DEMAND PLANNING AND FORECASTING IN THE HIGH TECHNOLOGY INDUSTRY

By Jim Langabeer and Tim Stoughton

Forecasting practices have to utilize more sophisticated methods to avoid some of the of the biggest planning pitfalls...overall firm performance will be maximized if the demand forecasting processes are collaborative, sophisticated, oriented towards the product life cycle, and developed using non-constrained consumer demand data.

Most high tech firms are experiencing significantly more turbulence in the operating environment than in previous years. Wall Street has reacted negatively to most dot-coms, as well as to large computer hardware and software companies. The Amex computer technology index has fallen over 40% during the last twelve months. Additionally, the average net profit margin has fallen to a modest 5.6% level.

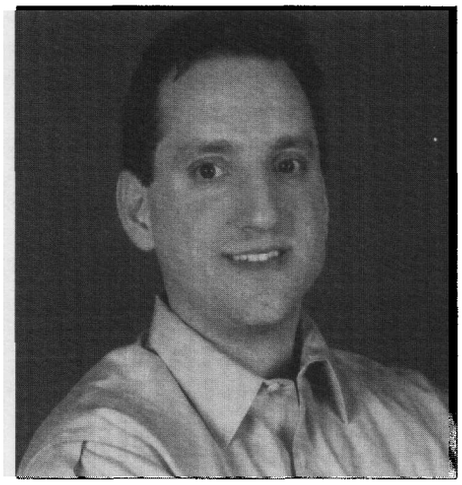
So how can forecasting impact these profitability measures? Those firms that did a better job of forecasting had significantly better control over their inventory and customer service levels. For example, while the average days of cost of goods (COGS) sold held in component and finished goods inventory is 16 days on the average for the hardware industry, those firms that more closely matched their supply with demand predictions reported less than 10 days on the average.

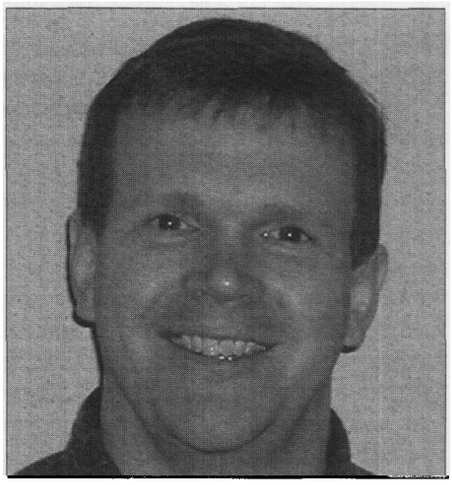
Furthermore, better demand forecasting helped many high tech firms to beat the average of 23.2 for inventory turnover (i.e., the number of times you sell your inventory per year) by nearly 25%.

KEY CHARACTERISTICS OF HIGH TECHNOLOGY INDUSTRIES

Despite the staggering range of products manufactured within such a broad classification, many companies in high technology industries share several common characteristics:

- Markets for high technology products are generally young, sometimes less than a decade old. There is a dearth of historic examples and patterns to analyze for planning future demand.
- Product life cycles are often short, while supply chain lead times for some components are relatively long.
- Tactical planning is crucial, but requires so much attention that the strategic outlook is sometimes neglected. The rapid pace of technological evolution makes long range planning extremely difficult; new developments can create new markets almost overnight, or drive existing products into early obsolescence.
- Demand for high technology products is influenced not only by the state of the economy, but also by fads and cultural shifts that can be difficult to anticipate.
- Consumers are increasingly demanding unique configurations, especially in the computer hardware industry segment, which creates havoc for procurement





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and production planners alike.

- Profit margins often start out high, but quickly fall as competitors enter the new market. Inventory management in the early phases of a new product is therefore very critical.
- Many key components are manufactured by a relatively limited number of suppliers, who may have to deal with several companies engaged in active competition. Failures to manage forecasts and maintain supplier relations are therefore not only injurious to a manufacturer, but also may inadvertently result in an advantage to its direct competitors.

There are some key elements, which produce most of the supply chain headaches for forecasters and demand planners. Those elements are discussed below.

RATE OF TECHNOLOGY DEVELOPMENT

Many people are familiar with the story of how Intel Corporation's co-founder, Gordon Moore, who predicted in 1965 that the density of transistors in an integrated circuit would double every year. This observation became known as Moore's Law. This was later amended to double every 18 months, which has proven to be remarkably accurate for over 30 years.

The Moore's Law produces an incredible rate of improved performance in electronics technology. With nearly every new chip generation, transistors are scaled down by a factor of 0.7. Compared to the previous generation, each transistor takes up only half of the surface area on the chip, can be switched in 30% less time, and requires only a third of the power for operation.

Gordon Moore himself believes that the law may reasonably continue to hold until around the year 2017, when insurmountable barriers based on the laws of physics will put an end to increasing granularity of silicon-based technology. Even so, developments in new areas such as quantum, optical and DNA computing may continue to provide increasing computing power at stable or falling prices, effectively extending the effect of Moore's Law.

