School of Systems&Enterprises

Demand Management

"Where Practice Meets Theory"

Elliott S. Mandelman

School of Systems&Enterprises

Agenda

- What is Demand Management?
- Components of Demand Management (Not just statistics)
- Best Practices Demand Management
- Performance Metrics
- Summary
- Q & A

School of Systems&Enterprises

Agenda

- What is Demand Management?
- Components of Demand Management (Not just statistics)
- Best Practices Demand Management
- Performance Metrics
- Summary
- Q & A

School of Systems&Enterprises

What is Demand Management?

Definitions

- **Demand Management** – *The tactical process of integrating all tasks to develop a demand stream.*
- **Demand Planning** – *The strategic process of determining the longer range demand requirements.*
- **Accuracy vs. Error**
- **Statistical Forecasting** – *Generate a forecast using historical data as a basis for projections.*
- **Rule Based Forecasting** – *Generating a forecast based on a set of rules derived from operational experience.*
- **Optimization** – *The mathematical process of identifying a maximum or minimum.*
- **Outliers** – *Data points that lie outside the band of "normal" variability.*
- **Causal** – *Unique events that impact the level of the forecast.*

School of Systems&Enterprises

What is Demand Management?

Demand Management involves proactively executing the following functions

- The creation of a new demand forecast
- Overriding/adjusting the “system” forecast
- Achieving consensus across multiple groups
- The evaluation of past performance (error not accuracy)
- Proper metrics that reflect reality
- The communication of the demand plan for upstream or downstream use

What is Demand Management?

Why forecast?

- **Yogi Berra -** *"I don't like forecasting, particularly if the future is involved."*
- **Paul A. Samuelson -** *"The stock market has forecast nine of the last five recessions."*
- **Albert Einstein -** *"All models are wrong, nevertheless some are useful."*

School of Systems&Enterprises

What is Demand Management?

Why forecast?

Because…

Operations forecasting is a critical component in demand management as it begins the process that drives rationalized inventory levels and supply chain performance.

School of Systems&Enterprises

What is Demand Management?

Demand Management, more than just a statistical forecast, must focus on the company's objectives, for example:

- Reducing Inventory

  there is a direct link between forecast error and the level of safety stock (a component of total inventory)

- Maintaining Customer Service Levels

  there is a direct link between customer service and the level of safety stock

- Minimizing Inventory of Obsolete Items

  right product at the right place at the right time with the right volume

- Appropriate Pipeline Fill of New Products

  new product forecast and error to be closely monitored

School of Systems&Enterprises

Agenda

- What is Demand Management?
- Components of Demand Management (Not just statistics)
- Best Practices Demand Management
- Performance Metrics
- Summary
- Q & A

School of Systems&Enterprises

Components of Demand Management (Not just statistics)

A good demand management system will include:

- Statistical forecasting engine
  - *quantitative methods*
  - *rule based methods*
- Management interaction
  - *qualitative methods*
  - *management by exception*
- Performance measurement system
  - *feedback*
  - *publication*
  - *accountability*
- Information organization
  - *visibility into data*
  - *analysis capabilities (graphs)*

School of Systems&Enterprises

Components of Demand Management (Not just statistics)

Statistical forecasting is only one phase of demand management

- Exponential smoothing forecast methods
- Linear Regression
- Multiple Regression
- Box Jenkins
- Fourier Models
- Intermittent Demand
- Bayesian Models
- Rule Based Forecasting

Components of Demand Management (Not just statistics)

Statistical forecasting caveats (Be aware!)

- No substitute for common sense and a knowledge of the business environment
- An extrapolation of historical activity is a good indicator of future activity
- An appropriate starting point for projecting future demand
- “Rule Based” are based on a set of rules derived from operational experience
- Forecasts are meaningless unless they make sense
- Statistical forecast methods do a better job in forecasting “large” numbers where random variability is negated by high volume

Components of Demand Management (Not just statistics)

The importance of management interaction

- Many times quantitative methods alone aren't enough
  - *new products*
  - *promotions*
  - *unusual demand patterns*
- For many product/geography combinations, the data will not be statistically significant
- In most cases, a good consensus process will lead to a more accurate forecast than statistics alone
- Time limitations require a process methodology that enables the review of items based on criticality

Components of Demand Management (Not just statistics)

The importance of measurement systems

"What gets measured gets rewarded

and

What gets rewarded gets done."

