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**Third-party logistics providers offering form postponement services: value propositions and organisational approaches**

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## Third-party logistics providers offering form postponement services: value propositions and organisational approaches

In today's global supply chains, third-party logistics providers (3PLs) can play an important role in implementing the principle of form postponement (FP). This proposes that activities creating product variety and the associated production mix decisions are deferred along a product family manufacturing and distribution process as long as possible. While both FP and third-party logistics have increasingly drawn the attention of the academic community over the last few years, less research has been done on FP supported by 3PLs. The present paper empirically investigates how 3PLs can deliver value to companies offering product variety by providing FP services, defined as the carrying out of variety-creating activities on behalf of these companies close to the target markets. Our findings indicate that through an FP service, a 3PL can give its customers two different kinds of benefits: either improved performance in serving the customer's existing markets or entry into new geographical markets. Further, our results show that through the choice of the organisational solution for FP service provision, the 3PL can increase FP value by mitigating a number of disadvantages that the customer might incur in case of in-house implementation of FP. Challenges that the 3PL needs to overcome to actually provide these potential benefits are also identified. The paper concludes by discussing the implications of our findings for both practice and research on FP.

**Keywords:** form postponement; delayed product differentiation; third-party logistics; mass customisation; case study-based research.

### 1. Introduction

Form postponement is an operations design principle that more and more companies today are turning to (Matthews and Syed 2004) under the effect of increasing product variety and customisation (Pine 1993, Bayus and Putsis 1999, Funke and Ruhwedel 2001). The principle of form postponement (FP) proposes that companies defer their commitment of resources to a specific end-product in the manufacturing and distribution process as long as possible (Alderson, 1950; Heskett, 1977). Application of FP requires deferring at least one product differentiation activity (PDA), which specialises the work-in-progress into particular end-products, and the decision driving such activity (Lee, 1996; Garg and Tang, 1997). By deferring a PDA, FP allows for the collecting of new information about customer demands (e.g., actual customer orders, or updated sales forecasts in case of make-to-stock production) prior to the making of the decision driving the PDA, thereby reducing uncertainty (Yang *et al.* 2004a, Forza *et al.* 2008, Wong *et al.* 2009).

Third-party logistics providers (3PLs) can play an important role in FP implementation (van Hoek 2000a, Yang *et al.* 2007), owing to the increasing geographical dispersion of supply chains. As production moves farther away from primary markets, there is a greater incentive to implementing FP by placing PDAs in the distribution channel. By doing so, companies serving

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global markets avoid making decisions on final product configurations far ahead of the moment of customer purchase and assure high responsiveness, while retaining scale economies at centralised factories (Cooper 1993, Van Hoek 1998). With more and more companies trying to place PDAs in the distribution channel, it comes as no surprise that 3PLs, especially large 3PLs operating on a continental or even global scale, see the carrying out of PDAs on behalf of manufacturing companies as a viable extension of their service offerings (van Hoek 2000a). By doing so, 3PLs can raise turnover in a higher-margin area of the supply chain than the increasingly commodified traditional logistics services (van Hoek 2000b). Moreover, by supplementing transport- and warehousing-based services with the carrying out of PDAs in the distribution channel, 3PLs can reap the benefits of deeper relations with existing customers and increased customer loyalty (van Hoek 2000a).

While both the literature on FP (van Hoek 2001, Yang *et al.* 2004b) and the literature on third-party logistics (Selviaridis and Spring 2007, Marasco 2008) have rapidly grown over the last few years, less attention has been paid so far to FP supported by 3PLs. The present paper aims to augment our understanding of how 3PLs can deliver value to companies offering product variety by providing FP services, defined as the carrying out of PDAs on behalf of these companies close to the target markets. Accordingly, the paper empirically investigates the following two research questions: What FP services can a 3PL offer and how do they create value for the customer buying the service? Moreover, what organisational solutions can a 3PL adopt to provide an FP service, how do they influence value to the 3PL's customer, and what are the associated challenges for the 3PL?

The remainder of this paper is organised as follows. Section 2 provides motivations for our research in the context of the existing literature on FP. Section 3 describes and justifies the inductive research design we used to address our research questions. Three observations linking 3PL-provided FP services, value to the 3PL's customer, organisational approaches, and enabling or hindrance factors are presented, along with the evidence supporting each observation, in Section 4. Section 5 concludes by discussing the contribution of this study to the FP literature, the managerial implications of our findings, as well as their limitations and associated opportunities for future research.

## 2. Background

The notion of FP first appeared in literature in the 1950s, when Alderson (1950, 1957) proposed postponement in product differentiation as a principle to improve the efficiency of a production and distribution system. Product differentiation may occur in product form and identity, thereby resulting in different varieties, or in product location, thus leading to geographical dispersion of inventories. Postponement of changes in product form and identity has been subsequently termed in literature as FP, delayed product differentiation, late customisation, manufacturing postponement, or simply postponement (Swaminathan and Lee 2003, Forza *et al.* 2008). On the other hand, postponement of changes in inventory location has been later called logistics postponement, delayed geographic differentiation, place postponement, or time postponement (Pagh and Cooper 1998, Aviv and Federgruen 2001).

The majority of extant literature addresses FP on a single company level (Yeung *et al.* 2007). From such a perspective, many studies have researched FP antecedents, focusing on market characteristics, product characteristics, and production process characteristics that influence FP (Yang *et al.* 2004b). Market characteristics promoting FP include factors such as a high number of product variants (Zinn 1990, Johnson and Anderson 2000), high uncertainty and

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3 substitutability of product variant demands (Zinn and Bowersox 1988, Aviv and Federgruen  
4 2001), and short product life cycles (van Hoek *et al.* 1998, Chiou *et al.* 2002). In turn, product  
5 characteristics favouring FP encompass high product value (Zinn and Bowersox 1988, Chiou *et*  
6 *al.* 2002), high product modularity (Lee and Tang 1997, Yang *et al.* 2004a), and high component  
7 standardisation (Lee 1996, Harrison and Skipworth 2008). Finally, production process  
8 characteristics facilitating FP comprise low capital intensity and no need for special capabilities  
9 at the postponed PDA (van Hoek 1997, Pagh and Cooper 1998), high process modularity  
10 (Feitzinger and Lee 1997, Swaminathan and Lee 2003), and availability of substantial excess  
11 capacity at the deferred activity (Gupta and Benjaafar 2004, Harrison and Skipworth 2008).  
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14 Similarly, from a single company's perspective many studies have researched FP  
15 consequences, focusing on FP operational outcomes rather than on its strategic implications  
16 (Anand and Girotra 2007). For a detailed discussion of previous research findings on FP effects  
17 on six performance dimensions (i.e., inventory-holding costs, delivery lead-times, processing  
18 costs, transport costs, order specification flexibility, and quality conformance), we refer to Forza  
19 *et al.* (2008). They distinguish three mutually exclusive and exhaustive types of FP at the  
20 company level of analysis: From-forecast-to-order-driven FP, Remaining-forecast-driven FP and  
21 Remaining-order-driven FP. Further, they show that the effects of FP on a given performance  
22 dimension and/or the mechanisms explaining such effects often vary according to the type of FP  
23 that is being considered. Notably, a few of these effects and mechanisms, such as lower  
24 transport costs due to the changed nature of the items shipped to distribution centres or higher  
25 processing costs owing to fixed asset duplication at distribution centres, are specific to the  
26 situation in which a PDA is moved into the distribution channel (Zinn and Bowersox 1988, Lee  
27 and Billington 1994).  
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30 Less research has been devoted to examining FP from an inter-organisational perspective  
31 (van Hoek 2001, Yeung *et al.* 2007). A few studies address this topic at the whole supply chain  
32 level of analysis. Yang and Burns (2003) argue that postponement in general, including FP,  
33 requires that uncertainties in the supply chain be reduced as much as possible through internal  
34 and external integration. Such an argument is supported by a subsequent exploratory survey  
35 conducted by Yang *et al.* (2005a), who find that most of the highest ranked barriers to  
36 postponement were related to how a company manages its external networks (both suppliers and  
37 customers). Yang *et al.* (2007) further highlight the importance of choosing appropriate inter-  
38 organisational structures to successfully implement postponement. In turn, Yeung *et al.* (2007)  
39 investigate how one company's postponement decision is affected by the company's degree of  
40 external integration and by the market structure in both the upstream and downstream parts of  
41 the company's supply chain. Finally, building on Bucklin's (1965) seminal work on the  
42 combined principle of postponement and speculation, García-Dastugue and Lambert (2007)  
43 show that when one organisation implements postponement without considering its impact on  
44 the other supply chain members, inventory-holding costs for the supply chain as a whole may  
45 turn out to be higher.  
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48 Other studies researching FP from an inter-organisational perspective focus on either the  
49 upstream or the downstream part of a company's supply chain. Examining the upstream part,  
50 Prasad *et al.* (2005) find that close integration with suppliers is essential to prevent FP from  
51 impairing product delivery lead-times. In turn, Kumar and Wilson (2009) show that when  
52 manufacturing operations are moved to overseas suppliers, FP can help minimise the inventory  
53 cost impact of increased lead-times. Looking at next-tier customers, however, Krajewsky *et al.*  
54 (2005) link higher levels of FP application to tighter contract restrictions on the magnitude and  
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3 frequency of the changes that customers are allowed to make to order quantities. In turn, Brown  
4 *et al.* (2000) and Davila and Wouters (2007) investigate the operational benefits of implementing  
5 FP by transferring PDAs to customers. Finally, two survey-based studies focus on the role of  
6 3PLs in implementing FP by moving PDAs into the distribution channel. Van Hoek and van  
7 Dierdonck (2000) and van Hoek (2000a) find that 3PLs were mostly involved in relatively  
8 simple PDAs, such as packaging and labelling, and that 3PL involvement in FP implementation  
9 was expected to grow in the years to come. Moreover, van Hoek's (2000a) results indicate that a  
10 higher rate of engagement of 3PLs in FP implementation was associated with the use of  
11 integration mechanisms such as account management and comprehensive performance  
12 measurement systems covering production and customisation activities.

