applied successfully, with Step 4 representation completed by the researcher on her own. To visualise how stakeholders were associated with elements at different levels, an idea was generated. The idea was to map the stakeholders identified in Step 1 as important to the PSS directly onto the mini representation diagrams generated in Step 4, via the elements they are interested in or impacted by, along the customer perceived value-level (y-axis). This new step was added to SDC, forming the first stakeholder-value mapping approach (SVM). SVM was then applied to Case B with Step 4 representation completed by the researcher on her own. The participant (same person) for Case A and B found the stakeholder-value map useful in understanding where stakeholders could have been engaged differently in the PSS development. The findings generated from stakeholder-value map also aligned with anecdotes that the participant had heard about why these two PSS were not more successfully.

The application of SVM in Case C was slightly more time-consuming compared to Case A and B for Step 3 decomposition, because of the number of sub-systems involved in the PSS. Step 4 representation was completed by the researcher on her own. Most of the other steps were completed via e-mails, and the face-to-face on-line meetings were used to introduce the research and to clarify researcher's understanding of the elements in the PSS. The stakeholder-value map of Case C and the observations made by the researcher were shared with the participant, but he did not comment on whether the stakeholder engagement opportunities identified were insightful. However, the communications with the participant had inspired the researcher to modify SVM to make it easier to follow, improving its feasibility and usability.

To prepare for Step 5, the participant was asked to identify the elements that each identified stakeholder had an interest in or were impacted by. The participant appended at the end of the stakeholder identification table a numbered-list of the elements identified and used in Step 2 and 3, and then behind each element, in bracket its associated value-level (see Figure 1). This inspired the researcher to modify the element identification table and the stakeholder identification table to make Step 5 easier to follow.

Figure 2 presents the stakeholder-value map from the application of the original SVM on the four cases.

service or are impacted by the service	Beneficiaries	External	Yes	Yes	1,2,3,8	4,7,8
	Beneficiaries' family	External	Yes	No	1,2,3,8	
	External organisations providing services to beneficiaries	External	No	No	2,6,12	
	User group (formed by beneficiaries) or charities for the beneficiaries	External	Yes	Yes	1,2,3,8	4,7,8

Elements from the element identification table (value level associated in brackets):

1. Customer receive shipment (8)

2. Shipping (7)

3. Notifying winner (7)

4. Allocating order (6)

Informant of Case 3 added the numbered-list and the two columns in the stakeholder identification table

Figure 1 A snap-shot of the Stakeholder identification that is modified by the participant in Case C

The newly modified SVM approach was applied in Case D. Again, Step 4 representation was completed by the researcher on her own. Because of the 9-hour time difference between the participants and the researcher, most steps were completed via e-mails. The participants followed the modified Step 5 without any issue. Case D was different from the other cases - it has no route of value-creation (see Table 1). None of the stakeholders that the participants considered as important to the PSS were associated with elements at the highest value-level. During the discussion about stakeholder engagement opportunities, the researcher highlighted to the participants that some stakeholders that were not considered as important to the PSS actually had interests that spanned across all value-levels. This resulted in the idea of adding to the stakeholder-value map the additional stakeholders that are associated with elements at the highest value-level and elements that span from the lowest to other value-levels.

Table 1 Summary of the four cases

Case	Industry	No. of stakeholders (total to select from: 32)	No. of important stakeholders	No. of elements	Customer perceived value-level	Complexity of PSS (connectivity number)	No. of route of value-creation	Opportunities in stakeholder engagement *
A	Polymer – application in the medical market	22	9	15	5	26	3	Extend 3 stakeholders' interest; Recognise 7 additional stakeholders as important, and extend interests of 6 of them
B	Polymer – application in the medical market	23	11	10	5	17	1	Extend 6 stakeholders' interest; Recognise 7 additional stakeholders as important, and extend interests of 5 of them
C	Shoe & Apparel	24	18	14	9	13	7	Extend 12 stakeholders' interest; Recognise 7 additional stakeholders as important, and extend interests of 6 of them
D	Government	19	3	19	5	16	0	Extend 3 stakeholders' interest; Recognise 8 additional stakeholders as important, and extend interests of 5 of them

Figure 2 Stakeholder-value maps of the original SVM application to the four cases

The simplified Stakeholder-Value Mapping approach

To simplify SVM, the proposal is to remove Step 4, and to add columns in the tables used in Step 1 and 2 to make Step 5 (stakeholder-value mapping) easier to follow. An additional sub-step for stakeholder-value mapping is also proposed to highlight stakeholders who are not identified as important stakeholders in Step 1, but would be better if they were recognised as important to the PSS in development. The following shows the changes made to each SVM step. The new approach is called SVM-II.

