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Developing a conceptual framework for PSS business models

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Abstract

This paper proposes a conceptual framework to assist with the development of PSS business models. The paper includes a literature review of theory applied in existing PSS research, and a review to identify existing theoretical perspectives that could be applied in the field of PSS business model development. Five theoretical perspectives are considered as a basis for the creation of a new conceptual framework. The output of the paper is a new conceptual framework that can be used to help researchers to identify existing theories to help to develop understanding of PSS business models.

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1. Introduction

Theories help to create coherent explanations, improve our ability to improve predictions and ultimately help to achieve understanding [1]. To develop new theories, researchers can use methods such as grounded theory [2], or they can look to adapt existing theories using an abductive approach to theory development [3]

In this paper, we concentrate on the latter and specifically we aim to address the following research question:

What are the most relevant theoretical perspective to understand “why” a company elects to pursue a PSS business model and “how” it would implement the delivery of the selected business model?

2. Methodology

Our overall methodology includes four main steps:

- 1) A literature review to identify existing theories used in PSS research

- 2) A review of possible theoretical perspectives that could be used for PSS research
- 3) The selection of those theoretical perspectives most relevant for the research question set out in this paper
- 4) Creation of conceptual model to combine theoretical perspectives

For the literature review, PSS papers were searched in three separate search engines: Google Scholar, Research Gate and EBSCO Discovery Service (EDS). The aim of the search method was to collect a broad number of ideas from google scholar, contemporary papers from Research Gate, and quality, peer reviewed papers found through EDS.

The initial search of the term “PSS” generated a high number of results. Additional key words including “theory”, “concepts”, “motivations” and “strategy” were used to further filter the results and identify the relevant papers. From this, 171 papers were selected based on their relevance to the research question set in the introduction to this paper.

The papers were reviewed to identify any explicit mention of theoretical models used. Any paper that specified a

theoretical underpinning was recorded in an excel spreadsheet, with the theory specified.

A second search was carried out to identify existing business theories that could be used by PSS researchers. This uncovered a very large number of possible theories. To reduce the number of theories into a manageable number, we limited our research to five different theoretical perspectives which could be used to research PSS business models. Each of the five perspectives is then considered for their suitability to address the research question set out. It is proposed that three of the five perspectives are particularly useful. These three perspectives are then integrated and proposed as one unified conceptual framework.

2.1. Research limitations

As the search strategy only included articles which included the term “PSS”, this could result in important ideas that are closely related to PSS (such as dematerialization, eco-efficient services, and functional economy) but researched under a different name being overlooked. Similarly, the five theoretical levels were selected based on a review of existing PSS literature, which may have restricted the search for applicable theories. Further work is needed to explore theories from other fields which could be used in PSS research. This wider search could increase the number of theoretical levels under consideration.

The paper proposes a framework based on findings from the literature review, but as yet the framework has to be applied and tested in the real world. It is intended to do this as a next step in the research

3. Literature review findings

3.1. Defining theory

A paper that aims to explore theoretical perspectives for PSS must first begin with an explanation of what is meant by theory. In its simplest sense, a theory should help to make sense of the complex world around us [4]. But that is not to say that anything that helps to make sense of the world is automatically a theory. Descriptions, concepts, frameworks, typologies and metaphors can also be used to make sense of the world, but do not necessarily constitute a theory [4].

Whetton [5] argues that a theory contains four essential elements: First, identification of the factors (variables, constructs, concepts) to be considered as part of the explanation of the phenomena. Secondly, an explanation of how the factors are related. Thirdly, the theory should include why these factors are related as they are – in other words, the underlying dynamics that justify the selection of the factors and their proposed relationships. Lastly, the theory should explain when, to whom and where the theory is applicable.

The debate on what does and does not constitute a theory continues [6,7] and it is not the intention of this paper to resolve this debate here. Rather, our aim is to consider a number of theoretical perspectives that have been used outside of the field of PSS, to understand their suitability of

use to understand why and how companies pursue a PSS business model.

3.2. Theory in PSS

In 2006 Tukker stated that “a sustainable PSS-theory with explanatory and predictive power still largely lacks” [6, pg. 1554]. The literature review carried out found no evidence that this has changed.

