

# Section 3.1

## *The Product Line as a “System”*

You’ve volunteered to coach a youth soccer team and you’re determined to lead your kids to victory. What should your training strategy be? Should you focus on each team member’s individual skills, or emphasize teamwork and cooperation? Is it best for one or two superstars to carry the team, or should you try to balance each member’s abilities so that no one person dominates the game? The problem with sports analogies like this one (for which I refuse to apologize) is that the reality of competition rarely supports the great “lessons” we are supposed to learn from them. Clearly, I am trying to build a case for teamwork and cooperation. Yet plenty of successful sports franchises have been built around a single superstar player, and teams that are loaded with talent often win championships without much teamwork.

The same is true in business (see, there was a reason for the analogy after all). There are many firms that have been supported for years by one or two “superstar” products. Pharmaceutical manufacturers are an excellent example. One breakthrough drug can sustain a firm through years of failed new product attempts. Likewise, businesses that are well-positioned in a hot market have little need for “cooperation” among their products. If margins are high enough and demand is strong enough, a bit of inefficiency can easily be absorbed. Many high-tech firms fall into this category, including telecoms, semiconductor fabricators, software designers, and so on.

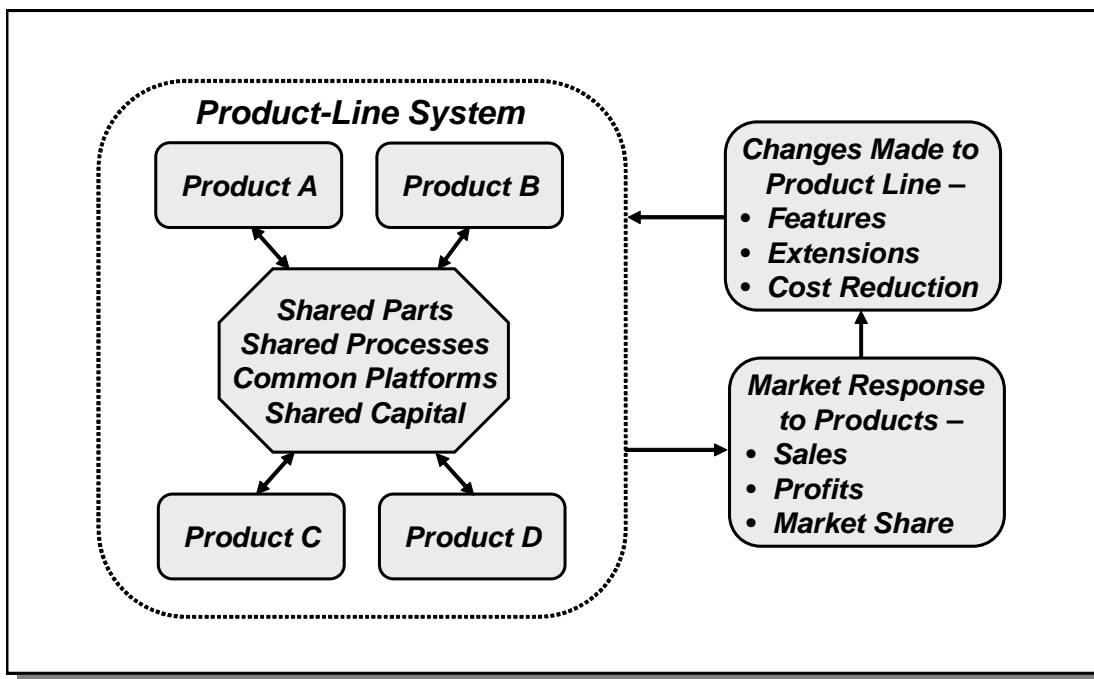
Now, here’s my long awaited point. You *might* win at sports with one or two superstars, and you *might* win with a bunch of talented but uncooperative individual contributors, but you *will* win if you have *both talent and cooperation*. In business, you can manage to keep the doors open with one or two profitable products, but why not thrive and flourish by embedding cooperation and synergy into your product design strategy? The most dramatic opportunities for your firm to boost overall profits require that you treat your entire line of products as a *profit-maximizing system*. To accomplish this, however, you must first learn the art of systems thinking.

