In recent times, the demand forecasting function has become an increasingly complex, but vital discipline for planners to master in consumer-driven supply chain organizations. Yet, a proficiency in applying an effective forecasting process to the job is still missing in most supply chain organizations. Many organizations still operate under the simplistic notion that a forecast is "just a number". Moreover, they often fail to recognize the essential difference between an unbiased demand forecast and a balanced supply/demand plan for a consumer-centric supply chain. In this presentation, I will examine and challenges some of the common myths surrounding best-in-class practices for achieving improved forecasting performance.

Along the way, I will describe a pathway for making quantitatively- challenging processes more accessible and useful to supply chain practitioners. Illustrated with practical career experiences, he will outline a four-tiered program involving (1) the 'big data' issues of data quality and analysis, (2) the 'predictive analytic' process for selecting statistical forecasting solutions, (3) the approach to forecast evaluation and performance measurement and (4) the reconciliation of models and demand forecasts to support an effective integrated business planning process.

I have been involved in demand forecasting and demand planning for about forty years

I started my career as an applied statistician or data scientist as it might be called today, working first at Bell Laboratories and then AT&T, the parent company. At AT&T I gained my first experience in demand forecasting as a **forecast manager** responsible for the corporate administrative forecast as it was known then.

My objective is to describe how demand forecasting has changed from the early days to the present and what it might become in the future

Particularly, I would like to discuss how I see it changing in the future, especially from my recent experiences conducting demand forecasting and planning workshops for supply chain practitioners that participate in the CPDF training and certification workshops.

I will be talking about what turns out to be a collaborative forecasting process involving **all** Integrated Business Planning Practitioners in supply chain.

To go forward, I will begin with a backward glance.

Bell System

(I started this professional journey in 1970)

- The Bell System – An incubator for effective demand forecasting since the 1950's
- 1963 - First system standard forecasting practices published
- 1967 - High-level directive to create professional forecasting organization staffed by trained, qualified people – the die was cast!
- In the early 70's, a customer service crisis leads to the recognition of a *demand-supply gap*
- Development of a forecasting process based on statistical approaches (data analysis, time series models and graphics)
  - A quantitative focus
  - Data-driven methodologies
  - Multiple economic, demographic and regulatory drivers, etc.
  - Structured, job-related training

Bell System

I started my professional journey with the Bell System in 1970.

AT&T, the parent company in the Bell System, was a microcosm, the very large corporation in the US, with no significant competition.

As a regulated telephone utility, it benefitted tremendously from the technology transfer from its research arm Bell Labs, which included the transfer demand forecasting knowledge.

As a result, it was very much a best practices operation, with standards, job descriptions and guidelines as to how to do the job with formalized training.

That ended with the breakup of the Bell System in the early 1980's through a government *mandate,* called the *Bell .System Divestiture*

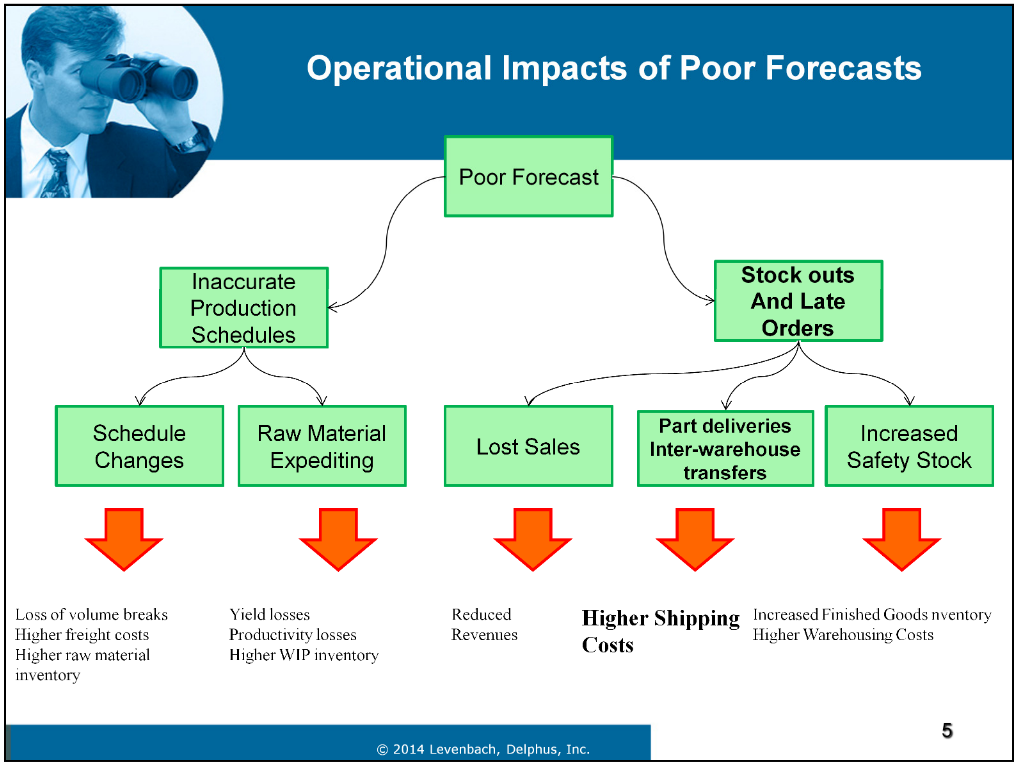
Agenda

- A Forty-Year Professional Journey

Why Demand Forecasting ?

- A Collaborative Process for Demand Forecasters & IBP Planners:
  - Preparing Healthy Data
    - Data Analytics: Data Mining, Data Exceptions and Data Quality
  - Executing Data Analytic Modeling Methodologies
    - Predictive Analytics: Methods versus Models
  - Evaluating Performance Diagnostics
    - Performance Measurement : Myth of the MAPE
  - Reconciling Multiple Modeling Pathways
    - Demand Link Forecasting and Supply Chain Partnering

Before addressing the **future** of demand forecasting, let me first focus on the **current impact** of forecasting on the business



If you start to look at the impact of bad forecasting on a business, you can quickly see why demand forecasting is so vital to a supply chain organization

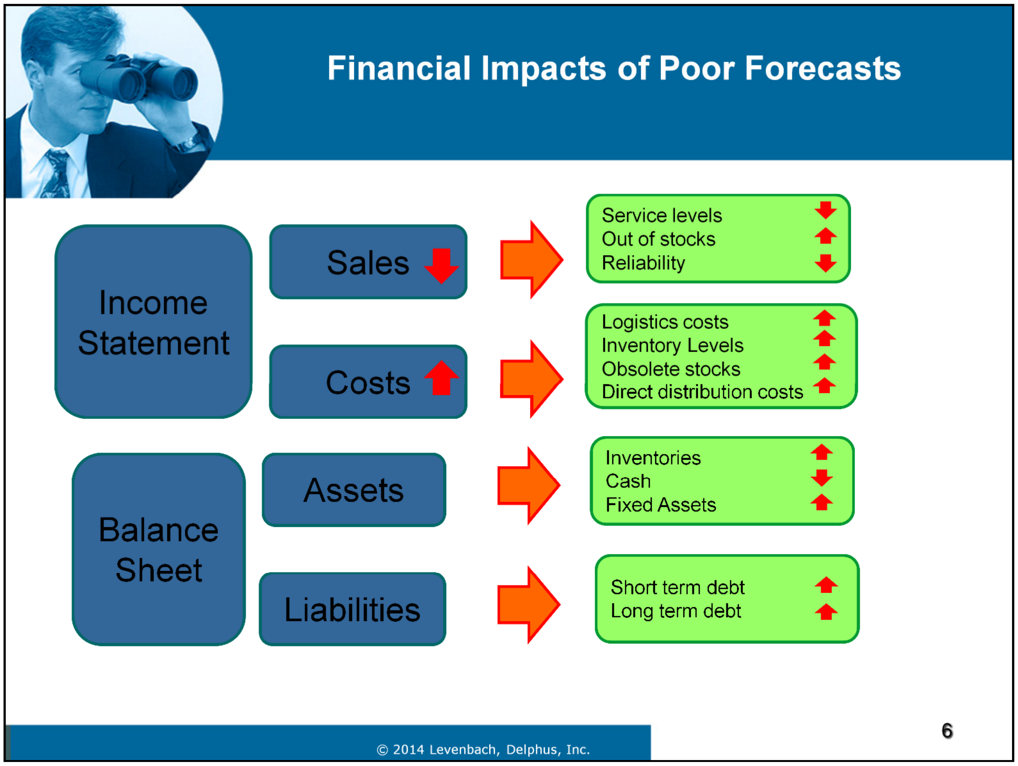
For example,

Poor Forecasts influence ➔

Stock outs and Late Orders Which in turn impact ➔

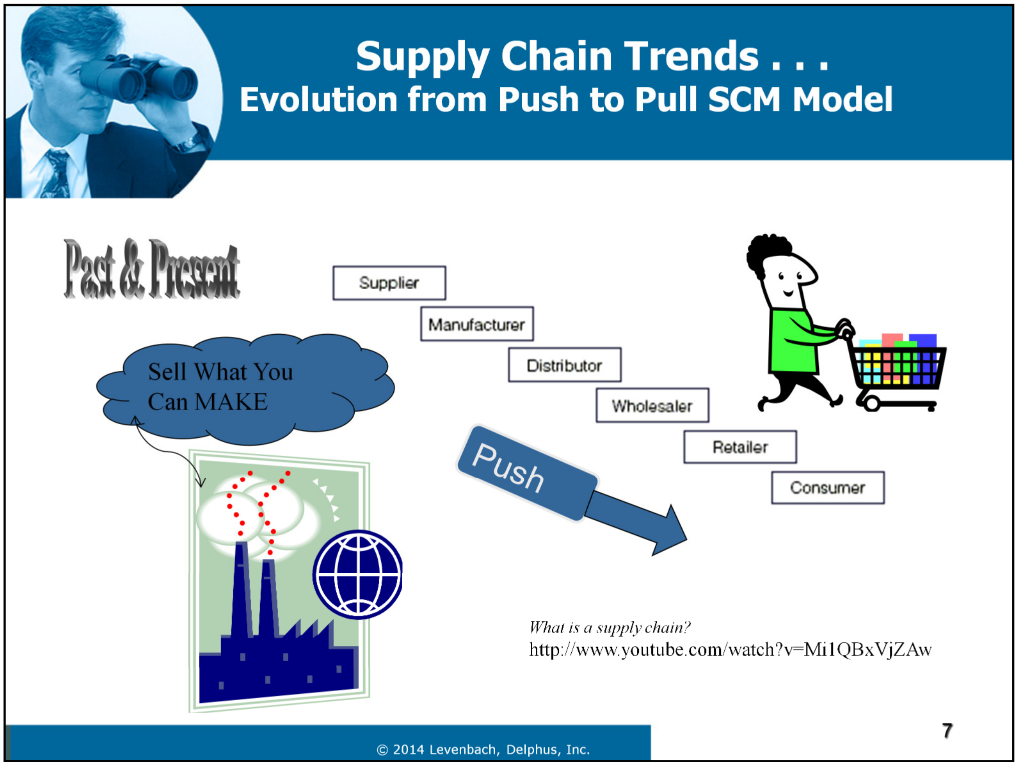
Part Deliveries and Warehouse Transfers and ➔

Higher Shipping Costs.



Besides operational issues, you will also find financial impacts on the business as a result of poor forecasts.

For example, on the Income Statement, Costs will impact all sorts of costs to the business including Logistics



So, what has changed over the years?

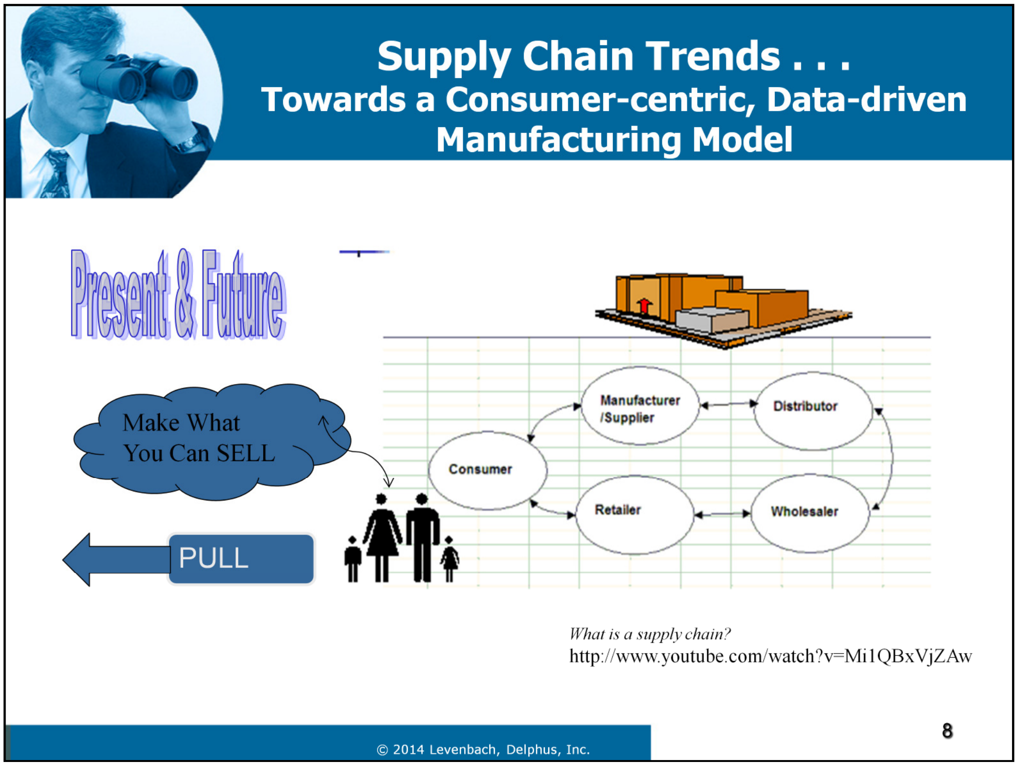
The supply chain has changed from a **push model** to a **pull model**.