Microprocessors are not the only high tech components exhibiting this type of behavior; computer memory (RAM: Random Access Memory) has tracked along a similar growth curve. Hard drive (permanent memory / storage) capacity has also grown while falling in price. Since the first introduction of IBM's magneto-resistive (MR) head technology in commercial products in 1991, real density of disk drives has increased by roughly 60% per year. More recent developments in MR head technology and giant magneto-resistance (GMR) have resulted in even higher growth rates in recent years.

While consumers of technology benefit from these developments, the impact on manufacturers is staggering. A general rule of thumb often cited in the PC industry is that a personal computer simply sitting in inventory loses its value at a rate of about 1% per week, due to the frantic pace of technological development.

At the same time, product life cycles for high technology goods tend to be significantly shorter than those experienced by other industries, sometimes lasting only months. A product's attractiveness to its targeted market may not allow for significant lead times in restocking, and the window of opportunity for competition-free activity may be limited. Accurate anticipation of demand is therefore crucial.

INVENTORY MANAGEMENT

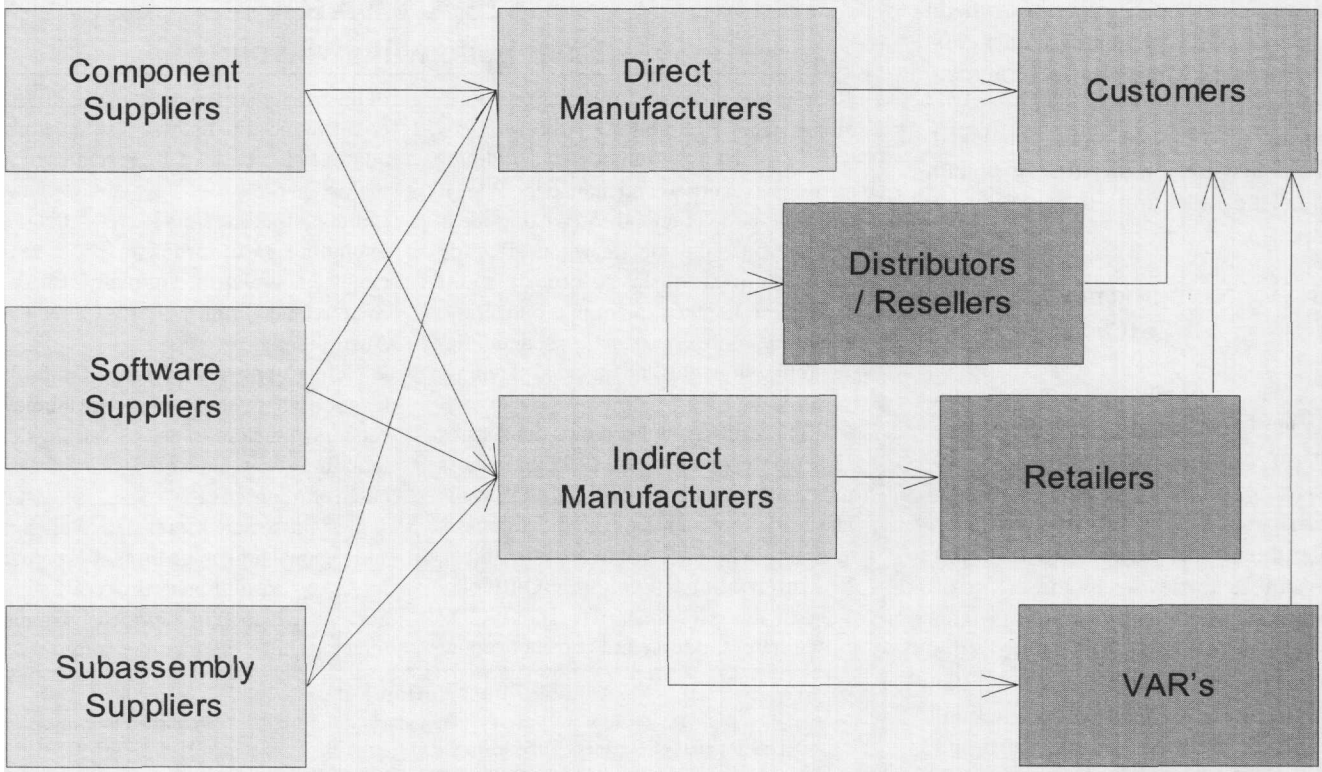
Not only is material parts inventory generally expensive in high technology industries, but also efficient inventory management is often exacerbated by a number of additional factors. Component lead times can sometimes be on the order of weeks to months in duration. Supplier production capacity is often relatively fixed, requiring considerable investment and advance planning. Capital investment is expensive; today a new state-of-the-art chip fabrication plant can easily cost in excess of $2 billion. As a result, additional capacity can generally be added only slowly and in large increments. Shortages are not uncommon, and may be interspersed with supply gluts that last for months but do not permit the build-up of significant stockpiles (again, because of the rate of technological advancement). The market for RAM (random access memory) is a typical example.

