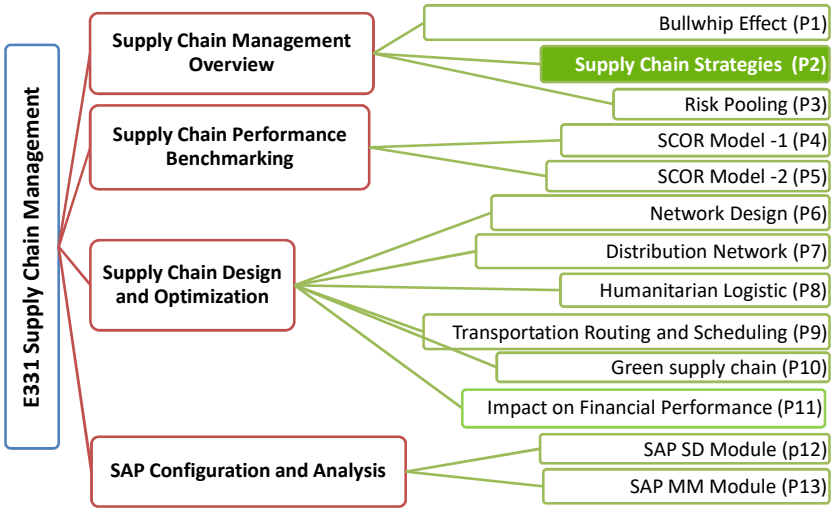
P02
What's your Strategy?

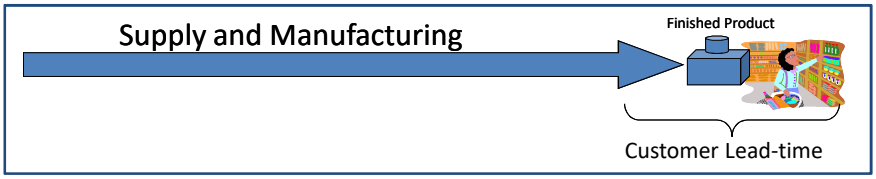
E331 Supply Chain Management

Diploma in Supply Chain Management (DSCM)