### *A Holistic Approach to Design*

There are some words in the English language that we use every day but have no idea what they really mean. The word “system” is an excellent example. There are laundry-cleaning systems, and computer systems, and sewer systems, and even shaving systems, so evidently these things are everywhere. But what makes a system a system? Well, there are, in fact, several specific criteria that must be met for something to truly be

a system (despite what some advertisements might lead you to believe). First of all, a system must consist of more than one element or component. Second, a system must perform at least one function that cannot be accomplished without cooperation among its elements. Finally, the system must receive some form of feedback, meaning that the way in which the world interacts with the system must in some way influence how the system behaves, as shown in Figure 3.1. If these three criteria are met, then you've got a system on your hands. Hence, for a laundry detergent to be a *real* system, it must: a) consist of more than one type of cleaning agent, b) be able to clean certain types of laundry only if these multiple cleaning agents work together synergistically, and c) react in some way to the type of dirt being removed.

Somehow I can't picture a group of advertising executives sitting around a table ticking off these three criteria before approving an advertisement that uses the word "system." Yet for our purposes, these criteria are critical, because true systems have some predictable behaviors *that can help us make more money*. Picture in your mind every product that your firm produces (or at least all products within a business unit). If managed properly, this suite of products can constitute a *system for profit maximization*, or they can remain a bunch of isolated loaners that gain no benefit from their brethren.



**Figure 3.1** – The general definition of a system requires that three criteria be met: 1) more than one element or component must be involved, 2) these elements must work together cooperatively toward a common purpose, and 3) there must be some feedback process that enables the system to adapt or change based on its interaction with the outside world. A closed-loop feedback system for profit maximization within a manufacturing firm is shown.

For a product line to behave like a system, it must meet our three criteria. First, there must be more than one product in the line. Ok, that one is probably fairly easy. Next, the various products within the product line must work together synergistically to accomplish the function of the system. Since the function that we have defined for our system is to make maximum profits, *the products within your firm must somehow be working together to increase profitability*. This one is a bit harder, *n'est pas?* Luckily, the final criterion is also relatively easy. The feedback for a product-line system comes from the sales and profit dollars generated in the marketplace. A negative or positive response from the market is detectable almost immediately, and provided that the system reacts to this feedback (such as by changing the type of products offered), we are in good shape.

So how do we meet criterion number two? Suppose, for example, that our current products each use their own unique set of fasteners. If we could define a common fastener that would work for all of our products, we would increase our profits across the board. Why, you ask? Because we could purchase the common fastener in higher volumes (thereby gaining quantity discounts), and we would have fewer parts in our inventory that need to be purchased, received, inspected, counted, stored, moved, etc. As trivial as this example may seem, the cost savings that can be derived from parts-count-reduction initiatives can be dramatic.

There are a number of other ways in which multi-product synergies can help maximize profits, as shown in Figure 3.2. In almost every case, some form of commonality is involved. Common parts, as mentioned above, are only the beginning. How about common capital equipment, shared workcells, common raw-material stock, standardized testing and inspection, and so on? In fact, an ideal product line would consist of products that are virtually indistinguishable from a manufacturing standpoint. The problems they solve might be very different, but there are huge economies of scope among them. To accomplish this, however, we must do some things that may seem counterintuitive.

For example, we may need to actually *increase* the cost of one product to capture significant savings across our entire product line. Suppose we have ten products within a product line and eight of them require enclosures made of stainless steel. The other two products are lower-priced models that can be sold with just a painted metal enclosure. It would increase the cost of the low-priced models to use stainless steel instead, but overall it might be cheaper than maintaining an inventory of plain sheet metal and a painting facility that would otherwise be unnecessary. We have to look beyond the superficial to see the network of synergies that lies below the surface of any product family.

