

The Architecture of Product Offerings

David S. Evans and Karen L. Webster*

“I want a pair of jeans—32-28,” I said. “Do you want them slim fit, easy fit, relaxed fit, baggy, or extra baggy?” she replied. “Do you want them stonewashed, acid washed, or distressed? Do you want them button-fly or zipper-fly? Do you want them faded or regular?” “I just want regular jeans. You know, the kind that used to be the only kind.” Barry Schwartz, *The Paradox of Choice*.¹

“The customer can have any color he wants so long as it’s black.”—Henry Ford on color choices for the Model T.²

What choices should you offer your customers and which ones shouldn’t you?

The answer to this question has profound consequences for business strategy, product design, marketing, and pricing, not to mention product adoption. Designing products and architecting product lines are the most difficult, expensive, and vital decisions that your business will make. They determine a significant part of your development, manufacturing, and distribution costs and most, if not all, of your sales to consumers. Yet, aside from glib anecdotes and vague “lessons learned,” existing management literature provides little guidance to managers and entrepreneurs. *Product-offering architecture* (POA) fills that void.

This management concept is based on field research on product offerings, business models, and pricing in diverse industries and draws on theoretical work on bundling, versioning, and other aspects of product architecture. POA provides a unified framework for making informed decisions about consumer choice and optimal product design. Although related to the literature on product bundling, it differs dramatically from previous thinking because it shows how the *cost* of alternative product offerings affects the most profitable offering. The POA principles set forth here help enable companies to increase long-run profits, identify product innovations, and avoid disruptive competition.

*Founder, Market Platform Dynamics and Vice Chairman, LECG Europe; President, Market Platform Dynamics. Some of the work discussed in this article is based on joint work reported in several papers with Michael Salinger.

¹ BARRY SCHWARTZ, *THE PARADOX OF CHOICE: WHY MORE IS LESS* 1 (2004).

² See WikiQuote at http://en.wikiquote.org/wiki/Henry_Ford.

POA is a new strategic approach that answers two critical and interrelated questions concerning what product offerings your company should make available to customers to maximize profits.

- What *features* should you bundle with a product? The term *feature* means an aspect of a product that a consumer values. Should an automobile manufacturer, for example, make satellite radio standard on its cars? Should a software platform maker include virus software? Should a cable television company bundle a digital video recorder and video-on-demand service? The answer determines the optimal *product design*.

- What *versions* should you make available? The term *version* refers to products that have different features although they may share a common base. Should an automobile maker offer one version of mid-size sedans with satellite radio and another without? Should a search-engine portal make a version available with premium paid content? Should a cable television company offer VOIP and cable service. These versions determine the optimal *product line or product offering*.

All products, in essence, can be thought of as *bundles* of features and versions in a product line can be thought of as being different *bundles* of features. A feature could be an attribute such as a color. Or it could be something that could be sold as a distinct product. TiVo, for example, offers a bundle that includes its digital video recorder and a year's subscription to its service. Banks, to take another example, sometimes offer bundles that include a credit card along with a checking account. Each alternative bundle defines a product version. The multiple versions offered by a firm define its product offerings.

Businesses, of course, address what product offerings to make available to their customers all the time. Sometimes they decide to give consumers many versions, as consumers

know from shopping for jeans or wandering down the breakfast cereal aisle at their local supermarkets. Other times they give consumers few versions. Model T buyers could only get black cars from 1915-1925. Consumers cannot subscribe to particular sections of newspapers—they get all or none. And Apple tries to make sure you can't use your its iPod with a music service other than its iTunes store.

Most businesses, in practice, settle somewhere between these two extremes. They offer consumers several alternative product versions but far from all they could offer or all that at least some consumers might buy if they did. In fact, the Model T was available in several colors during its early years of production (1909-1914) and again in its final two years of production (1926-1927). Most car companies today offer many versions of their cars—with different options—although, in most cases, far fewer than they did 20 years ago. Cable television companies, unlike newspapers, do not offer consumers an all-or-nothing deal. On the other hand if you want ESPN you will probably have to take the premium package and along with it a lot of channels you will never watch.

In this Article

Making the Model T available just in black reflected a strategic decision to focus on scale economies from specialization at the expense of product variety that consumers would value, and a product design decision to make the cars black rather than some other color.

Conversely, making Levi Strauss blue jeans in numerous fits and finishes reflected a strategic decision to focus on product variety at the expense of scale economies, and design decisions that led to myriad choices for consumers but hardly as many as could have been offered. This article examines how businesses should determine their “product offerings” to maximize their long-term profits.

The first three sections of this article present the basic way of thinking about POA, the alternative product offerings businesses can make, and the profit-maximizing approach for choosing among the many possible offerings. The fourth section shows these principles in action in three industries: pharmaceuticals, automobiles, and computer operating systems. The fifth section uses the popular recording industry to describe analytical methods for architecting product offerings that enable companies to innovate and secure long-run profit opportunities.

I. PRODUCT OFFERINGS ARCHITECTURE: THE BASICS

One can think of product architecture as assembling building blocks—like Legos—into a product with a given set of features or into several versions of products with varying features. Even as basic as the Model T appeared, it consisted of many Lego-like components—including Japan black paint—that were assembled to make the final product that became the first mass-produced car of the early 20th century. As the industry evolved, automobile companies faced many decisions about what features to include in its base product, what to offer as options, and what to leave to after-market firms. Carmakers initially decided not to use the air-conditioning “Lego” when it became available in 1939³. But, later they added air-conditioning as a feature on some versions of their products in response to heightened consumer demand for this feature. More recently, to tap into the widespread demand for this feature, many have decided to make air-conditioning a standard feature; now cars most always include this building block.