E331 Module Overview

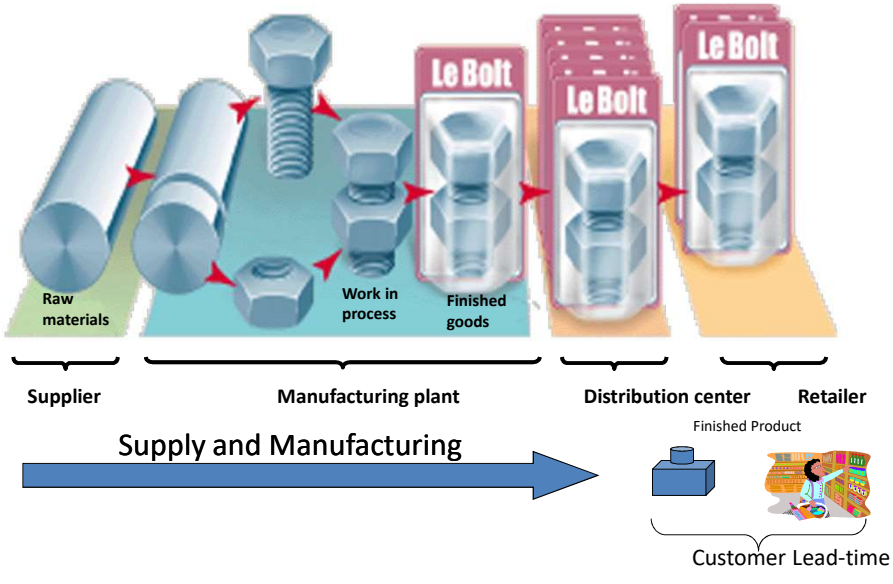


Build-To-Stock (BTS) – Push Based

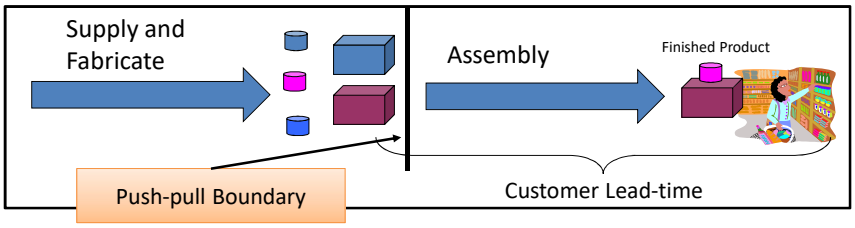


- The BTS product is built prior to demand with a **standard Bill of Materials (BOM)**, usually produced in large quantity to leverage on the economy of scale.
- Fastest response time to the customer. The customer order is fulfilled directly from a retail shelf or from a finished-goods stocking point. The disadvantage is the loss of choices. The customer takes what is available in **pre-determined specifications**. Customers end up purchasing more products if they want different features.
- Example, products on the shelves in supermarket, such as laundry powder, shower gel and shampoo, drinks and snacks, etc.

Illustration of Build-To-Stock (BTS)

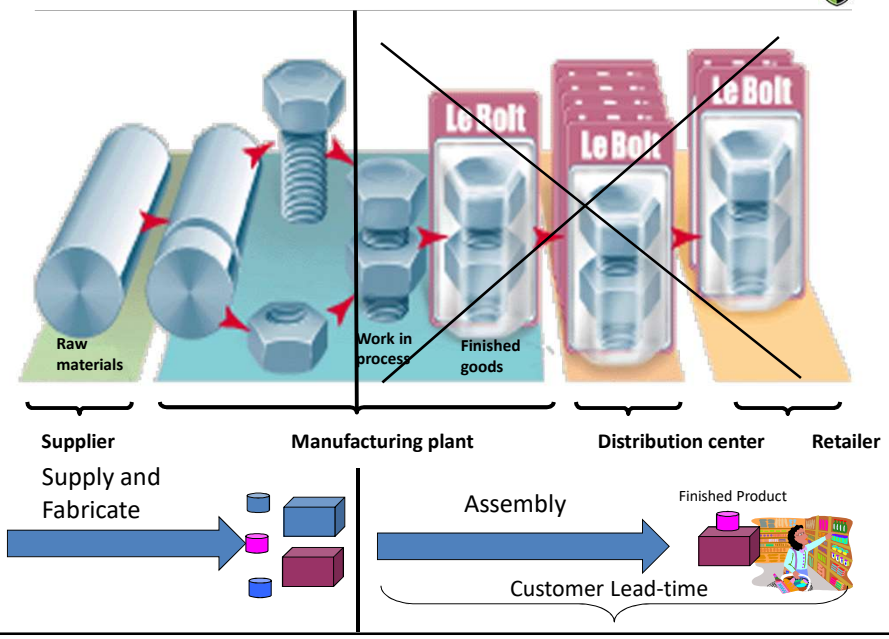


Configure-To-Order (CTO) – Push-Pull



- The CTO product is **assembled to demand with standard modules or components**.
- Introduces orders prior to assembly but replenishes (push) the parts to build the order. Hence the assembly sites generally keep the component parts/ modules as stock instead of finished goods.
- The customer receives greater end-item **choices** but sacrifices some of the immediacy of order fulfillment. A key consideration for CTO strategy is how quickly the customers' needs are satisfied, i.e. **responsiveness**
- *Example: A laptop is available in different RAM sizes, hard disk types and capacities as well as the outer finishing to provide users exactly what they are looking for.*

Illustration of Configure -To-Order (CTO)



Configure-To-Order (CTO) - Examples

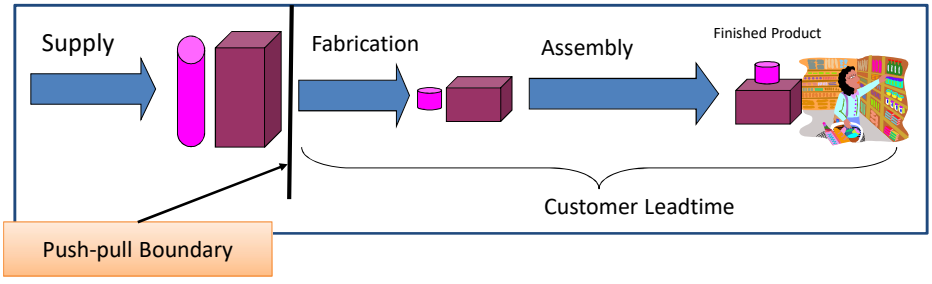
- Now McDonald's not only sells their burgers from standard recipes, but also allows customers to mix and match the ingredients, buns, and sauces they like via the e-ordering system. Customers satisfaction is greatly improved by creating their own tastes



- Ikea Kitchen, actually most of the kitchen brands, provides the service for customers to plan their own kitchen cabinets, kitchen appliances and accessories, on top of the standard kitchen sets.

