Client:
PricewaterhouseCoopers

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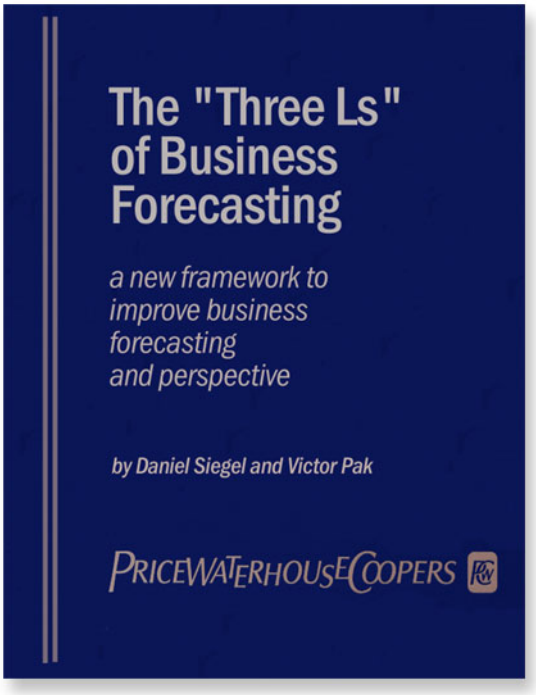
Objective:
Present new theory of business forecasting



I wrote this white paper for two PricewaterhouseCoopers consultants on a new theory of business forecasting. It was published in the company's journal for clients and consultants. At the end is a sidebar on how the theory worked in practice at Adaptec.

COPY

The Three 'Ls' of Business Forecasting

Two Price Waterhouse consultants offer a new framework to analyze business forecasting and improve perspective

by Daniel Siegel and Victor Pak

At one Silicon Valley high-technology company, a new business forecasting model was supposed to help every business unit and department make correct decisions. Instead, forecasts are paralyzing the company. Decisions cannot be made quickly enough and last quarter's disappointing earnings was the result.

The CEO of an east coast apparel company is proud of the detailed forecasts his company generates. Inventory, sales and marketing projections, and financial estimates are all tied together in a complex model that forecasts company activities on a weekly basis. Unfortunately the CEO does not yet know that in the long run, the benefits of generating these detailed forecasts will pale in comparison to the costs.

A European manufacturing company depends upon extremely accurate projections to assure that its just-in-time manufacturing process functions efficiently and that components are available when needed. Still, critical parts are often missing, holding up production and resulting in canceled orders. Other parts are stockpiled for months before being used resulting in inefficient use of capital.

These companies, of course, are hypothetical; but the problems they face are real. They're based directly upon our experience as Price Waterhouse management consultants, assisting companies with what is a seemingly complex and intricate process—business forecasting. Many companies have the right idea—to continually reexamine the methods by which they gather and use information so supply chains can be tighter and manufacturing cycles made shorter.

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Unfortunately, many companies do not adopt the best practices in this critical area. By the time consultants are called in, there may be a process implemented which is too complex, doesn't measure the correct parameters, or has become cost-prohibitive. And in many cases, company executives seem far too concerned with minor details to really see the major issues that need to be addressed. Our approach, therefore, calls for stepping back and examining the forecasting process from a much wider perspective.

Because we have seen so many similar challenges faced by many companies in a wide variety of industries, we began to formalize our approach—to experiment with whether there could be a relatively simple model or framework that could help senior executives address the key issues of forecasting and implement viable solutions.

The model we developed helps bring these complex issues and challenges into focus. It simplifies the study of forecasting and offers a new framework for analysis . It is called "The Three 'Ls' of Business Forecasting."

A new approach to reengineering business forecasting:

With so much riding on what is going to happen in a business and when, can a relatively simple model of the business forecasting process be effective in helping companies design and implement effective forecasting? Our experience suggests that it can.

When reengineering a business forecasting process we probe senior executives with many questions so that we can identify a general, structured framework. The forecast is a 'product'—used by many "customers" in the organization. So in the same manner in which the product development process calls for interviewing customers, ascertaining their needs and then creating products to meet those needs; we use the same approach in developing forecasting specifications. We determine the forecast environment requirements; create the forecast environment specifications, and consult in implementing the processes and systems to meet those specifications.

