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Product-Service Systems across Life Cycle

## Understanding the conditions of separation for an integrated organizational setup – PSS divisional boundaries in the light of heterogeneity and duality theories

Bernd-Friedrich Voigt\*

*Ruhr-University Bochum, Universitätsstraße 150 - NB 1/168, 44801 Bochum, Germany*

 \* Corresponding author. Tel.: +49-234-32-27872; fax: +49-234-32-14198. E-mail address: [bernd.voigt@rub.de](mailto:bernd.voigt@rub.de)

### Abstract

Determined by an integrated value proposition PSS constitute a unique organizational setup that is pivotally grounded in the co-existence of integrated but yet separate product-, service- and customer sub-systems. In order to benefit from the variety of available skills, competences and knowledge resources, PSS try to arrange sub-system boundaries most permeable, thus striving for the highest possible level of integration. At the same time, PSS decrease the level of divisional separation towards a minimum. However, the relation of integration and separation needs further analysis in the light of organizational theory. While recognizing the need for increasing integration towards product&service co-designed, customer integrated solutions, research also claims that a separation-typed setup determines the crucial resource configuration that is needed for novel problem-solving approaches in PSS. More precisely, it is said that the upholding of a minimal threshold between separated organizational elements secures sufficient tension between established organizational thought-worlds which again may initiate processes of organizational learning and renewal. The contradictory nature of decreasing while also pertaining separation under the umbrella of an integrated organizational setup raises the need for a nuanced understanding of how boundaries within PSS form an important area of operation for the dynamic balancing of divisional knowledge transfer versus identity-shaping. With reference to the organizational development process towards a fully integrated PSS this paper presents suggestions about how PSS can design minimal threshold for a mutual but fluid co-existence of product-, service- and customer sub-systems.

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### 1. Introduction

Determined by an integrated value proposition PSS constitute a unique organizational setup that is pivotally grounded in the co-existence of mutually dependent and integrated product-, service- and customer sub-systems [1,2]. It is claimed that it is exactly the rich heterogeneity of this setup that provides the variety of skills and competences to sustain customized and innovative solutions [3,4,5]. By designing a PSS organizational setup that successfully integrates product-, service-, and customer sub-systems the transfer of information

and knowledge secures a common knowledge base in order to fuel innovative capacities and to constitute the adaptive value-co-creation for changing customer needs [6,7]. Consequently, this setup calls for an optimized degree of the permeability of PSS boundaries and a decrease of divisional and functional separation [3]. Following this line of argumentation the level of integratedness becomes a crucial determinant of what PSS is in the light of organizational theory and what benefits may arise from its unique organizational setup [3,8]. At the same time, literature also points to the fact that PSS should be set up to orchestrate mutually dependent but yet separate product-,

service- and customer subsystems [2,8,9]. This need for separation becomes a crucial factor of organizational renewal and growth as PSS aim for an integrated solution offering that dynamically responds and adjusts to the “front end’s pull for customization” [10] by continuously repatching the portfolio of PSS entities or recoupling the links among them [2,9,11,12] striving for “the back end’s standardization” [10]. As such, pertaining separation for adaptability and renewal demands for boundary stability and identity maintenance by at least a minimal threshold [13] between PSS divisional sub-systems.

It is exactly the seemingly contradictory nature of decreasing and pertaining separation in the development of PSS that calls for a nuanced understanding of the critical boundary conditions between integrated, but mutually dependent and separated product-, service and customer sub-systems.