That is to say, companies used to SELL what they can MAKE, in contrast to a more consumer-centric model that says you should MAKE what you can SELL.

As an example of a ***push*** *model*, Henry Ford used to ask his customers what they would like to see in transportation, and their response was A FASTER HORSE.

Instead, he streamlined the assembly line and sold his customers any kind of transportation they desired as long as it was his black, model T automobile.

In my own experience, in the Bell System, you could get any kind of telephone you like as long as it was the black, rotary dial model manufactured by Western Electric, the manufacturing arm in the Bell System.



In a ***pull model*** of the supply chain, shown here, consumers are KING, so there is a flow of information about consumer needs to manufacturer/supplier in a counter-clockwise direction with a corresponding flow of goods going clockwise in the chain.

Also, there is the possibility to go directly from manufacturer to the consumer, as we experience with shopping on the internet

In this model, you MAKE what you can SELL.

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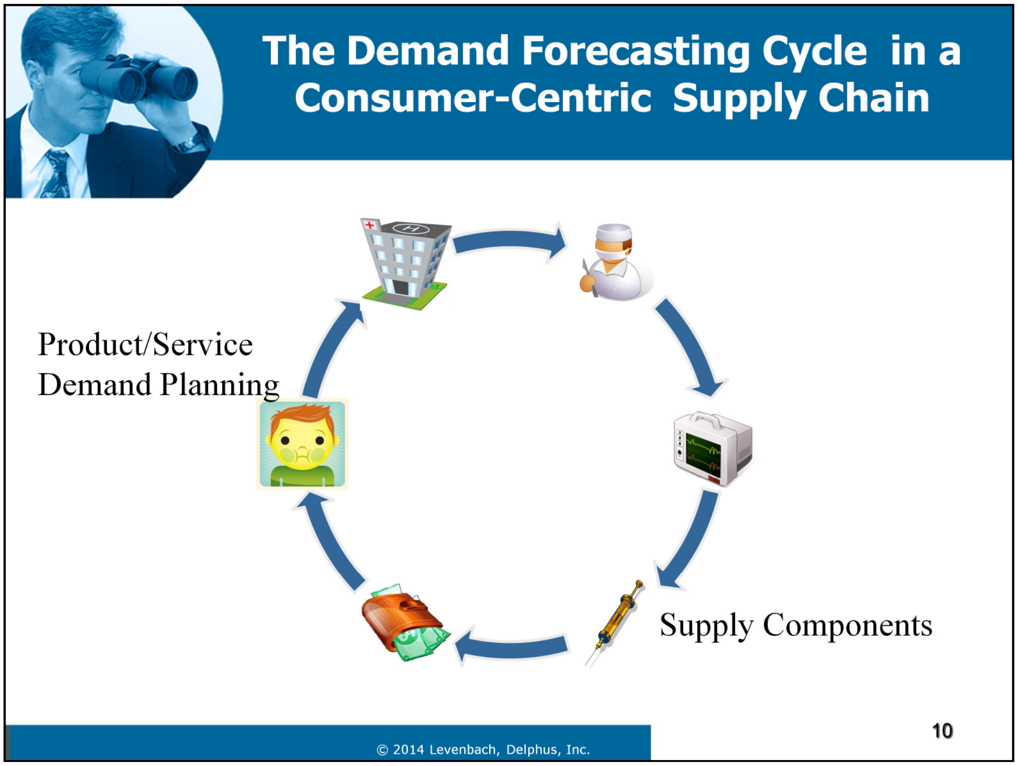
Next, I want to talk about how to organize oneself in the future for a changing role of demand forecasting in the supply chain.

In essence, a company needs to establish a ***collaborative*** demand forecasting process working closely with all the planning functions in the company.

This forecasting process can be described to have four stages, which I call the PEER Process, consisting of Preparation, Execution, Evaluation and Reconciliation.

I will give some examples of each stage of the cycle



To illustrate this consumer-driven process in terms of what happens to patients admitted to a medical facility, you can look at what hospital administrators are responsible for: They need to forecast the ***admissions*** of patients and managing the supply chain.

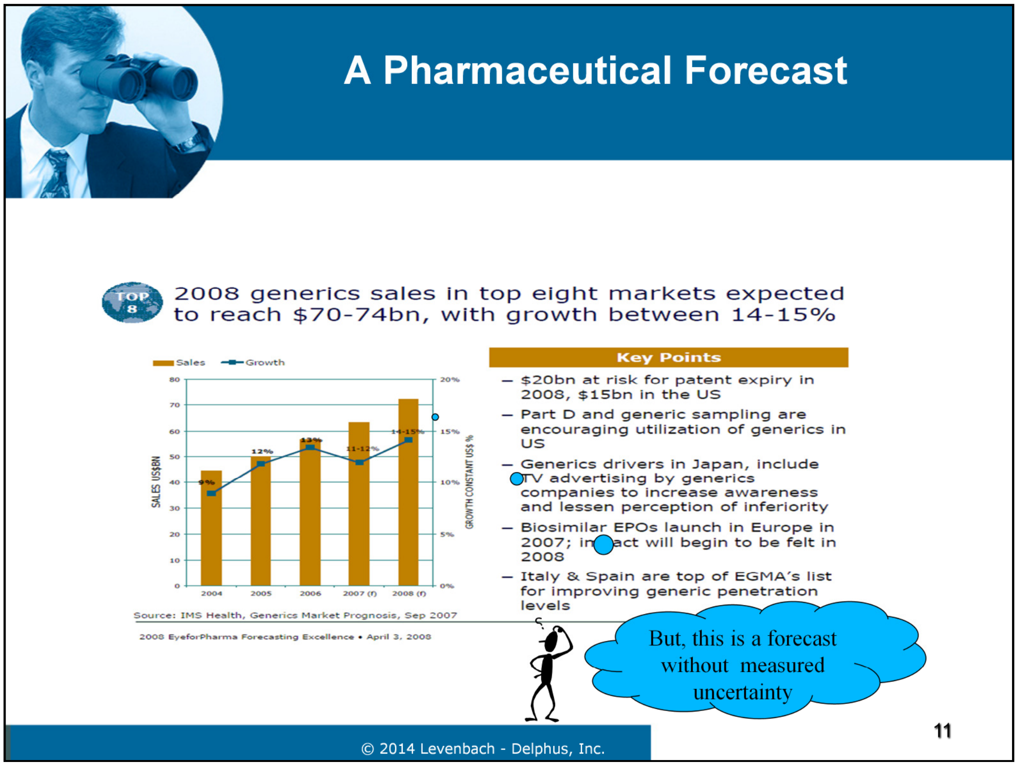
In this example, a *stock-keeping unit* is a hospital admission of a patient.

The *product* lines are characterized by the parts of the body that need medical treatment. A *service* category would be things like surgery, medicine, maternity, psychiatry and neonatal care.

As the patient gets treated by medical practitioners, like being processed through manufacturing stations; the patient requires medical supplies from inventory.

After passing a quality control stage, the patient is discharged from the hospital and the cycle is complete.

In forecasting the *demand for admissions* at a hospital, hospital managers firstly have a the need for accurate, timely data (patient records), secondly there is the execution of appropriate medical procedures or clinical pathways, (3) the evaluation of charts, and lastly, the reconciliation of multiple clinical pathways to lead to a successful outcome.



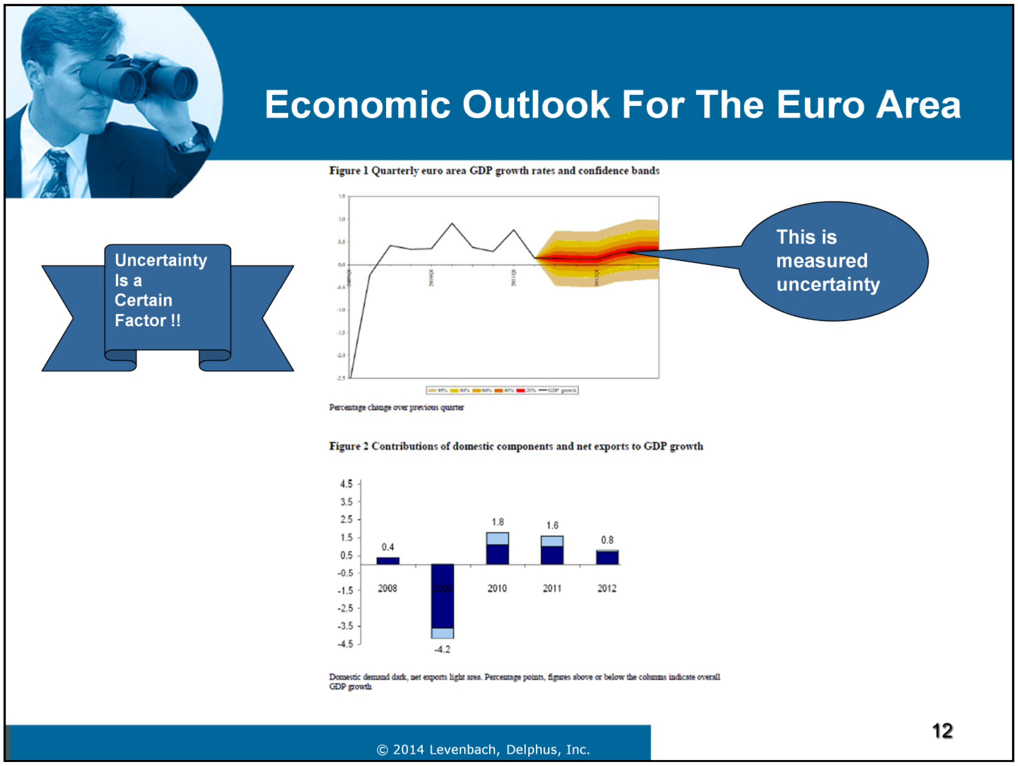
There are analogous steps to a periodic *demand forecasting cycle* in supply chain organizations like manufacturing, distribution or retail firms

What are the key ingredients of a demand forecast?

Using a demand forecast I saw presented at a pharmaceutical forecasting conference, you can see there are charts of data about historical trends, and expected growth rates. This is supplemented with key assumptions and background information in a narrative description of the forecast.

What is typical is that forecasts are expressed simply as NUMBERS without explicit statements of the inherent uncertainty.

However, ALL demand forecasts, as we know, are uncertain.



In contrast, economic forecasting , which has been around a longer time than demand forecasting, **uncertainty** is typically quantified as you can see by colored bands on the top chart.

For economic forecasters UNCERTAINTY IS A **CERTAIN** FACTOR

This is generally not the best practice of sales /demand planners who have mostly been responsible for forecasting in *push* supply chain organizations.

China Confronts Mounting Piles of Unsold Goods

- Export Slow, but not factories – Problem masked in data
- China encountering unfamiliar problem
- Has led to price wars and manufacturers redoubling efforts to export
- Severity of problem masked by blocking or adjusting of economic data by the government in order to prop up confidence in the economy among business managers and investors

Source :New York Times, August 24, 2012

This is from an article that appeared in the New York Times almost two years ago.

It reported inventory increases attributed to government policy rather than noting a decrease in demand.

This suggests that the uncertainty surrounding the demand forecast had changed rather than the forecast itself.

The change in uncertainty is the result of an increase in the *chance* that demand should be lower rather than higher.

As you will see next, there will need to be a critical distinction made between *forecasting* and *planning* in the future.

A New Perspective on Demand Forecasting for Supply Chain Organizations

- Demand Forecasting ≠ Demand Planning
  - **Different visions**
  - **Different data**
  - **Different methodologies**
  - **Different goals**
- Transformation from report jockeying to professional advisory services
- Objectivity - independent, organization-neutral function
- IF neutrality can be preserved, then function can be in sales, marketing, operations or finance

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Firstly, demand **forecasting** is NOT THE SAME as demand **planning** in several aspects. We recognize this in principle, but not widely in practice.

