

# Demand Forecasting in the Information Technology Industry

Kuldeep Gharat (04305010)      Tejaswi N (04329016)      Kaushal Mittal (04329024)  
Sandesh Tawari (04329014)

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## 1 Introduction

Forecasting what's going to happen in the future has never been easy, but in today's fast moving and often volatile world, predicting future events is more difficult than ever. Anyone involved in decision making needs to base their decisions on what has happened in the past, what's happening now and what they think will happen in the future. In this report we will focus our attention on forecasting demand in the IT industry.

## 2 IT Industry

Information technology (IT) is a broad field that covers all aspects of managing and processing information. IT professionals design, develop, support, and manage computer software, hardware, networks, telecommunication and the Internet. From the exuberant growth of its early years to the uncertainty of recent times, the IT industry has stabilized now - and continues to evolve in order to meet the needs of society. These needs keep fluctuating as trends, people's desires, economic conditions and other parameters change in this changing world. To keep themselves profitable,

The IT industry can be roughly divided into four major sectors: Services, Products, Consulting and Internet Businesses. In services, IT firms mostly have long term relationships and partnerships with their customers. Here, the IT firms mostly deliver custom solutions to their clients in various areas of their clients' operations like Supply Chain Management, Inventory Control, Financial Software, Insurance, etc. Products based IT industries sell units of products in the general market place like any other commodity. One aspect of the IT product sector that separates it from conventional products is the idea of premium upgrades of products. Products are sold at some price, and their upgrades are also sold at a premium price capitalizing on people who like their core product. IT components like Small Financial Packages, System Tools like Operating Systems, Computer Games, etc. Consulting in the IT sector involves specialist consultants who salvage lost projects, streamline processes, maximize productivity, bring in niche domain knowledge and the like. Internet businesses work on advertising money. There is a recent trend in the pay-per-service kind of model being used, but advertising is still the most important source of business and revenue. These companies offer services on the Internet and attempts to maximize their customer user base. Most times, this service is free to the mass user base. The firm charges advertisers who pay money to promote their products on the website where the service is offered. Internet Email, Search, Yellow Pages, Dating, etc are prominent in this sector. Due to the disparate nature of their businesses, these four types of companies do not and can not forecast demand the same way.

The companies that form the IT industry are of various sizes: in terms of market share, number of employees, cash flow, profits, and various other parameters. Across these parameters, there are roughly three types of companies. There are these established firms with strong clientele or customer bases at one end of the spectrum. At the other end, there are startup companies that are small, mercurial, hoping to strike big. Lastly, there are companies that come in between these two. All these companies forecast demand for their deliverables and try to meet this demand by making suitable decisions in their management, HR, and financial spheres.

### 3 Forecasting in General

In general, Forecasting proceeds through three stages:

- Analyse the past to try and spot trends and patterns in the data.
- Project these trends and patterns in to the future (extrapolative forecasting).
- Modify the projected data based on our own experience and judgment (qualitative forecasting).



Figure 1: The Forecasting Process

#### 3.1 Extrapolative Forecasting

Using time-series analysis, its possible to extracts trends from your past sales data, breaking it down into four principle components:

##### 3.1.1 The Trend Component

Regardless of other fluctuations, there is generally an overall sales trend. Over a period of time, sales may be increasing, decreasing or remain static. Typically, changes in sales growth rates are caused by new technologies, population dynamics, changes in tastes, changes in the firm’s marketing strategies, competition in the market place, etc. Established companies have an advantage here as they have volumes of historical data on which they can do time-series analysis and the like.

##### 3.1.2 The Cyclical Component

Sales are often effected by swings in general economic activity as consumers have more or less disposable income available. These fluctuations normally follow a wave-like pattern being at a

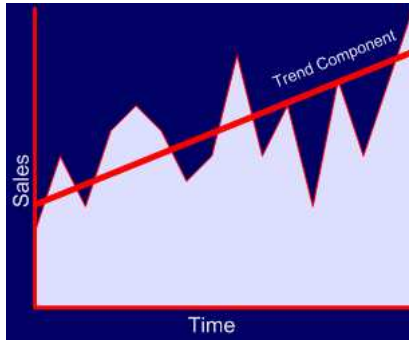


Figure 2: The Trend Component

crest when the economy is booming and a trough in times of recession. For these changes to have any significant impact on demand forecasting, they have to be long term in nature. The IT recession of 2000-2001 is a benchmark against which factors leading up to recessions can be compared with and analyzed.