## 2. Research aim and scope of theoretical background

PSS feature a high organizational complexity in terms of the heterogeneous constituent components, diversified stakeholders, and dynamic evolution [14]. Only by means of successful integration the benefits of the PSS organizational setup can be fully harvested [3,15]. In this regard, various means and organizational design aspects for securing permeability of sub-system boundaries have been named in PSS literature [16,17,18,19,20]. Most of this work is based on implicit assumptions about the positive effects of knowledge integration for cross-functional and cross-divisional teams and it refers to the intended effects by means of knowledge transferring or traversing for (rapid) solution co-creation in novel problem situations and across internal team boundaries [21]. In referring to the question of a PSS organizational setup as systems seller vs systems integrator a recent work from Salonen & Jaakkola [22] has applied different theoretical boundary conceptions to PSS in order to highlight that the matter of integration needs to be evaluated from more than just pure transaction cost logics. This work shifts attention to external PSS organizational boundaries under the conceptions of identity, competence and power in order to maintain the adaptability and reconfigurable resource portfolio for dynamic and novel conditions of integration and customization [22]. However, in an organizational setup for solution selling the formerly clear distinction between internal and external organizational boundaries becomes blurred with increasing integration of a product-, a service- and a customer sub-system. As such, PSS constitute a relatively new problem driven boundary phenomenon with new boundary choices where former organizational boundaries morph and reappear as cross-functional and cross-divisional boundaries inside of the PSS organization.

In order to start a discourse on this rather contemporary boundary issue in PSS this paper seeks answers to three guiding questions about the decisive conditions of a separation-typed internal PSS setup: First, if integratedness is a driving goal in organizing for PSS, what is the nature of separation and its relation to integration? Second, if separation is named as a pivotal feature in securing innovation and strategic renewal for PSS, what theoretical perspective may be applied in order to underline this line of argumentation for a minimal threshold

between highly integrated PSS sub-systems? And third, if the PSS organizational setup relies on integration and separation likewise, what are useful conceptions of the boundaries lines between a product-, a service- and a customer sub-system in PSS in order to achieve a maximum level of integratedness for efficient knowledge transfer while at the same time pertaining sufficient tension from separation for innovation and renewal? In addressing these issues this paper summarizes extensive literature research that links a theoretically distinct type of heterogeneity, namely separation [23] with a dualities-aware perspective on paradoxical tensions of organizing separation [24] for the case of PSS. Insights are framed by two boundary conceptions, namely boundaries as competence demarcation and boundaries as identity demarcation [25], as they provide the framing of meaning for a nuanced understanding of the conditions of a separation-typed PSS organizational setup.

## 3. Competence and identity as applicable boundary conceptions for organizational challenges of innovation, growth, adaptability and strategic renewal

In moderately and highly dynamic environments organizational boundary decisions often mirror the coevolution of resources with environmental opportunities [25]. As such, contingency approaches [26] and a resource based view on the firm [27] set up the theoretical grounding of a boundary conception as competence demarcation. This conception relates the firm’s configuration of a heterogeneous resource base to competitive advantage and superior performance [28,29]. Shared access to a variety of knowledge resources enables innovative activities associated with adaptation and flexibility [30]. However, as environment dynamism increases, the coupling of resources becomes more loosely. Next, dynamic capabilities become essential as they represent organizational efforts by which members rearrange resources to set up new value-creating strategies [31,32]. Based on these organizational processes organizations manage to recombine existing resources in new ways and among other processes master the recoupling of business units to create value by building new resources [32]. Finally, with extreme ambiguity in high velocity markets the loose coupling of resources even blurs the distinction between horizontal and vertical boundaries [33], thus also pulling down the distinction between internal and external. Therefore, under highly dynamic and complex circumstances, the competence conception may even mismatch established functional, divisional and organizational boundaries. In order to guarantee organizational adaptability to disruptive environmental changes the competence conceptions therefore focuses boundary decision as the quantitative and qualitative choice about the integration of a variety of loosely coupled resources in the organization’s portfolio.

The identity view recognizes the mostly unconscious boundaries of the mind that can exist for organizational members. Identity boundaries mirror the inclusion of activities perceived as coherent with team or organizational identity [25]. They are particularly resistant to change because of their unconscious character. Based on the deep emotional component identity focuses on boundary decision as the choice of “who we are.” [25]. As such, the identity conception is particularly

valuable for enabling action in ambiguous environments. However, despite of securing focus and distinctiveness identity may also become a competitive weakness in dynamically changing environments [34]. Deep emotional attachments to identities make information and knowledge resources difficult to transfer [35]. This undermines explorative learning for strategic renewal [36] and may result in a frozen, unproductive and less competitive separation-typed organizational setup.

