Investment analysis

2018-05-08

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Agenda

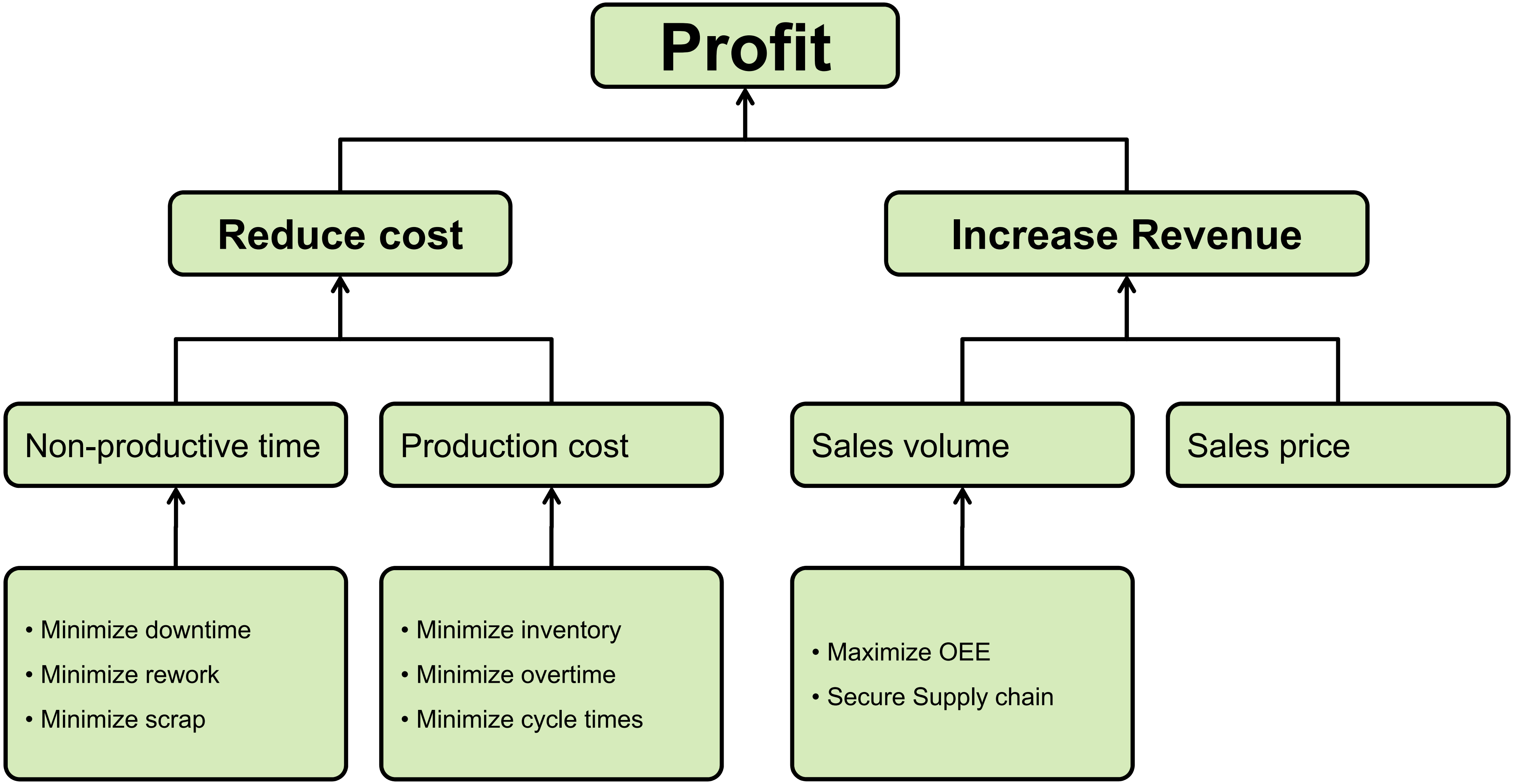
- Fundamental economy
- Fundamental production economy
- Investment calculation, analysis and assessment
- LCC, Life Cycle Cost

Fundamental economy

- Profit
- Revenues
- Costs

Profit = Revenues - Costs

Fundamental production economy



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Investment calculation, analysis and assessment

Methods for investment calculation, analysis and assessment

Net Present Value

Annuity Method

Pay-back Method

Investment calculation

Net Present Value

This method indicates how profitable an investment is at present.

