

FORM POSTPONEMENT: A RECONCEPTUALIZATION

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Abstract

Form postponement has been widely acknowledged as one of the main avenues to mitigate the adverse effects of product proliferation or customization on operational performance. As it often happens with long debated concepts, however, the proposed definitions of form postponement sometimes display substantial differences. Consequently, a shared answer to the question as to what form postponement is and a shared framework that relates form postponement to other concepts, both antecedents and consequents, do not exist, which hampers the advancement of scientific knowledge. This paper aims at moving a step forward towards a more precise definition of form postponement in the domain of tangible products. A first result on this way is that form postponement can be referred to physical activities or decisions concerning product differentiation. A constitutive and an operational definition of form postponement with a decision-oriented focus are then proposed.

Keywords

Postponement, Product Variety, Definition, Literature Review

INTRODUCTION

In its most generally understood meaning, the term “postponement” refers to “causing an event to take place at a later time” (Vocabulary). When such delayed event is differentiation of a tangible product, the expression “form postponement” is used. The word “form” refers to whatever physical product characteristic may be leveraged to attain different variants of a given product, including shape, functions, performance, etc. Take, for instance, a sweater whose variants differ only in color: postponing dyeing into different colors from before to after knitting is a well known example of form postponement (Bruce, 1987).

Form postponement has been acknowledged as one of the main avenues to mitigate the adverse effects of product proliferation or customization on operational performance (Feitzinger and Lee, 1997; van Hoek *et al.*, 1998; Waller *et al.*, 2000). Form postponement ranks among the most beneficial means of reducing or eliminating risk and uncertainty associated with product variety in a make-to-stock environment (Aviv and Federgruen, 2001b). In such a context, especially when demand is volatile, product life cycles are short and lead times are long, form postponement enables firms to avoid excessive inventory while providing great service to customers (Brown *et al.*, 2000; Lee *et al.*, 1993) and enhances firms’ flexibility to respond to changing product mixes (Ma *et al.*, 2002; Lee, 1993). For companies serving global markets, in particular, form postponement can contribute to “glocalization” through centralizing upstream activities at a global level and decentralizing downstream configuration and customization activities at a local level. Thus, scale economies can be exploited without compromising product variety offering and product differentiating activities can be performed upon customer order while still assuring delivery times that customers are willing to wait (Yang and Burns, 2003; Ernst and Kamrad, 2000; van Hoek, 1998, 1999; Cooper, 1993).

More and more firms are facing the challenge of product proliferation or customization (Pine, 1993; Åhlström and Westbrook, 1999). This can explain why for the last few years form postponement has been increasing both in applications among businesses (Bowersox, 1995) and in interest within management literature (van Hoek *et al.*, 1999; van Hoek, 2001). However, form postponement is a long standing concept: the notion is already encompassed in the first definition of postponement within management literature, which was set forth in the early 1950s (Alderson, 1950), while the term appeared only in the late 1980s (Zinn and Bowersox, 1988).

As it often happens with long debated concepts, the definitions of form postponement proposed in the literature sometimes display substantial differences, concerning the nature of form postponement and the temporal relation which form postponement implies between differentiation of a tangible product and order penetration point (Ohlager, 2003). Moreover, some confusion surrounds the notion itself of product differentiation as object of delay when form postponement is dealt with. These definitional ambiguities, in addition, cannot be explained in terms of historical evolution of the concept, since they can be found by comparing even the most recent works on form postponement.

As a result of such definitional ambiguity, a shared framework that relates form postponement to other concepts, both antecedents and consequents, is lacking in the literature. Consequently, a shared model for decision-making on matters such as the viability of form postponement in specific operating circumstances is not available for firms (van Hoek, 2001). Definitional ambiguity hampers scientific knowledge advancement also because it makes impossible to establish content-valid measures and, therefore, to test theory (Rungtusanatham, 1999).