What's more, most, if not all, of the forecast design specifications can be created by looking at the problem with the new tool—the "Three 'Ls' of business forecasting. These are:

- LENGTH: To establish optimum requirements for how long the forecast runs and for the periodicity, or smallest measurable unit, for its increments (i.e., a one-year forecast in monthly increments or a five-year forecast in quarterly increments)

- LEVEL: To identify the proper position in the hierarchy where forecasts should be based (i.e., business unit, product line, marketing family, SKU, etc.)

- LOCK: To determine the key period during which forecast error requires measurement, so

that the organization can react to this critical period (i.e., one month out, one quarter out, etc.)

Decisions made in each of these three areas have major ramifications for the effectiveness and the cost of forecasting throughout the organization. An analysis of needs based on these criteria is necessary before any forecasting decisions are made.

For each of the "three 'Ls,'" there are many organizational nuances for consideration, so it is useful to examine each in some detail. For an example of how we recently applied this framework to forecast reengineering project, see "Putting the "Three 'Ls'" to Work" on page 00.

LENGTH:
How long is long enough?

It is said that when Abraham Lincoln was asked how long a man's legs should be, he answered, "Long enough to reach the ground—no longer."

Actually, Lincoln's observation has some merit. But each organization within a company will have different needs. In addition, this first of the "three 'Ls'" requires careful consideration of its two major facets—the length of the forecast and the number of periods in each cycle.

Forecast Length: Forecast horizons can be as short as six months for a high-technology company where business conditions change rapidly and where operations are flexible enough to react to unforeseen changes. Or they may be as long as 20 years at a utility company where changing energy demands and the extreme lead-times for developing new production capacity drive such long horizons.

For very diverse companies, two forecast horizons might be more appropriate: one forecast horizon for a periodic forecast cycle and another for an annual forecast cycle. The right selection of a forecast length depends largely upon the application.

Period Size: For companies using a one-year forecast horizon, a period size of months or quarters might be selected. Companies with shorter forecasting horizons do tend to use finer period sizes because their business environment means facing rapidly changing conditions with short product life cycles.

Companies with longer forecast horizon often use larger period sizes because the finer period sizes are not necessary. A utility company with a 20-year forecasting horizon, for example, may use a period size of one year because parameters such as changes in demand and construction of new plants are measured over much longer periods than days and weeks.

Each organization in a firm will have a different perspective on length. In a manufacturing company, for

example, sales might require a six-month horizon and monthly periods to predict bookings and meet sales targets. Operations might require 12-month visibility and quarterly periods to plan products and order raw materials from suppliers. Is twelve months too long? Are monthly periods too fine a cut to expect real improvement in the firm's ability to forecast?

The answer to this question depends on the impact of the functions on the strategic intent of the firm. If, in our manufacturing company example, a major goal is to capture more market share, availability of product and overall demand would be important. A 12-month forecast would be used for product lifecycle planning, but in quarterly periods since the reaction time gained by monthly forecasting would almost certainly be less than the inventory investment over a quarter.

In most cases, operations does tend to drive length because procurement and manufacturing usually require the longest lead times of all of the functional organizations. Yet length is often driven by a company's supply chain flexibility. If it takes a company two years to order raw materials and manufacture products, a minimum two year length is required. On the other hand, if a company can supply their product instantaneously, they would need no forecast at all.

Another important point to keep in mind is that length is not necessarily driven by a company's ability to supply products and services to their customers. It may instead be driven by regulatory or reporting requirements.

For example, a company's operations may only require a three-month forecast, but finance may be required to report a 12-month revenue projection to its investors. In this case, it is important to distinguish between the forecast length and period size used on a regular basis and what may be used on a less frequent planning basis. A company might forecast for six months in weekly increments every week for manufacturing purposes, and forecast for two years in monthly increments once each quarter for its investors. The same is true for any type of long-term planning, such as long term manufacturing capacity planning or product research and development.

LEVEL:
Analyzing the hierarchy

The second of the "three 'Ls'" requires examining a companies hierarchy because forecasts are most effective when they created at the proper level in a hierarchy.