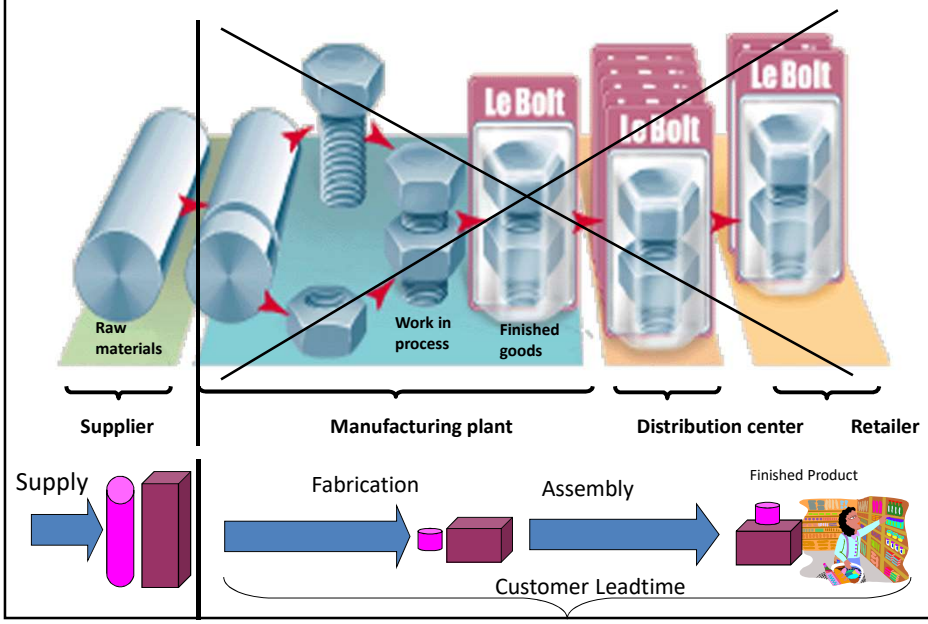

Plan and design your dream kitchen

Build-To-Order (BTO) – Push-Pull



- The BTO product is fabricated and assembled to order with a **standard bill of materials**. For example, industrial machinery.
- The customer orders are introduced prior to fabrication or at the start of the production process. Hence the fabrication sites generally **keep the raw material as stock**.
- BTO products are usually highly **customized** to customer specifications, very **costly** to manufacture or both.

Illustration of Build-To-Order (BTO)

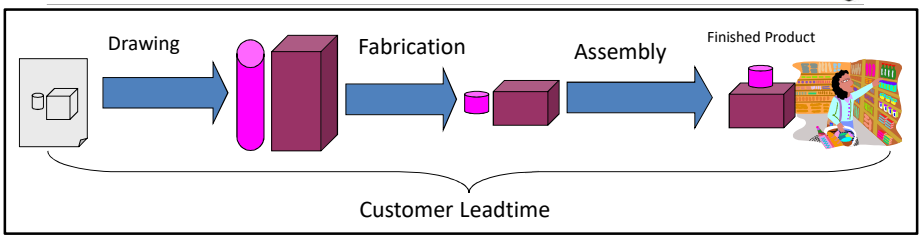


Build-To-Order (BTO) - Examples

- Airbus and Boeing only start to make new airplanes when an airline places its order. They would not keep any aircrafts as ready stock, nor make any sub-assemblies first. Of course, the airline can discuss their specific requirement with the manufacture before production. Normally, an airline has to wait for years before its order can be delivered.