### ***Designing Product Lines Instead of Products***

If your firm is well down the road toward a lean enterprise, you may have considered abandoning those stogy old functional departments in favor of “value-stream teams.” A value-stream team sounds fancier than it really is; it is simply a cross-functional team that includes all skills needed to design, develop, launch, manufacture, and support an entire product line. These value-stream teams take the place of traditional functional

<b>Capturing Product-Line Synergy</b>	
<b>Opportunities for Cooperation</b>	<b>Primary Cost Benefits</b>
<b>Shared Parts</b>	<ul style="list-style-type: none"> <li>Reduces overhead charges for inventory management, purchasing, inspection, storage, handling, etc. Can enable lower per-part cost due to higher volumes.</li> </ul>
<b>Shared Raw Materials</b>	<ul style="list-style-type: none"> <li>Same as above, plus added cost savings due to reduced wastage and scrap.</li> </ul>
<b>Shared Processes</b>	<ul style="list-style-type: none"> <li>Reduces overhead costs of factory re-layout, process development and prove-in, training, test and inspection, etc.</li> </ul>
<b>Common Capital</b>	<ul style="list-style-type: none"> <li>Spreads the cost of capital equipment over several products, thereby shortening payback period. Reduces floor-space requirements, maintenance costs, etc.</li> </ul>
<b>“Second-Order” Effects</b>	<ul style="list-style-type: none"> <li>There are many less obvious costs that will decline due to product-line synergy. Examples include packaging, warranty, service, and repair costs, qualification testing costs, agency approval costs, and so on.</li> </ul>

**Figure 3.2** – Ways in which a multi-product family can act as a profit-maximizing system. Note that it may be necessary to actually *increase* the cost of a single product slightly in order to capture cost synergies across all products within a business unit.

departments and can improve operating efficiency considerably...provided that you survive the transition. Although there is merit to the BIG-THINK approach of reorganizing entire business units, this is a practical, little-think kind of guidebook. Hence, we will find a way to get some of the benefit of value-stream teams without the cultural and organizational turmoil.

Before I describe how this can be accomplished, a few definitions are in order:

**Product Line** – A product line is any collection of products that have a common configuration, market segment, technology, or some other logical similarity.

