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Operations Management
Exercises

Mock exam
OPS 08.H01 Exercises W1-W7.pdf
OPS 12.H04 Exercises W8-W12.pdf

Week 1
Group Work: Process Description
Bring the car for maintenance at the garage – map it as SIPOC (Time 20')

Suppliers	Inputs	Process	Outputs	Customers

Week 2
Compare ISO9004 Principles & EFQM Concepts

When do you consider a company "excellent"?
A company is excellent when…

Exercise: Client ABC curve
The company wants to better organise it's sales team, made of an expert Sales manager, a Salesman and a Trainee. Today the first available person serves whatever customer.
1) Put the sales in ABC format and assign who shall be the contact person (Key Account) for each company and why
2) What other criteria should be considered on top of sales?

Client	Sales TCHF		Client	Sales TCHF
Absolut Oi	46		Everest AG	61
Argon Inc.	52		Exonar AG	72
Assur Ltd	1095		Kung GmbH	23
Bell Co.	1542		Moxip Inc	99
Benhur SA	742		Pixon GmbH	25
Dertan AG	128		Sopala SA	30
Eragon Ltd	136		Xenop AG	37

→ Use the ABC excel from ILIAS

Interview: Kaizen Culture
Key Points

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Week 3
Case: Kühne+Nagel
→ Dropbox

Case: Weisse Arena
→ Dropbox

Week 4
Case Benetton: Sales changed the Supply Chain
→ Dropbox

Exercise 1: Calculate the Safety Stock

- Part X101 is a foldable sunscreen for cars, sold by an OEM as traded accessory – particularly during summertime
- The warehouse operates all week days of an year (260 days)
- Customer demand is 20'800 pieces yearly, with σ_D=10 pcs/day
- Supplier is able to supply any quantity in 5 days lead time

Questions:
1. What is the daily average demand?
2. What the minimum Safety Stock, to ensure a 96% Service level?
3. Should the safety stock for this part be the same all year long?

Exercise 2: Seasonal Safety Stock

- A better analysis shows demand in the 5 months May to September of about 11'000 pieces out of the total 20'800, with σ_D=14.2 pcs/day
- In the other 7 months σ_D=7 pcs/day

Questions:
1. What is the Demand and the Safety Stock then, to ensure a 98% Service level in high season?
2. And how much for 95% in the rest of the year?
3. How much SS as weighted average? What is better than before?
4. What would you do now, to decrease the Safety Stock?

Exercise 3: Stock is idle Capital

- Finished product Y07B costs 2'570 CHF each
- Annual demand is 20'000 pieces (stable)
- Order quantity is 2'000 pieces
- Safety stock is set to half month's demand
- The internal Cost of Capital is 10%

Calculate:

1) Safety stock
2) Average inventory (pieces and CHF) assuming no stockouts occur
3) Yearly cost of capital bound in inventory
4) Inventory turns

NB Storage costs (Warehousing, Internal transportation, Inventory control, Insurance…) are not considered here as a simplification

Exercise 4: Logistics full cost

Beyond cost of capital, the storage costs (inventory control, use of space, tools & employees, insurance…) add costs to products stored

- Part X26 costs in production 976CHF and sells 16'000 pieces/yr; its 824 pieces on stock (average) occupy 7% of the warehouse space and it requires half an employee for data entry, control, reordering
- Warehouse costs (building lease, fork lifts lease and maintenance, forklift drivers salary, energy, insurance) total 3.5 mCHF /year
- Control costs (office setup, salary of 4 employees, IT system for data entry & control) total 0.8 mCHF/yr
- Cost of capital is 10%

Calculate inventory turns, logistics costs mark-up and full cost of the finished part X26.

