7th Industrial Product-Service Systems Conference - PSS, industry transformation for sustainability and business

Coping with the challenges of a heterogeneous working context – a configuration of individual competencies for PSS workers

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Abstract

While new organizational offerings, such as product-service systems (PSS), are evolving from adapted strategic decisions, the actors involved in the dynamic implementation of the product-service work system (PSWS) originate from different organizational backgrounds, contribute from various fields of expertise and are familiarized with different working cultures. This built-in heterogeneity is rooted in three distinct compositional sources of the PSWS and it can be classified into a separation, a variety and a disparity type. It gives floor to the successful co-creation of value but also contains numerous challenges as it demands the integration of product and service dominated logics within a heterogeneous, yet collaborative problem-solving working context. This paper aims at eliciting a set of individual competencies that helps workers cope with the demands of PSWS with specific interest in positive and negative effects of different types of built-in heterogeneity. Data presented result from a survey among PSS engineers across branches and organizational entities that were asked to answer a standardized questionnaire in 2012-2013 about competencies as behavioral ad-hoc regulations for unstandardized problem-solving environments. An explorative factor analysis results in a three-dimensional configuration: a) a set of coordinative practices is bundled for improved problem-solving mainly based on positive variety utilization, b) a set of optimistic information filtering activities is bundled to reduce complexity and to benefit from separation and variety, c) a set of reflective in-depth-learning practices supports a high aim at improving and builds on the utilization of variety and separation effects. Based on this configuration positive effects of PSWS built-in heterogeneity can be maximized while negative effects are minimized.

1. Introduction

Product-service systems (PSS) are designed to build a shared value creation by integrating product- and service-oriented elements with a relatively high degree of customer integration [1]. Hence, the organizational setup of PSS necessitates a working context that can be viewed as a dynamic force-triangle (see figure 1) that is put up between product-, service- and customer-influences [2,3]. Each apex of this force-triangle brings in a separate set of requirements, technologies, machines, actors, behaviors and routines [3], each of which is cultivated and manifested within separate ways of organizing [4]. This built-in heterogeneity gives floor to the successful co-

creation of value [5] for financial, ecological, environmental and social benefits [6,7]. However, as heterogeneity is becoming a conditional influence on work performance and organizational output with positive and negative effects at the same time [8], the heterogeneous working context itself is creating a complex coping challenge for PSS workers [4,9,10]. Accordingly, Servadio & Nordin [11] reflect on the fact, that a lack of capabilities to handle the complexity of PSS may be one of the reasons why a relatively high ratio of PSS managers reports, that their offering does not meet expected economic results. Hence, various authors have emphasized that the operation of a PSS demands competences denoted to dynamic and cross-functional cooperation going beyond the limits of

traditional organizational boundaries [2,7,12,13]. However, a competence based perspective has not been applied so far with respect to a detailed exploration of the needed coping mechanisms when facing the built-in-heterogeneity of PSS. Therefore, this paper aims at eliciting the individual competencies that help workers cope with the challenges of the heterogeneous working context in a way that suits the needs of successfully establishing an integrated PSS.

The analytical procedure of this paper is based on the integration of theoretical backgrounds from heterogeneity and work systems research. On this basis an integrated framework of built-in-heterogeneity for a product-service work system (PSWS) is conceptually developed. In the further course of the paper this framework is applied to analyze data from a survey among German PSS engineers for an explorative quantitative study of competence configurations. As a result, an interpretation of possible underlying coping mechanisms is provided with respect to different sources and types of heterogeneity and related positive or negative effects in PSS.

2. Conceptual and theoretical background

As a first layer of the conceptual framework the underlying heterogeneity construct is theoretically specified for a more precise understanding of effects: two theoretical positions on positive and negative heterogeneity effects are briefly summarized and a framework for classifying different types and meanings of heterogeneity within an organizational setting, introduced by Harrison & Klein [14], is presented. As a second layer, the present paper adopts a work systems approach proposed by Alter [15] to introduce a heuristic framework for a classification of the underlying sources of heterogeneity in a PSWS. As a third layer a differentiating attribution of different types and amounts of heterogeneity is developed with reference to specific sources in the organizational set-up of a PSWS. An integrated ascription of possible positive and negative effects for each heterogeneity type completes the conceptualization of PSS heterogeneity challenges.

