IDENTIFICATION OF POSTPONEMENT POINT IN SERVICE DELIVERY PROCESS: A DESCRIPTION MODEL

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ABSTRACT
The paper intends to extend the manufacturing-oriented postponement theory to the service sector, and propose a conceptual understanding of CODP (Customer Order Decoupling Point) identification in service delivery process. Based on a review of relevant literatures, the paper discussed the differences between manufacture process and service process with special concern on customer contact, which helped to reach an understanding of service postponement and the factors influencing the determination of CODP in service operation. Finally a description model for how to identify the CODP in service delivery process was proposed and tested in a practical case and further research directions were suggested.

Keywords: System modeling, Production systems, Customers contact, Postponement, CODP

1. INTRODUCTION

The concepts of postponement has attracted more and more interests from both academia and industrial practitioners and become one of the popular topics in management researches. However, the majority of the related works focus on manufacturing operations rather than services, especially in CODP (Customer Order Decoupling Point) identification, against the context that the importance of service sector in a national economy has been commonly recognized. This paper makes efforts to reach an understanding of the postponement in service operation with special concern on CODP in service delivery process and intends to develop a description model for identifying it.

2. Review of related literatures

2.1 The nature of postponement

Postponement has a long history of practical business application dating back to the 1920s (CLM, 1995) while postponement literature back to 1950s introduced by Anderson. He noted that postponement could change the differentiation of goods to as late a time as possible, and thus, it could be used to promote the efficiency of a marketing system (Anderson, 1950). Bucklin considered that postponement was originally applied in distribution channel, which could shift suppliers' risk to the buyer (Bucklin, 1965). Researchers suggest that postponement has the potential to improve responsiveness while reducing inventory, transportation, storage, and obsolescence costs (Yang et al, 2004).

As development of postponement theory, the definition of postponement was applied from a supply chain perspective (Hoek, 2001). Waller et al. described three additional stages in the supply chain that hold
opportunities for the application of postponement: upstream, downstream, and distribution. Some researchers focused on the use of third party providers for some postponement related activities (Twede et al 2000; Hoek and Dierdonck 2000) as a result of increase of outsourcing corporation business. Similarly, some researchers integrate postponement into globalization (Battezzati and Magnani 2000; Hoek 2000; Hoek et al 1999).

The essence of postponement, as mentioned by Pine (Pine et al 1995), is to reduce customization through put off postponement point, in other words, to find out the balance point between customization and efficiency so that total benefit (including risk, inventory cost, etc) would be optimized.

2.2 Postponement point

The principle of postponement is to delay some of the value adding activities until a customer order arrives. Hence the point when customers’ orders come in is called postponement point (also known as customer order decoupling point, CODP). The CODP determined the beginning of customization activities in overall process of provision of goods and services. Selection of CODP becomes the core decision in postponement.

Bucklin pointed out that activities cannot be postponed forever (Bucklin 1965), which is to say that the postponement cannot occur everywhere (Christopher et al 2007). Zinn and Bowersox (1998) figured out four points could be postponement points, namely the points of labeling, packaging, assembly and manufacturing. Pagh and Cooper (1998) considered that postponement strategies were going towards integrating both logistics and manufacturing activities, and not only limited in the downstream portion of the supply chain. Yang and Burns pointed out that we should view postponement through a complete supply chain view (Yang and Burns 2003), and Lampl and Mintzberg (1996) argued that location of postponement point was relative to the degree of customization.

Many efforts were made in classifying postponement which were suitable for selecting postponement point, such as the three categories of postponement: the time postponement, form postponement and place postponement (Bowersox and Closs 1996); and classification proposed by Lee (1998): the pull postponement, logistics postponement and form postponement.