To take another example, the building blocks for cable television include mainly the channels they offer. Cable television networks create alternative versions of their products—basic and premium cable for example—from these channels. Moreover, their product versions are fluid in the sense that cable television companies routinely add and subtract channels from the “products” they offer. Products and product lines are based on varying combinations of these

³ See <http://web.archive.org/web/19990423055451/vintagecars.tqn.com/library/weekly/aa050898.htm>.

building blocks. Later we will see the evolving role of “songs” as building blocks in the music recording and downloading industry.

The basic strategic and design decisions faced by businesses concern how to take the building blocks available to them and combine these blocks into the one or more versions of products that maximize profits. Sometimes, there is a basic product that consists of many features—a car consists of thousands of parts for example. Different versions result from modifying some of those building blocks—offering different paint colors—or adding a feature—satellite radio for example—to the basic version. Other times the basic product can be thought of as consisting of a single component whether or not the firm offers that option. Cable television, companies, for example, could make individual channels—which can be thought of as the basic component of their offerings—available but generally do not.⁴

II. ARCHITECTING THE PRODUCT OFFERING

To get deeper into POA, let’s revisit the Lego concept and architect a product offering from two red and blue Legos. In practice, red and blue could be two different songs, a basic car and a navigation system, a mobile phone and a content package, or any other potentially divisible parts of real-world products. For now though we are just going to build a product offering from our two building blocks.

You can actually design three distinct product versions for consumers from the red and blue Legos: just the red Lego, just the blue Lego, or the combination of red and blue. Think of the red Lego as the basic product, a refrigerator or an airline ticket. Adding a blue Lego—in essence another feature—creates another version of the product like a refrigerator with designer doors or an airplane ticket that comes bundled with a hotel room. In both cases, consumers can

⁴ But even here one can argue that this product is a bundle of even more basic products. Cable television channels are bundles of shows. Video-on-demand, in fact, enables consumers to get some of these shows.

still buy a plain old refrigerator or an airplane ticket sans hotel room. In other cases, combining the red and the blue Legos creates a product that is so much greater than the sum of its parts that is actually becomes its own unique product. Credit cards, for example, combine a transaction feature and a borrowing feature that make them distinct, in most people's minds from either debit cards or consumer lending.

When they have the possibility of creating different versions of products companies can adopt one of four product-offering strategies. POA shows how to decide which of these strategies is the most profitable and should therefore determine the architecture of the firm's product offerings.

- In the ***“a la carte” product strategy*** the company offers the red and blue features individually so that consumers can create any version they want themselves. iTunes, for example, offers consumers individual songs that can be downloaded and combined on personal computers or iPods in any way consumers wish.
- In the ***“specialization strategy”*** the company offers only one feature. Other firms may offer the other feature in which case consumers can get the other feature and combine it themselves. That was the case until recently with satellite radio.
- The ***“all-in-one” product strategy*** offers only the features together, essentially the red/blue option. You can't get a version of your daily newspaper with only the news and business sections; it generally comes bundled with sports, entertainment and lifestyle sections irrespective of your interest in reading those sections.
- The ***“and/or” product strategy*** offers a combination of features plus at least one and perhaps both features (in our Lego example, the red/blue plus red, or plus blue, or plus red and blue) offered a la carte. Microsoft offers both *Office* and the individual software programs that comprise this product suite.

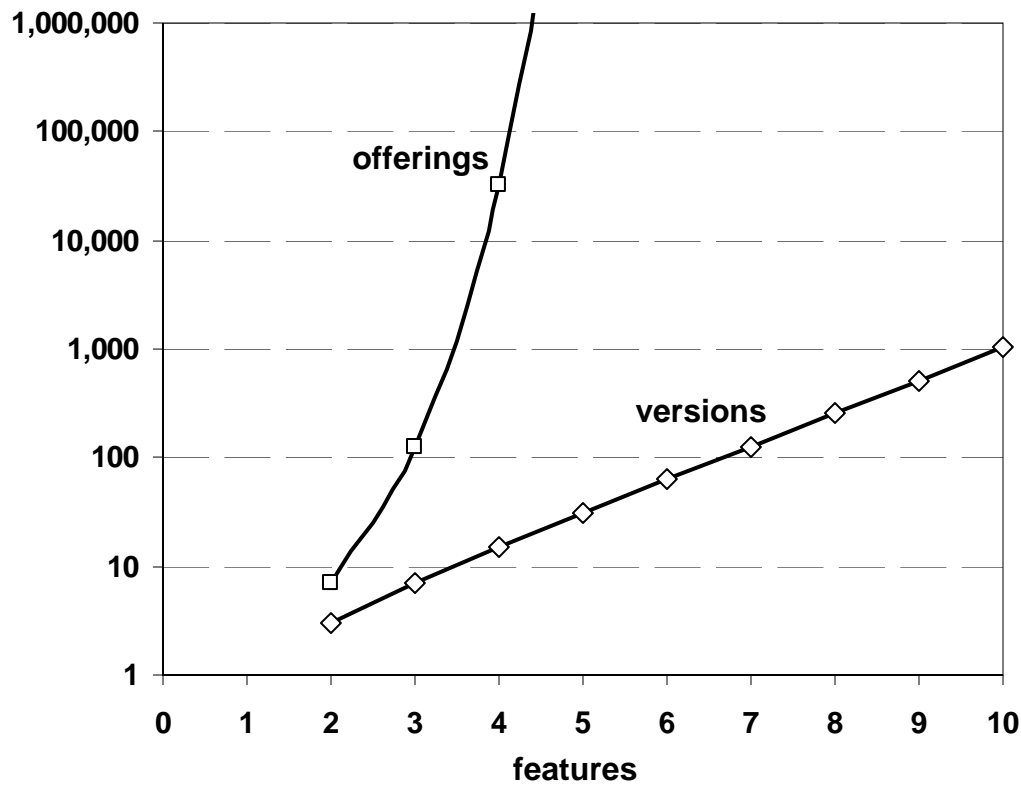
These four strategies lead then to seven possible *alternative* product offerings when there are two product features from which a company can build three product versions. These offerings are shown in Figure 1.