This paper aims at reducing such definitional ambiguity and moving a step forward towards a more precise definition of form postponement in the domain of tangible products. This goal is firstly pursued by reviewing the relevant literature in order to argue the definitional issues affecting form postponement. Publications wherein the term “postponement” is used as a synonym of form postponement, other postponement types being ignored, are included. Then these puzzles are addressed and a definition of form postponement is proposed accordingly. Thirdly, a measure of form postponement is developed on the basis of the definition set forth. Finally, the implications of the proposed definition and operationalization for both research and practice are discussed.

1. THE DEFINITIONAL ISSUES

The ambiguity surrounding the notion of form postponement concerns two topics: the meaning of product differentiation as object of delay on the one hand, the nature of form postponement and the temporal relation between product differentiation and customer order receipt on the other hand. These definitional issues are argued separately in the following subsections.

1.1 The notion of product differentiation as object of postponement

There is concordance across the academic literature that form postponement refers to postponing the differentiation of a tangible product. Yet, different terms are used to denote the object of delay when form postponement is dealt with.

Some works refer to the postponement of physical activities: the stages at which different customizations occur within a production process (Garg and Tang, 1997); final manufacturing or processing activities (van Hoek, 1997); the task of differentiating a product (Lee and Billington, 1994; Feitzinger and Lee, 1997).

Other works, instead, refer to the postponement of decisions: commitment of resources/production to specific end products (Heskett, 1977; Cooper, 1993); decisions concerning finalization or differentiation of goods (Bowersox *et al.*, 1999); allocation of the aggregate order to the individual products (Aviv and Federgruen, 2001b).

In other works, finally, it is not clear whether form postponement deals with when product differentiation activities are performed or when decisions on the performance of such activities are made, as the object of postponement may be changes in product form and identity (Alderson, 1957), final formulation/configuration of a product (Zinn and Bowersox, 1988; Zinn, 1990) or the point in time when a product assumes its identity (Lee, 1993).

Although physical and decisional levels are related, the difference between physical activity-oriented and decision-oriented perspective is not immaterial: for example, dyeing sweaters into different colors, that is a physical activity, could be postponed from before to after knitting while the decision on sweaters color could continue to be made at the same time along the production planning cycle. Hence, form postponement from a physical activity-oriented perspective does not necessarily entail form postponement from a decision-oriented perspective, and vice versa. Furthermore, from a physical activity-oriented perspective the object of postponement is necessarily some manufacturing (fabrication, assembly, packaging or labeling) activity. As long as decisions regarding differentiation of goods are concerned, instead, the object of postponement might be some sourcing decision as well as some decision on the performance of a manufacturing activity. For example, if a product's variants differ in only one component which is sourced based on a lot for lot or order sizing policy, then from a physical activity-oriented perspective product differentiation takes place when that component is fitted into the rest of the

product, whereas decisions concerning product differentiation are to be made at the sourcing level, not at the assembly one.

In addition, publications with a physical activity-oriented focus do not clearly define the notion of product differentiation activity and refer to the intuitive meaning of terms. As a result, it is not clear whether product differentiation activities are those which add some product-specific attribute to a given material/subassembly or those which contribute to product variety generation. Note that a physical activity can add some product differentiating attribute while not contributing to product variety generation because the attribute's levels are univocally tied to the ones of some previously added attribute. Take, for example, two PCs that differ in two attributes, RAM size and hard disk size. The former one has two levels (128 MB and 256 MB), as well as the latter one (10 GB and 20 GB). If these attributes' levels co-vary across product variants, *i.e.* the 128 MB RAM and the 10 GB hard disk have to be purchased as a "bundle", as well as the 256 MB RAM and the 20 GB hard disk, and if RAM chip is added to the rest of the product before hard disk unit, then the hard disk insertion activity does add a product differentiating attribute but does not contribute to product variety generation.