However, the literature review did find that PSS abounds with descriptions, frameworks and typologies. Examples include Tukker’s PSS framework [9], Song’s innovation management framework and the framework for lean product-service-systems created by Resta et al [10].

Despite this plethora of frameworks, the majority of PSS research does not explicitly specify the theoretical underpinning on which it is based. The terms “theory”, “theories” or “theoretical” was found in only 84 of the 171 papers reviewed (47%). This already indicates that underlying theory is not explicitly set out in many PSS research papers. Of those papers mentioning theory, only four papers (2%) explicitly identified the theoretical underpinning on which the research was based; Batistia et al [11] apply viable systems theory, Kuo and Wang [12] use multi-attribute utility theory, Durugbo [13] proposes work systems theory and Durugbo and Riedel [14] propose network theory for their PSS research. Hanski [15] does not apply a specific theory, but provides a useful overview of existing theories that could be used in PSS research, including Real Option Theory, Game theory, and Benefit Theory, but also concludes that there is little evidence of how the techniques work in practice.

Despite Tukker’s call for a PSS theory, it is argued in this paper that PSS research questions, particularly business related one, can and should first draw on existing theory, before developing new PSS specific theory.

To do this, it is proposed that the first step is to explore and define the different theoretical perspectives that can be applied for PSS. The literature review of PSS research leads us to believe that five theoretical levels can be considered for PSS business model research questions.

In the next section, these five theoretical levels are proposed and then assessed for their suitability for use in research related to PSS business model development

4. The five theoretical perspectives considered

With over 5000 different theories to choose from [16], the first question is which theoretical fields should PSS researchers draw from? Based on the PSS literature review, it is proposed that PSS can be considered from five possible levels, visualized in the figure below.

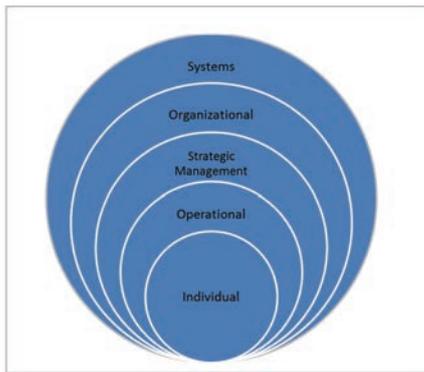


Figure 1: Possible theoretical levels for PSS research

At the highest level, a systems level, one aims to review PSS from the highest possible position; understanding for example how PSS is influenced by and influences companies, governments and other institutions, and how they interact within the commercial and natural environment. At the lowest level, we consider reviewing PSS from an individual level, and understanding individual attitudes and decision making related to PSS

In the following sections each of the 5 levels is explained in more detail and their possible use for PSS business model research is considered.

4.1. Systems level

A useful starting point for this level is general systems theory, which is described as the scientific exploration of wholeness [17]. The theory proposes that individual elements of a system should not be considered in isolation, but rather considered as a whole, with a particular focus on the interaction of the elements within the system.

Considering PSS business models from this broad theoretical perspective opens up PSS research and allows researchers to investigate PSS beyond a purely commercial perspective. For example, a general systems theory approach could be used to investigate PSS from two angles. Firstly, it could be used to research the impact that factors external to the business (such as national governments or other non-business institutions such as the European Union) could have on business decisions. Secondly, it could be used to explore the impact that business decisions have on fields beyond the field of commerce, such as the impact of business decisions on the environment or other social groups.

General systems theory is then considered useful as a theoretical model when considering PSS from a wider perspective than pure business. In those cases where the PSS research question aims to explore non-business related factors, either as an influencer on business decision or as an output variable, the general systems theory perspective can be useful.

However, general systems theory broadens the scope of any research, and its main drawbacks are that it often extends the scope beyond the influence of the commercial organization

and its broad scope and complexity can make systems level theory difficult to apply in a purely business context.

On balance, we propose not to use systems level theory in our framework to address the research question in this paper, due to the broad scope and complexity that this level of theoretical research requires.

4.2. Organization level

Organizational level theory considers the wider purpose of organizations. As this paper is focused on the development of commercial business models, it makes sense to limit the theoretical scope to focus on commercial organizations and exclude other institutions such as governments, or not for profit agencies. For this, the theory of the firm, a sub-element of organizational theory, is proposed as it specifically focuses on the role and purpose of commercial organizations. The theory of the firm addresses two central questions (a) why firms exist (their purpose) and (b) what determines their scale and scope [18]. This theory is particularly relevant for PSS researchers, as it raises the fundamental question of whether firms have an obligation (beyond their legal requirements) to help the environment or whether the purpose of the firm is solely to generate maximum profits.