In summary the competence conception motivates increased resource integration with inclining environmental dynamics whereas the identity conception may motivate both, high or low separation depending on members' emotional need for belongingness or shared mental model cognition [25]. However, identity and competence may also coevolve, and therefore increase the consistency between "who we are" and "what we are good at" when managed appropriately for high pace of change as well as high ambiguity and uncertainty [25]. Starting from this cognizance it is possible to analyze the enabling and hindering conditions of applying both conceptions to boundaries of product, service and customer sub-systems in PSS.

#### **4. Applying competence and identity conception to internal PSS boundaries**

This paper primarily envisions PSS as systems sellers rather than systems integrators [10] in order to narrow the line of argumentation to an intra-organizational entity setup in contrast to a network of actors with a central coordinating PSS entity [37]. The system seller's search for an integration optimum becomes exclusively apparent when applied to the different levels of systems integration [12,38] and solution offering transition paths [39,40]. PSS literature also refers to achieving integratedness by the increasing level of the servitization of manufacturing or the service transition towards integrated solutions [41,42,43,44]. Starting from mainly transactional interaction between a product organization with only peripheral service and a product market, separation decreases as products and service become combined in for a next level of servitization. With increasing customization the level of integratedness needs to be achieved thus reducing separation between a product-, a service- and a more distinct customer subsystem. In a final stage the product&service co-designed, customer integrated solution calls for a maximum of integratedness where the management of integration becomes an internal challenge which largely refers to the orchestration of cross-functional and cross-divisional teams [3]. The need for integration becomes apparent in practice as PSS rely on input across departmental units, such as R&D, service, product, marketing, technology and operations. Integration also secures that the external pull for customization is managed in balance with the internal push for standardization [12,15].

The predominant aim to adjust and increase the level of integratedness with respect to innovativeness for a highly dynamic and complex customer individualized environment appears to be a decisive decision making rule for the conditioning of boundaries in PSS. The contingency and resource-based theoretical framing of competence boundaries puts this integration aim in PSS mainly into the light of the

competence conception on deciding about the quantity and quality of the coupling of a high variety of heterogeneous resources. However, following the PSS defining element of mutually dependent but yet separated product-, service- and customer sub-systems [1,2] separation decrease needs to come to a stop and at least a minimal threshold needs to be pertained at some stage of integration. Research in PSS points towards the chances and challenges of integrating the broad variety of actors, skills and competences as they stem from separate spheres of work-practices, routines and even contradictory ways of organizing under the overarching umbrella of one single PSS organization [3,4,9,45]. In contrast to a relatively broad scope of research on establishing means of integration for the dynamic competences in PSS, the question of establishing means of pertained separation is still rarely addressed [9]. So far, the need for separation in order to develop new capabilities and enable experimentation with solution activities is addressed in PSS literature when referring to separating a service department from the core organization [3] or initiating project-based solution activities in separate units [10]. However, if integration is a pivotal principle of the organizational setup of PSS, pertained separation of existing organizational entities may even become a major obstacle.

By building on the prevalence of established mindsets and emotional distance between organizational sub-systems this notion of separation mainly refers to the identity conception of boundaries in PSS. As indicated above identity may result positively or negatively under ambiguous and dynamic conditions, such as the PSS environment. Therefore, in order to further clarify the understanding of separation in this regard a reference to recent theoretical conceptions on heterogeneity [23] and "thought diversity" [46] is taken in section 4.1. In addition the question of adjusting the sufficient amount of separation is addressed in referring to theoretical discourse on minimal threshold between dualistic organizational sub-systems for the sake of upholding constructive organizational tensions in section 4.2. In concluding on both theoretical inputs implications for the conditioning of competence and identity boundaries are derived in section 4.3.

##### *4.1. Separation: a distinct heterogeneity characteristic of PSS*

The heterogeneity conceptualization as separation addresses "opinions, beliefs, values and attitudes especially regarding team goals and processes" [23]. It constitutes the existence of different "thought-worlds" [47] or "thought diversity" [46], distinct work practices and perceived ways of organizing by homogeneous subgroups on a cross-functional or cross-divisional level. Team functional heterogeneity is defined as "the diversity of organizational roles embodied in the team" [48 p. 353]. Functionally heterogeneous teams assemble people from different disciplines and functions who have pertinent expertise in the proposed course of action [49]. As such separation measures a composition of differences in (lateral) positions or opinions with an n-modal distribution. It attributes highest separation when members of a higher order system are being split into two halves (subgroups) at opposite ends of a separation continuum.