Class work: Draw a simple BOM for a car
Put in a BoM structure (3 levels) the following parts of a cabrio:

Axles (2)	Engine hood
Body	Gearbox
Break systems (4)	Interior trims
Bumper (2)	Powertrain
Cabrio	Seat sys (2)
Convertible roof system	Steering wheel
Dashboard	Transmission
Differential	Trunk boot
Doors (2)	Wheels (4)
Engine	Windscreen

Class work: Change a flat tire
While driving, you realise that one tire is flat. List the sequence of steps you have to perform to change it

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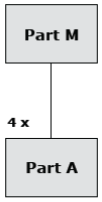
Week 5
Case Telecom: From Complaints to Improvement
→ Dropbox

Exercise 1: one level only
Use the Excel sheet: OPS 05.H02 MRP Blank

Part M has Lot size **20** units, LT **1** week
Safety stock **20**, Initial stock **20** units
demand is **50** units in W2, **30** in W4, **70** in W6

Part A has Lot size **50** units,
is purchased and delivered Just in Time
Safety stock **0**, Initial stock **60** units



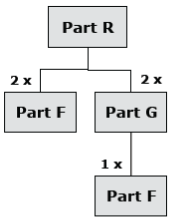
Question: When and how big will be the purchase orders for Part A?

Exercise 2: two levels
Use the Excel sheet: OPS 05.H02 MRP Blank

Part R has Lot size **20** units, LT **1** week
Safety stock **20**, Initial stock **25** units
demand is **55** units in W4, **35** in W5, **65** in W6

Part F has Lot size **30** units, LT **1** week
Safety stock **10**, Initial stock **60** units

Part G has Lot size **0** units, LT **1** week
Safety stock **10**, Initial stock **0** units

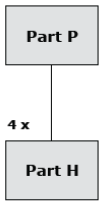


Question: When and how big will be the purchase orders for Part F?

Exercise 3: Lead Time Constraints
Use the Excel sheet: OPS 05.H02 MRP Blank

Part P has Lot size **20** units, LT **1** week
Safety stock **20**, Initial stock **20** units
demand is **50** units in W2, **30** in W4, **60** in W7

Part H has Lot size **50** units,
Safety stock **0**, Initial stock **60** units
but now has a LT of **1** week



Question: When and how big will be the purchase orders for Part A?

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Week 6

FMEA Exercise

The sales organisation communicates increasing warranty costs for a given farming tractor gearbox (tendency to jam)

The causes identified were:	**frequency**
1. Missing Oil (due to undetected leakage)	high
2. Lateral strain (gear lever has too much play)	mid
3. Gear micro-fractures (hardness below specs)	low

In cases 2 & 3 the damage builds-up slowly and does not always cause a total failure, like in case 1.

Assign values to occurrence, severity, detection and calculate RPN

- Identify potential corrective actions for each of the failures.
- Indicate which of the RPN factors will be reduced

	Measure	Occ.	Sev.	Det.
1. Missing Oil				
2. Lateral strain				
3. Gear micro-fractures				

Case study: R&D Assessment

→ Dropbox

Week 7

Case study: Supplier Evaluation

This company produces machines; each mounts 1 very expensive customized Robot for parts handling, and several (less expensive) standard Networked Control Systems (NCS) that drive a large number of electric motors, moving parts or tools within the machine.

1. What purchasing classes we have here? (NB: both are A parts)
2. Identify 3 purchasing strategies for each component and explain why they are important
3. You are evaluating current suppliers and want to reduce them to 2 for key components: what criteria will you use to select them and to control their performance? Identify 6 criteria for each

→ Dropbox

Week 8

Case: Supplier defaults

What to do if a supplier risks insolvency?

→ Dropbox

Class work: Your opinion

1. What was attractive for a consumer in Japanese cars 30 years ago? What is it now? Did the consumer perception change?
2. How much did the Toyota Production System and Total Quality contribute to building the image of Toyota?
3. What is your opinion about the principles expressed in the "Toyota Way"?