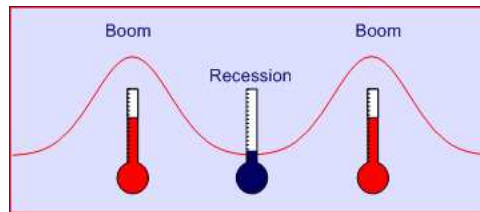


Figure 3: The Cyclical Component

### 3.1.3 The Seasonal Component

During the year, whether its on an hourly, weekly, monthly or quarterly basis, there is normally a distinguished pattern to sales. The Seasonal Component is generally effected by such things as the weather, holidays, local customs and general consumer behaviour. Internet sales companies like Froogle (<http://www.froogle.com/>) and Yahoo! Shopping (<http://shopping.yahoo.com/>) have significantly heavier sales during the holiday season, and this is always a main factor in their demand forecasting efforts.

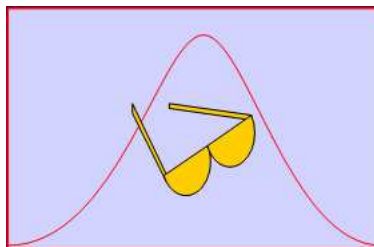


Figure 4: The Seasonal Component

### **3.1.4 Erratic Events**

Having extracted the three components above, what's left over is data that cannot be accurately predicted, such as strikes, floods, fads, riots, fires, etc. These events are generally random in nature and are difficult to forecast using statistical methods. However, they can, and should be considered using the qualitative forecasting methods described below.

## **3.2 Qualitative Forecasting**

Forecasts shouldn't rely on statistical methods alone. While they can give useful insights into what might happen in the future, there are no guarantees that past trends will continue. New technologies, markets, products, competitors and changes in marketing strategies or in the economic or political environment can all effect future sales. Furthermore, new business will inevitably have insufficient historical data for extrapolative forecasting to be effective.

There are various qualitative forecasting techniques that, when combined with extrapolative forecasting, can improve the accuracy of your sales forecasts. They include:

### **3.2.1 Visionary Forecasting**

This method uses personal insight, judgment and when possible facts about future events. It is characterised by subjective guesswork and imagination. If used alone, this method is generally inaccurate, but if used to adjust forecasts based on statistical methods, it can be relatively effective.

### **3.2.2 Panel Consensus**

This technique is based on the assumption that several minds are better than one. Groups of people who can give sensible estimates of sales, such as sales representatives and brand managers, discuss sales expectations and arrive at some consensus on which to base the forecast.

When using Panel Consensus forecasting, you should bear in mind that social pressure, peer pressure and emotional attitudes displayed in small group behaviour can effect the results of the forecast. Furthermore, research suggests that groups are less risk-averse than their component members.

### **3.2.3 Delphi Technique**

This approach to forecasting was developed by Olaf Helmer and others at the RAND Corporation in the 1960's. It is similar to Panel Consensus, but rather than meeting together to debate future sales, the experts are kept apart so their judgment isn't influenced by social pressure and the negative aspects of small group behaviour.

The process relies on questionnaires to collect the opinions of the experts, while statistical summaries of each series of questionnaires provides controlled feedback about the opinions of the other panel members. The statistical summaries enable the experts to re-evaluate their opinions in the light of the general consensus, thus gradually narrowing the range of estimates until an acceptable consensus is reached.

### **3.2.4 Historical Analogy**

Similar products and markets often display similar growth patterns or life cycles on which you can base your forecast. In product based companies, the S-shaped product life cycle is a typical example. It is generally divided into four stages:

**Introduction** - a period of slow growth while the product is introduced onto the market.

**Growth** - sales rapidly increase at an increasing growth rate as the market accepts the product.

**Maturity** - sales increase slowly but with a decreasing growth rate. The product has now been accepted by the majority of the people that are likely to buy it.

**Decline** - a decline in sales caused by changes in tastes, increased competition or a shift away from your product towards a new or improved product.

