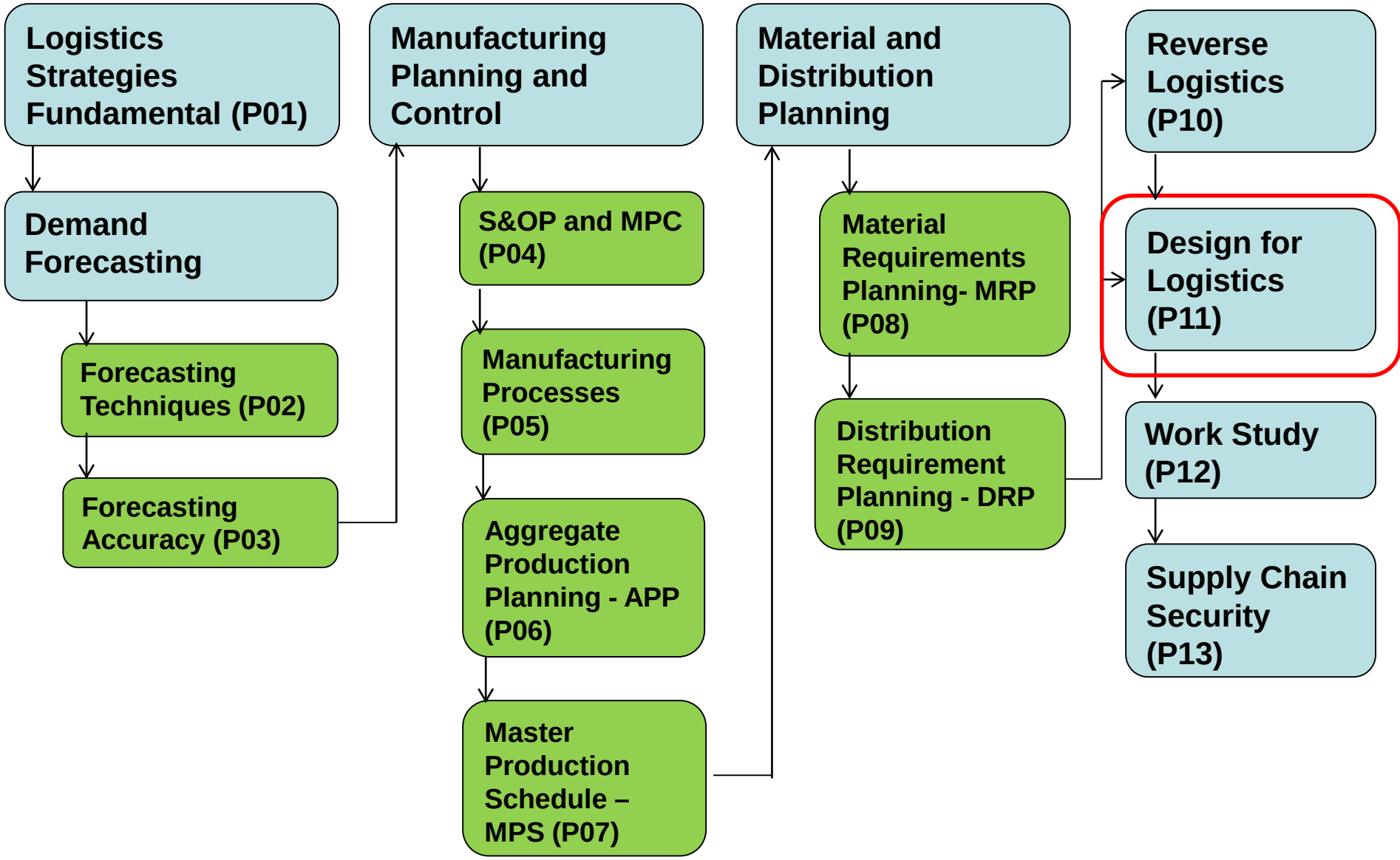
Problem 11
Logistics-Friendly Design

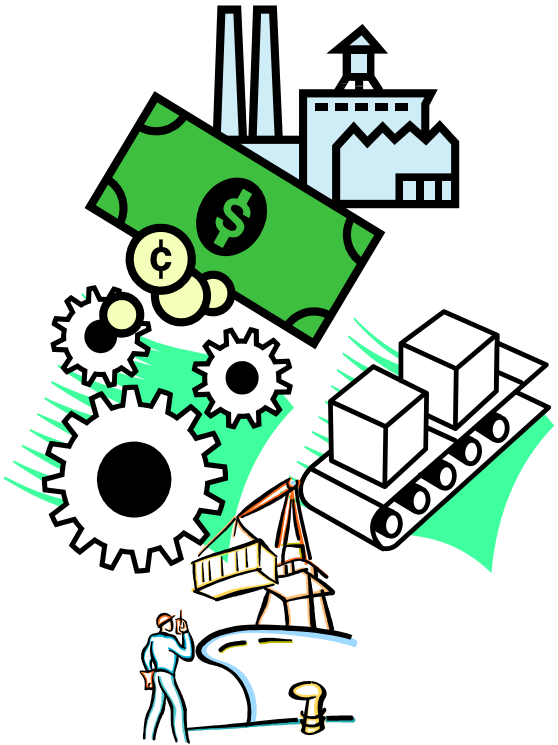
SCHOOL OF ENGINEERING

E222 – Logistics Planning and Control

E222 Logistics Planning and Control – Topic Tree



P11 – Logistics-Friendly Design



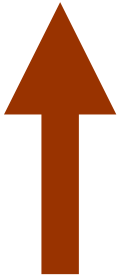
- Explain the Economic Packaging and Transportation (DFL)
- Explain the advantages of Concurrent & Parallel Processing
- Apply Standardization Strategies
- Determine Safety Stock and Aggregate Safety Stock

The Manufacturing Environment

- Rapid Changes
  - New products rapidly introduced
  - Short, unknown product life cycles
- High Variety of Products
- Long Production Lead Times
- Increasing storage and transportation costs
- Difficult to forecast demand

Problem Faced…

- Forces for keeping low inventory
  - inventory expensive
  - low salvage values
- Forces for keeping high inventory
  - long lead times
  - customer service is important
  - demand is hard to predict
  - reduction in transportation quantity



Design for Logistics (DFL).. (Why?)

1. Product trends

- High product variety
- Short life cycles

2. Challenges to meet product trends

- **Shorter production lead times**
- **Difficult to forecast demand**
- **High storage & transportation cost**

3. Design for Logistics to meet the challenges posed by product trends

- **Economic Packaging and Transportation**
- **Concurrent & Parallel processing**
- **Standardization**

3 Components for DFL

Economic Packaging and Transportation (E.g. IKEA)

Why do I have to assemble the furniture myself?
Even though it's tricky sometimes, it means not paying someone in a factory to do it for you.
That's why.

Why should I deliver my own furniture?
Taking home the furniture yourself means you can have it on the same day. You also don't have to pay for a "free delivery service" that's usually included in the price.
That's why.

Why do we make so many of everything?
By producing and distributing in bulk, we get big discounts which we pass on to you.
That's why.

Why isn't there always an assistant when I need one?
The information you need is on the price tag. Serving yourself means you don't pay for help you don't need.
That's why.

Why are we obsessed with keeping things flat?
IKEA furniture is flat-packed. This means it's cheaper for us to store and transport.
That's why.