Step 1 Stakeholder Identification

Two columns are added to the right-hand side of the stakeholder identification table: “Associates with which elements” and “Associate with which customer perceived value-level”. These additional columns do not change Step 1. The purpose of these two columns is to make the step to produce the stakeholder-value map easier to follow.

Stakeholder level	Stakeholder group	Company's perspective	Is a stakeholder? (Yes/No)	Is important to this system?	Associate with which elements*	Associate with which customer perceived value-level
Environment – those in the industry, business, government	Industry interest groups	External				
	Government quality and regulatory agencies or department	External				
	Law & legislation	External				
	Quality standard & guidance	External				
	Domain experts or industry experts (can be external or internal to the company, but not involved in the development)	External				
	Media	External				

Figure 3 The modified stakeholder identification table template in SVM-II

Step 2 Element Identification

Two columns are added to the right-hand side of the element identification table: “Element ID”, and “Customer perceived value-level”. Each element identified in Step 2 is given a unique number. Its associated customer perceived value-level is obtained from the decomposition diagram produced in Step 3. These additional columns do not change Step 2, but would make the step to produce the stakeholder-value map easier to follow.

Functions & features	Elements for delivering the functions and features that customers want	Sub-system all New or all Existing? (Yes/No)	New (N) or Existing (X)	Product (P) or Service (S)	Relative importance to customers Bold: most important Blank: as long as it works	Element ID	Customer perceived value-level

Figure 4 The modified element identification table template in SVM-II

Step 3 Decomposition

The decomposition step is changed minimally - the customer perceived value-level is noted in the left-hand side of the decomposition diagram, so that it is easier to see which value-level each element is at

(Figure 5, also see highlights in Figure 5 insert). This information is used in the new Step 4 to produce the stakeholder-value map.

