Organizing the integration demands across PSS life cycles: Towards a specific form of improvisation for creating customer-specific solutions

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Abstract
This paper seeks to explore a distinct form of improvisation as a specific coping mechanism for organizing the integration demands across PSS life cycles. The line of argumentation is based on state-of-the-art literature which calls for a new form of organizing in PSS and the recent theoretical discourse of organizational improvisation in organization research. It is argued that organizational improvisation addresses the high integration demands and fosters the capability of innovative ad hoc problem-solving in PSS. An empirical investigation is introduced in order to specify a distinct pattern of organizational improvisation for PSS as a context of highly integrated value creation. The empirical results reveal a specific form of improvisation which can be characterized as a pattern of rapid responses for solving ad hoc problems in a selective bricolage of internal and external knowledge. On this basis an improvisation-integration model is suggested which outlines that organizational improvisation, as specified in this paper, may contribute to the mutual integration of product and service in a customer-specific way.

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1. Introduction

The mutual integration of product and service processes towards highly individualized solution offerings such as Product-Service Systems (PSS) is discussed as a promising approach for organizations to gain advantages in today’s more customer-driven market environments [1,2]. The value creation processes along the whole PSS life cycle should be closely aligned to the customer perspective in order to meet the demands of high customer individualization [3]. This requires an integrative value creation approach in order to offer highly individualized solutions. In that regard, the concept of integration is discussed intensively in the research field as a mutual combination of technology, knowledge and production systems, e.g. in order to deliver products closely intertwined with services [4,7]. In the PSS literature, integration is understood as the creation and provision of value as a solution for customers, preferably corporate customers who operate in dynamic market environments [e.g. 1,5,6]. In addition, integration is also outlined as an operational approach addressing the alignment of processes during the design, development and operation of products in close relationship with services [4,7]. However, this can lead to potential contradictions and tensions, as well as efficiency issues, e.g. during ad hoc problem-solving demands in PSS [e.g. 2,8,9]. Recent literature in the field of PSS and servitization argues that the PSS concept calls for a new form of organizing [7,9] in order to constructively integrate rapidly changing customer needs at early stages of design and development and to secure ad hoc problem-solving in the operation of PSS [e.g. 6,8,9]. The integration capability of PSS providers is discussed as a success critical element [10]. However, literature remains rather silent about a specification of the distinct organizational mechanisms which emerge as coping approaches for the growing demands of integrating product and service processes for highly customized solution offerings. In order to address this research gap, it is the aim of this paper to outline further specification of distinct
organizational mechanisms for coping with a high level of integration of product and service to address customer needs in PSS. From a conceptual point of view, PSS organizations are considered as ad hoc problem-solving contexts [11] which recognize, understand and solve very specific customer problems rapidly. This conceptualization points towards improvisation, which can be understood as an action-oriented concept of ad hoc problem-solving. Recent contributions in the field of PSS refer to improvisation as a promising approach, but remain rather silent about its specific configuration for integrated problem-solving contexts, such as PSS [12]. It can be stated that despite its increasing relevance for highly ambiguous and dynamic environments, it still remains an open research question whether organizational improvisation shows higher relevance in the context of integrated solution offerings and, thus, can be an organizational coping mechanism to meet integration demands in PSS. This paper, therefore, focuses on improvisation as an enabling element for integrated PSS design, development and operation. It specifies a PSS-specific form of organizational improvisation. The argumentation is based on empirical results of a survey among 172 engineers in Germany. The conceptual interpretation scheme of the empirical results builds on a combination of the recent discourse about growing challenges of organizing integrated solution offerings and the theoretical discussion about organizational improvisation in related literature.