Economic Packaging and Transportation

(E.g. IKEA)

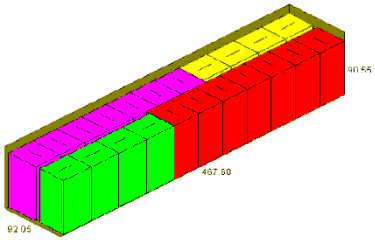
- Products are designed to be packed compactly for customer to take from store and then assemble at home
- Economies of scale from transporting high volume of compact furniture
- Warehouse to store and display all its 10,000 products rather than relying on distributors

Economic Packaging and Transportation

Ocean Shipping Cost = Function (Packing density) + Materials to Ship

✓Container cost is fixed

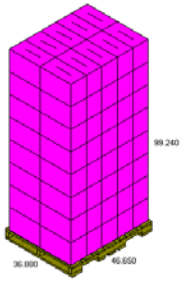
✓Packing more units per container lowers per unit shipping costs.



HOW ?

1.Optimize use of Container Rectangular volume space

- Shipping cartons are box-shaped
- Products are collapsible or foldable



2.Robust product design to allow less external packaging & cushioning/foam materials.

Economic Packaging and Transportation

- Some companies would redesign product rather than packaging
- Many retailers favor products that takes up less storage space, stack easily and fit onto their shelves (revenue per m^2 increase)
- Therefore, Tupperware and Rubbermaid containers/pails are made to stack

Economic Packaging and Transportation

- Tetrahedron shape reduces material use
- Box/Square-shaped products
- Foldable products