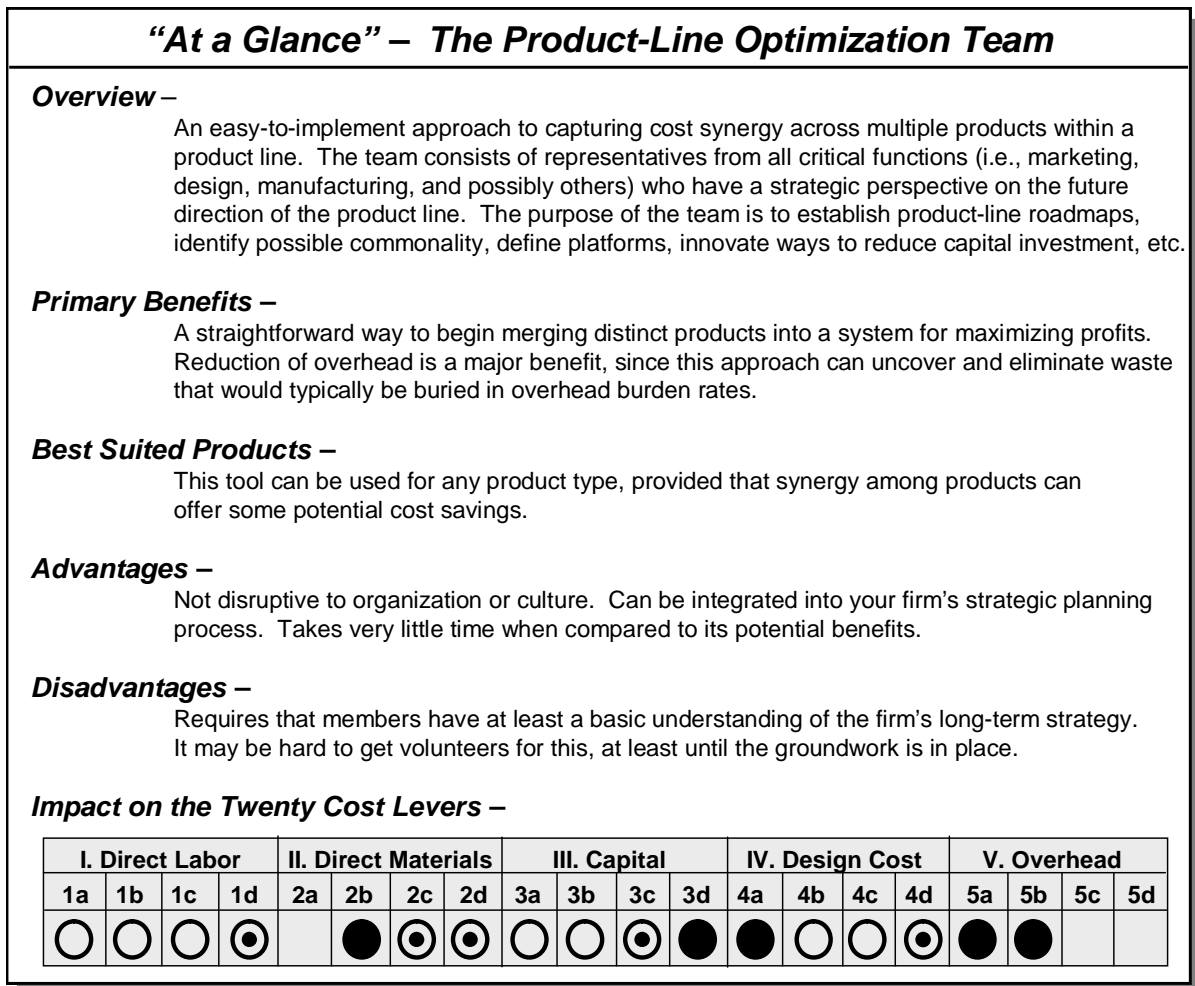
**Product Platform** – A subset or portion of a product that is common to multiple models (or versions) within a product line. Traditionally, platforms have been thought of as nearly finished products that have not yet received the customization that differentiates the various models. In the sections that follow, I will demonstrate how taking a much broader view of platforms can yield substantial cost savings.

**Product Family** – Similar to a product line, but often the commonality involved is in how the products are manufactured.

**Line Extensions** – These are models within a product line that have been added to capture new subsegments of the target market. Often a line extension is a relatively minor modification of an existing product within the line, such as offering a new color, size, or other superficial change.

**Product-Line Roadmap** – A strategic guide to the future of a product line. The horizontal axis represents time (typically in years), while the vertical axis represents the segments of the market that will be targeted. A product-line roadmap helps designers see opportunities to merge functions, provide for future extensions, implement low-cost customization, and other cost-saving measures that require some visibility into a product-line’s future.

Armed with these definitions, we can introduce a new lean design tool; the Product-Line Optimization Team (PLOT), as described in Figure 3.3. The PLOT (god I love that acronym) is an ad hoc team that comes together for a specific purpose; to advise design teams on ways to capture multi-product cost savings. The PLOT consists of representatives from each critical design area, along with manufacturing, marketing, and possibly others. The goal is to establish a group that can visualize cross-product-line opportunities, so use your own judgment.