Figure 1. Product Offerings with Two Features			
	Red	Blue	Red-Blue
A la carte strategy	✓	✓	
Specialization strategy: Red	✓		
Specialization strategy: Blue		✓	
All-in-one strategy			✓
And/or strategy: Red	✓		✓
And/or strategy: Blue		✓	✓
And/or strategy: Red-Blue	✓	✓	✓

Naturally, the number of alternative product offerings increases exponentially with the number of features. You can work out for yourself that three features can be combined into seven distinct product versions and 127 possible alternative product offerings. Figure 2 shows how the ultimate number of distinct versions and product offerings increases with the number of features.⁵

⁵ Let n be the number of features, v be the number of product versions, and o the number of product offerings. Then $v=2^n-1$ and $o=2^v-1 = 2^{(2^n-1)}-1$.

Figure 2. The Number of Product Versions and Product Offerings Increase Dramatically with the Number of Additional Features



Obviously, as in our car example, most products are recognized as consisting of thousands of building blocks, and therefore no one seriously considers offering cars without such essential features as headlights or fuel injection. Nevertheless, according to one study there were about eight million possible versions of the Dodge Omni available for sale before 1983.⁶ Nokia offers 58 models of mobile phones in the United States with an assortment of features including the now commonly integrated camera.⁷

⁶ Eppen et al., *Bundling—New products, New Markets, Low Risk*, SLOAN MGMT. REV, Vol. 32, No. 4 (Summer 1991).

⁷ See <http://www.nokiausa.com/phones/comparephones>.

The simple mathematics of product offerings has two important practical implications. First, companies cannot offer all of the product versions that they could make from the building blocks available to them. That is clearly not feasible. Second, as a result consumers generally cannot get all of the versions that they might like to have in a perfect world. That's part of the reason you can't get a Toyota Camry in vermillion, a Sunday *New York Times* without the Sunday Style section, or Fox News without The Bill O'Reilly Show.

As a result, companies have the arduous task of determining the most profitable product line—the best one of the seven in the two-feature case, the best of 127 in the three-feature case, and so forth. As with everything in life, that involves making trade-offs between costs and benefits.

III. DESIGNING THE MOST PROFITABLE PRODUCT OFFERING

The challenge for businesses is to determine the product offering—and accompanying prices—that *maximize long-run profits*. The traditional literature on product bundling is not sufficient since it focuses entirely on maximizing the *revenue* that businesses can get from consumers. Of course, it is fundamental that businesses should focus on profit maximization—the difference between revenue and costs—and not how to maximize revenue. POA shows that to maximize profits businesses need to engage in a non-linear analysis that compares the costs and revenues from alternative product offerings. The traditional literature on product bundling and pricing is helpful for a part of this analysis but will lead businesses down the wrong profitability path if it neglects the critical cost considerations to which we now turn.

A. The Cost Dimension: There is no such thing as a free product offering

Companies must determine how much it really costs to offer a distinct product when deciding whether to make it available as part of a product line. And the spectrum of costs extends

beyond simply what companies incur directly: they must consider costs for the entire supply chain—from manufacturing to wholesale to retail—because these will ultimately affect the prices will have to recovered from consumers. Critical costs to consider include product development, manufacturing, packaging, distribution, and selling costs. Moreover, in addition to hard costs, it is important to consider soft costs such as the effect of multiple versions on management and production time. The soft costs—sometimes called complexity costs—are hard to quantify but also too significant to ignore.

Whether a product is offered and how it is designed will generally affect both the fixed costs of offering that product—the costs you incur regardless of how many units you sell—and the marginal cost of that product—the additional costs you incur for each additional unit sold of that product.

Fixed Costs. If you have to put each product in its own separate package and the retailer has to devote shelf space to it, there is a fixed cost of offering each distinct product. One of the advantages of an “all-in-one” strategy is that you only incur the fixed costs of offering one product and these are almost certainly less than offering the two products “a-la-carte.”

Consider headache and cold medicines. Two chemical compounds, which are no longer covered by patents and cost very little to make, are generally used to provide relief for these ailments. However, to get these compounds into a product that can be purchased at the local pharmacy, the manufacturer has to do several things. First it must formulate a pill from the compounds and secondly, assemble those pills into a package that serves multiple purposes. This packaging must provide legally required information to the consumer, promote the product on the store shelf, and provide a convenient way for the consumer to obtain the pills. Moreover, the retailer will incur costs for shelf-space and stocking for each distinct product it offers.

Marginal Costs. The effect of bundling features on marginal costs is more complex.

Sometimes combining components can increase marginal costs. Adding features can result in interdependencies among components that lead to additional design costs and potentially additional costs resulting from service calls or product recalls. Those costs are likely to be greater for complex manufactured goods than for information-based goods. Adding a house and garden section to a newspaper, for example, is much easier to do than adding a camera to a mobile telephone.

Other times combining components can actually decrease marginal costs. Consider our headache and cold medicine example once again. It is cheaper to make a tablet that handles both headaches and colds than to make a tablet for each. That's because the costs of the chemical ingredients is a very small portion of the cost of making a single tablet. As a result, the marginal cost of a single tablet with both medicines is less than the sum of the marginal costs of two tablets each with one of the medicines.