Publications with a decision-oriented focus, in turn, do not clearly define the notion of decision concerning differentiation of products. As a result, it is not clear whether decisions on the performance of activities adding some product-specific attribute are referred or decisions on the performance of activities contributing to product variety generation. Moreover, it is not clear whether any decision on the performance of a product differentiation activity is concerned or just those decisions that necessarily require, on some periodic basis, specific predictions about product variants demand at some future time. In fact, the same decision on the performance of some product variety generating activity could be made based on periodically revised sale forecasts over a given planning horizon or could be triggered by some decision rule. The latter one is the case, for example, of a component family fabrication activity whose different possible outputs (the product-specific component variants) are all held in stock, with timing and sizing of inventory replenishment orders being triggered by the order point rule. Note that in such a case some prediction about product variants demand is still required, in order to set the reorder point, but in theory this prediction has not to be revised on a periodic basis (and it need not, indeed, if all product variants' demand distributions are stationary and perfectly known). Should decisions on the performance of the same component family fabrication activity be made based on dependent demand logic (Silver and Peterson, 1979), instead, specific predictions about product variants demand over a given planning horizon would be needed on some periodic basis. Whether form postponement deals with all decisions concerning product differentiation or just with the non-triggered ones is not immaterial, as both the amount of its benefits and the way it yields them can be different (Aviv and Federgruen, 2001a; 2001b).

To summarize, the literature review highlights that it is not clear whether form postponement deals with when product differentiation activities are performed or when decisions on the performance of such activities are made. Moreover, whatever is the perspective adopted, no precise and shared criterion exists to determine when product

differentiation takes place, which would be needed to operationalize the concept of form postponement.

1.2 The nature of form postponement and the temporal relation it implies between product differentiation and order penetration point

The ambiguities surrounding the nature of form postponement and the temporal relation between product differentiation and customer order receipt seem to stem from semantic ambiguity: to postpone an activity or a decision can mean to perform the activity or to make the decision after a given event, but can also mean to perform the activity or to make the decision later than it used to be. This could explain why some publications regard form postponement as a possible characteristic of a manufacturing or decisional process, *i.e.* a process state wherein at least one product differentiation activity or decision takes place after customer orders are received, while other works view form postponement as a change of a manufacturing or decisional process whereby at least one product differentiation activity or decision is performed or made later than it used to be.

Whether form postponement is regarded as a possible process characteristic or as a change in process characteristics has an impact on the temporal relation form postponement implies between product differentiation and order penetration point. Those works that view form postponement as a possible process state necessarily restrict it to deferring product differentiation until customer orders are received. Hewlett Packard, for example, instead of fitting 110V or 220V power supply modules into Deskjet printers at its primary manufacturing plants based on sale forecasts, shifted such operation to its distribution centers, which put together printers and power supply modules upon customer order (Lee *et al.*, 1993). Those publications that regard form postponement as a process state change, instead, can refer to it in a broader sense: as long as at least one product differentiation activity or decision takes place later than it used, no matter if before or after customer order receipt, they can still talk about form postponement. For example, Xilinx' initiative of moving semiconductors differentiation from the wafer fabrication level to the assembly level while still basing differentiation on demand forecasts, with inventory held in finished-good form, can be quoted as a case of form postponement (Brown *et al.*, 2000). On the contrary, those who regard form postponement as a process state wherein at least one product differentiation activity or decision takes place after customer orders are received, could not refer to the aforementioned initiative of Xilinx as an example of form postponement.

The nature of form postponement and the temporal relation it implies between product differentiation and order penetration point are used in Table 1 to classify the literature reviewed. A few publications are not mapped as their definitional perspective is not clear.

Table 1
Literature Classification Based on Form Postponement Nature and Temporal Relation between Product Differentiation and Order Penetration Point

	Process Characteristic	Change in Process Characteristics
Postponing At Least One Product Differentiation Activity/Decision Until Customer Orders Are Received	Zinn and Bowersox (1988), Zinn (1900), Pagh and Cooper (1998), Chiou <i>et al.</i> (2002), Graman and Magazine (2002)	van Hoek (1997; 1998; 1999; 2001), van Hoek <i>et al.</i> (1998; 1999), Jonhson and Anderson (2000)
Postponing At Least One Product Differentiation Activity/Decision Nearer To The Time When Customer Orders Are Received		Alderson (1957), Cooper (1993), Lee and Billington (1994), Brown <i>et al.</i> (2000), Hsu and Wang (2003)
Postponing At Least One Product Differentiation Activity/Decision Even Though Originally Performed/Made Upon Customer Order		Lee (1993), Garg and Tang (1997), Aviv and Federgruen (2001a; 2001b), Ma <i>et al.</i> (2002)

Four different definitional perspectives emerge. As a result of such definitional ambiguity, a shared answer to the question as to what form postponement is does not exist and a shared framework that relates form postponement to other concepts, both antecedents and consequents, is still lacking.