John T. Mentzer, University of Tennessee

School of Systems&Enterprises

Components of Demand Management (Not just statistics)

The importance of measurement systems

- Critical to have a feedback mechanism that is published
- Identify appropriate metrics that will focus on forecast improvements, easy to understand and be relevant to the forecast user community
- Ideally, track both system generated and management (consensus) forecast
- Measure against whatever you're forecasting (e.g., sales, orders, etc.)
- Measure over the appropriate time frame (weekly, monthly, etc.)
- Different organizations may require measurements over different time frames
  - *Safety stock determination requires weekly measurement*
  - *Sales requires monthly measurement*
  - *Finance requires quarterly measurements*

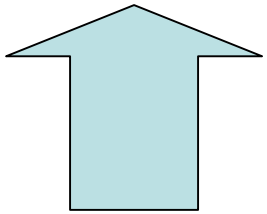
School of Systems&Enterprises

Agenda

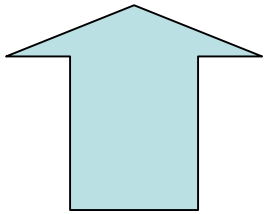
- What is Demand Management?
- Components of Demand Management (Not just statistics)
- ➔ Best Practices Demand Management
- Performance Metrics
- Summary
- Q & A

Best Practices Demand Management

Demand Management Objectives



Demand Management Process



Functions to Support Process

School of Systems&Enterprises

Best Practices Demand Management

Identify and Focus on Demand Management Objectives

- Reducing Inventory
- Maintaining Customer Service Levels
- Minimizing Inventory of Discontinued Items
- Appropriate Pipeline Fill of New Products
- Consistent demand management process across the enterprise thereby eliminating “Islands of Analysis”

Best Practices Demand Management

Steps to achieve best practice process

- Assign ownership of process and individuals to maintain process
- Identify and include in the process organizations that are impacted by the demand plan
- Implement a consensus and collaborative procedure
- Define appropriate aggregation points to support objectives
- Identify the timing and frequency of the forecast review cycle

Best Practices Demand Management

Steps to achieve best practice process (Continued)

- Define management of forecast by exception
- Identify appropriate measurements of forecast error
- Implement procedure to report and disseminate forecast results
- Review the entire demand management process procedures on a regular basis (at least once a year) with an eye toward improvements in accuracy, performance and efficiency

Best Practices Demand Management

Identify and Implement Tools to Support Demand Management Process

- Statistical forecast methods including rule based
- Error Metrics
- Exception criteria
- Reporting methods

Best Practices Demand Management

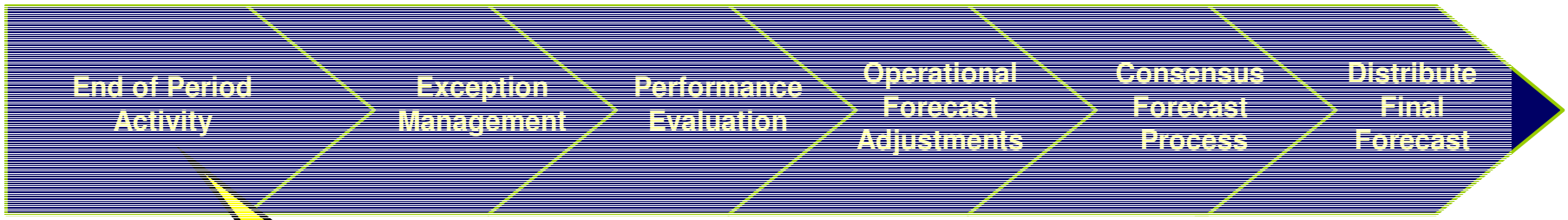
A typical demand management process

This process will support several company objectives

- Proactive rather than reactive management
- Maintain or exceed service level objectives
- Reduced inventory levels

Best Practices Demand Management

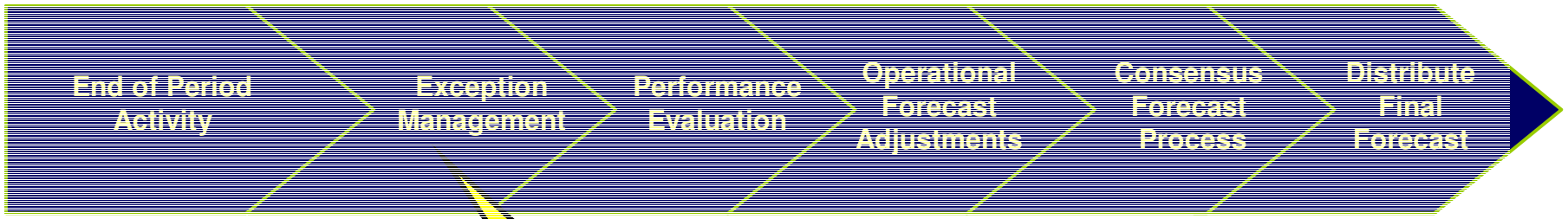
A typical demand management process



- Update database with latest demand information
- Generate forecast performance metrics
- Update the statistical forecast using most recent historical data, promotion and event indicators