**Figure 3.3** – “At-a-glance” description of the Product-Line Optimization Team (PLOT) cost-saving tool.

Keep the membership relatively low (five to ten people is a good range) so that consensus is at least a possibility. Members should be explicitly identified, notified, and given basic instructions in the process that I will describe below. The team should come together whenever a new product design project is initiated, and will typically exist for only one day on each project. Just a quick infusion of great cost-saving ideas, without any muss, fuss, or waste.

Upon the invitation of the project leader, a PLOT meeting is called at the beginning of each new product development project. A sample agenda and invitee list for such a meeting is shown in Figure 3.4. The duration of the meeting should scale to the complexity of the product; for single-function products a few hours should be plenty, whereas for major systems products, such as aircraft and automobiles, a week or more might be warranted. A standardized process is followed, based on a checklist such as the example provided in Figure 3.5. After pleasantries, the PLOT works its way through the checklist. For each cost-improvement opportunity, a brief brainstorming session is held to harvest ideas for cross-product-line cost savings. These suggestions are then rank-ordered by the team, based on two factors: potential *impact* on product-line profitability and *ease* of implementation on the current project. The entire team performs the ranking, using a 1-5 subjective scoring system. A “1” score for impact implies insignificant cost-saving potential, while a “5” score represents a major cost-improvement opportunity. For ease of imple-

**Meeting Notice**

**Time:** Wednesday, March 23, 2010      8:00 am – 12:00 noon

**Place:** Conference Room 3

**Purpose:** Product-Line Optimization Team Review Meeting

**Deliverable:** Prioritized list of recommendations to the A-35 core design team for product-line cost reduction.

**Attendees:** PLOT team, A-35 core design team, and if available: engineering manager, manufacturing manager, marketing manager, materials manager, purchasing manager, chief financial officer (or controller), business-unit / product-line managers.

**Agenda:**

8:00 – 8:15	Introduction and Description of Process
8:15 – 9:00	Question and Answer Session with A-35 Core Design Team
9:00 – 11:00	Brainstorming Sessions Based on PLOT Checklist
11:00 – 11:45	Group Priority Ranking of Cost Improvement Ideas
11:45 – 12:00	Summary of Recommendations to A-35 Core Design Team

**Figure 3.4** – A sample agenda and invitee list for a Product-Line Optimization Team meeting. This meeting is typically held very early in a new product development project and provides non-binding cost-saving recommendations to the design team.

Cost Improvement Opportunities	Ideas for Cross-Product-Line Cost Savings	Ratings (1-5)		Priority Ranking
		Impact	Ease	
<b>1. Shared Parts</b>	1.			
	2.			
	3.			
	4.			
<b>2. Shared Raw Mtls.</b>	1.			
	2.			
	3.			
	4.			
<b>3. Shared Processes</b>	1.			
	2.			
	3.			
	4.			
<b>4. Common Capital</b>	1.			
	2.			
	3.			
	4.			
<b>5. Other Opportunities</b>	1.			
	2.			
	3.			
	4.			

**Figure 3.5** – An example of a PLOT meeting checklist. The opportunities included on your list should be derived from your specific business situation. I've identified several categories that are almost always important to product-line optimization.

mentation, a “1” score implies the idea is difficult to incorporate, while a “5” score indicates that the opportunity will require minimal time and effort. The two scores are then multiplied together (twenty-five is the highest possible total and one is the lowest) and recorded next to the appropriate idea.

After a set period of brainstorming (which should scale to the size of the cost-saving opportunity), the PLOT moves on to the next item on the checklist until it is completed. The opportunities that receive the highest total scores are gathered up and provided to the new product design team *as recommendations for action*. It should be left to the design team to evaluate the practicality of each high-ranking suggestion and to validate its potential cost savings. It is *not* a good idea to require that PLOT-team recommendations be mandatory for design teams. The design team has a much more detailed knowledge of what is and is not possible for their specific product. Mandatory actions from a PLOT meeting would likely result in lots of wasted time chasing down rabbit trails just to prove that an idea is a turkey (sorry for the mixed metaphor). It is, however, entirely reasonable to consider incentivizing a design team to incorporate one or more product-line cost improvements into their product. What these incentives consist of depends on your culture, but I've found that money works quite well.

