Product Platform: its strategic implications

Kwok L. Shum

Abstract: Firms often find it necessary to offer variety of products in order to compete in existing and emerging product market segments. The extreme requirement of this trend is that of mass customization. An important principle is to mitigate costs due to variety and manage complexity in order to achieve efficiency level similar to that of mass production. A systematic and fundamental strategy to achieve mass customization at an efficiency level is through the method of product platform. We propose a conceptual model of a product platform to suggest some normative principles for implementing variety or mass customization system.

This formulation takes into account explicitly the production and market interaction of derivatives from a product platform; we find that a platform – based firm needs to leverage upon economies due to cross learning to make sure that increasing number of differentiated derivatives will increase aggregate installed base and help lower production cost while achieving product differentiation or even customization. Cross learning among customized offers or derivatives is analogous to and takes a similar role to volume – based learning in the mass production regime.

Beyond product development, from a strategic management perspective, product platform can be seen as a synthesis of firm's intangible competencies such as market insights, product technology, production technology and organizational capability to address market opportunities. In the competency domain, platform – based firm must focus on managing its production and organizational capabilities in order to pursue a variety strategy; otherwise, it should emphasize market insights and product technologies if it is to pursue a fixed variety priority. A strategic focus therefore emerges.
Product Platform:

[Mass] Customization is an important emerging business agenda and management paradigm. Mass customization roughly corresponds to producing customization products for the mass at an efficiency level close to that of mass production of relatively standard products. If successfully implemented, mass customization resolves the dichotomy of cost and differentiation. We can roughly divide the mass customization literature into the front – end or back – end. Front-end literature concerns how to incorporate customer preference into the production process. This literature is best summarized by the notion of a customer – centric enterprise [Tseng and Piller 2001] and is enabled by concepts such as users’ innovation toolkit [Franke and Piller] in which customers are actively involved to participate in the product development process to the extent that the innovation locus may shift to the users. Backend literature is predominantly concerned with the implementation or execution aspect. [Jiao, Tseng and Lin 1998] suggested the application of product platform to enable a mass customization regime. However, there are as yet normative principles for the management of a platform – based operations infrastructure.

A product platform is a product architecture addressing an underlying specific product design problem. The problem is decomposed, via an interface schema, into several sub-problems each in turn is solved by an underlying element or solution module. These technology modules, to be reused, mixed and matched and augmented with specific features, can be used to address more specific variants of the original problem leading to variety of offers. Product platform is therefore an effective variety generation mechanism that allows leverage of modularity and components commonality to address differentiated opportunities or market niches for a broad market segment. Existing literature of platform all focus on static formulations that give rise to [static] economies of scope due to reuse of platform assets among product derivatives.

Competencies formulation of product platform:

Beyond product development, from a general management and competitive perspective, Meyer and Utterback [1993] suggested that platforms are themselves the applied result of a firm’s broader and more durable core capability. Based upon this conception of platform, Meyer [1999] suggested the platform as a coupling device to connect and convert a firm’s competencies to address market opportunities. These competencies are: market insights, product technology, production processes and technologies and organizational capabilities and infrastructure [Figure 1]. As firm pursues variety or mass customization competitive strategy, it is important to understand if a particular set of competencies will be more important than the other for strategic focus.
This short paper proposes a conceptual and integrated model of product platform that goes beyond static economies of scope and captures explicitly as well the market and production interaction of products from the platform. Taking into the process aspect of a product platform, we strive to discover a *global* picture of a product platform and derive the normative and strategic implications of competing using a product platform.

**A conceptual model of product platform:**

We conceptualize a platform as an upstream vs. downstream configuration. The product platform is a general architecture and is an entity or a meta – product, the technology level of which can be *continually* extended or improved upon via an active research program in the upstream. The family of product derivatives generated by this platform can also be viewed as a collective. There is a product manager managing the design and production of these derivatives from the platform. The derivatives, sharing the same architecture, are related in two ways. 1) They all compete with each other in the product markets. 2) They are manufactured by the same production process.