2.1. Disentangling the heterogeneity construct

Literature on heterogeneity theorizes positive effects from an information/decision-making perspective [16]. The underlying value-in-heterogeneity hypothesis claims that greater heterogeneity may lead to more innovative and creative solutions, enhanced responsiveness and greater flexibility for dynamic requirement adjustments [17]. Negative effects can be subsumed from a social categorization perspective [18,19]. As a consequence of in-group and out-group classification processes [20], conflict and destructive slack are likely to arise from perceived differences, misunderstandings and ineffective communication [21,22] as people prefer to work with similar others [23]. In addition, literature provides proof that a positive heterogeneity mind-set moderates social categorization as well as information/decision-making processes [24,25]. However, despite intensive efforts throughout the last decades, research on heterogeneity effects has provided a rather disappointing accumulation of either weak, inconsistent or mixed findings [18,26]. In search for possible underlying reasons of this status Harrison and Klein [14] suggest a typology of heterogeneity which falls into three different meanings whereas the three types may also interact to influence outcome variables.

The heterogeneity conceptualization as separation addresses "opinions, beliefs, values and attitudes especially regarding team goals and processes" [14]. Separation measures a composition of differences in (lateral) positions or opinions with a bimodal distribution, attributing highest separation when members are being split into two halves at opposite ends of the separation continuum. The heterogeneity conceptualization as variety addresses content expertise, functional background, nonredundant network ties or industry experiences. Variety measures "a composition of differences in kind, source or category of relevant knowledge or experience" [14] among unit members with a uniform distribution, attributing highest variation when members are evenly spread across all possible variation categories. The heterogeneity conceptualization as disparity addresses "pay, income, prestige, status, decision making authority, social power" [14]. Dispersion measures a composition "of (vertical) differences in proportion of socially valued assets or resources held among unit members" [14] with a skewed distribution, attributing highest dispersion when one member is at the highest and all other members are the lowest endpoint of a dispersion continuum.

Coping with heterogeneity for organizational effectiveness acquires capabilities and coping structures that are specifically configured to maximize the positive effects of heterogeneity while minimizing the negative effects [27,28,29] with respect to different types of heterogeneity [14].

2.2. PSS in the light of the work systems approach

A work system is defined as "a system in which human participants and/or machines perform work using information, technology, and other resources to produce products/services for internal and/or external customers" [15]. The characteristic elements of this definition constitute the incidents of a work system [15]. As such, an organization can be viewed as a unique set-up of the work system which is aligned to serve costumer needs under specific environmental and strategic conditions and supported by adequate infrastructure [15]. The work system approach provides a solid basis to broach the issue of a balanced integration of product-, service- and customer-influences in PSS [6]. The forced interplay of these partly contradictory spheres within PSWS creates a heterogeneous conflation of at least three different underlying ways of organizing [30] and numerous operational sets of different social actors and behaviors all of which contribute to built-in-heterogeneity [31]. In this light actors and their work practices conjoin as core elements of the PSWS making up the integrating centroid of an organizational force-triangle (see figure 1). Work system theory gives strong emphasis to the fact that the design of the PSWS, and more specifically its various incidents, need to have adequate coping strategies and behaviors for dynamic change, heterogeneity and complexity at their disposal [15].
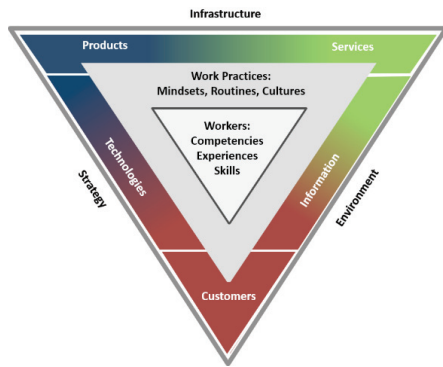
Fig. 1. PSWS – elements and incidents of a force-triangle (inspired by Alter [15] and Süße [2]

2.3. Attributing types to sources of heterogeneity in a PSWS

The following section builds on the assumptions of this PSWS framework and connotes sources of heterogeneity and work system incidents with reference to the characteristic organizational set-up of a PSS. This application serves as a basis for deducting corresponding heterogeneity meanings with reference to the typology introduced by Harrison and Klein [14]. In addition, a heuristic taxation of the presumed amount and relevance is introduced for each type with respect to its sources and effects within PSWS.