There are differences in visions, data, methodologies and goals

These differences will manifest themselves in how demand forecasting is regarded in a company, starting from demand forecasters being seen as essentially report jockeys to professional advisors with their own standards, skill sets, and job descriptions.

To perform the function, demand forecasters need to be in an **independent organization**, capable of producing objective, unconstrained, baseline forecasts of consumer demand without the influence of planning objectives.

Demand Forecasting ≠ Demand Planning

- **If Demand Forecasting** is all about CHANGE and CHANCE, by creating an objective, unconstrained and unbiased view of what consumers desire (and are willing to purchase) in products and services
- **Then Demand Planning** is about actions to sense and shape demand for business purposes and
- **Demand Management** is about preparing for and providing of the *right* amount of the *right* product to be in the *right* place at the *right* time at the *right* price

Plans are what we can 'feel we can do' while forecasts are statistical estimates of what is most likely

Video Clip: I Love Lucy Candy Factory
http://www.youtube.com/watch?v=HnbNcQlzV-4

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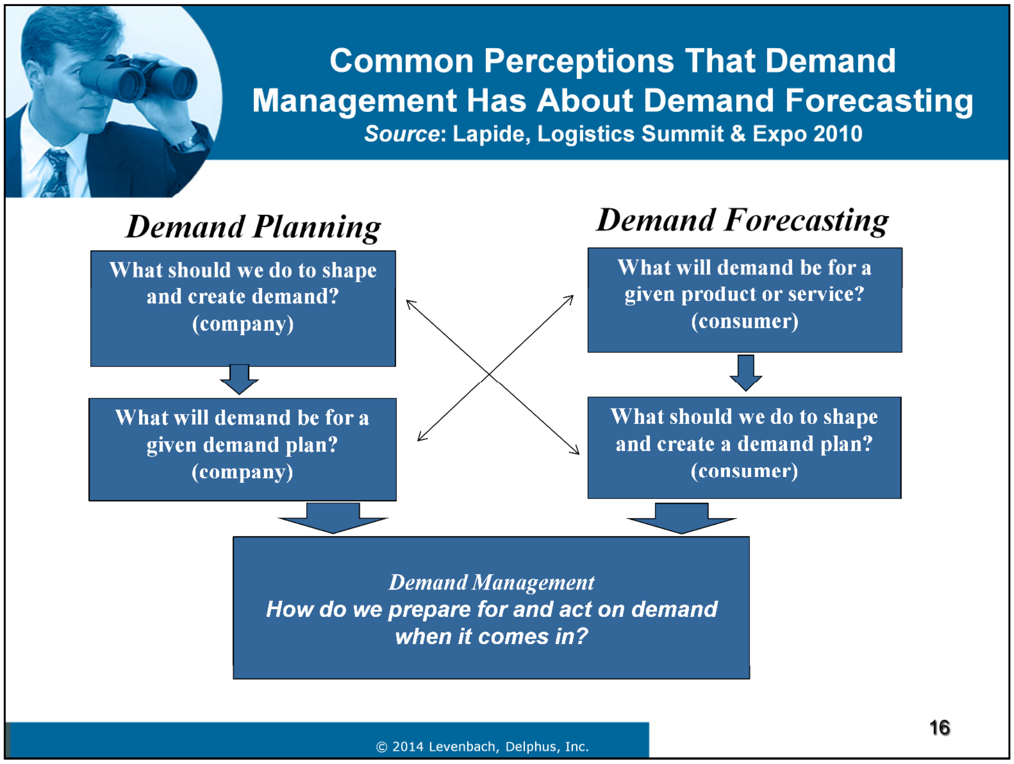
So what are the essential differences? ….*See definitions*

Plans are what we can *feel we can do* while forecasts are statistical estimates of what is *most likely*.



At this Logistics Summit & Expo in 2010, Dr Larry Lapide from MIT presented a keynote on demand planning and demand management.

The left side describes his notion of the Demand Planning function and the role of demand forecasting in that process. It is the *push* supply chain model in which a demand forecast is manipulated to achieve planning objectives.

In contrast, on the right side, the demand planning function in a consumer-centric pull supply chain model **follows** the execution of the demand forecast as an independent advisory function.

Note that the demand management function remains the same in both cases.

Why Change?

What is it that needs to change with the Demand Forecasting process as it is currently practiced?

For that we turn to the Elephant and Rider metaphor

The Elephant and the Rider Metaphor

"The Elephant is the emotional side of motivation, while the Rider is the logical side. Perched atop the Elephant, the Rider holds the reins and seems to be the leader. But the Rider's control is precarious because the Rider is small relative to the Elephant. Anytime the six-ton Elephant and the Rider disagree about which direction to go, the Rider is going to lose. He's completely overmatched."

Let's examine how these two internal motivations play together (or not). The most obvious examples we can relate to are sticking to a diet, staying on an exercise program, or quitting smoking. We know it is the right thing to do (Rider) but we have a difficult time sticking to it (Elephant). The Elephant and Rider are the yin and yang of our psyche. The Rider is the planner (getting thin on a diet), while the Elephant is attracted to the short term payoff (enjoying an ice cream cone).

"*Changes often fail because the Rider simply can't keep the Elephant on the road long enough to reach the destination.*"

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"*Changes often fail because the Rider simply can't keep the Elephant on the road long enough to reach the destination.*"

Are We Talking to the Elephant or the Rider?

For demand forecasting we may need to induce change. A change in direction.

Getting people to rethink their forecasting approach is about motivating them away from what they do today.

Getting them to take a different path — a new path.

The question is are we talking to the Elephant or the Rider?

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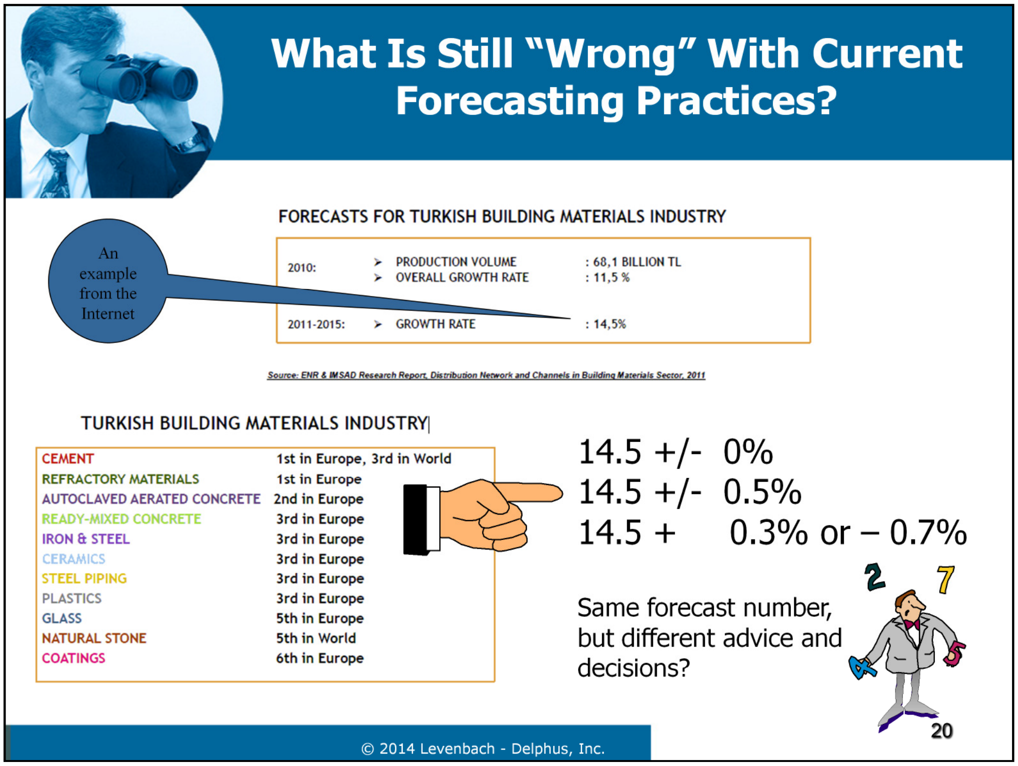
Getting people to rethink their forecasting approach is about motivating them away from what they do today

Getting them to take a different path – a new path

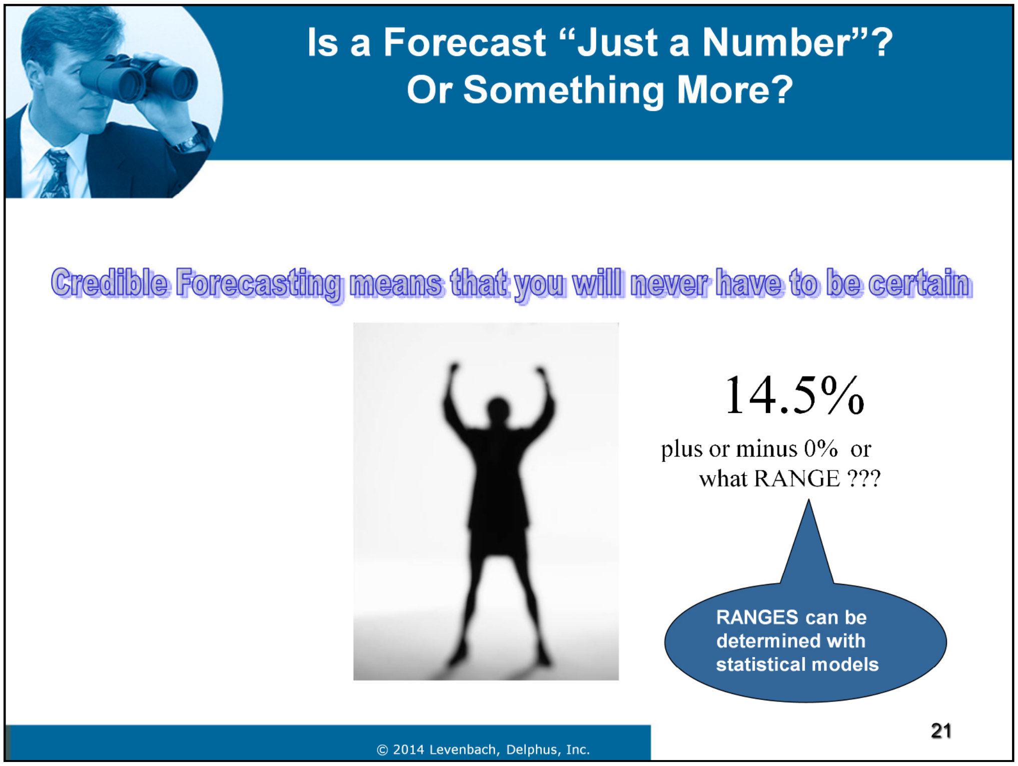
The question is: Are we talking to the Elephant or the Rider in your company?



On the internet, you can find lots of industry forecasts. In this example, we see that the forecasted growth rate is simply a NUMBER

Stated just as a number, it implies certainty, plus or minus 0% uncertainty

Alternatively, the same forecast number could also be stated with different ranges of uncertainty implying different information about the forecast leading to possibly quite different advice for planners to use.



So, is a forecast just a number or something more?

Credible forecasting means that you will never have to be certain

So, a demand forecast is **not** a credible forecast unless it is accompanied by **measured uncertainty**

A Forecast Is NOT Just a Number
It is About
CHANGE (Numbers) and *CHANCE (Uncertainty)*

- 14.5% +/- 0 %
- 14.5 +/- 2 %
- 14.5 + 3 or - 1 %

We see three scenarios: Same forecast number, different uncertainties leading to possibly three different t plans

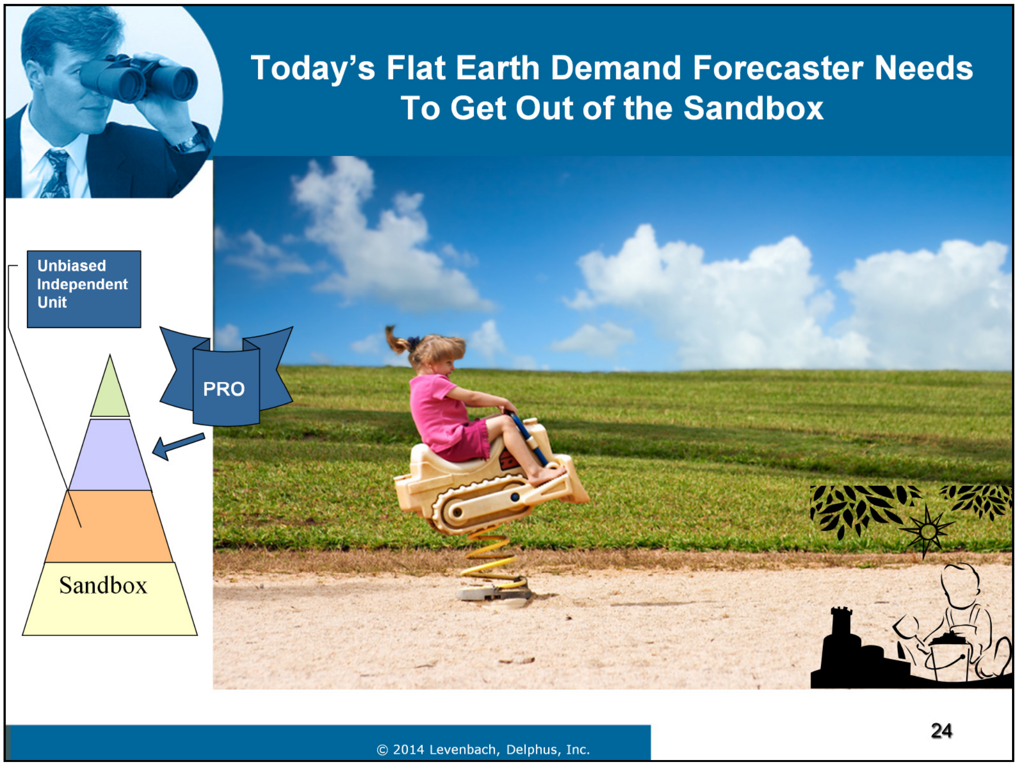
5000 years or more ago: Raise your right hand if you believe the earth is flat → almost everyone

Today: Raise lef t hand if you believe forecast is just a number

Back then, there was a fork in the road: It took many years to move the elephant in the right direction from a flat earth to accepting a curved pl anet. Moon landings and space shuttles would not be possible in the old model.

