

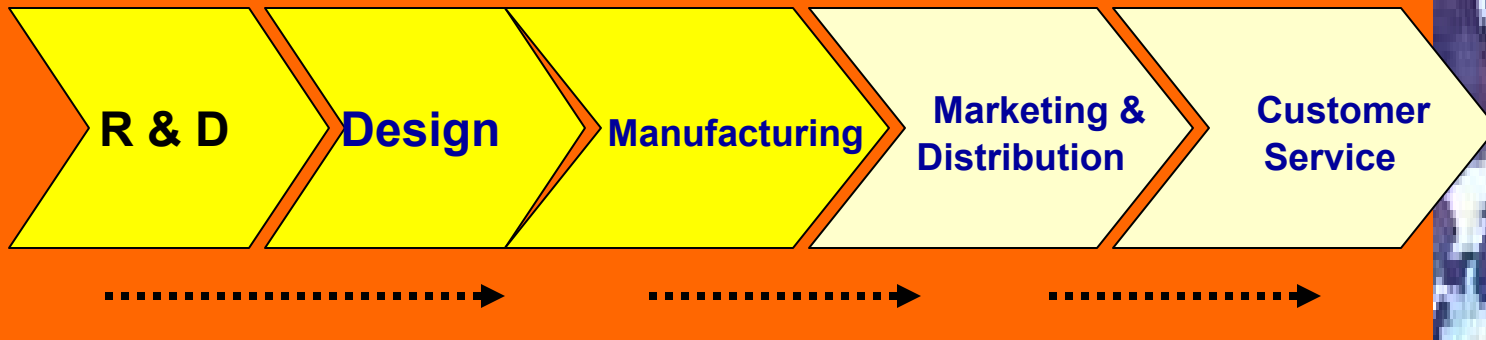
theory of ConStraints



**Technique used to improve speed
in the manufacturing process**



Measuring Speed at each step of Cost Life Cycle



Measure of Speed	Pr Development Time	Cycle Time	Delivery Time	Customer Response
How to improve speed	Design Software Web-based Engineering tools	Theory of Constraints	Reduce Complexity, Automate the Shipping function	Customer Service Software
Example of speed	BMW Reduces New model Development time by 100% to 3 years	Porsche reduces Cycle time On the 911 Carrera from 120 to 60 hours	Amazon. com Shipment of Many items in Less than 24hours	Siebal Customers Include Otis Elevators, Bank of America Cancer Society



Cycle Time

It is the amount of time between the receipt of Customer order and the shipment of the order



Manufacturing Cycle Efficiency

MCE is the ratio of Processing time
to total cycle time



Constraints

Constraints are those activities that slow the product's cycle time



Constraint

Every Organisation has

- **at least One Constraint**
- **it limits the system's Performance**
- **internal or**
- **market Constraint**
- **constraint must be identified**
- **constraint keeps on Changing**





Scouts on a hike: the slowest hiker is the Constraint and sets the pace for the troop



Steps in TOC Analysis

1
Identify the Constraints

2
Determine Most Profitable Product Mix

3
Maximize the Flow through Constraints

4
Add Capacity to Constraints

5
Redesign Manufacturing Process



Steps in TOC Analysis

1

Identify the Constraints

Develop the Flow Diagram

A **flow diagram** is a flow chart of the work done that shows the sequence of processes and the amount of time required for each