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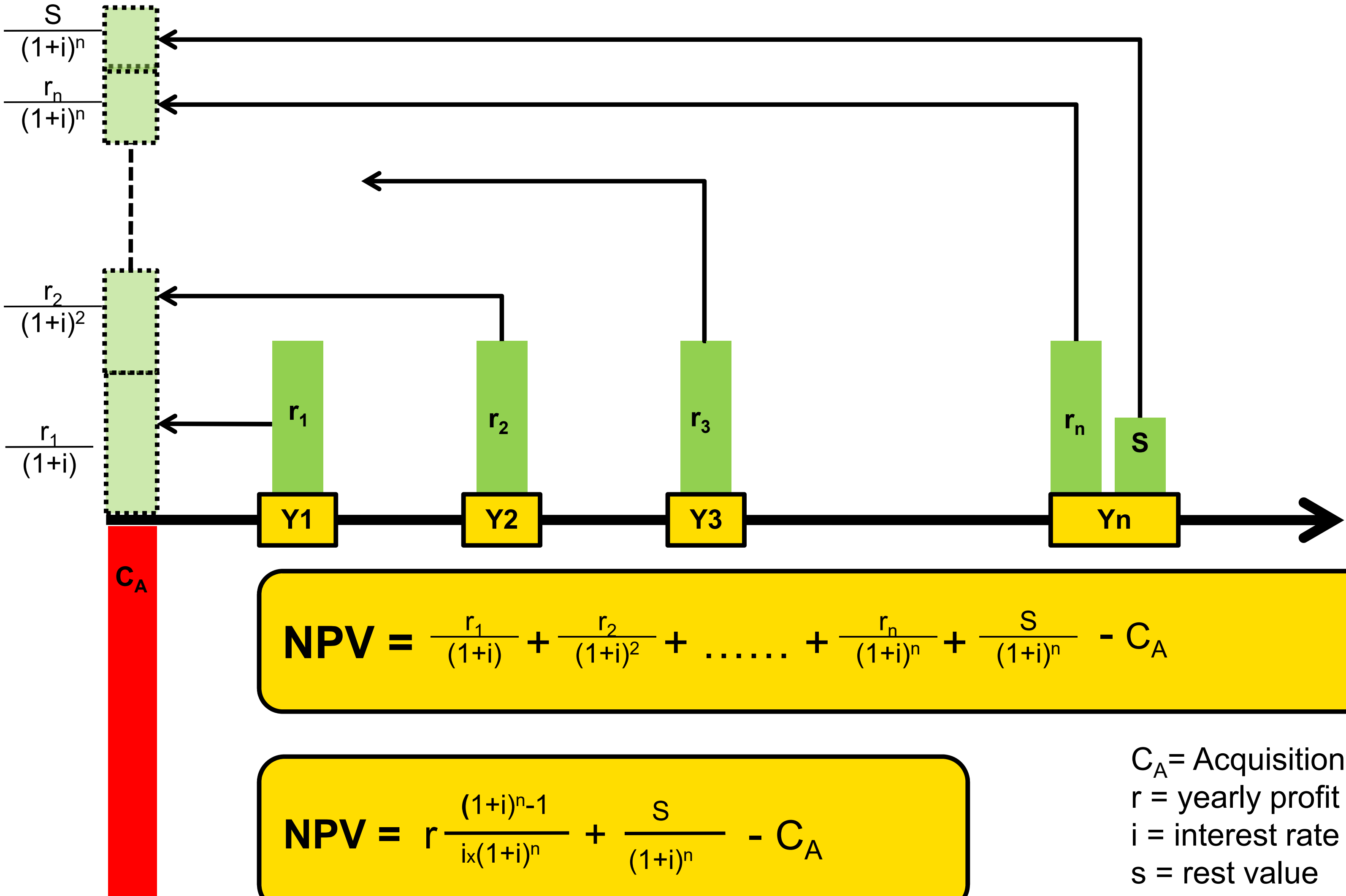
Net Present Value



$$NPV = \frac{r_1}{(1+i)} + \frac{r_2}{(1+i)^2} + \ldots\ldots + \frac{r_n}{(1+i)^n} + \frac{S}{(1+i)^n} - C_A$$

$$NPV = r\frac{(1+i)^n-1}{i x (1+i)^n} + \frac{S}{(1+i)^n} - C_A$$

C_A= Acquisition cost
r = yearly profit
i = interest rate
s = rest value
n = calculated, economic life time