It could be argued that the fact that some firms are considering PSS business models is testament to a growing awareness of a firm's environmental responsibilities. Alternatively, it could be argued that firms are considering PSS because it is seen as a business model that maximizes profits. This raises a number of interesting research questions that have not been fully explored in the PSS literature. For example, what motivates a firm to pursue a PSS business model? Is it purely commercial motivations or purely environmental or a combination of both? Secondly, what are the relevant antecedents that motivate a company to elect to pursue a PSS? Does the firm ownership model, size, industry or location have an influence on the decision to pursue a PSS business model? And do these antecedents have an influence on the success of implementing the business model?

PSS research to date largely overlooks these fundamental questions as most PSS research is applied using case studies of firms that have already selected to pursue a PSS. Furthermore, most PSS research assumes that firms have a responsibility beyond maximizing economic profit, and that environment considerations should influence a firm's decision making. However, many of the initial theories of the firm, developed by theorists such as Coase [19], Smith [as summarized by Butler] [20], Friedman [21] Grossman and Hart [22] are based on the premise that the purpose of firms is solely to maximize profits.

Although one could argue that these theories are now outdated and should be replaced with the ideas of researchers such as Elkington [23] who argues that firms should consider environmental and commercial objectives in equal measure, the most appropriate means of assessing the relevancy of the theories is to test which theory best reflects the actual behavior of firms. Consider an example, where a firm has to make a choice between two legally compliant business models. The first, maximizes profit, but has a higher negative

environmental impact. The second, a PSS business model, produces slightly lower profits, but has less environmental impact. Friedman's theory suggests that a firm should choose the former, Elkington's the latter.

These fundamental questions generated from a review of the theory of the firm, have yet to be fully addressed by PSS researchers. It is proposed that PSS researchers looking to develop PSS business models should first address the questions of motivation for developing a PSS, making explicit whether the firm being researched is considering PSS just as a means to maximize profit, or whether the firm would be willing to sacrifice profit for environmental gains.

Based on this review, it is concluded that the theory of the firm is a key theoretical perspective in the development of PSS business model research, as it is at the heart of why certain firms pursue a PSS and why some do not. Consequently, this theoretical perspective is included in the proposed conceptual framework.

4.3. Strategic management theory

If the theory of the firm focuses on why commercial organizations exist, strategic management theory aims to understand why firms act as they do and how they execute certain strategies. The link to the theory of the firm is clear, as if a firm understands their purpose is only to maximize profit, then it is likely to pursue a different strategy from a company that believes they have a responsibility (beyond their legal responsibilities) for environmental improvements.

To date, PSS researchers have not made much explicit use of the existing theoretical ideas in this field. Theories such as Porter's dynamic theory of strategy [24], which, through the lens of the 5 forces [20] aims to explain why companies respond to different competitive pressures, could be a useful theory through which to understand the motivations or the "why" a company would pursue a PSS business model.

Researchers have considered the motivations and barriers for pursuing a PSS [26,27], but it is proposed that positioning these within the existing frameworks provided by Porter, would facilitate understanding outside of the wider PSS research community. Reviewing PSS through the lens of the 5 forces for example could help to identify, understand and predict the external forces which would encourage or discourage firms from developing PSS models, giving researchers increased insight into understanding why a company may pursue a PSS business model.

In the same way that Porter's 5 forces could be applied to assess external factors and understand why a company may elect to pursue a PSS, Barney's Resource Based View of the firm [28], a theory widely accepted and widely applied in business research [4], could be used to understand the internal capabilities of firms and their readiness to create a PSS. In other words, use of RBV could be used to lay the foundations for a company to understand "how" to implement such a business model.

Using RBV could be particularly useful to review multiple firms in a value chain to understand which firm is best positioned to create a PSS. Interestingly, this is an area that has not been considered by PSS researchers. Existing PSS

researcher often starts with the assumption that the production firm is best positioned to implement a PSS. For example, researchers have identified numerous capabilities required to implement a PSS (implicitly using an RBV approach) and then considered how a production company can achieve them [29]. However, a broader use of RBV could be to assess the capabilities of various firms (not just the production company) and based on this, select the company whose capabilities closely match the requirements to implement a PSS

Despite its clear application and widespread use in strategic management, Barney's resource based view has not been used in PSS research, at least not explicitly.