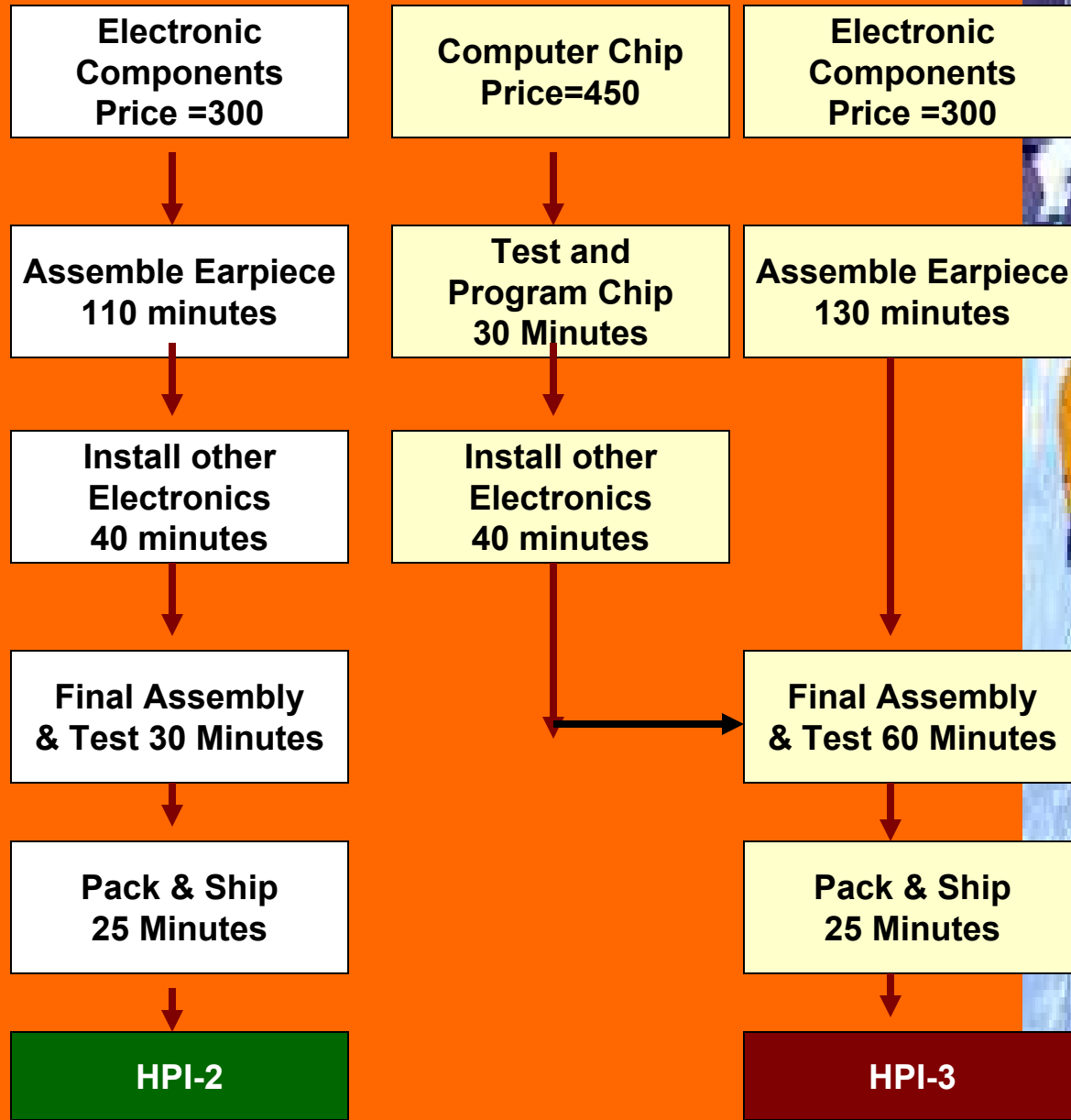


Steps in TOC Analysis

1
Identify the Constraints

5 Processes for Health Product Manufacturing

- 1 Assemble Earpiece
- 2 Test & Programme Computer Chip
- 3 Install Other Electronics
- 4 Perform final assembly & test
- 5 Pack up and ship



Steps in TOC Analysis

2
Determine Most
Profitable
Product
Mix given the
Constraint

The most Profitable product mix is
the combination of products that
Maximize total profits for both products

Throughput margin is a TOC measure
Of product profitability: it equals price
Less materials cost, including all
Purchased components and materials
Handling cost



Key Data For HPI for TOC Analysis

Steps in TOC Analysis

2
Determine Most
Profitable
Product
Mix given the
Constraint

	HP-2	HP-3
Demand (Per Month)	3000	1800
Price (Rs)	600	1200
Materials Cost (Rs)	300	750



Key Data For HPI for TOC Analysis

Process	Minutes Required for Each Product Per Unit		NO. of Employees	Total Hrs Av Per Month
	HP-2	HPI-3		
1 Assemble Earpiece	110	130	80	9600
2 Test & Programme Chip	0	30	8	960
3 Install Other Electronics	40	40	30	3600
4 Final Assembly & Test	30	60	20	2400
5 Pack and Ship	25	25	18	2160