Often for information goods one can add a component to a product with a negligible effect on marginal cost, as seen in the newspaper example. It also doesn't cost much to add another song to a CD, so long as there is room to do so. To take another example, when Microsoft adds another software feature to its Windows platform, it doesn't cost extra to include those features on the master CDs that it makes and distributes to computer manufacturers, which then install Windows on their computers.

Figure 3 provides an example of the cost consequences of offering different products and product lines.

Figure 3. Fixed and Marginal Costs of Product Versions: An Example			
	Red	Blue	Red-Blue
Fixed	7	8	12
Marginal	3	2	6

It compares the “all-in-one” product line with the “a la carte” product line. In this example offering the bundled product—the red/blue Lego—results in lower fixed costs than offering the red and blue Legos separately. However, because of complexity costs the marginal cost of offering these products together is higher overall than offering them separately.

POA Insight:

You should evaluate the fixed and variable costs of each alternative distinct product. These costs must be evaluated for the entire supply chain paying particular attention to the cost of offering a distinct product on development, manufacturing, packaging, distribution, and selling costs.

Consumers also incur costs from different product offerings. And while this ultimately affects the consumer’s willingness to pay for different versions it is worth considering these as part of our discussion of costs.

Consumers may actually realize savings when product features are combined, assuming they value the individual product components at all. If you like to read about sports and arts every day it is cheaper to get a newspaper with both. And if you have a cold and a headache it is more convenient to get a single package of pills. Letting the producer make choices for you saves you time as well. Indeed, the point of Schwartz’s *Paradox of Choice*—the book we quoted

at the start concerning jeans—is that it is bad for consumers to get too much choice; they do not want it.

When we go to the hospital for surgery most of us would prefer to leave most of the choices to the experts rather than do it ourselves. Downloadable music lets us pick individual songs for our collections. But some might prefer the bundles the artists and publishers put together themselves. Choice is costly because it takes time and effort to make informed decisions, ones that others may be able to do more efficiently. More generally, bundling reduces transaction and search costs for consumers.

On the other hand consumers may prefer to mix and match components—a common strategy in building home entertainment systems and increasingly popular for music collections. For example, while most consumers are happy to have air conditioning as standard equipment in most automobiles today, perhaps some in colder climates preferred the days when it was an option.⁸ And the success of downloadable music indicates that, perhaps as a result of the advent of a convenient technology, some consumers like being able to “pick-and-choose” from a vast array of unbundled alternatives.

POA Insight:

When architecting product offerings consider the costs to consumers of having product components combined or kept separate and the costs and benefits to them of being able to choose multiple distinct products from a product line. These costs will ultimately determine how much consumers will pay for a product version.

⁸ For a discussion of bundling in automobile packages, see D. Evans & M. Salinger, *Why Do Firms Bundle and Tie? Evidence from Competitive Markets and Implications for Tying Law*, YALE J. REG., Vol. 22, No. 1 (Winter 2005).

B. Tapping Consumer Demand: Aligning Price and Preference

Companies must determine how to extract the most revenue from consumers through the architecture of its product offerings. There are three major strategies that align the willingness of consumers to pay for alternative versions of products with varying features with the profit maximizing potential of the product offering.⁹

The *aggregation strategy* is especially important for information goods as the following example shows. Consider your family's decision to subscribe to the *New York Times*. You like the national news and sports sections. Your husband likes the weekly science and the business sections. Your 16-year old son likes the fact that he gets to use New York Times Select on-line for his homework. None of you would be willing to pay \$9.30 a week for an individual subscription.¹⁰ But the bundle of those features makes the subscription worth it to you and your family.

What's true for you as a family works on a larger scale in the market overall. It turns out that this example is a simple application of the well-known *law of large numbers*. This principle is concerned with the variation across the population of potential consumers with regard to how much they value particular aspects of a product. If the *New York Times* combines lots of features into its paper, chances are that some grouping of those features will appeal enough to consumers for all of them to pay the subscription price, even if each consumer doesn't care about some of features in the bundled package. But, as we know, adding things is not costless. In the case of many information goods, there is a significant fixed cost of creating a single product—like a

⁹ William J. Adams & Janet L. Yellen, *Commodity Bundling and the Burden of Monopoly*, 90 Q.J. ECON. 475 (1976); Yannis Bakos & Eric Brynjolfsson, *Bundling Information Goods: Pricing, Profits, and Efficiency*, 45 MGMT. SCI. 1613 (1999).

¹⁰ See

<http://homedelivery.nytimes.com/HDS/SubscriptionAcquisition.do?mode=SubscriptionAcquisition&ExternalMediaCode=W11FZ>.

newspaper, magazine, or software program—but a relatively low incremental cost of adding features to that product or distributing those additional features to consumers.

The all-in-one strategy exploits the law of large numbers. Generally, consumers end up getting features they don't care about. Sometimes these features may annoy them. But more often, like the *Style* section of the Sunday *New York Times* one can safely ignore them, and the costs of ignoring that one section far outweighs the cost of either not having the paper, or potentially paying more for the paper itself. Consumers generally benefit from aggregation strategies because it keeps costs low to them and allows producers to realize scale economies that they pass on in the form of lower prices. If the *New York Times* were forced to distribute sections separately—as the result of some ill-conceived government regulation for example—the newspaper would lose scale economies, raise prices and probably eliminate some sections that don't attract many followers.

The Law of Large Numbers and Music Albums

Suppose that the first tenth of the population of 100 persons would be willing to pay \$10 for song 1, the second tenth \$10 for song 2, and so forth up to song 10. Each would be willing to pay only \$2 for each of the other nine songs. Also suppose that it costs \$1.50 to make a CD but it doesn't cost anything to add an additional song to a CD. If the music publisher sold each song separately, it could charge \$2 for each, sell all 10 to all customers, and thereby make \$500 (\$2000 of revenue minus \$1500 of cost).