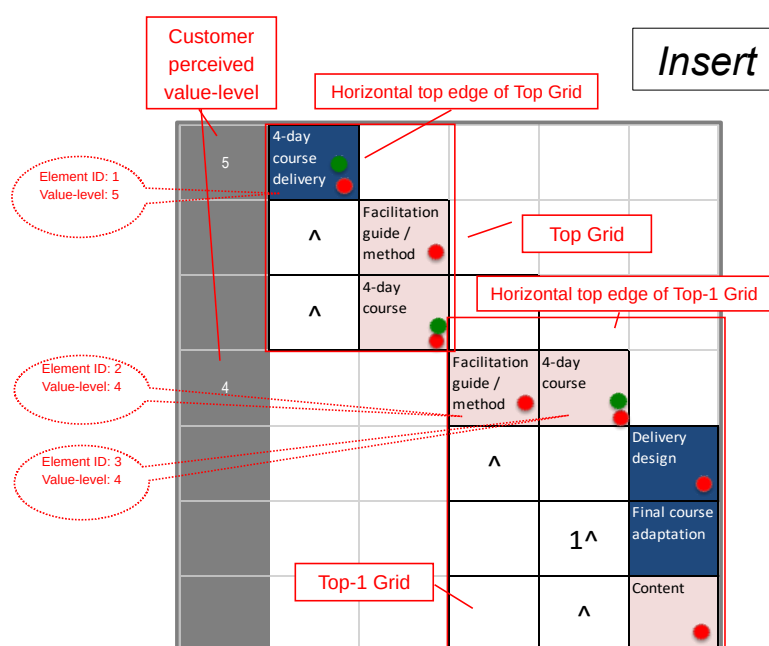
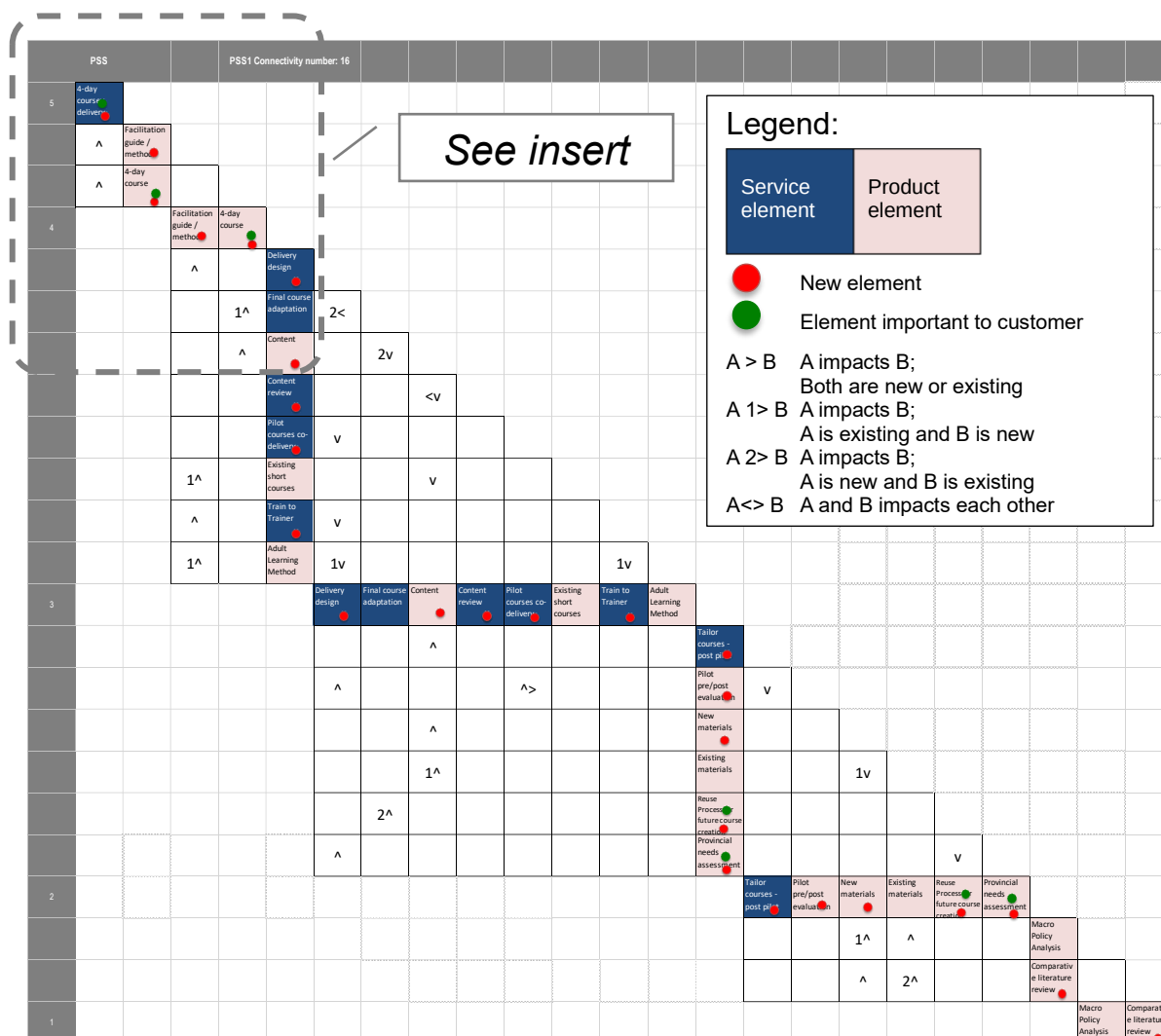


Figure 5 Illustration of the decomposition diagram for SVM-II (Case D as an example)

Step 4 Stakeholder-value mapping

The previous Step 4 decomposition is removed, and the new Step 4 is a new stakeholder-value mapping step, which is made easier to follow with the modifications to the stakeholder identification table, the element identification table, and the decomposition diagram (Figure 3, Figure 4, Figure 5) and more detailed sub-steps.