2.3 Postponement in service operations

Though not stated as a separate challenge, researchers focus on manufacturing operation rather than service operation in postponement study (Schmenner 1986; Hoek 2001). Van Hoek regarded service-based postponement as a valuable undertaking in third party logistics service industry, and he characterized a service industry as one that consumption and production partially coincide and in which postponement strategies may be applicable (Hoek 2001). However, we could identify very few research efforts especially exploring service industries and the implementation of specific postponement opportunities and their performance results (Christopher et al 2007). Fleiß and Kleinaltenkamp (2004) drew an "order penetration line" in service blue printing and tried to identify two types of activities, namely the activities above the line which were customer-driven or customized, and the activities below the line which were not customer-driven and could be conducted before knowing their needs. This in essence is the application of postponement concepts. However, they did not point out how to locate the line (the postponement point).

Further research should be done in the service sector since the importance to develop this sort of research is obvious if we consider the differences between manufacturing and service operation, and the implications these differences may have in applying postponement to service process.
3. The Characteristics and construction of the service process

3.1 The key features of service delivery process

Service process distinguishes from the manufacturing counterpart in many aspects. Firstly, manufacture process focuses on making tangible products, whereas service process focuses on meeting the requirements of customers or solving some problems, and customers could only be served when they participate in the process of service provision. In other words, before service suppliers can really start the production and delivery of service, the customers' requirements need to be specified (Fließ and Kleinaltenkamp 2004). Secondly, manufacturing process is independent from customers who cannot come into the process and contact with the products until the production is completed. However, the services in most cases require the presence of the customers (customer contacts) in all or some of part of the service delivery process (Fließ and Kleinaltenkamp 2004). Lastly, it is far more difficult to maintain quality control in service system than manufacturing one since customers contact may lead to high variation in service system. High customers contact may bring about efficiency, as the customers carry out tasks that otherwise have to be carried out by the service employees (Hoffman and Bateson 1997), and also cause high demands on the provider's service process management. Missing, delayed or unqualified customers’ contributions will influence costs, time and tasks carried out by the supplier's employee (Schmenner, 1986).

3.2 The two consecutive stages in service delivery process

The aforementioned features of service process imply that customer contact is the most influential factor and hence determines the construction of service delivery process. It includes two consecutive parts, namely the service assembly process and service providing process, as mentioned in many literatures (Fließ and Kleinaltenkamp 2004). Service assembly is to primarily preparing the services before customers arrive in service system, such as the layout of establishment, the arrangement human resources and the prescript of service delivery process, while the second process is providing the services for customers after they arrive in service system.

The view of service construction is based on whether customers some contacts with the service providers, namely whether customers are present in service system. The service assembly process is independent from customers before they come into the service system. The basic and standardized service modules are generally produced in advance in this stage, and mass production methods could be utilized. However, the service-providing process is highly interrelated with customers after customers arrive in service system, customization occurs in this stage.

4. The postponement point and the service delivery process

A postponement point is the turning point that shifts the entire process from forecast-driving production (push production) to customer-driving production (pull production), in other words, from mass production to customized production. This point is the time when customer orders arrive in terms of postponement point in manufacture. When it comes to service, we have to take further consideration since there two points for customers’ order coming into the service delivery process: the customer reservation and customer contact points.

Customer reservation tells the service organization their requirements for services before they enter into the service system. However, the service products cannot be provided without customers’ participation in the service process. The customer reservation point could not distinguish the make-in-advance and make-to-order here. Furthermore the customer reservation point could not stand for the point where all the customer’s order come in since in practical numerous customers arrive without reservation.

Nevertheless when customers (whether have reservation or not) arrive in the service system and contact the
Jue Chen and Daijian Tang

service provider, the requirements of customers are known by provider, and service provision is hence triggered. The customers contact point brings into customers’ order, distinguishes forecast-driving and customer-driving activities, and hence is suitable for the point for postponement in service delivery process.

Figure 1 shows that the service delivery process which takes customer contact point as the decoupling point is divided into two basic stages: the service assembly process and the service providing process. In the first stage, forecast-driving production (push production) is to be organized for prefabricating the general-use and standardized modules, which helps to achieve efficiency due to the utilization of mass production. In practice the service assembly process is also regarded as the phase of making service preparations before customers coming in. Beside the general modules, some customized modules could also be produced if detailed reservation received. In the second stage services are delivered with the presence of the customers in the process by integrating the general modules produced in previous stage with the customized modules produced according to customers’ orders in the second stage. Customer-driving production (pull production) should be conducted in this stage and high customization in services could hence be achieved. Some service companies may provide follow-up services after basic service rendering, which could be classified into the services provided in the second stage since they are delivered after the customer contact point and should be customized.