Best Practices Demand Management

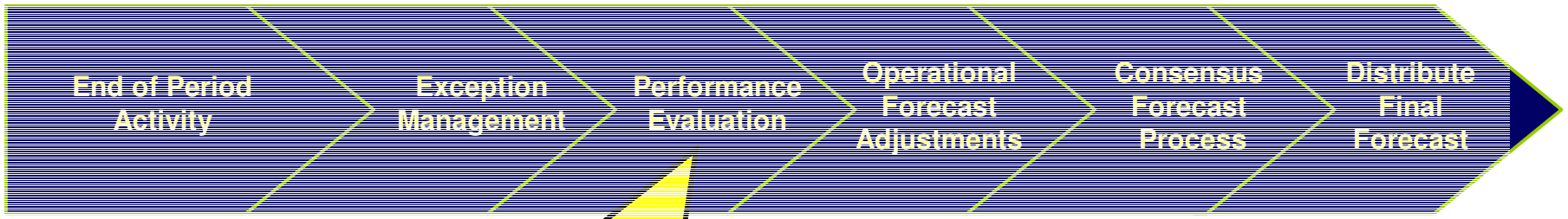
A typical demand management process



- Review exceptions based on established criteria
- Modify, if appropriate, forecasts for exception items
- Review exception criteria

Best Practices Demand Management

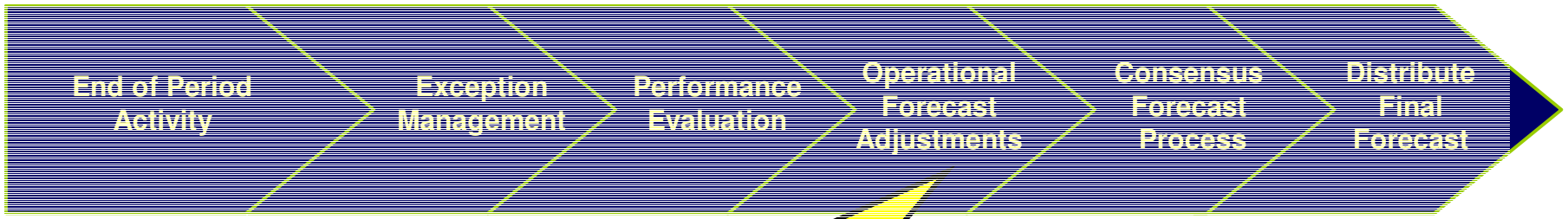
A typical demand management process



- Review and distribute forecast error metrics
- Evaluate error trend of forecasts at different aggregation levels and time horizons
- Evaluate actual year-to-date demand against annual revenue and/or volume targets

Best Practices Demand Management

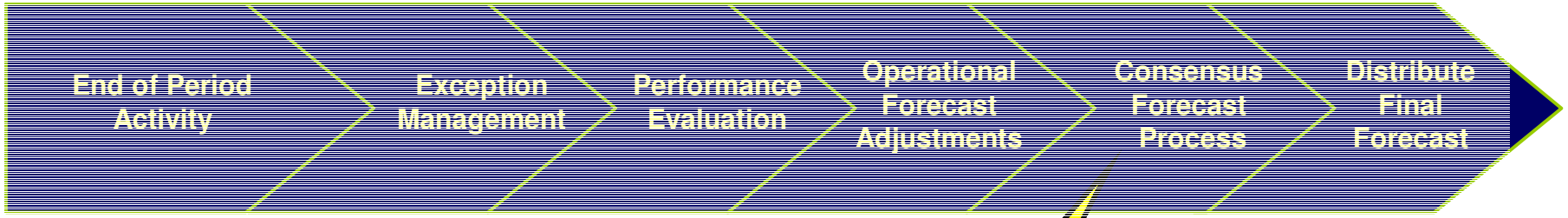
A typical demand management process



- Forecast adjustment from Sales, Marketing, Logistics, Manufacturing and/or Finance based on forecast performance, promotional events, management objectives and items identified in exception process
- Evaluate actual year-to-date demand against annual revenue and/or volume targets