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15 In summary, our review of the FP literature indicates that while the carrying out of  
16 postponed PDAs in the distribution channel has been widely discussed (e.g., Lee *et al.* 1993,  
17 Twede *et al.* 2000, Shao and Ji 2008), less attention has been paid to examining such an FP  
18 strategy when it involves other supply chain members than the manufacturing company. In  
19 particular, while the possibility of outsourcing PDAs placed in the distribution channel to 3PLs  
20 has been well documented in the FP literature (e.g., van Hoek 2000a, Yang and Burns 2003,  
21 Yang *et al.* 2007), research on the contribution that a 3PL can make to a company's FP strategy  
22 is still in its infancy.  
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### 25 26 **3. Research objectives and method**

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28 This study aims to contribute to a better understanding of how 3PLs can deliver value to  
29 companies offering product variety by providing FP services, defined as the carrying out of  
30 PDAs on behalf these companies close to the target markets. More specifically, our study  
31 addresses the following research questions:  
32

33 **RQ1.** *What FP services can a 3PL offer and how do they create value for the*  
34 *customer buying the service?*

35 **RQ2.** *What organisational solutions can a 3PL adopt to provide an FP service,*  
36 *how do they influence value to the 3PL's customer, and what are the associated*  
37 *challenges for the 3PL?*  
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40 Owing to the lack of research examining these questions, our inquiry employed a case study  
41 approach (Yin 1984, Eisenhardt 1989). When little is known, the richness and detail of  
42 qualitative data are crucial in identifying key constructs relevant to explaining the focal  
43 phenomenon (Patton, 1990). In addition, qualitative data are particularly useful for examining  
44 "how" and "why" questions (Yin 1984), and understanding how and why FP services create  
45 value for the 3PL's customer and how and why FP service organisational solutions influence  
46 such value was one of the fundamental aims of our research.  
47

48 The unit of analysis, in this exploratory study, was a product-customer combination—namely  
49 a given product type of a given customer—for which a 3PL carries out at least one PDA on behalf  
50 of the customer. This is an appropriate unit of analysis, as FP applies to a product that is made  
51 in at least two different variants sharing the same basic functionalities and common  
52 manufacturing activities (Garg and Tang 1997, Gupta and Krishnan 1998). Accordingly, those  
53 product-customer combinations for which the 3PL performs transformational activities that do  
54 not create product variety (e.g., ironing cloths shipped in bulk from overseas factories) were  
55 excluded from the reference population.  
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Cases were chosen from among the product-customer combinations served by one of the world's leading logistics groups, which provides both traditional logistics services and value-added services (VASs) through an international network linking more than 200 countries and territories worldwide. This 3PL presented an interesting context for our research for two reasons. First, the 3PL was supplying a broad range of FP services to several product-customer combinations under a variety of labels, such as postponement, contract assembly, kitting, co-packing, etc.<sup>1</sup> Secondly, the 3PL was interested in better understanding both the mechanisms through which FP services can create customer value and the challenges in improving such services. To increase the likelihood of observing different types of FP service and different types of FP service organisational solution, we selected cases from different industries or, if an industry is the same, from different types of product (Table 1).

Insert Table 1
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Data were collected in two rounds partially overlapping with data analysis to take advantage of flexible data collection (Eisenhardt 1989). During the first round, we gathered information according to a semi-structured research protocol covering the following areas: customer profile, product family profile, supply chain configuration, facility profile, postponed PDA characteristics, FP service outcomes, FP service enablers, and FP service obstacles. To probe particular themes emerging from first-round data analysis, in the second round of data collection we added one case (i.e., case 6) and adjusted the research protocol to gather additional information on the role of resource-sharing in the provision of FP services. In particular, we defined a comprehensive list of resources that a 3PL may use in serving a product-customer combination, which list covers the following resource categories: facility, equipment, workforce, information technology (IT) system, transport, administrative staff, licences and other services. Based on this list, for each case we gathered information on whether and which resources were systematically shared with other product-customer combinations, as well as information on the characteristics of the product-customer combinations among which resources were shared.

Data were collected from three main sources: open-ended interviews, archival documents, and direct observations. Each case involved at least one visit to the 3PL site where the product-customer combination was served. Furthermore, we conducted in-depth interviews with middle- and upper-level managers in charge of the whole site or the specific FP service within the site. To reduce observer bias (Voss *et al.* 2002) and simultaneously enhance the creative potential of the study (Eisenhardt 1989), 70% of the in-depth interviews were conducted by two investigators. Additional primary data were collected through shorter interviews with 3PL executives in charge of business development in the industries from which the cases had been selected. Finally, primary information obtained from manager interviews and site visits were supplemented with secondary data from archival documents collected before and after the visit, such as responses to requests for quotation and internal presentations.

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1. The exact number of product-customer combinations that the 3PL provides FP services is not available. This is because, within the 3PL organization, FP services often go under the same labels as other contract manufacturing services that do not involve execution of PDAs. During our preliminary check of the 3PL's FP services in Europe, the 3PL informed us about 32 cases that, in the company's opinion, were relevant to our research. After careful examination, however, we ascertained that only 18 out of these 32 cases were undoubtedly cases of FP.

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Data analysis consisted of two steps, namely within-case analysis and cross-case analysis. Following Eisenhardt's (1989) suggestions, within-case analysis involved writing detailed descriptions of the selected cases in order to become intimately familiar with each case as a stand-alone entity. Additionally, open and axial coding techniques (Strauss, 1987) were used to reduce qualitative data and identify the main themes and variables relevant to the research questions. In the subsequent phase of cross-case analysis, we compared and classified the selected cases according to the related supply chain configurations before and after FP service implementation and according to the resource-sharing profile observed in each case. Moreover, variable-oriented comparisons were made through comparative matrices to highlight patterns. The insights generated from cross-case analysis were finally submitted to the criticism of informants and other 3PL executives in order to check the correctness of our interpretation and discuss generalisability of our findings.

#### 4. Results

##### 4.1 Form postponement services and their value propositions

The data from this research indicate that a 3PL may provide different types of FP service, which have the potential to create value for the 3PL's customer through different mechanisms. The empirical evidence on the FP services supplied in the selected cases and on the value delivered to the 3PL customer is summarised in Table 2. Moreover, pictorial representations of the offered FP services are provided in Figures 1-4.

Insert Table 2

A first type of FP service comprises those situations in which the service provider takes on responsibility for creating product variants that the 3PL's customer used to produce upstream in the supply chain. Stated otherwise, this type of FP service applies to existing PDAs, which create product variants for geographical markets that the 3PL's customers were already serving. Accordingly, we refer to this type of FP service as an *existing-PDA* FP service. The 3PL's customers may take advantage of this type of FP service to improve their operational and financial performance in supplying their existing geographical markets, as shown by cases 1-4.

In case 2, an originally forecast-driven PDA ends up being carried out on a to-order basis (Figure 1). Accordingly, this existing-PDA FP service may be classified in Forza *et al.*'s (2008) terms as a from-forecast-to-order-driven-PDA FP service. A fundamental benefit, in this case, is that the FP service enables order-driven execution of PDAs without excessive increase of delivery lead-time. The manufacturer no longer incurs the risks and associated costs of inaccurately forecasting the demand mix relative to the varieties created by the postponed PDA. Furthermore, the increase of delivery lead-time due to elimination of finished goods speculative stock is alleviated as compared to the situation in which the PDA were performed on a to-order basis at a site farther away from the target markets. Case 2 also indicates financial benefits of this FP service, as the manufacturer need not invest in setting up a facility to create varieties based on customer orders close to the target markets. Finally, there are other financial and operational advantages, such as reduced overhead and increased volume flexibility, that are contingent on the specific organisational approach adopted by the 3PL to provide the service and are, therefore, discussed in Section 4.2.

Insert Figure 1

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In cases 1 and 4, an originally forecast-driven PDA continues to be carried out on a to-forecast basis after FP service implementation (Figure 2). Accordingly, this existing-PDA FP service may be classified in Forza *et al.*'s (2008) terms as a remaining-forecast-driven-PDA FP service. A fundamental benefit, in this case, is that the FP service enables the manufacturer to reduce finished goods inventory-holding and shortage costs without sacrificing on-hand availability of end-products. The postponed PDA is performed close to the target markets and, hence, the forecast window associated with this activity is shorter and the related forecast is more accurate. Furthermore, lead-times in responding to unanticipated market requirements are shorter. Common to both case 1 and case 4 is also the financial benefit of reduced investment in fixed assets, as compared to the situation in which the manufacturer itself sets up a facility to carry out the PDA close to the target markets. Finally, other financial and operational advantages of this FP service, such as the reduced transport costs and lower overhead observed in either case 1 or case 4, depend on the specific PDA to which the service is applied or the specific organisational approach adopted by the 3PL to supply the service.