Foldable Chopping Board

Collapsible Colander

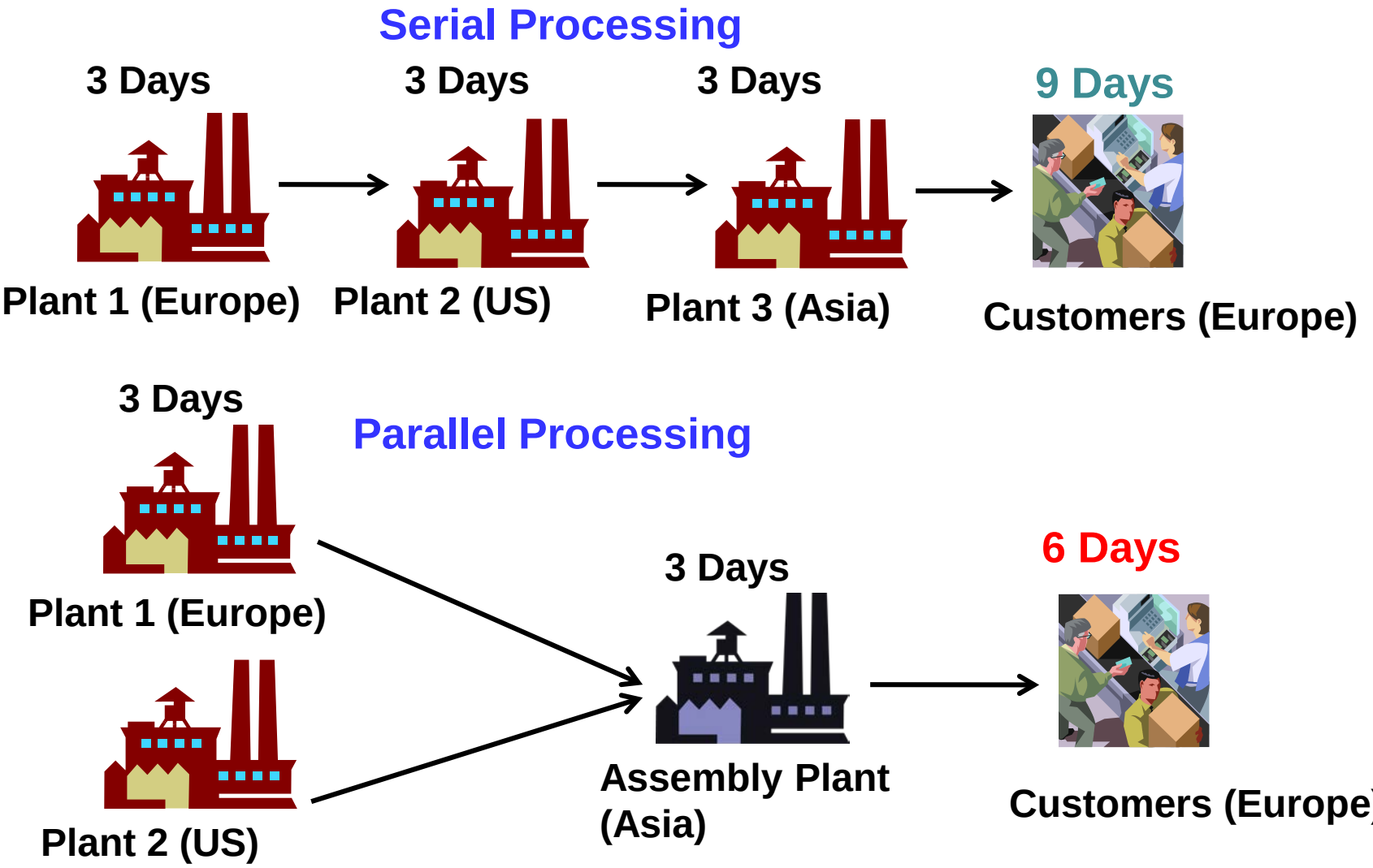
Collapsable Storage Bins

Economic Packaging and Transportation

Considerations:

- Design products so that they can be efficiently packed and stored
  - ✓ e.g. Compact, stackable, flat
- Design products to efficiently utilize retail space by packing more compactly
  - ✓ e.g. bulk, sub-packaging, fit to shelves
- Design packaging so that products can be consolidated at cross docking points
  - ✓ e.g. easily identifiable, less than 25kg
- Less packaging material
  - ✓ Prism/tetrahedral shaped packaging
  - ✓ Robust product design
  - ✓ Box-shaped product

Concurrent & Parallel Processing



Concurrent & Parallel Processing

- Steps that are performed in sequence can be completed at the same time
  - ✓ Reduce manufacturing lead time
  - ✓ Lower inventory cost due to improved forecasting
  - ✓ Reduce safety stock requirements
  - ✓ If raw material supply is uncertain for a particular component, a higher inventory can be held for the component, rather than product

Standardization

- **Modular product** – a product assembled from a variety of modules such that for each modules, there are a number of options.

E.g. Personal computer, Mac-Donald's burgers, watches, cars etc…

- **Modular Process** – is a manufacturing process consisting of discrete operations so that inventory can be stored in partially manufactured form between operations

E.g. garment making process

Standardization

- Standardization to help reduce inventory level and increase forecast accuracy through risk pooling from aggregate planning

- Product modularity and process modularity are key to choosing the right standardization strategy

Selecting the Standardization Strategy

Product \ Process	Non-Modular	Modular
Modular	Part Standardization	Process Standardization
Non-Modular	Product Standardization	Procurement Standardization

New production methods to be used by Toyota, Nissan

Conventional method

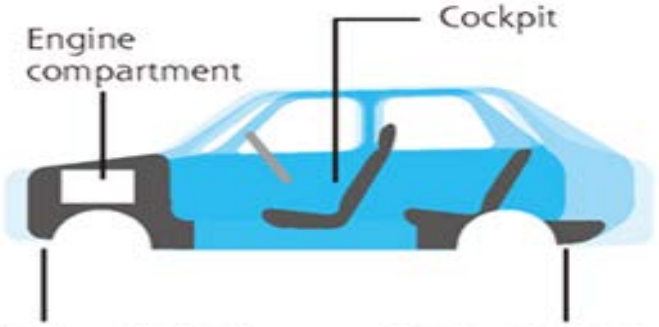
Different vehicle platforms are provided for each model. Many other parts are also developed for each model.

Toyota's new method

Regardless of vehicle size, half of major vehicle parts (about 4,000 to 5,000 items) will be standardized.

Nissan's new structure

Parts will be standardized in four modules. Vehicles will be designed by combining these modules in different ways.



