



# Production Planning & Control: Days 1 & 2

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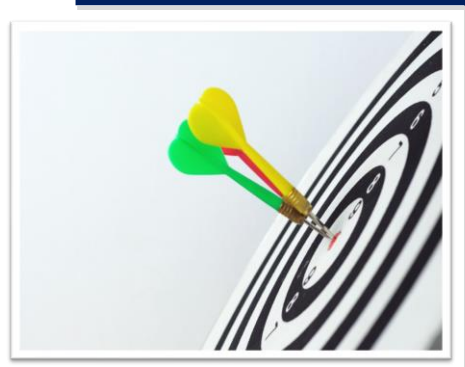
BEEAH  بيئة



1

## Course Objectives

- Understand planning and control including differences in operations, customer influences, process categories, and production planning flows.
- Understand forecasting principles, methods, techniques, and the importance of forecast errors and computer assistance.
- Understand S&OP processes, strategies, resource balancing, and qualitative considerations.



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2

## Agenda

- 1 Overview of Planning and Control**  
 Discussion: The PP&C Process at Bee'ah  
 Introduction to PP&C  
 Production Systems  
 Process Categories  
 Process Analysis and Information Flows  
 End of Section Exercises  
 Case Study: Overview of Planning and Control

- 2 Forecasting Fundamentals**  
 Fundamental Principles of Forecasting  
 Major Categories in Forecasting  
 Qualitative and Quantitative Methods  
 End of Section Exercises  
 Case Study: Forecasting Fundamentals

- 3 Sales and Operations Planning**  
 Purpose and Objectives of S&OP  
 Trade-Off Approaches: Level, Chase, Combination  
 Balancing Resources in S&OP  
 Internal and External Strategies  
 End of Section Exercises  
 Case Study: Sales and Operations Planning

3



## Overview of Planning and Control

4

## Group Discussion: PP&C Process at Bee'ah

- What do you understand by Production Planning & Control?
- What is the PP&C process at Bee'ah?
- How does your role contribute to it?
- In your view, what are the main pain-points that we should focus on improving?



5

## What is Production Planning?

Production Planning is a managerial function which is mainly concerned with the following important issues:

- What production facilities are required?
- How these production facilities should be laid down in the space available for production?
- How they should be used to produce the desired products at the desired rate of production?



6

## Main Aspects of Production Planning

Broadly speaking, production planning is concerned with **2 main aspects**:



Routing or planning work tasks



Layout or spatial relationship  
between the resources.

Production planning is dynamic in nature and always remains in fluid state as plans may have to be changed according to the changes in circumstances.

7

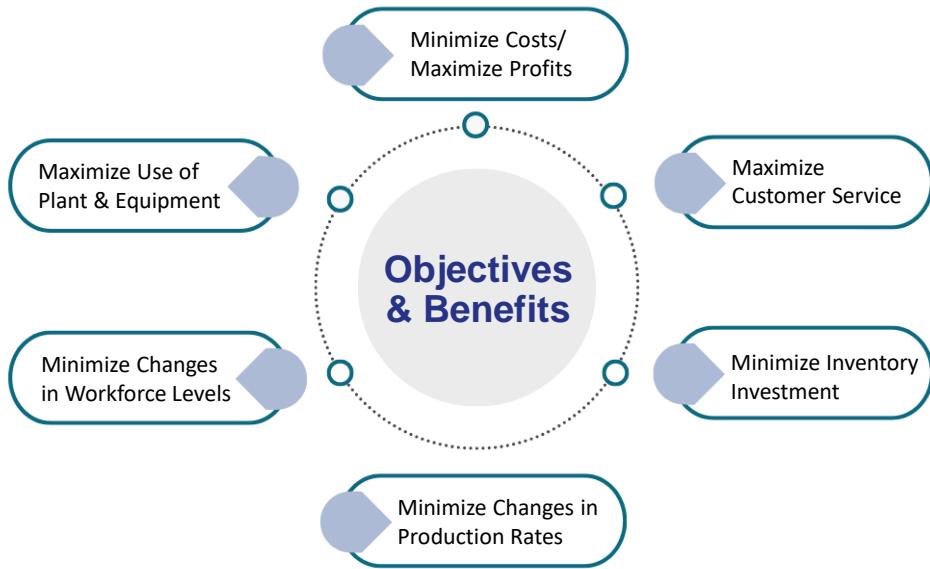
## Functions of Production Planning

### Production Control

*Definition:* A mechanism to monitor the execution of the plans.

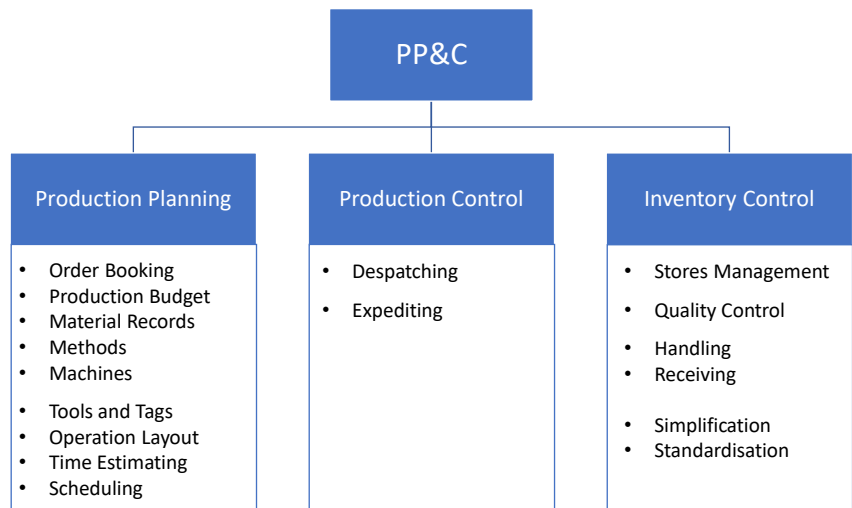
- ✓ Making sure that production operations are started at planned places and planned times.
- ✓ Observing progress of the operations and recording improperly.
- ✓ Analyzing the recorded data with the plans and measuring the deviations.
- ✓ Taking immediate corrective actions to minimize the negative impact of deviations from the plans.
- ✓ Feeding back the recorded information to the planning section in order to improve future plans.

8



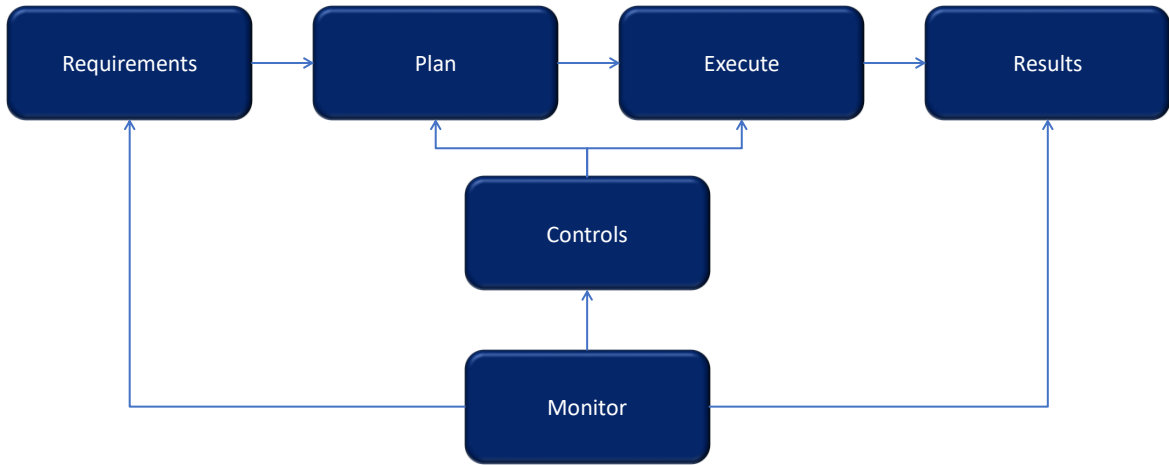
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## Organization Chart for a PP&C Department



10

## Architecture of a Control System



11

## What is a Production System?

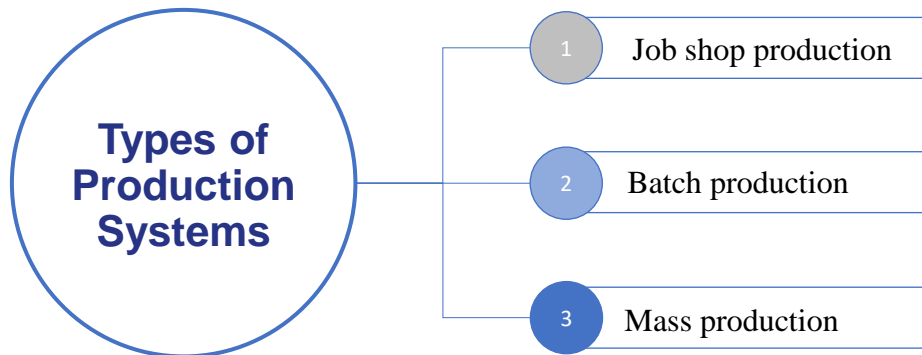
A Production System can be defined as a transformation system in which a saleable product or service is created by working upon a set of inputs. Inputs are usually in the form of men, machine, money, materials etc.



Production systems are usually classified on the basis of the following:

- ✓ Type of product
- ✓ Type of production line
- ✓ Rate of production
- ✓ Equipment used

12



## Product Design

Product design impacts the choice and effectiveness of a production system.