## *Visualizing Your Future With a Product-Line Roadmap*

Since we've already made the effort to set up a Product-Line Optimization Team, we might as well give them something else important to do. A Product-Line Roadmap is a tool that graphically illustrates the future development of a given product line, as described in Figure 3.6. Whether you use a complex template or just a simple fishbone diagram, it makes sense that the PLOT for your business unit be responsible for the initial creation and ongoing maintenance of the roadmap. At the kickoff of each new product development project, the PLOT comes together to discuss cost-improvement opportunities and to update the Product-Line Roadmap. In this way, the roadmap is kept relatively current, and can be used for strategic planning, resource and capital allocation, capacity planning, and so on. Its main purpose, however, remains eminently practical: A tool to help the PLOT identify cross-product synergies and plan for cost-saving opportunities across all products within the business unit.

The format of a Product-Line Roadmap can be anything your heart desires, but I'll share with you one possible implementation; a medium-complexity version that can work for the smallest of firms and still be useful for firms with complex products and multi-segment markets. Some potential elements of a Product-Line Roadmap include:

***Time Base*** – This one is essential. The time base for a Product-Line Roadmap typically runs horizontally across a landscaped page, with a scale suited to the type of products and markets involved. For very fast moving markets (e.g., the fashion industry, some high-tech sectors), a one- or two-year horizon may be sufficient. For products that require a long time to mature (e.g., pharmaceuticals, aerospace), a significantly longer time base may make sense. I generally use a three-year horizon unless there is a dramatic need for longer or shorter. Remember this is not intended to be a prognostication tool; it simply captures your firm's best thinking about what the future of a product line might hold.

***Top-Level View*** – It is critical that your roadmap show a top-level view of the product line. A whole sheaf of individual product-level roadmaps won't do the job (although you certainly might consider developing such detail after a top-level map has been formed and agreed upon). Climb to 40,000 feet and show everything on one page, then you can drill down to lower levels in a nice logical way. Obviously, if the roadmap is too high level, it won't provide enough insight into cross-product synergies, so use a tiered approach if the top-level view proves to be a bit too rarified.

***Market Segmentation*** – The vertical axis of a typical Product-Line Roadmap lists several market segments. The goal is to understand how products (and the parts that comprise them) can bridge segment boundaries and enable higher production volumes and greater levels of commonality. Again, start with high-level segmentation (e.g., military vs. commercial, or East Coast vs. West Coast), and then consider adding more detailed roadmaps if they are needed to capture reality.

### **“At a Glance” – The Product-Line Roadmap**

**Overview –**

A visual representation of the “future” of a product line. A time base is provided that typically spans three to five years. Each major product platform is presented, along with any important versions or models of each platform. New product development projects are shown in outlying years, along with terminations of current models. The goal is to capture your firm’s best current understanding of the evolution of a product line.

**Primary Benefits –**

An outstanding tool for identifying cross-product-line cost-saving opportunities. Which models could share parts, processes, suppliers, workcells, capital equipment, etc.? Also provides a critical feed into the strategic planning and portfolio management processes for your firm.

**Best Suited Products –**

This tool can be used for any product type, provided that synergy among products within a product line can offer some potential cost savings.

**Advantages –**

Excellent visual management and communications tool. Allows a team (such as a PLOT) to discuss cross-product-line opportunities and can support the strategic planning process.

**Disadvantages –**

Insight and future visualization skills are hard to come by. Don’t set too high an expectation for the roadmap; it’s really just a strawman to help your teams identify opportunities.

