Garment Production Management

Week 9

Demand management and forecasting

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Recap-previous week

- Work measurement concepts
- Types of work measurement techniques
- Nature of work and recommended techniques

Lecture Learning Outcomes

1. Understand demand forecasting concepts
2. Analyze various forecasting techniques
3. Measure accuracy of forecasting techniques
4. Compare different forecasting techniques

Session outline

- Demand management and forecasting concepts
- Importance of forecasting
- Forecasting methods
- Measuring forecasting accuracy
- Collaborative forecasting and planning in the fashion supply chain
- Practical cases of forecasting and demand management in garment industry

Demand management and forecasting concepts

- All the operations management decisions (in both the strategic and the tactical category) require a good estimate of future demand as input
- Forecasting is to foretell sales demand volume even though the probabilities have never been formally studied
- Demand and forecasting management is a complex challenge in garment industry than other consumer goods sectors
- Business people reach decisions based on what will happen than data-based input from previous records
- Often there is empirical basis for estimating what is likely to happen in the future

Demand management and forecasting concepts

- Demand forecasting is a popular research topic in garment industry
- Many fashion forecasting models have been proposed in the literature
- Unlike products with stable demand patterns, fashion items are characterized by:
  - Short product life cycles
  - Seasonal volatility/seasonal trends
  - Demand uncertainty
  - Emotional purchasing behavior
  - Lack of historical data (continuous introduction of new products and styles)

Demand management and forecasting concepts

- Forecasting is the basis for:
  - Budgeting
  - Capacity planning
  - Sales planning
  - Production and inventory decisions
  - Personnel planning
  - Purchasing
- Drives efficient operations management plans or planning process
- Enable managers to anticipate the future and plan accordingly

Poor forecasting

Poor forecasting impacts:

- Stock outs or high inventory
- Obsolescence
- Low service level
- Rush orders
- Inefficient resource utilization
- Bullwhip propagating through the upstream supply chain

Types of forecasts

- Economic forecasts; predict a variety of economic indicators (money supply, inflation rates, interest rates, etc)
- Technological forecasts; predict rates of technological progress and innovation
- Demand forecasts; predict the future demand for a company's products or services

Scope of forecasting

Demand forecasting predicts customer demand for specific items or categories

Inputs:

- Historical sales
- Market trends
- Economic indicators, promotions

Techniques:

Time series models (e.g., ARIMA, exponential smoothing)

Machine learning (e.g., regression, neural networks)

Collaborative forecasting with retailers

Goal: Reduce overproduction, overstocking and stockouts

Scope of forecasting

Trend forecasting predicts future consumer preferences in style, color, fabric, and silhouette.

Techniques:

- Fashion weeks
- Cultural trends
- Social media analysis
- Forecasting agencies (e.g., WGSN, Pantone)

Users:

- Designers
- Merchandisers
- Brand managers

Scope of forecasting

Sales forecasting estimates future revenue over a period (monthly, seasonal, annual)

Application:

- Budgeting and planning
- Sales targets and inventory decisions

Inventory forecasting determines inventory levels of raw materials, work-in-progress, and finished goods

- Minimizes carrying costs and avoids stockouts

Production & capacity forecasting anticipates production workload and resource needs

- Essential to plan manufacturing schedules, staffing, and material procurement

Intermittent demand forecasting

Types of forecasting intermittent demand:

- Exponentially Weighted Moving Average (EWMA) methods (including Croston's method)
- Early Sales (Ea Sa)
- Order Over planning (Or Ov)
- Parametric Bootstrapping

Forecasting approaches/methods

Qualitative methods:

- Judgments, opinions, intuition, emotions, or personal experiences
- Based on subjective inputs (the factors are difficult and impossible to quantify)
- Do not rely on any rigorous mathematical computations
- Permit inclusion of soft information (e.g., human factors, personal opinions, hunches) in the forecasting process

Forecasting approaches/methods

Quantitative methods:

- Based on mathematical (quantitative) models
- Objective and avoid personal biases
- Rely heavily on mathematical computations
- Involves either the projection of historical data or the development of associative models(using causal/explanatory variables) to forecast
- Mainly consist of analysing objective or hard data
- In practice, either qualitative, quantitative or a combination of both might be used

Forecasting techniques

- Judgmental forecasts rely on analysis of subjective inputs obtained from various sources:
  - Consumer surveys; sales staff; managers and executives; panels of experts
- Time-series forecasts attempt to project past experience into the future
  - Use historical data with the assumption that the future will be like the past
  - Some models only attempt to smooth out random variations in historical data
  - Other models identify specific patterns in the data and project or extrapolate those patterns into the future, without trying to identify causes of the patterns
- Associative models use equations that consist of explanatory variables to predict demand
  - Example: demand for garment might be related to variables such as:
    - Quality of the garment; price; specific characteristics of materials

Time series forecasting

- Time series is a time-ordered sequence of observations taken at regular intervals
  - Example: hourly, daily, weekly, monthly, quarterly, annually
- The time series data is measurements of:
  - Demand
  - Revenue earnings
  - Profits
  - Shipments
  - Accidents
  - Output, precipitation, productivity, or the consumer price index

Time series forecasting

Time series behaviors can be explained as:

- **Trend:** A long-term upward or downward movement in data
- **Seasonality:** Short-term regular variations related to the calendar or time of day
- **Cycle:** Wave like variations lasting more than one year
- **Irregular variation:** Caused by unusual circumstances, not reflective of typical behaviours
- **Random variations:** Residual variations after all other behaviours are considered

Requirements of a good forecast

A properly prepared forecast should fulfil certain requirements:

- **Timely:** forecasting horizon must be enough to implement possible changes
- **Accurate:** enable users to plan with minimum errors
- **Reliable:** should work consistently
- **Expressed in meaningful units:** financial planner, production planner, scheduler
- **Documented or written form:** help to evaluate the forecast accuracy once actual results are known
- **Simple to understand and use:** less complex yet efficient

Elements of a good forecast

Basic steps in the forecasting process:

- Determine the purpose of the forecast
  - How will it be used and when will it be needed? the level of accuracy necessary
- Establish a time horizon:
  - Forecast must indicate a time interval; accuracy decreases as the time horizon increases
- Obtain, clean, and analyse appropriate data
- Select a forecasting technique
- Make the forecast
- Monitor the forecast errors

Elements of a good forecast

Measures of forecasting accuracy:

- Mean absolute deviation (MAD): measures summation of average of the deviation of the forecast from actual
- Mean square error (MSE): summation of average of square of the deviation or error
- Mean absolute percent error (MAPE): Average of summation of percentage error

Types of forecasting

Naïve method:

- A simple but widely used approach to forecasting
- Uses a single previous value of a time series as the basis of a forecast
- Used with a stable series (variations around an average)

Exponential smoothing:

- A weighted average of past observations
- Unlike simple moving averages, exponentially decreasing weights are assigned to older observations or historical data
- More responsive to recent demand patterns and still smoothing out random noise

Types of forecasting

Trend-Adjusted Exponential Smoothing/double smoothing:

- A variation of simple exponential smoothing
- Used when a time series exhibits a linear trend
- Appropriate only when data vary around an average or have step or gradual changes
- If a series exhibits trend, and simple smoothing is used on it, the forecasts will all lag the trend:
  - If the data are increasing, each forecast will be too low
  - if decreasing, each forecast will be too high

Types of forecasting

Seasonality:

- Seasonal variations in time-series data regularly repeate upward or downward movements due to recurring events
- Seasonality may refer to regular annual variations
- Familiar examples of seasonality are:
  - Weather variations (e.g., sales of winter and summer sports equipment)
  - Vacations or holidays (e.g., airline travel, greeting card sales, visitors at tourism sites)
- Seasonal variation applied to daily, weekly, monthly, and other regularly recurring patterns in data