2. DEFINING FORM POSTPONEMENT

The two definitional issues argued in the previous section are addressed separately in the following subsections. A definition of form postponement is then proposed accordingly.

2.1 The notion of product differentiation as object of postponement

Consider a product family, which we provisionally define as a set of products offered by one company which are partly, if not fully, substitutable in their demands, possess underlying similarities in their functionality and further have the potential to share components, subassemblies, production process and sometimes even a common concept and/or architecture (Gupta and Krishnan, 1998).

In order to address the issue as to what the object of postponement is when form postponement is concerned, we distinguish between physical and decisional level. The physical level comprises all of the operations performed by the company for the product family, from sourcing through manufacturing to physical distribution. For the sake of simplicity, hereinafter we shall refer to all these activities as the production process. The

decisional level comprises all of the decisions which govern the operations performed by the company for the product family.

At the physical level we consider whatever activities have the potential to contribute to product variety generation, namely sourcing and manufacturing activities, and classify them into product differentiation related activities (PDRA) and *non*-PDRA. Any sourcing or manufacturing activity whose physical output is the same for all products belonging to the family is referred to as a *non*-PDRA, since its physical output does not relate to product variants at all. On the contrary, any sourcing or manufacturing activity whose physical output is different for at least two different products within the family being considered is referred to as a PDRA. Note that physical outputs may differ from one another in form and/or unit quantity. With regard to a PC family, for example, two different products could require the RAM sourcing activity to provide PC assembly line with two different RAM chips or with two different quantities of the same RAM chip. In both cases the RAM sourcing activity would result in different physical outputs for different PC variants and, consequently, would be a PDRA.

A PDRA is not necessarily a product differentiation activity (PDA), *i.e.* an activity that adds some product-specific attribute to a given material/subassembly. A painting activity, for example, could result in different physical outputs for different products within the family simply because the corresponding inputs are different, whereas color and paint thickness are equal. Such an activity would be a PDRA but not a PDA. In turn, as we have already seen, a PDA does not necessarily contribute to product variety generation, since two differentiating attributes could be “bundled”. Any activity adding to product variety generation is referred to as an independent product differentiation related activity (IPDRA).

By definition, a PDRA has multiple possible physical outputs, differing from one another in form and/or unit quantity. Therefore, performing a PDRA requires a decision on what physical output, in terms of both form and unit quantity, the PDRA will result in. Since different physical outputs correspond to different products (or product sets) within the family being considered, choosing one physical output is the same as deciding on which product variant(s) the PDRA will be performed for. Hence, such a decision is referred to as a product differentiation related decision (PDRD).

However, a PDRD does not necessarily involve any degree of freedom. We can distinguish three cases wherein the choice among the alternatives defining a PDRD is totally constrained. Obviously, no degree of freedom is involved in a PDRD whenever the corresponding PDRA is performed after customer order receipt. Moreover, a PDRD could be totally constrained by some previous PDRD(s), provided the corresponding PDRA(s) are linked according to dependent demand logic. Consider, for example, some products differing in only one purchased component. Should component variants be sourced based on a lot for lot ordering policy, the decision on which component variant will be fitted into the rest of the product would be totally constrained by the previous decision on which component variant will be sourced. Finally, a PDRD is totally constrained whenever it is triggered by some decision rule. Take, for example, a component family fabrication activity. No degree of freedom would be involved in the corresponding decision if all

component variants were held in stock and timing and size of their inventory replenishment orders were triggered by the order point rule.