![Figure 1. Reservation point and customer contact point in service delivery](image)

5. Factors affecting CODP in service delivery

5.1 Customer contact

Customer contact is the interaction between customer and service provider and is the key feature in service provision. Though the extent of customer contact is determined mostly by the nature of service products, we could also utilize some technical method to change it. High-contact in service provision means less service modules could be prefabricated and therefore postponement point could only push forward in service process, whereas service products with low customer contact get chances to fabricate more modules in advance, and the CODP could be further pushed back.

5.2 Modularization in service delivery

The concept of modularization is that a product could be disassembled through certain rules to many modules, and manufacturers could produce the common modules in the way of mass production and customize the final product by combining the common modules and customized modules. Modularization is one of the most important factors of CODP selection in service because the basic rules of postponement is accordant to modularization, in other words, they put both scope economy and scale economy together. If the extent of modularization is appropriate, more service modules could be picked out for prefabrication in the way of mass production, and more economy of scale efficiency from postponement could then be achieved. Whereas if modularization were low, the probability of prefabrication would be less due to the shortage of disassembling modules, the postponement point has to be pushed forward.

5.3 Reservations and demand forecasting
Prefabricating modules according to service reservation is more reliable than doing it by forecast, it allows service organization prefabricate more general modules even customized modules (only if they could be completed without customer participation). This is to say, we could put off the postponement point, and enhance efficiency through increasing prefabricating parts in forms of mass production, and service modules after customers’ arrival could be relatively reduced, thus increasing the service speed. As a result, the earlier the customers book services, the more specific the booking requirements, the more reservations are made, the bigger benefit we could get from postponement.

Because prefabrication of the service modules is based on the preciseness of forecasts, it influences CODP in the service process. The result of forecasting could be used to change short-term production by controlling variable input, such as materials and labor. It is also used to plan long-term operation by replacing service equipments. A precise forecast would be very helpful to locate the service postponement point appropriately since it helps to avoid over prefabrication or inadequate preparation of service modules, and hence cut down market risks and production risks.

5.4 Customer satisfaction and costs

Beside the above, customer satisfaction and costs should be also taken into account in determining the CODP in service delivery process. These two are actually among the most decisive influencing factors. The postponement is in essence to make balance between these two, namely on one hand it should provide sufficient customer satisfaction, on the other hand this should not sacrifice cost saving in service delivery.

6. Model for identification of the postponement point in service delivery

6.1 Hypothesis and notation

Before building up the model, we should list some hypothesis constructing the basic condition for the model based on the above understanding of postponement in service delivery. The following hypothesis is proposed:

H1. There are numbers of service products, but we disassemble them into modules, and hypothesize the number of modules as n. This study arrange them sequentially according to the requirements of the service product, listed as 1, 2, . . . , n. And j is the postponement point. Service provider produces modules through mass production before j, and produces through customized production after j.

H2. The study hypothesizes that service provider sets up standard for quality and extent of customization for modules, on which the satisfaction of customers is based. Customization can increase customers' satisfaction, and customization of service provided is determined by the customization of the number of modules.

H3. The study also hypothesizes that the time of mass production before postponement point is fixed, no matter how many modules being produced. However, the cost of mass production would be changed with the change of quantity of the modules being produced because of raw material, labor and so on.

Follow notation should be introduced before set an analysis framework of model:

\( t \) index for time needed to accomplish overall service.

\( t_0 \) index for time needed in mass production which is fixed.

\( t_i \) index for time needed to accomplish i module after j(postponement point).

\( c \) index for overall cost planned.

\( c_k \) index for cost of general module k before j according to demand forecasting or reservation.

\( c_l \) index for cost of customized module l before j when reservations exist.

\( c_i \) index for cost of module i after j.