4 Approaches to Standardization

- Part Standardization
- Process Standardization
- Product Standardization
- Procurement Standardization

Toyota Engine Assembly

Part Standardization

- Common parts are used across many products
- Reduce inventory through risk pooling
- Reduce part cost due to risk pooling and economies of scale
  - E.g. Common circuit board & print-head for different printers
  - E.g. Same sesame seed buns, lettuce, tomato slices for different types of burgers
  - E.g. Cars – Same engine, braking systems, gear box, wipers, for different types of cars

Toyota 1ZZ-FE Engine

Toyota Wish

Toyota Corolla 1.8

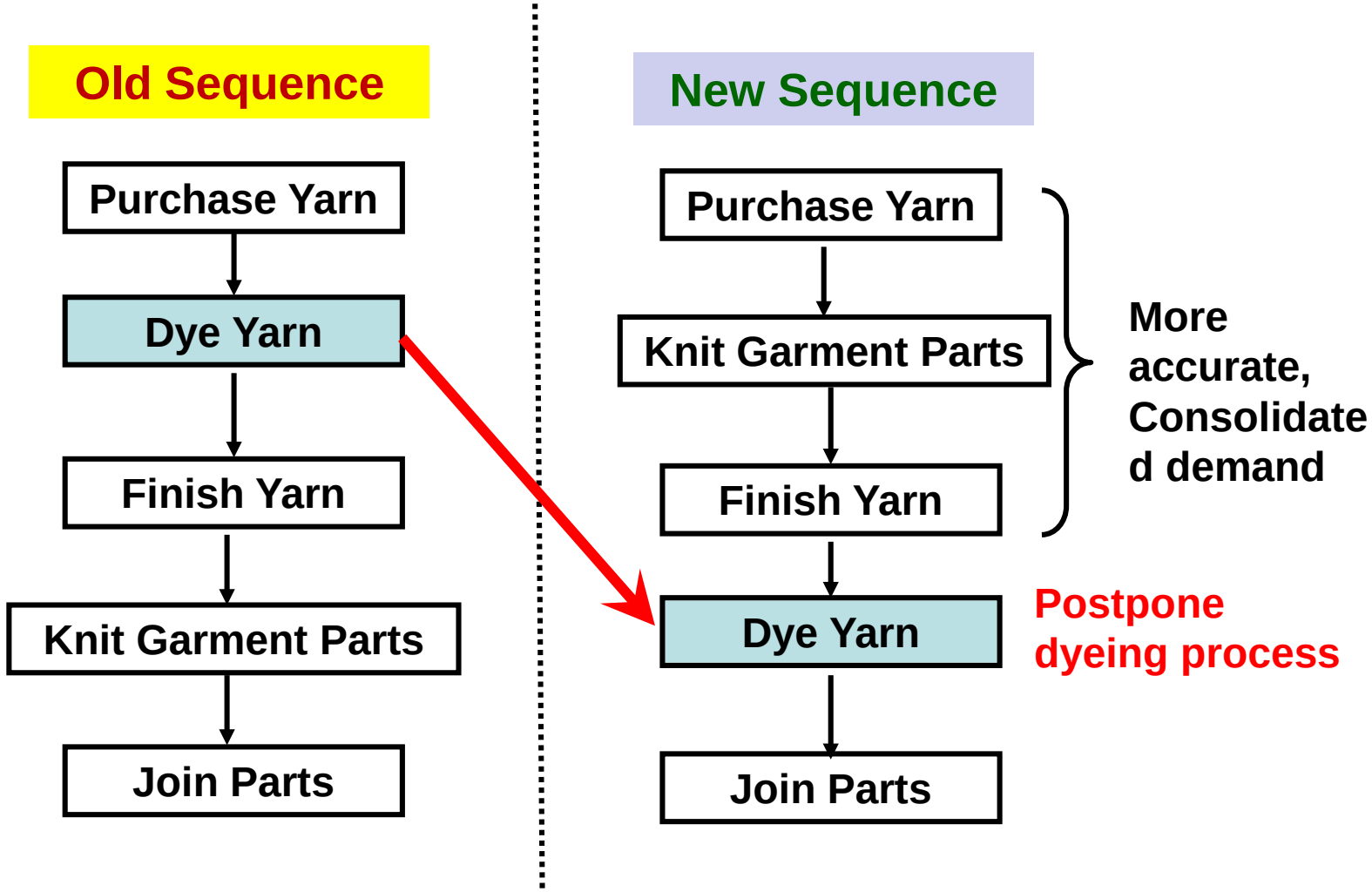
Lotus Elise 111S !!!!