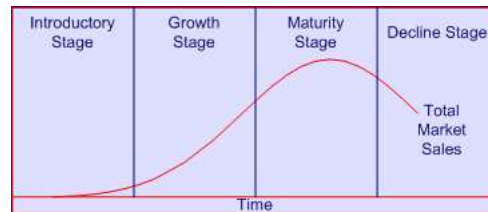


Figure 5: The Product Life Cycle

## 4 Forecasting in IT

Due to the nature of the IT industry, traditional forecasting techniques cannot be used directly. The IT industry bring in a few challenges to the are of Demand Forecasting. Modifications to old techniques and sometimes, entirely new techniques need to be employed to overcome these challenges and effectively forecast demand.

### 4.1 Challenges

Due to the nature of the IT sector, there are many challenges that the the demand forecaster faces when tackling it. These challenges are a result of the all pervasive nature of IT, low innovation costs, global economic differences, etc.

#### 4.1.1 Sources of Information

Unlike conventional industries which operate on sources of information that are restricted, the IT industry has access to information on products, sales, demand, and other economic parameters that far exceed its capacity to process it. Demand forecasteting techniques, when being applied to the IT industry now need to identify the right sources of information amidst this plethora of available information and use them judiciously. One such information source that is typical in the IT industry is sales duration. The amount of time it takes for a sales person to sell an IT based product to a customer is an indicator of the demand of that product. This is especially true in the service sector because of its long sales cycle. The challenge on the sales team, other than the sale itself, is to document this sales procedure thoroughly so that demand forecasting techniques can be applied on this data to analyse sales cycle information.

### **4.1.2 Market Place**

Conventional market places have been replaced in the IT industry to some extent by next generation market places like the Internet. The Internet has changed the way IT firms operate. Every IT firm worth its salt has an E-Business wing that handles and tries to exploit the Internet market place. With information on the overall market in each segment being readily available, forecasting can be more accurate.

Additionally, services and product companies work in the unique market place of global interaction. Products are sold across different countries. Services are similarly offered to different countries. Outsourcing by developed countries is catching up in a big way. Other industries can also use this advantage, but IT has an edge because of the relatively low costs of innovation and development of products and services.

### **4.1.3 Price/Promotion**

Changes in the selling price and the presence of product promotions are known to have a significant effect on demand in many industries. Today, in large part due to the proliferation of information and other technologies, price changes are less costly. They are even less costly in the Internet Sector as everything is managed electronically and changes are reflected very quickly to the entire consumer base. Even the logistical overhead of changes in pricing is low.

Product promotions are getting very sophisticated. Targeted marketing, and ultimately one-on-one marketing, has created complications in the analysis of promotion effects. Demand forecasting techniques that analyse promotions to predict short term demand surges have to adapt to these new promotional innovations. Information on past products, their promotional efforts, and the resulting sales need to be documented at a very microscoping level to leverage them in the forecasting process.

### **4.1.4 Product Supply Chain**

One of the serious challenges facing a demand forecaster in the e-business environment is ever shortening product life cycles. In many industries, a product can be expected to have a life of at most one year. To be able to use historical data, the firm should store a product hierarchy that gives the forecaster an idea of what historical product's data is needed to extrapolate demand for a new product. This calls for stricter information management of product chains etc.

### **4.1.5 Customers**

The IT industry is as diverse as it is because of the inherent diversity in its customer base. As demand depends directly on customer desires and necessities, a heterogeneous customer base makes demand forecasting very challenging. Customers include banks, huge corporations, governments, smaller companies, families and individuals. Each sector of the IT industry needs to have its own analysis techniques to predict customer behavior. This is one of the primary reasons why demand forecasting in IT industries is not formally well defined.

The Internet enables a more accurate mode for customer profiling. With appropriate privacy preserving mechanisms in place, firms can target the right customer for the right product, trace customers' buying patterns, use demographics data and the like to come up with detailed parameters for demand forecasting. Data mining techniques can be used to develop accurate models.