2. Theoretical framing

2.1. Organizing integrated solution offerings in PSS

Literature argues that PSS and integrated solution offerings in general demand a new form of organizing [7,9]. This creates major challenges for organizations transforming towards an integrated value proposition [1,2]. Cova and Salle [13] identified four major obstacles in organizing a firm to become an integrated solution provider: changing the orientation of the firm; the need for new capabilities and skills; the transformation of structure and processes; and the implementation of the transformation processes within the firm [13, pp. 142-3]. Uлага and Reinartz [14] describe significant challenges during the transformation for organizational structures, processes, routines and capabilities. It is widely accepted that the transformation towards PSS is a severe process of organizational development and renewal [e.g. 1,2]. During this transformational process, organizational practices become more complex and contradictory, while coordination needs increase [8,9]. Shepherd and Ahmed [10, p. 105] regard technical competence, integration competence, market or business knowledge competence and customer partnering competence as the bases for integrated offerings. Biloslavo et al. [15] mention the emergence of contradictions between opposing poles with regard to organizational structure and behaviour in product-service integration. In order to cope with these challenges, an organization’s capability to constantly adapt to ambiguous needs is considered as crucial [2,16,17]. While current PSS literature draws a picture of a transformation process leading to a new form of organizing with significantly different demands for organizational routines and employees’ skills [see also 1,2], it remains rather silent about the contribution of organizational improvisation as an enabling element for organizations to cope with very ambiguous and dynamic environments which increasingly demand ad hoc problem-solving capabilities. This paper contributes to the further understanding of organizing for integrated solutions by exploring a PSS-related form of organizational improvisation. In addition, based on an improvisation-integration model, the paper introduces first insights about how to organize integration demands more successfully. This approach suggests that organizational improvisation may have a positive impact on the integration of product and service to meet customer-specific demands.

2.2. Organizational improvisation

Several contributions to the concept of improvisation pointed out that competition increasingly demands the development of organizations’ improvisational capacity in order to be capable of growing sustainably in today’s turbulent and more customer-driven environments [18,19,20]. In that regard, literature especially in the field of organization theory contributed to a mature understanding and definition of organizational improvisation. The latter can be considered as “the conception of actions as it unfolds, by an organization and/or its members, drawing on available material, cognitive, affective and social resources” [21, p. 302]. This definition of organizational improvisation combines two dimensions: Firstly, it is planning in action that is deliberate and intentional; it is extemporaneous, thus, cannot be planned in advance; and it occurs during action [21,22,23]. Secondly, the definition of organizational improvisation refers to the concept of bricolage, which means the usage of currently available resources or repertoires to perform “whatever task one faces” [24, p. 352]. M. oorman and M. iner (1998) point out that “improvisation is a special case of intraorganizational innovation, which is defined as deviation from existing practices or knowledge” [25]. This argumentation implies that improvisation always has a certain degree of innovation, as it consists of an inherent deviation from planned routines, processes, structures or actions [see also 26]. Organizational improvisation is especially discussed by a growing body of literature in the field of new product development. This field of research outlines that the unfolding of improvisation mechanisms contributes to the organizations’ capability to sustain in turbulent and fast changing market environments [see e.g. 25,26,27]. It can also be argued that the understanding of improvisation as an intended variation by a distinct organizational design [28] may foster ad hoc problem-solving in the face of rapidly changing customer demands, e.g. in the context of integrated solutions such as PSS. This line of argumentation becomes particularly relevant when considering PSS business customers, where integrated solutions usually contribute to the adaptability of customers’ value creation processes in a mutually beneficial way [17]. Thus, improvisation gains increasing awareness in the PSS research community especially when it comes to requirements that demand routines of ad hoc and complex problem-solving
in PSS, e.g. in order to address highly individualized customer needs which become more fluid [12]. To summarize, it can be stated that improvisation is discussed as a mechanism that keeps ambiguous environments in constructive syn in order to not only sustain in turbulent situations, but also to recognize and utilize new opportunities for innovation and competitive advantages during problem-solving [15,27]. Based on this conceptual background, this paper argues that a distinct form of organizational improvisation in PSS can be regarded as a contributing element for coping with the high demand for integration by enabling organizations and their actors in generating innovative and more customer specific output under critical time constraints [25,27].