Insert Figure 2

In case 3, finally, an originally order-driven PDA continues to be executed on a to-order basis after FP service implementation (Figure 3). Accordingly, this existing-PDA FP service may be classified in Forza *et al.*'s (2008) terms as a remaining-order-driven-PDA FP service. A fundamental benefit, in this case, is that the FP service enables the manufacturer to improve customer service through greater order specification flexibility. The manufacturer's customers have more time to make their decisions on the product feature(s) added by the postponed PDA without time and cost performance being worsened, as the PDA is carried out later in the order fulfilment process. Case 3 also indicates financial benefits of this FP service, as the manufacturer need not invest in setting up a facility to perform the PDA close to the target markets. Finally, there are other financial and operational advantages, such as reduced overhead and distribution costs, that are contingent on the specific organisational approach adopted by the 3PL to provide this FP service.

Insert Figure 3

When we analyse the FP services supplied in cases 5-7, however, a different value-creating mechanism emerges. In all these cases, the fundamental benefit of the provided service is to enable the 3PL's customer to enter and profitably serve new geographical markets. Supplying such new markets requires creating new product variants, but the 3PL's customer could not profitably make these varieties in-house. It might be too costly for the 3PL's customer to ensure service levels in line with incumbents by creating these varieties at its factory, while the investment needed to set up a facility to perform the PDA close to the target markets might be excessively high (see case 7). Alternatively, the 3PL's customer might be a service company or a fables company that would not find it advantageous to set up a facility and develop manufacturing competences to carry out the PDA in-house (see cases 5 and 6). In any case, the 3PL's network of facilities enables the 3PL's customer to create the product variants needed to address the new target markets in a profitable manner. Not only is the initial investment minimised, but also operational performance is improved by virtue of the product variants being created close to the target markets. Additionally, further benefits, such as the reduced overhead and operating costs observed in cases 6 and 7, arise from the specific organisational approach adopted by the 3PL to provide the service.

In cases 5-7, in short, the FP service applies to a PDA that the 3PL's customer could not profitably carry out, and results in the 3PL performing the PDA in the distribution channel, close

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3 to the new target markets (Figure 4). Accordingly, we refer to this type of FP service as a *PDA-*  
4 *enabling* FP service. Involving a new PDA, rather than an existing one, this type of FP service  
5 cannot be mapped onto the FP types defined by Forza *et al.* (2008).  
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Insert Figure 4
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9 Based on the cross-case analysis, the following observation concerning FP services and their  
10 value propositions can be made:

11 **Observation 1.** *FP services have the potential to create value for the 3PL's*  
12 *customer either by improving operational and financial performance in serving*  
13 *existing geographical markets (existing-PDA FP services) or by enabling entry*  
14 *into new geographical markets (PDA-enabling FP services).*  
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17 While our empirical inquiry has focused on the mechanisms through which FP services can  
18 create value for the company buying the service, it is important to acknowledge the possible  
19 drawbacks of using FP services from the 3PL's customer perspective. When a PDA is moved  
20 into the distribution channel, processing costs may increase because labour and equipment  
21 required by the postponed activity need to be duplicated at multiple distribution sites.  
22 Additional costs are also incurred to pack and unpack the semi-finished products shipped from  
23 the manufacturing plant to the distribution sites where finished product variants are created.  
24 Furthermore, if the postponed PDA is carried out in the distribution channel on a to-order basis,  
25 processing costs may rise due to the loss of manufacturing scale economies at the postponed  
26 activity or because of the need for keeping excess capacity at distribution sites to enable quick  
27 response to demand peaks. Use of an FP service may also lead to higher quality assurance costs,  
28 if the level of training and experience of the people responsible for PDA execution in the  
29 distribution channel is lower than at the manufacturing plant. Other possible disadvantages of FP  
30 services include higher finished goods distribution costs and longer delivery lead-times. When  
31 the postponed PDA is carried out in the distribution channel on a to-order basis, logistics scale  
32 economies are lost, owing to direct deliveries to customers, and the work content of the order  
33 fulfilment process increases, as end-products are no longer available on-hand. Interestingly,  
34 some of the abovementioned drawbacks of using FP services can be mitigated if 3PLs succeed in  
35 supplying such services through appropriate organisational solutions, as we will discuss  
36 hereinafter.  
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#### 42 **4.2 Form postponement service organisational approaches, effects on customer value and** 43 **implementation challenges** 44

45 The data from this research indicate that different organisational approaches may be used to  
46 provide an FP service to a given product-customer combination, with different effects on the  
47 value delivered to the 3PL's customer. The empirical evidence on the organisational solutions  
48 adopted in the selected cases, their impact on customer value and the associated challenges for  
49 the 3PL is summarised in Table 3. Pictorial representations of the adopted organisational  
50 solutions are also provided in Figure 5.  
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Insert Table 3
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Insert Figure 5
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55 One fundamental approach to supplying an FP service to a given product-customer  
56 combination is to use resources dedicated to that combination: namely, an *ad-hoc facility*. This  
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ad-hoc approach is illustrated by cases 1, 4 and 5, in which all, or almost all, the resources employed to provide the service are dedicated to a single product-customer combination.

The alternative approach to supplying an FP service consists of using a platform, defined as a collection of resources systematically shared by a set of product-customer combinations. This platform approach is common to cases 2, 3, 6 and 7. When we compare these cases, however, different solutions emerge under the same “platform” label. In cases 2 and 3, resources are shared within a single facility among different product families of the same customer and, therefore, we refer to such a solution as a *multi-product platform*. Resource-sharing occurs within a single facility in case 6 as well, but involves different customers with similar products. Accordingly, such a solution will hereafter be labelled as a *multi-customer platform*. In case 7, finally, resources are also shared between distinct facilities located in close proximity to each other and, hence, we refer to such a solution as a *campus-style platform*.

The data collected in this study also indicate that in the supplying of an FP service, the platform approach has the potential to create more value for the 3PL’s customer than the ad-hoc approach. All the cases in which the ad-hoc approach is adopted exhibit problems of capacity underutilisation, especially where demand fluctuations are wider because of strong seasonal peaks (cases 4 and 5). Conversely, capacity utilisation increases in all cases in which the platform approach is used, even where promotions lead to high demand variability (case 6). This is because fixed assets are systematically shared among multiple product-customer combinations. Consequently, fewer resources are needed to serve each of these combinations and, hence, unit processing costs are lower.

Besides increasing fixed asset productivity, the platform approach tends to reduce dependence on temporary labour without sacrificing volume flexibility. All the cases in which an ad-hoc facility is used exhibit heavy reliance on temporary labour as a means of coping with demand peaks that are often strong and unpredictable. In case 5, for example, sometimes the 3PL has to quadruple production volume from one week to the next because of a promotion. However, the 3PL does not receive any prior information from its customer, who is concerned about possible dissemination of confidential promotion-related information among competitors. Heavy dependence on temporary labour may limit responsiveness, as this type of workforce may be difficult to find in the local market, especially at certain times of year such as just before Christmas (case 5). Additionally, strong dependence on temporary labour may lead to higher costs because of production losses owing to worker inexperience (case 5) and because of the need for multiple checks in the production lines to assure quality (case 1). On the contrary, the cases in which the platform approach is adopted show a lower dependence on temporary labour even though the postponed PDA is always labour-intensive and demand variability is sometimes high. In case 6, for example, requirements for additional workforce at a given product-customer combination are usually met through sharing of permanent staff with the other product-customer combinations served by the platform. In this case, the 3PL hires temporary workers only in July, when demand peaks for the product-customer combinations served by the platform overlap. Notably, not only is volume flexibility preserved, but may even improve, especially when longer training is needed to perform the PDA (case 6) and temporary workers are more difficult to find in the local market (case 2). This is because momentary excess capacity at one product-customer combination can be quickly diverted to another product-customer combination where capacity is insufficient, without the need for additional training.

Finally, using the platform approach in the provision of an FP service may increase customer value by reducing costs in the distribution of the product variants created by the postponed PDA.

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3 In cases 2, 3 and 7, distribution costs are lower because the product-customer combinations  
4 served by each of these platforms have partially overlapping delivery points and are distributed  
5 by the same 3PL. As product-customer combinations with overlapping delivery points are  
6 served within the same facility or group of facilities located close to each other, loading points  
7 overlap as well. Consequently, shipments of finished goods may be consolidated, if the  
8 company in charge of distribution is the same.  
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10 Integrating the above arguments concerning platform approach advantages in terms of fixed  
11 asset utilisation, dependence on temporary labour, volume flexibility, and distribution costs, we  
12 make the following observation:  
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15 **Observation 2.** *In the supplying of an FP service, the platform approach has*  
16 *the potential to create more value for the 3PL's customer than the ad-hoc*  
17 *approach.*  
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19 This observation focuses on the potential benefits of the platform approach. Many factors,  
20 however, influence both the possibility and the cost of systematically sharing resources among a  
21 given set of product-customer combinations without impairing responsiveness. The data from  
22 this research indicate a number of factors that enable or hinder resource-sharing among product-  
23 customer combinations served within the same facility or the same group of facilities located  
24 close to each other. Implementing such enabling factors and minimising such hindrance factors  
25 represent just as many challenges that a 3PL will face in applying the platform approach. As  
26 witnessed by case 1, in which only a few resources such as general site management, licences,  
27 security service and other auxiliary services are shared, bringing different product-customer  
28 combinations together is not sufficient to create a platform and enjoy its potential benefits.  
29