Separation: This form of heterogeneity can be found in PSWS with regard to differences in the ways and mentalities of organizing when balancing the duality of product-oriented and service-oriented traditions [2,32]. A similar bimodal representation maybe seen in a provider vs. customer separation or in more detail in a product-unit vs. customer respectively service-unit vs. costumer relation. As such, the separation type of heterogeneity is specifically characterized in a PSWS by the three apart apexes of the force-triangle (see fig. 1). The presumed amount of heterogeneity is estimated relatively high which is indicated by a bimodal distribution of icons on a grey background in the upper right corner of figure 2. Predicted outcomes of this type are of high relevance and negative effects resulting from reduced cohesiveness, more interpersonal conflict, distrust or decreased task performance need to be minimized to achieve positive over-all results.

Variety: Variety can be found in PSS with regard to the differences in educational or professional backgrounds, work practices and tasks expertise or PSS provision experience. It may also address dimensions such as the amount of interactions between network partners and the resulting industry experiences and cooperative routines. As such, the variety type of heterogeneity is specifically characterized in a PSWS by individual members differences, often connoted with task or job responsibilities, skills and knowledge. Sources of variety may to a limited extend be seen within (product or service or customer) and to a larger extend across units of the work system. Therefore, the presumed amount of heterogeneity is estimated moderate to high which is indicated by the two grey

fields in the middle row of figure 2 with the highest variety of icons in the right outside field for maximum heterogeneity. Predicted outcomes are of high relevance and can be both positive as well as negative as it can evoke greater creativity, innovation and higher decision quality or increased flexibility while at the same time increasing task or performance conflict.

Dispersion: This form of heterogeneity can be found in PSWS with regard to differences in years of organizational membership which is applicable across all units of the force-triangle. A similar skewed distribution may as well derive from differences in status or salary between sales and back-office, R&D vs. manufacturing, or product vs. service attributed members of the work system. As such, the disparity type of heterogeneity is specifically characterized in a PSWS by access to resources and information, strategic influence on the quality and design of the value proposition as well as related to outcome responsibilities and income. Its amount may vary from minimum to maximum (see lower row in figure 2) depending on financial settings, network contracts and ownership configuration which make it a less distinct type of heterogeneity when characterizing PSWS in general. Predicted outcomes can be both positive as well as negative as it can evoke greater within-work-system competition while at the same time increasing resentful deviance leading to reduced member input or withdrawal.
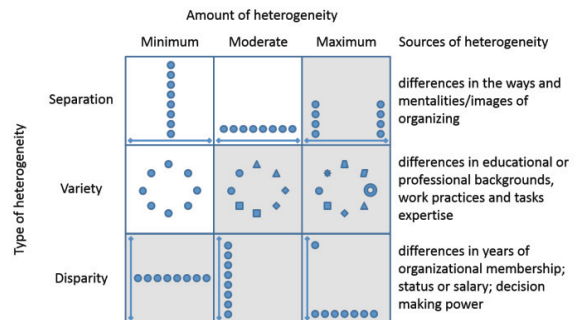

Fig. 2. Types and sources of heterogeneity in PSWS; grey fields indicating assumed amounts in PSWS (informed by Harrison & Klein, 2007, p. 5) [14]

Each of the three types is naturally present in PSWS and has either individual or confounded influences on unit outcomes, while all types require specific coping mechanisms to balance positive and negative effects. Hence, an appropriate coping with the multi-dimensionality of heterogeneity in PSWS should be more effective when addressing all three types of heterogeneity in a prioritized and specific manner, while disparity seems to be of lowest typical relevance for PSWS.

3. Research question, data collection and methods

This study is designed to elicit a specific configuration of individual competencies in the light of the challenges of a heterogeneous PSS working context. In addition, an a-priori assumption of the paper derives from a conceptual differentiation of heterogeneity types and amounts: The over-

all configuration is expected to contain an inherent logic that reflects a specific alignment of individual competencies with respect to different types of heterogeneity in PSWS. The guiding analytical question in this paper is therefore as follows: What configuration of individual competencies can be observed for PSS workers and how does each bundle of competencies relate to types of heterogeneity in PSWS? This question is addressed empirically by an explorative quantitative analysis of competence data from PSS workers.

Data were collected through an online-based survey that was conducted among German engineers from summer 2012 to spring 2013 with a return of 172 questionnaires. 67 respondents (85% male; 56% aged between 30 and 49 years) were collated with a PSS alike working context following a cluster analysis [2] which was guided by a scale classifying qualities of the organizational offering provided by Cova & Salle [33]. This subsample was used for further analysis in this paper. It gathers participants across branches and various organization entities to generate a wider ranged and statistically approved insight for a deepened competence discussion.