These factors are to be considered before designing a product:

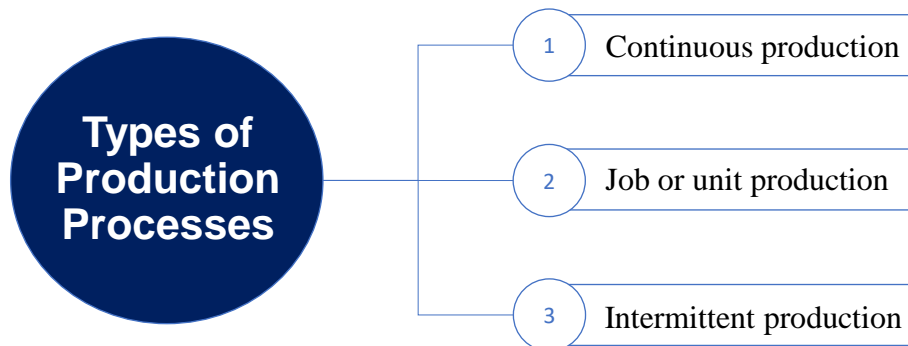
- |                     |                                      |
|---------------------|--------------------------------------|
| (a) Standardization | (g) Product simplification           |
| (b) Reliability     | (h) Quality Commensuration with cost |
| (c) Maintainability | (i) Product value                    |
| (d) Servicing       | (j) Consumer quality                 |
| (e) Reproducibility | (k) Needs and tastes of consumers    |
| (f) Sustainability  |                                      |

## Exercise: Production Systems at Bee'ah

Bee'ah has various recycling facilities that sort, process, treat, and regenerate different types of waste materials.

Research one of these facilities and be prepared to **discuss the following questions:**

- Which type of production system aligns with your selected recycling facility (Job Shop, Batch or Mass)?
- Which factors related to the product design would influence your decision?



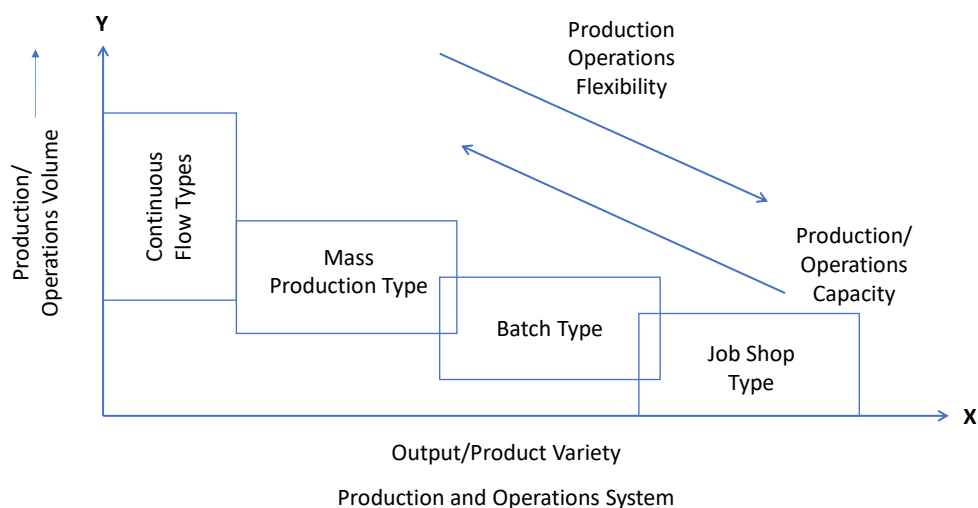


## Intermittent Production

- Under this system the goods are produced partly for inventory and partly for customer's orders.
- Components are made for inventory, but they are combined differently for different customers.
- E.g. Automobile plants, printing presses, electrical goods plant.

17

## Intermittent Production



18

## Manufacturing vs. Service Operations

Generally, the **service organization's** approach to planning and control is more difficult to manage.

There are four major reasons that influence the way planning and control approaches are designed for these organizations:

1. Timing
2. Customer Contact
3. Quality
4. Inventory



## Customer Influence in Design: Production Environmental Choices

Among the most critical of these factors are **the volume and variety of the expected output.**

These issues in turn tend to be largely driven by the amount of influence the customer has in the design of the product or service delivered to them from the organization's processes.

In some cases, the issue of customer design influence is a part of the firm's basic strategy but, in other cases, it is a reaction to market drivers.

E.g. Automobiles are purchased as finished goods from a dealer's lot primarily because the customers do not wish to wait for an automobile that is ordered with the exact options they want.

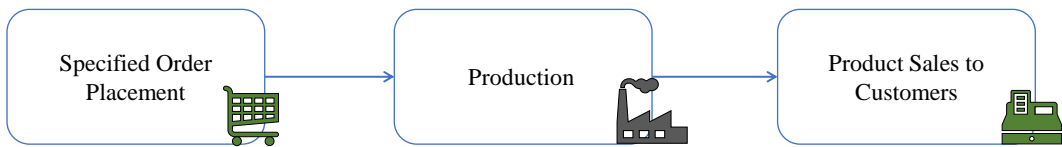
## Production Strategies



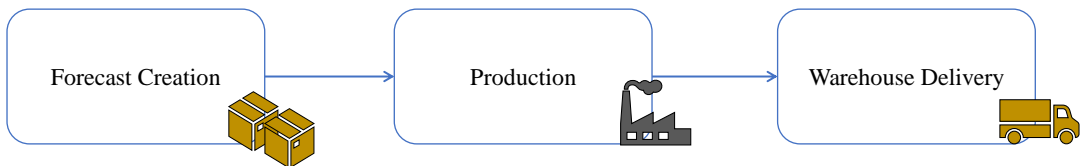
21

## MTO and MTS

### Make to Order

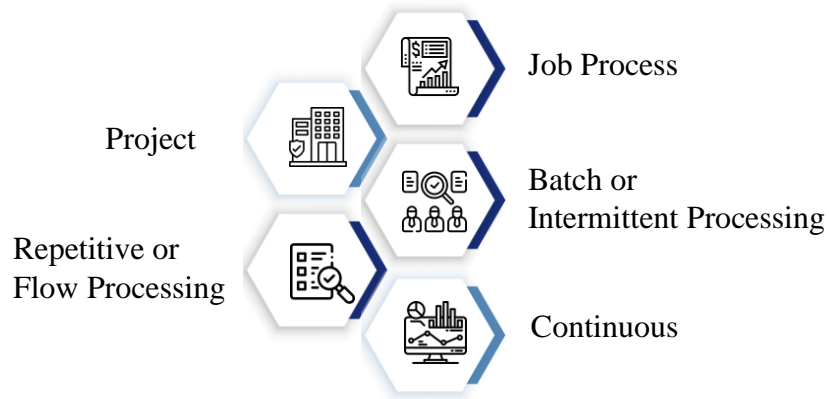


### Make to Stock



22

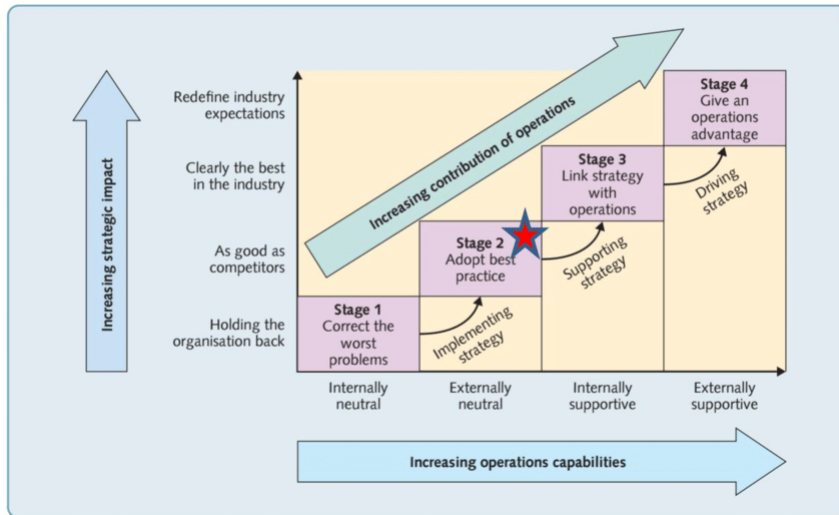
## Process Categories



## Deeper Dive: Process Categories

	Job Process	Batch	Repetitive
Equipment	General purpose	Semi-specialized	Highly specialized
Labor Skills	Highly skilled	Semi-skilled	Low skills
Managerial Approach	Technical problem solver	Team leadership	Efficiency – Keep the process moving
Volume Output per Design	Low	Medium	High
Variety of Designs Produced	High	Medium	Low
Design Environment	ETO, MTO	MTO, ATO, MTS	ATO, MTS
Flow of Work	Variable, Jumbled	More defined	Highly defined and fixed