However, every consumer would pay \$28 ($\$10 + 9 \times \2) for the bundle of all ten components. By bundling the firm could get all 100 consumers to buy the bundle. The firm would earn \$2,800 in revenue; moreover, it would only incur costs of \$150. It would earn profits of \$2,650.

Companies can also use an all-in-one strategy to get closer to the consumer's willingness to pay. We call this the ***block-booking strategy*** after the 1963 paper by that name by Nobel-prize winning economist George Stigler. He demonstrated this strategy by examining the economics of movie distribution. In his example, he supposed that exhibitor 1 was willing to pay \$8,000 and exhibitor 2 was willing to pay \$7,000 for movie A; that exhibitor 1 was willing to pay \$2,500 and exhibitor 2 was willing to pay \$3,000 for movie B. If the movie distributor charged a single price to the two distributors, it would charge \$7,000 and \$2,500 to attract both exhibitors; the distributor would collect \$9,500 from each for a total of \$19,000. But consider how much the exhibitors would pay for both movies: Exhibitor 1 would pay \$10,500 and Exhibitor 2 would pay \$10,000. Thus if the distributor charged each \$10,000 for the bundle it would collect \$20,000 and therefore make more money. Offering both movies together is known as “block booking.”

More generally, companies architect product offerings to implement a ***consumer demand segmentation strategy***. Different groups of consumers place varying values on groups of features. It is possible to design packages that segment these consumers. Some will want the car with the sports package, while others will want the basic package. The company can then charge a premium to customer groups that have a particularly high demand for a particular package, and offer an especially aggressive price to consumers that are very sensitive to price but are also willing to take the no frills deal. For this to work there must be a predictable correlation between combinations of components and demand (e.g. elastic demand, low demand for frills). A number of studies have found, for example, that automobile companies have much higher markups on luxury models than base models.¹¹

¹¹ Steven Berry, James Levinsohn, & Ariel Pakes, *Automobile Prices in Market Equilibrium*, 63 *ECONOMETRICA* 841 (1995).

This last point brings us to a critical aspect of product design. Firms can provide great value to particular segments of consumers by adding a feature to a product. Often it may not cost much to add that feature, but for a particular group of consumers that feature adds great value. In some sense that is what the carmakers have found. Certain features cost little to add but can lead to great markups.

POA Insight:

Companies can tailor product offerings to appeal to particular consumers and to establish prices that target the willingness to pay of those consumers. Product offering strategies combined with pricing strategies can help companies serve more consumers and enhance profits.

C. Searching for the Best Product Line

From the company's perspective, what ultimately matters when designing products and architecting product offerings is who, what, how and how much: who will buy, what will they buy and how much will they pay. Analyzing this is more complicated than it may seem, especially when considering that the goal is to maximize profits and not to maximize revenues. We'll explain how to answer these questions using the POA approach and apply it to the two-feature/three version case described in Figure 1. It is important to note that no company will actually do this sort of analysis because it is too hard to do and will therefore need to take some shortcuts. To illustrate the approach, we show hypothetical revenue, costs, and profits for each product line in Figure 4.

Figure 4. The Role of Costs, Revenues and Profits in Determining Product Offerings: An Example						
	Red	Blue	Red-Blue	Costs	Revenue	Profits
A la carte strategy	✓	✓		11	19	8
Specialization strategy: Red	✓			5	11	7
Specialization strategy: Blue		✓		4	12	8
All-in-one strategy			✓	7	21	14
And/or strategy: Red	✓		✓	6	18	12
And/or strategy: Blue		✓	✓	7	22	15
And/or strategy: Red-Blue	✓	✓	✓	13	26	13

1. A Rigorous but Difficult Approach

For each possible product line the company must consider the profit-maximizing prices to charge consumers for those products. That will entail examining the cost/benefit of the block-booking, aggregation, and segmentation strategies discussed above in order to devise the optimal demand strategy. For example, it may consider using an “and/or” product offering to implement a segmentation strategy or an all-in-one offering to implement an aggregation strategy. Once the company has decided which strategy to adopt and determined how much to charge, it can forecast the level of *revenue* it could achieve from the sale of each distinct product in the product line and from the product line as a whole.

In comparing the revenues from alternative consumer demand and product offering strategies it is important to keep a couple of points in mind. It is well known that offering another version of a product may “cannibalize” sales of another product. Thus a company that moves

from an “all-in-one” strategy to an “and/or” strategy may find that some of the customers that used to buy the bundle will decide to just get the feature offered. Such cannibalization, or siphoning of consumers, is one reason for differences in the revenues from different product offerings. Of course, it is also possible that giving consumers an additional choice—the “or” in the “and/or”—will persuade some consumers that didn’t want to for the “all-in-one” alternative to pay for a component of it. These “market-expansion” effects also account for differences between the revenues that can be realized with different product offerings.

Each of these alternative product offerings has an implication for the overall fixed and variable costs incurred by the company. Each of these seven possible product lines consists of one or more of the three products that can be assembled from the two components. The company must consider the fixed and marginal costs of each of these distinct products and then the overall cost for the product line.

The best product offering is the one that results in the highest profit after taking cost, demand, and pricing strategies into account. Figure 4 shows as an illustration the total profits that a company can obtain from each product offering. In the example, the best offering is the “and/or-2” option that offers the red/blue combination plus the blue component. The second-best offering is the “all-in-one” option that just offers the bundle.

This two-component example is complicated enough. It becomes exponentially more difficult as the number of possible alternative product offerings increase.