In order to measure a base set of individual competencies a validated scale for individual capabilities was applied because of its explicit direction towards a behavioral representation of cognitive and work related problem-solving processes under influences of complexity, uncertainty and heterogeneity [34]. The standardized questionnaire integrates items with respect to individual cognition, action and interaction. The pool of items was enlarged by questions that were explicitly directed at cognitive attributions of an individual contribution to higher future outcomes, thus covering the moderating influences of a general mind-set towards heterogeneity matters. Appendix A displays the list of items used in the analysis after running reliability and dimensionality testing. Respondents gave answers on a seven-step Likert scale, with "1" meaning "I totally disagree" and "7" meaning "I totally agree."

An explorative factor analysis was conducted to trace specific bundles of competencies. The principle component factor analysis was based on a "Varimax rotation". Only factors that accounted for an "Eigenvalue" greater than 1 were extracted [35]. The factor solution was optimized step-wise in 5 iterations accepting Kaiser-Meyer-Olkin criterion (KMO) above 0.6 [36]. Twenty-four selected items were suitable for the final solution. Results of scree tests [37] were considered. Cross loadings were accepted in accordance to the logic that specific competencies can have multiple contributions to more than one dimension represented by each factor.

4. Results

Factor analysis leads to a solution (KMO= .770) that represents a specific configuration of three competence bundles (see Appendix A). A first factor includes 15 items with factor loadings between 0,400 und 0,683; a second factor is made up from 7 items with factor loadings between 0,345 und 0,886; a third factor includes 4 items with factor loadings between 0,325 und 0,664. The inherent coping effects of these three competence bundles are derived on the basis of a qualitative

factor interpretation. Each competence set of the configuration is interpreted with respect to the utilization of heterogeneity based on the classification of heterogeneity types in PSWS.

1) Coordination/Mediation of meaning. This factor combines activities for new problem-solving approaches based on the combination and implementation of established work-based experiences paired with a high level of self-reflection. It is implemented within a high transformation readiness. Examples of activities are: 'For my continuous development, I actively ask others for feedback'; 'I am well able to adapt to various people and to work with them'; 'I find it easy to build strong working bonds with others'; 'I am well able to discuss problems with people from outside of my division'. With respect to heterogeneity sources, behaviors of this bundle mainly address the with-in unit variety type as they enable the effective interaction and learning of actors built on utilizing a broad scope of professional backgrounds, work practices and task experiences. The competence bundle also includes behaviors that support cooperative interaction across departments. It aims at utilizing the positive effects of a separation type of heterogeneity as it enables the productive integration of different underlying ways of organizing for enhanced creativity, innovative problem-solving and higher decision-making quality. In summary, based on activities in this factor, positive heterogeneity-dynamics are utilized for improved and creative problem-solving approaches. Negative effects are absorbed by a positive heterogeneity mindset and specific conflict resolution behaviors.

2) Confident coping with complexity. This factor combines activities that are aimed at filtering relevant information especially with regard to noticing risks and chances of innovation and organizational renewal within a generally high mode of optimism about one´s significant contribution to the value-creation. Examples of these activities are: 'While processing extensive problems, I consistently evaluate how well I am doing'; 'I feel confident to contribute to corporate strategy with my expertise'. With respect to heterogeneity sources, most items of this bundle can be attributed to all three types in PSWS. The configuration aims at establishing and pertaining a positive mindset, even in uncertain and complex situations. The general orientation of these behaviors enables actors to constantly reflect on their own performance and to be sure that individual contributions are an essential part of the overall achievement. Based on this, fears about negative effects of a separation related to contradictory mindsets and ways of organizing can be reduced. In addition, anticipated negative effects denoted to variety and even disparity can be addressed. Filtering relevant information from a large variety of information, however, refers to sources that mainly relate to differences in skills and knowledge or network complexity within PSWS. In summary, heterogeneity is dealt with through am optimistic and selective information management while integrating it into an active learning process. It utilizes positive heterogeneity effects mainly from both, separation and variety, while it also provides a confident mindset as an underlying part of a coping mechanism that minimizes potential conflicts and risks from all three types.