Flat earth forecaster takes trip from New York to Shanghai. Course is not a straight line, as flat earth forecaster would predict.

Likewise, forecasting needs to change from a flat earth mentality to incorporate the second dimension of uncertainty (as we now add a second dimension of curvature to the flat earth model.)

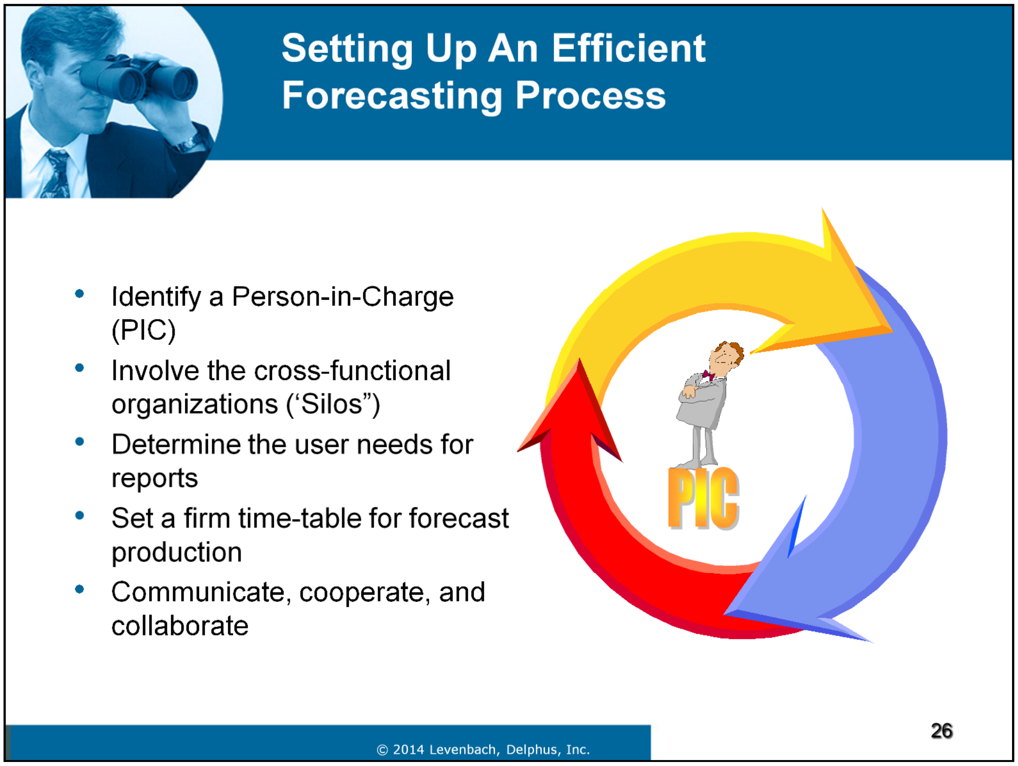


Today's "Flat Earth " forecasters are building sand castles, rather than real structures

On the way to a Professional status, demand forecasters have to learn how the create unbiased baseline forecasts and defend them as objective statements of *change* **and** *chance*

To measure uncertainty, you need to quantify uncertainty with the right statistical tools – there are models but this may take some new learning and training

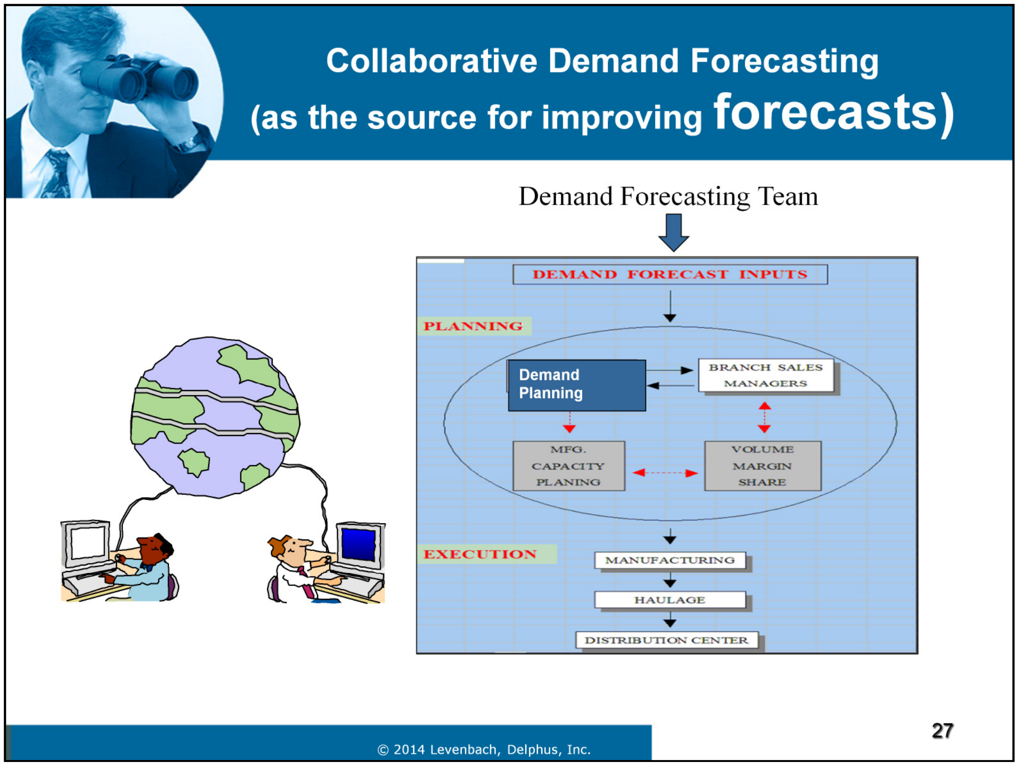
A collaborative process involving Integrated Business Planning Practitioners has four stages: Preparing Data, Executing Models, Evaluating Performance, and Reconciling multiple forecasts



We start by setting up an efficient forecasting process.

To be effective, you need to find a PIC (Person-In-Charge), a term coined by Robert G. Brown of exponential smoothing fame. A PIC is someone who can energize higher management about the proper role of demand forecasting in the supply chain organization.

This involves breaking down Silos into collaborative business units, determining user needs, establishing time tables for forecast production and embracing the 3 C’s of communication, cooperation and collaboration



A critical input to the forecast comes from the field, in terms of market and customer intelligence

The field sales activity is important because a statistically generated forecast does not contain sufficient realism to go into a forecast. This collaborative input is the major component of human judgment that goes into the forecast.

In its role as part of the planning team, demand forecasters should create inputs and take an **advisory role preceding** the planning process.

This is somewhat analogous to the quality control process developed by Deming, Shewhart and others for manufacturing, where you have quality measurement introduced at an **initial stage** in the process along with ongoing quality control program for performance improvement.

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Step 1 Preparing Healthy Data

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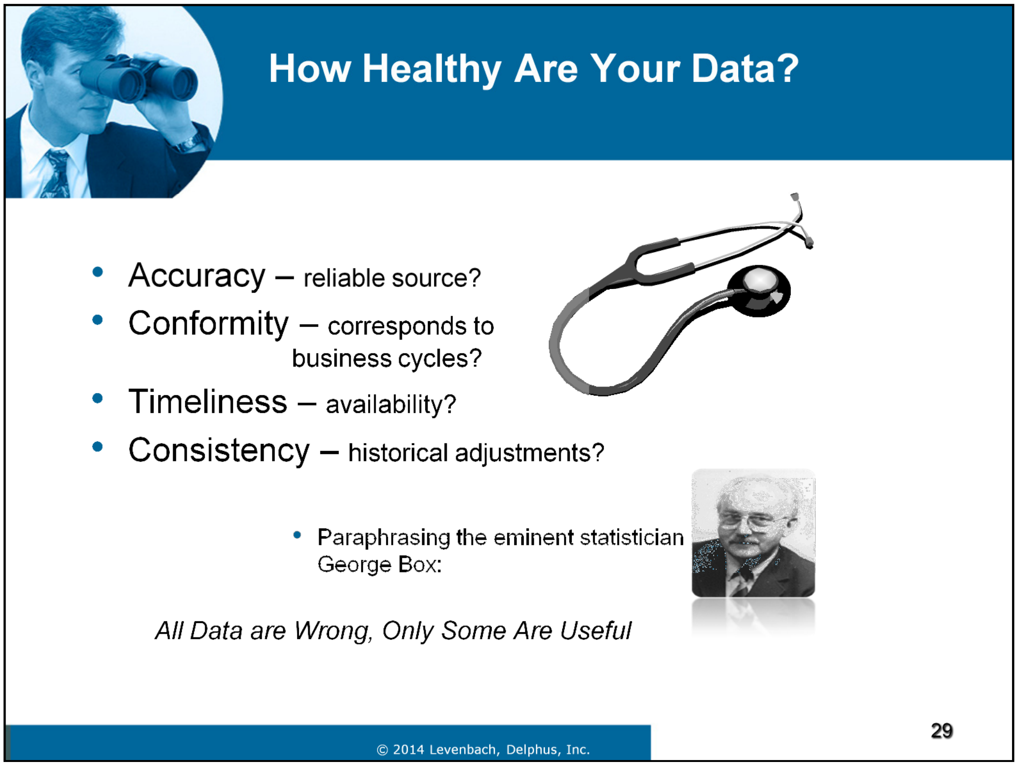
This is the topic of data analytics, which is comprised of data mining, data exception handling and data quality

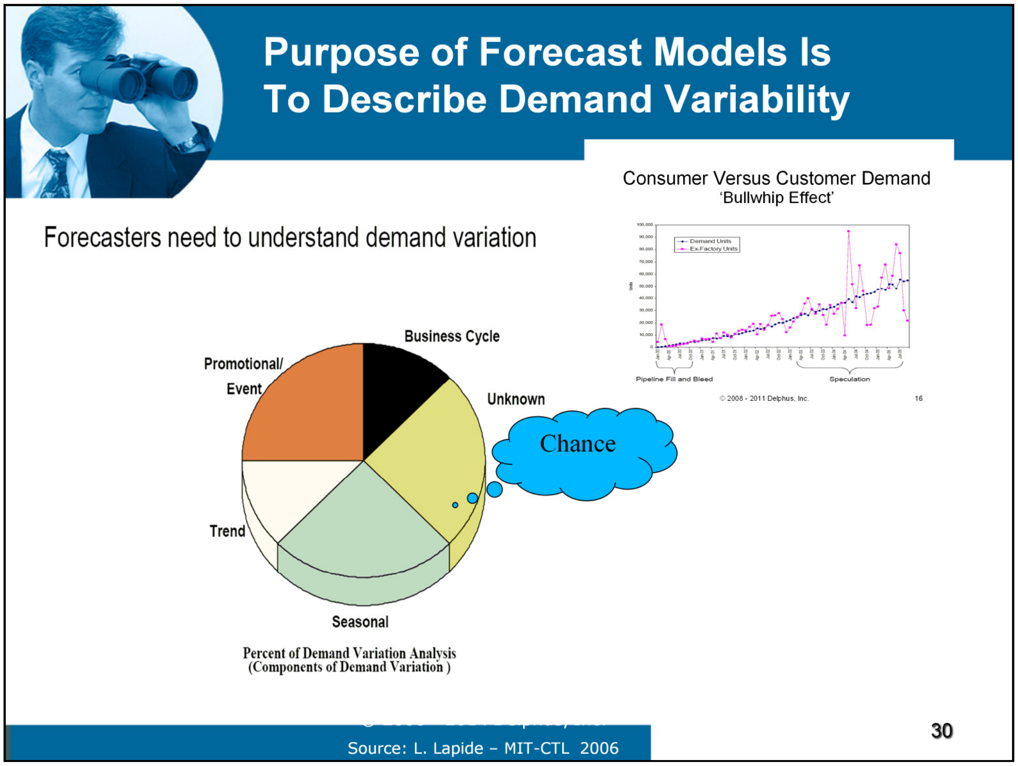


There are four key aspects to healthy data: Accuracy, Conformity, Timeliness and Consistency

For example, does the demand history move consistent with the up and downturns of an economic business cycle?