The information/decision-making perspective of a value-in-heterogeneity hypothesis provides theoretical reason that the integration of an enlarged pool of actors from different subgroups provides knowledge, expertise, problem-solving approaches, and other resources that, combined in novel ways, produce innovation especially for novel and complex problem situations [46]. In addition, heterogeneity theory postulates enhanced responsiveness and greater flexibility for dynamic requirement adjustments as a positive effect of higher team heterogeneity [50]. When applied to the case of a separation-typed organizational setup this heterogeneity perspective underlines the above mentioned competence conception of boundaries in PSS. However, facing the separation of different backgrounds and perspectives makes cross-functional team members feel less comfortable voicing divergent opinions. Fueled by in-group and out-group classification processes [51], conflict and destructive slack are likely to arise from perceived differences, misunderstandings and ineffective communication [46,52] as people prefer to work with similar others [53]. The matter of knowledge integration becomes increasingly difficult and costly as information and practices become more dispersed [54]. This flipside of heterogeneity can be subsumed from a social identity/social categorization perspective [55,56]. It underlines the above mentioned identity conception of boundaries in PSS.

In order to benefit from cross-functional and cross-divisional heterogeneity team members with different backgrounds and perspectives tend to develop a shared mindset [46] and to overcome diversity by sameness in the form of establishing overlap in the mental models of group members [57,58]. Driven by the aim to leverage their resources teams create a shared way of seeing and interpreting reality thus enforcing collective problem solving and choice [59]. Paradoxically, however, once a shared mindset evolves, unique points of view or knowledge that contradict the shared mindset may be less likely to get shared in the group. Hence, the positive heterogeneity effects fall short as team members strive to create a shared mindset [60]. However, initiated by the work of Star and colleagues [61] heterogeneity theory also provides evidence that collaboration of diverse professionals in teams can still be successful even if they uphold and maintain to function in separate socio-cultural (thought) worlds. This indicates that integration and separation are not necessarily two opposing poles of the same dimension but rather two complementary aspects of the PSS organizational setup. It challenges the matter of maximum sameness as the goal of integration and rather points to a balanced relation of integration and separation for mutual understanding and learning [62,63].

#### *4.2. Minimal threshold – a guiding characteristic for a nuanced understanding of the PSS boundary conditions*

A bi-directional relationship and bipolar systems of thinking and acting are discussed as the corner stones of effective knowledge transfer in PSS [1,66], and the dynamic interplay of sub-systems is seen as an enabling force of PSS to survive in complex and novel environments [22]. Secured by means of the dynamic interplay creative and innovative solution approaches

become a viable and competitive advantage. In the light of a competence conception divisional boundaries within PSS therefore need to be kept most permeable for a maximum variety of knowledge bases. The high level of integration allows to sustain organizational adaptability and flexibility within dynamic environments. Under the identity conception internal PSS boundaries need to be kept up in order to secure the uniqueness of distinct divisional “thought worlds”. This form of pertained separation allows to create novel solutions to unknown environmental challenges under the umbrella of an integrated setting. In this regard a minimal degree of separation still serves as an enabling structural pole for the organizational setup of PSS, despite of potentially negative effects of an identity framed boundary conditioning [64]. Along the PSS life-cycle it sustains the simultaneous presence of separate PSS sub-systems as the crucial factor of value co-creation and it catalyzes effective utilization of paired resources [44,65]. A minimal degree of separation guarantees the upholding of organizational tensions in PSS which in organizational theory are regarded a crucial source for explorative learning strategies and renewal in novel and complex problem solving environments [67,68]. From a dualities-aware understanding of separation they are subsumed under the characteristic of minimal threshold [13].