Sub-step 4.1 Label elements with unique ID and find their associated value-level

Each element is labelled with a unique ID in the element identification table. Then, the value-level that each element is associated with is entered in the element identification table, by checking the element's value-level in the decomposition diagram. One way to complete the two new columns in the element identification table is to follow the decomposition diagram in labelling the elements and finding their associated value-levels. First, label the element(s) in horizontal top edge of the top-grid as 1, 2, 3, etc., then check their associated value-level and complete the entry in the element identification table. For elements at the horizontal top edge of the top-grid, they are elements at the highest customer perceived value-level. Then moves to the Top-1 grid and repeat the same procedure (see Figure 5 insert).

Sub-step 4.2 Identify the elements each identified stakeholders are interested in or impacted by

Identify the elements that each identified stakeholder ("Yes" to "Is a stakeholder?" in Step 1) is associated with, and enter this information in the first additional column "Associate with which elements" in the stakeholder identification table. For example, in Case D, the stakeholder "Industry interest group" is associated with element ID 4, 7, 10, 14, 15, 18 (Figure 6 first row).

Sub-step 4.3 Find the value-levels that each element is associated with

Consult the element identification table for the customer perceived value-level(s) associated with the elements identified in sub-step 4.2. For example, in Case D, elements 4, 7, 10, 14, 15, 18 are associated with customer perceived value-level 1, 2, and 3.

Stakeholder level	Stakeholder group	Company's perspective	Is a stakeholder? (Yes/No)	Is important to this system?	Associate with which elements*	Associate with which customer perceived value-level
Environment – those in the industry, business, government	Industry interest groups	External	USAID Chemonics, Inc.	Yes	4, 7, 10, 14, 15, 18	1, 2, 3
	Government quality and regulatory agencies or department	External	Ministry of Home Affairs (MOHA) Ministry of Education and Training (MOET)		18	1
	Law & legislation	External	MOET University Autonomy Laws	Yes and UEH had a chance to be the pilot for academic autonomy	18	1
	Quality standard & guidance	External	National Assembly Resolutions (e.g. around provincial official roles in IR 4.0)		18	1
	Domain experts or industry experts (can be external or internal to the company, but not involved in the development)	External	J.E. Austin and Associates		6, 14, 17	2, 3
	Media	External	No			

Figure 6 Example of how the new columns of the Stakeholder identification table are filled in (Case D)

Sub-step 4.4 Highlight 'opportunity' stakeholders

This sub-step is to identify stakeholders that potentially need to be considered as important stakeholders to the PSS in development. In the stakeholder identification table, for all stakeholders that are associated with the highest value-level, and those that are associated with the lowest value-level and more (i.e., associated with value-level 1, 2 or 1, 2, 3 or 1, 3, etc., but not just 1), highlight the numbers in the customer perceived value-level in a different colour (e.g., in blue in Figure 6 row 1). The reason for highlighting all stakeholders that are associated with the highest value-level is that it is important to engage all stakeholders who are interested in or impacted by the element(s) at the highest value-level, as they are to interact directly with the targeted beneficiaries of the PSS. As to why highlighting stakeholders that are associated with value-level 1 *and* one or more other value-level(s), the reason is that stakeholders with interests that span across multiple value-levels are those who potentially can help strengthen the route(s) of value-creation. These highlighted stakeholders are referred to as opportunity stakeholder hereafter.