Paraphrasing the eminent statistician George Box, who said *All Models are Wrong, Some are Useful*, we can say same about DATA

With DATA too, *All Data are Wrong, Some are Useful*. The challenge to forecasting is to understand the data and see that it makes sense. That is where Data Science comes in.



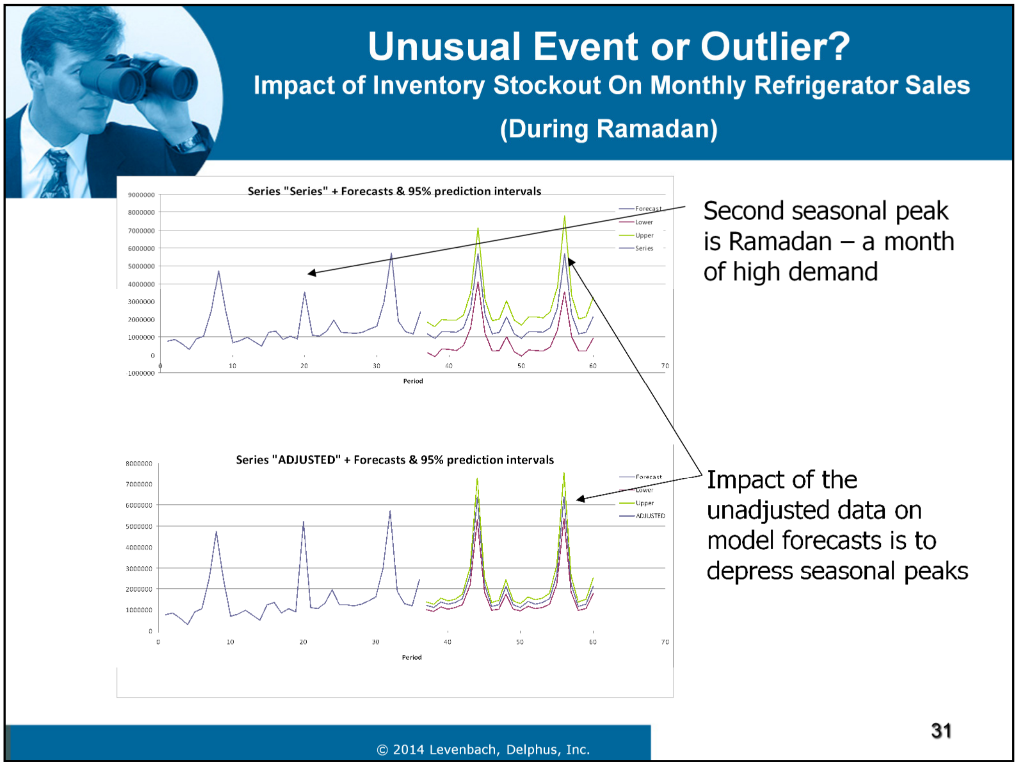
Demand Forecasters need to understand **demand variation**

Statistical models are used to describe variation or variability.

Demand variation is mostly due to seasonality (*habits of consumers*), trend (*growth of underlying consumer base*), promotional events, economic business cycles, and Unknown uncertain piece we call *Chance*

Think of it as a pizza pie. The total variation is the pie. When ordering pizza pies, would you keep buying pizzas with a missing slice?

Likewise, don't buy a forecast as a number (Change) without the measured uncertainty (Chance)



Forecasters often deal with unusual events and outliers.

For example, without historical data adjustments and checking data quality, models will give misleading results and the wrong information about the forecast and uncertainty

Top chart: Trend/Seasonal Forecast model applied to unadjusted historical data results in (1) leveling of trend and (2) a wide band of uncertainty.

Bottom chart: Unusual seasonal peak is identified and rationalized, then normalized for modeling purposes (Place the peak on the straight line joining the normal seasonal peaks). When the same Trend/Seasonal model is run (without manual intervention), the result is quite defensible, credible and the prediction limits are considerably narrower.

Typical Database Sizes in Supply Chain Organizations

Wal-Mart has 5,000 Stores, 100,000 items, and if a typical store carries a full line of items, then you can then potentially expect

500,000,000 lowest level records

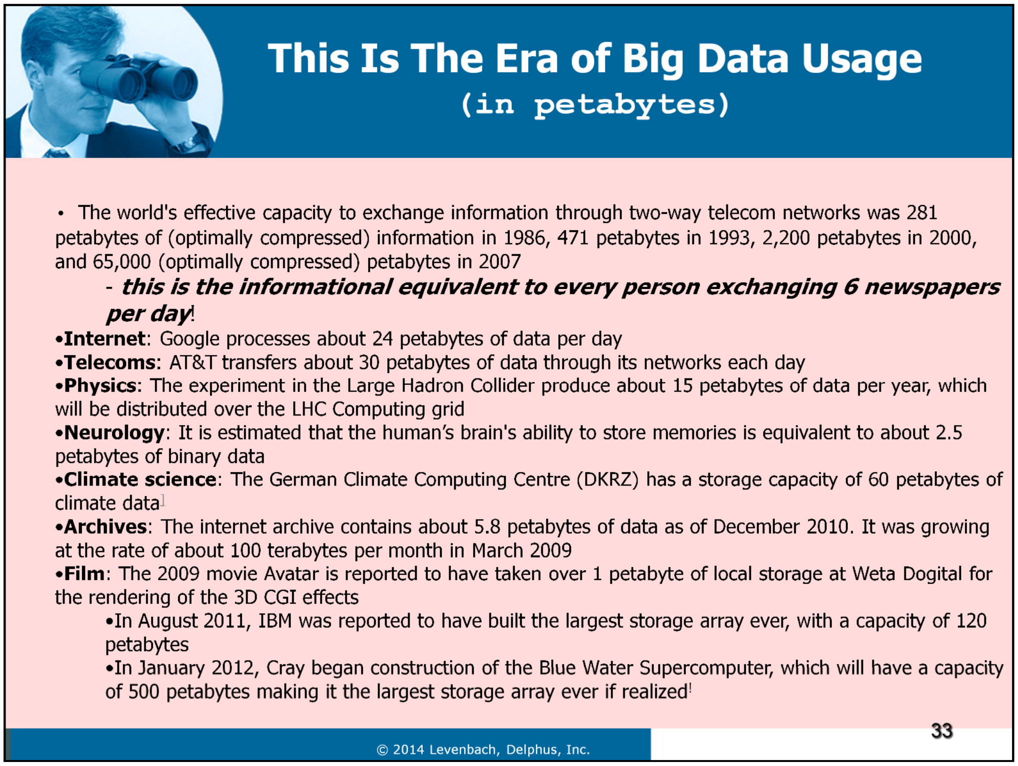
If an online Store has 6 Distribution Centers and 35,000 Items, and each distribution center carries a full line of items, one can then expect

210,000 lowest level records

For typical Hospital supply chain, with 5 years of history and approximately 30 competitors, 15 geographic areas, 4 financial classes, 6 services and 23 products we end up with **220,000 lowest level records** in the demand table

Most forecasters use spreadsheets for forecasting

This will not be the right tool for the job in the future ; the spreadsheet is a supplementary tool for data analysis, and is inadequate and inappropriate as a database



We have entered the era of rapidly increasing data needs. This can make traditional approaches obsolete. For example, in August 2011, IBM was reported to have built the largest storage array ever, with a capacity of 120 petabytes. My thumb drive has only a few gigabytes of storage. When I was a forecaster, we could only talk of kilobytes. Remember the PCs without hard drives?

The world's effective capacity to exchange information through two-way telecom networks was 281 petabytes of (optimally compressed) information in 1986, 471 petabytes in 1993, 2,200 petabytes in 2000, and 65,000 (optimally compressed) petabytes in 2007 - this is the informational equivalent to every person exchanging 6 newspapers per day!

Internet: Google processes about 24 petabytes of data per day **Telecoms**: AT&T transfers about 30 petabytes of data through its networks each day **Physics**: The experiment in the Large Hadron Collider produce about 15 petabytes of data per year, which will be distributed over the LHC Computing grid **Neurology**: It is estimated that the human's brain's ability to store memories is equivalent to about 2.5 petabytes of binary data **Climate science**: The German Climate Computing Centre (DKRZ) has a storage capacity of 60 petabytes of climate data] **Archives:** The internet archive contains about 5.8 petabytes of data as of December 2010. It was growing at the rate of about 100 terabytes per month in March 2009 F**ilm**: The 2009 movie Avatar is reported to have taken over 1 petabyte of local storage at Weta Dogital for the rendering of the 3D CGI effectsI n August 2011, January 2012, Cray began construction of the Blue Water Supercomputer, which will have a capacity of 500 petabytes making it the largest storage array ever if realized!

How Big Is a Petabyte?

A petabyte (derived from the SI prefix *peta*) is a unit of information equal to one quadrillion bytes, or 1024 terabytes.

The unit symbol for the petabyte is PB. The prefix *peta* (P) indicates the fifth power to 1000.

According to IBM: Everyday, we create 2.5 quintillion bytes of data– so much that 90% of the data in the world today has been created in the last two years alone

Multiples of bytes V·T·E

SI decimal prefixes		Binary usage	IEC binary prefixes	
Name (Symbol)	Value		Name (Symbol)	Value
kilobyte (kB)	10^3	2^{10}	kibibyte (KiB)	2^{10}
megabyte (MB)	10^6	2^{20}	mebibyte (MiB)	2^{20}
gigabyte (GB)	10^9	2^{30}	gibibyte (GiB)	2^{30}
terabyte (TB)	10^{12}	2^{40}	tebibyte (TiB)	2^{40}
petabyte (PB)	10^{15}	2^{50}	pebibyte (PiB)	2^{50}
exabyte (EB)	10^{18}	2^{60}	exbibyte (EiB)	2^{60}
zettabyte (ZB)	10^{21}	2^{70}	zebibyte (ZiB)	2^{70}
yottabyte (YB)	10^{24}	2^{80}	yobibyte (YiB)	2^{80}

See also: Multiples of bits · Orders of magnitude of data

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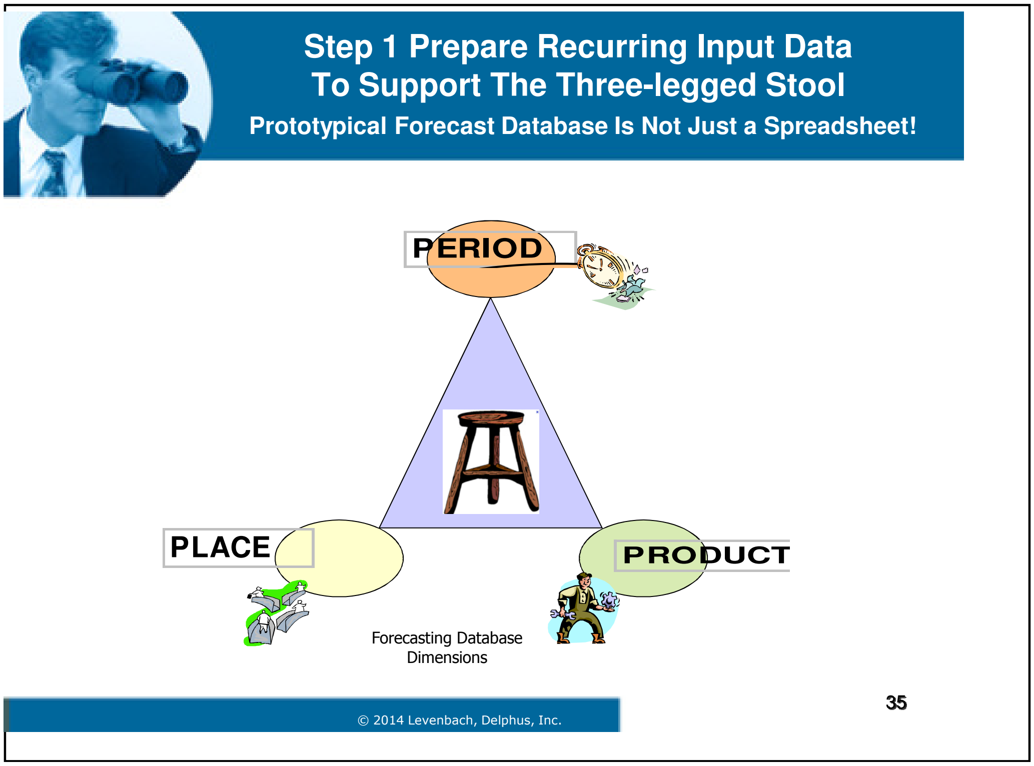
So, how big is a petabyte. I cannot get my hands around this, but the next generation of forecasters will almost certainly have to.