For example, consider the product hierarchy at a company with levels in a being broken down by business division, product line, product class, and SKU.

Forecasts might be created at the product class level and then rolled up by using percentages to product line, business division, and corporate level—and then rolled down by percentages to create SKU level fore-

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casts. Some companies with unique business requirements use alternative hierarchies, such as corporate, continent, region, sales representative, then SKU.

Regardless of how levels are structured, sound forecasting practices require that the sales hierarchy be linked to the product hierarchy at some level in both hierarchies.

A company may have one level where forecasts are started, with forecasts then rolled up or down through the product and sales hierarchies.

To a great extent, determination of the correct level comes from an understanding where the greatest forecast detail and accuracy are required. Each functional organization will certainly have a desired forecast level, but it is usually the functional organization with the lowest required level in the hierarchy that will drive the level for the enterprise.

Generally, rolling up the product hierarchy from the lowest level will satisfy the needs of the other functional organizations. Like length, we have found that the operations function usually has the most detailed requirements for a firm's level. Typically, the level required by operations is associated with the point in the manufacturing process at which inventory is held.

A near-textbook example of a company where selecting the proper level is critical is Dell Computer Corporation. Dell's build-to-order strategy (BTO) has made Dell the industry's hottest and fastest growing company.

In a BTO environment, the manufacturer builds the PC up to a common level, a product-line level for example, and then puts it into stock until an order is received. This triggers the final stage of production where the product goes through limited customization becoming the end product.

Several PC manufacturers have tried to adopt the BTO strategy, but failed to change their forecast level to correspond with the change. For example, in a strategy where the products are built up to the product line level before customization, forecasting at the product line is critical because this is the juncture in the hierarchy through which all products must pass. Forecasting at any lower level would be a waste of resources. In addition, it would fail to take advantage of the fact that forecast error variation is lower at higher levels in the product hierarchy.

Another company might employ a make-to-stock (MTS) strategy, where a finished product is produced and put it into inventory to satisfy incoming customer orders. Thus, the forecast would need to be at the SKU level in order to allow manufacturing to effectively plan production.

From these examples, it would be easy to conclude that level will invariably be set at the point where manufacturing holds its inventory. There are, however, instances in BTO environments where lower level

requirements come from marketing. For example, consider a company where the operations function only requires marketing family as the forecast level, but, due to promotions at the SKU level, marketing drives this requirement downward.

Of course, just because a forecast is started at one level in one hierarchy doesn't mean that it needs to be started on that same level on another hierarchy. In fact, more accurate forecasting has been accomplished in many companies where forecasts start at one level in the product hierarchy and another in the sales hierarchy.

For example, the marketing or business planning department might start at one level in the product hierarchy and create a baseline forecast. Then, another functional organization such as sales might create a market-based forecast at a particular level in the sales hierarchy. The two forecasts are then reconciled and a single forecast emerges as all levels of both hierarchies. Higher accuracy can result from optimizing the forecasting abilities of each organization—and is especially useful in companies which have a diverse range of business units.

LOCK:
When is accuracy critical?

What gets measured gets improved. And that is the focus of the third of the "three 'Ls,'"—lock.

Lock specifies a key period during which forecast error is measured. It does not mean the forecast is "locked" from changing, but that the locked period forecast is saved and stored until the future period occurs so that accuracy can be measured. This period is selected for the time in which prediction accuracy is the most critical.

For example, a company that adopts a forecast length of six months with monthly periods may find that its optimal lock period is during the fourth month. This means that the measurement period will occur four months from the time a forecast is created.

Why not measure all periods? We have found that in most companies, a limited number of lock periods helps focus resources in improving predictability where it is most critical.

While technology does allow us to measure accuracy in all periods, understanding and improving each one is another matter. Because forecast inaccuracies can have different causes depending on the time period, the solutions or fixes are different—making it difficult and expensive to attack accuracy improvement during all periods. Furthermore, there may be no benefit in improving accuracy in a period during which the firm has little or no ability to flex its procurement, manufacturing or marketing muscle. The benefits of improving accuracy in these periods are simply not worth the cost of doing so.