2. Winnowing Down the Product Offerings

POA, however, provides insights that enable firms to eliminate many offerings and focus on the subset that is likely to be the most profitable. The most important filter is whether there’s enough demand to warrant the fixed costs of making a product available.

Companies should compare the fixed cost of offering a product against the demand for it. It obviously doesn't make business sense to produce many products because there isn't enough demand for them. Sometimes the lack of demand is apparent after the product is offered and it is quickly pulled. For example, Uncle Ben's Inc. introduced a version of its popular Uncle Ben's Rice with calcium. The anticipated hordes of calcium-deprived rice-lovers did not materialize: at least not enough to warrant taking up scarce supermarket shelf space with product, marketing it, and making special packages for it.

Other times, though, the fact that demand is enough to warrant offering a particular product as part of product line will only be clear if the company considers the cost of offering that distinct product versus the *incremental* demand for it. As we discuss later, many car makers realized that it was expensive to offer so many versions—car models with various options—to consumers and have cut way back to reduce their costs. It's easy to see from these considerations why it is profitable for firms to make available only a fraction of the products—defined by the combination of components—they could make available. Even minimal fixed costs of offering these configurations to manufacturers or consumers would encourage producers to reduce the number of offerings to those for which there is significant demand. If you think about the products you buy, while you may have a great deal of choice you have infinitely less than you could have if firms did not bundle components—and things that could in principle be sold separately—together.

POA Insight:

There is no single “one size fits all” rule for when businesses should offer a la carte, all-in-one or and/or products. The most profitable product offering strategy depends on how much consumers are willing to pay for different products, the revenues that companies get for alternative product lines, and the fixed and marginal costs associated with offering alternative products and product lines.

D. Managing the Maze of Product Offerings

So, how does one decide which product-offering architecture strategy to pursue? Theory can help guide companies but ultimately the answer depends on the facts. Later we describe empirical methods for guiding business analysis, but here are some general rules of thumb.

Firms should follow all-in-one product strategies when:

- *there is little demand for other combinations of these features relative to the cost of offering them.* For example, there would likely be little demand for a version of the Porsche Carrera with the same engine as a Toyota Camry.
- *the marginal cost of including components is very low relative to the additional customers that are pulled in.* Adding Spike TV to a cable lineup costs little and likely attracts additional young males based on the programming offered.
- *the cost of combining features is more than offset by the ability to reach a larger audience.* Most computer users don't routinely use most of the features in their word processing programs (ever use the math editor?), but most use several they care about.

Firms should make and/or offerings when:

- *there is sufficient demand for a product configuration relative to the cost of offering it.* Enough people want crunchy peanut butter for most major makers to offer crunchy in addition to smooth.
- *different product offerings facilitate segmenting customers.* At \$128,725, the Mercedes S600 may only appeal to a limited segment of the population, but the demand for this exclusive automobile outweighs the additional production cost.

Firms should adopt an a la carte strategy when:

- *there is little demand for combining features, or consumers can do this themselves very easily.* Selling a bundle of jeans and cowboy boots might appeal to some customers but most would prefer to buy these components separately.

- *the fixed or marginal costs of combining features are prohibitive relative to demand.* Restaurants might find it easier to offer a set menu paired with wine but most restaurant patrons usually prefer to order food and wine a la carte.

IV. PRODUCT ARCHITECTURE IN PRACTICE

To see product-offering architecture in practice, let us examine several industries. Each illustrates the tradeoffs between the increased demand from making more choices available to consumers and the increased costs of making additional products available. The examples also underscore how these tradeoffs vary fundamentally between different kinds of products, especially those involving information.

A. Headache and cold medicines

Several pharmaceutical manufacturers make non-prescription headache and cold medicines that are sold in retail pharmacies around the country. Each medicine is based on a chemical compound (acetaminophen for headaches and pseudo ephedrine hydrochloride for sinus relief). To deliver this relief in an easily used form, pharmaceutical manufacturers combine the chemicals with other inert substances, make pills, and put those pills in containers.

Most of the major branded and generic manufacturers provide these drugs in several form factors (tablet, capsule), numbers (50,100, 250), and in combinations (headache, cold, or headache/cold). At the Walgreen's on 757 N. Michigan Ave. in Chicago, there were, for example, 305 headache and cold medicines in the Walgreen's store-branded product line; of these 115 were headache-cold medicine.¹² All of the headache and cold manufacturers therefore engaged in an "and/or" POA strategy for their product lines.

¹² Based on store visit on April 3, 2003. *See* DAVID S. EVANS & MICHAEL A. SALINGER, CURING SINUS HEADACHES AND TYING LAW: AN EMPIRICAL ANALYSIS OF BUNDLING DECONGESTANTS AND PAIN RELIEVERS, CESifo Working Paper Series No. 1519 (August 2005).

For the purposes of our example, let us just focus on the decision to offer headache, sinus, and headache/sinus relief. It's easy to see why that makes business sense. There are discrete groups of customers who care only about headache or sinus relief or both kinds of relief. Each kind of medicine has some limited side effects, so someone who doesn't have one condition would not want medicine for that condition, even if it were free. Therefore, there is demand for the separate products. For consumers with both conditions, combining headache and sinus medicine together saves them the cost of selecting and buying two products, storing two containers in their medicine cabinets, and opening and taking two pills instead of one.

However, the fact that different groups of consumers want the three different choices offered by the "and/or" strategy does not mean that it is profitable for manufacturers to offer it. That decision depends on the cost of offering these separate products. Such costs no doubt exist, including the cost that retailers must bear in order to provide each version with its own shelf slot. However, assuming the pharmaceutical manufacturers and retailers made sound economic decisions, the demand for each separate product was more than sufficient to cover the separate costs, including the additional shelf slotting fees incurred.