In this regard minimal threshold makes up the “structural pole” [13] that provides an enabling element, such as consistency, contentment and identity, at a minimal level. As a stabilizing representation of a dualities-aware perspective it is tied to manifested lines of demarcation between exclusive elements and it provides a judgement anchor for the needed degree of separation to keep up the duality within an integrated organizational setting. The concept of minimal threshold allows a perception of knowledge integration in PSS that does not demand for maximum permeability of knowledge boundaries but rather emphasizes the transcendence [69] of opposite but symbiotic knowledge bases. As Kellogg and colleagues found for dynamic organizational renewal: “Instead of transforming local understanding into shared meanings and common knowledge, organizational actors juxtaposed their diverse efforts into a provisional and emerging collage of loosely coupled contributions” [70, p. 38]. Minimal threshold is a distinct and crucial feature of how the heterogeneity of resources is configured in PSS by the transcendent existence of exclusive organizational sub-systems.

#### *4.3. Implications for the conditioning of competence and identity boundaries for a nuanced understanding of the separation divide in PSS*

The reference to the dynamic and changing interplay of divisional sub-systems in PSS is underlined in this paper by borrowing different levels of product-service integration for a servitization path. Along the integration process the degree of separation decreases. However, for the final stage of this integration process a minimal threshold between PSS divisional sub-systems is insinuated, thus guaranteeing a sufficient degree of bipolarity and transcendence of knowledge. At the same time the available variety of skills, work practices and competences increases even further as the highest level of

integration is achieved. Figure 1 shows that although the decrease of separation might come to a stop at the point of minimal threshold, available variety still increases as integratedness inclines with servitization. The figure also includes a visualization of the named three sub-systems as they merge with progressing servitization. The growing size of the overlapping area of circles gives an impression of the higher level of available variety and improved integratedness by means of efficient knowledge transfer and a common knowledge base. Likewise non-overlapping areas represent separate and non-integrated sub-systems with clearly separate identities. The dotted lines around areas inside overlapping areas finally demarcate separate but integrated sub-systems. The four areas of separated and integrated product-service, product-customer, service-customer as well as product&service-customer become larger as separation decreases. However, a full overlapping is not realized even for the final level of servitization due to the upholding of minimal threshold.

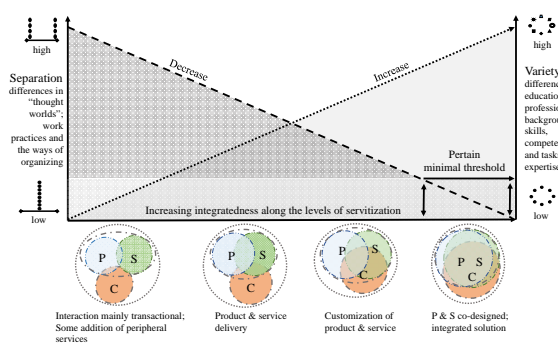


Fig. 1. PSS entity portfolio repatchment along different levels of servitization (own figure with reference to 27,46)

Based on the conception of a complementary relation between integration and separation this paper concludes with suggestions about how the shaping of PSS divisional boundaries could be guided by competence and identity aims likewise: a) an increase of functional heterogeneity can guarantee sufficient resource variety for a dynamic adaptation to novel environmental situations (competence conception); b) the promotion of connective thinking discourages over-reliance on existing methods and it fosters rapid parallel experimentation and broader thinking for efficient knowledge integration and dynamic resource (re-)configuration (competence conception); c) improved collaborative learning boosts innovation in PSS because it encourages members to experiment, reflect on results, and discuss errors. It also fosters psychological safety (competence and identity conception); d) the development of a frozen shared mindset needs to be discouraged in order to maintain access to new information and knowledge (identity conception).

## 5. Conclusion

This paper critically analyzes the separation conditions within PSS in referring to a competence and to an identity conception as they form important boundary decision areas for

the dynamic and complex PSS organizational environment. The analysis uncovers different and partly contradictory boundary effects but also underlines that both applied conceptions may even coevolve for improved innovativeness and strategic renewal in the case of PSS. The paper contributes to a theoretical discourse on boundaries within PSS by linking insights from heterogeneity theory and a dualities aware perspective to the named boundary conceptions. This leads to a nuanced understanding of the dynamic conditions of the separation divide in PSS. In practice the quintessence of the study may help PSS managers to establish minimal threshold for sustaining a resourceful and dynamically learning organizational setup. In summary results underline, that managing the separation divide in PSS requires a multi-faceted understanding of its possible organizational manifestations beyond basic exchange efficiency considerations.

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