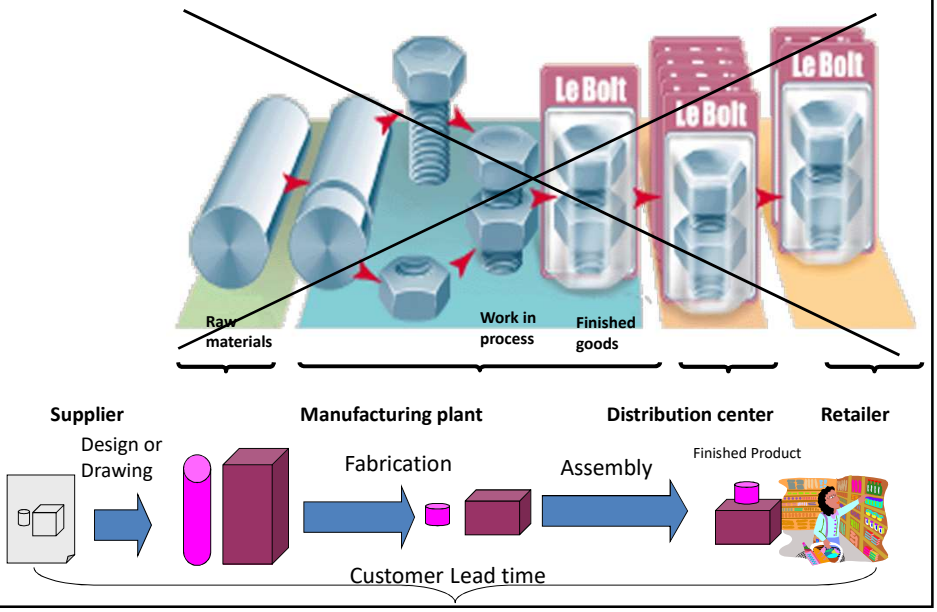

- In Singapore, Build To Order (BTO) is one type of HDB flat allocation system. Buyers can apply for apartments in their preferred location from specific sites launched. Tender for construction will be called only if the number of applicants is more than a minimum number. Otherwise, the project is not built.


Engineer-To-Order (ETO) – Pull Based



- ETO involves **designs** and manufacturing of a product based on very specific customer requirements with **unique** parts and drawings.
- This approach is only appropriate for specific and rare items, such as Formula 1 cars, a thermo-chemical reactor or the US space station.
- Because the end product tends to be **complex**, customers are engaged throughout the entire design and manufacturing phases to ensure their specifications are met.
- Lead-time from order to delivery is often **long** because of the customized nature of the product.
- Typically the single-lot, job-shop environment. Distribution and transportation of the ETO products are often planned in units of one.

Illustration of Engineering-to-Order (ETO)



Production Models

Models	WHEN TO CHOOSE	BENEFITS
Build to Stock (BTS)	• **standardized** products • relatively predictable demand	• Low manufacturing costs • meet customer demands quickly
Configure to Order (CTO)	• many **variations** on finished products • infrequent demand	• Low inventory levels • wide range of product offerings • simplified planning
Build to Order (BTO)	• **customized** products • many variations	• Customization • reduced inventory • improved service levels
Engineer to Order (ETO)	• **complex** products • unique customer specifications	• Enables response to specific customer requirements

Note: BTO is also known as Make-to-Order
CTO is also known as Assemble-to-Order

Pure Push System

Classical manufacturing supply chain strategy, used in BTS

- Manufacturing forecasts are long-range
  - Demand is forecasted based on historical demand
  - Orders from retailers' warehouses
- Longer response time to react to marketplace changes
  - Unable to meet changing demand patterns
  - Supply chain inventory becomes obsolete as demand for certain products disappears
- Increased variability (Bullwhip effect) leading to:
  - Large inventory safety stocks
  - Larger and more variably sized production batches
  - Unacceptable service levels
  - Inventory obsolescence
- Examples: FMCGs, etc.

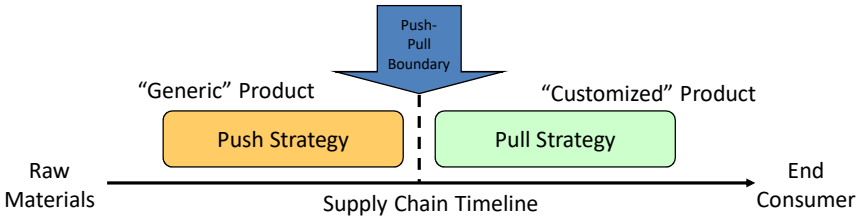
Pure Pull System

A manufacturing supply chain strategy used in ETO

- Production and distribution are demand-driven
  - Coordinated with true customer demand
- None or little inventory held
  - Only in response to specific orders
- Fast information flow mechanisms
  - POS data
- Decreased response time to changing customer demands
- Decreased retailer inventory
- Decreased variability in the supply chain and especially at manufacturers
- Decreased manufacturer inventory
- More efficient use of resources
- More difficult to take advantage of scale opportunities
- Examples: Amazon, customized cakes, etc.