3) In-depth-learning/team-orientation. This factor combines activities that allow to utilize external knowledge and best practices paired with the ability to break with established routines within a generally high aim at improving. Examples of these activities are: 'I always try to learn from others in my daily work'; 'I find it easy to ask others for help if problems arise'. With respect to heterogeneity sources, behaviors of this bundle mainly address the variety type as they refer to differences in work practices and cooperative routines. The competence bundle also hints towards a coping with separation in PSWS as it supports the integration or subordination of individual opinions and problem-solving routines in the face of higher quality team decisions. In summary, the main aim of this competence bundle is directed to a constructive coping with PSWS variety and separation effects. A positive impact of this heterogeneity type is exploited by the individual`s capability of accepting and implementing third-party best-practices.

5. Conclusion and limitations

This explorative empirical study identifies a configuration of individual competencies which appears to support coping with heterogeneity demands under the conditions of a PSWS. The detected configuration mainly addresses separation and variety as those heterogeneity types that were assumed to be of highest relevance and specificity in PSWS. Item sets within factors reveal that some coping mechanisms (e.g. coordinative activities) are specifically directed at challenges in exploiting the positive effects of the PSWS built-in-heterogeneity. Other competencies are clustered as a coping mechanism to minimize negative effects that result from heterogeneity (e.g. mediation of meaning). This applies specifically with respect to forms of separation. The relevance of a positive heterogeneity-mindset can be identified in activities deducted to reducing complexity and utilizing separation and variety. In combining the coping mechanisms of all factors the configuration is apt to be seen as an aligned set of individual competencies to cope with PSWS heterogeneity challenges in a balanced and confident manner.

The proposed classification and meaning of heterogeneity types in this study is framed by a work systems perspective. While this approach has proven to be of significant deductive quality, more empirical research may in future be directed towards testing the integrity of the proposed application of the heterogeneity typology for PSWS. In doing so, PSS research might gain a specific structuring approach for analyzing the demands and challenges related to organizational set-ups. Additionally, theorizing on the construct of heterogeneity may benefit from empirical operationalization of heterogeneity types and effects for this specific and other work systems.

Limitations of the generalizability of these findings need to be considered with regard to the chosen sampling strategy which results in a rather high level, less context specific interpretation. Sample size and structure are also limiting the generalizability beyond a population of engineers as PSS workers. Moderators such as access to resources and decision making power may in future be taken into consideration for a deepened analysis of separation and disparity effects.

In summary, this study adds a building block in forming a better understanding of how PSS can successfully be operated from a competence-based perspective. Results provide insights for future research and practices addressing issues of the selecting and training of PSS workers. Future research needs to be directed at validating the explorative findings of this study through case applications or larger empirical designs. The applied conceptualization of heterogeneity in PSWS adds an important argument for disentangling separation, variety, and disparity in PSS as well as heterogeneity research.

Acknowledgements

Appendix A: List of items and factor loadings

Item	Component		
	1	2	3
I often use creative methods for developing new problem solutions.	,683	,239	-,160
I am well able to adapt to various people and to work with them.	,673	,213	,050
I am good at getting my ideas across to others.	,649	,192	,149
I approach others about promised support.	,635	,159	,319
I find it easy to build strong working bonds with others.	,628	,388	,206
I succeed in transferring my existing knowledge to novel problems.	,616	,410	-,168
I get my ideas across to others easily.	,589	,089	,070
I am able to put myself in someone else's position.	,478	-,038	,157
I find it difficult to plan and schedule tasks.	-,463	-,155	-,031
Consistently, I take time to think about how I can improve my way of working.	,453	,087	,201
I feel obliged to keep a promise.	,446	,102	,229
For my continuous development, I actively ask others for feedback.	,414	,272	,329
In conflict situations, I am able to arrive at a mutual solution.	,411	,086	,028
I am well able to discuss problems with people from outside of my division.	,400	-,018	-,096
I am optimistic concerning my future career perspectives.	,029	,886	-,171
I feel confident to contribute to corporate strategy with my expertise.	,079	,689	,333
I emphasize the positive side in professional difficulties.	,236	,589	-,019
I expect the best in uncertain situations at work.	,171	,547	,088
I find it difficult to filter the relevant information from a great variety of information.	-,245	-,405	-,172
While processing extensive problems, I consistently evaluate how well I am doing.	,050	,345	,044
I support team decisions even if I hold a different opinion.	-,039	,321	,664
I always try to learn from others in my daily work.	,209	-,068	,627
I can handle stressful situations at work in a relaxed manner.	,415	,148	-,453
I find it easy to ask others for help if problems arise.	,237	,150	,325

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