Product Design in the Age of Variety

Consumers want more variety than ever before. This means product design needs to be rethought to avoid multiple and costly production lines.

In any supermarket or retail store these days, the amount of product variety is tremendous, nearly overwhelming. What is the cost of our need for choice and how can it be mastered?

In our paper, **The Impact of Product Variety on Logistics Performance**, the late Professor Xavier de Groote and I found when a production line must incur non-negligible set-up time switching from one product to another for a given amount of products, the lead time to bring the product to market increases significantly, adding to costs and making products less profitable. We found that the increase in lead times is linear (and not as the square root of the number of products) due to the loss of the pooling effect. The pooling effect occurs when the overall demand for a product is spread over multiple locations or multiple models/versions at different times and high demand in one is generally offset by low demand in another. Pooling can be physical (consolidating all local inventory in a single regional platform), information-based (allowing horizontal transhipments across various demand points) or product-based (designing a common platform that can be specialised to a particular end product through delayed customisation).

Every time a factory switches products, it loses capacity, time and, ultimately, profit. When, however, the design of the production process is incorporated with the design of the product(s) and of the supply chain, as taught at INSEAD, cost increases can be tamed.

Many milk products

In order for producers of multiple products to beat the linear increase in time and cost, they must turn towards operational flexibility. Operational flexibility is an organisation's ability to change or react with little cost in time and effort to the changes in customer preferences.

For example, **dairy producers** have managed to create a production line for which there is virtually no switchover time, and the increase is therefore not linear. They collect the milk, then run tests to ensure the milk is bacteria-free and there are no traces of antibiotics. The raw milk then enters a centrifuge at the processing facility to separate the cream from the "milk water". Next, depending on what is needed for that day, for a given variety (full-fat, 1 percent, 2 percent), it literally takes 10 seconds to switch the dial to one of the options and then the milk is remixed. The dairy producers can then switch to the next variety of milk needed, again with a very short changeover time.

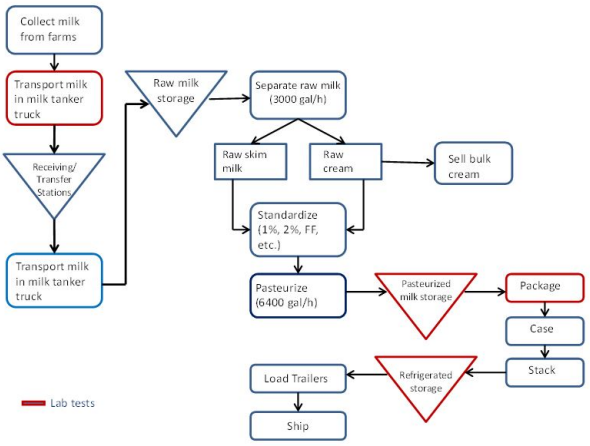


Figure 2. Fluid Milk Processing

The product as a platform

Incorporating operational flexibility in different sectors is not as easy as turning a valve for a new variety of milk.

For clothing manufacturers, producing a small number of a variety of items with very little switchover can then generate the same economies of scale.

In fact, when fast fashion giant **Zara** creates a new look, it doesn't just design a single article, it designs a platform. It designs a shirt but makes non-structural modifications to the shirt – with or without pockets, with a zipper or with buttons, long-sleeve/short-sleeve. Once the base design is created, Zara introduces many versions of an item and depending on the reaction from the market, it responds to customer needs and switches over production to the popular item extremely quickly. Within 72 hours, the new version is on the shelf.

Once it has discovered the best-selling version of the shirt model, Zara has its network of local mom-and-pop garment factories produce more of that particular item. The company signs a blanket contract for aggregate capacity with the small producers for the year, but the consumption of that capacity is dependent on the actual sales. As a result of this agility, it is no longer necessary to store large quantities of finished items.

Further theory

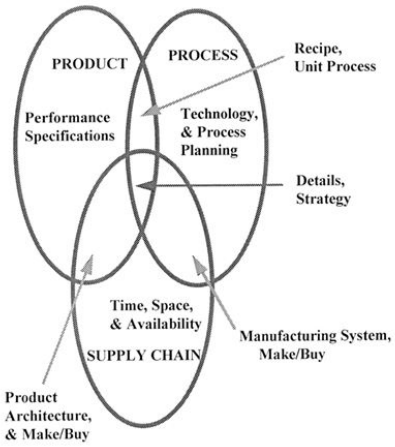
Our paper can also be viewed within the context of a formal theory, the so-called polling system.

Rather than having a single queue and a single server, this model includes multiple queues that represent different products – each queue is a different variety of the product. The server arrives at the first queue, incurs a setup time and can perform gated service or exhaustive services. Gated service is first-come, first-served around all the queues. Exhaustive service clears each queue before moving on to the next one. The so-called polling system within queuing theory analyses this idea and finds the same linear relationship between product variety and the associated costs that we found in our paper.

Operational flexibility from day one

In our paper, the experiment itself was a simulation model, validated with data. We ran individual experiments to test the robustness of the analytical model to determine whether linear growth was an artefact of our stylised model or a more general type of phenomenon. We confirmed that it was indeed a general phenomenon and then checked our findings against the data from the **Best Factory Award**. We propose operational flexibility as a solution.

Taking this flexibility further, Professor Charlie Fine at MIT created a 3D concurrent engineering (**3D-CE**) framework – showing that product, process and supply chain should all be created together from the design stage.



(Source: Fine, Clockspeed)

In order to facilitate a transition from one type of product to the next, one has to actually design the product, the process, and the supply chain simultaneously to achieve optimal operational flexibility.

Organisations must design new products along the three dimensions of product/process/supply chain. When designing the product itself, include the manufacturing process and the supply chain network in an end-to-end fashion. The alternative of designing the product, then handing it over to the manufacturing department, which then hands it over to the supply chain team leads to constraints every step of the way.

In pharmaceuticals, for example, redesigning a

process within the 3D-CE framework has saved time and money. Pharmaceuticals use small quantities of active ingredients in their products. It would be difficult to dedicate an entire production site to an expensive single active ingredient. So, pharma firms use multiple active ingredients but after producing a batch with one active ingredient, the site must then stop, tear down all the equipment, clean/sanitise the site, reconfigure the equipment, and certify the equipment for a new active ingredient. Six weeks could be lost in that entire process. Now pharmaceuticals, considering the whole design, use disposable equipment. The switchover period is now a week or two, allowing for multiple batches throughout the year. Redesigning the process also reduces the inventory of expensive active ingredients.

Sharing economy

The sharing economy would be the ultimate example of zero switching costs.

Consider the Zara model with the sharing economy in mind; it has an established relationship with small garment factories. Zara consumes the capacity as the demand materialises. Here the sharing economy goes a step further: A buyer needn't have a formal contract with a provider, but whenever demand arises, they may call on that provider. If the provider has capacity, it can choose to work with the buyer. This kind of model presents extra flexibility now that this kind of activity can be done at the national, continental or global level.

From an operational perspective, the sharing or gig economy has the ultimate flexibility, but, from a human cost perspective, it is not as straightforward. The real cost is on the provider who is on call 24/7, and although one can choose not to take a job, it is very difficult to say no.

Costing the variety

Creating a multitude of products has been increasing over a generation now. In the period from 1986-2006, new products in the packaged goods industry doubled. As consumers expect continued product variety, firms are encouraged to consider all three dimensions in designing future products.

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