Although the explicit use of the above theories was not found in existing PSS research, this is not to say that authors have not used strategic management thinking. Authors such as Hinton [30] investigates the drivers and barriers to creating a PSS and the required capabilities to do, implicitly using the theories of authors such as Porter and Barney. However, the theoretical underpinning is implicit, and explicit use of the theories would help academics to more rigorously investigate the connections and interactions between the identified variables.

From this review, it is concluded then that there is a wealth of theoretical perspectives in the area of strategic management that could be used in PSS research and applied to the research question set out in this paper. Making explicit use of theories from this field could be useful for developing more robust and repeatable PSS research. Consequently, this theoretical perspective is included in the proposed conceptual framework.

4.4. Operational theory

The next level of theory is related to *how* to operationally execute on the selected strategy and more focused on the tactical elements of implementing a PSS. The literature review found that this is the area where most PSS research is focused as most is case study based and investigates firms that have already embarked on a PSS strategy.

For PSS researchers, this theoretical field can be used to study how firms implement a PSS once they have decided to execute on a selected business model. For this, researchers could draw on broader functional theories from the fields of supply chain or marketing, or more operational based theories such as the theory of swift even flow [31] or theory of constraints [32] to investigate the operational impact of delivering a PSS. The theories can be applied to research such as that carried out by Reim [33] who focuses on the tactical decisions that can be made to implement a PSS

This theoretical perspective could be particularly useful for researchers investigating companies who are already executing a PSS business model and improve understanding of "how" the model is implemented. The perspective is not considered relevant to understand "why" an organization may pursue a PSS, but is relevant to understand "how".

4.5. Individual behavioral theory

At the most detailed level, PSS could be researched using individual behavioral theories such as the theory of reasoned

action [34], which look to explain why individuals do what they do.

The literature review found no evidence of the use of this level of theory in the field of PSS. However, for PSS researchers, this theoretical field could be useful from two perspectives: First, understanding why certain individual business leaders and managers select to pursue a PSS strategy and second to gain a better understanding of why customers would (or would not) chose to purchase a PSS solution. In terms of the latter for example, many researchers focus on the functional customer requirements [35], but this perhaps overlooks some of the more subtle psychological barriers that a customer may have towards selecting a PSS, such as perceived concerns about moving from a product ownership model, to a product renting or sharing based model.

Although this theoretical perspective could be useful in understanding individual manager’s decision making towards PSS and also in understanding customer perceptions towards purchasing a PSS, at an organizational business model level, the theories are not considered useful and are therefore not included in the proposed conceptual framework

5. Proposed conceptual framework for creating PSS business models

Considering the analysis of the five theoretical levels, it is proposed that organizational theory and strategic management theory are the most appropriate perspectives with which to understand “why” organizations pursue a PSS business model, and operational theory is most appropriate to understand “how”. Strategic management spans both, and can be used to help the transition from “why” to “how”. The framework below brings together the three perspectives into a conceptual framework for the development PSS business models and gives examples of possible theories that can be applied

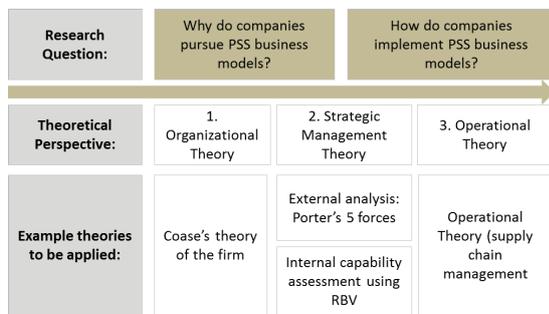


Figure 2: Proposed conceptual framework for development of PSS business models

In this framework, the first step for researchers is to understand the purpose of the firm being researched, drawing on the theoretical field of the theory of the firm. It is proposed that this will help to identify the motivations for a firm to pursue a PSS business model. This is key as the motivations for pursuing a PSS business model of each individual firm will have an over-riding impact on the external and internal

analysis carried out by the firm. This will in turn influence whether PSS is pursued as a strategy and eventually which PSS business is selected. To illustrate, it is proposed that a firm that believes it has a responsibility, beyond their legal obligations, to protect the environment, is likely to explore different markets (external analysis) and focus on different internal capabilities than a company that is focused purely on maximizing profit with no consideration for environmental matters. This is not to say that a company that is motivated solely on profit would not consider a PSS, but rather their motivations for selecting a PSS business model would be different from a company that believes that helping the environmental is part of their organizational purpose