Process Standardization

- Standardizing as much of the process as possible for different products, and customizing the products as late as possible (postponement)

Process Standardization

E.g. Benetton Manufacturing Process



Product Standardization

- Adopt when both the process or the product are non-modular
- Standardize the products so that one can be used to substitute the other.
- This will keep inventory to a minimum
- When product not kept in stock is ordered, the order may be filled by a product that offers a superset of features required by customers - *“Downward substitution”*

E.g. higher functionality/speed chip, multiple power supply options for printer

Procurement Standardization

- Involves standardizing processing equipment and approaches
- Particularly useful when equipment is very expensive
- Same equipment is used to produce each of the possible end-products

Toyota Assembly Line/ Robot

Toyota Yaris

Toyota Rush

Toyota Camry

P11 :Suggested Solution….

Today's Problem

Today's problem

Safety stock =

$$Z \times \sqrt{(\sigma)^2_{demand} \times (\bar{X})_{leadtime} + (\bar{X})^2_{demand} \times (\sigma)^2_{leadtime}}$$

Where Z = NORMSINV(service level)

Eg. Z = 1.64485 for 95% service level

(σ) = standard deviation

$(\bar{X})$ = average

Since leadtime is assumed fixed in today's problem,

$(\sigma)^2_{leadtime}$ = zero.