A PDRD that involves some degree of freedom is referred to as an independent product differentiation related decision (IPDRD). Making any IPDRD necessarily requires, on some periodic basis, specific predictions about demand for products belonging to the family at some future time. A PDRD that involves no degree of freedom, instead, does not necessarily call for periodically revised sale forecasts over a given planning horizon, as it is made based on either customer orders or forecasts required by some previous IPDRD or some decision rule.

Alderson, the very father of form postponement concept, ties differentiation, in form as well as in location of the product, to marketing risk: “every differentiation which makes a product more suitable for a specified segment of the market makes it less suitable for other segments [...] Each step in differentiation is taken on the basis of some prediction concerning demand for that differentiation at some future time” (Alderson, 1957, p.424), as long as it takes place in advance of customer orders. Marketing risk relates to the reliability of such a prediction. Postponement is regarded by Alderson as an answer to planning problems: it reduces marketing risk by moving differentiation nearer to the time of customer purchase and, therefore, by shortening the forecasting horizon. From Alderson’s standpoint, hence, form postponement deals with product differentiation related decisions that are made based on periodically revised sale forecasts. To us, in keeping with this decision-oriented perspective, the objects of postponement when form postponement is concerned are the IPDRDs.

2.2 The nature of form postponement and the temporal relation it implies between product differentiation and order penetration point

Since its introduction in academic literature, form postponement has been regarded as a way of reducing, or fully eliminating, risk and uncertainty associated with product variety in a make-to-stock environment. Accordingly, we see postponement as a change in production planning process characteristics.

Ceteris paribus, demand uncertainty affecting production planning is definitely reduced whenever a firm manages to eliminate at least one IPDRD by performing the correspondent activity upon order. Note that such a result could be achieved by redesigning product and/or process and/or supply chain while delivery time is unchanged. However, the same result could be attained even though neither product nor process nor supply chain is modified, by simply making customers to give their orders earlier and, consequently, by extending delivery time.

Yet, *ceteris paribus*, demand uncertainty affecting production planning is also reduced whenever one or more IPDRDs are moved nearer to the time of customer purchase, even though they continue to be made in advance of customer order receipt and, consequently, keep on requiring, on some periodic basis, specific predictions about demand for their outputs at some future time: shorter forecasting horizons entail less forecast errors

(Alderson, 1957; Ernst and Kamrad, 2000), with a given IPDRD's forecasting horizon being its time distance from customer order receipt. It follows that causing some product variety generating activity to be performed upon order is not the only way of accomplishing form postponement. We need to define form postponement in a broader way, hence.

Pursuing this goal requires to consider the case wherein an IPDRD's move nearer to the time of customer purchase is accomplished at another IPDRD's expense: prediction horizon for the latter decision becomes longer as a result of getting the former decision's prediction horizon shorter. In order to estimate the impact of such IPDRD shifts on demand uncertainty affecting production planning, the number of sale predictions required by each IPDRD has to be taken into account, besides its forecasting horizon: *ceteris paribus*, the lower the number of sale forecasts required by an IPDRD, the larger the risk pooling and, consequently, the more accurate the forecasts (Zinn, 1990). Uncertainty affecting a given IPDRD, hence, is positively correlated with the IPDRD forecasting horizon multiplied by the number of sale forecasts required by the IPDRD, *ceteris paribus*. It follows that, *ceteris paribus*, should two IPDRD calling for different numbers of forecasts be reversed, demand uncertainty affecting production planning would decrease if operations reversal causes the IPDRD requiring fewer forecasts to take place first, it would increase otherwise.

For the sake of simplicity, we shall refer to forecasting horizon multiplied by forecasts number for a given PDA as its weighed time-distance from customer order receipt.

2.3 Unit of reference and definition of form postponement with a decision-oriented focus

From a decision-oriented perspective form postponement is a concept referred to a set of products and decisions. Yet, it is not referable to any set of products and decisions.

The unit of reference for form postponement must comprise at least two tangible products that are different in terms of form as they are delivered to firm customers but share the production process, *i.e.* require the same sourcing, manufacturing and physical distribution activities in the same sequence (except for optional activities, if any). If we consider a kitchen appliances manufacturer, for instance, the unit of reference could comprise all of the firm microwaves with a given capacity but different cooking capabilities and aesthetics, as well as the whole firm microwaves range, but not blenders too. We refer to a set of different tangible products which share the production process as a product family.