Net Present Value

Example

Machine cost: 500 000:-
Capacity: 16 000 details/year
Selling price: 30:-/detail
Operator salary: 100 000:-/year
Operating costs: 150 000:-/year
Economic life: 5 years
Rest value: 50 000:-
Interest rate: 10%

Acquisition cost, C_A = 500 000:-
Rest value, s = 50 000:-
Revenue = 16 000 x 30 = 480 000:-/year
Cost = 250 000:-/year
Yearly profit, r = 480 – 250 = 230 000:-/year
Interest rate, i = 10%

$$\textbf{NPV} = r\frac{(1+i)^n-1}{i \times (1+i)^n} + \frac{s}{(1+i)^n} - C_A$$

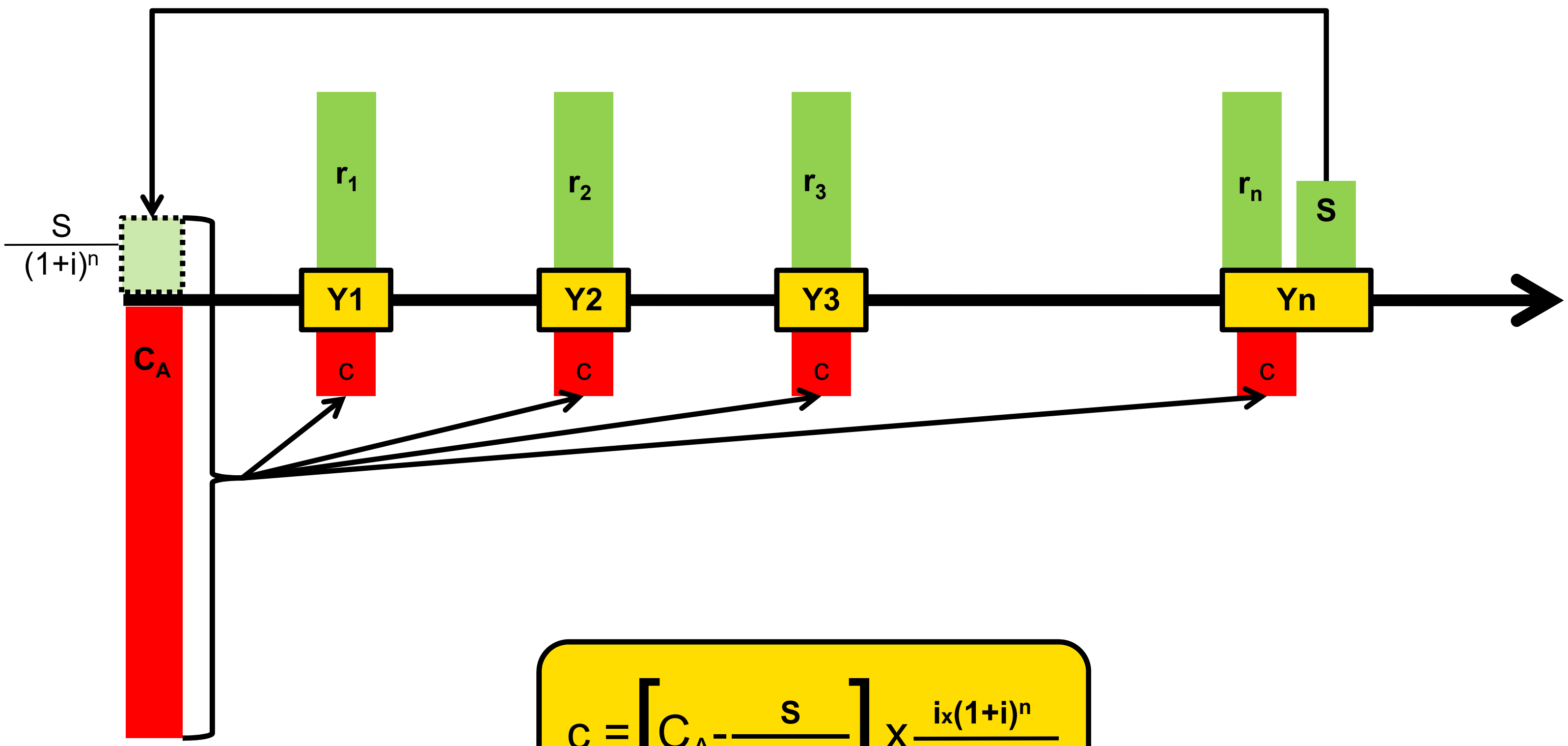
$$\textbf{NPV} = 230 \times \frac{(1+0,1)^5-1}{0,1 \times (1+0,1)^5} + \frac{50}{(1+0,1)^5} - 500 = 403 > 0$$