3. Data Collection and Evaluation

In order to specify a distinct form of organizational improvisation for PSS, an online-based survey among German engineers was conducted between summer 2012 and spring 2013 by a group of PSS researchers in Germany [29]. The survey had a return of 172 questionnaires (see sample structure in Appendix A). The questionnaire included items from the scale of Cova and Salle [13] in order to distinguish different types of integration in the value proposition. The scale asks about the degree of combination of products and services, the interrelatedness of these fields and the individualization in terms of customer-specific solutions. This allows the identification of a discrete form of organizational improvisation related to different styles of value creation. The questionnaire includes 108 items, while answers are given based on a seven-step Likert scale. The set of items builds on scales from evaluated instruments: Answers with regard to job characteristics and work environment are based on the scale by Morgeson and Humphrey [30], individual cognition, action and team interaction relate to Wilkens and Gröschke [31], and perceived leadership relies on the Global Transformational Leadership Scale developed by Carless, Wearing, and Mann [32] and items from the Multifactor Leadership Questionnaire developed by Bass and Avolio [33]. The questionnaire also contains psychological and socio-structural empowerment items [34,35]. This combination of scales may provide insights of a specific form of organizational improvisation.

3.1. Steps of data analysis

The first step of data analysis is a hierarchical cluster analysis in order to group respondents into different types of value creation, regarding their integration level. The distances between the participants are estimated using Ward’s method and squared Euclidian distances. The second step conducted is a multiple discriminant analysis in order to identify a configuration of organizational improvisation for the context of a high level of integrated value creation.

3.2. Results cluster analysis: Three types of integration

The results of the cluster analysis reveal that participating engineers of the survey can be classified into three groups (see Fig. 1). The first group of participants can be associated with a fully integrated type, as this group shows a high mean value for the combination and the interrelatedness of product and service, as well as the individualization of solutions. This type can most likely be understood as a PSS-oriented type of integration [see e.g. 1,2,17]. The second group is labeled as the combination-oriented type. It shows moderate degrees of product-service combination, as well as their interrelatedness. However, individualization of customer-oriented solutions is lowest for this type. It can be interpreted as a rather production-oriented value proposition, which builds its value creation processes on a high degree of standardization and lower levels of integration.

Finally the third group could be allocated by the cluster analysis to the customization-oriented type of value creation. For this type, combination of product and service as well as their interrelatedness is comparably low, while individualization is relatively high. This type can be associated with a highly specialized service or production-oriented value proposition, which scarcely shows integration of products and service in the value creation processes. Next, the differences in the organizational characteristics between these three types on the basis of the scales used were evaluated with the help of a discriminant analysis. The result reveals a differentiation between the fully integrated type and the combination-oriented type, as well as between the fully integrated type and the customization-oriented type.

3.3. Results of discriminant analysis: Distinct set of variables for the fully integrated type

As shown by Figure 2, the discriminant analysis conducted between the fully integrated and the combination-oriented type generated a discriminant function with five variables, had a Wilks’ Lambda of 0.753 (p < 0.01) and a canonical correlation of 0.497. The function for the centroid of the fully integrated type is 0.491 and for the centroid of the combination-oriented type is -0.658. This means that there are considerable differences between both types (fully integrated vs. combination-oriented) with respect to the five variables shown by the upper section of Figure 2. The most important predictor for the fully integrated in comparison to the combination-oriented type is the item “I usually try to learn from other people during daily work.” with the standardized
The discriminant analysis focusing on the differences between the fully integrated and the customization-oriented type generated a discriminant function with four variables (see Fig. 2 lower part), had a Wilks’ Lambda of 0.830 (p < 0.01) and a canonical correlation of 0.413. The function for the centroid of the fully integrated group is 0.387 and for the centroid of the customization-oriented group -0.519. The greatest reduction in Wilks’ Lambda occurs between the first and second steps. Interestingly, the most important predictor for the customization-oriented type in comparison to the integrated type is the variable “The management motivates the employees and treats them with respect.” with a standardized canonical discriminant coefficient of -0.668 (see Fig. 2). The fact that this coefficient is negative shows that leadership, in terms of motivating employees and treating them with respect, can more likely be expected in customization-oriented types than in a fully integrated environment. In comparison to the customization-oriented type, there is a generally higher demand of performing new tasks (variable 3) and a feedback-based self-improvement (variable 1) in the integrated type of value proposition. Furthermore, a certain degree of standardization seems to be more important for the fully integrated type. The analysis correctly classified 61.2 % of all cases (cross validated 57.8 %), 67.2 % of fully integrated type (cross validated 65.7 %) and 32.8 % of customization-oriented type (cross validated 34.3 %).