We adopt a general systems theory [von Bertalanffy] perspective to consider the platform entity and the collective set of derivatives jointly as well as their explicit relationship. Such a systemic or comprehensive perspective is also encouraged by [Abernathy and Utterback 1971] when they first proposed a *productive unit*, as a unit of analysis used in the context of the study of pattern of industrial innovations of firm, should include both the product and the processes aspect of the firm.
Market interaction of product derivatives:

Even though these derivatives address different niches in the same broad market segment, these niches may overlap. We assume that these derivatives compete with each other in the product markets [Figure 2].

![Figure 2: Price level differentiation of derivatives in the product market. Derivatives compete with each other on each inverse demand curve.](image)

Note that the demand curve of each of the product derivative is assumed to be linear [for mathematical tractability] and downward sloping, suggesting that each product has some market power over the other products from the same family despite that they compete with each other. This gives the model a monopolistically competitive favor. [Vertical] product differentiation is modeled in two ways. First, each product faces a different demand curve characterized by a different level of choke price\(^1\). Second, along a given demand curve for a particular product from the family, its price will be more elastic to change of its own production volume than those from the others. The manufacturing of these derivatives by a similar process allows manufacturing [cost] learning of a product from its own production and those of the others.

Production interaction of product derivatives [Learning in product platform organization]

Since these derivatives are to be manufactured by the same general production process, we aim to address an important dynamic efficiency potential and inherent in the production operations within a platform – based firm, but that received scant attention in the literature. Drawing upon existing learning curve and progress function literature which is geared towards learning within a product, we suggest that since the derivatives are generated from the same platform, there exists a tremendous opportunity for cross [cost] learning

---

\(^1\) A choke price is the price at which its demand is zero. A higher choke price can be interpreted as that the product has a higher inherent quality. This feature suggests that different products can be ranked in terms of the choke price each commands.
among these products. Production learning garnered within one product is readily applicable to other members in the product family and vice versa in the platform context. This cross learning effect will enable each product to travel down its own [self] learning curve faster. Developing products from a common platform therefore provides this additional dynamic learning advantage. As we will argue later, firm must have the ability to leverage this potential in order to achieve positive return to variety \(^2\) enable mass customization.

**Patterns of innovation in a platform – based firm:**

Without loss of generality, three types of innovations are featured in a product platform:

1) Demand enhancing innovations at the upstream level. We assume that continual platform improvement and extension along platform’s vector of differentiation [McGrath 2001] will create additional demand for all the derivatives in the downstream. This mode of innovation is costly, dependent upon the product technology that is used to build the platform and its constituent modules.

2) Product differentiation at the downstream derivative level. Product innovation at this local level leading to specific features in the derivative will create demand for the particular derivative only.

3) Cost reducing process innovation during production of derivatives at the downstream derivative level. These process innovations refer to volume driven autonomous learning by doing and explicit managerial efforts geared towards induced learning [Alder and Clark 1992] and take place within a product line and across product lines.

It is important to understand that both cost reduction and demand enhancing are innovation goals in the upstream and downstream. However, we argue that innovation at upstream should be more geared towards the demand enhancing aspect because the specific applications from the platform and the associated production processes are not well defined as yet. In addition, emphasizing cost reduction in such an early stage of product development will necessarily rule out later features possibilities.

On the other hand, as more focused applications are defined and developed in the downstream, innovations at the downstream can be targeted towards more upon cost reducing, continual and incremental process innovations. We therefore postulate a “sand-cone” model of innovation in the context of product platform; i.e. demand enhancing innovation at the upstream product platform and cost reducing process and minor local product innovation at the downstream product derivative level. The sand-cone model is developed by Ferdows and De Meyer [1990] and others as they postulated in the build up

---

\(^2\) Positive return to variety concerns about increase of aggregate installed base with addition of more differentiated variety. Note that increase of aggregated installed base or volume will drive down unit cost of production via cross – learning effects.