Investment calculation

Annuity Method

This method indicates how profitable an investment is per year.

Annuity Method



$$c = \left[C_A - \frac{s}{(1+i)^n} \right] \times \frac{i \times (1+i)^n}{(1+i)^n - 1}$$

C_A = Acquisition cost
r = yearly profit
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Annuity method

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Interest rate, i = 10%

$$c = \left[C_A - \frac{s}{(1+i)^n}\right] \times \frac{i \times (1+i)^n}{(1+i)^n - 1}$$

$$c = \left[500 - \frac{50}{(1+0,1)^5}\right] \times \frac{0,1 \times 1,1^5}{1,1^5 - 1} = 124000: \text{-/year}$$

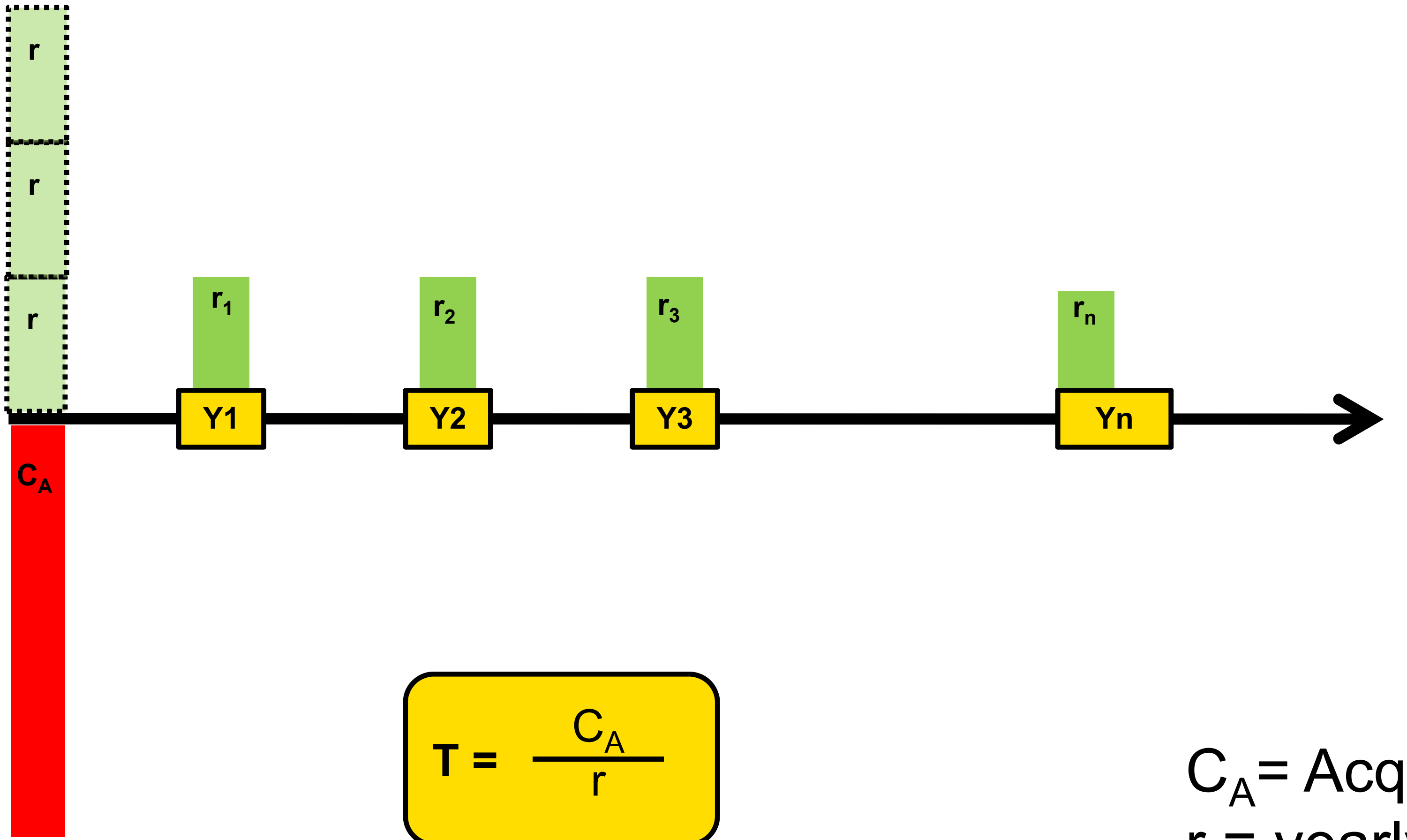
Profit = r-c = 230000-124000 = 106 000:-/year