## The Hayes and Wheelwright Model



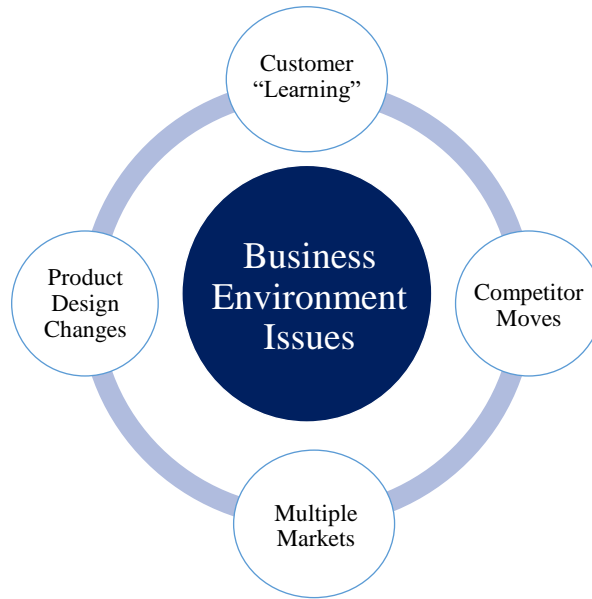
25

## Order Winners and Qualifiers

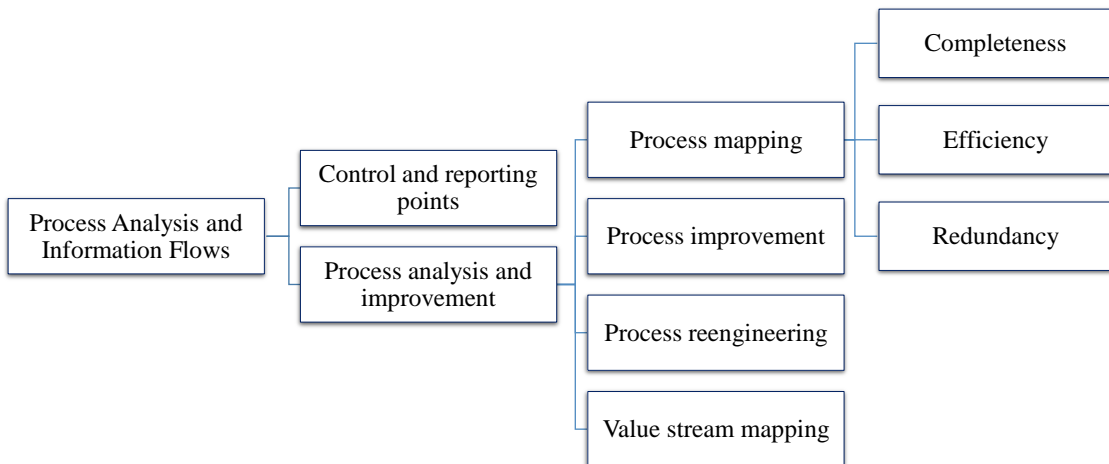
### Dimensions of competition include:

1. Price
2. Quality
  - Tangible quality
  - Intangible quality
3. Delivery
  - Speed-how quickly can the product or service be delivered?
  - Reliability-once a promise for delivery is made, is it kept?
4. Flexibility
  - Volume – Can the producer easily produce a wide range of product volumes?
  - Variety – Can the producer easily produce a wide range of product designs and/or options?

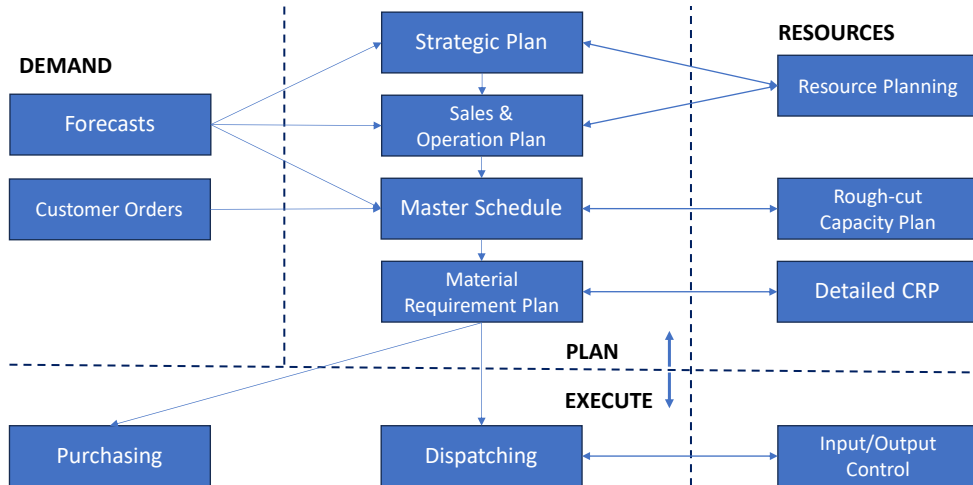
26



## Process Analysis and Information Flows



## General Information Flows



29

## Recap Key Terms

- ✓ Make-to-Stock (MTS)
- ✓ Make-to-Order (MTO)
- ✓ Job Shop
- ✓ Continuous Processing
- ✓ Kaizen
- ✓ Assemble-to-Order (ATO)
- ✓ Engineer-to-Order (ETO)
- ✓ Batch Processing
- ✓ Order Winner
- ✓ Package-to-Order
- ✓ Project
- ✓ Flow Processing
- ✓ Order Qualifier

30

## End of Section Exercise: EcoWaste Recycling Co.

Your team has been tasked with preparing a comprehensive report for the upcoming review with the Production Planning and Control (PP&C) team at EcoWaste Recycling Co.

The goal is to analyse how various factors impact the design and effectiveness of the EcoWaste Recycling Co.'s planning and control systems.

Your report should provide insights into how elements like customer proximity, technological advancements, and shifting demands affect operational efficiency. The findings will help the PP&C team make informed decisions to optimize processes and improve overall performance in waste management (*you may be asked to present the report*).

Your manager has outlined **9 guidelines** that should be addressed in your presentation (*see next 4 slides*).

31

## Guidelines

1

Discuss the potential impact that each of the following may have on the design of a planning and control system. Will the impact change if the organization is more focused on products rather than services?

- Location proximity to customers
- Introduction of new technology impacting the design
- Customers demanding faster delivery
- Customers demanding lower prices

32



## Guidelines

2

Discuss the potential impact that the evolution of "quasi-manufacturing" organizations can have on planning and control. E.g. The development of large consumer credit organizations (typically classified as a service organization) within automobile manufactures.

3

What are the possible consequences on planning and control if the organization has a wide cross-section of product types (MTS, ATO, MTO) within the same organization?

4

Describe the possible cost implications of producing a standard product in a job shop environment.

33

## Guidelines

5

Discuss possible implications on planning and control if the customer base changes to the extent that an order qualifier has shifted to become an order winner.

6

Is it possible that there can be more than one order winner in a defined market? Why or why not?

7

What is the potential impact on planning and control if the organization has several types of customers, each with a different order-winning characteristic?

34

## Guidelines

8

Discuss how a change in a product design could produce a change in the design of a planning and control system.

9

Would a change in process design necessarily imply a corresponding change in the design of a planning and control system? Why or why not?

35





**Let's Move to the Case Study!**

36



## Forecasting Fundamentals

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### Fundamental Principles of Forecasting

Forecasting is a technique for using past experiences to project expectations for the future.

## Fundamental Principles of Forecasting

- 1) Forecasts are almost always wrong
- 2) Forecasts are more accurate for groups or families of items
- 3) Forecasts are more accurate for shorter time periods
- 4) Every forecast should include an estimate of error
- 5) Forecasts are no substitute for calculated demand

39

## Major Categories of Forecast: Qualitative Forecasting

Key characteristics of **Qualitative Forecasting** data include:

- 1 The forecast is usually based on personal judgment or some external qualitative data
- 2 The forecast tends to be subjective and, since they tend to be developed from the experience of the people involved, will often be biased based on the potentially optimistic or pessimistic position of those people
- 3 An advantage is that this method often does allow for some fairly rapid results
- 4 In some cases, qualitative forecasts are especially important as they may be the only method available

These methods are usually used for individual products or product families, seldom for entire markets.

40

## Methods of Qualitative Forecasting



Market Surveys

01.

Life Cycle Analogy

03.

Delphi or Panel  
Consensus

02.

Informed Judgment

04.

41

## Case Study

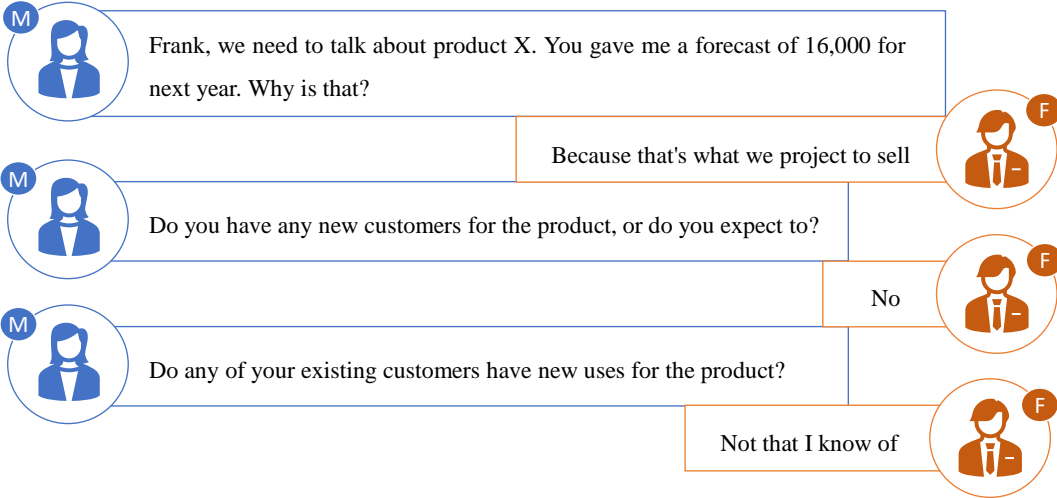
Mary, the production control manager, had just gotten the sales forecast for all the major products for the next year from Frank, the sales manager (the company does not use Sales and Operation planning).