4. Interpretation of results under the lens of improvisation

As this paper seeks for an exploration of a form of organizational improvisation as a coping mechanism for the context of highly integrated solutions such as PSS, the empirical results should be interpreted on the basis of the related theoretical discourse. The empirical results of the previous section revealed that there are three distinctive types of value creation, which could be identified on the basis of the survey among German engineers. As shown by Figure 2, there is a fully integrated type of value creation which best relates to PSS as being defined in the sense of mutually integrated product and service elements to meet individual customer demands [17]. The first comparison between the combination-oriented type and the fully integrated type on the basis of the respective discriminant analysis shows a reliable predictable difference between both types of 70.9 % (cross validated) on the basis of the five characteristics for the integrated type. In summary, these characteristics refer to an integration of internal and external knowledge and information. Compared to this, the predictability of the discriminant analysis between the customization-oriented and the fully integrated type is about 57.8 % (cross validated), which is much lower than 70.9 % for the other comparison stated before. On the basis of this result, it can be argued that there seem to be more fundamental differences between the fully integrated type and the combination-oriented type than between the fully integrated type and the customization-oriented type.

4.1. Interpreting distinct variables between the integrated and the combination-oriented type of value creation

As shown by the variables in Figure 2, the bricolage of individual knowledge in a group setting happens to be crucial for the fully integrated type in comparison to the combination-oriented type. It can be argued that the set of variables points towards an interorganizational exchange process, which focuses more on knowledge-intense innovation. This shows relations to the characterization of organizational improvisation as an interorganizational innovative process [see 25, p. 5]. More precisely, it can be stated that learning and development activities are of key concern in the context of the fully integrated type, as this is the strongest differentiator between both. This reveals aspects of team-oriented improvisation activities, which are characterized as the unfolding of methodologies for the interchange of beliefs and project routines in groups [see 27, p. 205]. Most interestingly, these activities, which also include deviation from established routines, are supported, stimulated or framed by leadership in the fully integrated type of value creation. Thus, a huge number of communication and co-ordination...
processes seem to be directly linked to knowledge sharing and information evaluating efforts on a group level. This draws additional connections to the concept of improvisation, as it also denotes facets of retrospective sense-making [24], as well as reflection-in-action [36]. Both point towards acquiring new information and allow the “criticizing, restructuring, and testing of the intuitive understanding of experienced phenomena” [27, p. 205]. This also relates to the understanding of improvisation as being rather change-driven and, thus, more closely related to exploration than to exploitation [26]. This is mirrored distinctively by the variable of inspiring leadership and the variable which states that utilizing the experience of others for one’s own projects is more a characterization of the combination-oriented than of the fully integrated type. In summary, it can be stated that the communication especially across different organizations pointing towards the integrated type, supported by the fact that external communication with partners and customers is seen merely as an easy day-to-day task, underlines two aspects: Firstly, it emphasizes the bricolage of knowledge which is required to deliver highly innovative and individual solutions for customers and, secondly, this bricolage can be considered as a selected or reflected process. Both are supported by an inspiring leadership.