30 One factor hindering platform approach implementation is heterogeneity of workforce  
31 training requirements, which increases the cost of sharing direct labour. In cases 1, 2 and 3, in  
32 which significantly different product types are processed within the same facility, cross-training  
33 of workers is too costly. Consequently, either VAS operators are not shared at all (case 1), or  
34 sharing only occurs when complex PDA operators are employed to carry out simpler PDAs  
35 (cases 2 and 3). Conversely, in case 7, workers are systematically shared among most product-  
36 customer combinations. A few combinations, however, require such different training from the  
37 rest, owing to their product complexity or regulations, that they need a dedicated workforce. In  
38 case 6, finally, the workforce is shared among all product-customer combinations, but due to  
39 partially different processes and procedures, training requirements are not exactly the same for  
40 all combinations and, therefore, some cross-training is needed. Case 6 shows that even when  
41 customers with similar products are brought together, sharing of workforce may not be free.  
42

43 A second hindrance factor in platform approach implementation is heterogeneity of  
44 equipment requirements, which increases the cost of sharing equipment and, at times, of indirect  
45 labour such as maintenance technicians. Cases 1, 2, 3 and 7 all exhibit some product-specific  
46 equipment, such as an antistatic floor for PoS terminals in case 3 or controlled-temperature  
47 storage containers for clinical trials in case 7, which would be too costly to use for the other  
48 products served within the same facility or campus. Furthermore, because of equipment  
49 specificity, clinical trials in case 7 require dedicated maintenance operators. Conversely, in case  
50 6, in which the facility serves customers with similar products, the clean room where medication  
51 labelling and display building take place are shared without limitations.  
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53 Another factor that hinders resource-sharing among product-customer combinations is  
54 similarity of their target markets, meaning that the product-customer combinations are in direct  
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competition and/or have overlapping demand patterns. When different product-customer combinations are in direct competition, it may be impossible not only to share workforce or equipment, but even to serve these combinations under the same roof, owing to confidentiality issues (cases 4 and 5). Furthermore, demand patterns for these combinations tend to overlap. When product-customer combinations face demand peaks and valleys simultaneously, opportunities for resource-sharing are slim, regardless of confidentiality issues, because capacity must be held at peak demand for each combination in order to ensure high responsiveness. Unsurprisingly, in cases 6 and 7, which exhibit high levels of resource-sharing, at least main customers are not direct competitors and demand patterns are, for the most part, complementary. This makes it possible for the 3PL to systematically share resources and, therefore, reduce the total capacity required without impairing the ability to match supply with demand and, hence, without delivery delays. Notably, there is less chance that direct competition and overlapping of demand patterns are a problem when different product types of the same customer are brought together, as witnessed by cases 2 and 3.

A fourth factor that negatively affects resource-sharing is heterogeneity of IT systems. Using different IT systems for different product-customer combinations not only prevents sharing of IT resources (case 1), but also may lead to duplication of IT staff. In case 6, for example, there are two people responsible for IT management, each trained in working with one of the two main systems in use at the facility. Different IT systems also make it more difficult to share processes and procedures, thereby hindering sharing of workforce (cases 6 and 7). The problem of heterogeneity of IT systems is more likely to arise when the same facility or campus serves different customers, as different customers may have different systems and may want the 3PL to use their system. Conversely, IT resources are more likely to be shared when different product types of the same customer are brought together, as shown by cases 2 and 3.

Another factor that influences the possibility of sharing resources among product-customer combinations brought together within the same facility or campus is the inclusion of distribution in the service supplied by the 3PL. In cases 2, 3 and 7, the 3PL provides all product-customer combinations a global service including distribution. Consequently, the company in charge of distribution is the same for all product-customer combinations and, whenever delivery points overlap, transport network is shared. On the contrary, in cases 1, 5 and 6, the 3PL does not provide distribution. Therefore, even when different product-customer combinations served within the same facility have overlapping delivery points, opportunities for sharing of trucks are lost because the carriers taking charge of finished goods transport are different.

A final challenge in platform approach implementation is to establish appropriate coordination mechanisms to re-allocate resources among product-customer combinations. Resource-sharing gives rise to reciprocal interdependence among different product-customer combinations. Therefore, mutual adjustment, defined as the transmission of new information during the process of action (Thompson 1967), is likely to be needed to manage such dependencies. In case 6, for example, there is one supervisor for each customer served at the facility, and each supervisor communicates with the operations manager whenever workloads for the corresponding customer are lower or higher than expected. The operations manager then adjusts the number of people assigned to each product-customer combination, diverting workers from the customers with temporary excessive capacity to the customers with insufficient capacity. In this case, sharing of workforce cannot rely on the establishment of a common schedule for the interdependent product-customer combinations, as different 3PL customers have different planning routines and transmit orders at different times during the day. Even when

resource-sharing involves different products of the same customer and the same IT system is used for all these products, differences in planning routines may hinder aggregate planning (cases 2 and 3) and, therefore, the need for lateral relations and mutual adjustment arises.

Integrating the above arguments concerning challenges facing a 3PL in implementation of the platform approach, we make the following observation.

**Observation 3.** *The use of the platform approach to serve a given set of product-customer combinations is enabled by:*

- *similarity of workforce training requirements among the product-customer combinations (3a),*
- *similarity of equipment requirements among the product-customer combinations (3b),*
- *similarity of IT systems among the product-customer combinations (3c),*
- *dissimilarity of target markets among the product-customer combinations, meaning that the combinations are not in direct competition and have complementary demand patterns (3d),*
- *provision of a distribution-included service to the product-customer combinations (3e),*
- *reliance on coordination by mutual adjustment among the product-customer combinations (3f).*

## 5. Discussion and conclusions

The present study contributes to a better understanding of the potential benefits of 3PL-provided FP services by developing a framework that links FP service type, FP service value for the 3PL's customer, FP service organisational approach, and resource-sharing enablers (Figure 6).

Insert Figure 6

This framework distinguishes different types of FP service, which have the potential to create value for the 3PL's customer through different mechanisms. On the one hand, existing-PDA FP services may enable the 3PL's customer to improve its operational and financial performance in serving geographical markets that the 3PL's customer was already supplying. In this case, the FP service does not necessarily lead to market advantages for the company buying the service. This is because, for instance, the 3PL's customer may decide not to translate its lower inventory-related costs to lower prices so as to increase sales. On the other hand, PDA-enabling FP services are always aimed at producing market advantages, rather than cost savings, by making it possible for the 3PL's customer to enter and profitably serve new geographical markets.

Such a distinction extends previous research findings on the types of FP strategies and their performance implications for the company implementing FP. The extant FP literature focuses on FP strategies that concern existing PDAs and lead to improved operational performance (Forza *et al.* 2008). Market advantages, if any, are just a second-order outcome of the operational benefits produced by these FP strategies. Our results indicate a different type of FP strategy, which concerns new, rather than existing PDAs and which has the potential to improve company performance by producing direct market advantages, rather than by enhancing operational performance.

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4 Pragmatically, such a distinction has important implications for both 3PLs offering FP  
5 services and their potential customers. As regards 3PLs, they need to be ready to engage with  
6 not only logistics or supply chain directors, but also marketing directors if the main benefit of the  
7 offered FP service is to create market advantages rather than cost advantages. Likewise,  
8 potential customers should regard 3PL-provided FP services not only as a means of reducing  
9 costs, but also as a possible way to increase sales. Small and medium-sized companies, in  
10 particular, could find support for their strategies of market internationalisation and expansion.  
11 The 3PL's network could be crucial, in this case, in order to postpone the creation of the  
12 varieties targeted to the new markets to a point closer to the markets themselves. This means  
13 that smaller companies, who have been reported as using 3PL services to a lesser extent than  
14 large companies (e.g., Murphy and Poist 1998, Hong *et al.* 2004), might look at 3PL service  
15 offerings with greater attention in the future.  
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18 Our findings also highlight the importance of the choice of the organisational solution with  
19 which an FP service will be provided. This is because through the choice of the FP service  
20 organisational approach, a 3PL has the possibility of increasing the value of an FP strategy, as  
21 compared to the situation in which the manufacturer implements FP in-house. By leveraging its  
22 serving of multiple customers, the 3PL can resort to organisational solutions, such as the multi-  
23 customer platform or the campus-style platform, which are not viable for individual  
24 manufacturers, and these solutions may mitigate a number of possible FP disadvantages. A  
25 major drawback of FP strategies, for example, is the increase in processing costs due to the loss  
26 of manufacturing scale economies and the need for excess capacity (Yang *et al.* 2007, Harrison  
27 and Skipworth 2008, Forza *et al.* 2008). By allowing use of the same capacity for a variety of  
28 customers, a multi-customer or campus-style platform decreases the total capacity required and,  
29 therefore, alleviates the negative effect of FP on processing costs. Other possible disadvantages  
30 of FP include higher transport costs, owing to direct deliveries to customers and the subsequent  
31 loss of logistics scale economies (Yang *et al.* 2005b, Forza *et al.* 2008), and higher quality  
32 assurance costs when the postponed PDA is performed in the distribution channel (Lee and  
33 Billington 1994, Forza *et al.* 2008). Again, the platform approach, if viable, can mitigate these  
34 FP drawbacks by reducing dependence on temporary labour without sacrificing volume  
35 flexibility and by enabling consolidation of finished goods shipments for a variety of customers.  
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38 The potential advantages of the platform approach appear particularly appealing as markets  
39 become more turbulent and 3PL customers are less willing to pay for committed capacity.  
40 Continuing downward pressure on prices is a major trend in the 3PL industry (e.g., Lieb and  
41 Bentz 2005), as also witnessed by most of our cases. As long as product-customer combinations  
42 face sufficiently high and stable demands, this challenge can be overcome while using the ad-  
43 hoc approach: for example, through automation or process improvement. When environmental  
44 turbulence increases, however, enhancing efficiency is more likely to require sharing of  
45 resources among multiple product-customer combinations in order to increase flexibility while  
46 decreasing the total capacity required. Nowadays, therefore, the platform approach no longer  
47 appears as a solution for serving only small customers who do not have scales that justify ad-hoc  
48 facilities. On the contrary, today the platform approach may also be crucial in increasing the  
49 value delivered to those large customers that have been traditionally served through ad-hoc  
50 facilities.  
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53 Our results, finally, indicate a number of challenges that face a 3PL in the supplying of an  
54 FP service through the platform approach. The possibility and cost of systematically sharing  
55 resources among a given set of product-customer combinations depend on the 3PL's ability to  
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bring together, within the same facility or group of facilities, product-customer combinations with complementary demand patterns and with similar resource requirements.