Since products belonging to a family differ from one another in form, at least one PDRA exists within the product family production process and, consequently, at least one PDRD has to be made. Yet, if none of the PDRDs involved by the product family production planning process were an IPDRD, yet, talking about form postponement from a decision-oriented perspective would make no sense. Hence, form postponement is referred to a product family whose production planning process originally involves at least one IPDRD. In keeping with the aforementioned decision-oriented perspective, the unit of reference for

form postponement must comprise all the IPDRDs originally required by the product family production planning process.

Given a unit of reference, we define form postponement as a change in production planning process such that the sum of all IPDRDs' weighed time-distances from customer order receipt is reduced, product variety within the unit of reference and manufacturing planning and control system being equal.

Note that, should a company manage to replace all of the product variants belonging to a given family with only one product which has built-in capabilities to handle the same range of customer requirements, this would be called standardization, not form postponement: from an operations viewpoint the product variety being offered by the firm would not be generated at a later time, it would be just less. By the way, any product differentiation activity performed by customers falls outside the boundaries of the unit of reference, as it does not require any product differentiation related decision to be made by the company.

REFERENCES

- Åhlström, P. & Westbrook, R. 1999. Implications of mass customization for operations management, International Journal of Operations and Production Management, Vol. 19, No. 3, pp. 262-274
- Alderson, W. 1950. Marketing Efficiency and the Principle of Postponement, Cost and Profit Outlook, Vol. 3, September, pp. 15-18
- Alderson, W. 1957. Marketing Behavior and Executive Action, Richard D. Irwin Inc., Homewood, IL
- Aviv, Y. & Federgruen, A. 2001a. Capacitated Multi-Item Inventory Systems with Random and Seasonally Fluctuating Demands: Implications for Postponement Strategies, Management Science, Vol. 47, No. 4, pp. 512-531
- Aviv, Y. & Federgruen, A. 2001b. Design for postponement: a comprehensive characterization of its benefits under unknown demand distributions, Operations Research, Vol. 49, No. 4, pp. 578-598
- Bowersox, D.J. 1995. World class logistics, the challenge of managing continuous change, Council of Logistics Management, Oak Brook, IL
- Bowersox, D.J., Stank, T.P. & Daugherty, P.J. 1999. Lean Launch: Managing Product Introduction Risk Through Response-Based Logistics, Journal of Product Innovation Management, Vol. 16, No. 6, pp. 557-568
- Brown, A.O., Lee, H.L. & Petrakian R. 2000. Xilinx Improves Its Semiconductor Supply Chain Using Product and Process Postponement, Interfaces, Vol. 30, No. 4, pp. 65-80
- Bruce, L. 1987. The Bright New Worlds of Benetton, International Management, November, pp.24-35
- Chiou, J., Wu, L. & Hsu, J.C. 2002. The adoption of form postponement strategy in a global logistics system: the case of Taiwanese Information Technology industry, Journal of Business Logistics, Vol. 23, No. 1, pp. 107-124
- Cooper, J.C. 1993. Logistics strategies for global businesses, International Journal of Physical Distribution and Logistics Management, Vol. 23, No. 4, pp. 12-23
- Ernst, R. & Kamrad, B. 2000. Evaluation of supply chain structures through modularization and postponement, European Journal of Operational Research, Vol. 124, No. 3, pp. 495-510
- Feitzinger, E. & Lee, H.L. 1997. Mass customization at Hewlett Packard: the power of postponement, Harvard Business Review, Vol. 75, No. 1, pp.116-121
- Garg, A. & Tang, C.S. 1997. On postponement strategies for product families with multiple points of differentiation, IIE Transactions, Vol. 29, No. 8, pp. 641-650
- Graman, G.A. & Magazine, M.J. 2002. A numerical analysis of capacitated postponement, Production and Operations Management, Vol. 11, No. 3, pp. 340-357
- Gupta, S. & Krishnan, V. 1998. Product family-based assembly sequence design methodology, IIE Transactions, Vol. 30, No. 10, pp. 933-945