**Impact on the Twenty Cost Levers –**

I. Direct Labor				II. Direct Materials				III. Capital				IV. Design Cost				V. Overhead			
1a	1b	1c	1d	2a	2b	2c	2d	3a	3b	3c	3d	4a	4b	4c	4d	5a	5b	5c	5d
○	○	○	⊙	□	●	⊙	⊙	○	○	⊙	●	●	○	○	⊙	●	●	□	□

**Figure 3.6 –** “At-a-glance” overview of the Product-Line Roadmap visualization tool.

**Platforms –** Platforms are those portions of a product that are shared across multiple models within a product line. A platform can be a large subset of the final product (as is the case with automobiles, for example), or it might be something as innocuous as a package, software module, or enclosure. Capturing opportunities to merge non-synergistic products into common platforms is one of the most useful and powerful applications of a Product-Line Roadmap.

**Extensions –** If you strive for a bit more detail in your roadmap, adding potential product-line extensions is a great idea. These branches can be placed at the approximate times in the future that make sense to your team. A solid line can be used to indicate a “sure thing” (as if anything on this roadmap is really a sure thing), whereas a dotted line would indicate a potential avenue of growth that will need further validation before being addressed.

**New Technologies** – At the risk of cluttering up your roadmap with too much junk, including an indication of when new technologies will impact your product line can be critical for fast-moving industries. You may also consider creating a “multi-view” roadmap in which the same fishbone-style plan is used to illustrate market segments in one view, technological change in a second view, competitive landscape in a third, and so on. Please strive to keep it simple, however. These tools can take on a virulent life of their own, and soon they’ll be sucking valuable resources into a bureaucratic black hole.

**Competitive Factors** – This is another example of a valuable perspective that might represent too much detail for a useful and practical roadmap. How do competitors’ anticipated product introductions impact your market strategy? Are you “me tooing” the competition as a “fast second,” or are you the market leader, with your introductions timed to keep that lead intact? This roadmap addition can help you visualize your priorities and recognize threats before they are upon you.

An example of a Product-Line Roadmap is shown in Figure 3.7. In this version, a three-year time base is used for the horizontal axis, while the vertical axis serves multiple purposes. Above the timeline, the current and planned products offered by XYZ Corp. are represented. Either a Gantt or fishbone format can work well for this type of roadmap, but I prefer the latter approach because I feel it gives a clearer picture of interconnections and dependencies. Current product lines die and new products are born as your firm’s future unfolds. Opportunities to consolidate products into platforms, or to redesign them to enable low-cost customization, are indicated by simple notations. Remember that the purpose of the roadmap is *not* to show explicitly every idea for cross-product-line cost savings. It is simply a tool to help visualize various opportunities; specific recommendations should be documented separately for each new design opportunity.

Below the time base are two of many possible “feeds” that could be included in your roadmap. If your firm has an R&D activity that is distinct from new product development, a section can be provided to show when new product and process technologies might be ready to feed into new product development projects. Likewise, if competitors’ actions are of concern, a few milestones can be included that represent your best guess as to when new and troublesome products will enter the market. Market segments could be shown on either the top or bottom half of the roadmap, depending on how fractionated your markets are. As with all of the tools in this guidebook, there are no dogmatic rules here; feel free to innovate and modify my example in any way that you deem beneficial.

Now that we have some “procedural” tools in place to help your firm identify cross-product-line cost savings, I’ll spend the remainder of Part III describing several detailed strategies with which to arm your design teams. Keep in mind that these synergy-enhancing tools must be considered early in the development process, since they may affect the fundamental architecture of the product. Once we’ve embedded as much product-line-level optimization as we can into our new product design, we will narrow our focus in Parts IV, V, and VI to consider powerful tools for slashing the manufacturing cost of an individual product.