Push-Pull System

- Hybrid of "push" and "pull" systems to overcome disadvantages of each, used in CTO and BTO.
- Early stages of product assembly are done in a "push" manner
  - Partial assembly of product based on aggregate demand forecasts (which are more accurate than individual product demand forecasts)
  - Uncertainty is reduced so safety stock inventory is lower
- Final product assembly is done based on customer demand for specific product configurations
- Supply chain timeline determines "push-pull boundary"



Shifting from One Strategy to Another

- BTS to CTO
  Reason: customer wants more varieties/ personalization and know exactly what he/she wants
- BTO to CTO
  Reason: customer wants to get products faster but with some choices
- Key technologies behind the shift:
  - Standardization
  - Modularization/ Modular design
  - Postponement/RAP(Raw-as-Possible)/Delayed Differentiation

Is it possible to switch from ETO to CTO?

Product / Parts Standardization

- Workers have fewer parts to deal with.
- Training time and cost is reduced.
- Easier purchasing, checking, handling.
- Standardization results in less variation.
- Results in simplicity and speed.
- Disadvantage is less variety

Modular design/ Modularization:

- An extension of standardization.
- Clusters of parts treated as a single unit.
- Reduces the number of elements to deal with.
- Delayed differentiation is also applied to modules.

Raw As Possible (RAP) Principle

- RAP means keeping work-in-process (WIP) as “raw as possible”.
- The principle uses a small number of components to configure a large variety of finished products. This principle can be accomplished by configuring the product offerings so that material and resource commitments are postponed for as long as possible.
- The RAP principle can be fulfilled by the CTO strategy, which differentiates the product only at the final assembly stage.

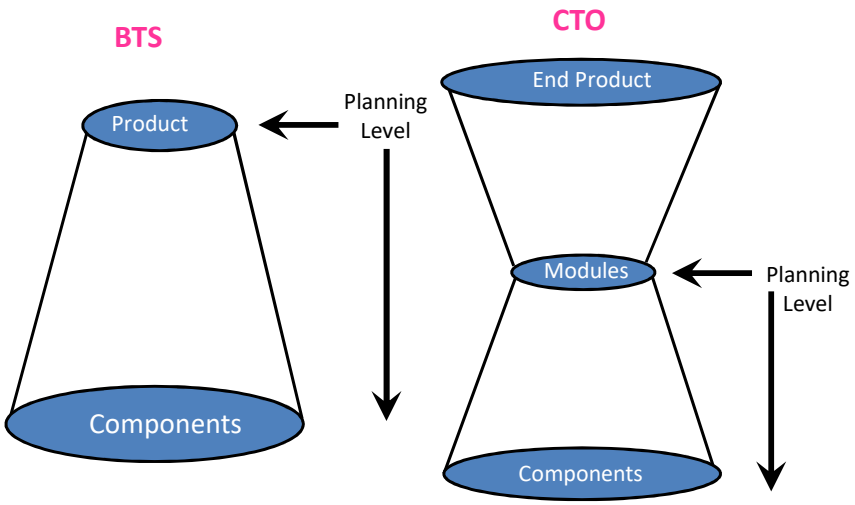
Raw As Possible (RAP) - Examples

- The extent that the RAP principle can be implemented depends on **configuration** of the item being produced and the **lead-time** requirements of the customer.
- Even the consumer goods using BTS strategy can benefit from the RAP principle. For example, a bottling facility can implement the RAP principle by using in-house labeling of 2-litre bottles rather than purchase pre-labeled bottles from external suppliers.
- In the apparel industry, unique or differentiating parts (for example, decal) are assembled at the downstream, onto the finished products, thus delaying differentiation according to the RAP principle.

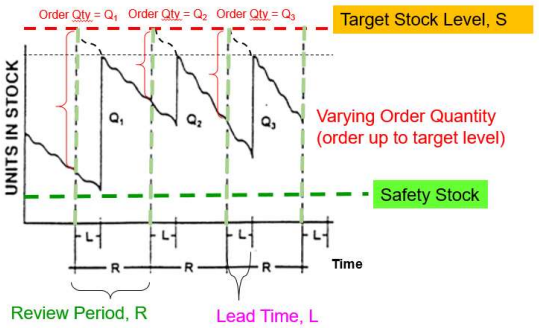
Raw As Possible (RAP) - Examples

- Closely related to the RAP principle is the principle of **aggregation** or **risk-pooling**. It is well known that aggregated demand has lower variation than demand for the individual products.
- The concept of RAP is commonly known as **Postponement** or **Delayed Differentiation.**
- For example, the BOM can leverage on the benefits of risk-pooling. The idea is to pull all the unique materials to the same BOM level across multiple stock-keeping units (SKUs). By doing so, the manufacturer can strategically locate safety stock upstream to pool the risk across the individual product BOMs.