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Week 9
Case Acme: Current-state Map
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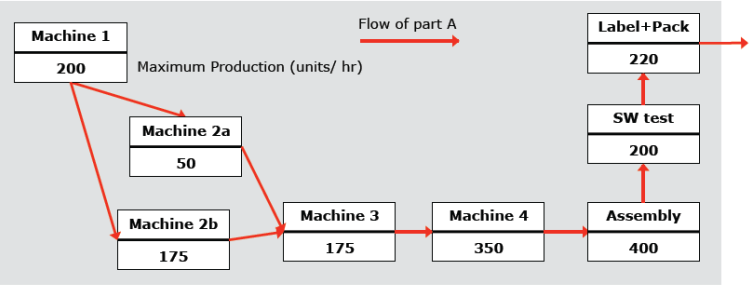
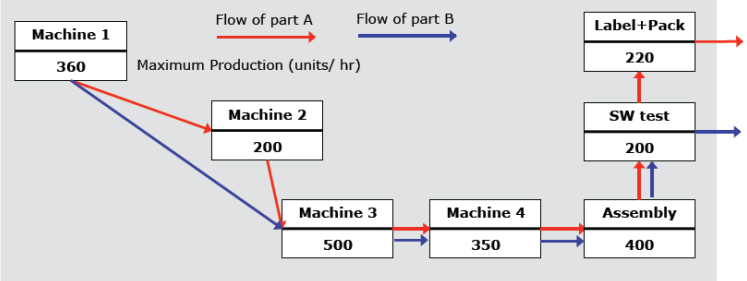
Class Work: Find the Bottleneck 1



1. What is the maximum output of the cell in units/ hr?
2. Where is the bottleneck?
3. We improve the bottleneck identifies in Q2 and want to reach 220 units /hr, what do we need to do?

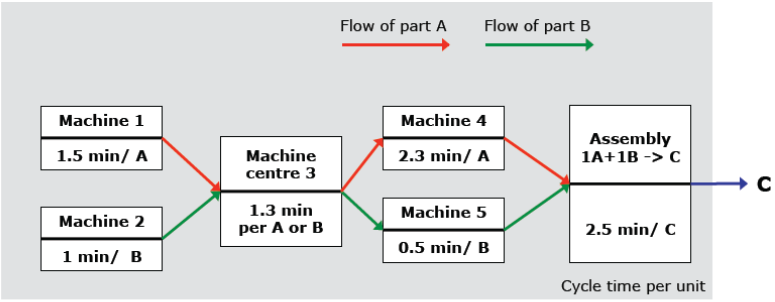
Class Work: Find the Bottleneck 2



Demand is 150 units/ hr of A + 150 units/ hr of B

1. Where is the bottleneck?
2. We elevate the bottleneck at 400 and want to reach 220 units /hr of B (at same A output), what do we need to do?

Class Work: Find the Bottleneck 3



Customer demand = 175 units of C each day
Available time = 420 min/ day (1 shift only)

1. What is the Takt time for Assembly C?
2. Where is the bottleneck?
3. Where is the "near" bottleneck?

Class Work: OEE
Use OPS 09.H05 OEE Calc Sheet.xlsx

A) Calculate OEE for a production cell where:

- Work is done in 3 shifts of 8 hrs, with 30 minutes of pauses/ shift
- Standard Cycle time is 0.60 min/ unit
- Defects are at 3'883 ppm, on average
- Machine stoppages totalled 15 minutes per shift, on average
- Actual performance is 94.7% on average

B) We want an OEE of 95%, calculate the performance to reach as well as the needed % improvement in performance

C) If demand is 2'200 units/ day, can we satisfy the customer demand with the improvements made?

Exercise: Takt Time
Your customer, automotive OEM, works 2 shifts, 5 days a week and requires weekly 10'000 airbags in one of his plants. You produce in 3 shifts of 7.5 net operating hours per shift and serve only that customer plant with a dedicated line. Your line produces at a standard cycle time of 40 sec/ airbag unit.

1) Calculate Takt time
2) Can you supply your client without problems?
3) What would you do?