Key Data For HPI for TOC Analysis

Step-1 Identify the constraint

Process where hours required exceed available Hrs



Process	HP-2	HP-2	Total Hrs	Hrs Avl	Slack Hrs
1 Assemble Earpiece(HP-2 3000x110/60	5500	3900	9400	9600	200
2 Test & Program chip	0	900	900	960	60
3 Install other electronics	2000	1200	3200	3600	400
4 Perform final assembly & test	1500	1800	3300	2400	(900)
5 Pack and Ship	1250	750	2000	2160	160

Key Data For HPI for TOC Analysis

Step-2 Identify most Profitable Product HPI-2

	HPI-2	HPI-3
Price	600	1200
Materials Cost	300	750
Throughput Margin	300	450
Contribution Time (Process 4)	30	60
Throughput Per minutes	10	7.50



Key Data For HPI for TOC Analysis

Step-3 Identify most Profitable Product Mix

	HPI-2	HPI-3
Total Demand	3000	1800
Units of Products in Optimal Mix	3000	900
Unmet Demand		900



Management Accountant looks for Ways to speed the flow Through the constraints by

- Simplifying processes,
- Improving the product designs,
- Reducing setup time,
- Reducing other delays &
- Non value added activities
- **inspection**
- **machine breakdowns**

Steps in TOC Analysis

3

**Maximize the
Flow through
The Constraints**



Steps in TOC Analysis

Drum-Buffer-Rope System

3

Maximize the
Flow through
The Constraints

DBRS is a system for balancing the flow of Production through a constraints, thereby Reducing the amount of inventory at the Constraints and improving overall productivity



Steps in TOC Analysis

Drum-Buffer-Rope System

3

Maximize the Flow through The Constraints

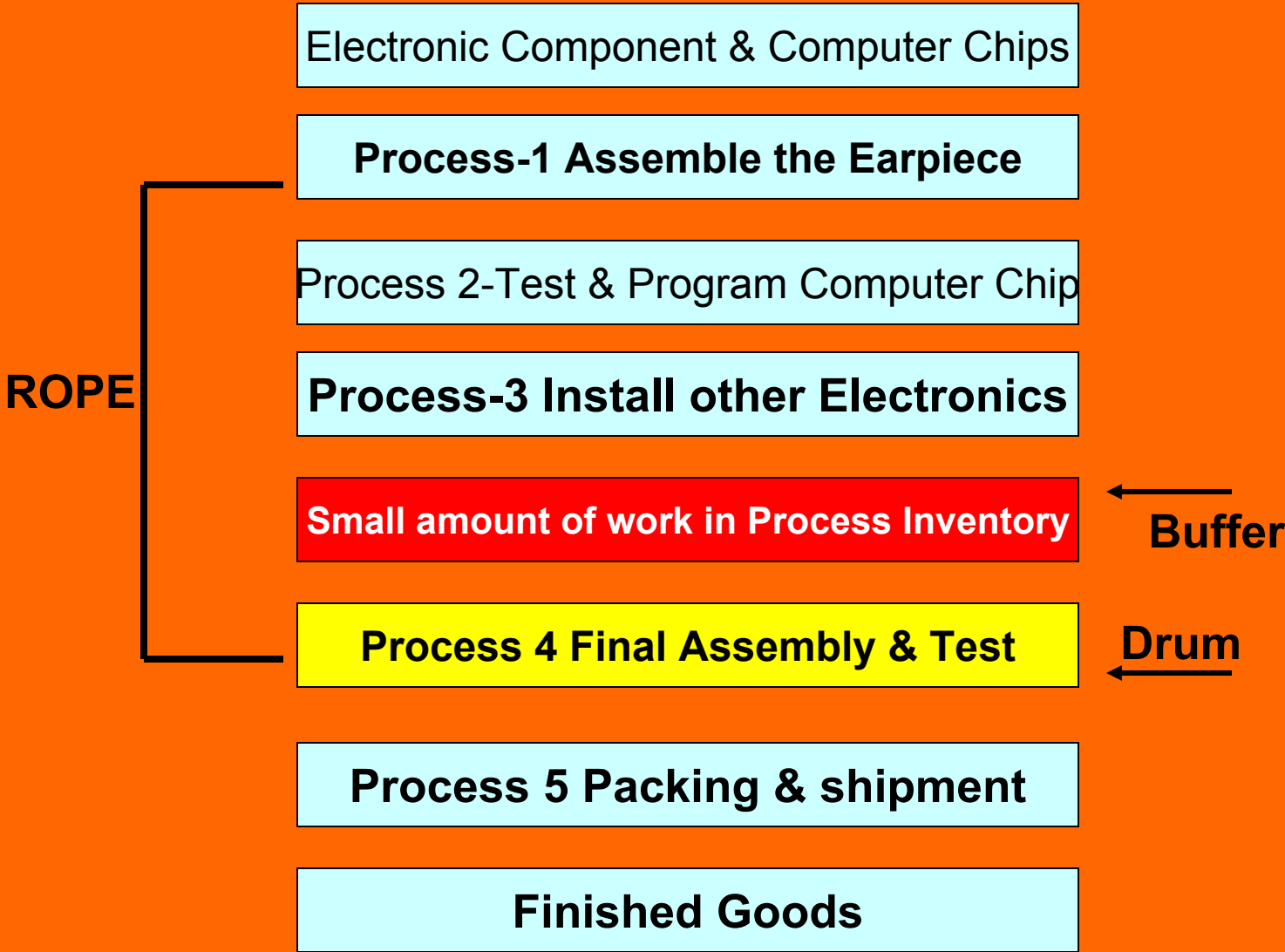
Buffer protects the drum, so that it always has work flowing to it. Buffers in DBR have time as their unit of measure, rather than quantity of materials. Traditional DBR calls for buffers at several points: The constraint, synchronization points and shipping