The second step uses the perspective of strategic management theory, and proposes the use of external analysis using the 5 forces to understand possible motivations and barriers for developing a PSS. This encourages an investigation into the forces that may be driving a company to select a PSS business model; some firms may be motivated to adopt a PSS to create a barrier for new entrants; others may be motivated to adopt a PSS to reduce their reliance on powerful suppliers. In either case, research carried out through the lens of the 5 forces will allow PSS researchers to more robustly measure and test the impact of the five forces and their relative influence on the decision to adopt a PSS business model.

In terms of internal analysis, applying the resource based view would allow companies not only to assess their internal capabilities, but also assess their competitor’s relative capabilities. Use of this theoretical thinking would allow researchers (and practitioners) to more systematically measure which capabilities are required to develop a successful PSS as well as measuring how capabilities develop over time as a company moves towards a PSS model. In the same way that Porter’s 5 forces would help to provide insight into the external variables influencing business model decisions, use of the resource based view would allow greater insight into the internal variables.

The final step is focused on the “how” and the use of operational theoretical perspectives to understand the practical methods to implement the business model.

Using the framework to identify variables related to the purpose of the firm together with the external and internal factors will allow researchers to understand which variables contribute to a firm selecting (or not) to pursue a PSS and also whether this influences “how” the business model is implemented. The knowledge gained from using the framework, can also then be used as a basis for understanding the selection of different business PSS business models, as ultimately business model selection will be based on the external market demands and the internal capabilities of the firm.

For practitioners, using this more structured framework to assess internal capabilities and changing external dynamics, allows the firm to assess and change their strategy to respond to change on an ongoing basis.

For academics, the use of this framework on a more consistent basis would facilitate replicability of research (a key drawback of using case based research methods) across

firms. The framework would also allow researchers to make use and benefit from existing theory, rather than looking to develop new theory specific to PSS.

6. Conclusions and further research

Referring back to Whetton's theory criteria referenced at the start of this paper, it is proposed that bringing together the established theoretical models related to the theory of the firm, Porter's 5 forces model and resource based theory, PSS researchers can begin to identify the factors that drive companies to select PSS as a strategy to understand the "why". With this knowledge, researchers can help to understand how and why the factors are related. Furthermore, researchers can use the knowledge to gain a better understanding of how these may differ across industries, geographies, companies or other organizational variables. With this, researchers and practitioners can increase their understanding of why companies elect (or not) to pursue a PSS. Furthermore, they can help to guide understanding of what factors to consider and "how" to implement the business model.

This paper proposes that PSS researchers have an opportunity to make use of existing theoretical constructs to develop more robust research methods. The paper challenges the view that a new theory of PSS is required, and rather, proposes that existing theory can be used for PSS research. It is only when existing theories have been proven not to work or not be applicable, that researchers should investigate grounded theory type approaches to develop new ones

The true test of this framework and the theories that it is based on, is in their practical use [36]. For this, it is proposed that the next step in the field of developing theoretical models for PSS is to use the framework to test its suitability with a case company.