Variability of resource requirements may be a major obstacle to implementation of FP platforms, especially for large 3PLs serving many different product-customer combinations. Creating FP platforms may require coping with such a massive variability, for instance through appropriate location decisions. This means that besides traditional criteria for location problems, a 3PL should also consider resource-sharing enablers when deciding where a given product-customer combination will be served. This also means that organisational barriers within a 3PL organisation may have to be overcome in order to create platforms. For example, a 3PL could create an FP platform by bringing together, within the same facility, product-customer combinations that belong to different industries, and as such are under the responsibility of different business units within the 3PL organisation, but have complementary demand patterns and similar resource requirements. Besides trying to cope with resource requirement variability, the 3PL should also strive to reduce such variability, seeking opportunities for increasing commonalities between the PDAs that are carried out, the machines that are used, the IT systems that are employed, etc. This could require, for instance, an increasing involvement of the 3PL in the design of the product families to which an FP service is to be provided.

The difficulty of reducing, or at least coping with, variability of resource requirements may eventually undermine the profitability of the concept of 3PL supplying FP services. The qualitative research approach adopted in this exploratory research, however, has not allowed us to investigate the conditions of economic viability of FP services from the 3PL perspective. Future research should address this issue, and this would require examining the relationships among the resource-sharing enablers identified in this study. There could be trade-offs, for instance, between increasing similarity of training and equipment requirements on the one hand, and reducing direct competition and overlapping of demand patterns on the other. Future studies could therefore be devoted to identifying which mixes of product-customer combinations, in terms of demand pattern characteristics, PDA characteristics, etc., are more advantageous to bring together in order to implement FP service platforms. In the pursuit of these research opportunities, we believe that our framework can assist by working as a conceptual model that guides the development of more detailed quantitative models (see Mitroff *et al.* 1974) capable of assessing the economic viability of different types of FP services in many different specific contexts. Such quantitative models would help 3PLs to understand the profitability of FP services as compared to other commonly provided services, thus supporting definition of 3PL service offering.

By showing that a 3PL may be crucial in enabling another company to implement FP or has the possibility of increasing the value of FP as compared to the situation in which the other company implements FP in-house, this study adds to past research findings in the area of inter-organisational FP. In our empirical inquiry, however, we have only got data from the 3PL, and this is another limitation of the present study. Future research would definitely benefit from collecting data from 3PL customers as well. This would allow, for example, in-depth investigation of the challenges and drawbacks of using FP services from a 3PL's customer perspective, which investigation was out of the scope of our research.

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Table 1. Description of the selected cases and data sources.

Case	Industry	ISIC code	PDA(s) performed by the 3PL in the distribution channel	PDA(s) description	Main data sources
1	Electronics	2817	Kitting of calculators	The same calculator may be packed together with different or optional components, such as manuals, cables, marketing leaflets etc., according to the country/market of destination (from 6 to 20 components per kit). Different possible types of packaging, such as cardboard boxes, pizza-style boxes or clamshells, may be used.	Contract operations manager interviews (2) Facility visits (2) Archival documents
2	Electronics	2620	Kitting of consumer printers	The same printer may be localised by adding different components, such as power supply cables, manuals, stickers, etc., according to the country/market of destination. Further, customer-specific components, such as retailer-specific labels, may be added.	Program manager interviews (2) Facility visits (2) Archival documents
3	Electronics	2620	Hardware and software configuration of point-of-sale terminals	A generic point-of-sale (PoS) terminal may be custom-configured (e.g., memory upgrade, Ethernet card to be included, software installation and firmware upgrade) just prior to dispatch of the finished product to the customer.	Program manager interviews (2) Facility visits (2) Archival documents
4	Personal care	2023	Co-packing of personal-care products	The same personal-care product may be packed together with different gifts according to the promotion conception.	Contract packing manager interviews (2) Facility visit Archival documents
5	Telecommunications	6120	Kitting of phone packs	Different phone packs may be created by putting together, in a transparent box, different mobile phone handsets, subscriber identity module cards, marketing leaflets, promotional materials, etc. according to the promotion conception (average components per kit: 15).	Business unit director interview Operations manager interview Facility visit Archival documents
6	Pharmaceuticals	2100	Building displays of over-the-counter products	Different displays of different over-the-counter (OTC) products for pharmacies may be created according to the promotion conception.	General manager interview Facility visit Archival documents
7	Pharmaceuticals	2100	Labelling and packaging of medicines for treatment of life-threatening diseases	Country-specific labels and literature (27 country variants / 24 languages) are added to four strengths of one medication, which is to arrive at the 3PL's facility without label and blank carton.	Product development healthcare manager interviews (2) Site visit Archival documents

Table 2. FP services provided in the selected cases and value delivered to the 3PL's customer.

Case	FP service	Value to the customer	Explanation
2	Existing-PDA	Improved operational and financial performance in serving existing geographical markets	The risks and associated costs of producing the wrong mix of printer variants are eliminated, as the customer no longer holds speculative stock of finished goods. Close-to-the-market specification of goods guarantees short delivery lead-times (1 day) and enhances responsiveness to varying demand in different countries, especially when launching or phasing out models. Fixed asset investment is reduced. Overhead decrease and volume flexibility increases because of one-stop-shop for all FP services provided to the customer.
1	Existing-PDA	Improved operational and financial performance in serving existing geographical markets	Speculative stock of high-value products is reduced while preserving on-hand availability of finished goods, as calculators are packed at a time closer to the moment of customer purchase and, hence, demand mix uncertainty is lower. Rework costs of leftover stock decrease, as the risk of overestimating a county's demand is lower. Lead-times in responding to unanticipated market requirements are shortened without using faster modes of transport. Investment in fixed assets is reduced. Overhead decrease due to resource-sharing among multiple product-customer combinations.
4	Existing-PDA	Improved operational and financial performance in serving existing geographical markets	The undifferentiated personal-care product is held in a location closer to the customer and is co-packed at a time closer to the promotional launch. As the promotion conception and sales forecast generation occur closer to the time when market demand is observed, there is less speculative stock and rework costs of leftover decrease. Lead-times in responding to unanticipated market conditions are shortened without use of faster modes of transport. Indirect operating costs decrease because of reduction in factory complexity. Investment in fixed asset is lower. Transport costs are reduced, as the undifferentiated product being shipped from the factory to the distribution centre is less bulky.
3	Existing-PDA	Improved operational and financial performance in serving existing geographical markets	PoS terminals are configured in a location closer to the market. Therefore, the customers can fully specify the product they need at a time closer to product delivery, when they have more information about the product features that will maximise their utility. Further, time and cost performance are not impaired by late order specification. Investment in fixed assets is reduced. Overhead decrease and capacity utilisation increases because of one-stop-shop for all FP services provided to the customer. Distribution costs are lower due to overlapping of delivery points for different product families of the same customer.
5	PDA-enabling	Entry into a new geographical market	Serving the new market requires carrying out kitting activities to create different phone packs according to the promotion conception. However, the 3PL's customer would not carry out manufacturing activities in-house because of its focus on the development and commercialisation of mobile telecommunications services. Phone packs are built in a location close to the market and, hence, at a time close to the promotional launch. Consequently, inventory-holding costs are low and reaction time on market demand is fast. Investment in fixed assets is reduced.
6	PDA-enabling	Entry into a new geographical market	Serving the new market requires building different displays of OTC medicines for pharmacies according to the promotion conception. However, the 3PL's customer is a fables company focused on the development and commercialisation of OTC products and would not carry out such activity in-house. As displays are built in a location close to the market, inventory-holding costs are low and lead-times in responding to unanticipated market conditions are short. Fixed asset investment is reduced. Overhead and operating costs are low due to resource-sharing among multiple product-customer combinations.
7	PDA-enabling	Entry into new geographical markets	Serving the new markets in Europe requires adding different labels and literature to the medication according to the country of destination. The 3PL's customer, however, is a small US-based biotech company and could not profitably create these product variants at its laboratories, owing to the high risks and associated costs of keeping speculative inventory of finished goods. Likewise, the company could not set up a facility to create these variants in Europe because of its scale. Close-to-the-market labelling and packaging based upon market demand lead to little inventory waste, low rework costs and great responsiveness to specific country trends or regulatory change. Overhead, processing costs and distribution costs are low due to resource-sharing among multiple product-customer combinations. The 3PL handles certified translation of labels and provides a single point of contact for component approval in each country, thus simplifying the process for the customer.

Table 3. Organisational approaches adopted in the selected cases to provide FP services, effects on customer value, and implementation challenges.