Hence,

Safety stock = $Z \times \sqrt{(\sigma)^2_{demand} \times (\bar{X})_{leadtime}}$

Or simply,

Safety stock = $Z \times (\sigma)_{demand} \times \sqrt{(\bar{X})_{leadtime}}$

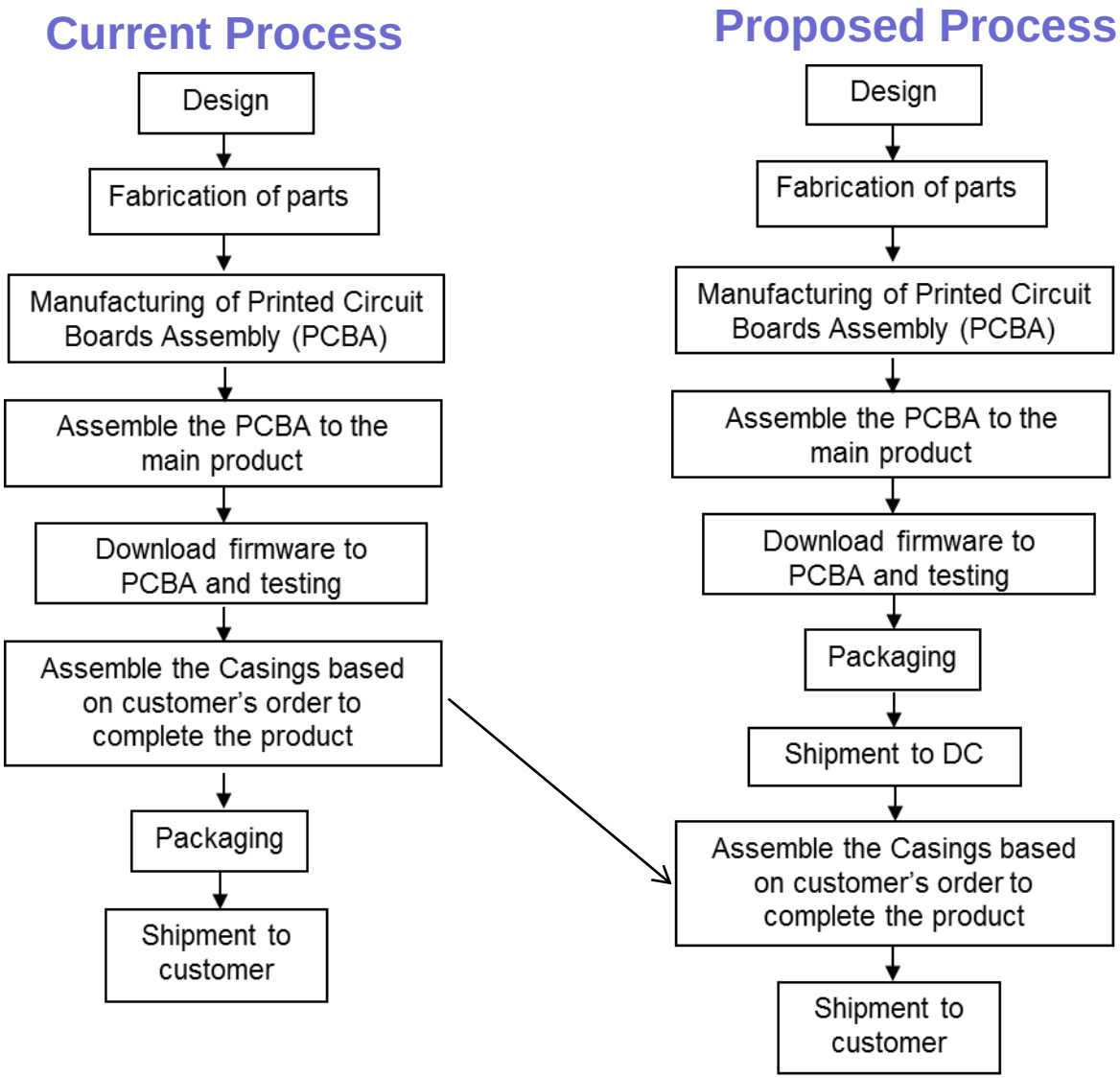
Today's Problem

Colour scheme	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	average demand	standard deviation	safety stock
Fiery Red	2450	1890	2120	2680	1950	1720	1470	1800	2000	1650	1900	2300	1994.1667	345.7918	493
Sky Blue	1400	1750	1825	1650	1270	1380	1750	1300	1550	1270	1400	1680	1518.75	205.38351	293
Sunshine Yellow	1320	1200	950	1280	1340	1100	820	900	1140	1250	1400	1000	1141.6667	188.91236	270
Platinum Black	1450	1050	1250	1340	1490	1650	1830	1720	1760	1890	1640	1500	1547.5	249.58602	356
Pearl White	1750	2150	1900	1650	1430	1580	1330	1210	1470	1360	1630	1500	1580	261.53394	373
Sum of individual colours															1785
Aggregate	8370	8040	8045	8600	7480	7430	7200	6930	7920	7420	7970	7980	7782.083	491.2852	700

Safety Stock Reduction of 1785 – 700 = 1084

Percentage stock reduction
= (1785 – 700)/ 1785 * 100%
= 60.78%

Today's Problem – Proposed Sequence



Today's Problem

- Economic Packaging and Transportation
  - Packing the products into box for ease of stacking and handling
- Process Standardization
  - Re-sequencing of process features (assemble the colour casings at the end of the process, preferably at the DC)
    - After customer order is being placed
  - Modular Product and Modular Process
  - Process Standardization in the form of Postponement
    - Reduction in safety stock
  - Note that for the proper sequencing of the process, some design changes would be required.

Learning Outcomes

- Explain the Economic Packaging and Transportation (DFL)
- Explain the advantages of Concurrent & Parallel Processing
- Apply Standardization Strategies
- Determine Safety Stock and Aggregate Safety Stock