Investment calculation

Pay-back Method

After how long time an investment will pay back invested money?

Pay-back Method



$$T = \frac{C_A}{r}$$

C_A= Acquisition cost
r = yearly profit
T= Pay-back time

Pay-back Method

Example

Machine cost: 500 000:-
Capacity: 16 000 details/year
Selling price: 30:-/detail
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Economic life: 5 years
Rest value: 50 000:-
Interest rate: 10%

C_A = 500 000:-
Rev = 16 000 x 30 = 480 000:-/year
Cost = 250 000:-/year
r = 480 – 250 = 230 000:-/year

$$T = \frac{C_A}{r}$$

C_A= Acquisition cost
r = yearly profit
T= Pay-back time

$$T = \frac{500}{230} = 2.2 \text{ years}$$

Pay-back example from industry

An industrial example

Machine

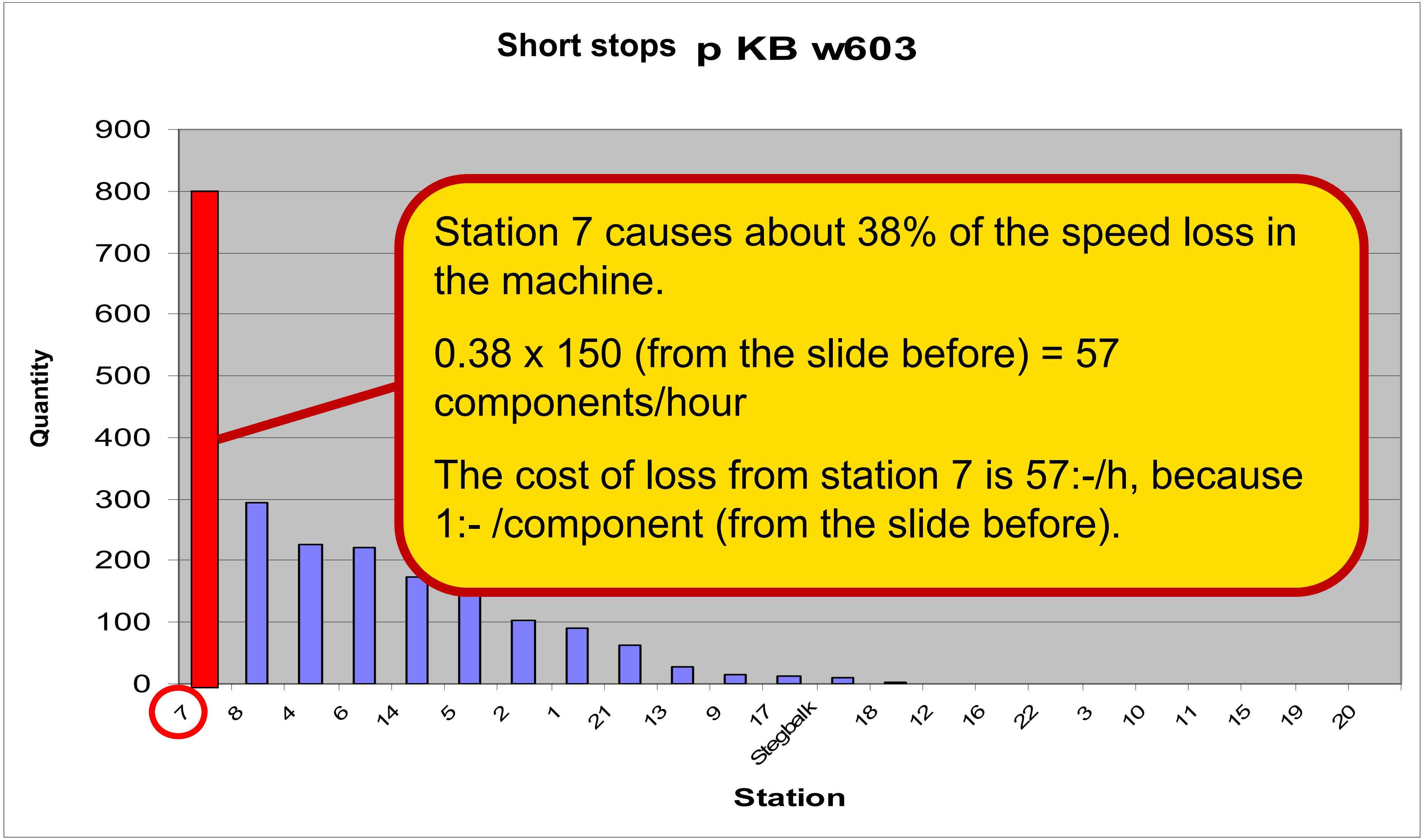
Theoretical speed: 650 components/hour.