Case	Organisational approach	(Lack of) resource-sharing (dis)advantages	Resource-sharing enablers (obstacles)
5	<u>Ad-hoc</u> The facility is dedicated to case 4	<u>(Capacity underutilisation)</u> (8 assembly lines, but only 2 of them are used out of peak periods) <u>(Dependence on temporary labour)</u> (up to 100 temporary workers in peak periods. Lower productivity due to learning curves. Temporary labour sometimes difficult to find)	<u>(Customers serving the same market)</u> (the customer would not allow resource-sharing with direct competitors, owing to confidential information related to promotions) <u>(Distribution not included in the service)</u> (distribution provided by another 3PL operating in the local market)
4	<u>Ad-hoc</u> The facility is dedicated to case 5	<u>(Capacity underutilisation)</u> (7 assembly lines, but only 3 of them are used out of peak periods) <u>(Dependence on temporary labour)</u> (up to 250 temporary workers in peak periods)	<u>(Customers serving the same market)</u> (the customer would not allow resource-sharing with direct competitors, owing to confidential information related to promotions)
1	<u>Ad-hoc</u> The facility is divided in six compartments for six customers operating mainly in the semiconductor industry. They are provided both logistics and value-added services, but PDAs are performed for case 1 alone	<u>Shared overhead</u> Part of the office and social areas, part of the administrative staff, licences and other services are shared with all the other PCCs <sup>a</sup> at the facility <u>(Capacity underutilisation)</u> (unused capacity in quarters 1 and 4) <u>(Dependence on temporary labour)</u> (kitting subcontracted to a sheltered workshop guaranteeing up to 100 operators in peak periods. Need for multiple quality checks in kitting lines) <u>(Loss of potential savings in distribution costs)</u> (lost opportunities for shipment consolidation despite partial overlapping of delivery points)	<u>(Heterogeneity of IT systems)</u> (the IT system used for case 1 is customer's property and is different from those used for the other PCCs <sup>a</sup> served at the facility) <u>(Heterogeneity of training and equipment requirements)</u> (no VAS operators are shared with the other PCCs <sup>a</sup> served at the facility, owing to different training requirements and high costs of cross-training. Sealing machines are specific to kitting activities and cannot be shared with the other PCCs <sup>a</sup> served at the facility) <u>(Distribution not included in the service)</u> (the customer performs all distribution management on its own and decides which transport to take from which 3PL)
2	<u>Multi-product platform</u> The facility currently serves two product families of the same customer: case 2 and case 3. In the future, the facility will serve a third product family of the same customer—business printers—which require performance of localisation and technical configuration activities	<u>Shared overhead</u> Office and social areas, IT system, administrative staff, licences and other services are shared with all the other PCCs <sup>a</sup> served at the facility <u>Higher volume flexibility and reduced dependence on temporary labour</u> Easier up- and down-scaling of personnel resources through sharing of permanent staff <u>Reduced distribution costs</u> Small direct-to-customer shipments are consolidated thanks to 3PL-provided distribution and partial overlapping of PCCs' delivery points	<u>(Heterogeneity of training requirements)</u> (configuration of PoS terminals—case 3—requires highly skilled workers, while kitting of consumer printers—case 2—does not. Due to the high costs of cross training, VAS operators for case 3 can be employed for case 2, but not vice versa. More sharing of workforce is expected with the coming of business printers) <u>(Heterogeneity of equipment requirements)</u> (VAS equipment and areas not shared, as configuration of PoS terminals needs to be done in a semi-clean environment with safety regulations) <u>Coordination by mutual adjustment</u> Coordination by aggregate planning is hindered by the fact that the 3PL has 5 days of visibility over the customer's delivery schedule for PoS terminals, but only 1 day for consumer printers

(continued)

Case	Organisational approach	(Lack of) resource-sharing (dis)advantages	Resource-sharing enablers (obstacles)
3	<u>Multi-product platform</u> The facility currently serves two product families of the same customer: case 2 and case 3. In the future, the facility will serve a third product family of the same customer—business printers—which require performance of localisation and technical configuration activities	<u>Higher capacity utilisation and shared overhead</u> Office and social areas, IT system, workforce, administrative staff, licences and other services are shared with all the other PCCs <sup>a</sup> served at the facility  <u>Reduced distribution costs</u> The 3PL also provides distribution services and delivery points partially overlap among the PCCs <sup>a</sup> served at the facility. Therefore, small shipments dispatched directly to the customers are consolidated	<u>(Heterogeneity of training requirements)</u> (configuration of PoS terminals—case 3—requires highly skilled workers, while kitting of consumer printers—case 2—does not. Due to the high costs of cross training, VAS operators for case 3 can be employed for case 2, but not vice versa. More sharing of workforce is expected with the coming of business printers)  <u>(Heterogeneity of equipment requirements)</u> (VAS equipment and areas not shared, as configuration of PoS terminals needs to be done in a semi-clean environment with safety regulations)  <u>Coordination by mutual adjustment</u> Coordination by aggregate planning is hindered by the fact that the 3PL has 5 days of visibility over the customer's delivery schedule for PoS terminals, but only 1 day for consumer printers
6	<u>Multi-customer platform</u> The facility provides logistics services to seven customers operating in the pharmaceutical industry and value-added services to three of them. However, a PDA is carried out for case 6 alone	<u>Higher capacity utilisation and shared overhead</u> Facility, equipment, workforce, part of the administrative staff, licences and other services are shared with all the other PCCs <sup>a</sup> at the facility  <u>Higher volume flexibility</u> Workforce for a single customer can be increased up to 50% from one day to the next through sharing of permanent staff  <u>Reduced dependence on temporary labour</u> All workers are permanent employees, except in July. This is the only period in which demand peaks for the PCCs <sup>a</sup> served at the facility overlap. Demand patterns are for the most part complementary, as the customers serve different markets: hospitals and pharmacies	<u>(Heterogeneity of IT systems)</u> (the IT system used for case 6 is customer's property and is common to only two PCCs <sup>a</sup> at the facility. Three different, either customer-owned or 3PL-owned, IT systems are used at the facility, with subsequent duplication of IT staff)  <u>(Heterogeneity of training requirements)</u> (though products are similar, cross-training of workforce is needed because of different processes and procedures among the PCCs <sup>a</sup> served at the facility. IT staff is cross-trained as well, owing to the use of different IT systems)  <u>(Distribution not included in the service)</u> (distribution provided by two small transport companies operating in the local market)  <u>Coordination by mutual adjustment</u> Need for mutual adjustments between the supervisors in charge of each customer's operations, as the customers have different planning routines and place delivery orders on a daily basis but at different points in time
7	<u>Campus-style platform</u> 35 customers in the pharmaceuticals, medical devices and hospitals industries are served in three facilities close to each other. The customers are provided both logistics and value-added services. PDAs are carried out for case 7 and another PCC <sup>a</sup> requiring assembly of different surgical kits	<u>Higher capacity utilisation and shared overhead</u> Inbound/storage/outbound areas, VAS areas, office and social areas, material handling and VAS equipment, workforce, IT system, administrative staff, licences and other services are shared among different PCCs <sup>a</sup> served within the campus  <u>Reduced dependence on temporary labour</u> All workers are permanent employees  <u>Reduced distribution costs</u> The 3PL also provides distribution services and consolidates small shipments, thanks to partial overlapping of delivery points among the PCCs <sup>a</sup>	<u>(Heterogeneity of training and equipment requirements and IT systems)</u> (Clinical trial customers have a few dedicated resources—storage/outbound areas, equipment, workforce, part of the administrative staff, licences, customer service—due to specific regulations and laws that are different from normal pharmaceuticals. Likewise, another PCC <sup>a</sup> has a few dedicated resources—inbound/storage/outbound areas, VAS area and equipment, workforce—because customer-specific IT system, processes and procedures, and training are needed in order to work with a very large amount of stock-keeping units—7500 possible end items)  <u>Coordination by mutual adjustment</u> Mutual adjustments between resource planners of different customer are needed, as the customers have different planning routines

<sup>a</sup>Product-customer combination.

**Figure captions**

Figure 1. Existing-PDA (from-forecast-to-order-driven-PDA) FP service.

Figure 2. Existing-PDA (remaining-forecast-driven-PDA) FP service.

Figure 3. Existing-PDA (remaining-order-driven-PDA) FP service.