Case study: Defining a Manufacturing Cell
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Week 10
Case: ACME part 2
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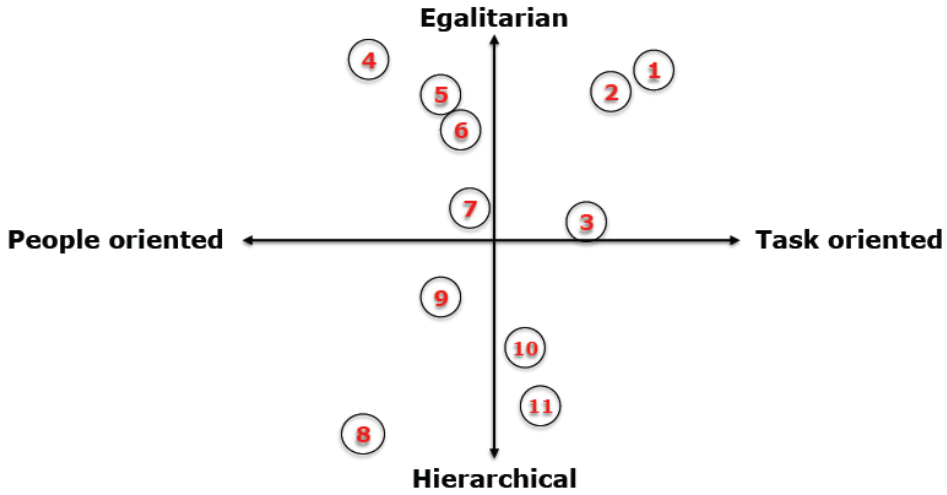
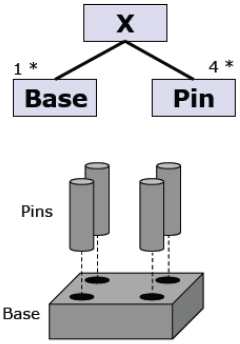
Week 11
Exercise: Be aware of Cultural diversity



Can you position: CH, DE, FR, IT, DK, SE, NO, FI, US, UK, KO?

Week 12
Exercise: Calculate minimum lead times
When you assemble a product, consider the lead time of each operation to obtain the total one (start from the end & go backward)



Op#	Description	WC	Lot	Setup	Work	Move
10	Drill 4 holes in base	003	10	8'	3' (*)	2'
20	Polish & check pins	003	10	--	1'	1'
30	Insert 4 pins in base	003	10	--	0.4'	1'
40	Paint after assembly	003	10	12'	2'	3'

(*) Op.10 is fully automatic

1) Draw the cycle & calculate the minimum lead time
2) Where to act to reduce it? How?

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Exercise: Real working conditions limit production

With OEE we calculate the realistic production capacity of a work cell
Low OEE does limit the possible output

→Calculate the residual daily capacity in minutes for a machine with OEE 76% and the following production plan:

	Day 1	Day 2	Day 3	Day 4
Production capacity (min)	430	430	430	430
Units A	100	76	25	65
Units B	0	37	65	70
Real residual capacity (min)				

Standard CT
A: 3min/unit
B: 2.5 ,, ,,

Exercise: Changeover times

Changes in product mix cause changeover times, thus reducing the available capacity: scheduling of production must consider it

- All 4 products are produced in whatever sequence on one machine
- Family changes (A→B, B→A) require more time

From \ to	A1	A2	B1	B2
A1	x	15	30	30
A2	15	x	30	30
B1	30	30	x	10
B2	30	30	10	x

→ Calculate the worst sequence condition (highest changeover time)
→ Calculate the best condition (lowest changeover time)