Demand Planning Across Supply Chain



Safety Stock - Periodic Review Policy (R, S)



Based on problem statement

- Customer service level = 98% → Safety factor Z =2.06
- Periodic Review, R = 2 week
- Replenishment Lead Time, LT = 4 weeks
- 1 month = 4.3 weeks
- Safety stock (SS) = Z x STDEV x √(R+L)

Today's Problem – if using BTS

Market	Model	Apr/19	May/19	Jun/19	Jul/19	Aug/19	Sep/19	MEAN	STDEV	Safety Stock
Japan	Comfort	450	390	410	350	400	320	386.67	45.90	112
Japan	Lite	200	180	225	240	230	322	232.83	48.87	119
Japan	Pro	65	66	77	90	21	23	57.00	28.59	70
Taiwan	Comfort	102	95	87	104	109	111	101.33	9.00	22
Taiwan	Lite	80	91	85	76	92	90	85.67	6.53	16
Taiwan	Pro	35	26	36	28	38	33	32.67	4.72	12
Singapore	Comfort	24	20	21	19	23	29	22.67	3.61	9
Singapore	Lite	18	13	10	13	6	12	12.00	3.95	10
Singapore	Pro	6	8	5	7	5	6	6.17	1.17	3
Korea	Lite	45	38	58	36	42	41	43.33	7.84	20
Korea	Comfort	61	69	50	42	39	51	52.00	11.35	28
Korea	Pro	22	21	16	14	18	17	18.00	3.03	8
									Total	429

For BTS, the total safety stock required for all the countries is 429.

What if we keep only one of the models as stock and leave the final configuration for other models in the respective country, i.e. adopting CTO?

Today's Problem – if changing to CTO

Market	Model	Apr/19	May/19	Jun/19	Jul/19	Aug/19	Sep/19	MEAN	STDEV	Safety Stock
Japan	Comfort	450	390	410	350	400	320	386.67	45.90	112
Japan	Lite	200	180	225	240	230	322	232.83	48.87	119
Japan	Pro	65	66	77	90	21	23	57.00	28.59	70
Taiwan	Comfort	102	95	87	104	109	111	101.33	9.00	22
Taiwan	Lite	80	91	85	76	92	90	85.67	6.53	16
Taiwan	Pro	35	26	36	28	38	33	32.67	4.72	12
Singapore	Comfort	24	20	21	19	23	29	22.67	3.61	9
Singapore	Lite	18	13	10	13	6	12	12.00	3.95	10
Singapore	Pro	6	8	5	7	5	6	6.17	1.17	3
Korea	Lite	45	38	58	36	42	41	43.33	7.84	20
Korea	Comfort	61	69	50	42	39	51	52.00	11.35	28
Korea	Pro	22	21	16	14	18	17	18.00	3.03	8
									Total	429
	Total	1,108	1,017	1,080	1,019	1,023	1,055	1,050.33	37.60	92
									Reduction	337

Based on CTO, Safety Stock = **92K pieces**

Reduction in Safety Stock = **337K pieces**

From inventory cost perspective, it makes sense to switch from BTS to CTO. However, can this be the only consideration? We will explore this further in the next lesson.

Today's Problem - Recommendations

- Maintain the BTS strategy on the base model to leverage on the economy of scales for lower production cost.
- Consider CTO strategy to allow customers the options to configure certain features on the other models. Such configuration can be done to suit different local requirements at the country e.g. color, logo, etc.
- The product design for configurable model must be standardized and modularized to support more customizations without compromising manufacturing cost and delivery time.
- Besides product design, the storage strategy will also need to be considered, i.e. centralised vs. distributed.

Learning Objectives

- Describe the 4 supply chain designs:
  - Build-To-Stock (BTS)
  - Build-To-Order (BTO)
  - Configure-To-Order (CTO)
  - Engineer-To-Order (ETO)
- State the concepts of push, pull and push-pull strategies
- Identify the push-pull boundary for each supply chain design
- Identify the pros and cons to shift from one supply chain design to another and the appropriate strategies to use
- Estimate the appropriate safety stock levels for BTS and CTO strategies