\(^3\) This is an important advantage of modularity and reusability. If a module within a platform is improved, all the products using this particular module will have their demands increased. In essence, there will be a multiplier effect. It is important to understand that this means the effect of platform extension is non – rivalries. This suggests that platform strategy has similar characteristics to knowledge – based economy.
of manufacturing capabilities, there is a hierarchy among capabilities such as cost, quality, dependability etc. and that capabilities higher in the hierarchy build upon those lower in the hierarchy. From an operations standpoint, manufacturers must first improve quality first and continue this effort before also engaging in improvement of cost. Here, we apply the same logic to understand and focus firm’s innovation efforts at the different stages of the platform process.

**Business model of the platform – based firm:**

We assume that production learning in the downstream will generate excess resources that will be diverted back to the upstream for further improving and extending the technology of product platform. This assumption is compatible to any financing mechanism in which R&D spending is proportional to sales or production volume. An endogenous mechanism [Figure 3] sustaining the production learning in downstream and extension of platform in the upstream perpetuates the growth of firm within its chosen segments and niches till it reaches a steady state, the stage of product life cycle at which the demand growth of the products and the production learning are concluded.

![Figure 3: Continual interaction between upstream platform extension and downstream production learning within a product platform structure.](image-url)
Mathematical formulation of the product platform:

**Platform innovation program objective in the upstream:**

\[
\text{Max. } \sum_{i \in \mathcal{I}} q_i z_{i+1} \left( \sum_{j \in \mathcal{J}} \rho_j q_{j, i+1} \right) - z_{i+1}^2
\]

\[
\text{s.t. } z_{i+1} > 0
\]

where \( z_{i+1} \) is the instantaneous improvement in the platform technological index
and \( \rho_j \) is a proportionality constant for the contribution of diversion of the \( i \)th derivative.

We will assume all the \( \rho \)'s to be equal. Note that the first term in the objective can be regarded as an income the platform objective receives from the product lines in the downstream. The functional form of this objective captures the assumption that the higher the expected sales of product lines and the expected improvement in the platform, the larger will the appropriation be. The cost of innovation is assumed to be quadratic. \( \alpha \) can be interpreted as an efficiency coefficient for the innovation upstream. Note that marginal cost of innovation is steadily increasing. \( \alpha \) may be dependent upon the current technology level of the platform due to that the higher the existing [cumulative] technology level, the more difficult it may be to innovate further. We ignore this saturation or diminishing return effect for mathematical tractability\(^4\).

**Product manager profit program in the downstream:**

\[
\text{Max. } \sum_{i \in \mathcal{I}} \left( c_i y_i + \sum_{j \in \mathcal{J}} \left( \sum_{z=0}^{\tau-1} \sum_{j \neq i} q_{j, i+1} \right) \right) - \sum_{j \in \mathcal{J}} \left( c_j - \lambda \sum_{z=0}^{\tau-1} q_{j, i+1} \right) - \sum_{j \in \mathcal{J}} \sum_{z=0}^{\tau-1} \mu q_{j, i+1} q_{i, i+1}
\]

\[
\text{s.t. } q_{j, i+1} \geq q_{i, i+1} \quad \forall i = 1 \rightarrow n
\]

The last constraint is due to that the demand is expanding before the products reach equilibrium. The structure of the objective is intuitive but notation cumbersome. The product manager optimizes all the product line output decisions. The first three terms represents the instantaneous choke price for the \( i \)th derivative. The next term describes the downward sloping part with respect to its own instantaneous production and those of the other. We have therefore assumed a downward sloping demand curve for all the products suggesting the firm has market power.