## 4.2 Solutions

The emergence of any new sphere of human activity brings with it, its own set of challenges. But as in the past, these challenges are analysed first, and eventually overcome. Currently, demand forecasting faces many challenges in the IT sector due to its diverse nature of business and customers. These are currently being evaluated, and new techniques and tools for demand forecasting are being developed. Some of them are:

### 4.2.1 Information Processing

Information processing is IT industry's forte. So, as time progresses, the demand forecasting related information overload problems will be completely solved by the industry. Some emerging techniques in this space are Data Warehousing and Data Mining. All transactions, sales, customer interactions, and various other forms of data are stored in Data Warehouses and Data Mining techniques are applied on them to find non-trivial patterns that can give any indications of future demand. Internet businesses like Search Engines, Shopping portals and News vendors store all user behavior logs in their systems. These systems do not crash inspite of handling information in the tera byte range. This is the first step in doing better demand forecasting: better information management.

### 4.2.2 Fine-Grained Forecasting

Demand forecasting needs to be done at a very low grained level to take care of all the facets of the IT sector. For example, technology startup companies cannot forecast demand for their innovative products because there is no historical data for the particular innovation that they have developed. They mostly forecast their cost, revenues, and based on how these are developing over time, they forecast demand for their products. They forecast fixed costs and variable costs of operations to estimate their profits and cashflow as this will directly impact their short term future investments, and hence their overall success.

The interesting aspect in demand forecasting at startups is that they invariably have two forecasts. A conservative forecast that will keep them operating for sometime, with sales, recruitment, and mostly conservative innovation running smoothly. An aggressive forecast that reflects their big dreams is also done that includes sweeping sales, heavy recruitment, and sizable cash flow. These two forecasts need to go hand in hand, and if either of them dominate the other during decision making, the startup is headed for trouble. Gross margin and operating profit margins can be used to assess the growth and health of the startup and more weightage to either of the forecasts can be given based on progress.

### 4.2.3 Sensitivity Analysis

Sensitivity Analysis is a common practice in IT industry for forecasting the demand and sales for its products and services. As discussed earlier, there is always a lack of historical data in the IT industry due to its dynamic nature. Sensitivity Analysis of Demand is the investigation into how projected demand varies along with changes in the key assumptions on which the projections are based.

According to a former project manager at TCS - a large IT consulting and services firm in India, this technique is mainly used to take into account various parameters and predict the revenue that can be generated in upcoming quarters. Revenue is the direct indication of the effectiveness of demand forecasting. Parameters that are considered in this technique are new technologies, product requirements, market trends set by their previous products, customer

feedback, market survey reports, expectations and feedback of their current clients, etc. and predict the revenue that can be generated in the next quarter. It also includes the effect of future plans. For services companies like TCS, demand lies in their clients requiring their solutions. They predict the effect of having an employee trained in a particular technology over the demand of the solutions that can be developed in that technology. This forecast helps them to hire the right set of people at the right time to attract and handle a large amount of work.

#### 4.2.4 Software Economics

Software economics is the study of how scarce project resources are allocated for software projects. The process of counting function points, gathering data, analyzing data is commonly referred to as Software Metrics, but in reality is a branch of economics which should be called Software Economics. Marginal Costs are studied closely during software project management. As the size of a software project rises, the unit cost (or average cost) rises. In other words software has increasing marginal costs and there are few economies of scale when developing a software application. Any large engineering or construction project follows this same economic model.

In all software projects there are some basic principles which cause diseconomies of scale in the technical aspects of Software Engineering. They are:

- There are low fixed costs relative to variable costs
- Communication becomes difficult as project becomes larger
- Multiple logical paths grow in a nonlinear manner as size increases
- Interrelationships of functions grow geometrically as project becomes large.

Many of in the field of software development limit their understanding of the field to only the technical aspects. But other influential non-technical aspects like psychology of individual employees, social psychology of an organization, Organizational Behavior, economics of individuals, etc need to be considered while managing costs and profits from the inside.

## 5 Conclusion

Due to the dynamic and pervasive nature of the IT industry, standard techniques for demand forecasting have not been formalized as yet. As various industrial models stabilize and historical data becomes clear and easily available, demand forecasting will evolve into a more accurate and deterministic science than the intuitive art that it is right now. In this report we have looked at the nature of IT industry, the smaller diverse components that constitute the industry, standard demand forecasting methods, challenges which the IT industry brings along during demand forecasting, and a few ideas to overcome these challenges.

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