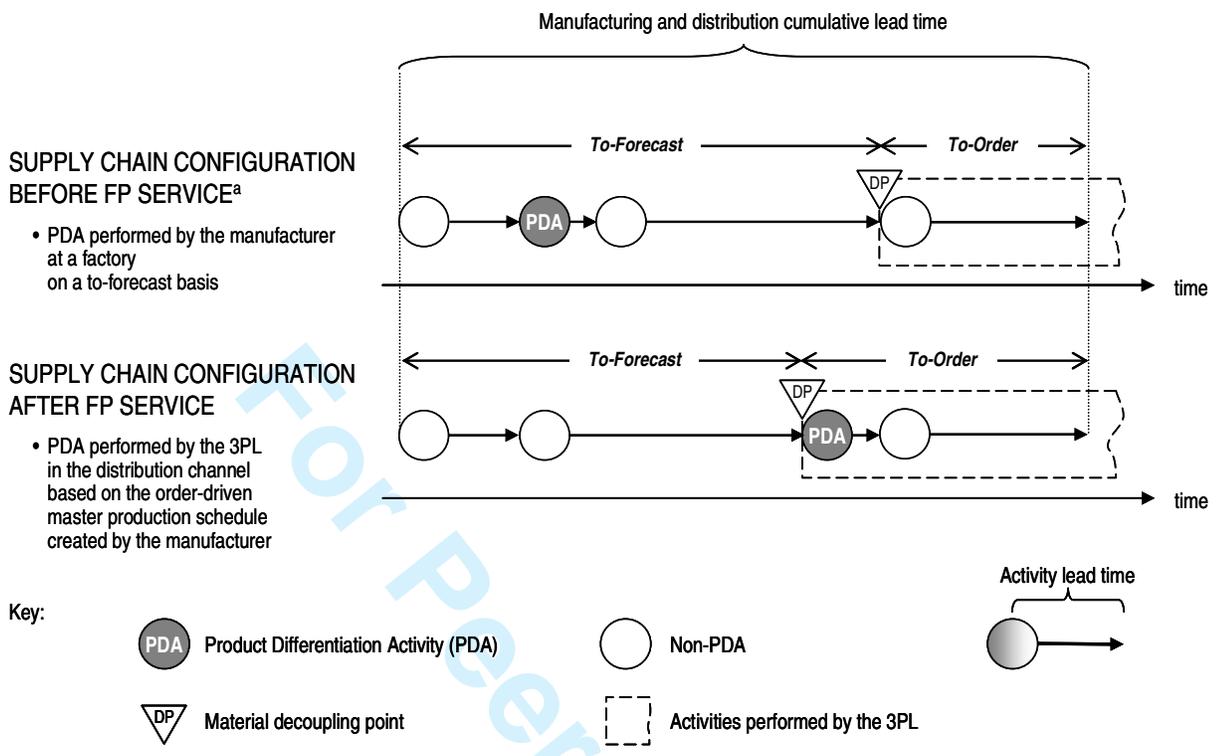
Figure 4. PDA-enabling FP service.

Figure 5. Organisational approaches adopted in the selected cases to provide FP services.

Figure 6. The proposed framework linking FP service type, customer value, organisational approach and resource-sharing enablers.

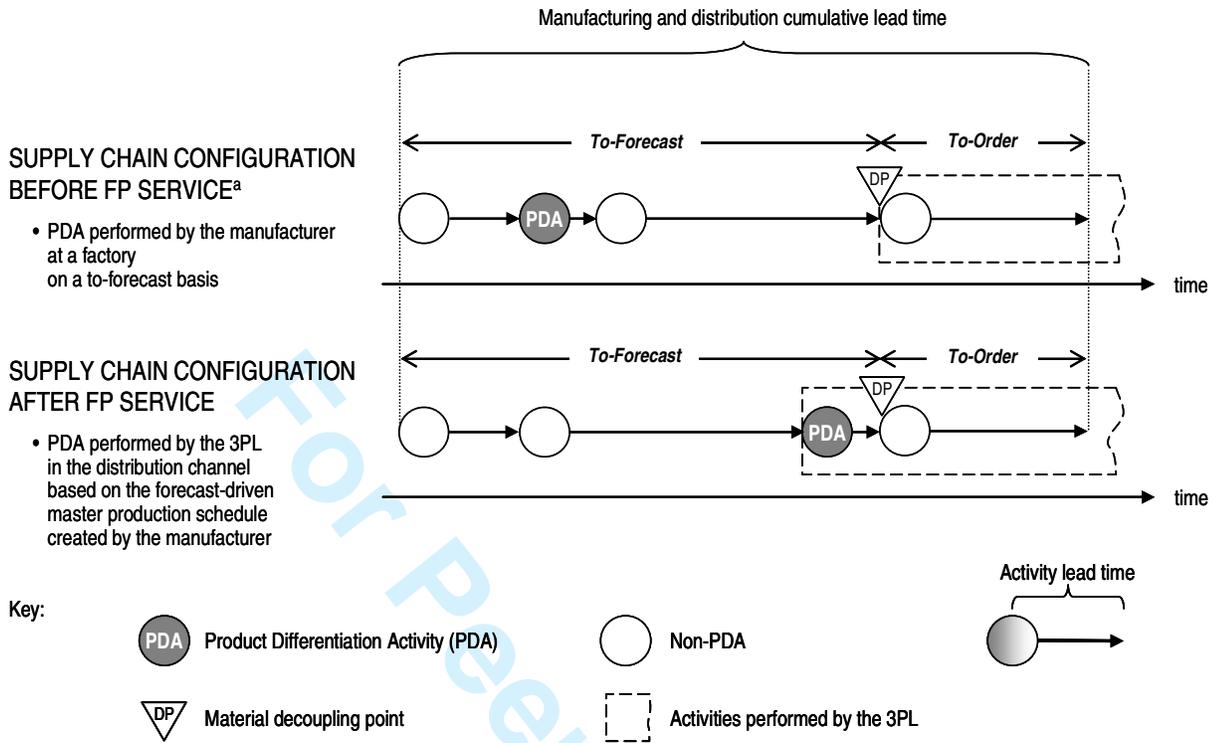
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<sup>a</sup>For the sake of drawing simplicity and without any loss of generality, the figure assumes that before FP service provision, the 3PL was responsible for finished goods distribution activities.

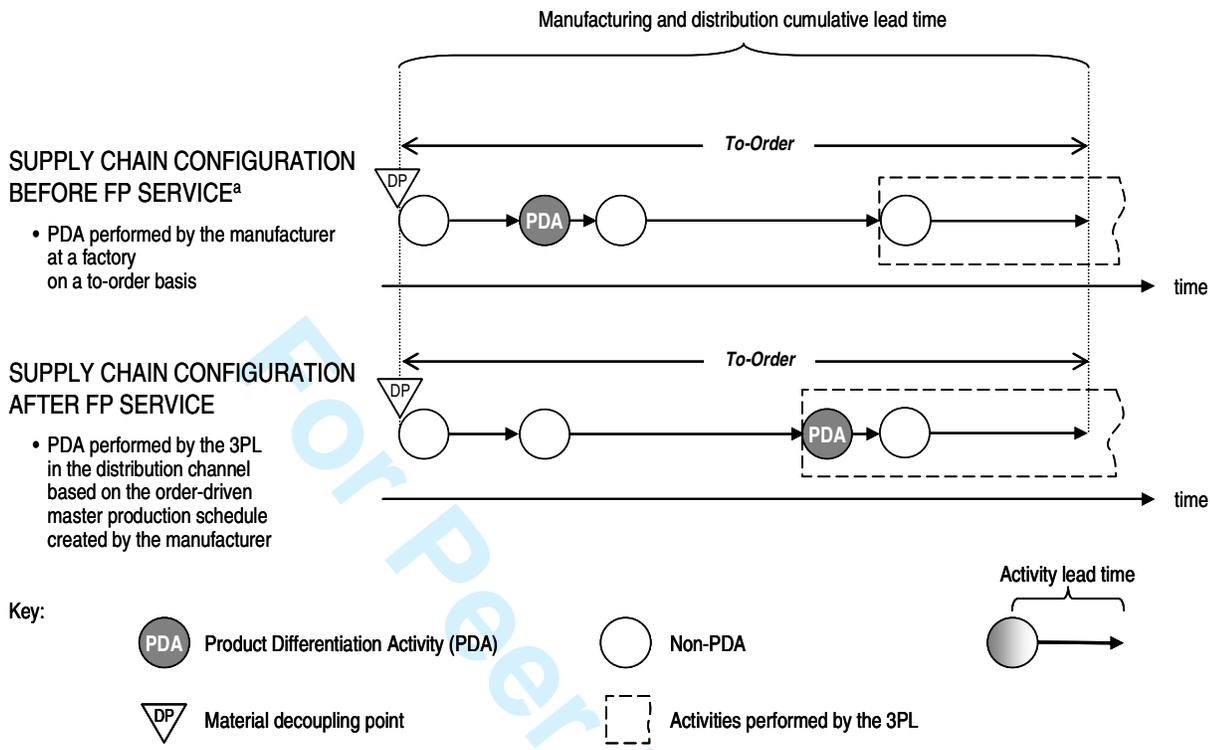
Figure 1. Existing-PDA (from-forecast-to-order-driven-PDA) FP service.



<sup>a</sup>For the sake of drawing simplicity and without any loss of generality, the figure assumes that before FP service provision, the 3PL was responsible for finished goods distribution activities.

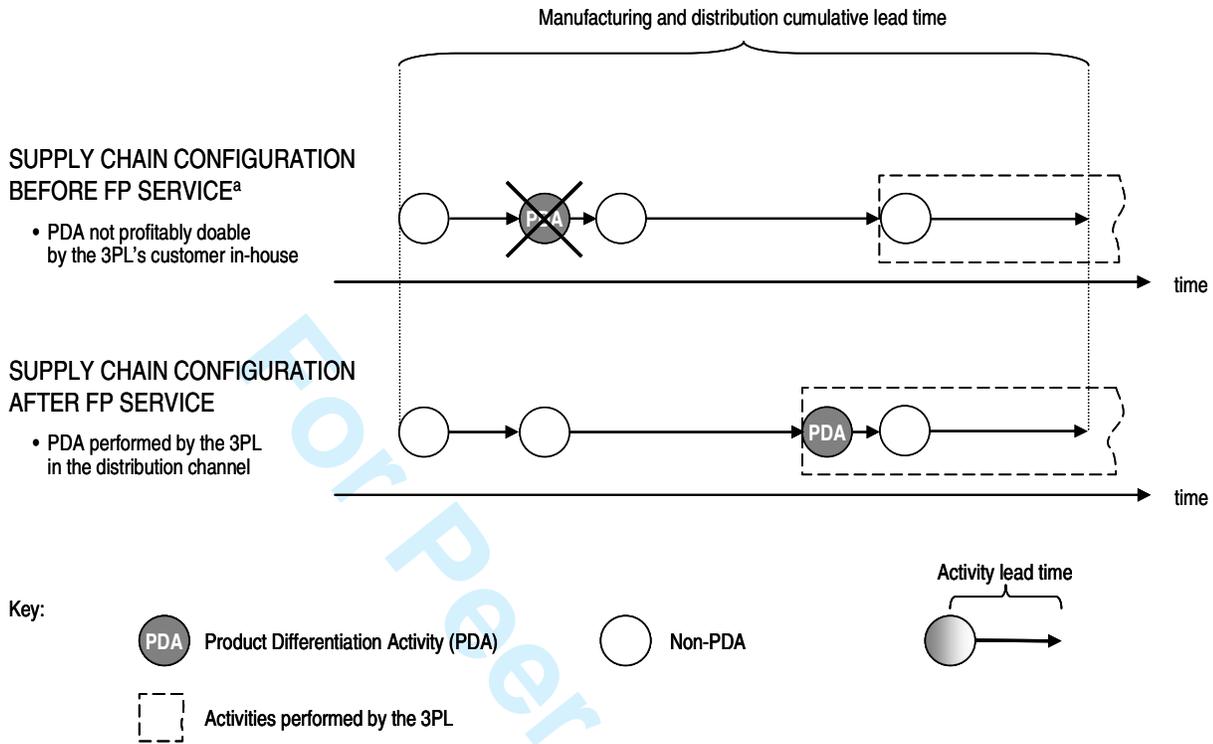
Figure 2. Existing-PDA (remaining-forecast-driven-PDA) FP service.