In this case, it is easy to imagine changes in costs and demand that could alter the conclusion that the "and/or" strategy is most profitable and lead manufacturers and retailers to choose a different strategy. For example, if someone developed a sinus medicine that had no side effects whatsoever, then it is possible that the manufacturers and retailers could avoid the fixed costs of offering sinus-only medicine by just offering the bundle. Or, if shelf-space costs were very high, it is possible that retailers would not offer all versions. Indeed, small kiosk and convenience stores often do not offer all the versions that manufacturers make available.

B. Models and options on automobiles

Automobile companies often offer consumers several alternative models of their cars and for each model they may offer a number of options. Consider the popular midsize cars sold in the United States in 2004. The Ford Taurus came in four models with between 3 and 13 options depending on the model. The Honda Accord came in six models with between 0 and 2 options; and Toyota Camry came in three models with between 9 and 12 options. While the dealer could add some of the options, the manufacturer and the dealer between them made a large number of choices available to car buyers.

Interestingly, Ford had vastly more choices available to consumers in 1986. It had three models but offered between 32 and 50 feature options. The new Japanese entrants at that time offered significantly lower prices but far fewer versions. Over time, the Japanese firms kept roughly the same size product lines while Ford drastically reduced its product line.

It seemed as though the Japanese were on to something. Their POA strategy recognized the cost of complexity in product offerings. In automobile business, there are no packaging or distribution costs. It doesn't take up any more space on the ships, trailers, or show room to offer a six-cylinder car than a four- cylinder one. And in principle it shouldn't take the assemblers any more time to paint a car midnight blue than fire engine red. However, a number of studies have found that it costs more to manufacture many different versions of cars.¹³ These costs tend to be subtle and hard-to-measure ones resulting from the accumulation of numerous inefficiencies in the assembly line and plant management. The fixed cost of a product line with 1000 choices is therefore higher than a product line with 100 choices.

¹³ Marshall L. Fisher & Christopher D. Ittner, *The Impact of Product Variety on Automobile Assembly Options: Empirical Evidence and Simulation Analysis*, 45 MGMT. SCI. 771 (June 1999); John Paul MacDuffie et al., *Strategies for Product Variety: Lessons from the Auto Industry*, in REDESIGNING THE FIRM 116 (Edward H. Bowman & Bruce M. Kogut, eds., 1995).

The tradeoff that the American and Japanese manufacturers faced was between giving their customers more choices that they clearly valued versus lower prices. The Japanese went for the lower prices. Their success led the way for the Americans.¹⁴ Of course, as the debt of General Motors and Ford get junk bond ratings and talk of bankruptcy looms one wonders whether the American makers learned simplicity—and optimal POA strategies—too little too late.

C. Computer Operating Systems

Apple's latest operating system for its personal computers--the MacOS Tiger which was released in 2005—includes a search program (Spotlight), a web browser (Safari), video and audio conferencing (iChat), a media player (QuickTime), and an e-mail program (Mail). All in all Apple says there are more than 200 new features in Tiger. At 4,000 megabytes Tiger takes 2.7 times as much hard disk space as its predecessor released in 2001. The MacOS Tiger does not come with options. And although some components of the MacOS are available separately, such as QuickTime, Apple mainly takes an all-in-one strategy with its operating system.

Apple's POA strategy is similar to that adopted by most other commercially significant operating system makers for personal computers, video game consoles, mobile phones, and personal digital assistants. The size of the operating system increases exponentially over time as a result of adding new features; for personal computer operating systems the average increase in the size of the operating system measured in lines of code or megabytes is around 50 percent a year. Operating system makers for personal devices generally offer few if any options.

Computer operating systems provide services to at least two distinct groups. Application developers rely on services provided by the operating system rather than writing the code for

¹⁴ See McDuffie at al., *supra* note 13; see also David S. Evans & Michael Salinger, *Why Do Firms Bundle and Tie? Evidence from Competitive Markets and Implications for Tying Law*, 22 YALE J. ON REG. 76 (Winter 2005); Gary D. Eppen, Ward A. Hanson, and R. Kipp Martin, *Bundling – New Products, New Markets, Low Risk*, SLOAN MGMT. REV., Vol. 32 No. 4 (Summer 1991) and Douglas R. Sease, *Getting Smart: How U.S. Companies Devise Ways to Meet Challenge From Japan*, WALL ST. J., Sep. 16, 1986.

these services themselves. Some of those services provide access to the hardware like manipulating pixels on a mobile telephone screen. But many provide services such as 3D animation for games. Computer users rely on the operating system to access the hardware directly. More commonly, they rely on applications that in turn rely on the services provided by the operating system. (Some operating systems also provide significant services to content providers and hardware makers.) Most of these customers use only some of the features in the operating system and the other features sit fallow on the computer storage.

The all-in-one product-offering architecture is a probable consequence of following an aggregation strategy. The fixed cost of including these features in a single product is substantially lower than the fixed cost of offering two or more products. Moreover, the marginal cost of distributing additional features to customers is essentially because they are included in a master copy that is downloaded to all computer devices containing the operating system. The aggregation of these features increases the demand by end users and application developers who use the operating system because there is “some” selection of features that they find attractive; different users and developers find different features attractive.

V. LEARNING THE FACTS TO GUIDE DESIGN AND CHOICE DECISIONS

The recorded music business helps highlight many of the empirical issues that businesses need to consider in architecting the most profit maximizing product offering. In the mid 2000s, music publishers such as Sony were facing serious business issues about whether to make their songs available on line in addition to physical media such as CDs, and whether to make their songs available on-line individually, in bundles, or both. The music publishers faced these issues largely because technological change—the emergence of the internet, increased broadband

penetration and capacity, and increased piracy through illegal downloads—has changed the costs and benefits of their pre-existing product line.