The next three terms bracketed constitute the unit production cost and learning dynamics. This cost learning formulation is adapted from Tirole and Fudenberg [1983] and DasGupta and Stiglitz [1988]. The parameter \( \lambda \) represents the learning effectiveness of a product from its own production and \( \mu \) represents its cross learning effectiveness from others' production. Note that instantaneous cost learning in downstream is not dependent upon all

---

\(^4\) An obvious complication is the resultant non-linearity of the dynamic system.
the cumulative production; instead it is only dependent upon the immediate past \( m \) periods. This is due to the fact that earlier production may not be relevant for current learning due to the continual extension of the product platform. This “sliding window” of learning can also capture any forgetting effects in learning.

An important feature to be noted is that the instantaneous improvement of the platform \( z_{j+1} \) will have an effect to shift all the inverse demand curves of the product derivatives in the downstream \textit{outward} by an amount of \( \psi_{j+1} \), in their respective instantaneous choke prices. This therefore will increase the instantaneous demand or sales for each of the product, at a given price. On an equal note, the amount of finance the platform objective received is proportional to the aggregate of the instantaneous sales from the derivatives. These interdependencies between upstream and downstream constitute the endogenous close loop in Figure 3.

\textbf{Analytical results:}

Since the objectives are both convex, first order necessary conditions are optimal and global. The resultant steady state of the aggregate output from the product family is:

\[
\lim_{t \to \infty} \sum_{j=1}^{n} q_{j,t} = \frac{(a-c)}{2bn - np\psi - mG} \left( \frac{n(n+1)}{2} \right) = \bar{Q} \text{ (say)}
\]

with the assumption that \( a_i = ia; \ c_j = ic \) where \( a, c \) are base values. Assume \( a > c \), otherwise the firm will not have an incentive to produce due to profit loss at the start. The derivatives in the downstream are linearly differentiated in terms of the choke price and the level of unlearned unit cost of production. Intuitively, the larger the magnitude of these two parameters \([a \text{ and } c]\) associated with a derivative, the higher the quality of the derivative. These two parameters therefore model \textit{vertical product differentiation} among derivatives. \( G = \lambda + (n-1)\mu + n\theta \). Therefore, in essence, \( G \) captures the learning or path dependent historic effects in the system. The larger this value, the stronger the current action is dependent upon those in the past in the downstream aspect of the product platform.

\textbf{Variety as a competitive priority:}

If the firm is interested to increase the number of derivatives, \( n \), and get an increase in the aggregate installed base, the conditions are given as:

\[
\frac{\partial \bar{Q}}{\partial n} > 0 \Rightarrow \mu > \lambda - \frac{n^2(a-c)}{m\bar{Q}}
\]

\(^5\) If we introduce a lag structure into the effect of platform improvement, the dynamic trajectory or steady state of the sales will change. However, our results which are based on the comparative analysis of steady state remain unchanged.
This is perhaps the singular most important result of this model. The advantages of using a product platform are usually attributed to the reuse of product assets without a good understanding of the competition among the market and production interaction of the products. This is a serious analytical deficiency: if the establishment of a platform encourages the generation of variety, how can our understanding of product platform be complete if we do not know how those derivatives will interact?

However, this requirement takes into account the interaction of the derivatives in the market and asserts that there must be an accompanying process capability, or production interaction among variety, in order that variety is a viable strategy. Since the cross-learning effectiveness parameter, $\mu$, is assumed to be smaller than [since other products' production may be less relevant to a product's own production for contribution to its own learning] $\lambda$, this suggests that the validation of this inequality will depend upon the magnitude of the minus term in the right hand side. Note that, this minus term can be regarded as a softening effect on cross learning required for positive return to variety and that the magnitude of this term increases the more differentiated the derivatives are. If a production technology is such that $\mu = \lambda$, the inequality will hold unconditionally. According to this inequality, growth of aggregate installed base, via addition of increasingly differentiated variety, depends upon only the production technology in the downstream. Process innovation in the downstream seems to be an important and dominant determinant to positive return to variety. The managerial implications will be discussed below.