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<sup>a</sup>For the sake of drawing simplicity and without any loss of generality, the figure assumes that before FP service provision, the 3PL was responsible for finished goods distribution activities

Figure 3. Existing-PDA (remaining-order-driven-PDA) FP service.



<sup>a</sup>For the sake of drawing simplicity and without any loss of generality, the figure assumes that before FP service provision, the 3PL was responsible for finished goods distribution activities.

Figure 4. PDA-enabling FP service.

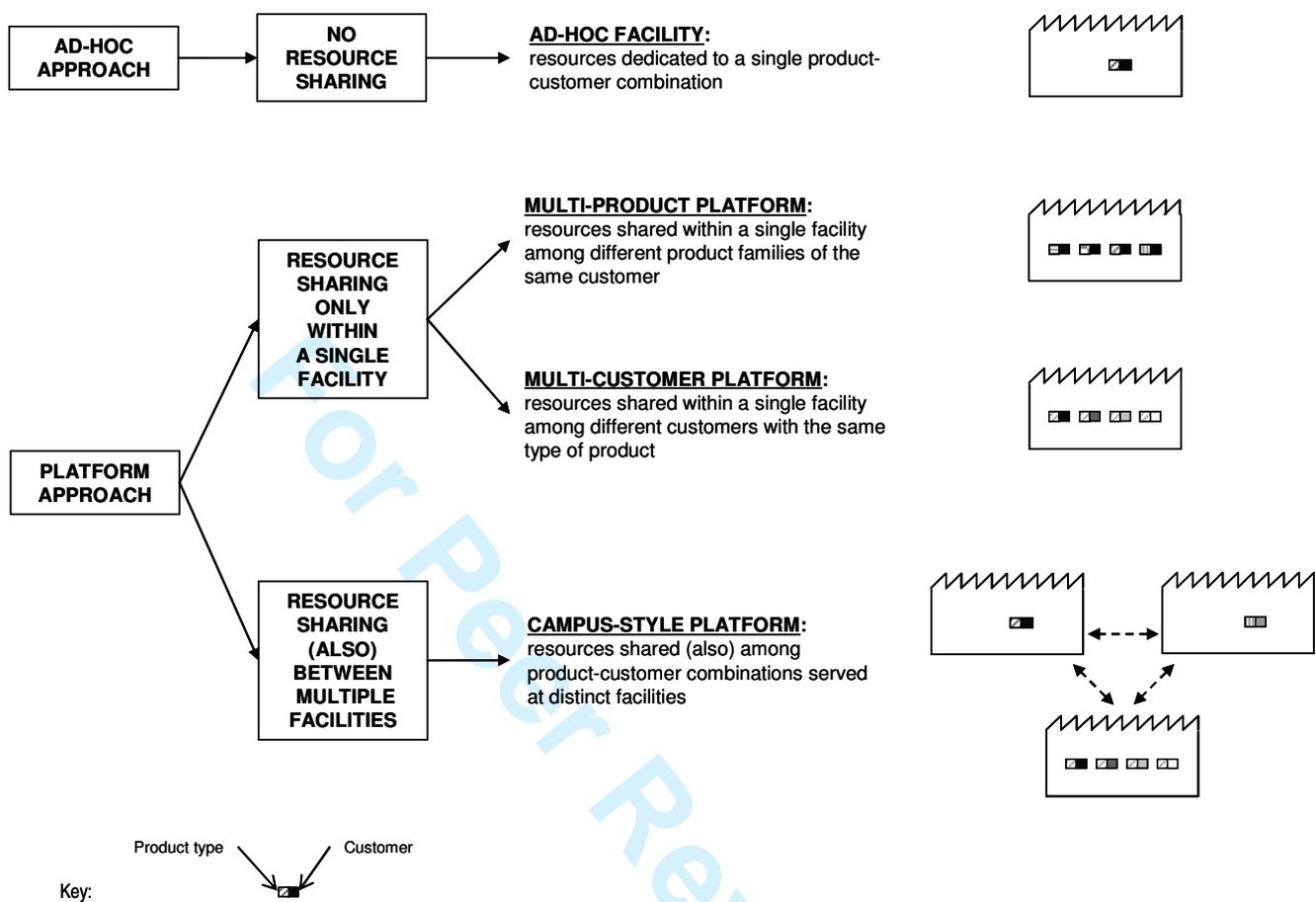


Figure 5. Organisational approaches adopted in the selected cases to provide FP services.

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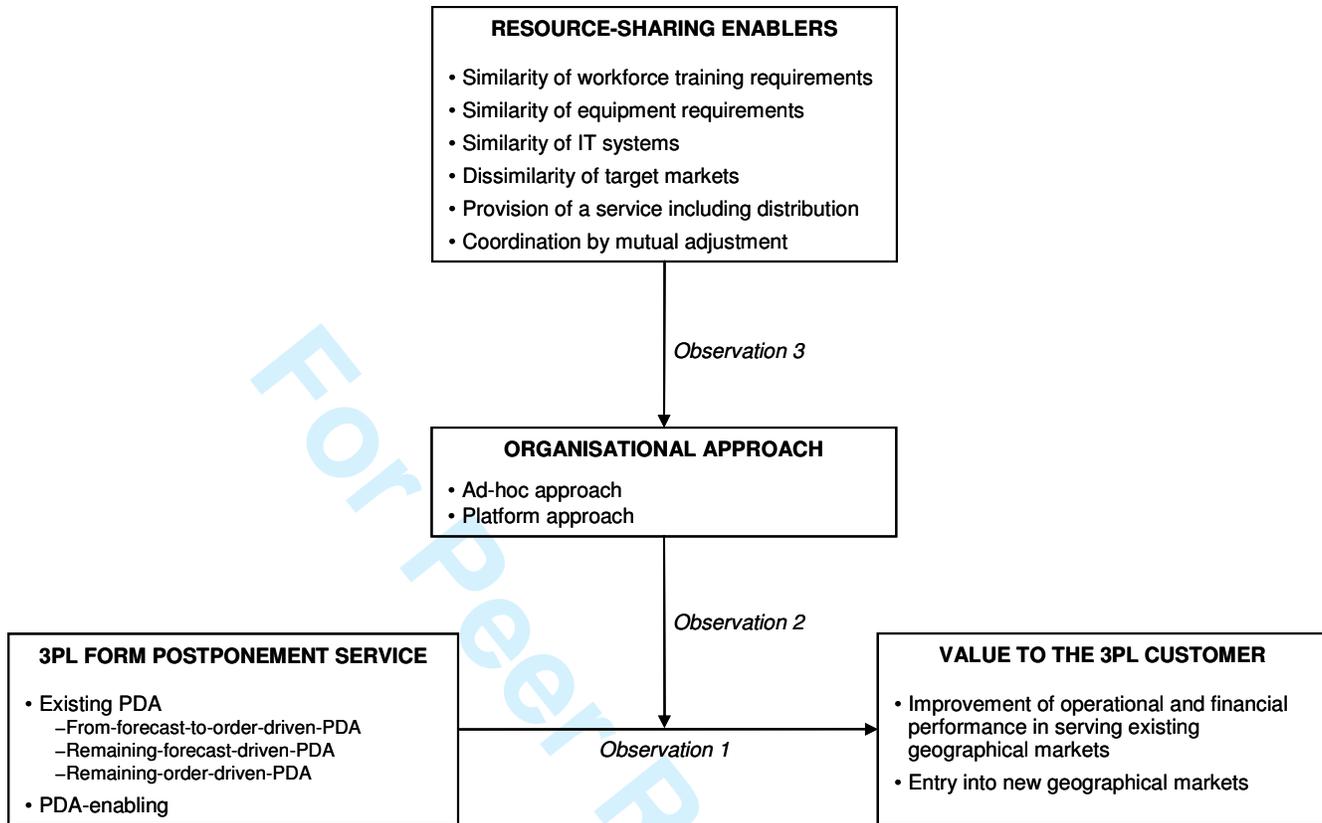


Figure 6. The proposed framework linking FP service type, customer value, organisational approach and resource-sharing enablers.