In order to appreciate the music industry's POA, it is important to understand a little bit about the industry's history. Popular songs were mainly distributed on 45-rpm records during the 1950s. They were called singles even though they often came with two songs; one on each side of the record. Although long-playing 33-rpm records had been available since 1948, it remained common to distribute songs as singles until those famous entrepreneurs, the Beatles, issued their *Sergeant Pepper's Lonely Hearts Club Band* concept album in 1967. Since then most popular music has been distributed as collections of 10-20 songs. If you wanted to hear Stairway to Heaven in the 1970's you had to buy the Led Zeppelin IV album, which had 8 songs of variable quality. If you wanted to hear Wannabee in the 1990s you had to buy the Spice Girls CD, which had 10 songs of variable appeals. Music publishers have started recently to distribute songs separately through digital downloads on services such as iTunes. So if you want to hear Coldplay's hit Speed of Sound you can download a copy for your computer or iPod from iTunes for 99 cents or buy the CD for \$13.49 plus shipping from Amazon.com.

For roughly forty years—from the mid 1960s to the mid 2000s—music publishers engaged in a classic “all-in-one” strategy for recorded popular music. The publishers and artists selected the best songs for the album and songs that didn't make the cut were either saved for the next album or, more likely, simply not distributed at all.

Assuming the music publishers were not leaving money on the table, we can make several inferences about this strategy. On the cost side, the music publishers would have to incur the cost of pressing and distributing additional smaller collections of songs, and retailers would have to incur the cost of stocking these, to release one or more songs separately. On the demand

side the music publishers would realize additional revenues from people who really just wanted one or two songs although that would be offset by any lost sales of the complete album. The business question is whether the net incremental revenues would outweigh the incremental costs. The music publishers answered that negatively with their actions.

The internet and related phenomenon changed both the cost and the demand sides of this equation. On the cost side the internet has made it much cheaper to distribute music to people and in particular to distribute individual songs to people. On the demand side people it is easier for people to download music illegally including individual songs. Such piracy reduces the demand for recorded music overall. But many people dislike pirated music either for moral reasons or because the song quality isn't as good as legally obtained music. So the possibility of illegal downloading has raised the demand for legally available individual songs.

The optimal POA strategy for the new digital era though, requires more facts on demand and costs.

On the one hand, the fact that it is possible to make individual songs available to people digitally doesn't necessarily mean that music publishers should not make bundles available digitally. People may still prefer that someone aggregates content for them because it is easier and less time intensive for "experts" to pick out the right combination of songs than for them to do it themselves. Moreover, it may be possible to music publishers to realize more profits by using various bundles to segment consumer demand and thereby realize higher profits. On the other hand, it may be that the internet results in the disintermediation of the music publishers for choosing combinations of songs. People will be able to rate songs and suggest bundles. In addition, the increased popularity of digital music devices may shift people away from playing CDs and towards playing from massive libraries of songs. These questions can be addressed

through the use of well-known statistical survey techniques such as conditional logit or conjoint analysis studies. These studies, in effect, confront individuals with alternative choices at various prices. Individuals are asked to express preference based on price. From this technique, it is possible to infer the optimal bundling strategy from the standpoint of consumer demand.

From the music industry's standpoint, two other important considerations are piracy and cannibalization. Digital downloading became attractive to music publishers because of the hope that legal downloads of individual songs would reduce the demand for illegal downloads. However, digital downloads also have the potential to reduce the demand for physically distributed recorded music. A study for EMI by Dr. A. Jorge Padilla found that the additional profits from reduced piracy was greater than the lost profits from cannibalization of physical media.¹⁵ Therefore it made business sense to add digital songs to the product offering.

Music publishers will eventually face the same decision for CDs and audiotapes as they did for 45-rpm records and eight-track tapes. At some point the demand for those media may decline relative to the cost of making those versions available. Alternatively, there may be other forms of distributing music for which demand increases. In all these cases, an important empirical investigation that music publishers and content providers will need to conduct is the cost of making each of these form factors available to consumers relative to the incremental revenue that these form factors bring in.

VI. CONCLUSION

Product-offering architecture provides a framework for helping businesses develop products and product lines that maximize their long-run profits. It provides a rigorous framework based on two underlying principles.

¹⁵ A. Jorge Padilla, *Music in the Digital Era: Using Econometrics to Model the Music Business: 2004-2009*, Presented in London at Abbey Road to EMI Group (July 1, 2004)), available at <http://www.lecgcpc.com/ec/forum/index.aspx?id=72>.

Choice costs. This simple observation has critical implications for product design and for architecting product lines. Choice costs consumers because they must acquire information, make decisions, and incur other transactions costs. That was Schwartz's point about the blue jeans. Choice costs producers because they have to separate production lines, make separating packing, and use more shelf space. That was Henry Ford's point about automobiles. Offering several different features requires additional resources and therefore results in higher prices.

Choice benefits. Consumers often value choice to a degree, although that degree varies by product and circumstance. Businesses value choice because it allows them to engage in various consumer segmentation and pricing strategies that can increase their profits. The most profitable product line is the one that balances the benefits and costs for both consumers and businesses.

Product-offering architecture provides a framework and set of principles for assisting businesses in achieving that proper balance. The best product line from the standpoint of maximizing profits depends critically on the facts about costs and benefits. An all-in-one strategy may be better in one industry while and and/or strategy in another. Armed with both POA and the knowledge about your customers, your markets and the costs of your product, your business can design products and product lines that maximize its profits and provide customers with just the right amount of choice.