Best Practices Demand Management

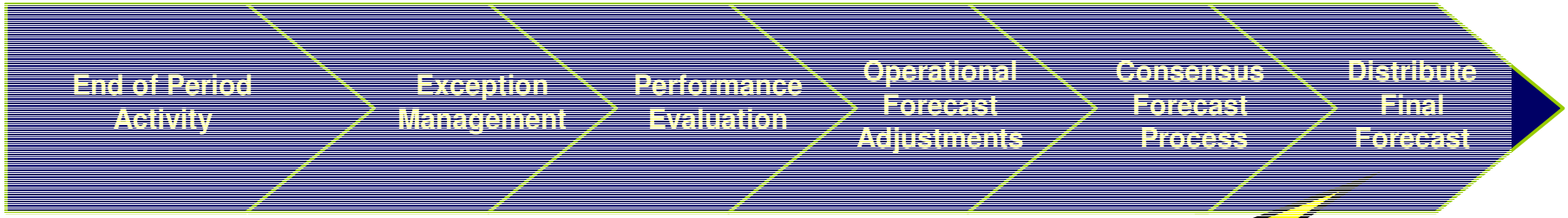
A typical demand management process



- Review forecasts provided by Sales, Marketing, Logistics, Manufacturing and/or Finance
- Evaluate organizational forecasts, statistical forecast, their error metrics and reconcile these forecasts to generate **ONE** consensus forecast

Best Practices Demand Management

A typical demand management process



- Generate the consensus, final, forecast for alternate time horizons; weekly, monthly, quarterly and annual
- Distribute the final forecast to all departments; including, Sales, Marketing, Logistics, Manufacturing and/or Finance

School of Systems&Enterprises

Best Practices Demand Management

Examples of Management by Exception

Identify instances where…

- Forecast is zero and actual non-zero
- Forecast is non-zero and actual is zero
- Absolute error is greater than 4*MAD from the forecast (outlier)
- Error/Volume matrix

Best Practices Demand Management

Examples of Management by Exception

Error/Volume Matrix - Creating indicators of forecast error in combination with demand volume

----------Volume----------►

%Error			
	3	2	1
	6	5	4

Lower Volume Level -----► ◄----- Upper Volume Level

School of Systems&Enterprises

Agenda

- What is Demand Management?
- Components of Demand Management (Not just statistics)
- Best Practices Demand Management
- ➔ Performance Metrics
- Summary
- Q & A

Performance Metrics

The importance of measurement systems

"What gets measured gets rewarded

and

What gets rewarded gets done."

John T. Mentzer, University of Tennessee

Performance Metrics

Some basic questions to determine appropriate error metric

- Absolute difference or signed difference ?
- In units or in Percent ? Percent of actual or percent of forecast ?
- Square of the difference to emphasize large differences ?
- Forecast(s) made how many period(s) into the future?
- Period by period differences, or sum of some forecasts compared with the sum of actuals over a period range?
- Most recent results or average of recent results? How about results last year at the same time period?
- Unweighted average or weighted average ? If weighted, what kind of weights ?

Performance Metrics

***Be Aware*:**

Performance metrics vary depending on the aggregation level at which metrics are computed

Performance Metrics

Measurement systems

- The most common error measurements look at deviations from actuals:
  - ***MD*** *= Mean Deviation*
  - ***MAD*** *= Mean Absolute Deviation*
  - ***APE*** *= Absolute Percent Error*
  - ***MAPE*** *= Mean Absolute Percent Error*
  - ***MSE*** *= Mean Squared Error*
  - σ_{Error} *= Standard Deviation of Error*
- Error targets vary depending on the level of aggregation
- Need to consider bias (deviation) - measures the tendency of the model to project consistently high or low
- Absolute or percent error cannot be summed

School of Systems&Enterprises

Performance Metrics

The impact of forecast accuracy improvements are reflected in reduction of inventory levels; that is where value will be found.

- Safety stock, a component of total inventory, is a function of forecast error
- The higher the error, the larger the requirement for safety stock
- Forecast error metrics must be sent downstream to inventory management applications
- Error metrics required to compute appropriate levels of safety stock include MAD and MD
- Once targets for customer service levels and inventory turns are established, appropriate forecast error targets can be determined

Performance Metrics

Characteristics of appropriate forecast error metric?

- Forecast error must support the process objectives
- More than one error metric can be used
- Must be easy to understand and the user must be able to use metrics to reduce error
- Must make sense… a convoluted mathematical formula for error does not assist in improving accuracy

School of Systems&Enterprises

Agenda

- What is Demand Management?
- Components of Demand Management (Not just statistics)
- Best Practices Demand Management
- Performance Metrics
- ➔ Summary
- Q & A

Summary

Demand management is more than just a statistical forecast

- A process that supports the company's objectives
- Adherence to the tenets of "best practices"
- The review of demand projections using "management by exception" methods
- The development, reporting and publishing of appropriate error metrics that reflect the true business environment

Summary

We have just scratched the surface of where "Practice meets Theory"

- Adjustments of historical data to provide consistent forecasts
- Identifying appropriate time horizons for error measurements
- Fit vs simulation – Dangers and pitfalls
- Using common sense when validating statistical forecasts

School of Systems&Enterprises

Agenda

- What is Demand Management?
- Components of Demand Management (Not just statistics)
- Best Practices Demand Management
- Performance Metrics
- Summary
- Q & A