You can memorize this chart at your leisure at home



The first step is preparing recurring input data in a data framework or database

A Forecast Data Framework has three dimensions, like a three-legged stool. This is one more than a spreadsheet can handle.

A spreadsheet is like flat file forecasting. We now need another dimension making it a relational database as the minimum requirement for data storage, data manipulation and data modeling.

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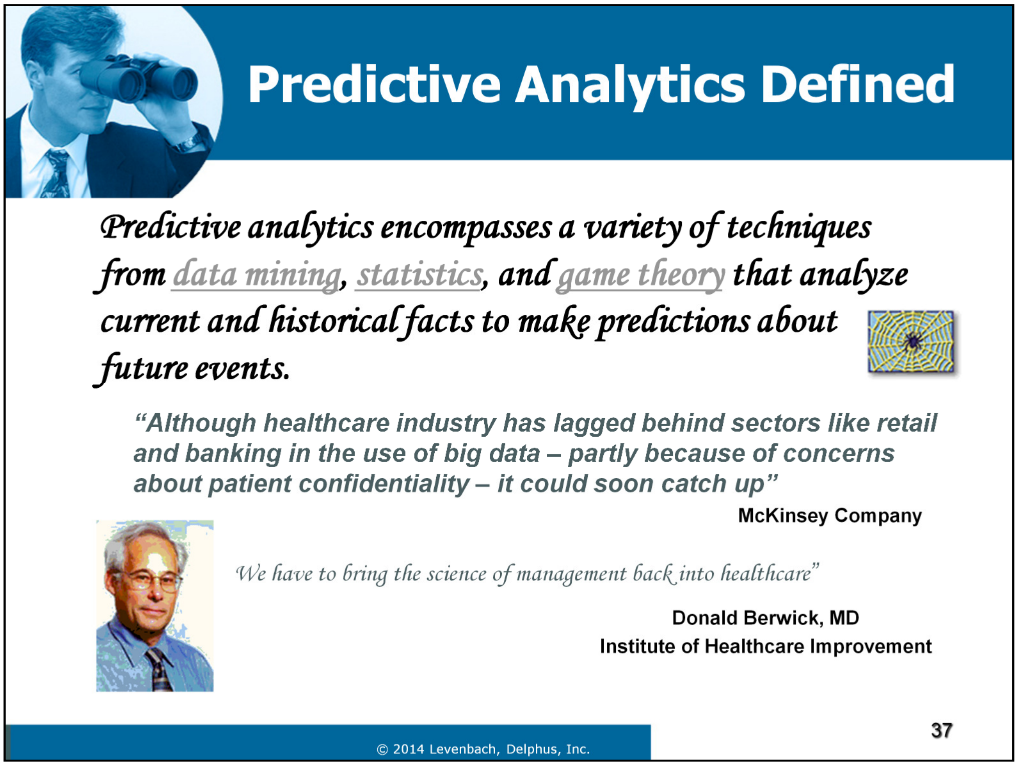
The second step is the Execution of data-analytic modeling methodologies

This stage of the forecasting job involves the use of Predictive Analytics

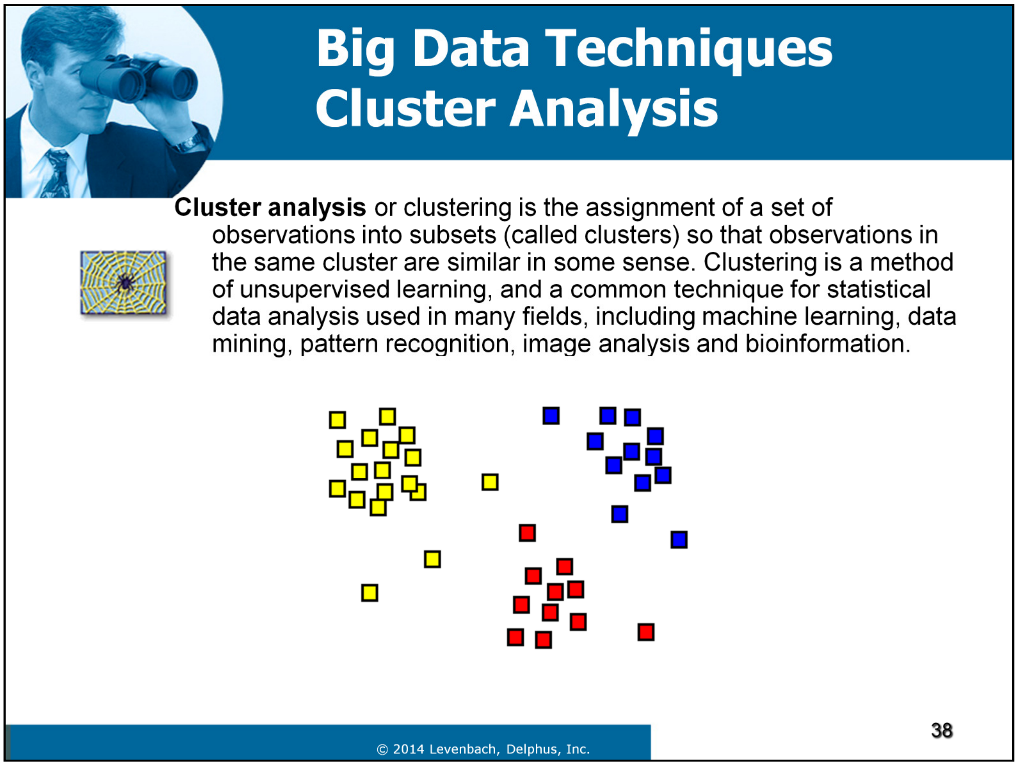
Here I want to make a distinction between a model and a method



For those who do not know Dr. Berwick, he is a professor of health care policy, pediatrician, and cofounder of the Institute for Healthcare Improvement (IHI). He was also one of the first and most effective voices to call for quality improvement in the health care system and many of us have followed the numerous, significant successes of IHI for almost 20 years.

Berwick also understands the balance between the science of "hypothesis testing" and the science of "continuous quality improvement." It is interesting that the same management methodologies that have fueled well-run organizations over the past 20 years (e.g. lean manufacturing and six sigma) are almost completely lost in health care. This is understandable because health care entities do not typically compete on quality and price when much of their payment is dependent on Medicare and Medicaid fee schedules. But for those health systems who value improvement, Berwick's IHI has worked to highlight, promote, and support their efforts. One example is Virginia Mason Medical Center, who has successfully implemented lean manufacturing principles to center care around their patients

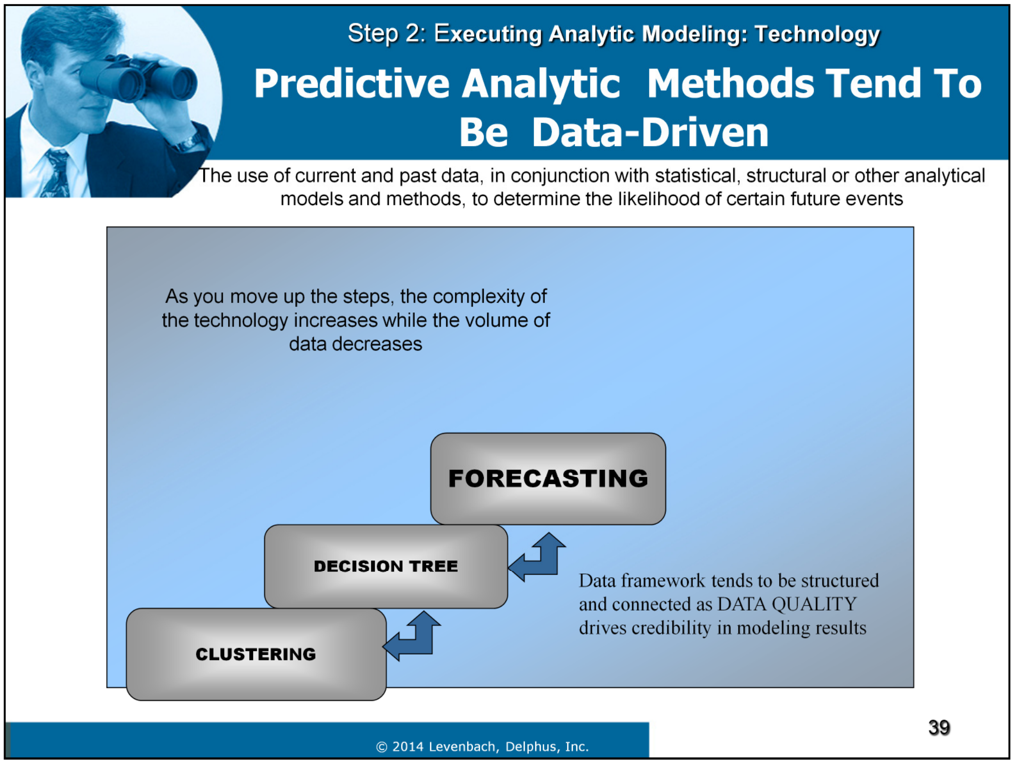
reconcile the fact that about 85% of all health care costs can be attributed to individuals (i.e. risk factors like obesity) and the rest to the system with Deming/Juran's experience that 94% of improvement opportunity resides with action on "the system" and the rest to individuals (i.e. they are flipped).



Common technique is cluster analysis, which places data is subsets with some similar characteristics

It is used in many fields other than forecasting

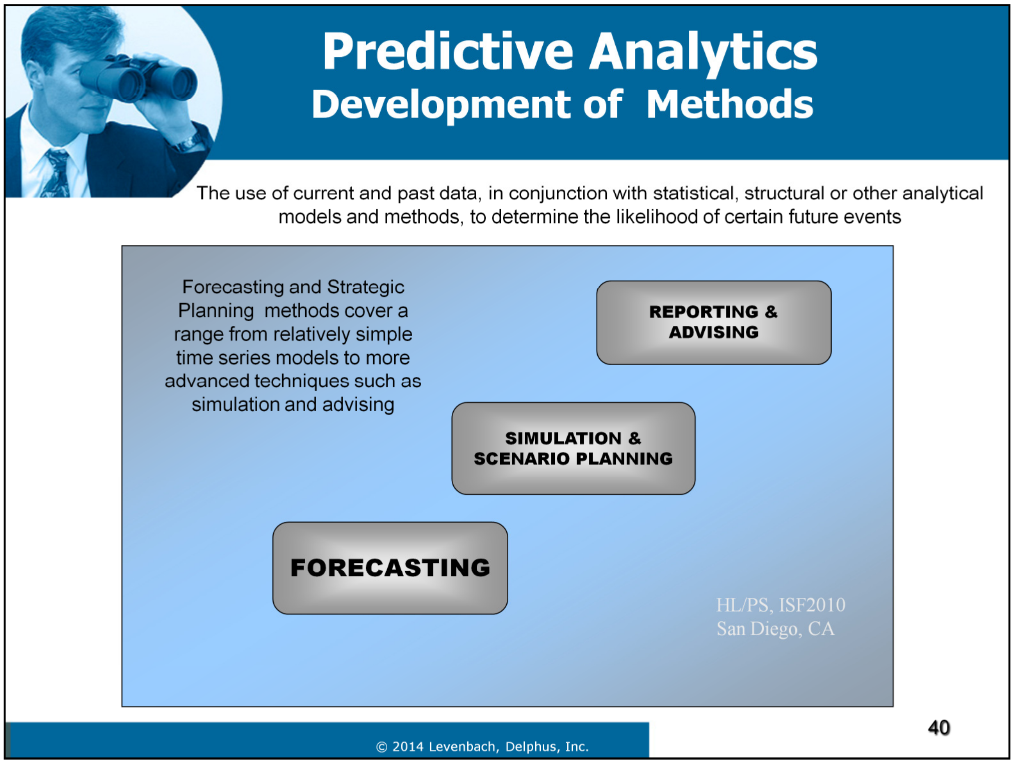
Cluster analysis or clustering is the assignment of a set of observations into subsets (called clusters) so that observations in the same cluster are similar in some sense. Clustering is a method of unsupervised learning, and a common technique for statistical data analysis used in many fields, including machine learning, data mining, pattern recognition, image analysis and bioinformation.