As Mary was developing his initial long-range production plans to meet the forecast, she noticed something that bothered her. For the past several years the company had sold roughly 10,000 product X per year. Product X was sold to a small group of about 6 companies that used it to make another product. The forecast for product X for next year was given as 16,000.

[Mary called Frank and their conversation can be seen on the following slides.](#)

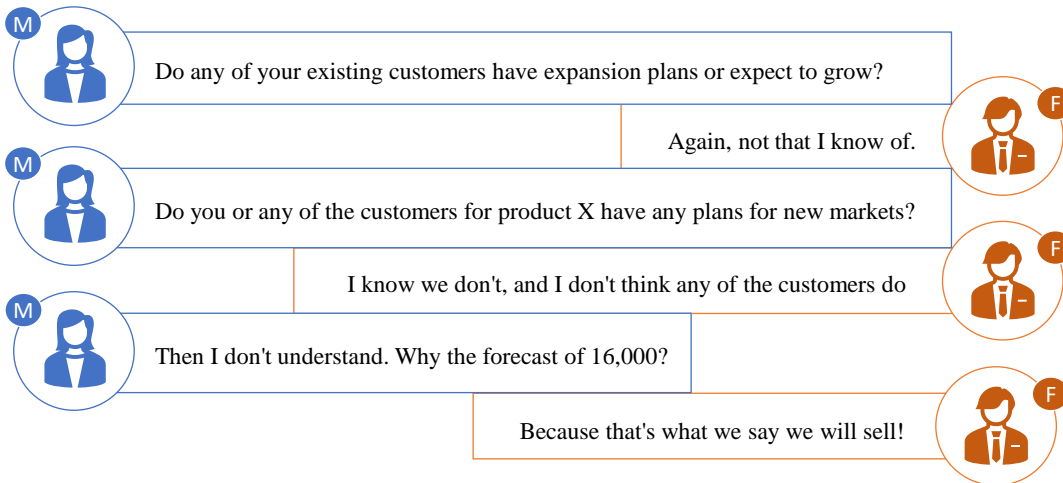
42

## Case Study



43

## Case Study



44

## Case Study

Mary is faced with a major problem. Product X uses some very expensive specialty steel that has a very long lead time. She needs to place an order for that steel soon to meet the needs for next year. Therefore, Mary sees **four possible scenarios**:

Make 16,000 & the demand is 16,000

Good

Make 16,000 & the demand is 10,000

Bad – Excessive Inventory

Make 10,000 & the demand is 10,000

Good

Make 10,000 & the demand is 16,000

Bad – Many reasons!

Sometimes people who hear this story say that she should make 13,000 (hit the average), but that is likely bad for any of the four scenarios above. **What does she do?**

45

## Quantitative Forecasting

Causal  
(Input-Output  
Models)

Time Series  
(Intrinsic  
Forecasts)

Econometric  
Models

Simulation  
Models

Regression

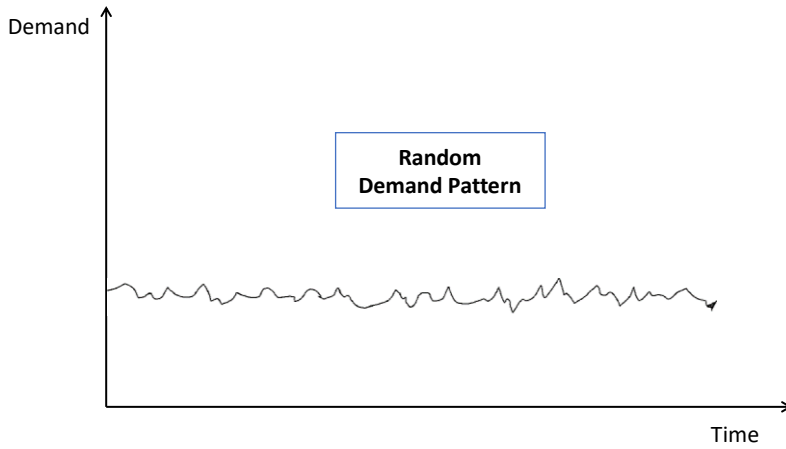
Random  
Demand  
Pattern

Trend  
Demand  
Pattern

Seasonal  
Demand  
Pattern

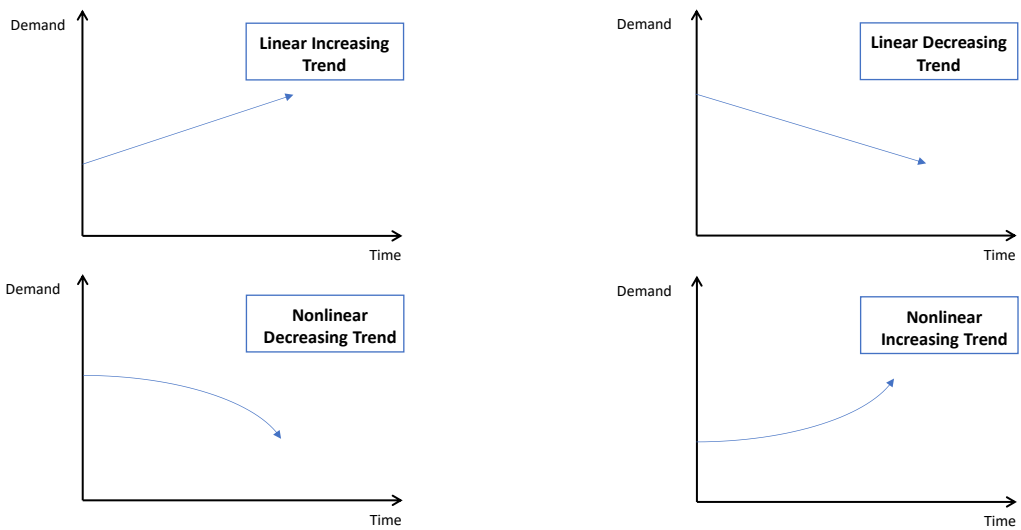
46

## Quantitative Forecasting: Time Series



47

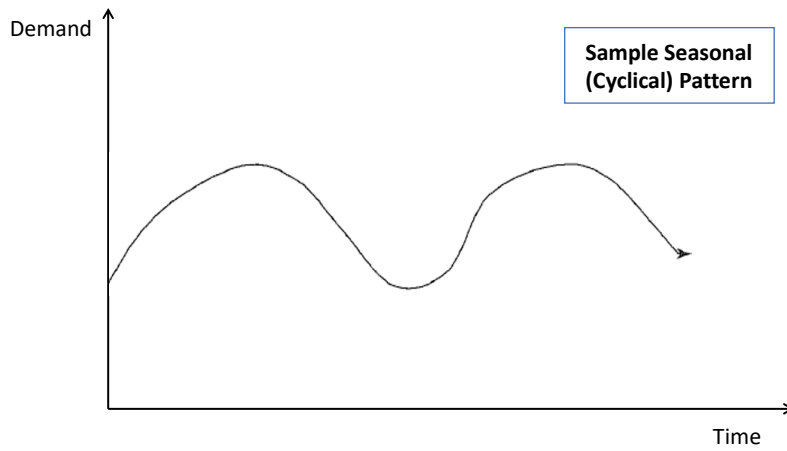
## Quantitative Forecasting: Time Series



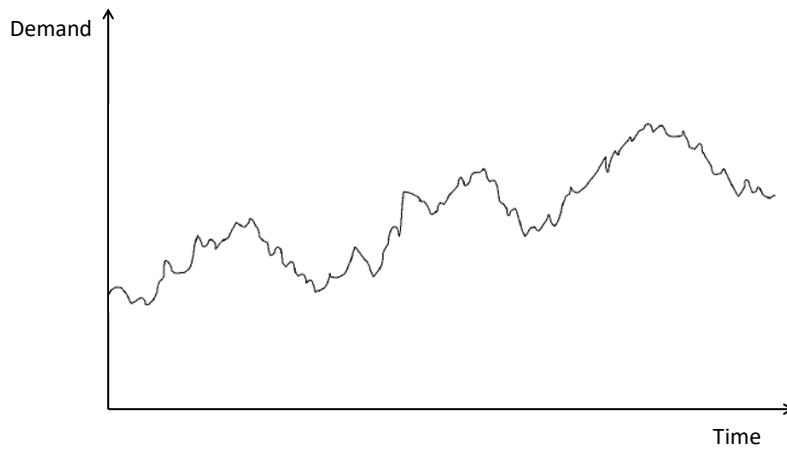
48



## Quantitative Forecasting: Time Series



## A Composite with Seasonality Demand



## Simple Moving Averages

$$F_t = \frac{A_{t-n} + A_{t-n+1} + \dots + A_{t-1}}{n}$$

**Where:**

$F$  is the forecast

$t$  is the current time period, meaning  $F_t$  is the forecast for the current time period