Sub-step 4.5 Visualise stakeholders that form the route(s) of value-creation

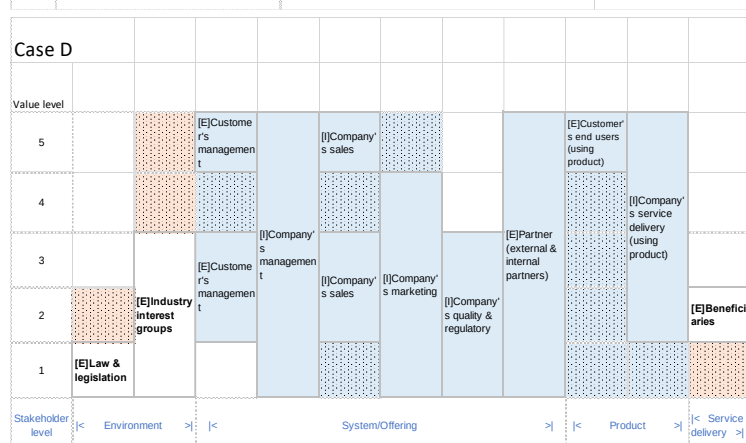
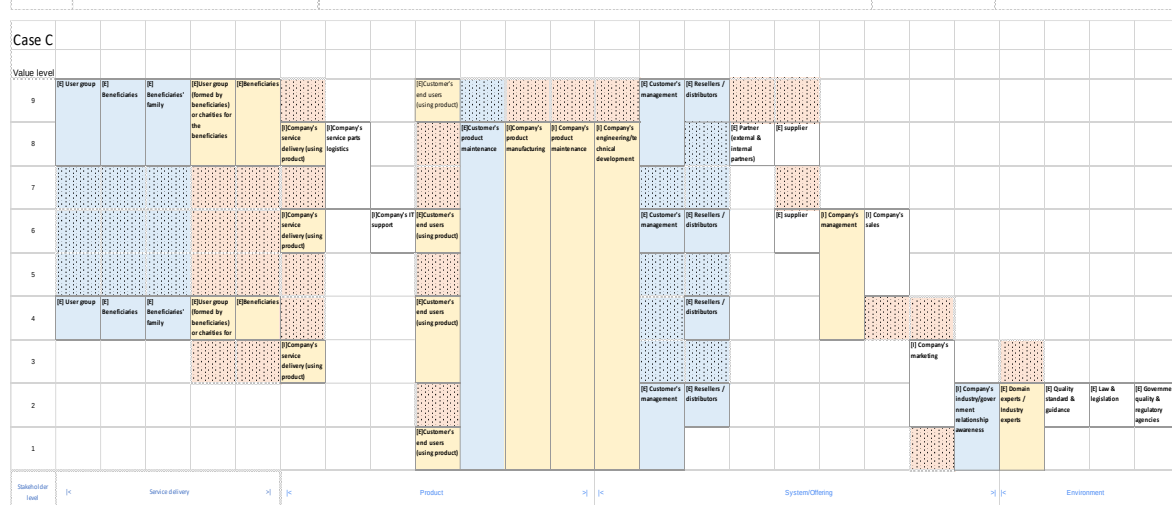
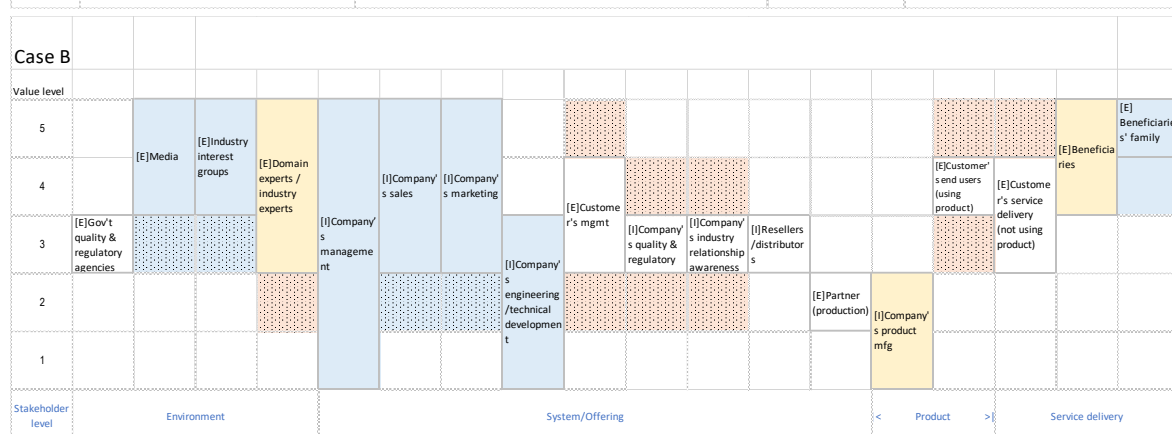
The stakeholder-value mapping template is relatively unchanged - it remains to have a y-axis for customer perceived value-level, and an x-axis for placing the important stakeholders according to their stakeholder level: "Environment", "System/Offering", "Product", and "Service Delivery". The important stakeholders are those that the company/organisation has identified in Step 1 as important to the system in development, or are subsequently identified in sub-step 4.4 as opportunity stakeholders. As in SVM, the important stakeholders are mapped to its value-level(s) via their associated elements in the stakeholder-value map.