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Each functional organization generally has a different requirement for the lock period—and often at different levels. Because what gets measured, gets improved, it is helpful to look for the measurement period that furnishes the "most bang for the buck."

For example, manufacturing may need to keep vast raw material inventories because forecast inaccuracies mean a greater lead-time is required to produce a finished product. Therefore, by focusing lock period beyond the production lead-time, a measure will be tailored to a clear economic objective.

On the other hand, suppose the marketing function wants to maximize the effect of its promotions by improving accuracy one month out. While this near-term objective may yield benefits to the firm, one must certainly weigh this benefit against the inventory investment needed to be this flexible. Unlike length and level, however, it is often prudent to have more than one lock period, as long as there are sufficient resources to act upon and improve accuracy at each lock period.

Selecting the right parameters

A firm understanding of the concept of the "three 'Ls'" is helpful, but how do executives make enterprise-wide decisions about applying them?

Obviously, the "Three 'Ls'" will be different for every company depending upon industry, strategy, structure and economic factors. While sorting through all of these criteria can be tedious, consider that the forecast is a "product" and treat it as such by interviewing the "customers" for the forecast. In most companies, these customers include those who actually use the product, such as procurement and operations. However, other customers such as sales, marketing or finance may use the forecasts for strategic planning.

Generally, these interviews will yield a complete functional organizational perspective on what the length, level, and lock should be within each area. Some organizations will have more stringent requirements than others; and the more stringent requirement will often be the driver for the enterprise.

In the search for the highest common denominator, the organization with the simplest forecast requirements will receive a forecast that exceeds their needs. At a manufacturing company, for example, the sales and marketing functions may need a length of six months with monthly periods at the level of business unit. Operations, on the other hand, may require a forecast horizon of twelve months with quarterly periods at the level of product family. Obviously, sales and marketing will be satisfied with a forecast of twelve months at the product family level, however, their need for monthly periods should be the driving requirement for that parameter.

Keep in mind, however, that executives in functional organizations do tend to ask for more than they need. This results in more of a "wish list" than a request for what is really important. Stated requirements must

be whittled down to true needs because as requirements become more complex, the company's forecasting process, organization, and system become more costly. To manage ever-growing complexity, tradeoffs must be weighed—between what functional organizations might desire versus what is practical and economical to produce. Here are considerations to keep in mind:

PROCESS: The longer and more finely sliced the length, the lower the level, and the more locks employed; the more time and resources will be required to create a forecast.

For example, using a length of six months in monthly increments means a forecast created more quickly than for one with a length of 12 months in weekly increments. There are fewer periods to consider and fewer data requirements.

From a level perspective, as you go down a firm's hierarchy, the number of forecasting points multiplies. If a company with 10 marketing families averages a ratio of 20 SKUs to a marketing family, there will be 200 points to forecast. What's more, there are also added multiple effects of a highly granular and long forecast length. A quick extrapolation can provide a sense of the cost in terms of time and intellectual effort.

As far as lock is concerned, by attempting to measure multiple lock periods, the organization will divide its efforts between each lock period. By selecting the most critical periods to measure, the number of process steps decreases and the process becomes more focused on core objectives. Furthermore, the further out in the future lock periods are set and the smaller the increments used, the greater the level of uncertainty to be expected.

ORGANIZATION: As in the case of process, the result of aggressive specifications for the forecast environment is complexity.

For example, by selecting lock periods in both the short and long term, the organizational requirements will demand a wider diversity of skills and knowledge, such as an expertise in short-term forecasting versus long-term forecasting.

In general, sales organizations tend to have the best short-term information because they are closest to the customers and their orders. On the other hand, marketing and central business planning groups tend to have the best long-term information.

Skill set and knowledge needs also apply. If a company wants to forecast at a level below SKU, such as SKU by sales region or SKU by sub-component, there would be increased data requirements to support such a forecast.

Similarly, the more locks a company chooses to implement, the greater the staff that is needed to generate

the forecast. In an extreme case, a company with many locks might need an entire dedicated organization to understand how to improve accuracy during all of the measurement periods. Furthermore, if analytical tools are required, a dedicated group may be needed perform the fine tuning on the models.