Actual output: 500 components/hour.

The loss is in external production that cost an additional 1:- /component.

Loss in external production: 650 – 500 = 150 components/hour that is equal to 150: -.

An industrial example

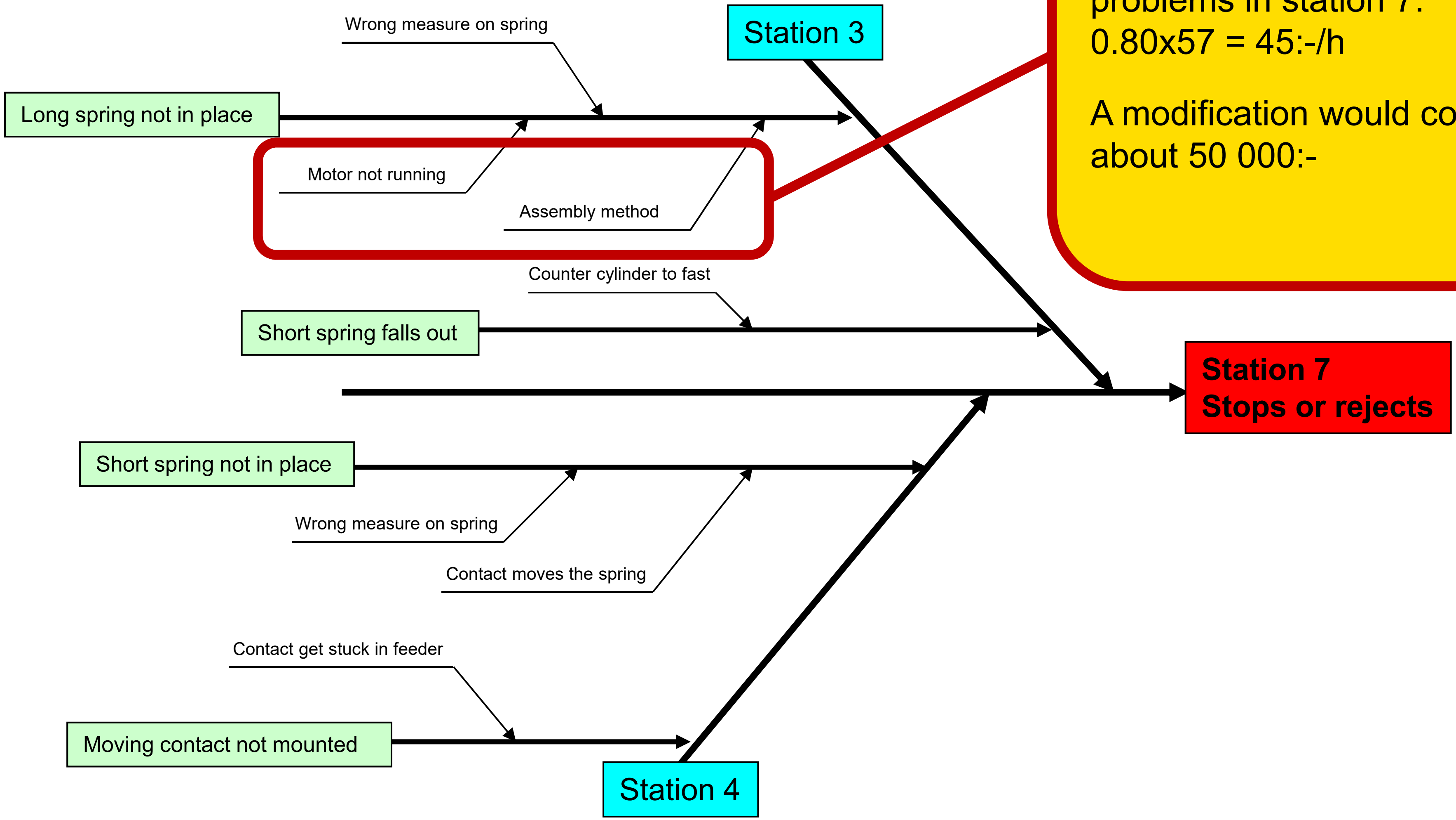


Station 7 causes about 38% of the speed loss in the machine.

0.38 x 150 (from the slide before) = 57 components/hour

The cost of loss from station 7 is 57:-/h, because 1:- /component (from the slide before).