Same as in SVM, the stakeholders that are associated with elements at all value-levels, from the lowest continuously to the highest, are coloured in beige, forming the route(s) of value-creation. The proposal of extending some stakeholders' interest to elements at adjacent value-level continued to be highlighted in orange dotted pattern. To simplify the step, the colouring all stakeholders associated with elements at the highest value-level in green is removed. This is because, upon reflection, the additional colour did not add value in the visualisation of route(s) of value-creation. Instead, all opportunity stakeholders, coloured in blue, are added to the stakeholder-value map. This is because it introduces another aspect of discovering opportunities to better engage with stakeholders to strengthen the route(s) of value-creation.

DISCUSSIONS AND NEXT STEPS

This study shows that deeper understanding of the engagement requirements of stakeholders could be teased out when key stakeholders and their associated system elements are plotted against the customer perceived value-level axis. This indicated the potential usefulness of the stakeholder-value map, as a visual representation, to facilitate discussions among development team members about whether there are needs to involve and/or to communicate with their identified stakeholders differently during the development of the new PSS. Figure 7 shows the stakeholder-value map produced by the retro-application of SVM-II on the four cases.

Figure 7



Legend	[I] = Internal stakeholders important to this system
	[E] = External stakeholders important to this system

The stakeholders that together link the lowest level elements to the highest level elements, forming the route of value-creation.

Opportunities in modifying stakeholders' interest in order to improve the opportunities to realise the highest value.

Opportunities in company recognising stakeholders to be important to the system.

Opportunities in modifying the newly reconginsed important stakeholders' interest to improve the opportunities to realise highest value.

A working theoretical construct is emerged from the study. The theoretical construct is this: for a new PSS to have a higher chance of success in creating value-in-use, one can first visualise the route of value-creation, from the lowest customer perceived value-level product/service elements to the highest customer perceived value-level product/service elements; then, identify the requirements for stakeholder engagement in the new PSS development. Stakeholder engagement refers to the timing of which stakeholders to engage and how to engage: to actively influence, to be informed about, or to disseminate their knowledge about specific product/service configuration parts of the new PSS.

With the aim that development teams could use a standard workshop approach on their own to generate the stakeholder-value map that assists stakeholder engagement requirement identification in the early stage of PSS development, the researcher are to continue to build and refine SVM-II. As the next steps, more cases from different industries will be solicited for application until procedural stability, according to PAR, is reached.

POTENTIAL CONTRIBUTIONS

For academics, there are two potential contributions. First, the emerging theoretical construct from the study can potentially contribute to the midrange theories of S-D logic. This working theoretical construct is about enhancing value-creation by new PSS, by identifying the required interactions between stakeholders (individuals and institutions) and product/service elements of a PSS. Second, the proposal of the new visualisation to support new PSS development, the stakeholder-value map, may contribute to the literature of stakeholder management in new PSS development process and the literature of stakeholder engagement in the process of value-in-use creation.

For practitioners, the stakeholder-value mapping approach (SVM) has shown to have facilitated the identification of human and institutional stakeholders and their engagement needs in the PSS development process. As of the time of writing, most of the case participants (three of the four cases) found the stakeholder-value map from SVM useful in enabling them to see how some stakeholders could have been engaged differently. The vision is to have the SVM-II approach, tested and stabilised after further case studies are completed, to become a practical tool for development teams to apply during new PSS development.

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