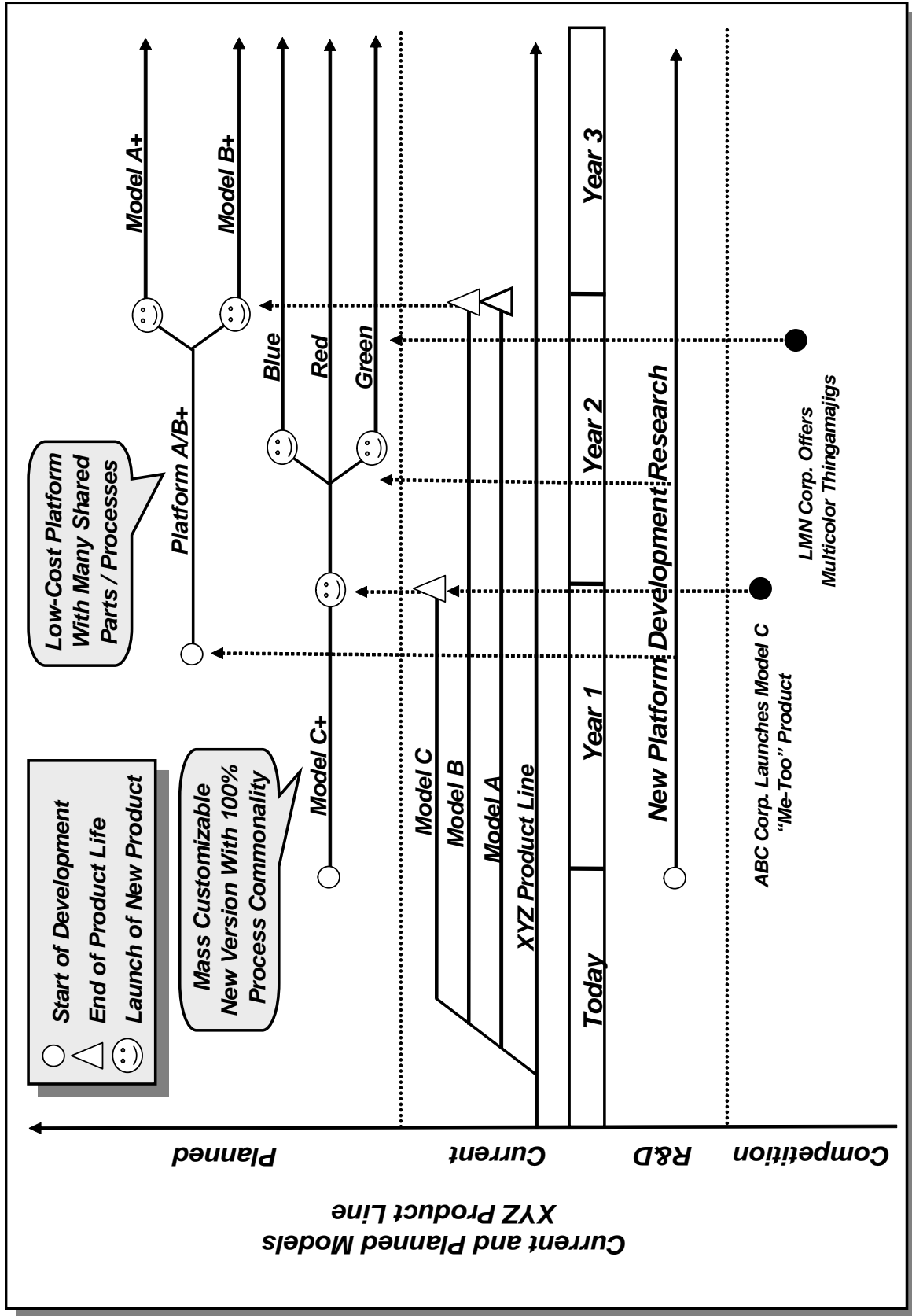


Figure 3.7 – A basic Product-Line Roadmap, showing time in the future along the horizontal axis and various current and planned products along the vertical axis. Note that either a fishbone-diagram format (shown) or a Gantt-chart format can be used.