A further difficulty particularly apparent in the personal computer industry, though not uncommon with the manufacture of any highly technical and integrated device, is the need for compatibility of interacting components from varying sources. Increasing demand for customized products results in a near-infinite set of combinations of components and peripherals, not all of which can be tested in advance for compatibility. Unforeseen non-compatibility issues can place additional constraints on production and the ability to satisfy demand.

As many high technology markets are relatively young, many component suppliers often deal with direct competitors in the same industry. Additionally, the supply chain has become highly networked and interdependent, as described in Figure 1. Inaccurate forecasts provided by a manufacturer may result in a supplier giving preference to a competitor when supplies are constrained.

The benefits of global sourcing and supply have resulted in improved quality and competitive pricing, but the problems of logistics have grown fairly complex. Scheduling among suppliers and assemblers still requires considerable expertise, while the majority of high-tech components still move through shipping and bulk delivery channels that may be cheaper, but are not significantly faster than they were decades ago. Management of channel inventory is a serious issue for indirect manufacturers. While direct manufacturers can avoid this problem, they must still deal with the ramifications of the indirect channel; excess inventories there often result in drastic price cuts with a dramatic influence on demand.

FIGURE 1
TYPICAL HIGH TECHNOLOGY SUPPLY CHAIN



DEMAND MANAGEMENT

Another category of issues in demand planning for high technology industries is the seasonal nature of demand itself. Consumer demand for high technology products is strongly seasonal, often linked to the fourth quarter holidays and falling off sharply in the second quarter and the summer months. Business demand follows other seasonal effects, and may be sensitive to quarterly and yearly capital budgeting, tax and accounting issues. Business demand also tends to be more susceptible to spikes, as companies replace their entire installed technology bases at once in order to maintain compatibility.

As technologies mature and become more integrated aspects of society, demand for these products becomes more sensitive to the conditions and outlook of the economy. Technologies experiencing the earlier phases of introduction and acceptance are often immune to economic downturns — demand may slacken only slightly in response to a recession, if at all. The transition from novelty to commodity can occur abruptly and with little advance notice, especially if the economy has been reinforcing demand throughout the entire life cycle of a product. Furthermore, it is not always clear when a product will reach saturation in market penetration, nor at what percentage. Both of these may be influenced by the presence or absence of competing technologies.

Cyclical influences also have an impact on demand, driven by replacement cycles in both hardware and software. A new must-have software application, or "killer ap" can suddenly appear either in the business or consumer markets, fueling a sharp surge in demand for hardware capable of running or supporting it. In 1995, anticipation of Microsoft's introduction of Windows 95 led many consumers and businesses to postpone the purchase of new PC's until after the product had been released. While net overall demand remained relatively stable, there were dramatic shifts in seasonal patterns during the weeks surrounding the release.

Innovation and new technologies continue to develop, with ongoing progress almost a given, but they do not appear on a smooth and regular schedule. Product delays, engineering issues, parts shortages, and newly discovered "bugs" (the infamous "Pentium bug" that plagued Intel in the fall of 1994 being only one example) all add to the irregularity in cycles of growth and decline for high technology.

Additionally, forecasting practices have to utilize more sophisticated methods and models to ensure that they avoid a few of the biggest planning pitfalls:

a) Predicting future demand using the "constrained" historical demand, which usually is the result of severe shortages in components and configured models.
b) Estimating demand by using price (as

an indicator of product maturity in the life cycle) to guard against over-building inventory in a product's final stages of the life cycle.

c) Utilize collaborative processes where retailers, distributors, and manufacturers can reduce the whiplash effect common in the high tech networked supply chain. Sharing of the same operational and sales data will allow all parties to obtain a realistic, and unified view of the market.

PLANNING PERFORMANCE METRICS

The pace of product development and the urgency of tactical considerations often result in a haphazard approach to measurement and process control. Flexibility and adaptability are key considerations, and there is little time and few resources to devote to the effort of streamlining processes or archiving data about their performance. The nature of the products and their markets leave little choice in the emphasis on a tactical perspective, but this comes with an associated cost. The lack of stability impedes efforts to monitor processes for ongoing optimization. Short timeframes and more pressing issues contribute to this problem. The reliable historic data is difficult to find even when the resources to analyze it are available.

In order to improve upon these significant issues impacting the supply chain, planning units within high technology firms must focus on a few key performance metrics. These include such metrics as inventory turnover, retailer service levels, consumer service levels, and converted demand percentages (e.g., when an e-shopper selects an item but finds it is out of stock, but is offered a comparable unit instead). Focusing on these will help firms adequately balance supply and demand and maintain an overall effective supply chain.

SUMMARY

High technology industries are in for a rough time in the immediate future. Incorporating consumer demand to align the networked supply chain is essential to the company's success, but improving the forecasting and planning processes is difficult, given the structural characteristics of the industry. However, it can be achieved, and the supply chain performance metrics (and overall firm performance) will be maximized if the demand forecasting processes are collaborative, sophisticated, oriented towards the product life cycle, and developed using non-constrained consumer demand data. When high technology companies achieve these effects, the end result will be a more positive correlation between improved demand planning and overall firm performance. ■

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