4.2. Interpreting distinct variables between the integrated and the customization-oriented type of value creation

While it has already been mentioned that the predictability of 57.7% for fully integrated value creation compared to a customization-oriented value creation is comparably low, it seems to be fruitful to briefly interpret the discriminating variables between both types of value creation. In the light of improvisation it is interesting to mention that the integrated type shows a higher degree of new tasks, e.g. new ad hoc problems individuals have to deal with. This can be regarded as a hint towards improvisation as “the conception of actions as it unfolds” [21, p. 302]. By contrast, the fourth variable points more towards a higher degree of standardization in the fully integrated type. On this basis, it can be argued that the fully integrated type may be a more paradoxical context, where standardization and individualization have to be balanced in order to meet efficiency and effectiveness targets at the same time. As Kamoche and Cunha [26] argue, improvisation can be a key coping mechanism for balancing such opposing demands. Furthermore, it reveals that the fully integrated type shows a higher degree of self-improvement and self-reflection, as individuals continuously aim to gather feedback from others [24,36]. An interesting result is the negative discriminant coefficient for the variable “The management motivates the employees and treats them with respect.” It can mean that motivation and respect by leaders is supported by an inspiring leadership.

5. Towards a specific form of organizational improvisation

A specific form of organizational improvisation for integrated solution offerings in PSS can be suggested on the basis of the outlined interpretation scheme above. It can be argued that the conceptual connections made in the previous section revealed fruitful insights about the newly emerging form of organizing in PSS. With reference to recent literature on organizational improvisation, it can be stated that the fully integrated type of value creation, which is closely related to PSS, shows major facets of group-oriented improvisation, such as queries of current practices, plans and beliefs by obtaining new information and knowledge [see also 37]. It also be outlined that the facets of improvisation support the emergence of new design alternatives, new market and technical perceptions, and new procedures, tools or solutions in PSS. In summary, this leads to a conceptualization of an improvisation-integration model for PSS (Fig. 3). This conceptualization focuses on the organization’s capability of rapid responses for solving ad hoc customer problems, e.g. by a group-oriented bricolage of internal and external knowledge resources to mutually integrate product and service processes during the generation of highly individual customer solutions.

6. Discussion and limitation

This paper seeks to provide more specific insights about improvisation in the context of integrated solution offering such as PSS. On the basis of empirical results distinguishing fully integrated solution offerings from other value propositions, the paper argues that improvisation as group-oriented activities among individuals sharing knowledge is likely to foster integration capability in PSS, e.g. in order to respond to ad hoc problems rapidly. On the basis of these results, it can be argued that this paper makes new contributions to PSS literature. Firstly, it provides a further specification of improvisation as crucial element of a new form of organizing in PSS, e.g. in order to foster integration along the life cycle of solution offerings. Secondly, it suggests
a conceptualization of improvisation as enabling element for the mutual integration of product and service for individual solutions. However, it should be noted as a limitation of this paper that the empirical results and their interpretation is of a high explorative character, as it is one of the first applications of this kind to PSS. Thus, the paper calls for further empirical research on the improvisation-integration model. This would contribute to additional insights about how to organize for high integration demands along the whole PSS life cycle.

Appendix A. Descriptive statistics of the sample

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>up to 29</th>
<th>30–39</th>
<th>40–49</th>
<th>50–59</th>
<th>60 and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>42 (24.4 %)</td>
<td>57 (33.1 %)</td>
<td>42 (24.4 %)</td>
<td>24 (14.0 %)</td>
<td>7 (4.1 %)</td>
</tr>
<tr>
<td>Work experience (years)</td>
<td>up to 5</td>
<td>6–10</td>
<td>11–15</td>
<td>16–20</td>
<td>21–25</td>
</tr>
<tr>
<td>Promoted</td>
<td>15 (8.7 %)</td>
<td>152 (87.8 %)</td>
<td>18 (10.5 %)</td>
<td>13 (7.3 %)</td>
<td>9 (5.4 %)</td>
</tr>
<tr>
<td>University/advanced technical college</td>
<td>11 (6.4 %)</td>
<td>17 (9.9 %)</td>
<td>17 (9.9 %)</td>
<td>12 (7.1 %)</td>
<td>7 (4.1 %)</td>
</tr>
<tr>
<td>University of cooperative education</td>
<td>4 (2.4 %)</td>
<td>1 (0.6 %)</td>
<td>7 (3.9 %)</td>
<td>1 (0.6 %)</td>
<td></td>
</tr>
</tbody>
</table>

References