References

- Hambrick DC. The field of management's devotion to theory: Too much of a good thing? *Acad Manage J.* 2007;50(6):1346–52.
- Strauss A, Corbin J. Grounded theory methodology. *Handb Qual Res.* 1994;17:273–85.
- Saunders M, Lewis P, Thornhill A. *Research Methods for Business Students.* Pearson Education; 2009.
- Walker H, Chicksand D, Radnor Z, Watson G. Theoretical perspectives in operations management: an analysis of the literature. *Int J Oper Prod Manag.* 2015;35(8):1182–206.
- Whetten DA. What constitutes a theoretical contribution? *Acad Manage Rev.* 1989;14(4):490–5.
- Imenda S. Is there a conceptual difference between theoretical and conceptual frameworks. *J Soc Sci.* 2014;38(2):185–95.
- Schmenner RW, Swink ML. On theory in operations management. *J Oper Manag.* 1998;17(1):97–113.
- Tukker A, Tischner U. Product-services as a research field: past, present and future. Reflections from a decade of research. *J Clean Prod.* 2006;14(17):1552–6.
- Tukker A. Eight types of product-service system: eight ways to sustainability? Experiences from SusProNet. *Bus Strategy Environ.* 2004;13(4):246–60.
- Resta B, Powell D, Gaiardelli P, Dotti S. Towards a framework for lean operations in product-oriented product service systems. *CIRP J Manuf Sci Technol.* 2015;9:12–22.
- Batista L, Davis-Poynter S, Ng IC, Maull R. Transformation of provider and customer organisations to achieve co-capability in outcome-based contracts: a viable service systems approach. 2013;
- Kuo TC, Wang ML. The optimisation of maintenance service levels to support the product service system. *Int J Prod Res.* 2012;50(23):6691–708.
- Durugbo C. Competitive product-service systems: lessons from a multicase study. *Int J Prod Res.* 2013;51(19):5671–82.
- Durugbo C, Riedel JC. Readiness assessment of collaborative networked organisations for integrated product and service delivery. *Int J Prod Res.* 2013;51(2):598–613.
- Hanski J, Kunttu S, Räikkönen M, Reunanen M. Development of knowledge-intensive product-service systems. *Outcomes MaintenanceKIBS Proj VTT Espoo VTT Technol.* 2012;21.
- Bothamley J. *Dictionary of theories.* 1993.
- Von Bertalanffy L. The history and status of general systems theory. *Acad Manage J.* 1972;15(4):407–26.
- Conner KR. A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm? *J Manag.* 1991;17(1):121–54.
- Coase RH. The nature of the firm. *economica.* 1937;4(16):386–405.
- Butler E. *The Condensed Wealth of Nations: And the Incredibly Condensed Theory of Moral Sentiments.* Centre for Independent Studies; 2012.
- Friedman M. *Capitalism and freedom.* University of Chicago press; 1962.
- Grossman SJ, Hart OD. The costs and benefits of ownership: A theory of vertical and lateral integration. *J Polit Econ.* 1986;691–719.
- Elkington J. Enter the triple bottom line. *Triple Bottom Line Does It Add Up.* 2004;11(12):1–16.
- Porter ME. Towards a dynamic theory of strategy. *Strateg Manag J.* 1991;12(S2):95–117.
- Porter ME. *How competitive forces shape strategy.* 1979;
- Battaglia D, Borchardt M, Patricio L. PSS Offering in a B2B Context: Towards the Drivers to Enable Integrated Solutions. *Procedia CIRP.* 2016;47:400–5.
- Isaksson O, Larsson TC, Rönnbäck AÖ. Development of product-service systems: challenges and opportunities for the manufacturing firm. *J Eng Des.* 2009;20(4):329–48.
- Barney J. Firm resources and sustained competitive advantage. *J Manag.* 1991;17(1):99–120.
- Oliva R, Kallenberg R. Managing the transition from products to services. *Int J Serv Ind Manag.* 2003;14(2):160–72.
- Hinton J. Is the circular economy ambitious enough? A look at incorporating PSS (product-service systems) into China's leapfrog development strategy. Citeseer; 2008.
- Schmenner RW. Looking ahead by looking back: Swift, even flow in the history of manufacturing. *Prod Oper Manag.* 2001;10(1):87–96.
- Goldratt EM, Cox J, Whitford D. *The goal: a process of ongoing improvement.* Vol. 3. North River Press Great Barrington^ eMA MA; 2004.
- Reim W, Parida V, Örtqvist D. Product-Service Systems (PSS) business models and tactics—a systematic literature review. *J Clean Prod.* 2015;97:61–75.
- Fishbein M, Ajzen I. *Belief, attitude, intention, and behavior: An introduction to theory and research.* 1977;
- Long HJ, Wang LY, Shen J, Wu MX, Jiang ZB. Product service system configuration based on support vector machine considering customer perception. *Int J Prod Res.* 2013;51(18):5450–68.
- Lewin K. *Field theory in social science.* 1951;