\( \delta_0 \) index for weighted value of service satisfaction of prefabricating modules.
(Note: the modules constructing service product would have different influences on the final customer satisfaction to the product. Some of them having greater influences should be given bigger weight. The prefabricating modules have no customer contact and customers can not evaluate them immediately. Therefore these modules \( s_0 \) are given a relatively fixed weight \( \delta_0 \). While the modules after the CODP have a full customer contact and have more influences on the customer satisfaction, we give them weight \( \delta_i \) respectively.)

\[
\delta_i \quad \text{index for weighted value of service satisfaction of modules after } j.
\]

\[
s \quad \text{index for service satisfaction required.}
\]

\[
s_0 \quad \text{index for service satisfaction of modules before } j.
\]

\[
s_i \quad \text{index for service satisfaction of modules after } j.
\]

\[
p_i \quad \text{index for module } i.
\]

\[
Y \quad \text{index for the number of customized modules.}
\]

\[
\alpha_i \quad \text{index for the indicator for way of producing modules}
\]

and

\[
\alpha_i = \begin{cases} 
1, & \text{if module } i \text{ is customized produced} \\
0, & \text{otherwise}
\end{cases}
\]

6.2 Objective function and goal constraints

The aim of this study is to set up a model that could help the service provider find optimal postponement point. Therefore, we should find the optimal point that minimizes number of customized modules. Thus the objective function could be listed bellow:

\[
Y = \min \sum_{i=j}^{n} \alpha_i p_i, \quad (1 \leq j \leq n)
\]

The last two terms of equation capture whether module \( i \) is customized or not, the function expresses the optimal postponement point is the point minimizing the number of customized modules.

The objective function formulated in the previous is confined by three sets of constraints. They are lead-time constraint, cost constraint, and customer satisfaction constraint. Goal constraints as following:

St.

\[
t_0 + \sum_{i=j}^{n} (1-\alpha_i)t_i + \sum_{i=j}^{n} \alpha_i t_i \leq t, (1 \leq j \leq n) \quad (1)
\]

\[
\left( \sum_{i=j}^{n} (1-\alpha_i)c_i + \sum_{i=j}^{n} \alpha_i c_i \right) + \left( \sum_{i=j}^{n} (1-\alpha_i)c_i + \sum_{i=j}^{n} \alpha_i c_i \right) \leq c, (1 \leq j \leq n) \quad (2)
\]

\[
\delta_0 s_0 + \sum_{i=j}^{n} \delta_i (1-\alpha_i)s_i + \sum_{i=j}^{n} \delta_i \alpha_i s_i \geq s, (1 \leq j \leq n) \quad (3)
\]

\[
\alpha_i = 0 \text{ or } 1 \quad (4)
\]

\[
\forall p_i = 1, \quad (1 \leq i \leq n) \quad (5)
\]

Constraint (1) determines the time of providing an overall service. It expresses that the time of mass production before postponement point and the time of mass production after postponement point plus the time of customizing production after postponement that could not be more than the lead-time.

Constraint (2) determines the cost paid in service flow. It shows that the cost paid after postponement
Identification of Postponement Point in Service Delivery Process

49

point identified should not be greater than the cost planned. And the cost paid after postponement point identified include the cost of mass production before postponement point, the cost of customizing production before postponement point when reservations exist, and the cost of mass production and customizing production after postponement point.

Constraint (3) determines the customer satisfaction of service, and from H2 we know as customization increased, it would improve customer satisfaction. Moreover, constraint (3) shows that the customer satisfaction of prefabricating modules before postponement point and the customer satisfaction of standard modules after postponement point plus the customer satisfaction of customized modules after postponement point with different weighted values should not be smaller than the customer satisfaction required. Constraint (4) and (5) show constraints of parameters of objective function.

In this mathematical model, we could also find other influences caused by customer contact. When j=0, customer contact doesn’t happen. When j=1, customer and service provider have complete contact. When 0<j<1, there is incomplete contact between customers and service providers.