- Heskett, J.L. 1977. Logistics – Essential to strategy, Harvard Business Review, Vol. 55, No. 6, pp.119-126
- Hsu, H. & Wang, W. 2003. Dynamic programming for delayed product differentiation, European Journal of Operational Research, Vol. 156, No. 1, pp. 183-193
- Johnson, M.E. & Anderson, E. 2000. Postponement Strategies for Channel Derivatives, International Journal of Logistics Management, Vol. 11, No. 1, pp. 19-35
- Lee, H.L. 1993. Design for supply chain management: concepts and examples, in Sarin, R. (Ed.), Perspectives in operations Management, Kluwer, Norwell, MA, pp. 45-66
- Lee, H.L. & Billington, C. 1994. Designing Products and Processes for Postponement, in Dasu, S. and Eastman, C. (Eds.), Management of Design Engineering and Management Perspectives, Kluwer Academic Publishers, Boston, MA, pp. 105-122
- Lee, H.L., Billington, C. & Carter, B. 1993. Hewlett-Packard Gains Control of Inventory and Service through Design for Localization, Interfaces, Vol. 23, No. 4, pp. 1-11
- Ma, S., Wang, W. & Liu, L. 2002. Commonality and postponement in multistage assembly systems, European Journal of Operational Research, Vol. 142, No. 3, pp. 523-538
- Olhager, J. 2003. Strategic positioning of the order penetration point, International Journal of Production Economics, Vol. 85, No. 3, pp. 319-329
- Pagh, J.D. & Cooper, M.C. 1998. Supply chain postponement and speculation strategies: how to choose the right strategy, Journal of Business Logistics, Vol. 19, No. 2, pp. 13-33
- Pine, J.B. II 1993. Mass Customization – The New Frontier in Business Competition, Harvard Business School Press, Boston, MA
- Rungtusanatham, M. 1999. Let's not overlook content validity, Decision Line, Vol. 29, July, pp. 10-13
- Silver, E.A. & Peterson, R. 1979. Decision Systems for Inventory Management and Production Planning, John Wiley & Sons, New York
- Van Hoek, R.I. 1997. Postponed manufacturing: a case study in the food supply chains, Supply Chain Management, Vol. 2, No. 2, pp. 63-75
- Van Hoek, R.I. 1998. Reconfiguring the Supply Chain to Implement Postponed Manufacturing, International Journal of Logistics Management, Vol. 9, No. 1, pp. 95-110
- Van Hoek, R.I. 1999. Postponement and the reconfiguration challenge for food supply chains, Supply Chain Management, Vol. 4, No. 1, pp. 18-34
- Van Hoek, R.I. 2001. The rediscovery of postponement: a literature review and directions for research, Journal of Operations Management, Vol. 19, No. 2, pp. 161-184
- Van Hoek, R.I., Commandeur, H.R. & Vos, B. 1998. Reconfiguring logistics systems through postponement strategies, Journal of Business Logistics, Vol. 19, No. 1, pp. 33-54

Van Hoek, R.I., Peelen, E. & Commandeur, H.R. 1999. Achieving Mass Customization Through Postponement: A Study of International Changes, Journal of Market Focused Management, Vol. 3, pp. 353-368

Waller, M.A., Dabholkar, P.A. & Gentry, J.J. 2000. Postponement, product customization, and market-oriented supply chain management, Journal of Business Logistics, Vol. 21, No. 2, pp. 133-159

Yang, B. & Burns, N. 2003. Implications of postponement for the supply chain, International Journal of Production Research, Vol. 41, No. 9, pp. 2075-2090

Zinn, W. 1990. Developing Heuristics to Estimate the Impact of Postponement on Safety Stock, International Journal of Logistics Management, Vol. 1, No.2, pp. 11-16

Zinn, W. & Bowersox, D.J. 1988. Planning physical distribution with the principle of postponement, Journal of Business Logistics, Vol. 9, No. 2, pp. 117-137

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