An industrial example



These two causes 80% of the problems in station 7.
0.80x57 = 45:-/h

A modification would cost about 50 000:-

An industrial example

Weekly working hours: 120 h
Planning factor: 0.8
Availability: 0.85

Resulting production time: 120x0.8x0.85 = 82 h

Improvement potential: 45:-/h (from ishikawa diagram)

Potential savings: 82x45 = 3700:-/week

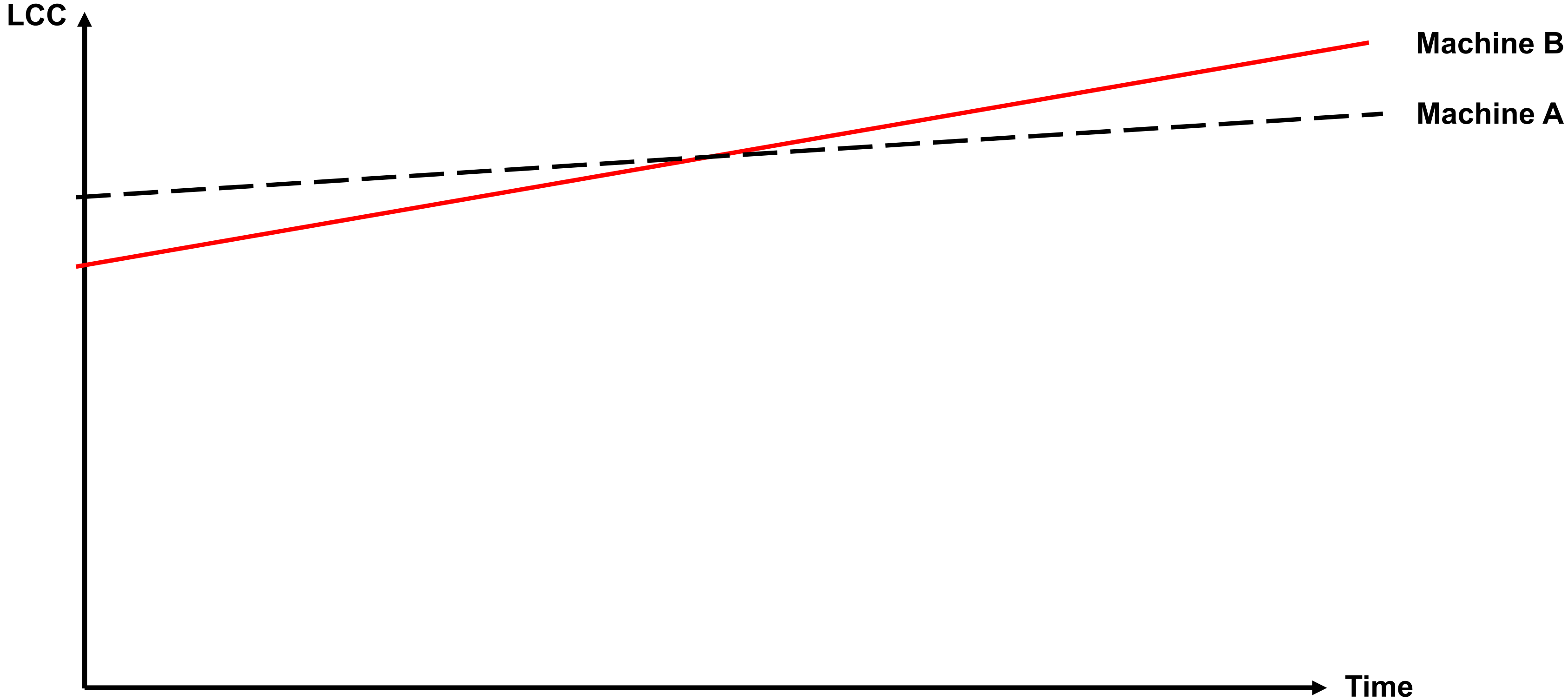
Investment cost: 50 000:- (from ishikawa diagram)