$A_t$  is the actual demand in period  $t$

$n$  is the number of periods being used

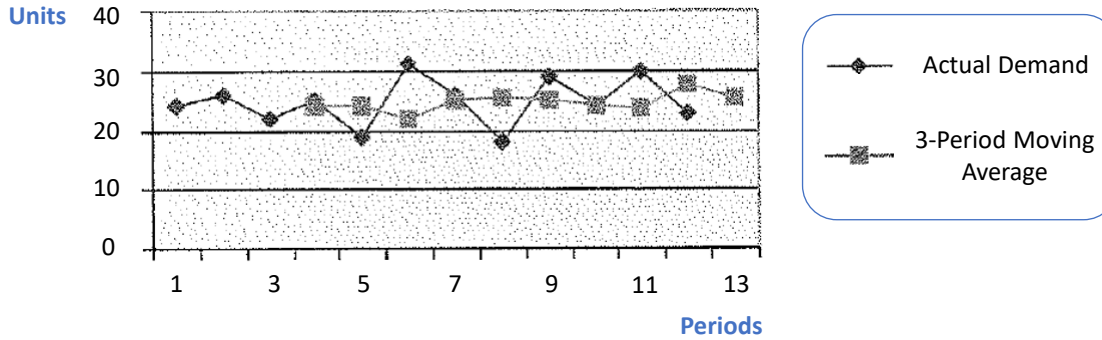
51

## Simple Moving Averages

Period	Demand	3-Period Moving Average Forecast
1	24	
2	26	
3	22	
4	25	24.0
5	19	24.3
6	31	22.0
7	26	25.0
8	18	25.3
9	29	25.0
10	24	24.3
11	30	23.7
12	23	27.7
13		25.7

52

## Simple Moving Averages



53

## Weighted Moving Averages

- Weighted moving averages are basically the same as simple moving averages, with one major exception.
- With weighted moving averages the weight assigned to each past demand point used in the calculation can vary.
- In this way more influence can be given to some data points, typically the most recent demand point. They take the basic form (the W stands for the weight):

$$F_t = W_1A_{t-1} + W_2A_{t-2} + \dots + W_nA_{t-n} \quad \text{where} \quad \sum_{i=1}^n W_i = 1$$

54

## Forecast Error

The alpha value is always between zero and one:

- If it equals zero you, add no part of the error and your forecast is always the same number.
- If it equals to one, you add the entire forecast error and do no smoothing at all.

As you might expect, the larger the alpha value, the more of the forecast error is added. It makes the forecast more responsive to actual changes in the demand, but also can equate to more reaction (and disruption) in the organization as it constantly strives to react to a more erratic forecast.

## Forecast Error

- The impact of the alpha value on the forecast can clearly be seen by taking the same data set used earlier and finding exponentially smoothed forecasts using alpha values (first of 0.2, then 0.5, and finally 0.8).
- The table uses simple moving average for the first two periods to develop an initial forecast of 25 units for period 3, after which exponential smoothing can be used to calculate the remaining forecasts.

## Regression

- Regression has sometimes been called the "line of best fit."
- It is a statistical technique to try to fit a line from a set of points by using the smallest total squared error between the actual points and the points on the line.
- A particular value for regression is to determine trend line equations.

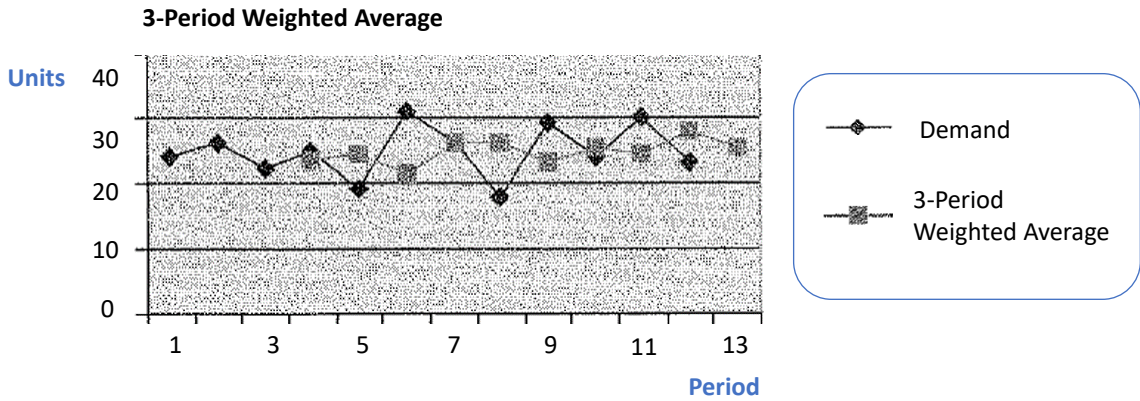
57

## Weighted Moving Averages

Period	Demand	3-Period Weighted Moving Average Forecast
1	24	
2	26	
3	22	
4	25	23.6
5	19	24.3
6	31	21.4
7	26	26.2
8	18	26.1
9	29	23
10	24	25.1
11	30	24.3
12	23	28
13		25.3

58

## Weighted Moving Averages



59

## Simple Exponential Smoothing

Simple exponential smoothing is another method used to smooth the random fluctuations in the demand pattern. There are two commonly used (mathematically equivalent) formulas:

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1}) \text{ or } F_t = \alpha A_{t-1} + (1 - \alpha)F_{t-1} \text{ where } 0 \leq \alpha \leq 1$$

60

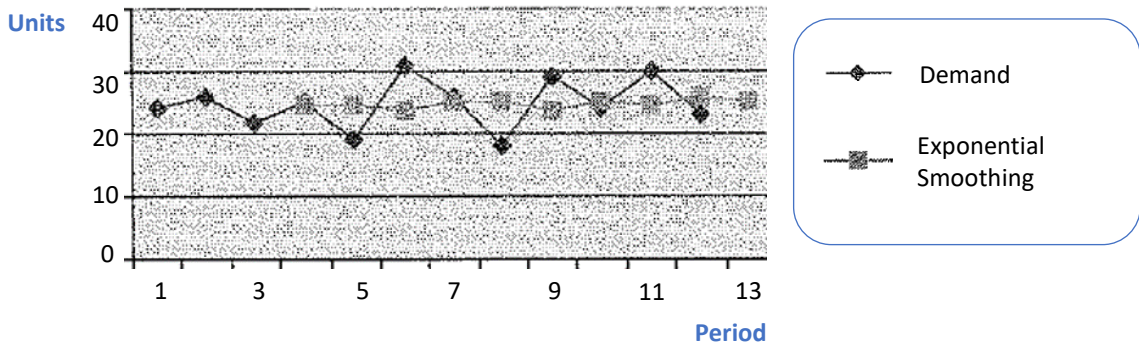
## Simple Exponential Smoothing

Period	Demand	Exponential Smoothing with alpha = 0.2
1	24	
2	26	
3	22	
4	25	24.4
5	19	24.5
6	31	23.4
7	26	24.9
8	18	25.1
9	29	23.7
10	24	24.8
11	30	24.6
12	23	25.7
13		25.2

61

## Simple Exponential Smoothing

Exponential Smoothing with 0.2 Smoothing Constant



62

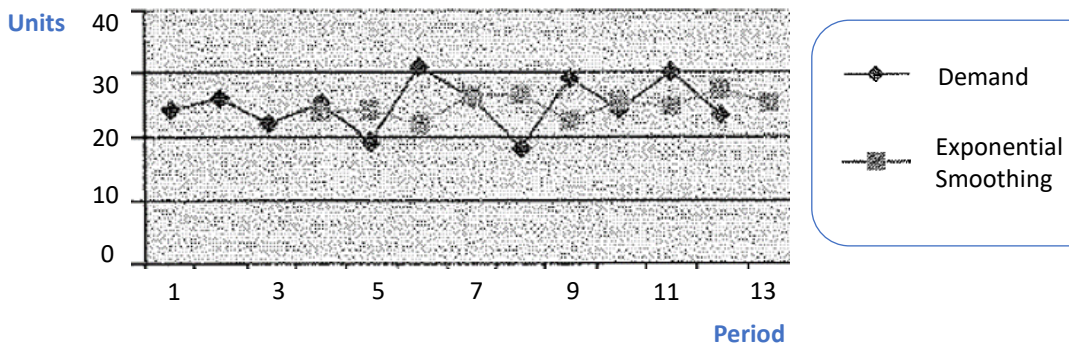
## Simple Exponential Smoothing

Period	Demand	Exponential Smoothing with alpha = 0.5
1	24	
2	26	
3	22	
4	25	23.5
5	19	24.3
6	31	21.6
7	26	26.3
8	18	26.2
9	29	22.1
10	24	25.5
11	30	24.8
12	23	27.4
13		25.2

63

## Simple Exponential Smoothing

Exponential Smoothing with 0.5 Smoothing Constant



64



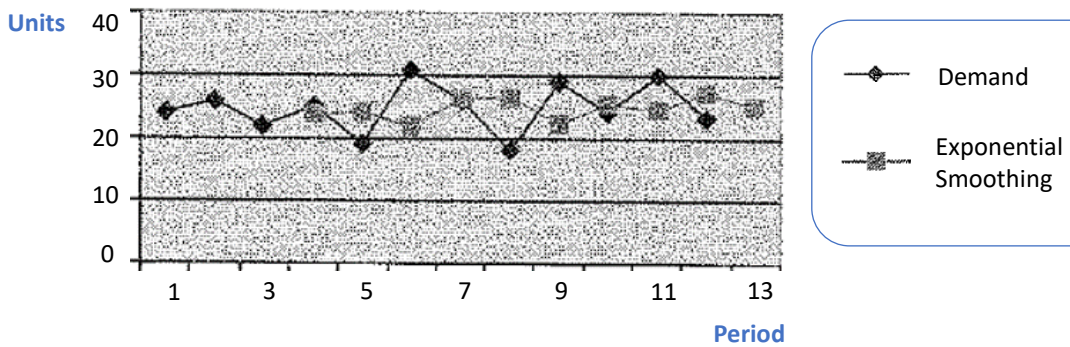
## Simple Exponential Smoothing

Period	Demand	Exponential Smoothing with alpha = 0.8
1	24	
2	26	
3	22	
4	25	22.6
5	19	24.5
6	31	20.1
7	26	28.8
8	18	26.6
9	29	19.7
10	24	27.1
11	30	24.6
12	23	28.9
13		24.2