COMPUTER SYSTEM: The system your company selects to enable the forecast environment is greatly influenced by the selection of the "three 'Ls.'"

First, the longer and finer the length, the lower the level, and the more locks that are used, the more storage data retrieval capacity will be required.

Second, a more aggressive selection of "three 'Ls'" will expand the required functionality of the software package intended for use. For example, consider a length parameter of one year that starts out in weekly periods the first month, then monthly periods for the next five months, then quarterly for the last six month. A software package with this capability will be expensive.

And in typical software packages, forecasts are created at the lowest level and then rolled up to the other levels in the hierarchy by some predefined tables. The more levels which are desired, the more table maintenance will be required, so it is important to consider the cost of the enabling system, especially in large, geographically diverse organizations.

The "Three 'Ls'"—a powerful framework

Using this approach simplifies the analytical process and helps map the strategic landscape of the forecasting environment. As we have shown, by identifying the desired "three 'Ls'" in a company and matching them to what can be supported by its infrastructure and resources, core competencies and capabilities of the firm can be effectively matched to the desired environment.

In essence, this methodology helps identify points in a firm where the marginal cost of satisfying the organizational needs for the forecast match the marginal return to the company of having that information.

If we can provide just one thought to keep in mind when engaging in a forecast reengineering project, it is this: Complexity can kill initiatives, so apply the "three 'Ls'" carefully to keep project priorities, focus and expectations on what is truly important—improving the forecast.

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(SIDEBAR)

Putting the "Three 'Ls'" to Work at Adaptec

A recently-completed forecasting reengineering project at Adaptec, Inc. provides a "real-world" demonstration of how the concept of the "three 'Ls'" might be applied.

Adaptec is a leading manufacturer of hardware and software products that capture, store and transfer electronic information. The company's forecasting system was somewhat disjointed and dysfunctional.

To analyze the company's needs using the "three 'Ls,'" interviews were conducted with executives in the major functional organizations at Adaptec to determine needs.

1) LENGTH: Adaptec executives told us that they forecast in monthly increments for a rolling 12-month period and explained that there was a separate financial forecasting cycle performed once a year with a length of 5 quarters in quarterly increments.

We asked if internal and external drivers behind the demand for their products was an effective match with the length of their forecasts. Could the business change dramatically and require a weekly forecast—or become more stagnant and require a quarterly approach? There seemed to be no logical explanation for the selection of the forecast length and period size because there had never been a formal consideration of these issues. The most common comment? "We have always done it this way."

At Adaptec, our analysis showed that because of manufacturing requirements, only a six month forecast horizon was needed —and that one year forecast horizon for product management and long term capacity planning was sufficient.

For the six month window, a monthly period size was adequate. However creating a monthly forecast in the later months of the one-year horizon seemed unnecessary, was unreliable, and difficult to produce on a rolling monthly basis. In this case, a hybrid solution—with a one year rolling forecast horizon broken down into monthly increments for the first six months, and quarterly increments thereafter was recommended.

2) LEVEL: Adaptec, it turned out, was extremely inefficient at forecasting largely because forecasts were made at just about every level, depending on the business unit and the product manager. Some product managers forecast by SKU; others did so by marketing families. There are no clear formalized policy.

As a result, Adaptec had product managers forecasting by marketing family and then distributing the forecast to a SKU level using fixed percentages. The one common element was that regardless of the level they

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started at, product managers had to roll up or down the product hierarchy to end at a SKU level because this was the manufacturing baseline required for resource planning.

3) LOCK: There seemed to be no focus on any particular lock period at Adaptec. Instead, the nearest forecast was compared to the actual results from that period using a mean average deviation measurement. With no idea (or no consensus) as to which period accuracy and measurement was critical, finding an optimum lock period would create far more forecasting accuracy in the long run.

It turned out that Adaptec needed to increase forecast predictability three months out. The key driver in creating this time frame was the company's ability to accurately predict and procure integrated circuits. Because the IC is the longest lead-time and highest cost component in their products, it was easy to demonstrate that the company's excess procurement of ICs resulted from measuring the wrong period and drove their inventory levels (both on-shelf and work-in-process).

—Daniel Siegel and Victor Pak