As you move up the steps, the complexity of the technology increases, while the volume of data decreases

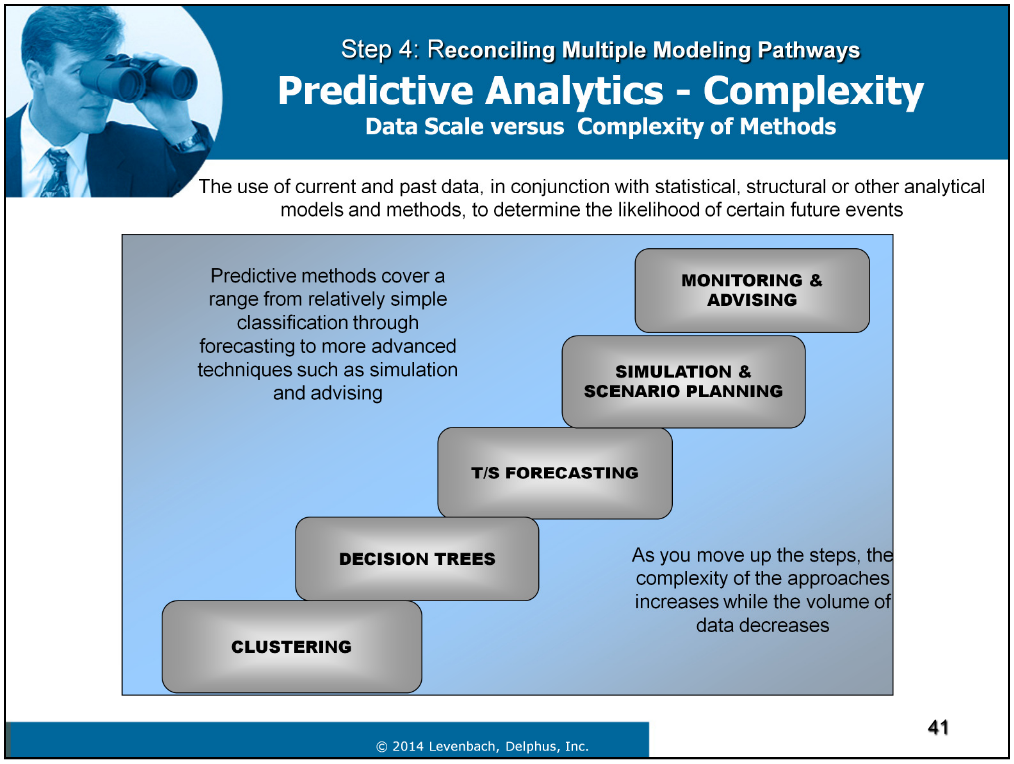
The data sets become smaller but the predictive techniques become more complex

Demand Forecasting, that is using historical data with statistical models, is on the third or middle level. There are two more levels above this



As you move up the ladder to higher levels of modeling complexity, data becomes scarcer.

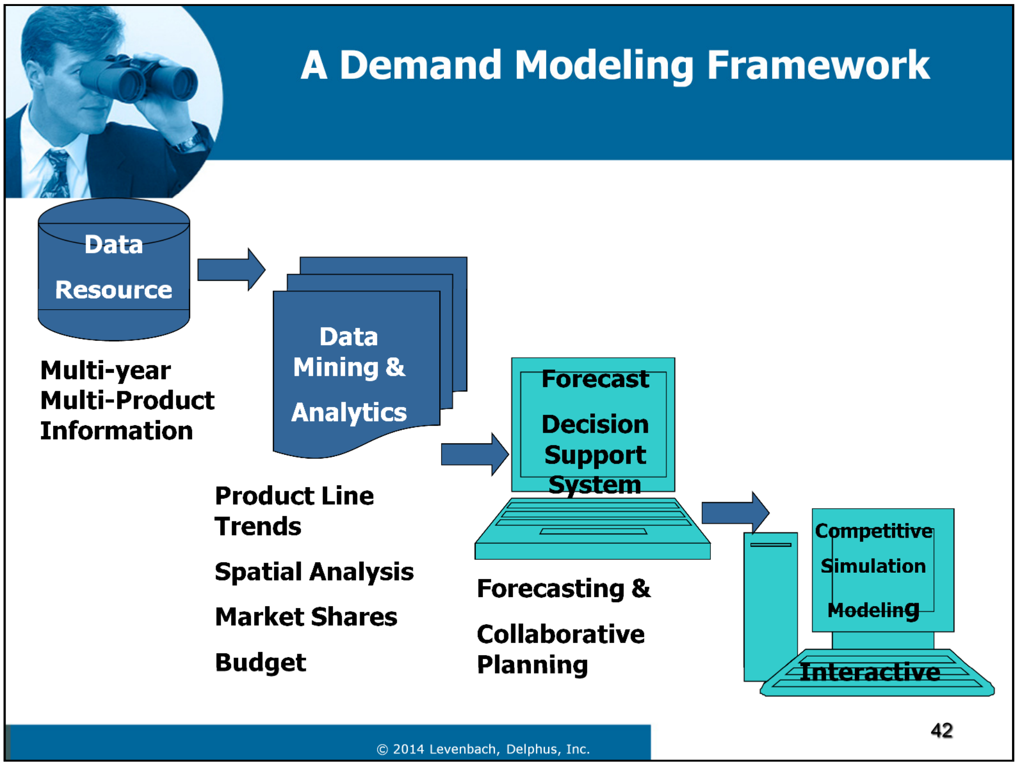
At the top level we have the Business Intelligence tools that typically work with highly summarized data.



This shows the entire ladder of DATA SCALE vs. Model COMPLEXITY for Predictive Analytic Methods

REMEMBER: All *Models Are Wrong, Some Are Useful*

There is no one best tool or technique to solve a particular forecasting problem, only useful approaches



For demand forecasting in the FUTURE, a spreadsheet approach is rapidly becoming obsolete. It must be replaced by a Data Framework, ranging from large data repositories, to relational data bases containing statistical and data-analytic software tools for reporting and reconciling multiple modeling approaches

Agenda

- A Forty-Year Professional Journey
- Why Demand Forecasting ?
- A Collaborative Process for Demand Forecasters & IBP Planners:
  - Step 1: Preparing Healthy Data
    - Data Analytics: Data Mining, Data Exceptions and Data Quality
  - Step 2: Executing Data Analytic Modeling Methodologies
    - Predictive Analytics: Methods versus Models

Step 3 Evaluating Performance Diagnostics

Performance Measurement: Myth of the MAPE

  - Reconciling Multiple Modeling Pathways
    - Demand Link Forecasting and Supply Chain Partnering

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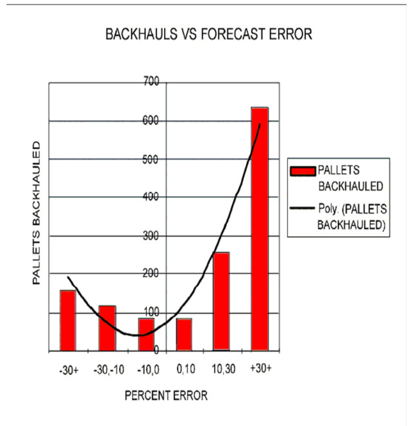
Step 3 is evaluating performance diagnostics and overcoming what I call the Myth of the MAPE

Step 3 Evaluate - Performance and Accuracy Measurement

Case: Coca Cola Bottling Company



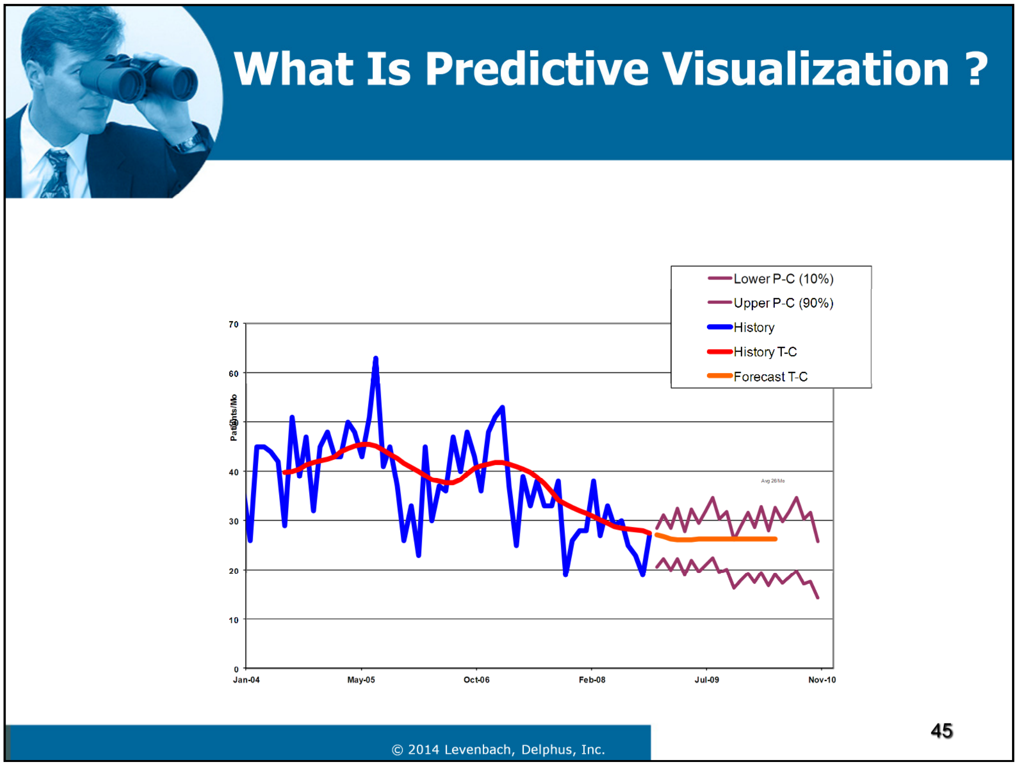
Forecast accuracy measurement is a much maligned and poorly understood issue by most supply chain planners

The popular MAPE measure of accuracy has been commonly misused. I call it the MYTH of the MAPE in the training workshops

This chart is from a real case in which a bottling company did not distinguish between underforecasting and overforecasting, so with the MAPE metric everything looked OK, on average.

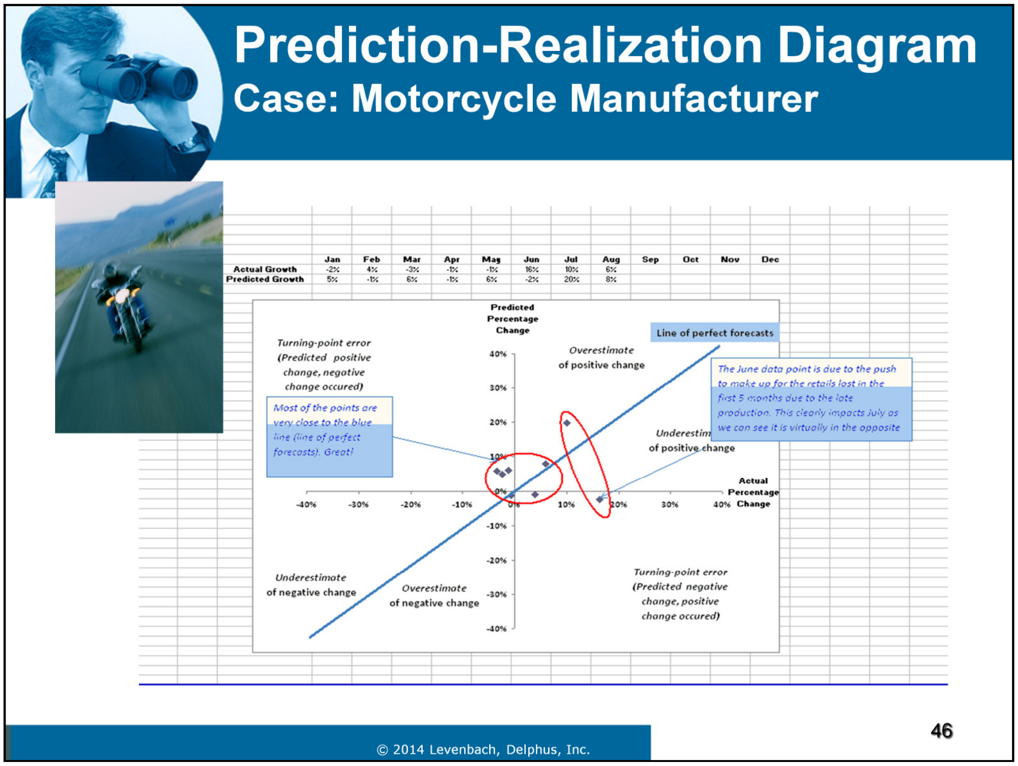
However, they incurred significant transshipment costs as a result of this misuse of a metric.

What I want to say here is the performance measurement has a human element as well as a numerical component. And in terms of the numerical component, no one measure (being MAPE, RMS, etc.) is not enough. The context in which the measurement is required is also important, which can mean an asymmetrical error measurement criteria. In this example, forecast accuracy had a bearing on whether pallets were being shipped back and forth around different Distribution centers because the location-specific forecast was mostly underforecasted.



The new challenge is to be able to summarize and display forecasts with measured uncertainty in a way that it can be readily grasped. That is the value of data graphics. This graphical display, for example, summarizes all the salient features of a forecast, both CHANGE and CHANCE

Tabular spreadsheet displays, like the old greensheet printouts, are inefficient and slow for users to absorb the meaning of the numbers.