65

## Simple Exponential Smoothing

Exponential Smoothing with 0.8 Smoothing Constant



66

## Forecast Error

Mean Forecast Error (MFE). As the name implies, this term is calculated as the mathematical average forecast error over a specified time period. The formula is:

$$MFE = \frac{\sum_{t=1}^n (A_t - F_t)}{n}$$

## Forecast Error

Period	Demand (A)	Forecast (F)	Error (A-F)
1	12	14	-2
2	15	13	2
3	13	12	1
4	16	13	3
5	14	15	-1
6	11	14	-3

## Mean Absolute Deviation (MAD)

The formula is again given as the name of the term. It literally means the average of the mathematical absolute deviations of the forecast errors (deviations). The formula is, therefore:

$$MAD = \frac{\sum_{t=1}^n |A_t - F_t|}{n}$$

## Tracking Signal

- Similar to the concept of control limits for statistical process control charts, the Tracking Signal provides a somewhat subjective limit for the forecasting method to go "off track" before some action is taken.

- It is calculated from the MFE and the MAD:

$$\text{Tracking Signal} = (n * \text{MFE}) / \text{MAD}$$

- In some cases, this formula is written using the "running sum of the forecast errors," abbreviated as RSFE. The formula then becomes:

$$\text{Tracking Signal} = \text{RSFE} / \text{MAD}$$

## Computer Assistance

- The speed, reliability, and relatively low cost of today's computers makes the use of very powerful computer packages utilizing time series formulas very attractive.
- Some modern packages come with several time series formulas built in with a variety of smoothing factors. Once demand data is input into the package, the system will find the best approach based on the lowest MAD (or some other error approach).
- The results from these packages can then become direct inputs into other planning and control systems, where they can be a great source to start the planning process.

71

## Calculation Exercise

- A pattern of waste received for recycling over the past 10 periods has been provided (*see next slide*).
- Forecast the amount of waste expected to be received in period 11 using each of the following methods: a 3-month moving average, a 3-month weighted moving average, exponential smoothing, and linear regression.
- Compute the Mean Absolute Deviation (MAD) for each method to determine which forecasting method is most suitable under the circumstances. Additionally, calculate the bias in the data, if any, for all four methods, and explain its significance.

72

## Calculation Exercise

Period	Demand	3 Mo. MA	3 Mo. WMA	Exp. Smooth.	Regression		
1	127	-	-				
2	113	-	-				
3	121	-	-				
4	123						
5	117						
6	109						
7	131					Method	MAD
8	115					3 Mo. MA	
9	127					3 Mo. WMA	
10	118					Exp. Smooth.	
11	-					Regression	

73

## Key Terms

- ✓ Forecasting
- ✓ Market Surveys
- ✓ Life Cycle Analogy
- ✓ Input-Output Model
- ✓ Regression
- ✓ Random Pattern
- ✓ Moving Averages
- ✓ Forecast Error
- ✓ Tracking Signal
- ✓ Qualitative Forecast
- ✓ Delphi Method
- ✓ Informed Judgment
- ✓ Econometric Model
- ✓ Intrinsic Forecasts
- ✓ Trend Pattern
- ✓ Quantitative Forecast
- ✓ Panel Consensus
- ✓ Causal Forecasts
- ✓ Simulation
- ✓ Quantitative Forecast
- ✓ Panel Consensus
- ✓ Causal Forecasts
- ✓ Simulation
- ✓ Quantitative Forecast
- ✓ Panel Consensus
- ✓ Causal Forecasts
- ✓ Simulation
- ✓ Exponential Smoothing
- ✓ Mean Forecast Error

74

## End of Section Exercise: GreenPlanet Inc.

As a key member of the PP&C team at GreenPlanet Inc., you've been tasked with a critical assignment. With increasing fluctuations in the amount of waste being received for recycling, your team is keen to improve the accuracy of the company's forecasting models.

You have been tasked to explore and analyze different approaches to forecasting. The goal is to ensure that the company can anticipate changes in waste volumes, optimize operations, and maintain efficiency even in the face of economic shifts. The insights you gather will be instrumental in shaping the company's strategic decisions moving forward.

Your team has provided some guidelines to include in your analysis. They have also provided you with the recent pattern of waste received by 2 different recycling facilities at GreenPlanet Inc. (*see next 5 slides*).

75

## Guidelines

1

Think of some of the leading indicators that could be used as a major input to causal forecasts in the economy. Discuss their use.

2

Which type of forecasts would most likely be used for Sales and Operations Planning (S&OP), and why are they the most appropriate?

3

What value does it bring to an operation if a forecasting method is used that only forecasts for families of products?

76

## Guidelines

4

Think of at least three products recently introduced that would probably use the life-cycle analogy. What products would they "copy"? Why is life-cycle appropriate for those products?

5

How should a company include information for their forecast that indicates the economy is headed for a recession? How, if at all, should that information impact time-series forecasting information?

6

Discuss the arguments for using a large smoothing constant for exponential smoothing instead of a small one. Under what conditions would each be better? Why?

77

## Guidelines

7

Describe in your own words why using the MAD is better for describing the forecast error than is the MFE. What is the major use of each? Should they really be used together? Why or why not?

78

## Forecast Details: Tyre Recycling Facility



Period	1	2	3	4
Demand	43	37	55	48

### Guidelines:

1. Calculate the three-period moving average for period 5.
2. Calculate the exponential smoothed forecast for period 5 using an alpha value of 0.4. Assume the forecast for period 4 was the three-period moving average of the first 3 periods.
3. Which method appeals the most for the data? Why?

79

## Forecast Details: Metal Recycling Center



Period	1	2	3	4	5	6	7	8
Demand	17	22	18	27	14	18	20	25

### Guidelines:

1. Calculate the four-period weighted moving average for period 9 using weights of 0.1, 0.2, 0.3, and 0.4 where the 0.4 is the weight for the most recent period.
2. Calculate the forecast for period 9 using a 3-month moving average forecasting method.
3. Which method would you recommend using and why?

80





Let's Move to the Case Study!

81



## Sales and Operations Planning

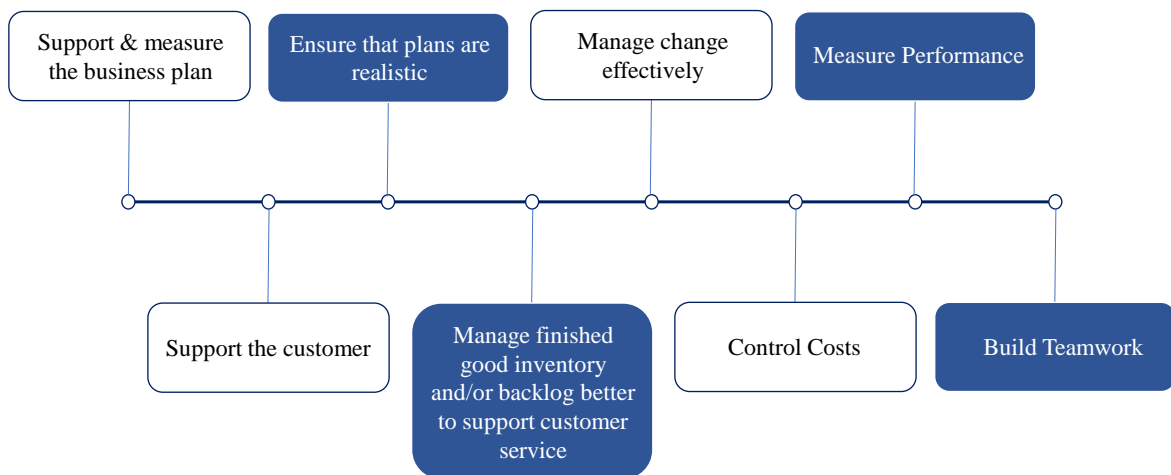
82

## Purpose of Sales and Operation Planning

The S&OP tends to be a major source for the planning of:

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Inventory Levels</li> <li>2. Cash flow</li> <li>3. Human Resource needs             <ol style="list-style-type: none"> <li>a. Number of people</li> <li>b. Skill levels</li> <li>c. Timing of need</li> <li>d. Training programs</li> </ol> </li> <li>4. Capital needs</li> </ol> | <ol style="list-style-type: none"> <li>5. Production outputs</li> <li>6. Capacity planning (e.g., equipment)</li> <li>7. Sales and marketing activities             <ol style="list-style-type: none"> <li>a. Sales promotions</li> <li>b. Advertising</li> <li>c. Pricing</li> <li>d. New product introductions</li> <li>e. Expansion of markets</li> </ol> </li> </ol> |
|---|--|