Drum is the physical constraint of the plant, the work centre, or machine or operation that limits the ability of the entire system to produce more. The rest of the plant follows the beat of the drum

Rope is work release mechanism for the plant. Pulling work into the system earlier than a buffer time guarantees high work in process and slows down the entire system



Drum-Buffer-Rope System



Takt Time

Takt- German word meaning the conductor's baton or Rhythm

Takt time is the speed at which units must be manufactured to meet customer demand

Takt time is the ratio of the total time available given current capacity to the capacity required for the expected customer demand

Time available per day=400 minutes
Consumer demand per day=800 units

Takt time =400 min/800units
= 1/2 minute
= 30 seconds per unit



Steps in TOC Analysis

4

Add Capacity to Constraints

To relieve the constraint and improve the cycle time, management should consider adding capacity to the constraint by adding new machine and/or additional labour



Steps in TOC Analysis

5

**Redesign
Manufacturing
Process**

Strategic Response

- Redesign manufacturing process,
- New Technology
- Deleting hard to manufacture Products
- Redesigning some product for ease
- Removing few product features
- Value engineering



TOC Report- for an Auto Glass Manufacturer

March 2006

	Style C	Style A	Style H	Style B
Window Size	0.77	.073	7.05	4.95
Sales Volume	High	Moderate	High	Moderate
Units in Order	1113	234	882	23
Av Lead time in days	16	23	8	11
Market Price (Rs)	2.82	6.68	38.12	24.46
Direct Production Costs				
Materials	0.68	0.64	5.75	4.02
Scrap Allowance	0.06	0.05	0.42	0.34
Mat. Handling	0.12	0.12	1.88	1.61
Sub total	0.86	0.81	8.05	5.97
Throughput Margin	1.96	5.87	30.07	18.49
Furnace Hrs Per unit	.0062	.0061	.0082	.0078
Throughput Margin Per hour (Rs)	316	962	3667	2370



ABC and Theory of Constraints

- TOC, Target Costing & ABC are used in together
- TOC Consider short term focus
- ABC for long term analysis
- ABC does not consider resource constraints
- ABC Cannot be used to determine short term best Product mix
- ABC & TOC are Complimentary methods



ABC & TOC -differences

Difference	TOC	ABC
Main Objective	Short term focus: through put margin analysis based on materials and related costs	Long Term Focus: analyzing all product costs ,including, materials, labour,OH
Resource Constraints And Capacities	Included explicitly, a Principal focus of TOC	Not included explicitly
Cost Drivers	Not Direct utilization of Cost Drivers	Develop an understanding of Cost drivers at the unit, Batch, product and facility levels
Major Use	Optimization of Production Flow and short term Product mix	Strategic pricing and profit planning