**Fixed variety as a competitive priority:**

If the firm decides to use a fixed variety as its strategy; it must focus on creating a bigger market for its existing family. Increasing the parameter $\psi$ will therefore help. Performing a comparative static analysis on this parameter leads to:

$$
\frac{\partial Q}{\partial \psi} = -\frac{2Q}{(n+1)(a-c)} \left( \frac{\rho}{2\alpha} \right)
$$

The term above is positive thus verifying our intuition that increasing $\psi$ will lead to an increase of the aggregate installed base with a fixed family set. However, the magnitude of this increase is modulated by the parameter $\alpha$, which is nothing more than the efficiency of platform innovation in the upstream. Again this rate of increase of the aggregate installed base is independent upon process related effectiveness in the downstream. We therefore can assert that if the firm is interested to compete using a fixed strategy, it should focus on improving the efficiency of extending the product platform. On the other hand, if it is to compete with increasing variety, it should focus on organizing production in the downstream for cross-learning among derivatives. We summarize the above results in the following table:
Innovations ↓ Firm strategies→ Variety / Mass Customization strategy Fixed variety strategy

| Platform differentiation at the upstream level | √ | √√ |
| Product differentiation at the downstream derivative level | √√ | √√ |
| Cost reducing process innovation at the downstream derivative level - cross learning | √√ | √ |

Table 1: Summary of innovation requirements for different competitive priorities of a platform – based firm [√ - emphasize less; √√ - emphasize more]

**Competitive implications of variety strategy:**

We assume a platform – based firm can pursue either a fixed family strategy or a variety strategy, i.e. by adding product derivatives or pursuing a broader product line. From a competitive standpoint, to pursue a variety strategy, cross production cost learning across product lines is a key determinant to positive return to variety. Positive return refers to growth of aggregate installed base of the whole product family with respect to growth of increasingly differentiated derivatives. Cross learning, in terms of the familiar learning curve framework, refers to the applicability of other products’ production [volume] to a given product’s cost learning purpose.

One way to achieve this is through flexibility of machinery. Product flexibility in manufacturing process technologies such that change over and set up are minimal with respect to change in production of different models allows workers or operators to transfer what they learn in one product to others. Smoothness of transition or uniformity of production environment allows operators to do just that. Other mechanisms that foster cross learning may be due to adoption of a process focused factory [Hayes, Wheelwright and Clark 1988], rotation of work forces, information technologies and infrastructure that allow sharing and dissemination of information and an organizational structure that allows horizontal information transfer.

In general, this cross learning requirement also motivates a microscopic framework for transfer of knowledge, or [production] knowledge management, among product lines from a product platform. One viable framework is that from Dixon [2000]. She suggests different transfer mechanisms for different types of knowledge:

- Serial transfer - same knowledge transferred to different setting
- Near transfer - explicit knowledge transferred to a similar setting
- Far transfer - tacit knowledge from a non-routine task to be transferred to other teams doing similar work
- Strategic Transfer - collective knowledge needed to accomplish a strategic task occurring infrequently but of critical importance
• Expert transfer - technical knowledge needed in special expertise distributed in individuals throughout an organization

A proper knowledge transfer mechanism in the context of product platform to enable cross-learning is a future research topic relevant to mass customization, along with a normative framework of learning as suggested earlier.

**Competitive implications of fixed family [variety] strategy:**

In this scenario, firms must create a bigger market for its [fixed] product family. Firm must from the outset pursue differentiation of the platform. A clear understanding of the market requirements in the broad market segment must be secured and a clear vector of differentiation for the platform defined. Relative importance of the modules making up the platform can be determined by standard techniques such as conjoint analysis. In addition, continual extension of the platform will play a major role in this strategy. Efficiency in innovation ($\alpha$) of the upstream platform or its extension will modulate the market creation effect of platform extension.