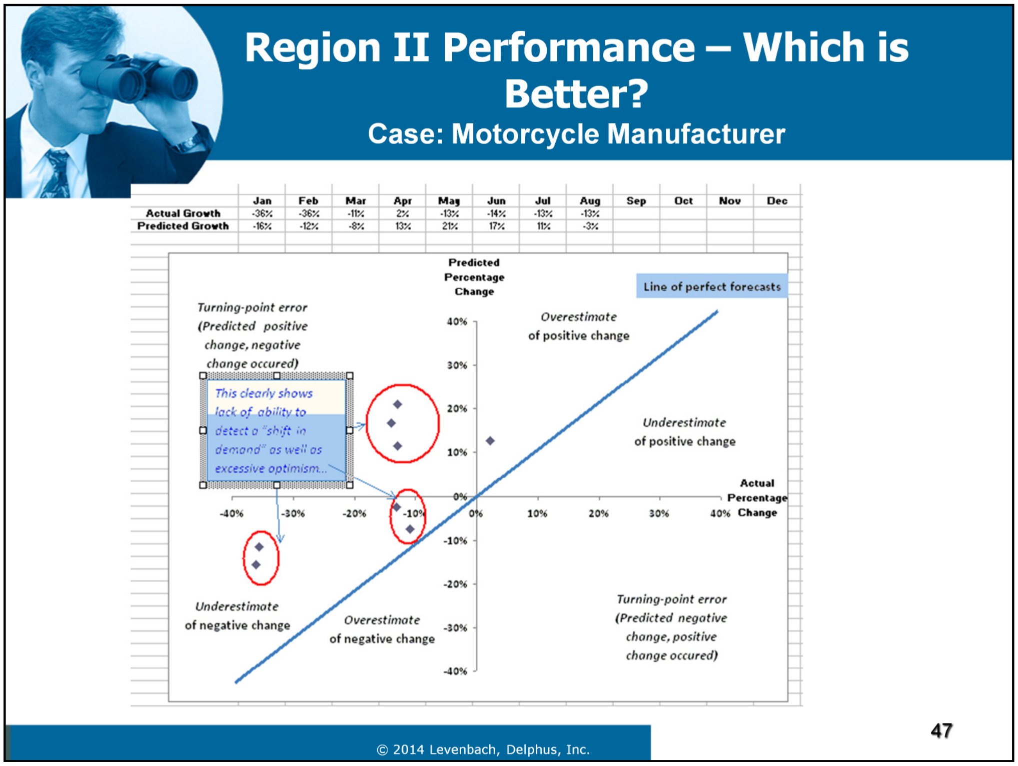


The P-R diagram has been in the economics textbooks and literature for half a century or more, but is rarely if ever seen in practice or covered in business forecasting texts.

At the top, a spreadsheet shows actual and forecasted month-to-month percentage changes.

On the chart, the solid line is the line of **perfect forecasts** and deviations from this line can be interpreted depending in which segment the data falls.

The scatter of points says something about the performance during economic upturns and downturns. For example, the points in the upper right hand quadrant show that you are over estimating a positive actual percentage change *above* the line and underestimating such changes *below* the line of perfect forecasts.



In contrast, for Region II, the forecaster experienced almost all negative percentage changes in the actual history, but showing excessive optimism in the forecasts

Which is Better, region I or II? Can't tell from the numbers, but a graph makes it clear. Manager exclaimed: **this is awesome**!!

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Step 4 Reconciling Multiple Modeling Pathways

Demand Link Forecasting and Supply Chain Partnering

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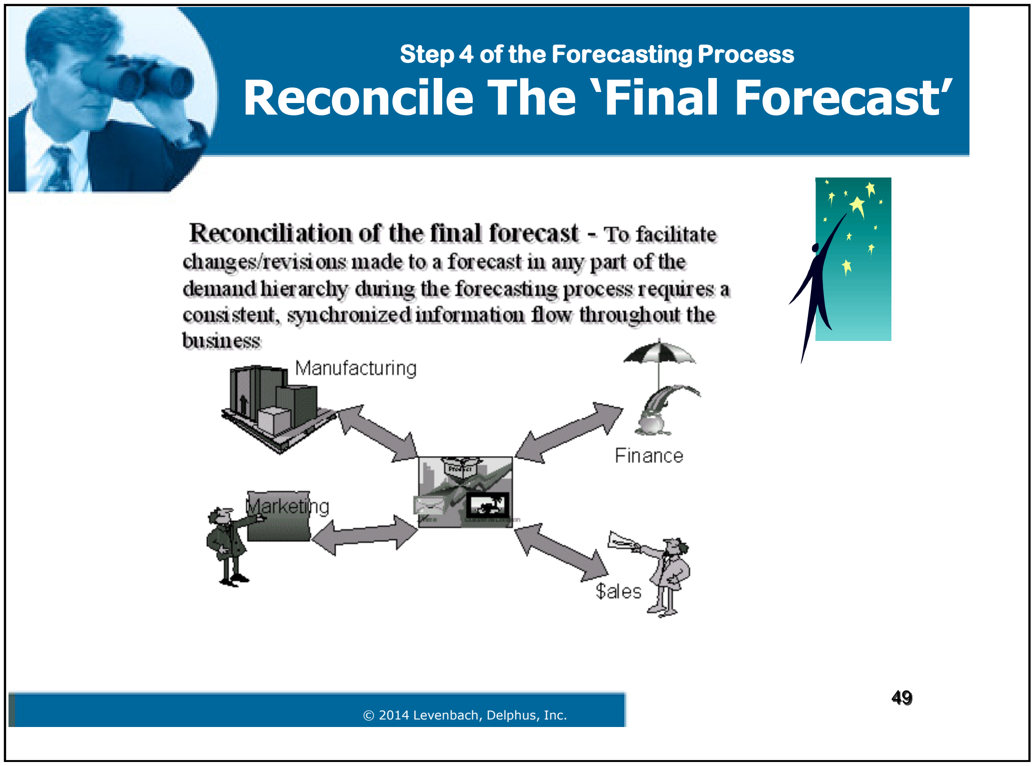
Last step in the Forecasting Process is reconciling multiple modeling methodologies

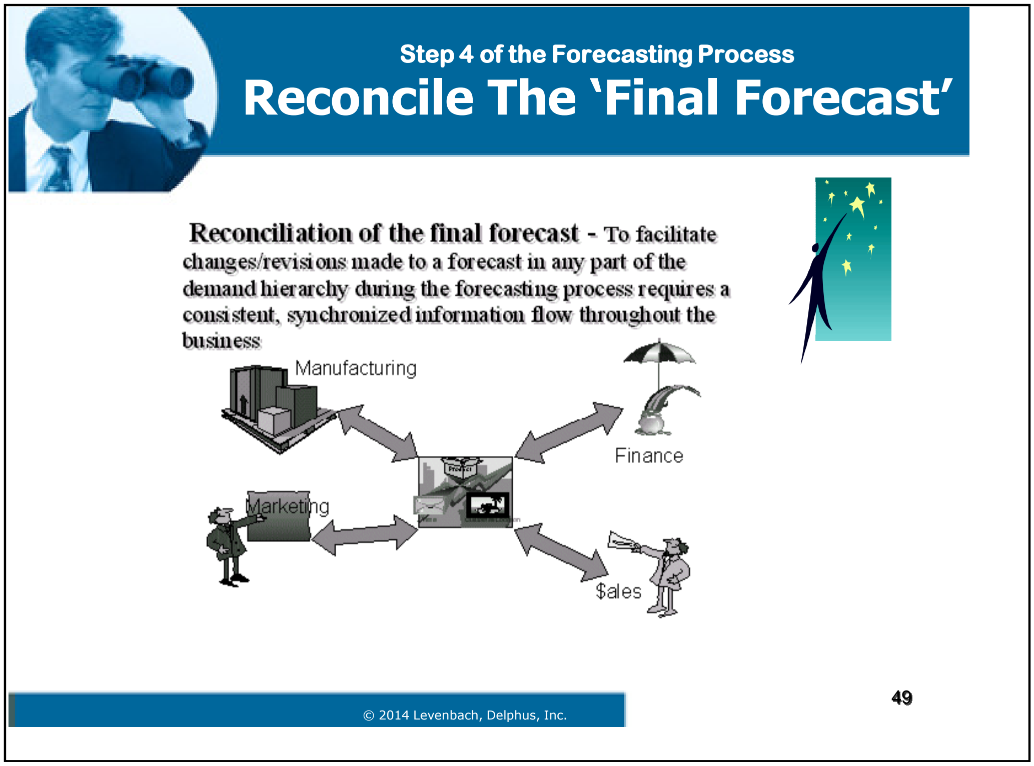


Functional Hierarchies

Each functional group in the company has its own forecast requirements. For example, marketing personnel may want to review the forecast at a brand level in sales and margin currency, rather than in stock keeping units (SKU) and unit volume level.

Similarly, sales personnel may find it more useful to see a forecast in currency by region or customer account. In support of these related requirements, forecasting approaches may need to be developed for multiple levels to support the reconciliation of these different forecasts.

A 'best practice' forecasting process, striving to obtain the 'single best number forecast' to drive the business, involves obtaining consensus among different functional organizations. To work effectively, the forecasting process must generate views that are familiar to each of the functions. These views need to be at different aggregation levels or dimensions as well as in different versions of the measure of demand. Some functions need to view the forecast in currency and some in units.



By functional organization, you can view the forecasting process in terms of:

- Marketing: Brand-level forecasts by channel and sales currency and margins
- Sales: Account or regional level forecasts by product category in sales currency
- Operations: Distribution territory-level forecasts by Stock Keeping Unit (SKU) in cases, or plant-level forecasts by SKU in units. (Incidentally, a SKU is the lowest level in which we might categorize a product, like a bar code or product code that you see on a box or the unit itself.)
- Finance: Regional-level forecasts by division in sales currency and margins.

Moreover, some functions need to view the forecast at the lowest level in a hierarchy, while others need to see it at higher levels. But, not all of these functions can necessarily be placed in hierarchies.

The differing functional views of a forecast are important for reaching consensus. Each function must first review the forecasts and should approve or modify them based on their view of the business.

These different types of planning indicate the key concepts that underlies planning – the concept of AGGREGATION and ALLOCATION.

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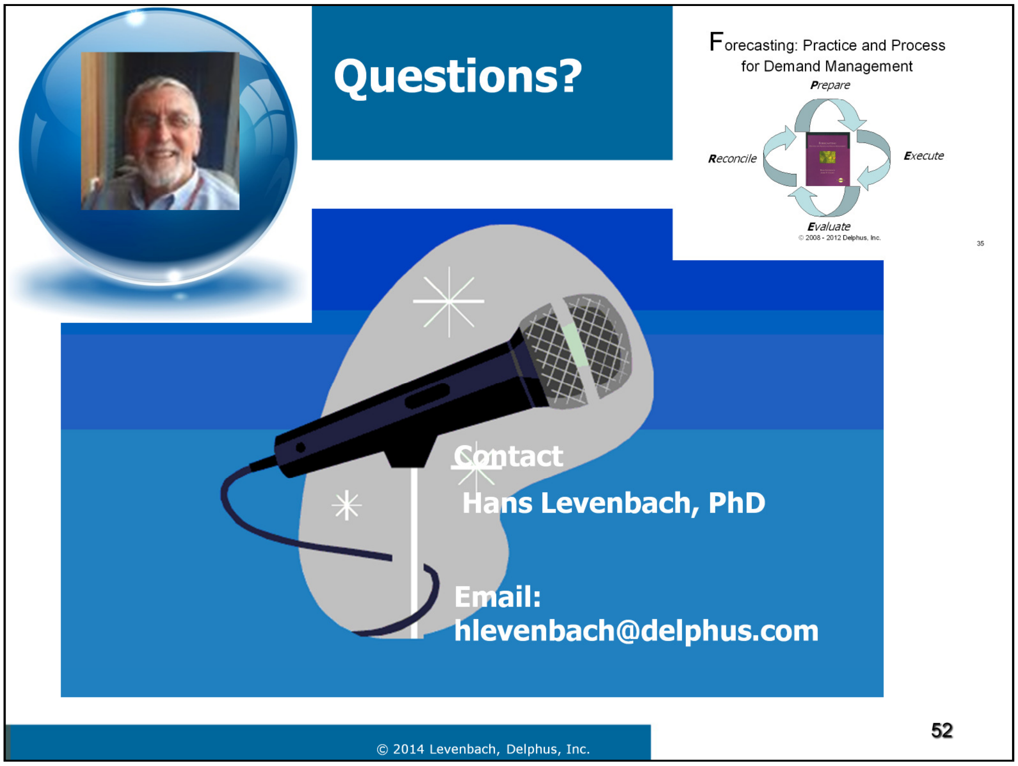
1. Anticipate Data Proliferation by creating the appropriate Data Framework
2. Break Down Silos through Collaboration, Cooperation and Communication
3. Manage Complexity by setting Standards and routinely apply checklists



1. Here is my email
2. And an unabashed advertisement for a book entitled Forecasting: Practice and Principles for Demand Management that I co-authored with Jim Cleary. It is available through Amazon.com and Barnes & Noble.
3. Thank you for your attention