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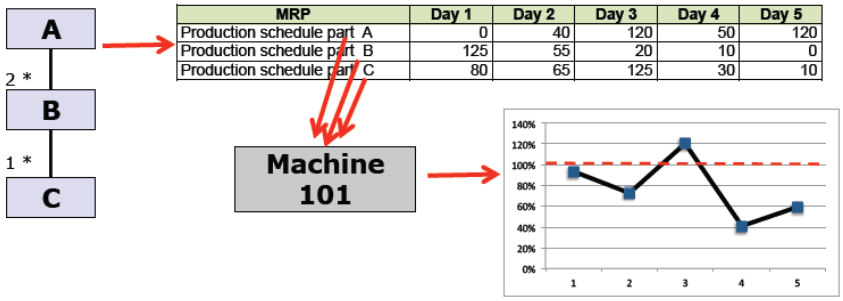
Exercise: From Material requir.mt to machine Load

With MRP we calculated the need of components ahead of the need for the finished product using the Bill of Material.
We must also check the availability of work cell capacity (which is not infinite): coexistence of several production orders on the same work cell may increase the standard lead time!



MRP	Day 1	Day 2	Day 3	Day 4	Day 5
Production schedule part A	0	40	120	50	120
Production schedule part B	125	55	20	10	0
Production schedule part C	80	65	125	30	10

Exercise: Absorption of Fix costs

	Sales	Variable Costs	Gross Margin	% Fix on Sales	Fix Costs Allocated	EBIT	EBIT %
Product X	160	140	20	10%	16	4	2.5%
Product Y	150	115	35	10%	15	20	13.3%
Product Z	90	88	2	10%	9	-7	-7.8%
Total	400	343	57		40	17	4.3%

Product Z is making losses: what if we take it out of our portfolio?

1) Calculate the new allocation key for fix costs in % of sales
2) Calculate the resulting profitability
3) What happened?
4) How to improve?

Exercise: Product Cost 1

- Product S21 is assembled from 2 parts E02, 1 parts G56 and 4 fixations H78.
- Product E02 is purchased and costs 25.00 CHF
- Product G56 is a semi-finished part with: Materials cost 42 CHF, Labour assembly time of 12 min
- Fixations H78 are bought and cost 3 CHF each
- Labour in this plant costs 74 CHF per hour
- Product S21 has a First Pass Yield of 98%

→ Calculate the unit product cost of S21

Exercise: Product Cost 2

- Product Y02 is obtained working part W33 for 20 min on a CNC lathe, then finishing it manually for 5 minutes (which includes a last visual quality check made by the operator)
- The CNC operation has not yet reached the expected 99.9% First Pass Through. Current level is 99%. Defects cannot be reworked and are scrapped automatically by the machine
- Normally no defects are detected by the last visual check
- Machine time costs 280 CHF/ hr and Labour costs 68 CHF/hr
- Part W33 is produced internally (Mat cost 89 CHF, Lab. 35 CHF)

→ Calculate the unit product cost of Y02 now

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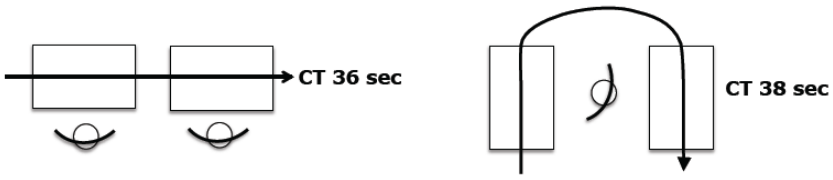
Exercise: Product Cost 3



- Production in 1 shift of 8 hrs with 10 min pauses, 220 days/yr
- OEE is 85%
- Material cost 5 CHF/unit
- Labour cost 80'000 CHF/ year and operator
- Machine depreciation 400'000 CHF/yr

→ Calculate the product cost in the two cell layouts

Exercise: Return on investment

Project proposal: 150'000 units/yr of Part Z6 will be sold at 2.5$ each (purchased at 2$ each), with an investment of 270'000$. Staff costs will be 20'000$. Current Assets 15'000$ (Account Receivable + Inventory - Accounts Payable).

1. Calculate the project ROI according to the project proposal
2. Recalculate the proposal ROI, if sales price is increased of 2%
3. Recalculate the proposal ROI, if purchase price is reduced of 2%
4. Recalculate the proposal ROI, for a cheaper machine (invest -2%)