It is interesting to supplement our results with the generic pattern of product competition from Sanderson and Uzumeri [1997]. They proposed a framework that juxtaposed product variety of product designs against the rate of serial change of product designs. This leads to four modes of product competition as shown in Figure 4. In our model, a firm that emphasizes a fixed variety strategy must continually extend the platform which will lead to continual serial changes of existing products. This strategy of competition may involve techniques such as product versioning in order that continual demand can be generated over a fixed portfolio. Note that the original meaning of versioning, in the context of product strategy for information products is that information product producers should offer different versions of products for maximum price differentiation among different types (willingness to pay) customers. Here, the versioning is not with respect to width of product line but more with respect to upgrade of existing products due to continual platform extension along the time line. Technically, we can call this a dynamic versioning strategy and may be the result of evolving interface management or configuration management rooted in the platform upstream.

On the other hand, if a firm is to compete in terms of variety, the other aspect in the generic product competition framework, it must rely on production knowledge organization, information system and date integration so that new products can reuse existing knowledge and benefited from intentional spillover learning. Data integration is usually discussed in the context of collaborative manufacturing or commerce [McClellan 2003] or in terms of product life cycle management. Combining both, it suggests the establishing of an integrated and collaborative architecture that supports remote access of the distributed and heterogeneous real time product production data across internal and external customers, suppliers across the extended enterprise implement-able by a CORBA integration framework. However, existing integration literature does not address integration of production
data across different products. It mostly addressed integration within a product along the supply chain and across stages of its own life cycle. Future works must investigate integration across product lines to enable cross – learning, maybe possibly with respect a normative learning behavior model such as pattern recognition [von Hippel et. al. 1997]. This cross – learning, if strong enough, can partially offset some of the cannibalization effects of old and new products. Our model therefore describes in more refined details the underlying enablers of the generic product competition framework.

Figure 4: The two dimensions of a generic pattern of product competition. Reprinted from Sanderson and Uzumeri [1997]

Effect of product [derivative] differentiation:

Product derivative [vertical] differentiation plays several roles in the context of product platform. First, the larger the number of differentiated offers, the larger the aggregate installed base the family will be able to sustain even though these offers compete with each other. Second, derivative differentiation will soften cross learning effectiveness necessary among derivatives in order for positive return to variety. Third, derivative differentiation will modulate the effectiveness of platform differentiation in creating demands for derivatives. Therefore, for a firm to use a product platform, a complementary strategy must be the differentiation of the derivatives downstream no matter what competitive priority it is going to pursue.

Strategic focus:

Content of competencies making up a product platform: [Meyer 1999]

1) Market insights – set of competencies that include the perception and understanding of the needs of customers.
2) Product technologies – set of competencies that are the core assets that are integrated and used to build sub-systems of the firm’s platform.

3) Production processes and technologies – set of competencies that provide the basis of cost leadership and are the process [downstream] elements of a platform.

4) Organizational capabilities – the set of competencies in managing distribution channels, customer support and information systems or its capability to manage and plan its supply chain.

From the analytical result, we here attempt mapping different competencies necessary to enable different competitive priorities such as a variety strategy or [relatively] fixed variety strategy.

**Mapping** different mentioned competencies to different firm strategies:

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Variety / Mass Customization Strategy</th>
<th>Fixed variety strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market insights</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Product technologies</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Production processes and technologies</td>
<td>√√</td>
<td>√</td>
</tr>
<tr>
<td>Organizational capabilities and infrastructure</td>
<td>√√</td>
<td>√</td>
</tr>
</tbody>
</table>

Table 2: Summary of competencies requirements for different competitive priorities of a platform-based firm [√ - emphasize less; √√ - emphasize more]

**Relating to some mass customization literature:**

Our variety prescriptions must be evaluated in light of the production requirements in the mass customization paradigm. Pine [1993] proposed that in mass customization, individual offers flow from flexible, long-term and stable production processes. The same processes are used to manufacture a new stream of products, each at a smaller lot. Volume based learning is foregone and must be replaced or compensated by some other form of economies. We propose that cross production learning among derivatives should be such a mechanism in order to expedite cost learning.