Pay-back: $\frac{50\ 000}{3700} = 13.5$ weeks

LCC = Life Cycle Cost

We can use LCC for comparison

Using LCC for comparison



Example

	Machine X	Machine Y
Aquisition cost , C_A	98500 €	66000 €
Maintenance cost , C_M	12500 €/y	?
Life length	25 years	30 years
MTTF	420 h	300 h
MTTR	3 h	3,5 h
Cost of downtime	500 €/h	500 €/h
Operations cost , C_O	12500 €/y	14500 €/y
Operating hours	4300h/y	4300h/y
LCC	?	905640€

Time span for comparison: 20 years

How to calculate LCC for Machine X?

C_A=Aquisition cost
t_c=time of comparison
C_O=Operations cost
C_M=Maintenance cost
C_{DT}=Downtime cost

$$\mathbf{LCC} = C_A + t_c(C_O + C_M + C_{DT})$$

$\mathbf{C_A}$ **=** Aquisition cost

$\mathbf{C_O}$ = Operations cost

$\mathbf{C_{DT}}$ = Downtime cost

$\mathbf{t_c}$ **=** time of comparison

$\mathbf{C_M}$ = Maintenance cost

Example

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Operating hours	4300h/y	4300h/y
LCC	?	905640€

Time span for comparison, t_c = 20 years

$$\mathbf{LCC} = C_A + t_c(C_O + C_M + C_{DT})$$

$$C_{DT(X)} = \frac{\text{MTTR x Cost of Downtime x Operating hours}}{\text{MTTF}} = \frac{3x500x4300}{420} = 15357€/y$$

$$\mathbf{LCC_X} = 98500 + 20(12500 + 12500 + 15357) = 905640€$$

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LCC	?	905640€

Time span for comparison, t_c : 20 years

How to calculate maintenance cost, C_M for Machine Y ?

Example

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LCC	?	905640€

Time span for comparison ,t_c : 20 years

$$C_{DT(Y)} = 3.5 \times 500 \times 4300/300 = 25083 \text{ €/y}$$

$$LCC = C_A + t_c(C_O + C_M + C_{DT})$$

$$LCC_Y = 66000 + 20(14500 + C_M + 25083) = 905640\text{€}$$

$$C_M = ((905640-66000)/20) - 14500 - 25083 = 2399 \text{ €/y}$$

Next

15 May: No lecture, send an email to San Aziz, if you need help with your industrial project.

17 May: Lecture with Karl Williams from ABB Robotics. Karl will talk about Quality Management.