7. Practical justification of the model

We take the room services of a hotel as example to test the model. The room services are supplied by both the house-keeping department and the front office. We know from the discussion above that there are two hypothesis postponement points, the reservation point and the customer contact point, namely the module 4 and module 6 in table 1.

Table 1. Service modules for room services

<table>
<thead>
<tr>
<th>Serial number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Modules</td>
<td>Cleaning the room</td>
<td>Equipment maintenance service</td>
<td>Supplying necessities</td>
<td>Customer reservation</td>
<td>Customized preparation</td>
<td>Registration</td>
<td>Guiding service</td>
<td>Making up the room</td>
</tr>
<tr>
<td>Category of module</td>
<td>☆</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servicing time (m)</td>
<td>30-45</td>
<td>10-20</td>
<td>3-5</td>
<td>2</td>
<td>5-10</td>
<td>5-10</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Servicing cost (proportional value)</td>
<td>8-10</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>weighted value of service satisfaction (%)</td>
<td>20</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>20</td>
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Table 1. Service modules for room services (continued)

<table>
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<th>Serial number</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
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<tr>
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<td>service</td>
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<td>Ticket-booking service</td>
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<td>Laundry service</td>
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<td>Checkout service</td>
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<td>Delivering luggage</td>
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<td>Calling taxi</td>
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<td>Other special service</td>
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<td>Category of module</td>
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<td>☆</td>
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<td>☆</td>
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<tr>
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<td>10</td>
<td>3</td>
<td>5-10</td>
</tr>
<tr>
<td>Servicing cost (proportional value)</td>
<td>1</td>
<td>2-4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2-5</td>
</tr>
<tr>
<td>weighted value of service satisfaction (%)</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

☆ index for customized module

In table 1, the first three modules are general modules under mass production while the last 10 modules are after the postponement point, among which some belong to general modules and some customized. Servicing time has been listed in the table in turn. The cost (only considered the servicing cost) for each module has been converted into proportional value. In order to be advantageous for the computation, the data with the scope sector is all substituted by the intermediate quantity. The time limit and the cost limit are respectively the sum of their maximum values. Suppose that the customer marks the degree of each service satisfaction as 1, so the total satisfaction is 1. Lead the data to the model, then judgment the postponement point by calculation.

First, suppose that the reservation point is the postponement spot, the constraints as follows:

\[
\begin{align*}
I & : \ 56.5 + 2 + 7.5 + 7.5 + 4 + 10 + 1 + 8 + 7.5 + 7.5 + 1.5 + 10 + 3 + 7.5 \leq 175 \\
C & : \ 9 + 5 + 2 + 1 + 3 + 2 + 1 + 4 + 1 + 3 + 3 + 2 + 2 + 3 + 2 + 3.5 \leq 50 \\
S & : \ s = 1
\end{align*}
\]

We could find that the constraints are all satisfied, this objective function \( Y = 8 \).

Then suppose that the customer contact point is the postponement spot, the constraints as follows:

\[
\begin{align*}
I & : \ 66 + 7.5 + 4 + 10 + 1 + 8 + 7.5 + 7.5 + 1.5 + 10 + 3 + 7.5 \leq 175 \\
C & : \ 9 + 5 + 2 + 1 + 3 + 2 + 1 + 4 + 1 + 3 + 3 + 2 + 2 + 3 + 2 + 3.5 \leq 50 \\
S & : \ s = 1
\end{align*}
\]

The constraints are also satisfied, this objective function \( Y = 7 \).

According to the minimum requirement of objective function, the postponement point is the spot of registration, namely the customer contact point.

8. Conclusions

The study suggested a primary understanding of postponement in services. Customer contact is one of the most influential features in service operation comparing to the manufacturing counterpart and could be located as the postponement point in service provision process. Besides this, modularization of service product, service reservation and forecast, cost of service provision and customer satisfaction would affect the movement of the postponement point. The mathematical model here presented us a comprehensive view of CODP identification in service operation with consideration of these factors, which has been also justified by the practical case analysis. Further research could be conducted in terms of the improvement on the mathematical model by
considering more factors such as forecast and reservation issues or constructing a practical model for the accurate decision of CODP in service process.

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