## Major Objectives



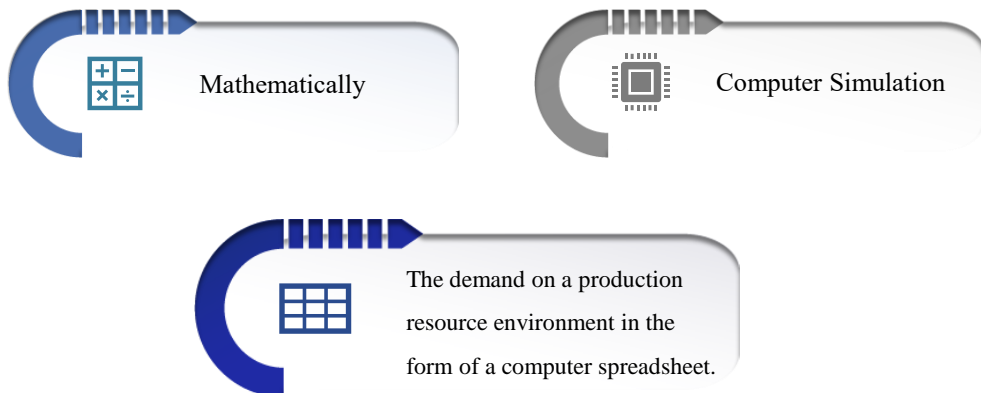
## General Design

Examples of plans that could impact demand include:



85

## Strategies for S&OP



86

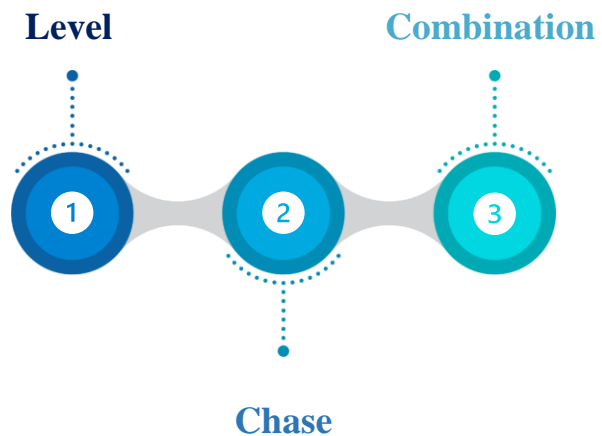
## Trade-off Approaches

The general objective of developing a good S&OP is to find the "best" alternative to align resources to meet the expected demand under certain operating conditions. Often "best" means an attempt to maximize firm profits, but other conditions can also be established to define "best" in the context of the firm's strategic plan. Examples of other conditions may be:

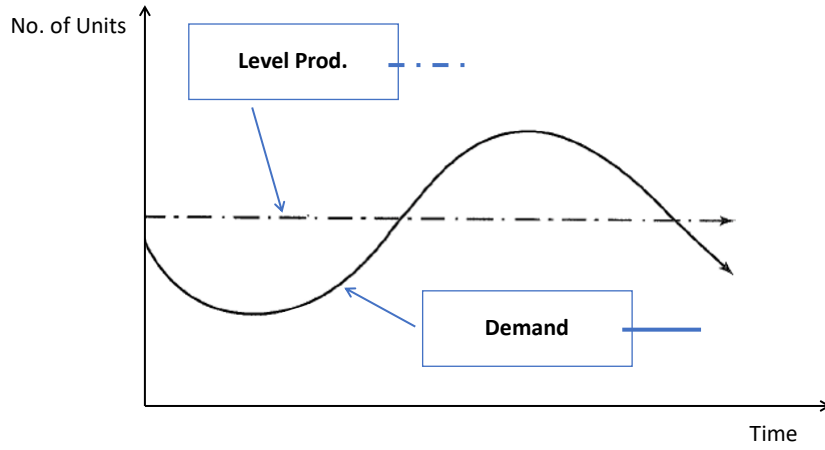
- Attempting to meet all expected customer demand
- Attempting to minimize inventory investment
- Attempting to minimize the adverse impact on people, often experienced with volatility in the workforce caused by frequent layoffs

## Trade-off Approaches

There are 3 general categories of approaches used. They are:

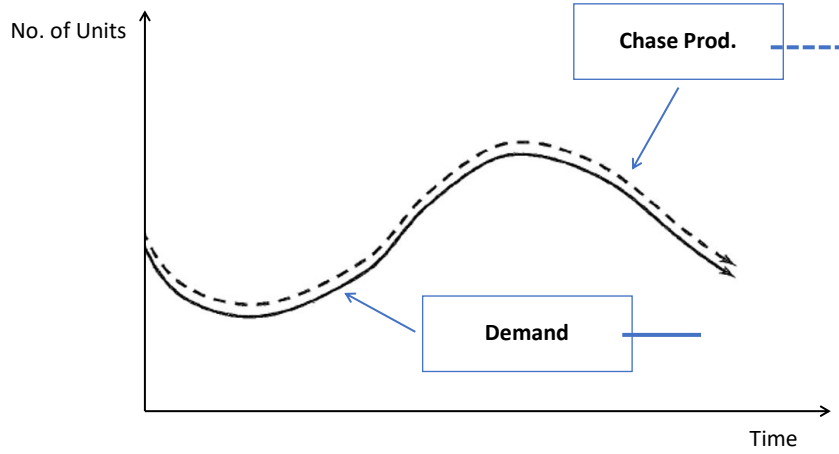


### Level



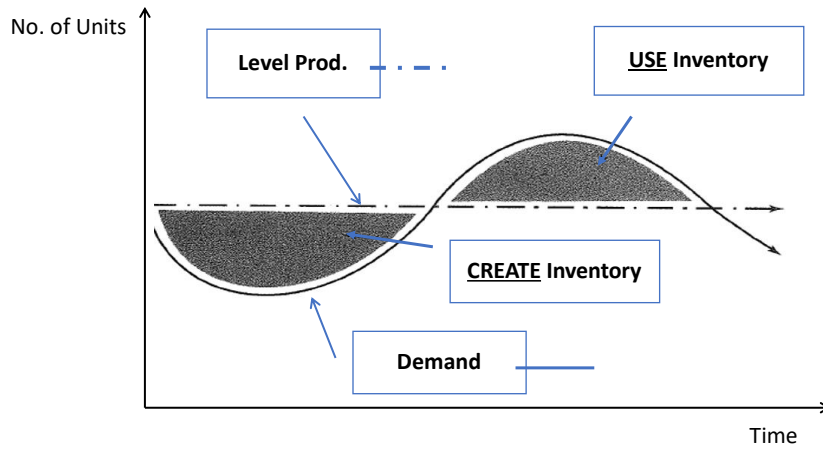
89

### Chase



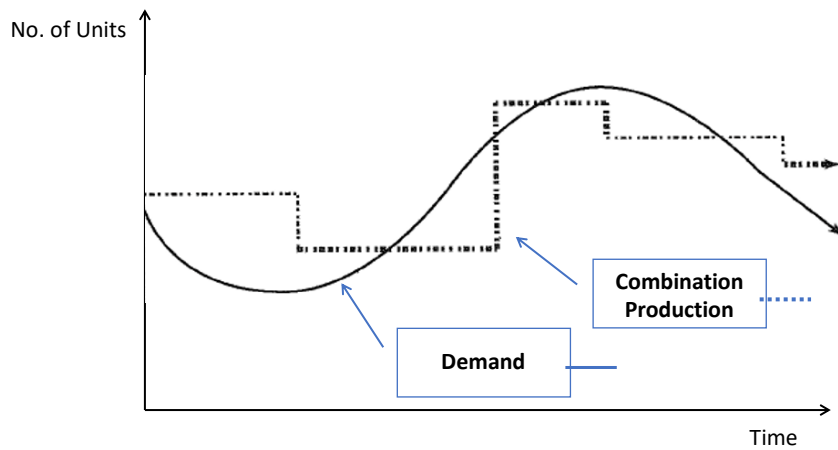
90

## The Use of Inventory with Level Strategy



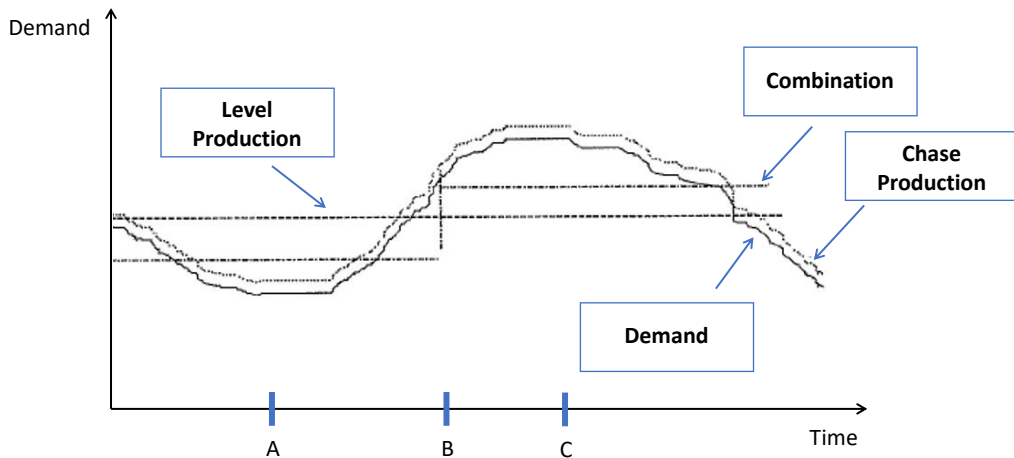
91

## Combination



92

## The Comparison



93

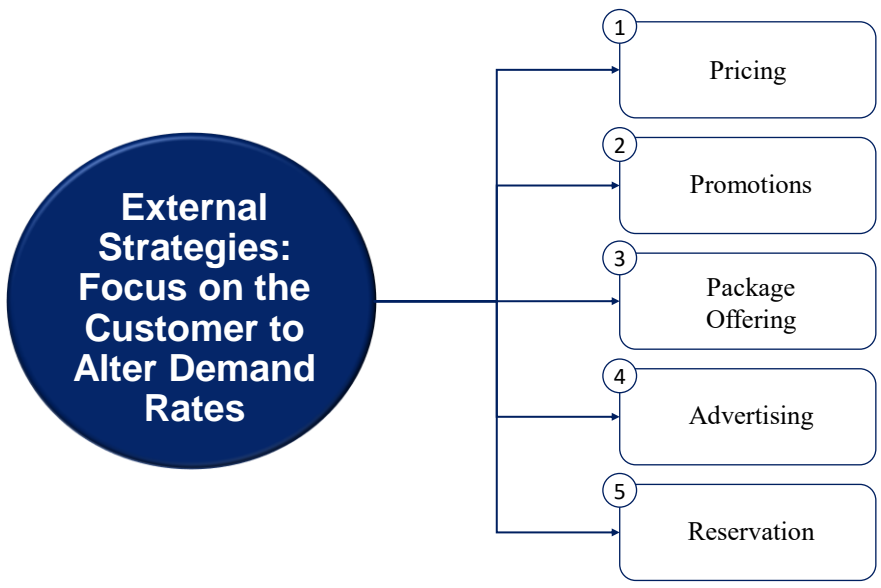
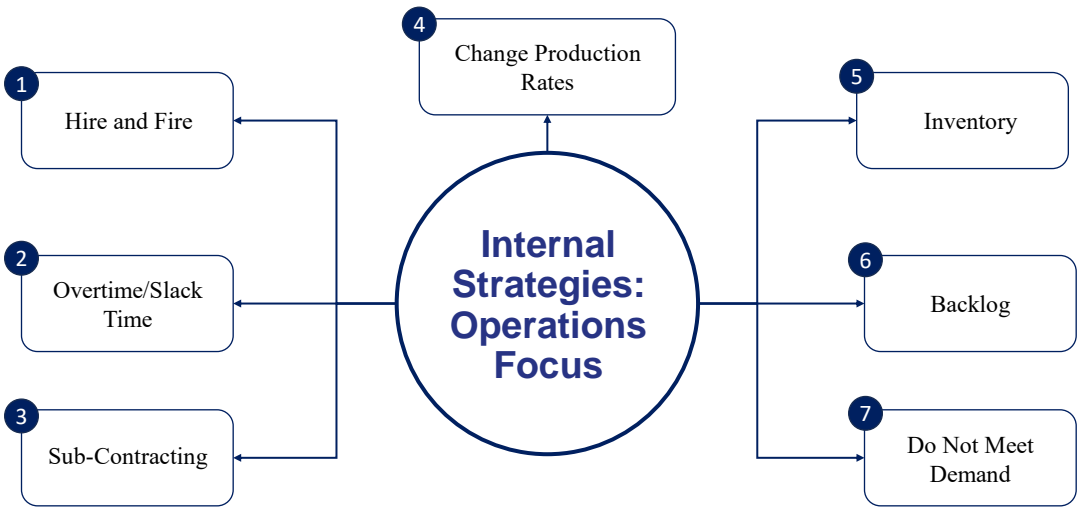
## Balancing Resources

There are several options open to most companies for accomplishing the planning of resources.

In general, they fall into two categories:

- One focuses on the supply side (Operations) to attempt to change the production supply.
- The other focuses on the demand side (Marketing and Sales) to attempt to alter demand patterns to meet production outputs

94





## Key Terms

- ✓ Sales and Operations Plan
- ✓ Staffing Plan
- ✓ Combination Strategy
- ✓ Aggregate Plan
- ✓ Level Strategy
- ✓ Internal Strategies
- ✓ Production Plan
- ✓ Chase Strategy
- ✓ External Strategies
- ✓ Backlog

## End of Section Exercise: EnviroTech Solutions

As a PP&C consultant for EnviroTech Solutions, a newly formed company focused on innovative waste management solutions, you have been tasked with developing their S&OP department from the ground up. Your primary goal is to establish effective S&OP strategies tailored to the company's unique needs and industry dynamics.

This involves analyzing various aspects of S&OP, including how S&OP for waste management differs from other industries like banking, fast-food, or legal services. You must also evaluate how different factors, such as the influence of militant labor unions and the perishability of inventory, might impact EnviroTech Solutions' S&OP strategies.

Your insights will be crucial in setting up a robust S&OP framework that aligns with EnviroTech's mission and supports its growth and operational effectiveness.

## Guidelines

1

Discuss the approach to Sales and Operations Planning that might be the most appropriate for the following companies. Explain your reasoning:

- Waste Management Company
- Bank
- Fast-food Restaurant
- Automobile service center attached to a dealership
- Hotel
- Attorney Office
- Retail Clothing Store

99

## Guidelines

2

Discuss the potential impact that an especially militant labor union can have on the strategic approach to S&OP.

3

If a company traditionally uses a level strategy for planning for several years, discuss the potential changes in their environment that could make them consider using more chase tactics.

4

What changes, if any, will the perishability of the inventory have on the capability of a company in using a level strategy. Consider, for example, a meat market and a fast-food restaurant.

100



**Let's Move to the Case Study!**



**Thank you!**



## Appendix

### Research Paper: Aggregate Production Planning in a Small-Sized Company

**Abstract:** The objective of this research is minimizing cost of production by using aggregate production planning (APP) and material flow cost accounting analysis technique (MFCA). The production process was divided into 12 processes from metal melting process to packing process. The data during past 24 months was used in five forecasting methods. The best forecasting method was the model with the smallest value of Mean Absolute Percent Error (MAPE). The result showed that quadratic trend method was the best method due to its lowest MAPE of 7.02 which was further applied this value for APP to minimize cost. We found the lowest aggregate production cost was 347,509.20 Baht with an inventory of 50 units.

Read the full article:

[https://www.researchgate.net/publication/338103207\\_Aggregate\\_Production\\_Planning\\_Case\\_Study\\_in\\_a\\_Small-Sized\\_Company\\_in\\_Thailand](https://www.researchgate.net/publication/338103207_Aggregate_Production_Planning_Case_Study_in_a_Small-Sized_Company_in_Thailand)

## Research Paper: Smart PP&C Systems in the Industry 4.0 Era

**Abstract:** In furtherance of emerging research within smart production planning and control (PPC), this paper prescribes a methodology for the design and development of a smart PPC system. A smart PPC system uses emerging technologies such as the internet of things, big-data analytics tools and machine learning running on the cloud or on edge devices to enhance performance of PPC processes.

It achieves this by using a wider range of data sources from the production system, capturing and utilizing the experience of production planners, using analytics and machine learning to harness insights from the data and allowing dynamic and near real-time action to the continuously changing production system.

Read the full article:

[https://www.researchgate.net/publication/352982302\\_Designing\\_and\\_developing\\_smart\\_production\\_planning\\_and\\_control\\_systems\\_in\\_the\\_industry\\_40\\_era\\_a\\_methodology\\_and\\_case\\_study](https://www.researchgate.net/publication/352982302_Designing_and_developing_smart_production_planning_and_control_systems_in_the_industry_40_era_a_methodology_and_case_study)

## Research Paper: PP&C in Printed Wiring Board (PWB) Manufacturing

**Abstract:** Production planning and control in printed wiring board (PWB) manufacturing is becoming more difficult as PWB's technology is developing and the production routings become more complex. Simultaneously, the strategic importance of delivery accuracy, short delivery times, and production flexibility is increasing with the highly fluctuating demand and short product life cycles of end products.

In the project, a discrete event simulation model is built of a pilot case factory. The model is used for comparing the effect of scheduling, queuing rules, buffer policies, and lot sizes on customer service and cost efficiency.

Read the full article:

[https://www.researchgate.net/publication/221525358\\_A\\_simulation\\_case\\_study\\_of\\_production\\_planning\\_and\\_control\\_in\\_printed\\_wiring\\_board\\_manufacturing](https://www.researchgate.net/publication/221525358_A_simulation_case_study_of_production_planning_and_control_in_printed_wiring_board_manufacturing)

## Research Paper: Alpha Lanka (Pvt) Ltd.

**Abstract:** Alpha Lanka (Pvt) Ltd operates in the apparel accessories industry in Sri Lanka, where Ontime delivery (OTD) performance is a vital factor. However, achieving OTD to the expected level, which is from 90% to 95%, has become a challenge due to the complications in the production planning process. Currently, the production planning process is done manually by using Excel spreadsheets which increases the complexity of the planning process. The aim of this study is to recommend an innovative production planning tool that enhances OTD performance while giving accurate promise dates.

This study suggested a model of a production planning tool that was developed using spreadsheets and related process improvements to achieve a proper production planning process. The tool was developed using various functionalities and formulas of spreadsheets to streamline the production planning with estimated lead time and to organize the production planning data effectively.

Read the full article:

[https://www.researchgate.net/publication/376201368\\_Production\\_planning\\_process\\_improvement\\_case\\_study\\_from\\_the\\_apparel\\_accessories\\_industry](https://www.researchgate.net/publication/376201368_Production_planning_process_improvement_case_study_from_the_apparel_accessories_industry)