Types of forecasting

- Associative techniques rely on identification of related variables that can be used to predict values of the variable of interest
- Simple Linear Regression Models
- For example:
  - Sales of beef may be related to the price per kg of beef
  - And prices of substitutes such as chicken, pork, and lamb
  - Real estate prices are usually related to property location and square footage
  - Crop yields are related to soil conditions and the amounts and timing of water and fertilizer applications

Forecasting in garment industry

- Predicting future customer demand, market trends, and operational requirements to ensure:
  - right products are produced, stocked, and delivered at the right time
- Vital decision-making tool to predict future sales, fashion trends, production needs, and inventory levels.
- Given the fast-changing nature of the fashion business, effective forecasting helps apparel companies to:
  - manage inventory
  - reduce uncertainty
  - optimize resources (minimize waste)
  - meet consumer demand
  - improve profitability
  - ensure competitiveness

Forecasting for garment industry

- Garment business is unpredictable and difficult to forecast
- This is mainly due to:
  - Short product life cycles
  - Seasonality and trend-driven demand
  - High stock keeping units (SKUs) variety (styles, sizes, colors)
  - Long supply lead times (especially in offshore manufacturing)

Collaborative forecasting in fashion supply chain

- The process of share data, insights, and market intelligence to produce more accurate demand predictions between multiple stakeholders
  - Retailers
  - Brands
  - Suppliers
  - Logistics providers
- Unlike traditional forecasting, this approach uses expertise and real-time information to address the unique challenges of fashion
  - Short product life cycles
  - High demand volatility
  - Seasonality
  - Bullwhip effect

Collaborative forecasting in fashion supply chain

Key elements of collaborative forecasting

- Data sharing: Point-of-sale (POS) data, inventory levels, return rates, social media trends, and weather forecasts.
- Joint planning: Retailers and suppliers align on forecasts, production schedules, and replenishment
- Technology enablers: Cloud-based platforms, AI/ML tools, and APIs that integrate systems like ERP and CRM

Collaborative forecasting in fashion supply chain

Common models in fashion:

- Collaborative Planning, Forecasting, and Replenishment (CPFR): Partners define a shared forecast and action plan.
- Vendor-Managed Inventory (VMI): Supplier manages stock based on retailer's real-time data.
- Postponement: Delaying final production (e.g., dyeing, printing) until closer to sale, using collaborative signals

Benefits:

- Reduced forecast error (often 20–50% improvement)
- Lower stockouts and markdowns
- Faster response to trends (e.g., fast fashion)
- Decreased bullwhip effect

Collaborative forecasting in fashion supply chain

Challenges:

- Trust and data privacy concerns
- System integration costs
- Misaligned incentives (supplier vs. retailer KPIs)
- Need for governance and legal agreements

Practical examples:

- A sportswear brand shares weekly sell-through data with its fabric supplier
- Supplier increases elastic material orders for sudden increase running stockings
- Retailer’s POS data triggers a replenishment forecast that adjusts for upcoming marathon events, reducing lost sales by 15%

Application of forecasting in garment industry

Type	Description	Examples
Demand Forecasting	Predicts customer demand for products	Estimating monthly T-shirts sales
Trend Forecasting	Anticipates future fashion trends in style, color, material, and silhouette	Planning next season's design themes
Sales Forecasting	Projects future revenue or unit sales	Estimating total revenue for a season
Inventory Forecasting	Predicts required inventory levels	Determine how much stock to hold
Financial/market Forecasting	Estimates future financial outcomes such as revenue, profit, and cash flow	Budget for annual expenses & profit margins
Production Forecasting	Projects production capacity & scheduling needs	Planning how many units to manufacture

Summary

- Forecasting helps to improve planning accuracy in businesses
- It may include production, sales, market trend, inventory level, etc.)
- Forecasting methods can be qualitative (subjective and judgmental) or quantitative(objective and data driven)
- A good forecast should be based on recent and relevant data
- Quick style changes, demand volatility, and quick production cycle make forecasting garment industry difficult but crucial
- Forecasting techniques should be measured based on metrics(forecasting errors)

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Thank You !

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