Another useful conceptual framework to understand how cross - learning is achieved is that of notion of functional variety and technical variety [Tseng and Jiao2001]. In order to facilitate cross - learning, the least amount of technical or process variety in manufacturing must be used to address the most functional variety as originated from sales and marketing. It is important to emphasize that, the continual attenuation or filtering of variety from sales and marketing to manufacturing passes through several intermediate steps and is constrained by configuration and differentiation requirements. But once the platform or commonality among different products has been established, the source of efficiency is driven by that of cross [production] learning among derivatives and is the wholesome responsibility shared by all between where production takes place and along all the partners in the supply or value chain [Figure 5].
Summary:

In this paper, we have proposed an original and conceptual model of a product platform at the firm level. Using a mathematical dynamic formalism and by explicitly modeling the market interaction and production interaction among derivatives from a product platform, we prescribe that cross learning among derivatives generated from a product platform is an important enabling factor for positive return to variety. Cross learning is the core mechanism for any mass customization systems to achieve product differentiation at a cost similar to mass production efficiency.

Dynamic cross learning stresses to pro-actively extract and transfer design and production knowledge distributed in the family of products from production floor to supply chain. A firm must have this knowledge, process and organizational capability to benefit from variety or mass customization based on the application of a product platform. In other words, firms must have this cross-learning or knowledge transfer capability in order that traditional static economies of scope provided by reusing platform assets can be realized. On the other hand, if the platform-based firm resort to use a fixed family to compete, it must focus on creating a bigger market [pie] for its family by using the most efficient product technology and extending the technology level of the platform along a clear vector of differentiation. We therefore have attempted to provide a theory of strategic management of product platform for mass customization.

Our dynamic model advances our current understandings of the economies of a product platform, from its static advantages of economies of scope to cross learning among product derivatives or dynamic economies of scope. Future works may consist of conducting case studies of platform – based firm to validate or modify the proposed results. In addition, it is instructive to study what industries or products are best described by this model: complicated products or those that involve simple assembly.

The essence being that production of derivatives that require simple assembly steps is very similar to production of a homogenous commodity, cross learning is not challenging and the key source of economy may be due to components commonality. On the other hand, to achieve mass production efficiency for more complicated or technologically intensive derivatives, efficiency due to component commonality may be insignificant and
Cointegration is paramount to achieving mass production level efficiency. In general, we hope that our analysis here opens up a more fundamental research issue in mass customization in terms of different principles to achieve mass production level efficiency for different complexity products.

Critique:

There are several important topics related to product platform that we have not captured in this model: first we transcend the arguments whether a firm should pursue a broader or narrower product line. In fact there are theories that argue for each strategy. In this paper, our position is to decide which aspect of the platform or which subset of competencies should a firm focus if it is to pursue different priority. In fact, we think that during the life cycle for a product platform or the evolution of the market place, a firm may need to use both strategies in different contingencies and during different stages of a platform life cycle.

Second, we have not addressed the economist's favorite concern of optimal variety or number of derivatives. To determine this, an equilibrium condition must be associated. One possible suggestion is to incorporate a congestion effect in the cross-learning effectiveness in terms of number of derivative. The most number of derivatives that will make \( \frac{\partial Q}{\partial n} \) positive can be regarded as the maximum number of derivatives. More generally, if fixed costs with respect to variety are included, the optimal variety can be solved as a two-stage game problem with the above model incorporated in the second stage.

Third, but not the least, we have not addressed the trade-off issue of product differentiation using common modules or components. Our model shows the critical role of product differentiation in lowering cost via cross-learning, a more fundamental and interesting proposition. Interested readers can consult [Desai et al. 2000] and Muffato and Roveda [2000] for their approaches to address the trade-off.
References:


